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Point-of-care ultrasound in emergency medicine: A position paper by the Danish Emergency Medicine Ultrasound Committee

Abstract

Since the first recommendations for the use of point-of-care ultrasound in emergency departments in Denmark were published in 2014, emergency medicine was established as an independent specialty in 2017, and continuing development and research within the ultrasound field have created a need for updating the existing consensus paper.

The purpose of this position paper by the Danish Emergency Medicine Ultrasound Committee is to describe the ultrasound protocols, education, organization, medico-legal issues, and research in point-of-care ultrasound in the emergency medicine specialty in Denmark.

Keywords:

Point-of-care ultrasound; PoCUS, emergency medicine; emergency department

Introduction

Point-of-care ultrasound (PoCUS) has become essential in Danish emergency medicine (EM), improving clinical practice through improved diagnostics, procedures, and patient outcomes (1).

Emergency Departments (EDs) were established as a governmental act in Denmark in 2007 (2). However, EM was not an individual specialty then, and physicians from various related specialties staffed the EDs as a part of their employment (3). Concurrently, the first PoCUS courses were held, but participation was not mandatory for physicians working in the ED. In 2014, the first recommendations for POCUS use were published, preceding the formal recognition of EM as an independent specialty in Denmark in 2017 (4). While many initial goals for PoCUS have been achieved, ongoing advancements in the clinical application and organizational frameworks necessitate revised recommendations.

This position paper by the Danish Emergency Medicine Ultrasound Committee outlines the current recommendations for POCUS protocols, education, organization, medico-legal issues, and research in EM PoCUS in Denmark.

Hvad ved vi?

- Point-of-care ultralyd (PoCUS) er en obligatorisk del af speciallægeuddannelsen i akutmedicin gennem teoretisk og praktisk kursus, superviserede skanninger og certificering.

The writing and recommendation panel

The recommendations panel comprises members of the Danish Emergency Medicine Ultrasound Committee and physicians from related specialties (the author group of this article), including respiratory medicine,

geriatrics, and cardiology, who possess expertise in ultrasound. The final recommendations reflect a consensus view, integrating the current evidence for PoCUS in EM settings.

The scope of practice

In this position statement, PoCUS is defined as an ultrasound investigation conducted and interpreted at the bedside in the clinical context, whereas focused PoCUS is a further abridged examination where simple dichotomous, clinically relevant yes/no questions are answered. As an expansion, PoCUS in EM in Denmark is now divided into level 1 (basic), an obligate part of the residency in EM, and level 2 (advanced), an optional part of continuing medical education for the specialist in EM. The committee advocates that all ultrasound examinations are performed on proper indication and not as a mandatory add-on to all patient evaluations.

Level 1 PoCUS

Level 1 ultrasound protocols

The ultrasound protocols are founded on evidence-based international guidelines and the panel's expert consensus agreement. The protocols are organ-based, where the ED patient is scanned based on symptoms or other suspected pathology in the relevant organ or structure. The following protocols are used with highlighted clinical yes/no questions (Table 1):

- Focused cardiac ultrasound (FoCUS): Signs of pericardial effusion, reduced left ventricular function, right ventricular dilatation, or abnormal IVC (7,8).
- Focused Abdominal Ultrasound (FAUS): Signs of gall stones, cholecystitis, hydro-nephrosis, abdominal aorta aneurism, urine retention, free fluid, or small bowel obstruction (9–12).

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Table 1. Overview of the level 1 and level 2 ultrasound protocols used in the emergency medicine specialty in Denmark

Ultrasound protocol	Level 1 ^a	Level 2 ^b
FLUS/LUS	Pneumothorax Lung consolidations Focal or multiple B-lines Pleural effusion	Differentiation between lung consolidations Parietal and visceral pleural thickness and regularity Quantification of pneumothorax Differentiation between different types of pleural effusions
FoCUS/CUS	Pericardial effusion Reduced left ventricular function Right ventricular dilatation Abnormal IVC	Reduced regional wall motion in the left ventricle Severe aortic stenosis Severe aortic regurgitation Severe mitral regurgitation Signs of pulmonary hypertension
FAUS/AUS	Gall stones Cholecystitis Hydronephrosis Abdominal aorta aneurism Urine retention Free fluid Small bowel obstruction	Cholestasis (intra- and extrahepatic) Colitis Diverticulitis Appendicitis Gastroparesis
2-CUS/CDUS	DVT in femoral, popliteal, or proximal lower leg veins Differential diagnoses of DVT	DVT in the whole lower extremity and use of color Doppler
FMSK/MSK	Achilles tendon rupture Free fluid in joints Hematoma Cysts	Fractures in the upper extremities in children up to 12 years, clavicle and rib fractures Shoulder examination with signs of tendon ruptures, inflammation, or impingement
eFAST	Pneumothorax Hemothorax Hemopericardium Hemoperitoneum	NA

2-CUS = 2-region compression ultrasound; AUS = abdominal ultrasound; CUS = cardiac ultrasound; CDUS = complete duplex ultrasound; DVT = deep venous thrombosis; eFAST = extended focused assessment with sonography for trauma; FAUS = focused abdominal ultrasound; FLUS = focused lung ultrasound; FMSK = focused musculoskeletal ultrasound; FoCUS = focused cardiac ultrasound; LUS = lung ultrasound; MSK = musculoskeletal ultrasound; NA = not applicable.

^a Level 1: The basic level learned as an obligate part of the emergency medicine specialty.

^b Level 2: The advanced level—an optional education.

Hvad tilføjer denne artikel til vores viden?

- Uddannelsen i PoCUS er evidensbaseret og organisatorisk forankret. PoCUS er opdelt i to niveauer – et obligatorisk basisniveau og et valgfrit avanceret niveau.

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- 2-region compression ultrasound (2-CUS): Signs of deep venous thrombosis (DVT) in the femoral vein, popliteal vein, and the proximal portion of the veins of the calf (13).
- Focused musculoskeletal Ultrasound (FMSK): Signs of Achilles tendon rupture, free fluid in joints, hematoma, and cysts (14,15).

Several whole-body protocols exist where different parts of the organ-based protocols are combined into a systematic examination in specific scenarios. In Denmark, the extended focused assessment with sonography for trauma (eFAST) is used in unstable trauma patients. Otherwise, it is emphasized that the organ-based approach is used with a combination of the different protocols depending on the symptom presentation.

Level 1 ultrasound-guided procedures

Ultrasound should be used in procedures relevant to the ED setting to increase success rates, reduce discomfort, and diminish the risk of complications. The following ultrasound-guided procedures are obligatory in the core curriculum:

- Venous access
- Therapeutic and diagnostic thoracentesis
- Therapeutic and diagnostic abdominal paracentesis
- Suprapubic bladder puncture and placement of bladder catheter

The use of ultrasound is not limited to the abovementioned procedures and could be expanded when appropriate, e.g., in arterial, joint, and lumbar punctures.

Education, clinical training, and certification in level 1 PoCUS

Figure 1 provides an overview of the educational program, consisting of theoretical e-learning, a practical course, supervision, certification, continuing education, and clinical use.

Theoretical e-learning

The educational program begins with a theoretical e-learning module. This module concludes with a self-test, but no formal passing is a prerequisite as trainees' competencies are evaluated in a final exam. However, the course content is expected to be mastered before the course; otherwise, it will be difficult for the ultrasound trainee to complete the practical course with sufficient yield.

Procedural ultrasound is learned through the same e-learning module as the ultrasound protocols.

Practical training course

In the two-day hands-on training, the trainees will learn the practical scanning techniques of all the ultrasound protocols. No formal lessons are held. On the first day, the trainees will scan healthy subjects in all the areas. One instructor is dedicated to two trainees to enhance trainee-instructor interaction and supervision. In the last part of the first day, the trainees repeat all the protocols combined with scenario training with pathological findings. On the second day, the trainees apply their acquired scanning skills to ED patients, and all the protocols are practiced again.

Supervision

After the course, the trainees return to their departments to qualify for the final exam. A local ultrasound mentor

is appointed to ensure the trainees receive supervision while scanning patients in all areas. The local mentor should be certified in PoCUS at the basic level, have used it in daily practice, and preferably be credentialed as a specialist in EM to provide the integrated clinical approach to the ED patient with PoCUS. No evidence exists regarding a specific threshold of scans required to reach an adequate level of competency, but the panel recommends 25 supervised scans in each protocol, also acknowledging that the learning curve may level out above or below depending on the individual abilities of the

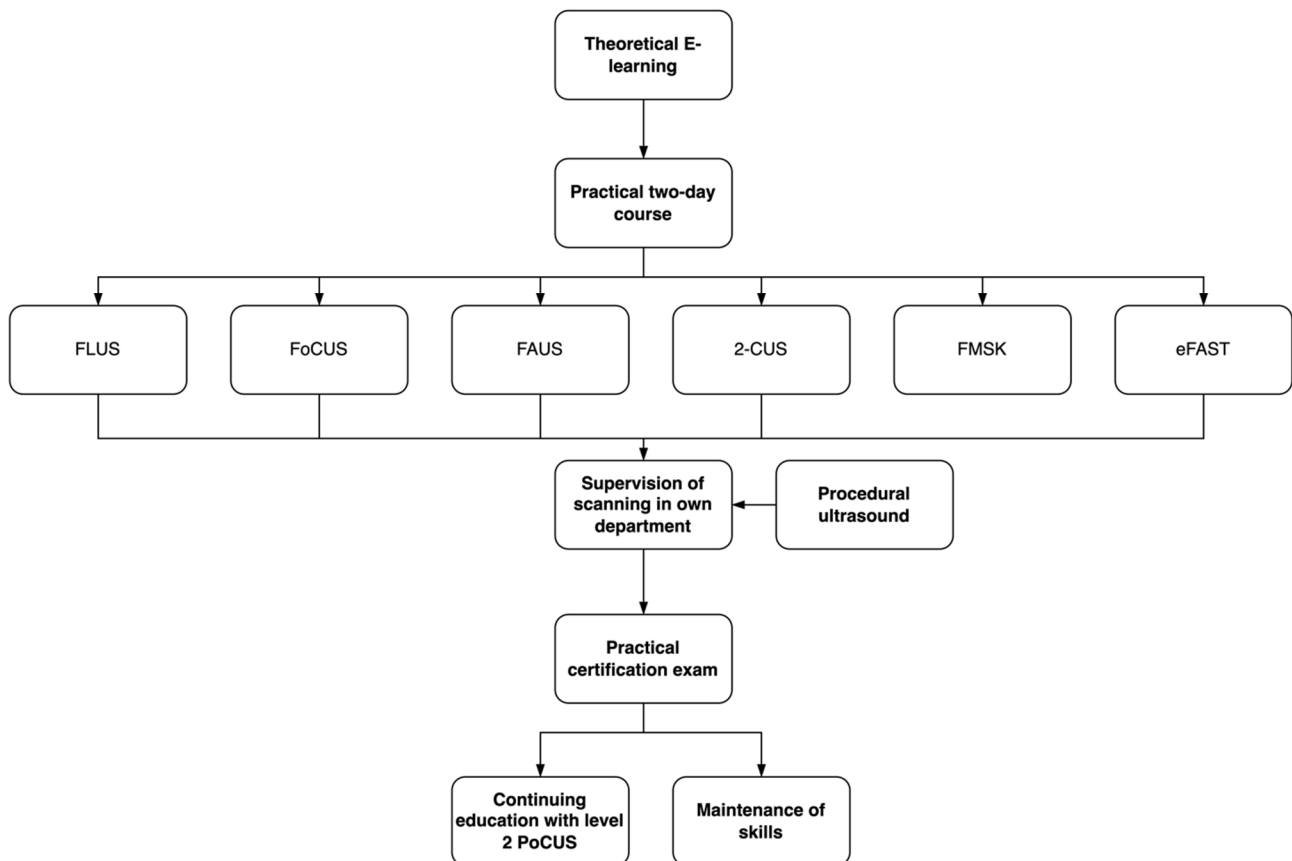
trainee and the local mentor's endorsement. Upon completing all the scans, the trainee is nominated by the mentor for the final certification.

Competencies in procedural ultrasound should be integrated during the same supervision period, and the trainee should complete five supervised and successful procedures in the four obligatory fields.

Certification

The certification consists of a practical exam in which the trainee scans all areas on a healthy subject, complemented by theoretical questions and interpretation of ultrasound clips. An approved PoCUS instructor evaluates

Figure 1. Overview of the educational program in PoCUS in the emergency specialty in Denmark.



2-CUS = 2-region compression ultrasound; eFAST = extended focused assessment with sonography for trauma; FAUS = focused abdominal ultrasound; FMSK = focused musculoskeletal ultrasound; FoCUS = focused cardiac ultrasound; FLUS = focused lung ultrasound; PoCUS = point-of-care ultrasound.

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the trainees' competencies using the Objective Structured Assessment of Ultrasound Skills (OSAUS) rating scale (16). Competences in the procedures are evaluated using phantoms/simulators. Certification is a criterion for obtaining the EM specialty.

Level 2 PoCUS

As part of continuing education, the EM physician credentialed in the basic course can advance to level 2 PoCUS in some or all ultrasound fields. Level 2 ultrasound protocols are built as superstructures of basic protocols with a more diagnostic focus. The level 2 syllabus lies in the field between the focused PoCUS and a diagnostic ultrasound, where all possible pathological conditions in an organ or structure are detected. Therefore, the level 2 PoCUS will have overlaps with ultrasound performed by other specialties, especially cardiology, respiratory medicine, and radiology. Consequently, the committee recommends formal meetings with the societies from the respective specialties to formulate consensus statements. However, EM physicians must recognize that many ultrasound findings require further diagnostic evaluation, either acute or at an outpatient clinic. The level 2 protocols include but are not limited to the following modalities (Table 1):

- *Lung ultrasound (LUS) level 2*: Differentiation between types of lung consolidations, parietal and visceral pleural thickness and regularity, quantification of the size of pneumothorax, and differentiation between types of pleural effusions (5,6).
- *Cardiac ultrasound (CUS) level 2*: Signs of reduced regional wall motion in the left ventricle, severe aortic stenosis, severe aortic regurgitation, severe mitral regurgitation, and signs of pulmonary hypertension (7).
- *Abdominal ultrasound (AUS) level 2*: Signs of cholestasis, colitis, diverticulitis, appendicitis, and gastroparesis (17,18).
- *Complete duplex ultrasound (CDUS)*: Signs of DVT in the whole lower extremity and the use of color Doppler of the common femoral and popliteal vein (13).
- *Musculoskeletal ultrasound (MSK) level 2*: Signs of fractures in the upper extremities in children up to 12 years, clavicle and rib fractures, shoulder examination with signs of tendon ruptures, inflammation, or impingement (14,15,19).

The teaching of the level 2 ultrasound protocols is provided through optional courses with experts within the field. The subsequent training takes place in one's department, which should have agreements for supervision from relevant specialties. Certification is the goal in the future.

Organization

Structure

The organizational structure of the application of PoCUS in EM is grounded within the Danish Society of Emergency Medicine (DASEM), where an appointed committee is an executive board with a chairman and dedicated volunteers with an emphasis on inclusivity and diversity. Final decisions are centralized. We recommend that every ED appoints an ultrasound director with educational, quality, research, technical, and medical-legal responsibilities. In addition, the ultrasound director should lead organizational structures to implement and improve

quality for the aforementioned areas. In addition, the EDs should have local mentors supervising the trainees to reach sufficient competencies and final approval for the trainees' eligibility for the final exam.

Tasks

The committee's tasks cover the following areas:

- *Advisory:* Advising DASEM regarding the society's current position related to the use, education, certification, and maintenance of PoCUS skills.
- *Cooperative:* Cooperates with the Danish Ultrasound Diagnostic Society (DUDS) and the Danish Society for Ultrasound in general practice and committees on ultrasound grounded within different specialties' societies as well as international societies—the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB), The ultrasound section of the European Society for Emergency Medicine (EUSEM), and World Interactive Network Focused On Critical UltraSound (WINFOCUS).
- *Educational:* Design of the educational program in close cooperation with the DASEMs education committee and responsibility for coordinating and holding courses in the core curriculum and masterclasses in level 2 PoCUS, the

later in collaboration with the Acute Ultrasound Academy (AKULA) at Odense University Hospital.

- *Guidelines:* Development of PoCUS guidelines and guidelines for course instructors.
- *Research:* The committee offers counseling, help with networking, coordination, ideas, and patient inclusion in PoCUS-related trials. It collaborates with the research network, the Ultrasound research network (UFO) at Aarhus University Hospital, AKULA, and the Research Entity for Studies in Clinical aCUte Medicine (RESCUE) at Slagelse Hospital.

Medico-legal issues

The legislative framework for ultrasound documentation involving the emergency setting is embedded in the Ministerial Act on Documentation in Health Records (20). The following is not an exhaustive list, but the minimum requirements for documentation:

- PoCUS protocol
- Indication
- Technique and procedural description
- Findings
- Interpretation

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All ultrasound examinations must be documented in the medical record (20). While there are no formal legal requirements for storing ultrasound images and clips, the committee strongly recommends and encourages that all PoCUS investigations be stored, provided it does not cause delays in critical care. Storage has several advantages: protection against malpractice claims, avoiding unnecessary interventions, educational purposes, audit of the quality of images/clips, and consultative purposes with other specialties.

Hvad tilføjer denne artikel til vores viden?

Understøtte brugen af PoCUS og muligvis nedsætte brugen af radiologisk udført ultralyd, tilsyn mhp. ekkokardiografi samt brugen af CT-abdomen.

Research

The Danish Emergency Medicine Ultrasound Committee seeks to promote and engage in various PoCUS-related research activities. Several members are actively occupied in PoCUS research, in practical issues like including patients, facilitating contact with relevant clinicians and/or researchers in related specialties, and as principal investigators in ongoing PoCUS projects. The committee aims to enhance multicenter ultrasound studies across Denmark and internationally. The research focus is not constrained to specific areas, but an overarching goal is to conduct ultrasound research applicable to an emergency setting logistically. The ongoing projects are collected on a webpage as a framework for inspiration, collaboration, and participation.

Conclusion

The Danish Emergency Medicine Ultrasound Committee sets standards for PoCUS use in emergency settings. It outlines mandatory structured education and skill advancement. Their framework promotes inter-specialty collaboration and research, enhancing patient care and clinical outcomes.

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