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ORIGINAL RESEARCH

Access to Point-of-Care Ultrasound in Maine Emergency Departments

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Introduction: Point-of-care ultrasound (POCUS) is an essential tool in emergency medicine. We evaluated access to bedside ultrasound machines and characterized POCUS use in Maine emergency departments (EDs).

Methods: We conducted a cross-sectional electronic survey of all ED medical directors in Maine. The survey included questions on ED characteristics, access to ultrasound machines, POCUS use patterns, POCUS administration, and barriers to use.

Results: Thirty-four EDs were identified, and 24 medical directors completed the survey, yielding a response rate of 71%. EDs were predominantly small and rural. Only 21% identified as urban, and 54% reported less than 20 000 annual visits. Surveys showed that 88% of EDs had immediate access to a bedside ultrasound machine in the ED. Also, 76% used ultrasound guidance to place more than 75% of internal jugular central venous catheters, while 24% used ultrasound to place less than 10% of catheters. Of EDs with ultrasound access, 90% had hospital privileges for providers, 71% had a credentialing process, 52% had quality assurance processes, and 48% had a designated ultrasound director.

Discussion: Compared to other states, Maine EDs were lower-volume and more rural but had similar access to ultrasound machines. Previous studies showed poor adherence to national guidelines for ultrasound quality assurance practices and provider credentialing. Our results demonstrate that this issue is ongoing.

Conclusions: Maine's predominantly rural EDs have excellent access to ultrasound machines. Areas for improvement in POCUS use and administration were identified, including enhancing quality assurance practices, boosting provider credentialing, and increasing the use of ultrasound guidance for vascular access.

Keywords: point-of-care ultrasound, clinical ultrasound, emergency medicine, rural medicine

Point-of-care ultrasound (POCUS) at the bedside is increasingly recognized as an essential tool in emergency medicine (EM). A growing body of literature supports that the use of ultrasound in the emergency department (ED) improves procedural success while decreasing complications, reduces ED length of stay, improves diagnostic accuracy, and decreases mortality.¹⁻⁹ The American College of Emergency Physicians (ACEP) supports the use of POCUS as a fundamental skill in the practice of EM, and the Accreditation Council

of Graduate Medical Education identifies POCUS as a core competency required in EM residency training.^{10,11} Despite these guidelines, many EDs in the United States continue to have limited access to ultrasound machines and do not use POCUS as recommended by the ACEP.¹²⁻¹⁸

Previous studies demonstrated variable availability of POCUS, with 34% to 96% of surveyed EDs reporting access to an ultrasound machine.^{12,13,15-18} These studies also highlighted POCUS disparities among EDs. Specifically, community EDs had less access to ultrasound machines and less use of POCUS than academic EDs, rural EDs had less than urban EDs, and low-volume EDs had less than high-volume EDs. Also, EDs with a lower percentage of EM board-certified/board-eligible

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physicians had less access and use than those with a higher percentage.¹³⁻¹⁶ These findings are particularly relevant in Maine, which, according to the 2010 US census, is the most rural state in the country.¹⁹ Among 34 EDs in Maine, 16 are at critical access hospitals, and only 1 is at an academic medical center.

To address POCUS access and education needs in rural EDs nationwide, we must first understand how ultrasound is being used in these centers. In this study, we sought to determine access to bedside ultrasound machines and characterize POCUS use among EDs in Maine.

MATERIALS AND METHODS

Study design

We conducted a cross-sectional electronic survey study of ED medical directors in Maine. We included all 24-hour EDs and excluded urgent care centers, acute psychiatric facilities, and state correctional facilities. Contact information for the medical directors was obtained through the Maine chapter of ACEP. Data was collected from Fall 2017 to Summer 2018. This study was designated as exempt by the Maine Medical Center Institutional Review Board.

Survey method and instruments

A 30-question survey was developed based on review of previous studies and discussion with EM faculty that were fellowship-trained in using ultrasound.^{12,13,15-18} The survey included questions on ED characteristics, access to ultrasound machines, POCUS use patterns, POCUS credentialing, interest in POCUS education, and barriers to use. Before distribution, the survey was pilot-tested for content and readability by 5 attending EM physicians using the online platform.

The survey was built and distributed using Qualtrics (Provo, UT). All ED medical directors in Maine were sent an email with a personalized survey link and a description of our research project. Non-respondents received up to 4 reminder emails and 1 phone call.

Data analysis

Survey responses were exported from Qualtrics to Excel for initial analysis. Analysis was performed using Stata version 10 software (StataCorp, CollegeStation, TX). Descriptive statistics were used to summarize the data. Survey responses are reported as the percentages of total respondents.

RESULTS

A total of 34 EDs were identified for participation in this study. Medical directors from 24 EDs completed the survey, yielding a response rate of 71%. Non-respondents included 6 critical access hospitals, 3 rural EDs, and 1 urban ED with variable volumes.

Respondent ED characteristics and corresponding access to POCUS are shown in Table 1. Respondents were predominantly from small, rural EDs. Only 21% of EDs identified as urban and 42% identified as critical access hospitals. The majority of EDs (83%) had no trauma designation, and 54% had less than 20 000 annual ED visits. Only 33% reported that their entire staff of ED physicians was board-certified in EM. Most EDs had advanced practice providers on staff (79%), and 84% of these providers worked independently within the main ED.

Of the responding EDs, 88% reported having immediate access to a bedside ultrasound machine in the ED. Two of the three (67%) EDs without an ultrasound machine had plans to obtain a machine within the next year. Barriers to getting a machine for the ED included limited access to training and supervision. Responses to survey questions addressing POCUS access and use characteristics are detailed in Table 2.

Emergency providers placed internal jugular central venous catheters at 92% of reporting EDs. Ultrasound guidance for these procedures varied greatly, as 76% of hospitals reported performing more than 75% of catheters under ultrasound guidance, and 24% of EDs reported performing less than 10% under ultrasound guidance. All EDs reporting ultrasound guidance for less than 10% of internal jugular central venous catheters also reported that less than or equal to 30% of their ED staff was EM board-certified or board-eligible (Figure 1).

Table 1. Maine ED characteristics overall and with immediate access to POCUS.

	All EDs	EDs with POCUS
	No.	No. (%*)
Total	24	21 (88)
ED visits per year		
<10 000	2	2 (100)
10 000-20 000	11	8 (73)
21 000-40 000	7	7 (100)
41 000-60 000	3	3 (100)
61 000-80 000	1	1 (100)
Trauma designation		
Level I	1	1 (100)
Level II	2	2 (100)
Level III	1	1 (100)
Not designated	20	17 (71)
Practice setting		
Critical access hospital	10	8 (80)
Rural	9	8 (89)
Urban	5	5 (100)
Staff physicians		
1-5	5	4 (80)
6-10	7	7 (100)
11-15	7	5 (71)
16-20	2	2 (100)
>20	2	2 (100)
% EM BC/BE		
0	1	1 (100)
1-25	4	3 (75)
26-50	4	2 (50)
51-75	3	3 (100)
76-99	3	3 (100)
100	8	8 (100)

Abbreviations: ED, emergency department; EM BC/BE, emergency medicine board-certified or board-eligible; POCUS, point-of-care ultrasound.

* Percentages are relative to row totals.

Table 2. POCUS access and use characteristics*.

Question and response	No. (%†)
Does the ED have an ultrasound that is immediately available for bedside use? (n = 24)	
Yes	21 (88)
No	3 (13)
How many ultrasound machines does your ED have? (n = 19)	
1	16 (84)
2	2 (11)
3	1 (5)
Which ultrasound probes does your ED have? (n = 21)	
Linear	19 (90)
Phased array	18 (86)
Curvilinear	14 (67)
Intracavitary	6 (29)
Is the ultrasound machine shared with radiology? (n = 21)	
Yes	2 (10)
No	19 (90)
What is your access to radiology performed ultrasound? (n = 24)	
24 hours, all applications	4 (17)
24 hours, limited applications	12 (50)
Limited hours	7 (29)
Never	1 (4)
How often do providers use POCUS for clinical care? (n = 21)	
Frequently for many applications	8 (38)
Frequently for specific applications	8 (38)
Occasionally	5 (24)
Rarely	0 (0)
Never	0 (0)
Do providers place IJ central lines in your ED? (n = 24)	
Yes	22 (92)
No	2 (8)
What % of IJ central lines are placed using ultrasound guidance? (n = 21)	
1%-24%	5 (24)
25%-49%	0 (0)
50%-74%	0 (0)
75%-100%	16 (76)
Do providers place ultrasound-guided IVs? (n = 21)	
Yes	19 (90)
No	2 (10)
Do nurses place ultrasound-guided IVs? (n = 21)	
Yes	15 (71)
No	6 (29)

Abbreviations: ED, emergency department; POCUS, point-of-care ultrasound.

* Due to branched logic and participation, questions have a variable number of respondents.

† Percentages are relative to row totals.

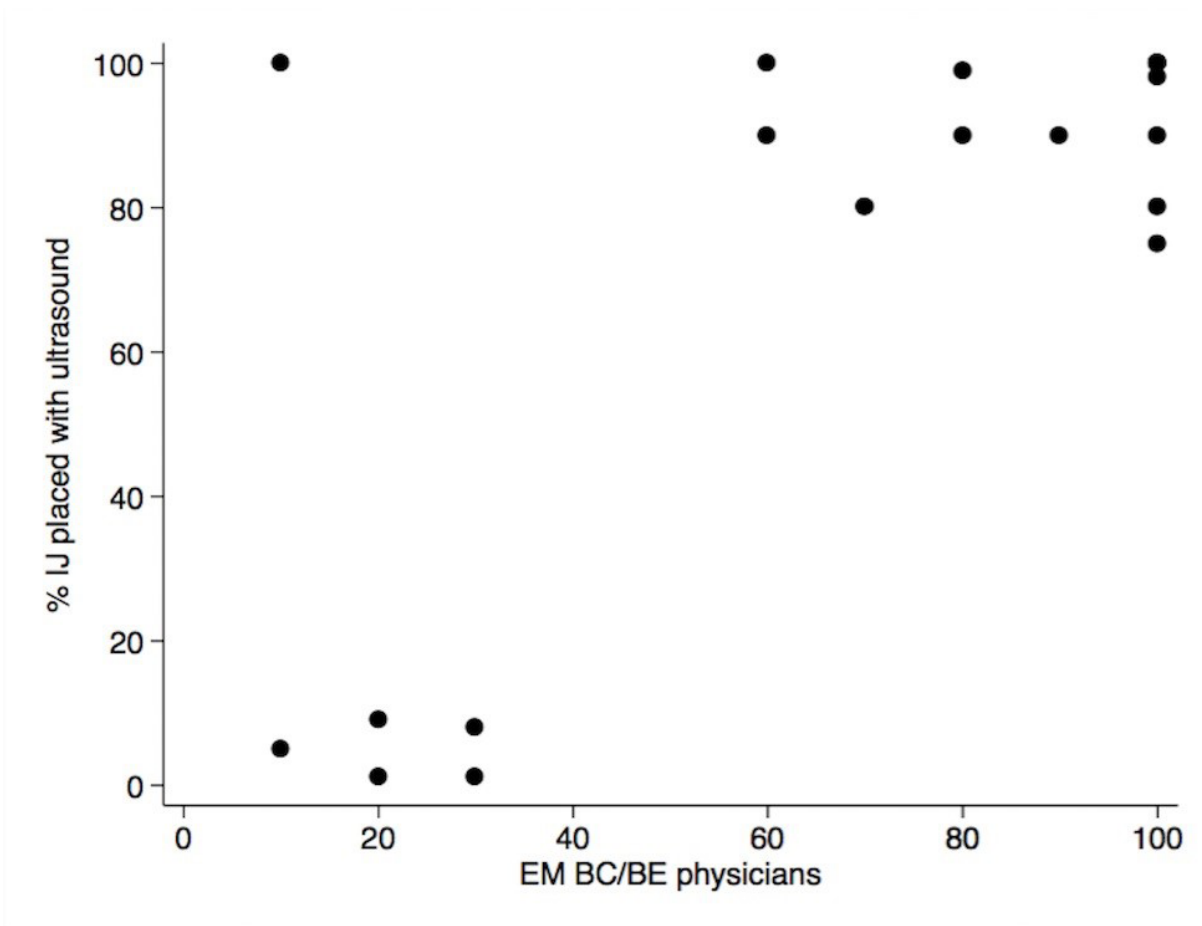


Figure 1. Scatter plot demonstrating percent of internal jugular central venous catheters placed using ultrasound guidance based on the percent of ED physicians on staff who were EM BC/BE. Abbreviations: EM BC/BE, emergency medicine board-certified or board-eligible; IJ, internal jugular central venous catheters.

Of departments that reported access to an ultrasound machine, 90% had hospital privileges for POCUS, and 71% indicated that there was a process for credentialing providers in using bedside ultrasound. Fifty-two percent had a process for quality assurance (QA) of ultrasound studies performed in the ED, and only 48% reported that providers could save ultrasound clips. Forty-eight percent of respondents with an ultrasound machine had a designated ED ultrasound director.

Forty-two percent of respondents indicated they were extremely interested in more ultrasound education, 21% were very interested, 25% were moderately interested, and 13% were slightly interested. Reasons for limited interest in further education included high cost, limited access to teachers, no perceived need, and having staff that were already well trained.

DISCUSSION

This study presents the first comprehensive survey of POCUS use in Maine EDs and builds on previous work to increase our understanding of access to ultrasound in the ED. Our results show that 88% of Maine EDs have immediate bedside access to ultrasound machines. This percentage is a significant improvement compared to several single- and multi-state surveys of predominantly community EDs between 2006 and 2011. These surveys reported ultrasound access in only 19% to 59% of EDs.^{12,13,15,16} Our findings are similar to more recent studies showing ultrasound access in 96% of surveyed EDs in Connecticut and 90% in Arizona.^{17,18} Maine's EDs are lower-volume and more rural compared to departments with similar overall access to ultrasound machines.^{17,18} We are encouraged that our results show improvement over the previously described disparity to machine access experienced in community, rural, and low-volume settings.¹³⁻¹⁶

Despite finding excellent access to machines, we discovered variability in POCUS use and adherence to national guidelines among EDs in Maine. Though most EDs reported frequent ultrasound use by ED providers, 24% reported only occasional POCUS use. While a detailed analysis of provider use patterns was outside the scope of this study, this study suggests that frequency of POCUS use is a potential area for improvement. A specific example of differences in POCUS use that we identified was variability in using ultrasound guidance to place internal jugular central venous catheters. The use of ultrasound guidance for this procedure is strongly supported by national guidelines and randomized controlled trials, and is often cited as an important step to improving patient safety in EDs.^{1,2,10,20} While most respondents reported frequent use of ultrasound guidance for placing internal jugular central venous catheters, 24% of EDs reported that less than 10% of these procedures were performed under ultrasound guidance (Figure 1). All hospitals reporting low rates of ultrasound use for this procedure were rural, consistent with previously reported disparities in ultrasound use among rural centers compared to urban EDs. These hospitals also had low rates of EM board-certified or board-eligible physicians on staff, which suggests a possible gap in training or knowledge among these providers.¹³⁻¹⁶

Previous studies showed poor adherence to ultrasound administration guidelines created by the ACEP. Our results demonstrate that this issue

is ongoing. ACEP offers several recommendations, including that (1) emergency ultrasound is a core credential for EM physicians undergoing hospital privileging, (2) there is a process for credentialing providers, (3) there is a process for QA in place, and (4) there is a physician director of ultrasound.¹⁰ Our survey showed that 90% of responding EDs had hospital privileges for POCUS, 71% had a process for credentialing, 52% had a QA process, 48% saved ultrasound images, and 48% had an ultrasound director. A study in Connecticut EDs revealed that 64% of EDs had hospital privileges, 36% had a QA process, and 60% saved ultrasound images.¹⁷ Also, a study in Arizona showed that 52% had privileges, 25% had a QA process, 16% saved ultrasound images, and 36% had an ultrasound director.¹⁸ Our study suggests better adherence to recommended quality standards in Maine EDs compared to Connecticut and Arizona, but there is an ongoing need for improvement.

There are several potential limitations to this survey study. Despite numerous attempts to contact all ED directors in Maine, the response rate was only 71%. We suspect that this rate was partially the result of an outdated registry of ED directors and contact information. However, responder bias may have also occurred, as EDs using ultrasound may have been more likely to respond to the survey than those not using ultrasound. The non-responding EDs had similar variety to those that did respond, including 6 critical access hospitals, 3 rural hospitals, and 1 urban hospital, each with variable volumes. Additionally, although the survey was based on previous instruments and pilot tested before distribution, the survey is not a validated tool. Lastly, our results highlighted the unique, predominantly rural characteristics of Maine EDs and, thus, may not be generalizable across the United States.

CONCLUSIONS

This study demonstrates that Maine's predominantly rural EDs had excellent overall access to ultrasound machines for POCUS. Our findings highlight deficiencies in bedside use of ultrasound and adherence to ACEP guidelines for ultrasound administration. Specific areas for improvement include enhancing QA practices and increasing the use of ultrasound guidance for placing internal jugular central venous catheters. These findings will be helpful to inform the development of continuing medical education programs to improve POCUS use and safety.

Conflicts of Interest: None

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