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Teaching Point-of-Care Ultrasound (POCUS) to Visiting Iraqi Physicians Using the Train-the-Trainer Model

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ABSTRACT The development of emergency medicine is still in its early stages throughout Iraq because the concept of emergent patient care by appropriately trained physicians is not fully established. Emergency medicine education is limited and more specifically bedside emergency ultrasound education is nonexistent. Continued advancements in ultrasound equipment provide opportunities for point-of-care ultrasound (POCUS) to be a cost-effective diagnostic tool in rural and underdeveloped areas throughout the world. As a component of The University of Toledo College of Medicine and Life Sciences Global Health Program, faculty and residents from The University of Toledo Emergency Residency Program had the opportunity to train non-emergency medicine educated physicians from Iraq utilizing POCUS training as a tool to advance emergency medicine in this region. Two Iraqi trained surgeons were placed into POCUS training sessions as participants of a one-month educational program to advance emergency medicine in Iraq. The assessment of their ultrasound education pre-and post-training through bedside ultrasound teaching and image recognition revealed significant retention of knowledge and utilization of this modality that could be implemented in advancing emergency medicine in Iraq as part of a train-the-trainer program.

INTRODUCTION

The Iraqi population is greater than 26 million people and has about 180 hospitals, some of which do not have emergency departments.¹ Emergency care provided in Iraq triages patients to a surgical or a medical area with the expectation that consultant physicians will be called to manage these patients in the emergency department. With no formal emergency medical training, there is limited emergency care provided by the physicians currently staffing the emergency departments throughout Iraq. Specifically, emergency departments in Iraq are underdeveloped with inconsistent processes lacking drugs, commodities, and communication infrastructure with no audit or training,²

This often leads to lengthy delays in patients receiving care while they wait for consultants to come see patients in the emergency department. More importantly, this could result in delays in managing life threatening problems due to the lack of emergency physicians in Iraq with advanced resuscitative skills. Patient flow is a crucial issue in Iraqi emergency departments and, with high morbidity and mortality in this country, the absence of protocols

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for guiding clinical treatments even in major cities like Baghdad and Mosul negatively affects patient care outcomes.² Performing a life-saving electrocardiogram (ECG) may be delayed because some Iraqi hospitals do not have a protocol in place for a triage nurse or technician to complete it. Conversely, in any U.S. emergency department triage nurses or technicians can initiate an ECG order without restriction or dependency on physicians. This is done to catch potentially fatal myocardial infarctions and cardiac arrhythmias as soon as possible. The Iraqi physicians participating in this study describe dire moments where the concept of emergency medical care is nonexistent and higher mortalities result in clinical situations that are otherwise correctable. More generally, emergency medicine staff has indicated that more than half of civilians brought to the emergency departments in Iraq died from injuries that could have been treated if there was an experienced and trained staff.¹ Emergency ultrasound has proven to be a useful, non-invasive diagnostic modality that can help speed up triage decisions, decrease costs and hospital stay lengths, and time needed for procedures and operations.³ An example of this is using the Focused Assessment with Sonography for Trauma (FAST) ultrasound exam to quickly diagnose hemoperitoneum in an unstable trauma patient upon arrival to an emergency department. Delay in diagnosis of this condition can lead to increased morbidity and mortality. In a patient with a positive FAST exam indicating internal abdominal bleeding, an increase in the time it took to get to the operating room correlated with an increase of in-hospital mortality at 24 hours.⁴

The risk of death was significantly lower at hospitals that were trauma centers versus hospitals that were not trauma centers.⁵ With the ability to increase efficiency and reduce costs of medical care, it is necessary to advance POCUS utilization in vulnerable patient populations with high clinical acuity and trauma. In developed countries such as the United States, emergency medical services include dedicated healthcare professionals including emergency physicians, nurses, and support personnel to receive and stabilize critically ill patients. They use the latest and most advanced resuscitative measures such as Advanced Cardiac Life Support (ACLS) and Advanced Trauma Life Support (ATLS) algorithms. The current literature and guidelines suggest that a short, yet intensive training period is sufficient in preparing clinical officers, nurses and physicians alike to perform basic ultrasound exams, especially if the training program includes both lectures and practical experiences, and provides opportunities for continued upkeep of skills through review sessions and ongoing quality assurance after the training period ends.⁶ In fact, several train-the-trainer educational programs in point-of-care ultrasound have been conducted in low-resource countries such as Rwanda and Sub-Saharan Africa with favorable outcomes in physician and non-physician training.^{7,8} These outcomes are relevant to Iraq and serve as effective indicators of a train-the-trainer program to succeed because the Iraqi health care system is similarly underdeveloped and short on essential educators. Train-the-trainer programs focus on teaching and mentoring a few educators and trainers at a time who later go on to teach and educate many others, which contrasts with teaching programs that train large amounts of individuals at a time. For instance, a study in Rwandan hospitals used a 9-week lecture and practice-based ultrasound curriculum training program for physicians in low resource settings which showed that ultrasound is a teachable skill and remains helpful in patient care.⁹ A similar study showed that use of a train-the-trainer model that collected 6 months of data resulted in trainees' long-term use of point-of-care ultrasound in low-income Rwanda hospitals, leading to improvement of patient outcomes through changes in medical management, medications, and disposition after ultrasound evaluation.¹⁰ POCUS is used to but not limited to diagnosing dehydration and volume depletion by identifying the inferior vena cava (IVC) and determining if it is collapsible or plethoric guiding intravenous fluid replacement, evaluating the abdomen with ultrasound to detect blood after a traumatic event, and assessing heart contractility in someone with chest pain. Ultrasound changed management for obstetric cases 43% of the time to have a surgical intervention in one study. These interventions included Cesarean section, biopsies, and minor surgeries.¹¹

Long-term follow up with trainees of the Rwanda study showed that the abdominal ultrasound exam in trauma (FAST) and obstetric applications of ultrasound were the most frequently used application of ultrasound, which is consistent with other reports of application of point-of-care ultrasound in low-resource settings.^{9,12} Other studies found that after a 12-week intensive training program in diagnostic ultrasound, physicians from Sub-Saharan Africa demonstrated a retention and even slight improvement in the ultrasound knowledge at 6-month follow-up, a time during which they were teaching others in their home countries.¹³

PURPOSE

The purpose was to provide and introduce basic point-of-care ultrasound training to physicians within a comprehensive emergency medicine train-the-trainer program. We chose to teach POCUS because it is a safe, noninvasive, cost-effective imaging modality with versatility to diagnose and guide medical management in patients. Essentially, ultrasound is dynamic and easily repeatable to check for clinical changes in a patient. For

example, a physician can assess cardiac function on a patient’s initial arrival and again later if they develop chest pain or hypotension. This is difficult to do with other imaging modalities such as CT and MRI. Furthermore, the ultrasound machine can be brought to the bedside removing the need to transport patients to other departments outside of the emergency department. Given the current political and economic climate, it was not feasible for UTMC physicians and staff to travel to Kufa, Iraq to train Iraqi staff on the use of bedside ultrasounds and make assessments of the model there. Consequently, this train-the-trainer model was created to take place at the University of Toledo Medical Center (UTMC). We decided to bring 2 Iraqi physicians to the UTMC campus and train them with the aim of these physicians returning to Iraq and training other healthcare providers at their home base hospitals. Teaching the Iraqi physicians at UTMC instead of in Iraq allows for quick, high yield training because all the necessary staff, equipment, and facilities are present to teach them in a defined amount of time. Understandably, it is different from training in Iraq, where the trainers would be in the actual environment and would have to adjust to an underdeveloped healthcare system with limited resources. The geopolitical situation also limits the ability to recruit necessary staff to travel to Iraq. It is also important to mention that the Iraqi physicians now have knowledge of how an emergency department in the United States functions, which they can mimic as much as they can with whatever resources they can acquire. Observing triage, patient flow, patient care, and disposition process is vital to developing Iraqi emergency departments.

A recent study conducted by Mandavia et al. found that a condensed 16-hour emergency ultrasound curriculum based on the Society for Academic Emergency Medicine guidelines served as a good introductory foundation in training emergency physicians focused ultrasonography.¹⁴ Similarly, we created our own curriculum in order to assess the effectiveness of our train-the-trainer model. We taught two Iraqi physicians bedside ultrasound skills in the UTMC emergency department and simulation center and assessed knowledge acquisition with ultrasound image recognition before and after the condensed curriculum. In their completion of eight hours of ultrasound training, they received closely supervised training with the ultrasound director and trainers. Our protocol differed from other models that took ultrasound training to other countries such as Rwanda and Ghana. Rather, it took place at the home institution (UTMC) and was part of an overall comprehensive emergency medicine train-the-trainer curriculum that included patient triaging, stroke management, using intraosseous (IO) vascular access systems, airway skills, and emergency department workflow. A disadvantage of completing the training at UTMC as opposed to the hospital where POCUS would be used is the ultrasound equipment available would be different and the trainers would not be able to appreciate the emergency department environment and needs first hand.

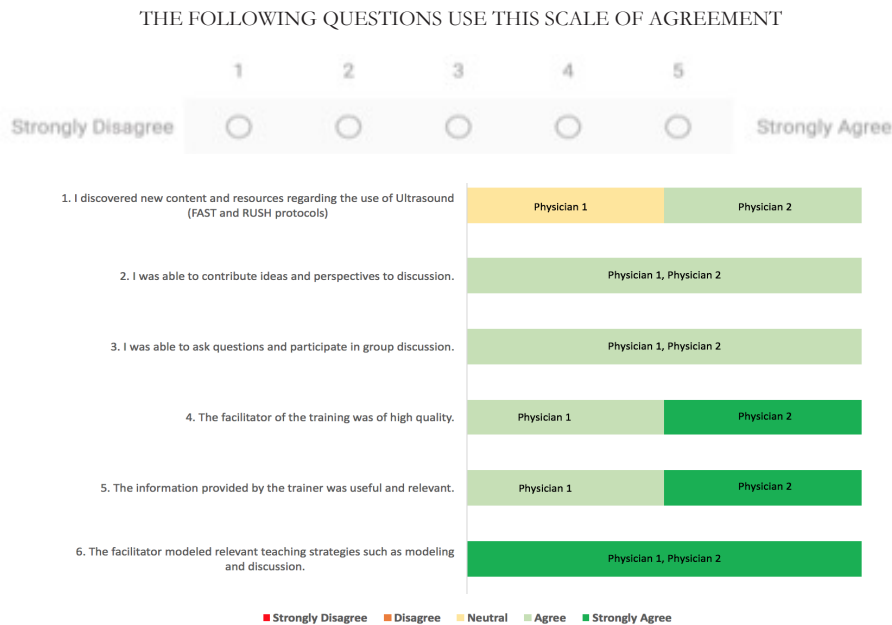


Figure I: Results of Likert Scale assessing physician impression of the point-of-care ultrasound training.

After providing instructions, we sought to assess the effectiveness of our training protocol implemented at UTMC and how well the information disseminated in the clinical setting at the hospital in Kufa, Iraq.

A key feature of our model was to conduct it in an intensive 1-on-1 high yield format in the patient care area and simulation center with our educators due to the limited time available to the Iraqi physicians. Regardless, we still wanted to measure whether the physicians applied the newly acquired skills, and whether they taught the concepts to other colleagues through follow up testing assessments and surveys. Through our findings, we hope to determine whether a train-the-trainer curriculum would be effective in improving patient outcomes in this resource-limited setting. Furthermore, a question that emerged was whether this teaching method could be applied to other regions and countries.

METHODS

Healthcare leaders from Kufa University and UTMC have developed a comprehensive training program in emergency medicine skills and techniques. We had looked at other programs that traveled to other underdeveloped health care systems but we felt we could have a high impact on training several physicians at our home institution and letting implement what they learned in their own way to their home hospital in Iraq. We do not claim that our model is better but rather an alternative in war-stricken regions of the world. In preparation for this training program, we met with Iraqi Physicians from Kufa University in Beirut, Lebanon in November 2015 to discuss this venture. After a series of meetings, phone discussions, and emails, two Iraqi physicians traveled to UTMC to begin their training in August-September 2016. An ultrasound training protocol was administered as a part of the month-long comprehensive emergency medicine training for the two Iraqi physicians. Kufa University currently has an emergency department volume of 35,000-40,000 patient visits per year. The integral focus that the Iraqi physicians requested was learning to use bedside ultrasound to help with hypotensive and critically ill patients. Customizing the curriculum was essential to addressing the needs of the Iraqi physicians and that is why we decided to focus on hypotensive and critically ill-type patients.

As part of the overall training of emergency medicine practice skills, the Iraqi physicians participated in a total of approximately 8 hours of POCUS training sessions that were based on Ultrasound Guidelines developed by the American College of Emergency Physicians.¹⁵ The training occurred over several separate learning sessions, and was led by the ultrasound director who is a practicing board-certified emergency medicine physician and a registered diagnostic medical sonographer (RDMS) through the American Registry for Diagnostic Medical Sonography (ARDMS). With the assistance of teaching faculty, residents, and medical students, the Iraqi physicians learned to perform many ultrasound studies (see Table 1) on real patients, on each other, and on medical students and residents. They also trained on a simulation teaching tool model called “VIMEDIX” manufactured by CAE Healthcare. The areas of POCUS are included in Table 1.

As surgically trained physicians in Iraq, the two trainees initiating this program had a basic understanding of ultrasound utilization, primarily in focused abdominal ultrasound of trauma (FAST) and basic abdominal ultrasound experience. With their surgical background, it might serve as an advantage over other physicians, but the versatility and ubiquitous history of ultrasound over the past few decades demonstrates that any physician can use ultrasound. There are training programs all over the United States that are open to all specialties of medicine and ultrasound fellowships have even been created in internal medicine (general practitioner). The majority of the ultrasound teaching sessions focused on the critical care aspects of patient care such as differentiating shock and hypotension. The Iraqi physicians were most interested in learning the Rapid Ultrasound for Shock and Hypotension (RUSH) protocol. It follows a bedside ultrasound scanning algorithm that differentiates causes of hypotension quickly and it would have the most impact on their patients in Iraq due to the combination of limited resources and high acuity patient illness. The RUSH exam sequence includes obtaining ultrasound images of the heart, inferior vena cava (IVC), abdomen, aorta, and lungs. During the teaching sessions, the Iraqi physicians were taught to recognize the likely causes of shock: decreased cardiac contractility, cardiac tamponade, right cardiac ventricular enlargement, collapse of the IVC, hemoperitoneum, and absence or presence of lung sliding to detect pneumothorax. Similarly, we focused on teaching the FAST protocol because of its rapid ability to diagnose abdominal trauma and guide medical and surgical management. Finally, an ultrasound image pre-test and post-test was administered at the beginning and end of the month of their stay to determine if there was any improvement in detecting pathology on bedside ultrasound images. Images were drawn from Table 1 as these represented commonly encountered pathologies in an emergency department. At approximately 2 months, the 2 Iraqi physicians were also emailed an ultrasound image test using a Google Quiz format. The scores of the assessments were designed give feedback to the trainers if knowledge of ultrasound image recognition was improving over the course of the training program. We tracked improvement between the pretest, posttest, and the follow up test sent to them in Iraq. Also, a Likert-type scale survey was sent to them 6 months after their training to obtain information on their impression if the POCUS

training they received at UTMC was helpful in their current practice in Kufa, Iraq. The selected questions of the survey were general evaluation statements designed to obtain subjective responses from the Iraqi physicians pertaining to their training at UTMC.

RESULTS

Point-of-care ultrasound training was given to 2 Iraqi physicians within a comprehensive emergency medicine train-the-trainer program at UTMC including airway skills, simulation patient care encounters, and POCUS. During their 1-month stay, the physicians scored low on a basic ultrasound image recognition pretest with a score of 2 out of 12. On the posttest, one physician had a score of 4 out of 12 while the other physician had a score of 2 out of 12. However, on a 2-month follow up test, both physicians had improved scores (scores of 4/10 and 5/10 correct). The Iraqi physicians did indicate in their correspondence with us that they were using bedside ultrasound more. The 2-month follow up electronic quiz sent to them in Iraq was 2 questions shorter to decrease the time needed to take the quiz and covered the bedside ultrasound areas of training but did not use the exact same images of the pre and posttests that they received at UTMC. The Likert Scale results assessing their impression of POCUS training they received are shown in Figure 1.

Before training at UTMC, both physicians responded that they had some training or experience using ultrasound (4-20 hours). One physician had no prior experience using RUSH ultrasound protocols (0 hours) while the other physician had some experience using RUSH ultrasound protocols (1-4 hours). Both physicians responded that they had access to using portable ultrasounds in their hospital, had access to 1-3 portable bedside ultrasounds, and felt that the training they received at UTMC changed the way they performed ultrasound. One physician responded that he felt much more comfortable performing bedside ultrasound while the other physician responded that he felt a little more comfortable using bedside ultrasound. Both physicians replied that they felt confident teaching others how to use FAST and RUSH protocols for patient care, with one physician stating that he felt very confident that they could instruct others how to use ultrasound and RUSH protocols. Likewise, the second physician stated that he felt somewhat confident he could instruct others how to use ultrasound and RUSH protocols.

DISCUSSION AND LIMITATIONS

The train-the-trainer concept in emergency medical education at UTMC utilized our simulation center and emergency department to educate physicians over a four to five-week curriculum. A significant component of this curriculum was utilization of ultrasound training (POCUS) along with education in hundreds of clinical scenarios in the simulation environment and in daily skills labs providing procedural advancements, vascular access, airway management, and other resuscitative procedures. . Our challenge in this program was to assess their current knowledge and expand the utilization of POCUS to advance the delivery of emergency medicine back in Iraq upon their return. From the beginning, we at UTMC were completely aware of the fact that the Iraqi physicians would learn bedside ultrasound scanning skills and customize and apply it in the matter that best suits their patient needs. As well as utilizing ultrasound in providing emergency care in Iraq, our second objective was to provide training that would allow them to educate providers in Iraq on utilization of ultrasound for basic and advanced emergency care. Implementing ultrasound in a newly developing emergency medicine curriculum and practice could become a useful and cost effective tool in advancing emergency medicine practice and training other physicians in utilization and management.

Our design to assess performance of these physicians and the use of POCUS involved pre-evaluation and assessment of ultrasound skills, post-evaluation upon completion of their four-week comprehensive training, which included eight hours of ultrasound training over several sessions, and finally a two month re-evaluation upon returning to Iraq and implementing the program back home. What became apparent upon returning back to Iraq was the advanced education and expertise they developed by continuing to use POCUS on patients in the emergency department setting at Kufa, and in general emergency medicine training they provided this information to trainees within their institution. More specifically the Iraqi surgeons requested focusing significantly on shock and hypotension (RUSH) evaluations. They were particularly astute at correlating these evaluations with need for fluid resuscitation for patients who would be in hypovolemic shock such as septic and hemorrhagic shock versus cardiogenic shock that would not require any fluid resuscitation and rather medical management. In this regard, POCUS serves as a diagnostic modality to interpret the hemodynamic state of a patient quickly because immediate fluid resuscitation can be a life-saving intervention. In contrast to using POCUS for shock and hypotension, ultrasound procedures that we covered with the Iraqi physicians in Table 1

such as vascular, renal, and gallbladder analysis did not generate much feedback or discussion from them because of their previous familiarity with these ultrasound studies. As surgeons, they are familiar with abdominal pathologies and abnormalities that would include the gallbladder and kidneys. Moreover, detecting deep venous thrombosis of the lower extremities was an area that we did not cover in depth in the training program and would include in future training sessions.

Limitations of this study clearly are the fact that this was our initial effort in educating non-emergency physicians for emergency education and practice in Iraq. This project involved only a limited number of physicians, i.e., two in assessing this training modality. We absolutely recognize that this was a very small sample size and statistical analysis of the data is virtually impossible but we feel that our intervention has the ability to quickly teach a condensed ultrasound curriculum to positively affect emergency patient care more than any other curriculum following the train-the-trainer model in the shortest amount of time. We feel that our protocol will continue to gain traction so that the Iraqi physicians will teach the skills they learned to others. There are ways to ensure correct dissemination of techniques and information by creating basic handouts and reference guides. Video recordings can help in other areas of the training program especially patient care scenarios and resuscitative cases. We also hope that our train-the-trainer curriculum can be adopted in Kufa, Iraq to provide educational value to healthcare providers. Since these types of ultrasound curriculums are absent completely in Iraq, it is important to remember that the training of even two physicians can have a huge impact on emergent patient care. These types of train-the-trainer models might seem inefficient here in the United States or other developed countries, but it is our opinion that they are considered efficient in a fragile and complicated country such as Iraq. Bedside ultrasound fits in well in hospital systems with assets and infrastructure.

Specifically on our training curriculum, limitations that may have affected performance include the language barriers and that the images used in their assessments did not point out which part of the body was being examined. For example, it can be difficult to discern a gallbladder from an inferior vena cava because they both appear as hollow fluid-filled structures of similar size in the same area of the abdomen. No specific measures were implemented regarding these problems because they were not realized until the training program was completed. Another limitation is without direct observation of the Iraqi physicians in Iraq, it is unclear if their survey answers regarding training others were related to knowledge and skill attained from the training or the actual ability to teach others. As far as the survey evaluation portion of their assessment is concerned, question number 4 in Figure 1 suggests wording bias because it links the facilitator to high quality. The responding physicians could be influenced to give a more favorable and positive response due to this wording.

Our future sessions in training with Kufa will incorporate better orientation to anatomical landmarks in our ultrasound testing, as well as improvements in our communication/translation throughout these educational sessions. We plan on training small groups from two to four physicians per training period provided there are opportunities not precluded by the current conflict and/or our own political restrictions to travel. Our original intention as part of this developmental curriculum was to visit the institution and assist in developing the emergency department structure, training nursing staff, and educating administrators on oversight and resources necessary to effectively provide state of the art emergency care. Hopefully there will be opportunities with the resolution of the current ISIS conflict and travel restrictions that may hinder this plan that will allow us to accomplish these goals in the future. Traveling to Kufa, Iraq and participating in ultrasound education session would likely reinforce and strengthen the application of POCUS.

CONCLUSION

As a leader of emergency medicine worldwide in both education and research, it is imperative that U.S. academic programs step up and develop curriculum and training programs to advance emergency medicine throughout the world. If programs cannot bring physicians to the United States like we did, they can take advantage of technology that allows for video conferencing and demonstrations of medical interventions and procedures. At the University of Toledo Medical Center and the Department of Emergency Medicine, we have initiated a condensed yet comprehensive program of emergency medicine development in Kufa, Iraq. In this educational program among other training exercises, an ultrasound educational program in POCUS was introduced and developed with Iraqi physicians. Without question, this ultrasound education was highly valuable to the Iraqi physicians in understanding emergency medicine resuscitation and they clearly grasped the concept of how to utilize this in managing critical patients. Email correspondence with the Dean of Kufa University as recently as December 23, 2017 indicates that patient satisfaction and standards of care have increased as a result of the training the two physicians received with us. We understand that this is subjective analysis and feedback but this

at least provides us further encouragement to replicate our model and hopefully achieve more objective data once more trainees participate. Moreover, future plans include repeating and integrating this train-the-trainer model into the Iraqi medical education system until the country's healthcare infrastructure and resources improve. Our mindset in this model was how we could have the highest positive impact in the shortest amount of time to help emergency patients in Iraq. This model does not seek to replace more traditional teaching methods in medical education but rather to provide an alternative when yearlong ultrasound training curriculums cannot be used. Once geopolitical stability, healthcare resources, and medical educational curriculums mature in one region, it can hopefully be exported to another region. We also anticipate visiting Kufa, Iraq to observe the effects of our train-the-trainer model and identify long-term benefits of the training the Iraqi physicians received at UTM.

Table 1: Emergency point-of-care ultrasound training for Iraqi Physicians

Ultrasound Exam	Pathologies, Abnormalities, and Measurements of the Affected Ultrasound Exam Area
Ocular	Evaluation of retinal detachment, optic nerve sheath diameter for intracranial pressure (ICP)
Vascular	Localizing deep veins for deep venous thrombosis (DVT) and identifying small veins and arteries
Cardiac	Qualitative assessments of cardiac function and fractional shortening
Lung	Detecting pulmonary edema and pneumothorax
Gallbladder	Evaluation for cholelithiasis and cholecystitis
Aorta	Assessing for abdominal aortic aneurysm (AAA)
Renal	Evaluation of hydronephrosis and nephrolithiasis
Inferior vena cava (IVC)	Estimating central venous pressure (CVP), volume status, and utilization for resuscitation assessments
FAST exam	Focused Assessment with Sonography in Trauma
RUSH exam	Rapid Ultrasound for Shock and Hypotension
Soft Tissue	Evaluation of cellulitis versus abscess

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