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Point-of-Care Ultrasound (POCUS) Curriculum for Internists in Turkey: A Position Paper by the DAHUDER Internal Medicine Society Ultrasound Working Group

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ABSTRACT

Background: Point-of-care ultrasound (POCUS) is the application of ultrasound imaging by clinicians at the point of healthcare delivery. Emergency medicine physicians and intensivists have used POCUS for a long time, but its use in internal medicine is relatively recent. Around the world, there are many position papers, curricula, and training programs regarding POCUS in internal medicine, but there is no standardized curriculum in Turkey. We aimed to set national standards for internists in the POCUS curriculum.

Methodology: The DAHUDER Internal Medicine Society Ultrasound Working Group convened members to establish the POCUS Internal Medicine curriculum. We conducted a literature search and informal clinician assessment to create a curriculum that meets the needs, demands, and resources of Turkish internists while also guaranteeing its compatibility with international curricula.

Results: We identified ten main domains under the basic and advanced POCUS curriculum as follows: Principles of ultrasound physics, machine basics, thorax imaging, abdominal imaging, cardiac imaging, vascular imaging, thyroid & neck imaging, musculoskeletal imaging, interventional imaging, and approach to clinical scenarios: Protocols. We expect these domains and their content to establish the POCUS imaging standard for internists in Turkey.

Conclusion: We expect the POCUS education curriculum to set standards, increase clinicians' skills, and improve patient care as the ultimate outcome.

Keywords: Diagnostic Ultrasound, Ultrasonographic Imaging, Internal Medicine, General Internal Medicine

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Point-of-care Ultrasound (POCUS) is the acquisition of an ultrasonographic image of interest to answer a specific question and guide the clinician's performance of an invasive procedure at the place where the care is delivered.[1] This point of care could be any of the following: outpatient clinic, inpatient ward, intensive care unit, palliative care unit, or emergency department. POCUS is not a novel means of imaging but a novel paradigm, thanks to relatively low costs, reduced sizes, higher availability of new ultrasound devices, and a short learning curve. The traditional imaging paradigm consists of specialized physicians, namely radiologists, who conduct imaging processes in a designated area after completing a formal clinical assessment, including a thorough history and physical examination by a clinician, which is not a part of the imaging process.[1,2] While radiologist-provided imaging is highly reliable, quantitative, and anatomically descriptive, there are several downsides to this traditional paradigm. Firstly, the full availability of radiologists at any given time at any given hospital means allocating too many resources, which is impossible even in the most prosperous countries. Secondly, there is a clinical need for rapid and sequential imaging to monitor treatment response, such as imaging cardiac contractility after each cycle of cardiopulmonary resuscitation.[3] Lastly, standard procedures done at the bedside, like paracentesis, thoracentesis, and central line insertion, are performed faster and have lower rates of complications when performed with ultrasound imaging than without it.[4-6] These main points form why clinicians should be involved in imaging processes. These clinical demands led to a new imaging paradigm, namely, POCUS. POCUS has begun to be regarded as an extension of conventional physical examination by adding clinical data that routine physical examination cannot obtain.[7-10] POCUS imaging dramatically differs from traditional radiologist-based imaging in the following ways: The criteria for evaluating images are mostly qualitative and dichotomous, serving as a complementary tool for specific conditions instead of gross anatomical imaging. Most importantly, the purpose of POCUS is not to supplant a comprehensive radiologist examination but rather to facilitate the rapid and guided resolution of clinical problems and questions.[11, 12]

There is no globally accepted POCUS training curriculum for internists. Furthermore, there has yet to be a universal agreement on whether every internal medicine physician should acquire POCUS skills or to what extent clinicians should apply them. Several societies and groups have published their position papers to standardize POCUS education.[11-15] However, research reveals that most internal medicine residency programs do not provide formal POCUS training. Several underlying causes lie beneath this, but the most crucial drawback for POCUS education seems to be the low number of POCUS educators.[16] Regarding our country, Turkey, there is no formal POCUS education program for internists. Besides, there is no certified POCUS educator as well.

DAHUDER Internal Medicine Society is a general internal medicine society formed in Turkey whose primary aim is to provide education, improve the clinical skills of internal medicine specialists and residents, and strengthen the generalist view of internists. The society established the Ultrasound Working Group to cater to all the POCUS needs of internists. With this mission, we have developed a roadmap with the ultimate goal that "every internal medicine physician should be able to perform basic POCUS applications." Our first aim is to create a national internal medicine POCUS curriculum that matches the country's needs and resources per global standards. Later, we plan to provide POCUS education in local universities and state hospitals, cover the entire country, reach as many internists as possible, and improve their POCUS skills.

In this paper, we would like to present our internal medicine POCUS curriculum and define the expected outcomes as a position paper.

METHODS

Since no national POCUS training standard exists for internists in Turkey, we started by developing a POCUS training curriculum. For this purpose, the DAHUDER Ultrasound Working Group performed an unstructured literature search using PUBMED. Despite the existence of several society position papers, we found that university- or hospital-level scales shaped many curriculums. While there is some shared curriculum content, many differences exist between programs.[11-15] The DAHUDER Ultrasound Working Group analyzed each piece of curriculum content and reached a consensus on its inclusion or exclusion during curriculum preparation meetings.

Besides a literature search, the DAHUDER Ultrasound Working Group also conducted an informal assessment during the 3rd DAHUDER National

Internal Medicine Congress to understand the needs and claims of practicing internal medicine physicians. After discussing each claim, the DAHUDER Ultrasound Working Group reached a consensus on whether to include or exclude the content.

RESULTS

We determined that the curriculum should cover ten main areas, split into two difficulty levels: the basic and advanced POCUS curriculum. These areas and their content are as follows:

1. Principles of Ultrasound Physics

- The basic principles of the ultrasound physics domain consist of ultrasound physics & principles, namely acoustic impedance, reflection & refraction, echogenicity & attenuation, common artifacts, safety, and bioeffects.
- The advanced principles of the ultrasound physics domain consist of Doppler imaging (color, power, pulse wave, and continuous wave Dopplers) and elastography.

2. Machine Basics

- The basic machine-basics domain consists of types of ultrasound machines (cart-based, hand-held devices), machine interface & settings, namely knobology (i.e., freeze, gain, depth, measure, focus), probe types and selection (convex, phased-array, and linear probes and their properties), image acquisition & scanning (probe movement types), and imaging modes (B- and M-modes).
- The advanced machine basics domain does not include any content.

3. Thorax Imaging

- The basic thorax imaging domain consists of understanding lung artifacts (A- and B-line detection in a similar fashion to the BLUE protocol)[17], determining pleural fluid, and pleural fluid-related findings (e.g., spine sign, curtain sign, jellyfish sign, etc.), and the presence or absence of lung sliding using both B- and M-modes, with their clinical implications for pneumothorax, consolidation, pulmonary edema, and pleural effusion.
- The advanced thorax imaging domain consists of diaphragmatic ultrasound to detect diaphragmatic thickness and mobility.

4. Abdominal Imaging

- The basic abdominal imaging domain includes abdominal free fluid detection using the FAST criteria[18]; liver size (normal, decreased, or increased) and parenchyma evaluation (homogenous or heterogenous, liver surface nodular or not), spleen size (normal, decreased and increased) and parenchyma (homogenous or not) assessment, gallbladder stone (present/absent), biliary sludge (present/absent), gallbladder anterior wall thickness measurement, gallbladder wall edema (present/absent), and biliary tract dilatation (present/absent) assessment; renal size (normal, decreased and increased) and parenchyma thickness assessment (normal or reduced), hydronephrosis (present/absent), nephrolithiasis (present/absent), bladder urinary retention (present/absent), as well as assessment of gross liver, spleen, and kidney cysts & masses in dichotomous fashion.
- The advanced abdominal imaging domain covers abdominal aorta aneurysm screening, ileus evaluation, and appendicitis assessment.

5. Cardiac Imaging

- The basic cardiac imaging domain mainly parallels the FoCUS core curriculum[11] and starts with the acquisition of five core echocardiographic windows: parasternal long and short axes (PLAX and PSAX), apical and subcostal four-chamber views (A4C and S4C), and subcostal vena cava inferior view (SVCI), followed by the determination of pericardial and pleural fluid, gross left ventricular systolic functions (trichotomously as normal, reduced, or severely reduced), chamber size measurements, detection of right ventricular strain, gross valvular abnormalities (without the use of Doppler imaging), inferior vena cava diameter and collapsibility, and the presence of gross intracardiac masses.
- The advanced cardiac imaging domain comprises the determination of left ventricular diastolic dysfunction and acquiring Doppler imaging of the valves.

6. Vascular Imaging

- The basic vascular imaging domain involves detecting deep vein thrombosis using a 3-point compression test (without Doppler imaging).
- The advanced vascular imaging domain consists of carotid intima-media thickness measurement.

7. Thyroid & Neck Imaging

- The basic thyroid & neck imaging domain consists of thyroid size measurement, nodule assessment (present/absent), and vascularity assessment (increased, not increased).
- The advanced thyroid & neck imaging domain consists of assessment of thyroid nodules in accordance

with the Ti-RADS classification and assessment of cervical lymph nodes (reactive, not reactive).

8. Musculoskeletal (MSK) Imaging

- The basic MSK imaging domain does not include any content.
- The advanced MSK imaging domain comprises joint effusion assessment and soft tissue collection evaluation.

9. Interventional Imaging

- The basic interventional imaging domain consists of paracentesis, thoracentesis, vascular access, bladder catheter placement, and confirmation of endotracheal intubation & position under ultrasonographic guidance.
- The advanced interventional imaging curriculum consists of synovial joint aspiration and abscess & collection aspiration under ultrasonographic guidance.

10. Approach to Clinical Scenarios: Protocols

- The basic protocols domain includes BLUE[17] and eFAST[19] protocols for lung assessment in critically ill patients and free fluid assessment in trauma patients, respectively.
- The advanced protocols domain includes the RUSH[20] protocol for assessment of a patient with undifferentiated shock.

Table 1 provides a brief overview of the POCUS curriculum for internists.

Table 1. Basic and advanced POCUS curriculum for internists

Domains	Basic POCUS Curriculum	Advanced POCUS Curriculum
Principles of US Physics	-US physics & principles	- Doppler imaging - Elastography
Machine Basics	- US machines & knobology - Probe types, imaging modes, and image acquisition	N/A
Thoracic Imaging	- Lung artifacts and sliding - Pleural fluid	- Diaphragmatic thickness and mobility
Abdominal Imaging	- Free fluid - Liver, spleen, and kidney parenchyma & size - Gross liver, spleen, and kidney cysts & masses - GB pathology & biliary tract dilatation - Hydronephrosis, nephrolithiasis, and bladder urinary retention	- Ileus - Appendicitis - Abdominal aorta aneurysm
Cardiac Imaging	- Main windows - Pericardial & pleural fluid - LV systolic functions - RV strain - Chamber sizes - Gross valve and mass assessment - IVC assessment	- LV diastolic dysfunction - Doppler imaging of the valves
Vascular Imaging	- Deep vein thrombosis	- Carotid IM thickness
Thyroid & Neck Imaging	- Thyroid size, nodule & vascularity	- Thyroid nodule characterization - Assessment of lymph nodes
MSK Imaging	- N/A	- Joint effusions - Soft tissue collections
Interventional Imaging	- Paracentesis & thoracentesis - Vascular access - Bladder catheter placement - Endotracheal intubation and position confirmation	- Synovial joint aspiration - Abscess & collection aspiration
Approach to clinical scenarios: Protocols	- BLUE protocol - eFAST protocol	- RUSH protocol

GB: Gallbladder, IM: Intima-media, IVC: Inferior vena cava, LV: Left ventricle, MSK: Musculoskeletal, N/A: Not applicable, POCUS: Point-of-care ultrasound, RV: Right ventricle, US: Ultrasound

CONCLUSION

Prior studies indicate that POCUS imaging applications are reliable and efficient after adequate education and training.

This paper marks the first comprehensive examination of Turkish internal medicine specialists' specific needs and objectives regarding POCUS training. It addresses a significant gap in the existing literature by focusing on the particular context and requirements of clinicians in Turkey, which paves the way for tailored education and skill development in this vital area of medical practice. We expect the POCUS education curriculum to set national standards, provide a reference point, increase clinicians' skills, and improve patient outcomes in Turkey.

As both the data supporting evidence-based applications of POCUS and the technology itself continue to evolve, we recognize the necessity for this paper to adapt accordingly. We intend to implement a dynamic framework that not only captures the current landscape of POCUS training but also commits to regular updates. By doing so, we aim to ensure that the curriculum remains relevant and meets healthcare providers' and patients' continuously changing needs. Through ongoing revisions, we strive to enhance the quality of POCUS education, ultimately contributing to better patient outcomes in Turkey.

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical Approval

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