



## ORIGINAL ARTICLE

## Evaluation of a point-of-care ultrasound scan list in a resource-limited emergency department in Addis Ababa Ethiopia

Maja Stachura<sup>a,b,\*</sup>, Megan Landes<sup>c,d,b</sup>, Fasika Aklilu<sup>e,d,b</sup>, Raghu Venugopal<sup>c,f,b</sup>, Cheryl Hunchak<sup>g,d,b</sup>, Sara Berman<sup>c,b</sup>, James Maskalyk<sup>h,j,b</sup>, Josee Sarrazin<sup>ij</sup>, Tesfaye Kebede<sup>k</sup>, Aklilu Azazh<sup>k,l</sup>

<sup>a</sup> Lion's Gate Hospital, North Vancouver, BC, Canada

<sup>b</sup> Toronto Addis Ababa Academic Collaboration in Emergency Medicine, Canada

<sup>c</sup> University Health Network, Toronto, ON, Canada

<sup>d</sup> Division of Emergency Medicine, Department of Family and Community Medicine, University of Toronto, Toronto, ON, Canada

<sup>e</sup> The Scarborough Hospital, Scarborough, ON, Canada

<sup>f</sup> Division of Emergency Medicine, Department of Medicine, University of Toronto, Toronto, ON, Canada

<sup>g</sup> Schwartz-Reisman Emergency Medicine Centre, Mount Sinai Hospital, Toronto, ON, Canada

<sup>h</sup> St. Michaels Hospital, Toronto, ON, Canada

<sup>i</sup> Sunnybrook Health Sciences Center, Toronto, ON, Canada

<sup>j</sup> Department of Medical Imaging, University of Toronto, Toronto, ON, Canada

<sup>k</sup> Addis Ababa University, Addis Ababa, Ethiopia

<sup>l</sup> Toronto Addis Ababa Academic Collaboration in Emergency Medicine, University of Toronto, Canada

## ARTICLE INFO

## Article history:

Received 10 November 2016

Revised 3 March 2017

Accepted 21 April 2017

Available online xxx

## Keywords:

Emergency

Ultrasound

Point-of-care

Low-resource

Emergency medicine

Curriculum

## ABSTRACT

**Introduction:** Emergency centres (EC) in low- and middle-income countries often have limited diagnostic imaging capabilities. Point-of-care ultrasound (POCUS) is used in high-income countries to diagnose and guide treatment of life-threatening conditions. This study aims to identify high impact POCUS scans most relevant to practice in an Ethiopian EC.

**Methods:** A prospective observational study where patients presenting to Tikur Anbessa Specialized Hospital EC in Addis Ababa were eligible for inclusion. Physicians referred patients with a clinical indication for POCUS from a pre-determined 15-scan list. Scans were performed and interpreted, at the bedside, by qualified emergency physicians with POCUS training.

**Results:** A convenience sample of 118 patients with clinical indications for POCUS was enrolled. The mean age was 35 years and 42% were female. In total, 338 scans were performed for 145 indications in 118 patients. The most common scans performed were pericardial (n = 78; 23%), abdominal free fluid (n = 73; 22%), pleural effusion/haemothorax (n = 51; 15%), inferior vena cava (n = 43; 13%), pneumothorax (n = 38; 11%), and global cardiac activity (n = 25; 7%). One hundred and twelve (95%) POCUS scans provided clinically useful information. In 53 (45%) patients, ultrasound findings changed patient management plans by altering the working diagnosis (n = 32; 27%), resulting in a new treatment intervention (n = 28; 24%), resulting in a procedure/surgical intervention (n = 17; 14%) leading to consultation with a specialist (n = 16; 14%), and/or changing a disposition decision (n = 9; 8%).

**Discussion:** In this urban, low-resource, academic EC in Ethiopia, POCUS provided clinically relevant information for patient management, particularly for polytrauma, undifferentiated shock and undifferentiated dyspnea. Results have subsequently been used to develop a locally relevant emergency department ultrasound curriculum for Ethiopia's first emergency medicine residency program.

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## African relevance

- Point-of-care ultrasound (POCUS) is a highly effective tool used to diagnose and guide treatment of emergency patients.

- POCUS is highly relevant to low resource settings since it requires less financial and human resources than other diagnostic imaging tests and can be provided at no cost to patients.
- Training in POCUS in Africa needs to be specific to the needs of local emergency physicians.

Peer review under responsibility of African Federation for Emergency Medicine.

\* Corresponding author.

E-mail address: [maja.stachura@gmail.com](mailto:maja.stachura@gmail.com) (M. Stachura).

<http://dx.doi.org/10.1016/j.afjem.2017.04.011>

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Please cite this article in press as: Stachura M et al. Evaluation of a point-of-care ultrasound scan list in a resource-limited emergency department in Addis Ababa Ethiopia. Afr J Emerg Med (2017), <http://dx.doi.org/10.1016/j.afjem.2017.04.011>

## Introduction

Emergency centre (EC) point-of-care ultrasound (POCUS) is a highly effective clinical tool in the hands of qualified emergency physicians [1–8]. In high-resource settings, emergency medicine residents often require ultrasound skills prior to graduation from their residency programs and these skills are acquired through a combination of didactic and practical bedside teaching, with direct supervision by qualified physicians in the EC [5].

In low-resource settings, interest in POCUS training is increasing [9]. As an imaging modality, POCUS is a valuable tool for making timely diagnoses in acute illness, as well as guiding resuscitation and invasive emergency procedures [8,10,11]. Ultrasound machines are portable, allowing for continuous monitoring of critically ill patients since scans can be performed directly at the bedside [9,12,13]. Furthermore, POCUS is highly relevant to low-resource settings as it can be provided at no cost to the patient, and requires much less financial and human resources than comparable tests such as computerized tomography (CT) scans and X-rays [9,12,13]. While POCUS has key features supporting its uptake in low-resource settings, training for emergency residents requires its own curriculum. This should be relevant to the clinical setting, the patient population and the needs of local emergency physicians.

Tikur Anbessa Specialized Hospital (TASH) is a tertiary care referral center in Addis Ababa, Ethiopia. It is Ethiopia's largest public hospital, a trauma referral centre and the site of the country's first emergency medicine residency training program, run by Addis Ababa University since 2010. The burden of trauma and acute illness is high in the TASH-EC, and rapid diagnosis and treatment of severely injured or ill patients is often required. However, in-hospital access to formal radiologic studies is limited and critically ill patients are often referred off-site for private imaging if they can afford it. This delays time to diagnosis and increases the risk of adverse outcomes during transport.

The goal of this study was to first determine which POCUS scans are most frequently requested in the TASH-EC. Second, we evaluated the clinical impact of POCUS on patient care by calculating how often the requested scans changed initial patient management plans. We utilized the findings of this study to develop and implement a context relevant POCUS curriculum for the emergency medicine residency program at Addis Ababa University.

## Methods

We conducted a prospective case series of TASH-EC patients with a clinical indication for POCUS. The TASH-EC sees the whole spectrum of emergency medical and surgical complaints in patients 13 years and older, including referrals from peripheral centres. The only patients that are not routinely seen are pregnant patients, as they are triaged directly to the labour and delivery ward. The estimated monthly census for the TASH-EC is 1500 visits, of which approximately 35% of patient visits are trauma related.

A list of 15 POCUS scans (Table 1) relevant to the Ethiopian EC was developed by an expert panel which consisted of the following physicians: three emergency physicians with global health experience, two POCUS fellowship-trained emergency physicians, and one board certified radiologist with experience performing and interpreting ultrasound scans in low-resource settings. This list of scans was distributed to all resident physicians working in the TASH-EC in order to identify those patients with a clinical indication for POCUS.

Patients presenting to the EC during two separate four-week study periods in 2012 were eligible for inclusion. Inclusion criteria

required that the patient have an indication for one or more of the POCUS scans listed in Table 1. Clinical indications included trauma, dyspnea, shock (hypotension), cardiac arrest, vascular assessment for deep vein thrombosis (DVT) and abdominal aortic aneurysm (AAA), renal/bladder, abdominal pain, pregnancy, musculoskeletal/soft tissue complaints and procedural. For example, the treating physician might want to rule-out intra-abdominal haemorrhage and pneumothorax in a poly-trauma patient. In another case, the physician might want to know if a patient with undifferentiated dyspnea has a pericardial or pleural effusion. Patients were excluded if they did not have a clinical indication for POCUS. Examples include obviously displaced extremity fracture, isolated head injuries, mental health concerns or stroke. Patients were also excluded if the diagnosis was obvious without ultrasound, such as patients with cellulitis, lacerations or gastrointestinal bleeding. A portable ultrasound machine, Sonosite MicroMaxx (on loan) or Full Digital Laptop Ultrasound Scanner RUS-9000F (owned by the TASH-EC), equipped with a 3.5 MHz curved array probe, was kept in the EC at all times. A SeeMore USB ultrasound system equipped with a GP3.5/5.0 MHz abdominal probe and SP7.5/24.0 MHz high frequency probe was available for the last two weeks of the study. This machine was donated to the EC on completion of the study.

Ethiopian emergency medicine resident physicians responsible for the care of EC patients were provided with the POCUS scan list (Table 1) and were instructed to refer patients for one or more POCUS scans when there was a clinical indication. All scans were performed and interpreted in real-time at the patient's bedside by one of the study physicians. Ethiopian emergency medicine residents caring for patients also had the opportunity to repeat the ultrasound scan under supervision to facilitate their training in POCUS.

The five study physicians performing and interpreting POCUS scans were Canadian consultant level emergency physicians, certified in emergency ultrasound as per the criteria established by the Canadian Emergency Ultrasound Society. Specifically, the minimum qualification for physicians performing and interpreting POCUS scans was the Emergency Department Echo (EDE) 1 certification and prior completion of the EDE2 course [14]. EDE1 certification involves 50 supervised scans in four POCUS areas: subxiphoid view of the heart, abdominal free fluid assessment, aortic assessment for aneurysm and assessment for intrauterine pregnancy in the first trimester. Certification also requires a written, visual and practical examination. The EDE2 course teaches advanced POCUS scans. The list includes but is not limited to advanced cardiac assessment, lung assessment, gallbladder, DVT, vascular access, procedure guidance, inferior vena cava (IVC), musculoskeletal POCUS and others [14]. One of the study physicians was fellowship-trained in POCUS.

The study population represents a convenience sample. Study physicians were available for up to eight hours per day, four to five days per week during the study period. They did have other teaching commitments so could not be available at all times. The TASH-EC does not keep medical records of patient visits, and although we attempted to enrol all patients with a clinical indication for POCUS when an ultrasound-certified physician was in the department, we were not able to determine how many patients were missed. For each patient scanned, the treating physician completed a standardized data collection form including patient demographics, clinical details, indications for ultrasound, ultrasound scans performed, ultrasound findings, and the pre- and post-ultrasound diagnosis and management plan. The pre-ultrasound working diagnosis and management plan was recorded prior to the POCUS examination. Data was entered into an Excel Spreadsheet (Version 14.6.1, Redmond, WA). Basic descriptive statistics including proportions were calculated using Excel. Data was analysed to determine whether ultrasound findings changed initial patient management

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