

International Emergency Medicine



SUSTAINABLE RESUSCITATION ULTRASOUND EDUCATION IN A LOW-RESOURCE ENVIRONMENT: THE KUMASI EXPERIENCE

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Abstract—Background: Point-of-care-ultrasound (POCUS) is an increasingly important tool for emergency physicians and has become a standard component of emergency medicine residency training in high-income countries. Cardiopulmonary ultrasound (CPUS) is emerging as an effective way to quickly and accurately assess patients who present to the emergency department with shock and dyspnea. Use of POCUS, including CPUS, is also becoming more prevalent in low- and middle-income countries (LMICs); however, formal ultrasound training for emergency medicine resident physicians in these settings is not widely available. **Objectives:** To evaluate the feasibility of integrating a high-intensity ultrasound training program into the formal curriculum for emergency medicine resident physicians in an LMIC. **Methods:** We conducted a pilot ultrasound training program focusing on CPUS for 20 emergency medicine resident physicians in Kumasi, Ghana, which consisted of didactic sessions and hands-on practice. Competency was assessed by comparing pretest and posttest scores and with an Objective Structured Clinical Examination (OSCE) performed after the final training session. **Results:** The mean score on the pretest was 61%, and after training, the posttest score was 96%. All residents obtained passing scores above 70% on the OSCE. **Conclusion:** A high-intensity ultrasound training program can be successfully integrated into an emergency medicine training curriculum in an LMIC. © 2017 Elsevier Inc. All rights reserved.

Keywords—emergency medicine; cardiopulmonary ultrasound; resuscitation; dyspnea; shock; low-resource; education; training

INTRODUCTION

In recent years, point-of-care ultrasound (POCUS) has become increasingly important for emergency medicine (EM) and acute care in high-income countries. A similar increase in use is now being seen in low- and middle-income countries (1). Many of the benefits of ultrasound, including its low cost, widespread availability, and favorable safety profile, are particularly well suited in low-resource settings (2). In an environment where advanced diagnostic tools are often unavailable, an ultrasound scan performed and interpreted by the emergency physician at the bedside can be of great value.

Many residency programs and medical schools in high-income countries have already begun to incorporate ultrasound training into their curricula. However, more often than not, training for physicians in low- and middle-income countries (LMICs) consists of a number of informal, disjointed sessions conducted by

visiting physicians with little to no follow-up or quality control. Several studies evaluating POCUS training programs have been conducted in LMICs, but because these relatively few studies vary greatly in design, target training populations, and follow-up time, it is difficult to draw unifying conclusions (3–7). Information regarding ultrasound training for physicians in EM residency programs in LMICs is even more difficult to find.

Focused cardiac and pulmonary examinations for the evaluation of shock and dyspnea, two common presenting complaints in the emergency department, are being increasingly performed by emergency physicians (EPs). Such illnesses have many different etiologies and are associated with high rates of in-hospital mortality, therefore it is important that the cause is identified early during the initial assessment (8). Methods for evaluating shock in LMICs typically rely on physical examination features, as advanced imaging and expensive laboratory testing are often unavailable, but these findings can be insensitive and unreliable, especially during shock (9–11). Even when advanced imaging is available, functional limitations still exist, such as the cost for the patient, a lack of trained technicians to perform the examinations, long wait times for formal readings, and equipment maintenance issues. Cardiopulmonary ultrasonography (CPUS) is emerging as an effective tool for EPs when evaluating patients with shock or dyspnea, and is also referred to as resuscitation ultrasound. Literature from high-income countries has demonstrated that CPUS helps to correctly identify the etiology of shock and dyspnea, and can reduce mortality in such patients (12–14). However, it remains unclear whether CPUS can similarly improve patient outcomes in LMICs.

To evaluate the feasibility of a formal ultrasound training program in an LMIC, we developed a pilot program consisting of a CPUS protocol and ultrasound curriculum. The pilot program was developed through the Ghana Emergency Medicine Collaborative, which is an existing partnership between the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana and the University of Michigan, Department of Emergency Medicine. Through this partnership, we performed a study assessing the implementation of a dedicated ultrasound training curriculum for EM residents in a resource-limited setting.

MATERIALS AND METHODS

Site and Participants

The training was conducted as part of a larger clinical study assessing the impact of the CPUS protocol on patient care in the LMIC setting and took place at KATH within the National Accident and Emergency Centre

(A&E). The A&E provides emergency medical care for the Kumasi region and serves as a referral center for eight of the 10 regions in Ghana, with over 29,000 patient visits each year. The EM training program at KATH is a 3-year residency program. A total of 21 EPs have graduated from the program through the Ghana College of Physicians and Surgeons since its first class in 2012, and there are currently 29 residents in the program, with nine attending physicians who oversee training.

Nine EM residents were selected to participate in the first round of training. Participants ranged from first- to third-year residents and were selected based on interest level and schedule availability. For the second round of training, another nine residents were selected, as well as two attending physicians. All residents had some previous, but highly variable experience with POCUS, such as introductory workshops during their first month of residency, followed by dedicated sessions on eFAST (extended Focused Assessment with Sonography for Trauma) and ultrasound-guided central line insertion in subsequent years, for an estimated total of 5 h of training during each year of residency. Additional informal learning is gained through teaching sessions held by attending physicians at the bedside and occasionally during resident conferences.

Ultrasound Machines

Two VScan devices (General Electric Company [GE], Boston, MA) were provided to KATH by GE for the purpose of conducting the ultrasound training and clinical study. These handheld devices are equipped with a probe that contains two transducers, a high-frequency linear transducer and a phased array transducer.

CPUS Protocol

The design for the CPUS protocol was based on the standardized and validated RUSH (Rapid Ultrasound in SHock) and BLUE (Bedside Lung Ultrasound in Emergency) protocols. The RUSH examination is a three-step ultrasound scanning protocol, evaluating “the pump” or heart, “the tank” or intravascular volume status, and “the pipes” or large arteries and veins (15). Ultrasound findings from the examination are then compared with those typically seen in hypovolemic shock, cardiogenic shock, obstructive shock, and distributive shock. The BLUE protocol provides specific profiles for six important causes of acute respiratory distress: pulmonary edema, pulmonary embolism, pneumonia, chronic obstructive pulmonary disease, asthma, and pneumothorax (16). Based on these two protocols, we developed a CPUS examination integrating scans from the lungs, heart, inferior vena cava, abdominal cavity, aorta, and femoral veins (Figure 1).

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