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Content and Adequacy of Emergency Medicine Point of Care Ultrasound Training: Evaluation of Turkey

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Abstract

Aim: With its widespread use for emergency patient care, point-of-care ultrasound (PoCUS) is included in postgraduate education in Turkey, but its practice may vary depending on the training program. Our study aimed to determine the content of practices regarding PoCUS training in Turkey, and to present a future perspective by revealing the relationship between years of education and competence perceptions.

Materials and Methods: This is a descriptive study conducted on emergency medicine students who were still residents approximately 2018-2019. The first part includes demographic data, theoretical and practical training content. The second part is created according to the Likert scale for self-assessment that questions the competence. The survey was conveyed to.

Results: In our study, including 249 residents, the participants reported their practical training hours for emergency ultrasound (US) use as 12.5 h, and theoretical training hours as 12.1 h. For all sonographic evaluations, it was found that 10.1% of the practices were performed under the supervision of an academic member.

Conclusion: It was found that Emergency Medicine clinics in Turkey had adequate equipment for the use and training of US, residents had a certain level of competence to using US, but there was no regular training with curriculum and assessment criteria in clinics.

Keywords: Ultrasound education, PoCUS, medical education, emergency room

Introduction

The use of ultrasound (US) in emergency departments has significantly increased in the last thirty years. The US increases the quality of patient care in the emergency department, shortens the duration of discharge, increases quality and value in terms of diagnostic accuracy and cost reduction and contributes to patient safety in interventional procedures (1). In parallel with this, the US has started to be included in the emergency training curricula over the last 20 years.

The US has taken been included into all levels of medical education, integrated into the medical school curriculum, entered postgraduate education after postdoctoral education, and started to be included in the training of nurses and prehospital care providers. In the United States of America (USA), which has a pioneering position in the field of clinical US use, and around the world, the content of both undergraduate and postgraduate US training has been described in detail, especially in the field of emergency medicine (1).

After the recognition of the value of the US in the emergency department, studies on the use of US have been conducted in many countries such as the UK (UK College of Emergency Medicine-CEM), Australia (Australasian College for Emergency Medicine-ACEM), Canada (Canadian Association of Emergency Physicians-CAEP), especially the USA (American College of Emergency Physicians-ACEP) (2). Because of these studies, training curricula on the use of US were created for emergency department personnel. In these curricula, minimum qualification criteria and contents, which differ on country basis, were determined to ensure the standardization of US training (1).

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In emergency departments, especially the use point-of-care ultrasound (PoCUS) is well known. Although PoCUS was previously used for managing patients with blunt trauma, it has been used for diagnostic and interventional purposes in non-trauma cases with the training and increased experience (1).

In the USA, ACEP states that the clinician should recognize the indications and contraindications for each PoCUS area as a prerequisite for 11 titles (trauma, intrauterine pregnancy, abdominal aortic aneurysm, cardiac, biliary, urinary, DVT, soft tissue and musculoskeletal, thoracic, ocular, interventional), which are defined as the core. To acquire adequate images and to provide this in different cases, it must understand the US physics to make an appropriate and accurate sonographic evaluation in patients with different body characteristics. Simultaneously with the image acquisition, the clinician should interpret the imaging by distinguishing between normal anatomy, common variants, as well as a range of obvious and indistinct pathologies. Finally, the clinician should be able to integrate emergency sonographic evaluation findings into individual patient care plan and management. It is stated that effective integration includes proper documentation, quality assurance, and immediate US reimbursement, as well as accurate information provided by each assessment (1).

In the core program of US training, emergency US rotation 2 weeks in the first year, in the following period 1 week for each year, and 80 h of emergency US training for each student are required during the residency period. These rotations should focus on the integration of the US into daily clinical practice in small groups, as well as device use, evaluation protocols, image optimization, interpretation, and recording. In addition to emergency US turn of duty under the supervision of a lecturer, weekly case discussions and simulations of less common cases are recommended (1). Numerous researchers have shown that simulation results in image acquisition, interpretation and practitioner confidence with equivalent success compared to traditional practical training (3,4). Simulation allows the practice of new skill in a safe environment before actual clinical performance. ACEP has also drawn attention to the weekly paper hours and according to the need, assessment in the form of question/answer in small groups, and the definition of assessment processes at the end of emergency US imaging periods and rotation (1).

In the evaluation of US training, ACEP recommends exam methods such as supervised question-answer, objective structured clinical exams (OSCE), one-to-one standardized direct observation tools, simulation (1).

In the first Emergency Medicine Specialization Training Curriculum approved by the Board of Medical Specialties (TUK) in 2008, emergency US was included with the content of Focused Assessment with Sonography for Trauma (FAST) under the title of trauma/orthopedic interventions (5).

In the curriculum approved in 2016, it was stated as the use of emergency US under the heading of "emergency imaging methods", and in 2017 and 2019, as the use of bedside emergency US and bedside echocardiography evaluation under the heading "emergency imaging methods" (6,7).

Although it has been used in the emergency departments in our country for a long time, the bedside US Emergency Medicine Education Curriculum is relatively new. In response to this new curriculum, many emergency departments have US, and transportation is getting easier. Accessing and using the US has increased the interest in US training among emergency department personnel and caused learning attempts through various courses or online training. Simultaneously, the ease of access to the US has increased its use for patients, symptoms, or treatment, which increases the perception of competence after a certain use.

This study investigates residents' content of the training and competence of PoCUS in emergency medicine clinics in Turkey.

Materials and Methods

The study is a descriptive study conducted on all emergency medicine residents who were still studying in 2018-2019, and who agreed to participate in the study. After obtaining the approval from the ethics committee, the survey questions about the competence levels and practice details of the participants were created online. During the stage of preparation, the validity of the survey was tested by applying it to 12 emergency medicine residents in different education years. The survey was sent the emergency medical training programs in Turkey in an online environment and were asked to respond.

The questionnaire, which consisted of Likert-type questions, had two parts. The first part includes questions about the demographic data of the participants (institution, age, gender, duration of education), US hardware quality of the program they were educated in, and didactic and practical training content. In the second part, they were asked to evaluate their competencies according to the Likert scale (which includes the options I strongly agree, agree, neutral, disagree, strongly disagree) with the questions prepared based on the comprehensive PoCUS educational objectives suggested by the ACEP;

1) knowledge of its indications and limitations,

2) to be able to define the sonographic anatomy,

3) to be able to evaluate pathology/entrapments,

4) ability to integrate the findings into patient management in the basic areas of PoCUS.

The questions on emergency echocardiographic practices were prepared separately in line with the educational goals, which are also the recommendations of the ACEP (1). In the last part of the survey, it was expected to make evaluation the subject of "integrating US into patient management" in each US intervention.

Statistical Analysis

In the statistical analysis, the "Statistical Package for Social Sciences (SPSS) Statistics 20.0.0 for Windows" (IBM-SPSS, SPSS Inc. Chicagoi Illinois, USA) software was used. While evaluating the results, "strongly agree" and "agree" preferences were considered "positive perception of competence". The perception of "being able to evaluate pathology/entrapments" was compared between the groups with the acceptance that it requires clinical practice experience on basic PoCUS knowledge for competence. The minimum sample size was determined considering a confidence interval of 95%, an alpha of 0.05, and a power of 80%. Categorical data were recorded with the percentage frequency and 95% confidence interval, the data obtained by measurement were recorded with the mean and standard deviation data.

Results

The assessment included the responses of 249 residents after 32 participants who did not complete the entire questionnaire-delivered online between September 2018 and February 2019 were excluded from the study (mean age, 29.2; range, 24-42). US device was available in the clinics of 96% (N=239) of the participants for 7/24, and 176 (N=70.7%) participants stated that they had three different types of probes in their clinics.

Except for in-house bedside procedures, the mean annual practice training time allocated to PoCUS training was 12.5 h [95% confidence interval (CI): 9.6-15.9], and the mean annual didactic training time was 12.1 h (95% CI: 10.2-14.9). Of the participants, 19.3% (N=48, 95% CI: 14.1-24.1) stated that they had ultrasonography (USG) rotations. The mean percentage of monthly PoCUS practice under the supervision of an academic member reported by the participants was 10.1% (range, 0-100). A summary of educational resources and methods is given in Table 1. The most commonly used assessment and evaluation method was multiple choice or standard written exams (43%, 95% CI: 37.3-49). The frequency of other assessment and evaluation methods is given in Table 2.

In the comparison of the groups of education years of 24 months (2 years) or more and less than 24 months (2 years) in our study, positive perception of competence ($p<0.001$ for aortic aneurism and dissection, $p<0,001$ for trauma, $p<0.001$ for gallbladder and cholecystitis, $p<0.001$ for hydronephrosis, kidney stones, mass and bladder volume, $p=0.019$ for DVT, while $p<0.001$ for CIS, $p<0.001$ for thorax, $p=0.003$ for ocular) was significantly different in other headings, while years of education did not make a difference in intestinal ($p=0.09$) and 1st trimester ($p=0.69$) PoCUS procedures, when the ability to "evaluate pathology and entrapments" in the related domain of PoCUS practice, which we positioned on the basic knowledge of indication and sonoanatomy and which requires practical experience, was assessed. The results were similar for the emergency echocardiographic learning goals (for each domain) ($p<0.001$).

Of the participants with ≥2 years of residency training, 46.7% (N=63, 95% CI: 37.8-55.6) had a "positive perception of competence" for the question "I know US physics and relevant definitions (frequency, resolution, Doppler, etc.)". This rate was 61.5% (N=83, 95% CI: 53.3-69.6) for "using the equipment properly", 56.3% for "recognizing common US artifacts" (N=76, 95% 47.4-64.4), and 40.5% for "ability to document US findings understandably and appropriately (N=64, 95% CI: 39.3-55.6).

The responses given by the participants according to the positive competence perception for PoCUS domains are given in Table

Table 1. Data on participants' training resources and methods

Method	Percentage (N, 95% CI)
"Learning by yourself" by applying	77.9 (194, 72.7-82.7)
"Learning by watching"	69.9 (174, 63.9-75.5)
Outside courses	66.3 (165, 59.8-71.9)
In-house seminars and theoretical courses	64.7 (161, 58.2-70.7)
Internet-based learning	35.3 (88, 29.3-41.4)
In-house courses	26.1 (65, 20.5-31.3)
In-house simulation training	18.9 (47, 14.5-23.7)
Supervised practice	13.7 (34, 9.6-18.1)

CI: Confidence interval

Table 2. Data on the measurement and evaluation methods of the participants

Method	Percent (N, 95% CI)
Multiple choice or standard written exams	43 (107, 37.3-49)
Real-time clinical evaluation with supervision	32.5 (81, 26.5-38.6)
Observational Assessment of Skill (DOPS)	32.1 (80, 26.1-37.8)
Objective Formal Clinical Exam (OSCE)	9.6 (24, 6.4-13.3)
Assessment with simulation	6.8 (17, 4-10)
Weekly image evaluation, question-answer exam, feedback	5.2 (13, 2.4-8.4)

CI: Confidence interval

Table 3. Positive perception of efficacy for aortic, thoracoabdominal trauma, biliary, urinary and first trimester pregnancy

Question (PoCUS field, N (percent) 95% CI)	Aorta	Trauma	Biliary	Urinary	1. trimester	Ocular	Intestinal	Thorax	DVT	CIS
I know the indications/limitations	169 (67.9) 61.4-73.5	185 (74.3) 68.7-79.9	164 (65.9) 59.8-71.5	136 (54.6) 48.6-60.6	78 (31.3) 25.7-36.9	81 (32.5) 26.5-38.5	59 (23.7) 18.1-28.9	150 (60.2) 53.8-66.7	161 (64.7) 58.6-70.3	81 (32.5) 26.5-38.6
I can describe his sonographic anatomy	128 (51.4) 44.6-57.8	161 (64.7) 58.2-70.3	134 (53.8) 47.4-60.2	151 (60.6) 54.6-66.7	60 (24.1) 19.3-29.3	81 (32.5) 26.9-38.2	28 (11.2) 7.6-15.3	147 (59.0) 52.6-65.5	117 (47) 41-53	78 (27.3) 22.1-33.3
I can evaluate the pathology/pitfalls	146 (58.6) 52.2-64.3	165 (66.3) 60.6-72.3	156 (62.7) 56.6-68.7	135 (54.2) 47.8-60.2	51 (20.5) 15.3-25.3	64 (25.7) 21.5-31.3	25 (10) 6.4-14.1	132 (53.0) 46.6-59.4	133 (53.4) 47.8-59.8	84 (33.7) 27.7-39.4
I can integrate these findings into my patient management	147 (59.1) 52.6-64.7	184 (73.9) 68.7-79.1	158 (63.5) 57.8-69.5	140 (56.2) 50.2-62.2	58 (23.3) 17.7-28.9	71 (28.5) 22.9-34.1	38 (15.2) 10.8-19.7	117 (47) 40.2-53.4	146 (58.6) 52.6-64.7	77 (30.9) 25.3-36.9

CI: Confidence interval, PoCUS: Point-of-care ultrasound, DVT: Deep vein thrombosis

3 for emergency echocardiographic procedures in Table 4. For the basic US-guided procedures, the rate of positive perception of competence was the highest (83.0%) among the participants in the same group. Of the participants, 60.0% (N=81, 95% CI: 51.1-68.1) had a positive perception of "knowing the indications and limitations of interventional US procedures". This rate was 62.2% (N=84, 95% CI: 54.1-69.6) for "I can integrate the US as a procedural guide into clinical patient management", and there was a significant difference compared the students with education years of <24 months ($p<0.001$).

Discussion

Although we could not get regular information about the content and evaluation of the training as there was no structured US training for graduate students, this study on PoCUS training in emergency medicine clinics in Turkey revealed that clinics were attempting to create a US training program and provide training accordingly, by complying with the guidelines as far as their facilities were sufficient.

ACEP recommends a theoretical and practical introductory course covering 16-24 hours of core competency domain for US training, as well as 4-8 hours of short courses for subjects other than basic domains and acquiring approximately 25-50 recorded images in the basic or other domains (1). In our study, the mean annual didactic training time was 12.1 h, and the clinical training time allocated to US training was 12.5 h. In a study conducted on the emergency department specialty programs in the USA, 15% of the programs had a US rotation for 1-2 weeks, and 47% had a US rotation for 2-4 weeks. It was stated that the mean time allocated to US training was 34 h (8). A study by Counselman et al. (9) on emergency medicine specialty programs found that 48% of the US clinical training hours were between 1 and 10 h per year. The didactic and practice training hours allocated to US training, which we determined in the emergency medicine clinics in our country, do not meet the times recommended providing the competencies in the guidelines. The reasons for this are thought to be due to the lack of competent academic members for USG training and the fact that it has recently been included in the TUK skill guidelines for emergency medicine assistants (6,7). Since there is no regular US training program in many of the emergency medicine clinics where we conducted the study, it could not be determined in which years these training was provided or how much of them was on the basic or advanced US training.

Of the research assistants who participated in the study, 19.3% stated that they had US rotations in their departments. Lewiss et al. (10) stated that the training should be provided with a 4-week longitudinal model as 2 weeks in the first year of postgraduate

Table 4. Positive perception of competence of the participants for emergency echocardiographic applications		
Questions	**N**	**Percent (95% CI)**
We can determine the indications and limitations of Emergency ECHO	128	94.8 (91.1-98.5)
I can do standard ECHO (subcostal, parasternal, Apex, four spaces, long and short axis)	126	93.3 (88.9-97.0)
I can recognize the pericardium, heart chambers, veins, the aorta and inferior vena cava anatomy on ECHO	128	94.8 (91.1-97.8)
I can evaluate left ventricular functions (EF) and central venous pressure estimation	124	91.9 (86.7-96.3)
I can recognize cardiac arrest, tamponade with or without pericardial effusion, aortic root dilatation on ECHO	125	92.6 (88.1-96.3)
I can integrate emergency ECHO findings into individual patients or departments	135	93.3 (88.9-97.0)
EF: Ejection fraction, ECHO: Echocardiographic, CI: Confidence interval		

education of trainee sonographers and 2 weeks in the second year. However, there are also some stating that it should be provided with a 4-week intensive program in the first year. Lack of regular training on this subject in our country and continuing only with courses given by specialist associations made it difficult to give a country-wide rate. Therefore, it does not allow us to compare with other results. When all the results are evaluated, it can be speculated that standard structured US training is not sufficiently structured in the emergency medicine training.

Although it was stated that US training should generally be taught by supervisors, this rate was found to be very low in our study (13.7%), a large proportion of the participants stated that they learned on their own. In many studies, US practice is supported as a learning method accompanied by supervision (for the USA, a 'supervisor' or a 'sonogapher' or 'sonogapher' candidate who has passed the exams at the end of the training is a final year student) (11). Damewood et al. (12) recommended that most of the courses be supervised directly by physicians and EUS members (if available at the institution) for the early development of US techniques. Practices with a supervisor and feedback are important in the acquisition of US skills. ACEP's recommendation on teaching methods is USG turn of duty and weekly case discussions under the supervision of an authorized academic member (1). In our study, the most frequently used method of "self-learning by practicing" does not comply with the standards, but the fact that the most frequently used method is self-learning by practicing raises questions about the US competencies of emergency medicine graduate students. Considering that highly sensitive patients are treated in emergency departments, it is important to create educational environments in safe medical simulation environments with the help of competent academic members for basic knowledge and clinical integration (13). The accuracy of the information obtained is doubtful since no feedback is provided in the training not conducted like this. This is perilous for educating people who decide on the treatment of highly sensitive patients, such as emergency medicine personnel. Since there is no feedback in self-learning by practicing, which is the most common learning method in our study, the accuracy of the learned information is doubtful. This needs to be corrected with certain feedback methods.

In US training, it is recommended to benefit from many training strategies, as well as didactic training. Our study found that they received help from online resources (35.3%) and external courses (66.3%) in addition to didactic US training. Even though it seems that the use of online facilities for education is low to a certain extent, it is thought that this rate will increase with the increasing number of options in the native language and the popularization of the existing ones. In a study conducted in Canada, it was observed that emergency department personnel used online training resources (56%), textbooks (52%) and US courses (52%), in addition to didactic training for education (14). Lewiss et al. (10) reported that that asynchronous emergency US learning could be equal to traditional didactic lectures. The results show that the training is provided in standard ways worldwide and that we are close to these standards.

For US training evaluation, it is recommended to be done repeatedly, at the beginning and at the end of the training using individualized assessment and evaluation methods (1). Considering the evaluation method in studies conducted in the USA, it is stated that almost all programs (99%) use the real clinical evaluation method under supervision to evaluate the US competence (2). Simultaneously, it is recommended to use more than one measurement and evaluation method, since domains such as anatomy, physiology, and clinical integration should be evaluated to determine the US competence (15,16). A study used the OSCE method for abdominal US competence, but it was thought that the evaluation performed in a limited simulated environment could not accurately predict their clinical performance (17). In fact, the best way to evaluate USG competence in emergency medical clinics is through direct observation (18-20). But since a certain standard cannot be achieved in this method, studies have been conducted on US competence in the emergency department using the standardized Direct Observation of Procedural Skills (SGOD) method, and it has been concluded that this method is an appropriate measurement

method as it enables emergency department personnel to recognize their strengths and weaknesses, and is an effective assessment method allowing immediate feedback (21), although our study revealed that multiple-choice or standard written exams were most frequently administered, it was followed by real-time clinical assessment under supervision and skill and observation-based assessment. Although the rate of using this assessment remained below 50%, it was observed that it agreed with the recommended assessment and evaluation methods.

It was noted that the participants had more than 50% positive perceptions of competence in determining the US indications for the aorta, trauma, biliary, urinary, thorax, DVT areas, recognizing the anatomy of the region, recognizing pathologies and entrapment, and integrating them into the clinic. According to the article of Emergency Medicine US milestones by the Accreditation Council for Graduate Medical Education (ACGME) and the American Board of Emergency Medicine in 2012, USG competence is divided into 5 levels (22). According to these level criteria, the level of our participants is 2, that is, the early moderate level. According to this level, US users are expected to be actively capable of performing US, to be able to determine the US area consistent with the clinic and demonstrate it. Participants who are level 2 are even probably level 3 (with a certain number of image recording in addition to their level 2 skills), as there is no system that clearly controls how many times and in which area they acquire images. It is thought that as the US training and competency determination criteria are developed in our country, it will be understood that the emergency medicine personnel are at higher levels.

In their study, Bustam et al. (23) found ECHO competence of emergency medicine interns as 93% for left ventricular estimation, 92.9% for ejection frequency measurement, 98% for pericardial effusion measurement, and 64% for the inferior vena cava evaluation. Similarly, in our study, it was observed that there were more than 90% positive perceptions of competence in the mentioned ECHO areas.

According to their own evaluations, it was observed that the participants felt themselves sufficiently in terms of US physics, US equipment, artifacts and documentation.

In a study by Kim et al. (14), more than half of the participants reported that they used US guidance for foreign body removal, incision and drainage, paracentesis, peripheral venous cannulation and thoracic evaluation, both for diagnostic and interventional purposes, and felt sufficient in this regard. In our study, more than 50% of the participants defined themselves competent for US-guided vascular access (67.1%) and thoracentesis (58.2%). This can be explained by the fact that the residents in many emergency medicine clinics have easy access to the US and they can try US-guided interventions very often, as they work in intensive emergency rooms.

Although US training practice, techniques, hours, evaluation criteria do not meet the standards in our survey, when we asked the residents to evaluate their own competence in recognizing pathologies and entrapment before and after 24 months, which is a key point in emergency medicine training, those with an education year above 24 months stated that they were better at aortic, trauma, gall bladder, renal, DVT, CIS, thoracic and ocular US. The most significant reason for this is that they have improved themselves in these areas by self-training on the US device (96%) and common pathologies frequently encountered in their clinics. A book created by medical educators and educational psychologists mentions that self-assessment in medical education is a vital skill in clinical practice. This includes not only self-assessment but also what they can do about what they will learn (goals), how they learn (methods, strategies), whether they have learned, what they learn (assessment) and using what they have learned (adaptation) (24). It can be speculated that the residents can convert these skills into a habit after a while, even if they do unknowingly do these skills. Self-assessment appears to be a driving force in this educational model. This may be because they manage the learning processes together in the adult learning process and gradually take more responsibility for their own learning. Similarly, in our study, it was observed that the more time they spend practicing US, the more they try to learn, feeling more responsible for recognizing common pathologies and applying them to the clinic.

Study Limitations

The major limitation of our study is that it is a survey study based on instant statements and it has the handicaps of similar survey studies. Moreover, since it is an educational content and situation analysis with only the perspective of research assistants, there may be limitations regarding the data of US training practices in emergency medicine educational institutions in Turkey. Another limitation is that only 66% of the educational institutions responded and no sufficient number could be reached. Not recording the geographical and other physical conditions that may affect the perception of competence due to the number and variety of patients is also a limitation of this study.

Conclusion

The US training provided in emergency medicine clinics in Turkey was below the generally accepted standard training programs. However, the fact that the residents consider themselves competent, especially in their basic subjects, shows that the

emergency medicine clinics are sufficient and well-equipped US and although they have not been developed into a specific program and feedback system, effective training is provided. US training programs in the emergency medicine clinics in our country should be prepared in line with the standards of the guidelines accepted in many world countries and training and crediting should be based on these.

Ethics

Ethics Committee Approval: The study were approved by the Akdeniz University of Local Ethics Committee (protocol number: 70904504/395, date: 03.09.2018).

Informed Consent: Survey study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: F.S., Concept: F.S., A.Y.Ü., Design: F.S., A.Y.Ü., Data Collection or Processing: F.S., E.G., Analysis or Interpretation: E.G., A.Y.Ü., Y.Ş., Literature Search: F.S., Writing: F.S., A.Y.Ü., Y.Ş.

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