WestJEM

Volume XIII, Number 4, September 2012 Open Access at www.westjem.org ISSN 1936-900X

Western Journal of Emergency Medicine

Integrating Emergency Care with Population Health

A Peer-Reviewed, International Professional Journal

Contents continued on page ii

Save The Date!

ORAL BOARD REVIEW

January 15–16, 2013

&

EMERGENCY MEDICINE: AN INTENSE REVIEW

January 17–21, 2013

Westin Chicago River North
Chicago, Illinois

ACOEP
The American College of Osteopathic Emergency Physicians

Register Online Today at www.ACOEP.org!

Western Journal *of* Emergency Medicine:

Integrating Emergency Care with Population Health

Official Journal of the California Chapter of the American College of Emergency Physicians, the America College of Osteopathic Emergency Physicians, and the California Chapter of the American Academy of Emergency Medicine

Publisher
Department of Emergency Medicine, University of California, Irvine

School of Medicine
University of California · Irvine
Discover · Teach · Heal

Available in Pub Med, Pub Med Central, CINAHL, SCOPUS, Google Scholar, eScholarship, Melvyl, Directory of Open Access Journals, Medscape and MDLinx Emergency Med.

*West*JEM, 101 The City Drive, Rt. 128-01, Orange, CA 92868-3201: Office (714) 456-6389; Email: Editor@westjem.org

Western Journal *of* Emergency Medicine:

Integrating Emergency Care with Population Health

JOURNAL FOCUS

Emergency medicine is a specialty which closely reflects societal challenges and consequences of public policy decisions. The emergency department specifically deals with social injustice, health and economic disparities, violence, substance abuse, and disaster preparedness and response. This journal focuses on how emergency care affects the health of the community and population, and conversely, how these societal challenges affect the composition of the patient population who seek care in the emergency department. The development of better systems to provide emergency care, including technological solutions, is critical to enhancing population health.

Table of Contents

continued

Western Journal *of* Emergency Medicine:
Integrating Emergency Care with Population Health

Table of Contents
continued

Western Journal *of* Emergency Medicine:

Integrating Emergency Care with Population Health

This open access publication would not be possible without the generous and continual support of our society, chapter, and department sponsors.

Professional Society Sponsors

American College of Osteopathic Emergency Physicians

California Chapter of the American Academy of Emergency Medicine

California Chapter of the American College of Emergency Physicians

Professional Chapter Sponsors

Florida Chapter of the American Academy of Emergency Medicine

Nevada Chapter of the American Academy of Emergency Medicine

Missouri Chapter of the American Academy of Emergency Medicine

Uniformed Services Chapter of the American Academy of Emergency Medicine

Virginia State Chapter of the American Academy of Emergency Medicine

Academic Department Sponsors

Advocate Christ Medical Center
Oak Lawn, IL

Baystate Medical Center/ Tufts University
Springfield, MA

Boston Medical Center
Boston, MA

Brigham and Women's Hospital/ Massachusetts General Hospital
Boston, MA

Carl R Darnall Medical Center
Fort Hood, TX

Denver Health
Denver, CO

Emory University
Atlanta, GA

Florida Hospital Medical Center
Orlando, FL

Harvard Medical School*
Boston, MA

Henry Ford Fairlane Medical Center
Dearborn, MI

Henry Ford Medical Center
Detroit, MI

Kaweah Delta Healthcare District
Visalia, CA

Kern Medical Center
Bakersfield, CA

Lehigh Valley Hospital and Health Network
Allentown, PA

Madigan Army Medical Center
Tacoma, WA

Maimonides Medical Center*
Brooklyn, NY

Maricopa Medical Center
Phoenix, AZ

Medical College of Georgia
Augusta, GA

Medical University of South Carolina
Charleston, SC

New York Medical College
Valhalla, NY

Regions Hospital/ Health Partners Institute for Education and Research
St. Paul, MN

Resurrection Medical Center*
Chicago, IL

Robert Wood Johnson Hospital*
New Brunswick, NJ

San Diego Medical Center
San Diego, CA

Stanford University
Palo Alto, CA

University of California Davis*
Davis, CA

University of California Irvine*
Orange, CA

University of California San Diego
La Jolla, CA

University of California San Francisco
San Francisco, CA

University of California San Francisco Fresno
Fresno, CA

University of Illinois at Chicago
Chicago, IL

University of Maryland
College Park, MD

University of Nebraska Medical Center
Omaha, NE

University of Nevada
Las Vegas, NV

University of Southern California
Los Angeles, CA

University of Texas, Houston
Houston, TX

University of Utah
Salt Lake City, UT

**denotes department & residency sponsor*

International Society Partners

Sociedad Argentina de Emergencias

Sociedad Chileno Medicina Urgencia

Thai Association for Emergency Medicine

Emergency Medicine Association of Turkey

Become a *West*JEM departmental sponsor, waive article processing fees, receive print/electronic copies, and free CME advertisement space at www.calaaem.org/westjem or contact:

Marcia Blackman
Cal/AAEM: WestJEM
Phone: (800) 884-2236
MBlackman@aaem.org

or

Shahram Lotfipour, MD, MPH
Managing Associate Editor
Phone: (714) 456-2326
Shahram.Lotfipour@uci.edu

11th Annual Western States Winter Conference on Emergency Medicine

January 27-31, 2013
Park City, Utah

www.wswcem.com

FAAEM
always means board certified

19TH ANNUAL SCIENTIFIC ASSEMBLY
FEBRUARY 9-13, 2013

THE COSMOPOLITAN LAS VEGAS, NV

Sonographic Identification of Tube Thoracostomy Study (SITTS): Confirmation of Intrathoracic Placement

Jamie A. Jenkins, MD*
Laleh Gharahbaghian, MD†
Stephanie J. Doniger, MD‡
Scott Bradley, MD*
Steve Crandall, MD§
David A. Spain, MD||
Sarah R. Williams, MD¶

* Stanford University/Kaiser Permanente Emergency Medicine Residency Program, Division of Emergency Medicine, Department of Surgery, Palo Alto, California
† Stanford University Medical Center Division of Emergency Medicine, Department of Surgery, Emergency Ultrasound Fellowship, Palo Alto, California
‡ Children's Hospital and Research Center, Oakland Division of Emergency Medicine, Oakland, California
§ Stanford University School of Medicine Division of Emergency Medicine, Department of Surgery, Palo Alto, California
|| Stanford University, Trauma/Critical Care Surgery, Department of Surgery, Palo Alto, California
¶ Stanford University/Kaiser Permanente Emergency Medicine Residency Program, Stanford Emergency Medicine Ultrasound Program and Fellowship Division of Emergency Medicine, Department of Surgery, Palo Alto, California

Supervising Section Editor: Seric S. Cusick, MD
Submission history: Submitted November 30, 2010; Revision received June 22, 2011; Accepted October 3, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.10.6680

Introduction: Thoracostomy tubes (TT) are commonly placed in the management of surgical, emergency, and trauma patients and chest radiographs (CXR) and computed tomography (CT) are performed to confirm placement. Ultrasound (US) has not previously been used as a means to confirm intrathoracic placement of chest tubes. This study involves a novel application of US to demonstrate chest tubes passing through the pleural line, thus confirming intrathoracic placement.

Methods: This was an observational proof-of-concept study using a convenience sample of patients with TTs at a tertiary-care university hospital. Bedside US was performed by the primary investigator using first the low-frequency (5–1 MHz) followed by the high-frequency (10–5 MHz) transducers, in both 2-dimensional gray-scale and M-modes in a uniform manner. The TTs were identified in transverse and longitudinal views by starting at the skin entry point and scanning to where the TT passed the pleural line, entering the intrathoracic region. All US images were reviewed by US fellowship-trained emergency physicians. CXRs and CTs were used as the standard for confirmation of TT placement.

Results: Seventeen patients with a total of 21 TTs were enrolled. TTs were visualized entering the intrathoracic space in 100% of cases. They were subjectively best visualized with the high-frequency (10–5 MHz) linear transducer. Sixteen TTs were evaluated using M-mode. TTs produced a distinct pattern on M-mode.

Conclusion: Bedside US can visualize the TT and its entrance into the thoracic cavity and it can distinguish it from the pleural line by a characteristic M-mode pattern. This is best visualized with the high-frequency (10–5 MHz) linear transducer. [West J Emerg Med. 2012;13(4):305–311.]

INTRODUCTION

The incidence of chest trauma is estimated at 12 persons per million of population per day.[1] Of those, only 5% to 10% require thoracic surgery; the majority can be adequately managed medically, at times with thoracostomy tube (TT) or mechanical ventilation.[1] A recent study showed that TTs are required in 25% of patients after major chest trauma.[2] TTs have been shown to be malpositioned in up to 20% of cases with increasing numbers seen at teaching hospitals and in emergent settings.[1] In order to identify proper TT placement, the American College of Surgeons recommends chest radiographs (CXR) as the initial imaging modality of choice.[3] This is controversial since computed tomography (CT) of the chest may be better in determining TT malpositioning[1,3,4] and have been determined to be the gold standard. However, both techniques expose the patient to radiation and require further time, resources, and expense. This is especially true in the intensive care unit (ICU), where patients are exposed to daily CXRs, and in the emergency department (ED), where multiple critical patients can present simultaneously. If TT repositioning is required, the patient is exposed to additional pain, more invasive procedures, and increased risk of infection.[5–7] Associated complications include empyemas, tension pneumothorax, lung contusions, and vascular injury.[1,3–8]

Ultrasound (US) has become an accepted imaging modality in the ED and ICU. It is a proven bedside tool that evaluates numerous disease processes and aids procedure guidance without the risk of radiation exposure. Emergency physicians have demonstrated proficiency in a wide range of US applications.[9–14] Emergency physician visualization of the pleura by bedside US is already an accepted part of the eFAST exam.[7,15–29] If the emergency physician can use bedside US in real time to visualize the chest tube going through the pleural line into the chest cavity, placement within the pleural space can be confirmed and the rate of chest tube malpositioning can be decreased.

It is important to optimize transducer choice to obtain the highest quality images for a given anatomic region.[19] The lung and pleural line are best evaluated with the high-frequency linear transducer, which is ideal for delineation of superficial structures. The deeper thoracic and intra-abdominal regions are best evaluated with lower frequency transducers. Both transducer types are used for the eFAST scan: high frequency to evaluate for pneumothorax and low frequency to evaluate for intraperitoneal fluid and hemothorax.[30] It is with this logic that we chose to use both high- and low-frequency probes in the study.

Due to the high rate and complications of malpositioned TTs, our primary objective was to evaluate whether bedside US can evaluate TT positioning within the pleural space and to define the best technique for this new US application.

METHODS

This observational proof-of-concept study approved by the institutional review board evaluated a convenience sample of consented adult patients with TTs from the ED and surgical floors at a tertiary care level one trauma center. Patients were identified by consultation with the emergency physicians who were part of thoracic and general surgical services on days where the sonographers were available. Those excluded were children, pregnant women, hospital employees and patients who declined to participate in the study.

The Sonosite M-Turbo (Bothell, Washington), with both the linear 10-5 MHz and phased array 5-1 MHz transducers were used for the study. Transducers and skin were disinfected adequately prior to performing the US. Sterile surgical lubricant was used at all times. Patient demographics (age and gender), reason for TT placement, service that placed the thoracostomy tube, presence and type of fluid in the TT (serosanguineous, air), and best US technique were collected and recorded by the sonographers on a common data sheet. All USs were performed anywhere from 15 minutes to 2 days after confirmatory CXRs were obtained to maintain current standard of care; however, the researchers were not privy to the results of the CXRs results nor did they view the CXRs prior to performing the US. The sonographers were composed of 3 fellowship-trained US faculty, 1 emergency US fellow, and 2 emergency medicine (EM) senior residents who were trained in emergency US through residency education. The primary investigator was present and involved in scanning during all image and data acquisitions to maintain standard of data collection.

The TTs were uniformly identified first in transverse and then longitudinal views by placing the linear transducer at the skin entry point and scanning to the point at which the TT penetrated the pleural line (Figure 1). The process was repeated with the low-frequency transducer. We alternated which transducer we used first in order not to affect the perceptions of the sonographers. Images were saved as still pictures and clips using 2-dimensional gray scale.

M-mode ("motion" mode) is a presentation of the temporal changes in echoes in which the depth of echo-producing interfaces is displayed along one axis and time is displayed along the second axis, recording motion of the interfaces toward and away from the transducer. Its applicability is expanding to encompass the evaluation of subcutaneous structures, including ribs.[19] After the third consented subject we noticed that M-mode imaging provided a distinct image that could help in TT identification; this was used with all subjects thereafter.

The TT was considered to be within the pleural space by the sonographer if it was seen entering the pleural space in both perpendicular and parallel views. Collected images were reviewed by EM US fellowship-trained faculty for quality assurance and for confirmation of the TT placement. This was then compared to CXR and, if available a CT. The research team discussed which modality and technique were best for

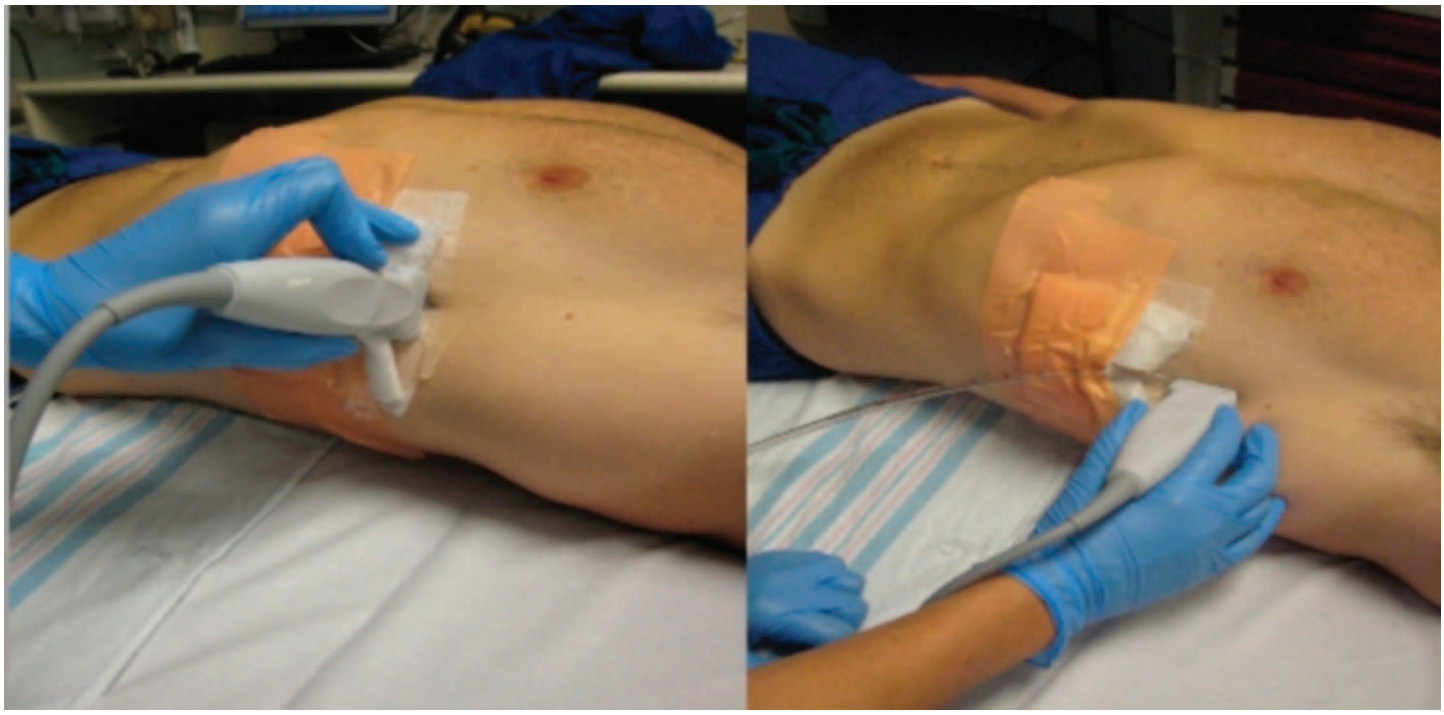

Figure 1. The thoracostomy tube (TT) was first identified in transverse and then longitudinal views by placing the transducer perpendicular to the TT insertion site (left) and then turning the transducer 90° to be parallel to the TT (right).

image acquisition and interpretation. There were no disagreements among the team.

RESULTS

Seventeen patients were enrolled, 4 of whom had 2 TTs, totaling 21 TTs evaluated. One TT was placed in the ED, the remaining were placed by inpatient surgical services. Patients' demographic data, indication for TT, and chest tube sizes (ranging from 8.5 to 14 French pigtail tubes up to 20 to 32 French standard TTs) are illustrated in the Table. All TTs were determined to be in the pleural space by the sonographers, which were confirmed by CXR in all patients (the standard of care) or CT in 9 of the 21 TTs (the gold standard). Both transducer types visualized the TT. The images where reviewed by the US faculty and it was determined that the linear transducer produced images that were subjectively better in delineating the subcutaneous tissue from the TT, pleural line, and adjacent rib. Therefore, the linear transducer was better able to identify the TT position within the chest wall and at entrance into the thoracic cavity. After the TT entered the intrathoracic cavity, it disappeared from visualization except in cases when there was persistent fluid evident beneath the pleural line. In those cases, the TT was visualized within the fluid but disappeared from visualization when deep to the fluid.

The US characteristics of the TTs are illustrated in Figures 2 and 3. With M-mode, the TTs were found to illustrate a characteristic pattern, which differs from that of the adjacent tissue. When the cursor is placed lateral to the TT, the appearance of the stratosphere sign[31] (a sign that a pneumothorax is present) is evident, with no differentiation between the lung and the chest wall. When the cursor is placed over the TT, there is a characteristic appearance: absence of wave-forms below the level of the TT. We have termed this new finding "the black-out sign." This appearance was noted for all tubes where M-mode was performed, regardless of TT size or type (Figures 4 and 5). If the cursor is placed over a rib, a similar appearance can be seen due to the absence of echoes beyond the rib. However, since the cursor is placed over the tube, which is seen beyond the pleural line, as compared to rib, which is above the pleural line, the confirmation of TT placement can be done using M-mode.

DISCUSSION

This study is the first of its kind to attempt to use US for TT evaluation on live human patients observing different transducer types and different techniques. Since TTs travel from superficial subcutaneous tissues through the pleural line into the pleural space, we chose to evaluate the TT by using both low- and high-frequency transducers. Many studies have illustrated that bedside US helps to decrease the risk of invasive procedures and improves patient care. If US can be used to aid in TT positioning by lending knowledge of malpositioning prior to breaking sterile field, it may also decrease patient morbidity from TT placement.

The current Advanced Trauma Life Support guidelines for the initial evaluation of TT placement is with CXR, followed by the gold standard CT.[3] These modalities require radiation exposure. If tube repositioning is necessary, additional risks are

Table. Patient demographic data.

Total patients	17
Sex	
Male	10
Female	7
Age (y)	
Mean	57
20–40	2
41–60	6
61–80	8
81–90	1
Total number of TT	21
Patients with 1 tube	13
Patients with 2 tubes	4
Reason for TT placement	
Postsurgical	14
Pneumothorax	2
Hemothorax	4
Pleural effusion	1
Contents of TT	
Air	1
Serosanguineous	20
Size/type of TT	
Pigtail 8.5–20 French	5
Straight 28–32 French	16

TT, thoracostomy tube.

incurred.[18,30,32] Bedside CXRs have proven unreliable in the determination and evaluation of TT placement.[11,32,33] CXR detects only 20% of malpositioned TT compared to CT.[12,34] However, CTs take time, require mobilization of the patient and hemodynamic stability for patient transfer, and expose the patient to increasing doses of radiation.[6,11] Therefore, another imaging modality is needed; US may be the perfect tool. US can be done quickly at the bedside, poses no risk to the patient, and does not expose the patient to radiation. US has been used to look at the placement of various other tubes including endotracheal tubes,[9,10] nasogastric tubes,[35] as well as nephrostomy stents and drains.[36] However, this has not been studied for TT placement. This study is a pilot study and is the first of its kind, which illustrates that US can be used to visualize the TT and its placement in the pleural space. Its use will not prevent initial malpositioning but may lead to earlier detection of malpositioning (prior to breaking sterile field) if it is performed before a confirmatory CXR.

Our study was a pilot study that looked at a series of US images and clips taken from patients with TTs in place using both high- and low-frequency transducers to determine if US could evaluate TT position. Linear transducers have a greater

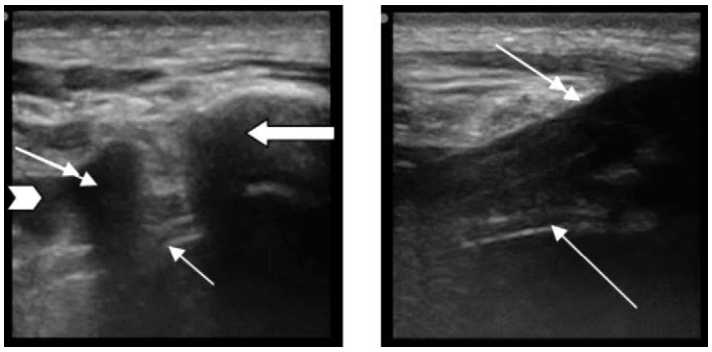

Figure 2. Left, transverse view of the thoracostomy tube (TT) using the linear transducer. The TT appears as a thinly curved echo with shadowing (double white arrow). A rib can be seen adjacent to the TT with a hyperechoic curved echo with shadowing (thick white arrow). In this image, a pleural effusion is also seen (thick short arrow) as well as the visceral pleura (thin white arrow). Right, longitudinal view of the TT using the linear transducer. The TT appears as a linear anechoic structure that courses through the subcutaneous tissues and into the pleural space (double white arrow). The visceral line is also seen (thin white arrow).

spatial resolution and are, therefore, better able to distinguish between objects within the subcutaneous space. The phased-array transducers are able to view deeper objects but have decreased spatial resolution.[19] In all 21 cases, we could easily visualize the TT as an anechoic circular structure with shadowing in its transverse view and an anechoic linear structure in its longitudinal view. However, in order to visualize the TT entering the pleural space for proper placement, it is important to see the TT in relation to the subcutaneous structures (Figure 2). Therefore, the linear transducer was subjectively determined to be optimal as it led to increased differentiation between tissues and structures. In our study, the research team agreed that the linear transducer more accurately illustrated the TT course through the subcutaneous tissue into the pleural space. As in a more recent study using cadavers, Salz et al[37] visualized the TT in

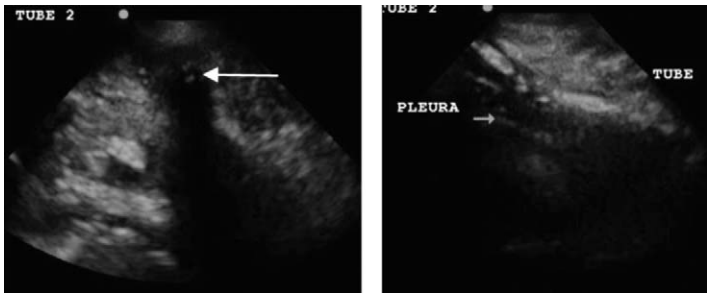

Figure 3. Transverse (left) and longitudinal (right) views of the thoracostomy tube (TT) using the low-frequency transducer. Left, the TT is visualized in the upper portion of the screen as the anechoic circular structure with shadowing (white arrow). The pleural line and adjacent rib are not well visualized. Right, the TT is seen as it courses through the subcutaneous tissues and into the pleural space. The visceral pleura is also seen (thin blue arrow).

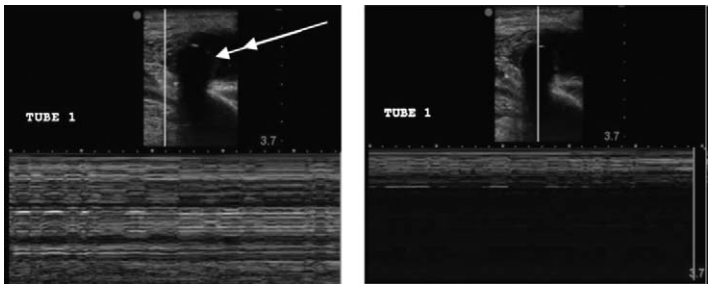

Figure 4. M-mode images with the linear transducer. Left, the thoracostomy tube appears in transverse view as an anechoic circular structure with shadowing (double white arrow). With the cursor to the lateral aspect of the tube a stratosphere sign is present (indicating pneumothorax). The visceral pleura is also seen (thin white line). A pleural effusion can be seen just above the visceral pleura. Right, when the cursor is placed on top of the tube there is a distinct absence of waveform. We have named this the black-out sign.

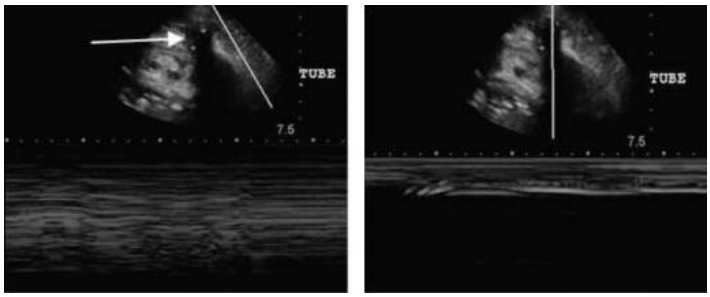

Figure 5. M-mode images with the low-frequency transducer. Left, the thoracostomy tube (TT) appears in transverse view as the anechoic circular structure with shadowing. When the cursor is placed lateral to the TT, a stratosphere sign is present. The visceral pleura is not well visualized. Right, when the cursor is placed over the TT, the black-out sign is seen.

the subcutaneous tissue but also saw the TT disappear from visualization after it entered the intrathoracic region, which they also concluded suggests intrathoracic placement. However, our study is on emergency and surgical patients and also illustrates that the TT can be seen past the pleural line if fluid persists in the intrathoracic cavity in the region of TT placement. Since our study only looked at the entrance of the TT into the pleural space (not position within the chest cavity), the depth was not a large factor.

M-mode is normally used to evaluate objects in motion, such as the heart and lungs.[17,19,31] However, when using M-mode in our study, we identified a distinct pattern. Unlike the expected finding of a stratosphere sign indicating pneumothorax, when the cursor is placed over the TT itself, we found a complete lack of waveform from the level of the TT and below. We termed this the black-out sign. It was found in 100% of the cases with both the phased array and linear transducers. The black-out sign was evident when the TT was subcutaneous and intrathoracic (Figures 4 and 5). Therefore, it helps TT identification.

We found that the best technique for TT identification and positioning involves placing the linear transducer adjacent to the TT insertion site perpendicular to the tube, evaluating it in transverse orientation, eliciting the anechoic circular shadowing structure in 2-dimensional gray scale. The linear transducer should then be advanced along the pathway of the TT distal to the insertion site, visualizing the TT course through the subcutaneous tissue passing the hyperechoic pleural line and entering the pleural space. Lastly, for confirmation, M-mode should be used to elicit the characteristic black-out sign. The linear transducer can also be placed parallel to the TT, evaluating it in its longitudinal orientation, and advanced to visualize the TT entering the pleural space. Therefore, the TT can be viewed in 2 different planes to assure its positioning within the pleural space.

Age, gender, reason for TT placement, and tube contents (air vs serosanguineous) did not subjectively affect image acquisition or interpretation.

As the scope of practice widens and emergency physicians gain more confidence in the practice of US, the possibilities for US utilization grow. We have found that bedside US is able to show TT placement within the thoracic cavity and aid in differentiating the TT from the surrounding subcutaneous tissues. Noting significant limitations, this study is a proof-of-concept pilot study to show that bedside US can identify TT placement within the thoracic cavity.

LIMITATIONS

Several limitations exist in our study. This was a proof-of-concept pilot study, with a limited number of enrolled patients, decreasing the generalizability of the study. However, we believe that given the current paucity of information regarding US and TTs, our results are significant in that we are describing a new application for bedside US and a novel technique. In addition, although the sonographer was blinded to CXR and CT results, it is generally presumed that the TT was intrathoracic based on the fact that it had been left in place after chest radiographs and CTs were performed. By not studying TTs that were malpositioned, we were unable to compare the findings between TTs that are malpositioned and those that are properly positioned. However, it can be inferred from our findings that if the TT can be visualized, it likely is within subcutaneous tissues of the chest wall. However, if it disappears from view beyond the pleural line, it can be inferred that it is within the pleural space. Since only 15% of TTs are malpositioned within the subcutaneous tissues of the chest wall itself, this technique would not decrease the majority of malpositioned chest tubes, including those that are intraparenchymal and subdiaphragmatic. Also, since the primary investigator was present during the data collection and interpretation, it is difficult to generalize these skills to a typical ED sonographer. More studies will need to

be done in the future to look at the generalizability of this study.

CONCLUSION

Bedside US may be able to determine TT position within the pleural space as well as distinguish the TT from surrounding subcutaneous tissue through a unique M-mode appearance termed the black-out sign. The optimal technique is to use the high-frequency linear transducer (subjectively found to be the best at differentiating between the subcutaneous structures) to visualize the TT in 2 planes, transverse and longitudinal, advance the transducer along the length of the TT, and watch it course through subcutaneous tissue, pass through the pleural line, and enter the pleural space. This can lead to further studies to determine (1) if this is applicable in real time, (2) if it will decrease time and cost in patient care, and (3) whether it will expedite transport of the patient to the operating room or ICU. On a larger scope, it could also then be used in austere situations, such as those encountered in disasters and in the wilderness, where higher levels of imaging are not available. Studies in larger populations and during real-time placement are needed to evaluate the further utility of this new technique. Thoracostomy tube evaluation is a very promising new application of bedside US.

Address for Correspondence: Jamie A. Jenkins, MD, Stanford University/Kaiser Permanente Emergency Medicine Residency Program, Division of Emergency Medicine, Department of Surgery, Emergency Medicine Offices, 300 Pasteur Dr, Alway M121, Palo Alto, CA 94304. E-mail: jamiegoodis@gmail.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Fitzgerald M. Pleural decompression and drainage during trauma reception and resuscitation. *Injury*. 2008;39:9–20.
2. Heng K, Bystrzycki A, Fitzgerald M, et al. Complications of intercostal catheter insertion using EMST techniques for chest trauma. *ANZ J Surg*. 2004;74:420–423.
3. Kool DR, Blickman JG. Advanced Trauma Life Support. ABCDE from a radiological point of view. *Emerg Radiol*. 2007;14:135–141.
4. Rowan KR, Kirkpatrick AW, Lui D, et al. Traumatic pneumothorax detection with thoracic US: correlation with chest radiography and CT—initial experience. *Radiology*. 2002;225:210–214.
5. Karmy-Jones R, Holevar M, Sullivan RJ, et al. Residual hemothorax after chest tube placement correlates with increased risk of empyema following traumatic injury. *Can Respir J*. 2008;15:255–258.
6. Baldt MM, Bankier AA, Germann PS, et al. Complications after emergency tube thoracostomy: assessment with CT. *Radiology*. 1995; 19:539–543.
7. Bouhemad B, Zhang M, Lu Q, et al. Clinical review: bedside lung ultrasound in critical care practice. *Crit Care*. 2007;11:205.
8. Osinowo O, Softah AL, Eid Zahraini M. Ectopic chest tube insertions: diagnosis and strategies for prevention. *Afr J Med Med Sci*. 2002;31:68–70.
9. Chun R, Kirkpatrick AW, Sirois M, et al. Where's the tube? Evaluation of hand-held ultrasound in confirming endotracheal tube placement. *Prehosp Disaster Med*. 2004;19:366–369.
10. Sustic A. Role of ultrasound in the airway management of critically ill patients. *Crit Care*. 2007;35:173–177.
11. Mandavia DP, Joseph A. Bedside echocardiography in chest trauma. *Emerg Med Clin North Am*. 2004;22:601–619.
12. Wright J, Jarman R, Connolly J, et al. Echocardiography in the emergency department. *Emerg Med J*. 2009;26:82–86.
13. Salen P, Melanson S, Buro D. ED screening to identify abdominal aortic aneurysms in asymptomatic geriatric patients. *Am J Emerg Med*. 2003; 21:133–135.
14. Kendall JL, Shimp RJ. Performance and interpretation of focused right upper quadrant ultrasound by emergency physicians. *J Emerg Med*. 2001;21:7–13.
15. Bahner D, Blaivas M, Cohen HL, et al. AIUM practice guideline for the performance of the focused assessment with sonography for trauma (FAST) examination. *J Ultrasound Med*. 2008;27:313–318.
16. Mock C, Lormand JD, Goosen J, et al. Management of abdominal injury. In: *Guidelines for Essential Trauma Care*. Geneva, Switzerland: World Health Organization; 2004:34–36.
17. Aylwin C, Brohi K, Davies GD, et al. Prehospital and in-hospital thoracostomy: indications and complications. *Ann R Coll Surg Engl*. 2008;90:54–57.
18. Heller M, Melanson S. Ultrasound in emergency medicine. *Am J Emerg Med*. 1996;14:235.
19. Jones R. Instrumentation and knobology. In: *Handbook of Ultrasound in Early Pregnancy*. Canton, OH: Haines International; 2006:6–25.
20. Dulchavsky SA, Hamilton DR, Diebel LN, et al. Thoracic ultrasound diagnosis of pneumothorax. *J Trauma*.1999;47:970–971.
21. Legome E, Pancu D. Future applications for emergency ultrasound. *Emerg Med Clin North Am*. 2004;22:817–827.
22. Targhetta R, Bourgeois JM, Chavagneux R, et al. Diagnosis of pneumothorax by ultrasound immediately after ultrasonically guided aspiration biopsy. *Chest*. 1992;101:855–856.
23. Lichtenstein D, Meziere G, Biderman P, et al. The comet-tail artifact: an ultrasound sign ruling out pneumothorax. *Intensive Care Med*. 1999;25: 383–388.
24. Lichtenstein D, Meziere G, Biderman P, et al. The "lung point": an ultrasound sign specific to pneumothorax. *Intensive Care Med*. 2000;26: 1434–1440.
25. Chan SS. Emergency bedside ultrasound to detect pneumothorax. *Acad Emerg Med*. 2003;10:91–94.
26. Stone MB, Secko MA. Bedside ultrasound diagnosis of pulmonary contusion. *Pediatr Emerg Care*. 2009;25:854–855.

27. Platz E, Cydulka R, Werner S, et al. The effect of pulmonary contusions of lung sliding during bedside ultrasound. *Am J Emerg Med*. 2009;27: 363–365.
28. Chan SS. Emergency bedside ultrasound for the diagnosis of rib fractures. *Am J Emerg Med*. 2009;27:617–620.
29. Wright J, Jarman R, Connolly J, et al. Echocardiography in the emergency department. *Emerg Med J*. 2009;26:82–86.
30. McEwan K, Thompson P. Ultrasound to detect haemothorax after chest injury. *Emerg Med J*. 2007;24:581–582.
31. Lichtenstein DA, Mezière G, Lascola N, et al. Ultrasound diagnosis of occult pneumothorax. *Crit Care Med*. 2005;33:1231–1238.
32. Gayer G, Rozenman J, Hoffman C, et al. CT diagnosis of malpositioned chest tubes. *Br J Radiol*. 2000;73:786–790.
33. Remerand F, Luce V, Badachi Y, et al. Incidence of chest tube malposition in the critically ill: a prospective computed tomography study. *Anesthesiology*. 2007;106:1112–1119.
34. Lima KE, Tai SC, Chan CY, et al. Diagnosis of malpositioned chest tubes after emergency tube thoracostomy. Is computed tomography more accurate than chest radiograph? *Clin Imaging*. 2005;29:401–405.
35. Hernandez-Socorro CR, Marin J, Ruiz-Santana S, et al. Bedside sonographic guided versus blind nasoenteric feeding tube placement in critically ill patients. C*rit Care Med*. 1996;24:1690–1694.
36. Cosgrove DO, Chan KE. Renal transplants: what ultrasound can and cannot do. *Ultrasound Q*. 2008;24(2):77–87.
37. Salz TO, Wilson SR, Liebmann O, et al. An initial description of a sonographic sign that verifies intrathoracic chest tube placement. *Am J Emerg Med*. 2010;28:626–630.

Evaluation of Breast Disorders with Ultrasound

Daniel C. Cheng, MD, MPH
Phillips Perera, MD
Los Angeles County + USC Medical Center, Department of Emergency Medicine, Los Angeles, California

Supervising Section Editor: Sean Henderson, MD
Submission history: Submitted July 27, 2011; Revision received August 9, 2011; Accepted September 19, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.9.6861
[West J Emerg Med. 2012;13(4):312–000.]

A 45-year-old nonlactating female presented to the emergency department (ED) fast-track area with a chief complaint of breast pain associated with redness. The symptoms occurred over a period of weeks. There were no constitutional symptoms of fever, chills, or weight loss. The patient had no known personal or family history of breast cancer. On physical examination, there was a 6- by 3-cm confluent area of erythema involving both lower quadrants of the breasts without dimpling. There were no palpable masses, areas of fluctuance, or discharge expressed from the areola. However, it was notable that the patient had large nonaugmented breasts that were difficult to examine. These findings were thought to be most consistent with infectious mastitis, and the patient was started on antibiotics for observation in the ED.

On reexamination of the patient, given the difficulty of direct manual evaluation, ultrasound of the breast was performed with a high-frequency linear array ultrasound probe. A 4- by 4-cm complex structure with both solid and cystic components was visualized 1 cm below the area of erythema (see Movie Clip, online only). The patient was then admitted for evaluation of possible breast cancer versus deep tissue abscess. Initial fine-needle aspiration biopsy revealed diffuse lymphocytic invasion that was nonspecific. However, a later ultrasound-guided core-needle biopsy revealed infiltrating ductal carcinoma.

Distinguishing between breast pathologies, such as simple infectious mastitis, breast abscess, or a malignant condition, can be quite challenging in the ED. A recent study of 127 adult mastitis complaints revealed that only 25% actually represented true simple infectious mastitis. Another 40% were found to be an abscess, and 6% represented a malignant condition.[1] Currently, there is a growing body of literature that identifies ultrasound as being a more sensitive modality in identifying more complicated conditions, such as malignancy, from simple mastitis.[2–3] Mammography, while more specific, is often difficult to obtain from the ED. Furthermore, the National Comprehensive Cancer Network endorses ultrasound alongside mammography as a class IIA screening modality for breast cancer with breast skin changes in their 2010 guidelines.[4] This case demonstrates that the potential use of bedside ultrasound by emergency physicians can be a rapid and helpful diagnostic tool in differentiating an uncomplicated infectious condition, mastitis, from more complex pathology, such as breast cancer, that was ultimately diagnosed in this patient.

Address for Correspondence: Daniel C. Cheng, MD, MPH, Los Angeles County + USC Medical Center, Department of Emergency Medicine, 1200 N State St, Los Angeles, CA 90033. E-mail: cheng808@gmail.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCE

1. Kamal R. Classification of inflammatory breast disorders and step by step diagnosis. *The Breast J*. 2009;15:367.
2. Gupta R. The role of ultrasound in the management of inflammatory disorders of the breast. *Med Principle Pract*. 1999;8:51.
3. Berg W. Combined screening with ultrasound and mammography vs mammography alone in women at elevated risk of breast cancer. *JAMA*. 2008;299:2151.
4. National Comprehensive Cancer Network. Breast cancer screening and diagnosis 2011. Available at: www.NCCN.org. Accessed June 2011.

Tuberculous Pleural Effusion

Shira A. Schlesinger, MD, MPH
Philips Perera, MD
Los Angeles County + USC Medical Center, Department of Emergency Medicine, Los Angeles, California

Supervising Section Editor: Sean Henderson, MD
Submission history: Submitted June 29, 2011; Revision received August 15, 2011; Accepted September 19, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.9.6846

Pleural effusions are a common finding in emergency departments, with cytologic analysis traditionally required for definitive diagnosis. This article describes a classic sonographic appearance of tuberculous pleural effusion. [West J Emerg Med. 2012;13(4):313–314.]

CASE

A 33-year-old male with no previous medical history presented for evaluation of a left pleural effusion detected on chest radiograph at a local clinic. The patient had visited the clinic the previous week for flu-like symptoms that had since resolved. He denied productive cough, recent weight loss, or night sweats. His only risk factor for tuberculosis was recent immigration. On exam, the patient was a thin, comfortable-appearing man with an intermittent nonproductive cough, normal vitals, and normal pulse oximetry. Chest auscultation demonstrated decreased breath sounds at the left lung base. Bedside emergency department (ED) ultrasound revealed pleural thickening adjoining a complex pleural effusion with multiple thin septations (see video; online only). The patient was placed in respiratory isolation and admitted for tuberculosis treatment following acid-fast bacilli positive sputums.

DISCUSSION

Approximately 13,000 cases of tuberculosis are reported in the United States each year. Foreign-born and racial/ethnic minorities continue to bear a disproportionate burden of the disease.[1] ED physicians are likely to have primary contact with these and other individuals unlikely to receive timely care from other settings.

Pleural effusions are associated with fluid overload, tuberculosis, and malignancy, among other conditions. Previous authors have subdivided effusions into 4 types by sonographic appearance: anechoic, homogeneously echogenic, complex septated, and complex nonseptated.[2,3] Studies and guidelines applying this scheme have demonstrated ultrasound to be a useful diagnostic aid, particularly in differentiating tuberculous from other etiologies.[4,5] Pleural thickening and a complex septated pattern, with fibrinous strands in the pleural space producing a weblike or branching appearance, has been strongly associated with tuberculosis.[6–8] Chen et al[9] found a 96% specificity for tuberculous pleural effusions when differentiating between tuberculosis and malignancy.

Bedside ultrasound examination of effusions is best performed using a combination of high- and low-frequency probes. A higher-frequency (10 MHz) probe gives a more detailed view of the effusion, while the 3-MHz lower-frequency probe provides a wider view. The probe should be positioned along the lateral chest wall over the effusion.

In evaluating a patient with a pleural effusion, increasing pretest probability of a specific etiology may eliminate unnecessary invasive procedures. Ultrasound appearance of a tuberculous pleural effusion in patients with low-to-moderate suspicion for the disease will assist in appropriate allocation of ED resources and rapid isolation from the general public. With the growing availability of bedside ultrasound, knowledge of this common appearance of tuberculous effusions can assist providers in rapidly stratifying and advancing care of otherwise challenging patients.

Address for Correspondence: Shira A. Schlesinger, MD, MPH, Los Angeles County + USC Medical Center, Department of Emergency Medicine, 1200 N State St, Rm 1011, Los Angeles, CA 90033. E-mail: shira.schlesinger@gmail.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations,

funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Centers for Disease Control and Prevention. Trends in tuberculosis—United States, 2008. *MMRW*. 2009;58:249–253.
2. Yang PC, Luh KT, Chang DB, et al. Value of sonography in determining the nature of pleural effusion: analysis of 320 cases. *Am J Roentgenol*. 1992;159:29–33.
3. Lai YF, Su MC, Weng HH, et al. Sonographic septation: a predictor of sequelae of tuberculous pleurisy after treatment. *Thorax*. 2009;64:806–809.
4. Beckh S, Bolcskei PL, Lessnau KD. Real-time chest ultrasonography: a comprehensive review for the pulmonologist. *Chest*. 2002;122:1759–1773.
5. Hooper C, Lee G, Maskell N. Investigation of a unilateral pleural effusion in adults: British Thoracic Society pleural disease guideline 2010. *Thorax*. 2010;65:Sii4–17.
6. Tshibwabwa ET, Richenberg JL, Aziz ZA. Lung radiology in the tropics. *Clin Chest Med*. 2002;23:309–328.
7. Martinez OC, Serrano BV, Romero RR. Real-time ultrasound evaluation of tuberculous pleural effusions. *J Clin Ultrasound*. 1989;17:407–410.
8. Akhan O, Demirkazik FB, Ozmen MN, et al. Tuberculous pleural effusions: ultrasonic diagnosis. *J Clin Ultrasound* 1992;20:461–465.
9. Chen HJ, Hsu WH, Tu CY, et al. Sonographic septation in lymphocyte-rich exudative pleural effusions: a useful diagnostic predictor for tuberculosis. *Am J Ultrasound Med*. 2006;25:857–863.

Emergency Ultrasound Identification of a Cornual Ectopic Pregnancy

Brian Doane, MD
Phillips Perera, MD
Los Angeles County+USC Medical Center, Department of Emergency Medicine, Los Angeles, California

Supervising Section Editor: Sean Henderson, MD
Submission history: Submitted October 11, 2011; Accepted October 24, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.10.6912
[West J Emerg Med. 2012;13(4):315.]

CASE

A 26-year-old female presented with complaints of vaginal bleeding. Her history was significant for fetal loss during her only prior pregnancy. Her last menstrual period was 6 weeks prior. The urine pregnancy test result was positive. She had visited an outside hospital the day before and was diagnosed with a threatened abortion. The patient reported that her ultrasound results at the time had revealed a "normal early pregnancy." Bedside transvaginal ultrasonography was performed (see video, online only) and a bicornuate uterus was identified. A pregnancy with gestational sac, yolk sac, and small fetal pole was identified high in the right cornual limb. The endo-myometrial mantle or EMM (the distance from the outer part of the gestational sac to the uterine wall) was found to be 5.6 mm. No free fluid was identified.

DISCUSSION

Typically, clinicians think of ectopic pregnancies as occurring outside of the uterus. This case is important in underscoring the fact that there are variants of ectopic pregnancies that exist within the uterus. One classic type is the cornual ectopic pregnancy, which occurs in a congenital bicornate uterus. The shape of this uterus may allow for implantation to occur high in one of the cornual limbs.

A bicornuate uterus may be appreciated as a continuation of the midline septa down the uterus.[1] This may be best visualized in the short axis, or coronal plane, as the center endometrial stripe will divide into 2 stripes rising up into the 2 cornual regions. In a cornual ectopic pregnancy, the pregnancy will be detected in 1 of these limbs.[2] Critical ultrasound findings in this condition include a pregnancy that is seen to the periphery of the uterus, with an EMM that measures less than 5 to 8 mm in either the sagittal or coronal planes.[3,4] Owing to this lack of a sufficient surrounding mantle of myometrium, uterine rupture may potentially occur as the ectopic pregnancy expands to thin the adjacent supporting tissue. In addition, women with cornual ectopic pregnancies have a higher rate of mortality than the more common ectopic pregnancy located in the ampullary region of the fallopian tube.[5]

Interestingly, there has been some disagreement in the literature about the exact EMM measurement that defines a cornual ectopic pregnancy. Critical EMM measurements of both 5 and 8 mm have been quoted previously. In discussion with the follow-up obstetrician, it was determined the patient would receive close follow-up with serial ultrasonography to look for thinning of the EMM below a 5-mm thickness.

Address of Correspondence: Brian Doane, MD, Los Angeles County+USC Medical Center, Department of Emergency Medicine, 1200 N State St, Rm 1011, Los Angeles, CA 90033-1029. E-mail: doane.brian@gmail.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Ackerman TE, Levi CS, Dashefsky SM, et al. Interstitial line: sonographic finding in interstitial (cornual) ectopic pregnancy. *Radiology*. 1993;189: 83–87.
2. Lin EP, Bhatt S, Dogra VS. Diagnostic clues to ectopic pregnancy. *Radiographics*. 2008;28:1661–1671.
3. Callen PW. *Ultrasonography in Obstetrics and Gynecology*. 5th ed. Philadelphia, PA: Elsevier Health Sciences Co Publishers; 2007.
4. Kaakaji Y, Nghiem HV, Nodell C, et al. Sonography of obstetric and gynecologic emergencies: part I, obstetric emergencies. *AJR Am J Roentgenol*. 2000;174:641–649.
5. Ng S, Hamontri S, Chua I, et al. Laparoscopic management of 53 cases of cornual ectopic pregnancy. *Fertil Steril*. 2009;92:448–452.

Ultrasound-Guided Hip Arthrocentesis in a Child with Hip Pain and Fever

James H. Moak, MD*
Aaron J. Vaughan, MD†
Benjamin A. Silverberg, MD†

* University of Virginia Health System, Department of Emergency Medicine, Charlottesville, Virginia
† University of Virginia Health System, Department of Family Medicine, Charlottesville, Virginia

Supervising Section Editor: Seric S. Cusick, MD
Submission history: Submitted May 13, 2011; Revision received August 26, 2011; Accepted October 24, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.10.6797

Children presenting to the emergency department with hip pain and fever are at risk for significant morbidity due to septic arthritis. Distinguishing between septic arthritis and other causes of hip pain may be challenging. Sonographic visualization of the hip with real-time ultrasound-guided arthrocentesis may allow faster differentiation between etiologies, hastening definitive therapy and improving analgesia. This report describes the use of hip sonography in a case of Lyme arthritis. The authors review the medical literature in support of bedside hip sonography and discuss how to perform ultrasound-guided hip arthrocentesis. Clinical findings in septic and Lyme arthritis are also described. [West J Emerg Med. 2012;13(4):316–319.]

INTRODUCTION

Distinguishing between septic arthritis and other causes of nontraumatic hip pain can be difficult in pediatric patients. The diagnostic evaluation typically involves arthrocentesis of the affected joint by a consultant in the radiology suite or operating room. Depending upon the availability of hospital resources and personnel, delays may occur before synovial fluid is obtained and effective treatment initiated. We present a case in which bedside ultrasound-guided hip arthrocentesis by the emergency physician expedited empiric treatment and disposition of a febrile patient with hip pain.

CASE

A previously healthy 7-year-old boy presented to the emergency department (ED) with a complaint of right lower extremity pain and fever. The preceding day his parents had noticed that he was limping upon returning home from school. The pain progressed that evening until he could no longer bear weight on his right leg. Overnight he developed a fever. The child reported no history of trauma. His parents stated that 2 days before presentation he had complained of contralateral leg pain, which had since resolved. On further questioning, his parents also reported that he had experienced left shoulder pain 3 days previously, which resolved within 36 hours. Neither the child nor his parents were aware of any recent tick exposures, but they did note that he had had tick bites several months prior during the summer. He was described as a very active child who enjoys playing outdoors. Other than a recent trip to Europe, there was no history of foreign travel. There were no known sick contacts. Review of systems was positive for fatigue, but negative for chills, weight loss, nausea, vomiting, diarrhea, abdominal pain, cough, congestion, rhinorrhea, sore throat, and urinary symptoms.

Physical examination revealed a pleasant, well-developed boy who appeared uncomfortable and localized his pain to the right anterior mid-thigh. His temperature was 38.0°C; heart rate, 132 beats/minute; respiratory rate, 24 breaths/minute; blood pressure, 106/54 mmHg; and O_2 saturation, 99% on room air. He was unable to bear weight on the right leg owing to pain. He had no tenderness to palpation at the right hip or knee, but had pain with passive internal and external rotation of the affected hip. He could flex and extend the right knee without difficulty. He had no appreciable edema at the right knee or hip but did have an effusion at the asymptomatic left knee. There was no erythema or calor present in either lower extremity. A thorough inspection of the skin and scalp revealed no rash or signs of insect bites.

The remainder of the physical examination was unremarkable.

Serologic studies revealed a white blood cell (WBC) count of 8,900/μL, erythrocyte sedimentation rate (ESR) of 53 mm/h, and C-reactive protein (CRP) of 5.7 mg/dL. Blood cultures and Lyme titers were obtained. Radiographs showed no abnormality at either hip, a small to moderate effusion of the right knee, and a moderate effusion of the left knee. Bedside ultrasonography was performed, revealing a hypoechoic fluid collection at the right hip (Figure 1) measuring 20 mm in the anterior synovial recess, which is the space between the anterior cortex of the femoral neck and the posterior surface of the joint capsule underlying the iliopsoas muscle. Normally, a fluid collection in this location, if present at all, should be no greater than 7.7 mm for a child of this age.[1] Sonography of the left hip was normal (Figure 2).

After applying topical anesthetic cream and injecting subcutaneous local anesthetic, an ultrasound-guided arthrocentesis of the right hip was performed in the ED under sterile conditions (video of procedure available online). Seven milliliters of turbid, yellow fluid was aspirated and sent for analysis. Repeated sonographic imaging of the right hip revealed a marked reduction in size of the effusion. After arthrocentesis, ceftriaxone was promptly administered intravenously, and the orthopedic service was consulted.

The synovial fluid had 109,495 white cells/mm^3 (95% neutrophils). The gram stain results showed no organisms. When examined by the orthopedist approximately an hour after arthrocentesis, the patient had significant improvement in his pain and was able to bear weight on the affected leg. A second arthrocentesis, this time of the left knee, was performed by the orthopedic consultant that yielded 82,887 white cells/mm^3 (92% neutrophils) and a negative gram stain result. In view of these findings, Lyme disease was believed to be the likely cause of the patient's illness. The patient was admitted to the family practice service, and ceftriaxone therapy was continued. The patient's symptoms improved in hospital, and after 3 days he was discharged and given a 4-week course of amoxicillin for presumptive Lyme arthritis. Ultimately, blood and synovial fluid cultures revealed no growth. Lyme studies, which were pending at the time of discharge, yielded positive results 3 days later by Western Blot analysis for IgG and IgM.

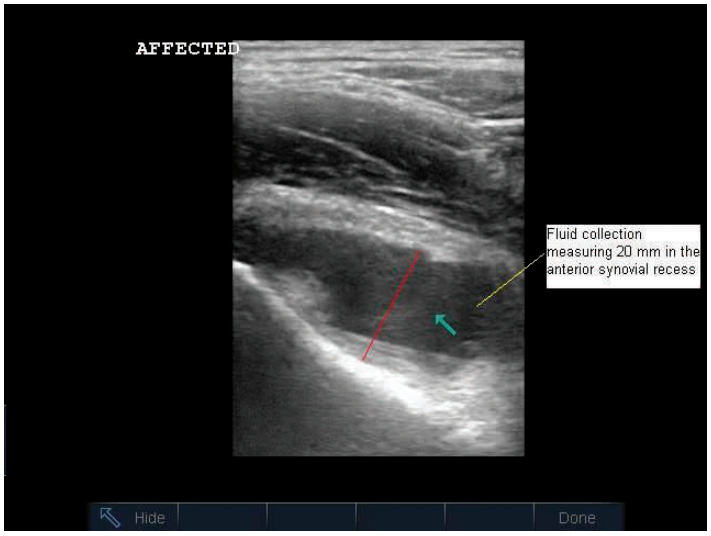

Figure 1. Sonographic appearance of the right hip demonstrating a fluid collection (arrow) in the anterior synovial space. This space is measured from the anterior surface of the femoral neck to the posterior surface of the joint capsule underlying the iliopsoas muscle (red line).

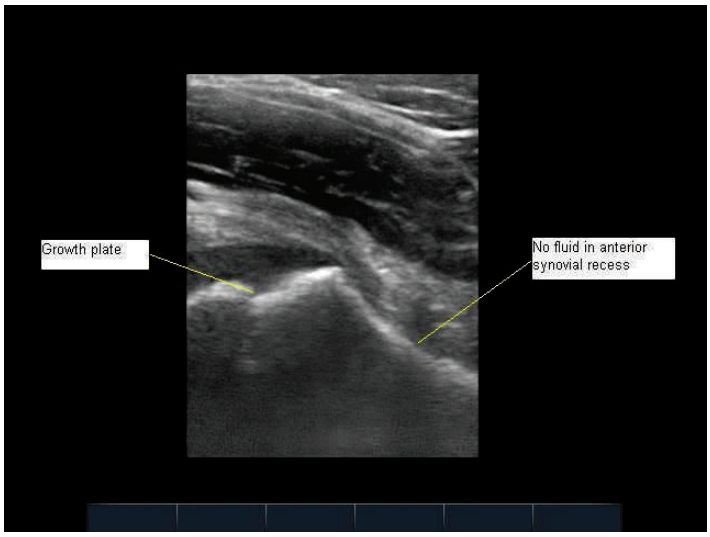

Figure 2. Normal appearance of the left hip with no fluid in the anterior synovial space. In this image, obtained by scanning slightly more proximally than in Figure 1, the growth plate is well visualized.

DISCUSSION

The differential diagnosis for a child with acute hip pain can be divided into disorders that are usually apparent on plain radiography (eg, fracture, neoplasm, slipped capital femoral epiphysis, and Perthes disease) and ones that are not (eg, transient synovitis, Lyme disease, and septic arthritis). If plain radiographs yield negative findings, early identification or exclusion of septic arthritis is critical. Without prompt treatment, septic arthritis can lead to osteonecrosis, osteomyelitis, epiphyseal damage, and systemic sepsis.[2–6]

Ultrasonography has long been used to evaluate hip disorders and is considered the preferred modality for diagnosing hip effusions in children.[4,7] In 1980, Graf[8] described the use of ultrasound to evaluate congenital hip dislocations. Ultrasound-guided arthrocentesis of the hip was later described by Hill and colleagues[9] using a static approach, and by Mayakawa et al[10] using real-time sonography. Only 3 prior reports of emergency physician–performed hip arthrocentesis have been published.[11–13] Smith[11] first reported using this technique in the ED in a 47-year-old male found to

have pseudogout. Freeman et al[12] described 4 adult patients who underwent ultrasound-guided arthrocentesis in the ED; 3 were found to have a nonseptic reactive monoarthropathy and 1 had avascular necrosis. Finally, Tsung and Blaivas[13] performed bedside ultrasound-guided arthrocentesis in 2 pediatric patients, of whom 1 was diagnosed with transient synovitis and 1 with septic arthritis. A review of the medical literature reveals no prior report of ultrasound-guided arthrocentesis in a patient with Lyme arthritis.

This case illustrates the potential for accelerating synovial fluid analysis and antibiotic therapy in suspected septic arthritis with bedside, ultrasound-guided arthrocentesis. At our institution, hip arthrocentesis is typically performed by an orthopedist in the radiology suite or operating room, using fluoroscopic guidance. Anecdotally, consulting orthopedists often prefer that antibiotics be withheld until synovial fluid can be obtained. Depending upon the availability of resources and personnel, significant delays may occur before arthrocentesis is performed. In the case presented, synovial fluid analysis and antibiotic therapy occurred promptly after initial radiographs and serologic studies.

Prior investigators have shown that hip sonography is an easily learned technique. Vieira and Levy[14] found that pediatric emergency physicians with minimal training in ultrasonography could identify hip effusions in children, with a sensitivity and specificity of 80% and 98%, respectively, after only 10 training examinations. A high-frequency, linear array transducer is placed over the proximal femur obliquely from inferolateral to superomedial, in plane with the long axis of the femoral neck. The probe indicator is directed toward the umbilicus. (As long as the screen indicator, or dot, is positioned on the left side of the screen, the femoral head will be seen on the left-hand side of the image regardless of which hip is being evaluated.) If present, an effusion will be visualized in the anterior synovial recess overlying the anterior surface of the femoral neck (Figure 1). Of note, Rohrschneider et al[15] found that 12% of asymptomatic children will have a thin layer of synovial fluid in this space. Tien and colleagues[1] have defined the normal range in millimeters for such a fluid collection as less than or equal to $6.52\ \text{mm} + 0.013 \times$ (age in months). Thus, the 93-month-old child in this case could have a fluid collection up to 7.7 mm wide in the anterior synovial recess in the absence of pathology. This measurement should be made from the apex of the concavity of the femoral neck (ie, the deepest point in the anterior synovial recess) to the posterior surface of the anterior joint capsule, which lies just posterior to the iliopsoas muscle. Tien et al[1] additionally reported that an effusion 1.46 mm wider than on the contralateral side is also abnormal.

When performing ultrasound-guided hip arthrocentesis, the operator must take care to avoid the femoral artery and vein, which are visualized by scanning more medially. Using an in-plane approach, the needle is directed into the anterior synovial recess with real-time visualization of the long axis of the needle. We recommend an approach from the inferolateral side of the transducer. In a case such as this one, involving a right-handed operator approaching the patient's right hip, we suggest seating oneself next to the patient's right flank facing the patient's feet, with the ultrasound machine adjacent to the patient's right knee. For the left hip, a right-handed operator may be seated next to the patient's left knee with the machine adjacent to the patient's left shoulder. Sterile technique should be maintained throughout the procedure. A local anesthetic is advisable, though younger patients may require sedation in addition.

This case of Lyme arthritis was unusual in that the predominant joint involved was the hip. Lyme arthritis, the most common late manifestation of infection with *Borrelia burgdorferi*,[16,17] is characterized by intermittent, asymmetric, monoarthritic or polyarthritic attacks of the large joints, most commonly the knee.[18] Distinguishing between Lyme and septic arthritis can be challenging. Most children with Lyme arthritis present without erythema migrans[18] and do not recall a tick bite.[18,19] Although involvement of the knee, absence of fever, and a low CRP make Lyme disease more likely, the discriminatory value of these findings is inadequate for excluding septic arthritis.[19] Our patient's synovial fluid WBC count, greater than 100,000/mm^3, was much higher than the mean value of 46,000/mm^3 reported by Thompson et al[19] in patients with Lyme arthritis. Synovial WBC, however, is known to have a wide range in patients with Lyme disease.[19] The synovial fluid gram stain test, which has limited sensitivity for septic arthritis of only 29% to 50%,[20] yielded a negative finding. To help differentiate between septic arthritis and transient synovitis, Kocher and colleagues[21] validated a clinical decision rule consisting of a history of fever, non–weight-bearing status, ESR $>$40 mm/h, and WBC count $>$12,000 cells/mm^3, each of which makes septic arthritis more likely. The presence of 3 of these predictors, as our patient had, yields a positive predictive value of 73% for septic arthritis.[21] Arthrocentesis and early antibiotic administration were, therefore, critical steps in this patient's management. In addition to accelerating the diagnostic work-up and presumptive treatment, we found that bedside ultrasound-guided hip arthrocentesis had an additional benefit in alleviating our patient's pain in the ED. Pain relief from joint decompression has been highlighted by others as an advantage of this procedure.[6]

CONCLUSION

This case of acute hip pain in a patient ultimately found to have Lyme arthritis demonstrates the potential for bedside ultrasound-guided arthrocentesis to accelerate diagnostic testing and empiric antibiotic therapy in cases of suspected septic arthritis. Earlier, more effective analgesia is an additional benefit. Bedside hip sonography and arthrocentesis appear to be useful skills in the ED setting. Further study is

needed to determine the amount of training required for proficiency.

Address for Correspondence: James H. Moak, MD, University of Virginia Health System, Department of Emergency Medicine, PO Box 800699, Charlottesville, VA 22908-0699. E-mail: james.moak@virginia.edu.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Tien YC, Yang CY, Chih HW. The normal width of anterior hip synovial recess in children. *J Pediatr Orthop*. 2000;20:264–266.
2. Sultan J, Hughes PJ. Septic arthritis or transient synovitis of the hip in children: the value of clinical prediction algorithms. *J Bone Joint Surg Br*. 2010;92:1289–1293.
3. Bennett OM, Namnyak SS. Acute septic arthritis of the hip joint in infancy and childhood. *Clin Orthop Relat Res*. 1992;281:123–132.
4. Kang SN, Sanghera T, Mangwani J, et al. The management of septic arthritis in children: systematic review of the English language literature. *J Bone Joint Surg Br*. 2009;91:1127–1133.
5. Wingstrand H, Egund N, Lidgren L, et al. Sonography in septic arthritis of the hip in the child: report of four cases. *J Pediatr Orthop*. 1987;7:206–209.
6. Fink AM, Berman L, Edwards D, et al. The irritable hip: immediate ultrasound guided aspiration and prevention of hospital admission [discussion in *Arch Dis Child*. 1995;72:3–4]. *Arch Dis Child*. 1995;72: 110–113.
7. Zamzam MM. The role of ultrasound in differentiating septic arthritis from transient synovitis of the hip in children. *J Pediatr Orthop B*. 2006; 15:418–422.
8. Graf R. The diagnosis of congenital hip-joint dislocation by the ultrasonic Combound treatment. *Arch Orthop Trauma Surg*. 1980;97:117–133.
9. Hill SA, MacLarnon JC, Nag D. Ultrasound-guided aspiration for transient synovitis of the hip. *J Bone Joint Surg Br*. 1990;72:852–853.
10. Mayekawa DS, Ralls PW, et al. Sonographically guided arthrocentesis of the hip. *J Ultrasound Med*. 1989;8:665–667.
11. Smith SW. Emergency physician-performed ultrasonography-guided hip arthrocentesis. *Acad Emerg Med*. 1999;6:84–86.
12. Freeman K, Dewitz A, Baker WE. Ultrasound-guided hip arthrocentesis in the ED. *Am J Emerg Med*. 2007;25:80–86.
13. Tsung JW, Blaivas M. Emergency department diagnosis of pediatric hip effusion and guided arthrocentesis using point-of-care ultrasound. *J Emerg Med*. 2008;35:393–399.
14. Vieira RL, Levy JA. Bedside ultrasonography to identify hip effusions in pediatric patients. *Ann Emerg Med*. 2010;55:284–289.
15. Rohrschneider WK, Fuchs G, Troger J. Ultrasonographic evaluation of the anterior recess in the normal hip: a prospective study on 166 asymptomatic children. *Pediatr Radiol*. 1996;26:629–634.
16. Steere AC, Grodzicki RL, Kornblatt AN, et al. The spirochetal etiology of Lyme disease. *N Engl J Med*. 1983;308:733–740.
17. Weinstein A, Britchkov M. Lyme arthritis and post-Lyme disease syndrome. *Curr Opin Rheumatol*. 2002;14:383–387.
18. Saulsbury FT. Lyme arthritis presenting as transient synovitis of the hip. *Clin Pediatr (Phila)*. 2008;47:833–835.
19. Thompson A, Mannix R, Bachur R. Acute pediatric monoarticular arthritis: distinguishing lyme arthritis from other etiologies. *Pediatrics*. 2009;123:959–965.
20. Margaretten ME, Kohlwes J, Moore D, et al. Does this adult patient have septic arthritis? *JAMA*. 2007;297:1478–1488.
21. Kocher MS, Mandiga R, Zurakowski D, et al. Validation of a clinical prediction rule for the differentiation between septic arthritis and transient synovitis of the hip in children. *J Bone Joint Surg Am*. 2004; 86-A:1629–1635.

Ultrasound Guidance for Central Venous Access by Emergency Physicians in Colorado

Brandon H. Backlund, MD*
Emily Hopkins†
John L. Kendall, MD†‡

* Harborview Medical Center, Department of Emergency Medicine, Seattle, Washington; University of Washington School of Medicine, Division of Emergency Medicine, Seattle, Washington
† Denver Health Medical Center, Department of Emergency Medicine, Denver, Colorado
‡ University of Colorado School of Medicine, Department of Emergency Medicine, Denver, Colorado

Supervising Section Editor: Seric S. Cusick, MD
Submission history: Submitted June 6, 2011; Revision received August 29, 2011; Accepted November 8, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.11.6821

Introduction: To survey emergency physicians (EP) regarding the frequency of use of ultrasound guidance for placement of central venous catheters (UGCVC) and to assess their perceptions regarding the technique and barriers to its implementation.

Methods: A 25-question Web-based survey was e-mailed to all members of the Colorado chapter of the American College of Emergency Physicians with a listed e-mail address. A total of 3 reminders were sent to nonresponders.

Results: Responses were received from 116 out of 330 invitations. Ninety-seven percent (n = 112) of respondents indicated they have an ultrasound machine available in their emergency department, and 78% indicated they use UGCVC. Seventy-seven percent (n = 90) agreed with the statement, "Ultrasound guidance is the preferred method for central venous catheter placement in the emergency department." However, 23% of respondents stated they have received no specific training in UGCVC. Twenty-six percent (n = 28) of respondents stated they felt "uncomfortable" or "very uncomfortable" with UGCVC, and 47% cite lack of training in UGCVC as a barrier to performing the technique.

Conclusion: Although the majority of surveyed EPs feel UGCVC is a valuable technique and do perform it, a significant percentage reported receiving no training in the procedure and also reported being uncomfortable performing it. Nearly half of those surveyed cited lack of training as a barrier to more widespread implementation of UGCVC. This suggests that there continues to be a need for education and training of EPs in UGCVC. [West J Emerg Med. 2012;13(4):320–325.]

INTRODUCTION

There is growing consensus in the medical literature that ultrasound guidance for central venous catheter placement (UGCVC) improves overall success, decreases complications, and shortens the time required to complete the procedure, when compared to anatomic landmark-based techniques.[1–5] Consequently, recommendations advocating for the use of UGCVC have been adopted by various professional medical organizations and government agencies.[6–10] Despite this support, it is unknown how widespread adoption of this technique is among emergency physicians (EP). Additionally, the perceptions of EPs regarding the utility and practicality of this technique are unknown, and to what degree these perceptions affect acceptance and implementation of UGCVC is unclear.

The goals of this study were to survey EPs in Colorado to obtain information about their practice and perceptions with regards to UGCVC. Secondarily, we sought to identify perceived barriers to widespread utilization of ultrasound guidance for central vascular access.

METHODS

Study Design

This was a cross-sectional, anonymous, Internet-based survey of EPs practicing in the state. Survey questions were pilot tested by a group of EPs at the authors' institution with experience in emergency ultrasound and/or research design. Questions were then modified according to feedback received during pilot testing.

Survey questions were converted to electronic format using a Web site (zoomerang.com), which specifically provides a platform to design and deploy online surveys. Respondents answered up to 25 questions; skip logic is incorporated into the survey design, which directs respondents to answer certain questions and skip others depending on previous responses.

Selection of Participants

Special permission was obtained for this study from the Colorado chapter of the American College of Emergency Physicians (COACEP) to access a list of all members with an e-mail contact. An invitation to complete the survey, along with a hyperlink directly to the survey, was sent by e-mail to all those on the list using the survey Web site's secure server. Three additional reminders were sent over the study period. As stipulated by COACEP, no more than 3 reminders were sent, and no other attempts at personal contact were made, such as telephone or mail. To maintain respondents' anonymity, no identifiable data were collected in the survey responses. Data were collected over a 3-month period from August to October of 2008.

Survey data were compiled by Zoomerang and exported to the investigators as an electronic database (Excel, Microsoft Corporation, Redmond, Washington).

This study was approved by the Colorado Multiple Institutional Review Board.

Statistical Analysis

Data were transferred electronically as an Excel spreadsheet and transferred into SAS format using translational software (dfPower/DBMS Copy, DataFlux Corporation, Cary, North Carolina). All statistical analyses were performed using SAS Version 9.2 (SAS Institute Inc, Cary, North Carolina). All data are reported using descriptive statistics; differences between continuous variables are expressed as medians with 95% confidence intervals (CI), and categorical variables are expressed as percentages with 95% CIs. Statistical significance between comparisons was determined by 95% CIs and P values ($P < 0.05$).

RESULTS

The database provided by COACEP contained e-mail contacts for all its members for whom they had this information available in their records. There were 330 e-mail addresses on the list. All were invited to complete the survey as described earlier. One hundred sixteen responses were received for a response rate of 35%.

Demographics—Hospital Characteristics

Descriptors of the respondents' practice environments are presented in the Table. Eighty-five percent (n = 99) of respondents reported primarily practicing in an urban or suburban area with a population greater than 50,000. The majority (59%) practice in a private or community hospital. With respect to trauma designation, 63% work in a Level 1 or Level 2 center. The median number of annual visits was 50,000 (IQR 38,000–60,000). The majority of respondents (65%) do not work in an emergency department (ED) that is affiliated with an emergency medicine (EM) residency program. To assess whether we were sampling physicians from a diversity of EDs, we asked the respondents to indicate the postal zip code for their primary practice site; 56 different zip codes within Colorado and the surrounding region were reported.

Responder Characteristics

The majority of respondents (76%) were board certified in EM, either by the American Board of Emergency Medicine or the American Osteopathic Board of Emergency Medicine. Twelve percent (n = 14) of respondents indicated they were still in residency training. The median number of years in practice postresidency was 10.5 (IQR 5.5–20).

Ninety-seven percent (n = 113) of respondents stated they have access to an ultrasound machine in their ED; 78% (n = 88) of respondents indicated that they perform UGCVC. The median overall percentage of CVCs placed using UGCVC was 75% (IQR 50–90%).

The 78% of respondents who stated that they use UGCVC

Table. Respondents' practice environments.

Which of the following most closely describes the area in which you primarily practice?	N (%)
Urban/suburban, population >50,000	99 (85)
Urban/suburban, population 2,500–50,000	12 (10)
Rural, population <2,500	5 (4)
Which of the following best describes your primary practice setting?	
Public/city/county hospital	37 (32)
Private/community hospital	68 (59)
University hospital	9 (8)
What is your hospital's trauma designation?	
Level 1	34 (29)
Level 2	39 (34)
Level 3	20 (17)
Level 4	10 (9)
Level 5	8 (7)
Unsure/don't know	5 (4)

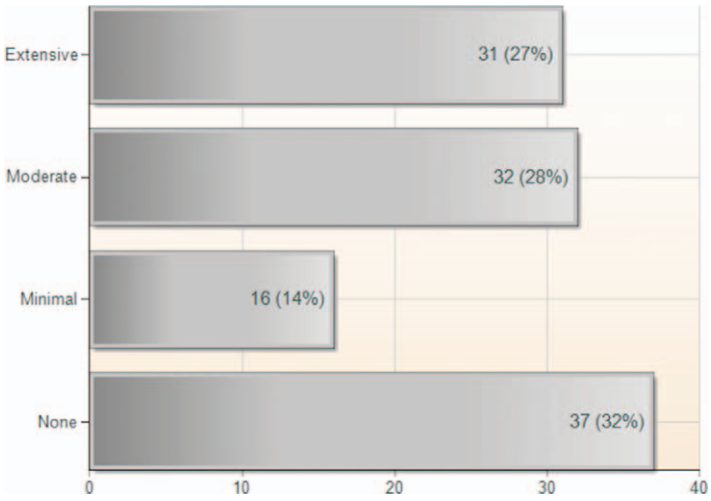

Figure 1. How much training did you receive in the use of emergency ultrasound during your residency?

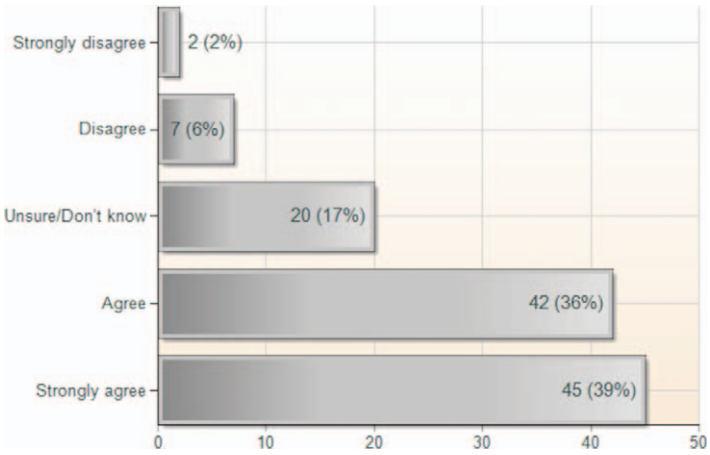

Figure 2. Please indicate your level of agreement or disagreement with the following statement: There is a higher success rate using ultrasound guidance for placement of central venous catheters as compared to the traditional (anatomic or landmark) approach.

indicated that they place a median of 1.9 CVCs per week (IQR 0.5–2). The 22% of respondents who stated they do not use UGCVC place a median of 0.5 central venous catheters (CVC) per week (difference: 1.4, 95% CI [0.8–1.4], $P < 0.0001$).

Of the 35% of respondents affiliated with a residency program, 95% use UGCVC. Of the 65% of respondents not affiliated with a residency program, 65% use UGCVC. This difference is statistically significant (difference: 30%, 95% CI [14–40%], $P < 0.0009$).

The portion of respondents in our study who said they had received minimal or no training in emergency bedside ultrasound (EBUS) during their residency was 46% (Figure 1). Although 98% of respondents said they have received some training in general EBUS, suggesting that they have pursued some form of education outside of their residency training, 23% of respondents stated they have received no specific training in UGCVC.

Of those who stated they have not received any specific training in UGCVC, 59% stated they do not perform this technique. Of those who stated they have received training in UGCVC, only 10% stated they do not use it (difference: 50%, 95% CI [31–71%], $P < 0.00001$).

Perceptions Regarding UGCVC

Seventy-seven percent (n = 90) of respondents indicated agreement with the statement, "Ultrasound guidance is the preferred method for central venous catheter placement in the emergency department"; 10% indicated disagreement. For the statements that UGCVC results in a higher success rate and fewer complications, the percentages of respondents indicating agreement were 75% and 74%, respectively (Figures 2 and 3). However, regarding the statement that UGCVC takes less time than the landmark-based approach, only 32% agreed, whereas 42% disagreed (Figure 4).

Forty-seven percent (n = 55) of all respondents cite lack of training as a barrier to implementing EBUS at their institution (Figure 5). In EDs with the capability of performing UGCVC, the top 3 reasons given for not performing it were: a perception that ultrasound guidance is more time consuming (39%), a perception that the preferred anatomic site was not amenable to ultrasound guidance (30%), and a preference for the landmark approach (29%) (Figure 6).

Overall, 26% (n = 28) of respondents stated they felt "uncomfortable" or "very uncomfortable" with UGCVC. Of those who stated they had not been trained in UGCVC, 59% (95% CI: 39–78%) stated they were "uncomfortable" or "very uncomfortable" with the technique. Of those who had been trained in UGCVC, 13% (95% CI: 7–22%) reported being "uncomfortable" or "very uncomfortable" with the technique ($P < 0.0001$).

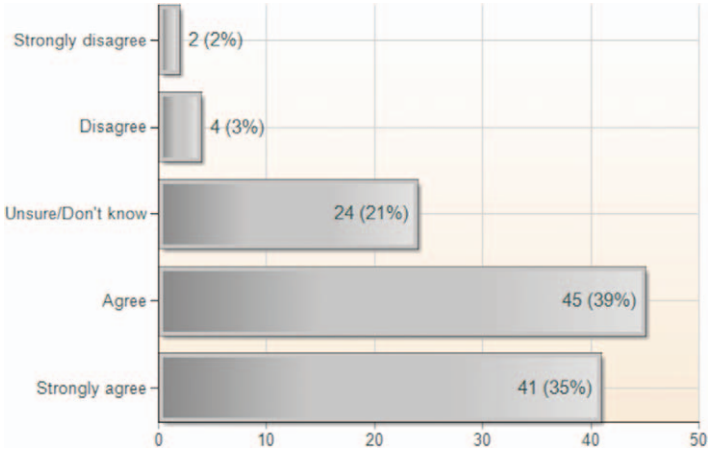

Figure 3. Please indicate your level of agreement or disagreement with the following statement: There are fewer complications using ultrasound guidance for placement of central venous catheters as compared to the traditional (anatomic or landmark) technique.

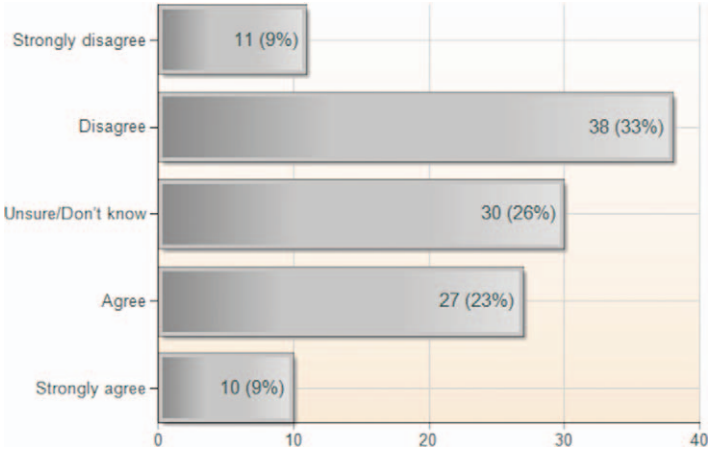

Figure 4. Please indicate your level of agreement or disagreement with the following statement: It takes less time to successfully place central venous catheters using ultrasound guidance as compared to the traditional (anatomic or landmark) technique.

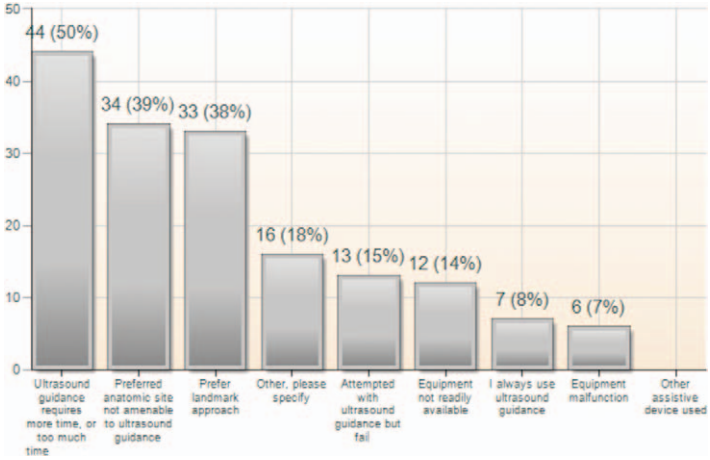

Figure 6. If/when there have been instances where you did not use ultrasound guidance to place a central line, what factor(s) were included in that decision?

DISCUSSION

There is an established and growing body of literature demonstrating superior safety and improved success using ultrasound guidance to place CVCs, as compared to traditional anatomic landmark-based techniques.[1–5] In 2001, UGCVC was endorsed by the Agency for Healthcare Research and Quality as one of 11 safety practices that was ". . . most highly rated. . . in terms of strength of the evidence supporting more widespread implementation. . ."[7] The following year, the British National Health Service published a similar recommendation, stating that ". . . two-dimensional. . . imaging ultrasound is recommended as the preferred method for insertion of central venous catheters. . . into the internal jugular vein. . . in adults and children. . ."[8] In 2008, the American College of Surgeons issued a statement supporting ". . . the uniform use of real-time ultrasound guidance for the placement of CVCs in all patients. . ."[9] The Canadian Association of Emergency Physicians endorses UGCVC,[10] and ACEP has included UGCVC in its ultrasound guidelines since 2001.[6,11,12]

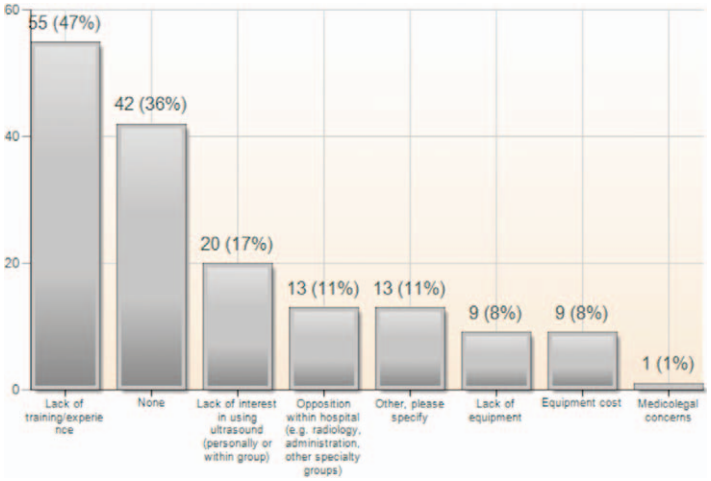

Figure 5. Please identify any barriers that you feel exist to emergency-physician-performed ultrasound in general in your hospital.

Despite these endorsements, the use of UGCVC by EPs is not uniform. In our survey, 97% of respondents had access to an ultrasound (US) machine, and 78% used UGCVC. This differs considerably from a 2006 survey by Moore et al, in which only 34% of ultrasound community EDs reported using EBUS in some form.[13] Similarly, a survey by Stein et al of academic and community EDs in California found a 34% rate of use of EBUS.[14] Neither of these surveys specifically investigated UGCVC, however. This difference may reflect variations in regional conditions; California's population is larger than that of Colorado, with more hospitals and EDs, and whereas there are currently 14 EM residency programs in California alone,[15] there is only 1 EM residency program in our state, with an EBUS curriculum since 1998 and an EM ultrasound fellowship since 2006.

Factors Affecting Use of UGCVC

Training. Education regarding UGCVC appears to be a very important factor influencing its use. In this survey, 47% of EPs cited lack of training in EBUS as a barrier to implementing it in their practice (Figure 1). This is similar to the survey by Moore et al[13] in which lack of training was cited as the most significant barrier to implementation of EBUS. Additionally, a 2008 survey of pediatric EDs found that the most significant barrier to implementation of EBUS was lack of adequately trained EPs.[16] In our survey, just under 1 in 4 responding EPs stated that they have received no specific training in UGCVC. A significantly higher percentage of physicians who had not been trained in UGCVC reported being uncomfortable with the procedure, as compared with those who had been trained. We also found significantly higher utilization of UGCVC among those who had been trained in the technique; 90% reported

using it in this group, compared to 41% of those who had not been trained.

Training remains a challenge for currently practicing EPs. The advent of emergency-physician-performed bedside ultrasound has occurred relatively recently, and training in EBUS was not a mandated part of the EM residency curriculum until 2001.[12] In a survey in 2003 by Counselman et al,[17] 95% of EM residency programs reported that they provided instruction in EBUS. However, only 21% included specific instruction in UGCVC at that time. Therefore, many EPs currently practicing did not receive training in EBUS during their residency and may not have received specific training in the technique of UGCVC. In our survey, 100% of those currently in residency (n = 14, 12%) stated they have received specific training in UGCVC, and all rated their training in EBUS as either "extensive" (79%) or "moderate" (21%). However, 88% of the respondents were not residents, and 52% of this group said they had received minimal or no training in EBUS during residency. Although 98% of all respondents said they have subsequently received some training in EBUS, indicating that they have pursued some form of education outside of their residency training, still 23% remain who indicated they have not been trained in UGCVC.

Training Centers. A significantly higher percentage of those who work with residents use UGCVC than those who do not. It appears that, in this study population, physicians at EM training centers use UGCVC more frequently than those practicing in nontraining centers.

Frequency of Procedure. Those who do not use UGCVC place significantly fewer catheters on a weekly basis than those who do. It may be that those who do not perform CVC placement as frequently do not perceive that the magnitude of the benefits of UGCVC with regard to patient safety are significant enough to make adopting the technique worthwhile.

Physician Perceptions. We included questions in the survey designed to assess the respondents' awareness and acceptance of the consensus in the literature regarding higher success rates and fewer complications using UGCVC. Approximately three quarters of respondents agreed that UGCVC reduces complications and increases success rates and that UGCVC is the preferred method for placement of CVCs in the ED. However, the majority disagreed with the statement that UGCVC requires less time to successfully complete the procedure. This would appear to demonstrate incomplete awareness of the current literature pertaining to UGCVC (as compared to the anatomic landmark technique) among the surveyed EPs, as the benefits of higher success rates, fewer complications, and the equivalent of less time required to completion have been consistently reported.[1–5] The impact of physician perception on ultrasound implementation has been shown previously, as well. Baka et al[18] surveyed the use of focused assessment with sonography for trauma (FAST) among EPs and trauma surgeons who treat pediatric trauma patients, finding that the implementation of FAST was lower among those who rated the perceived utility of FAST as lower, despite contrary medical literature demonstrating its usefulness.

We feel our results underscore the need for continued EP education in UGCVC, not only as part of required EM residency training, but with regards to increasing the availability of training opportunities for practicing EPs postresidency, as well. The technique has been demonstrated in multiple studies to have advantages regarding success rates and patient safety and is advocated by governmental agencies concerned with healthcare quality. Despite this, a considerable percentage of EPs in our study still are not fully aware of the evidence-based support for the technique and either have not been trained in performing it or have not had sufficient experience with the technique to feel comfortable performing it. Our results suggest that EPs who have been trained in UGCVC become more comfortable with the technique and are more likely to perform it.

LIMITATIONS

This study has several limitations. First, the response rate was 35%. This raises the possibility that the survey sample may not be representative of all EPs in Colorado. We were limited by the constraints imposed upon us regarding access to the database, which did not include mailing addresses or telephone numbers. It is probable that if we had been able to do follow-up telephone contact and/or postal mailings, our response rate would have been higher. Also included in the database were a few incorrect or outdated e-mail addresses, which were undeliverable and decreased our response rate. We did not use an incentive or reward for completing the survey, which likely would also have increased the response rate.

We specifically surveyed members of the ACEP chapter in our state. The responses therefore could possibly represent a regional bias that would not be present in another state. This is particularly important when trying to generalize our results to other regions that may not have an established residency program or a developed ultrasound curriculum or where conditions may be otherwise different. It may also be that EPs who are not members of ACEP would respond differently to a similar survey. Further research is needed to determine how the findings of this study compare to other populations where EM is practiced. To our knowledge, there were no data available in the published medical literature regarding the frequency of use of UGCVC among EPs prior to this study. These data provide a starting point upon which to base estimates for future studies to refine our understanding of perceptions and practices among EPs regarding UGCVC.

Ninety-seven percent (n = 113) of the respondents reported that they have ultrasound available. It is possible that EPs who are not as familiar with or who do not use ultrasound were less likely to complete the survey.

Inherent in surveys such as this, in which respondents are asked to self-report regarding past practices, is the risk of recall bias, which may affect the accuracy of the respondents' estimates.

CONCLUSION

The majority of EPs in our survey feel that UGCVC is a valuable technique and do perform it. However, nearly half of those surveyed cited lack of training as a barrier to performing EBUS, and approximately 1 in 4 reported receiving no training in UGCVC. A similar proportion also reported being uncomfortable performing this procedure, suggesting that there still exists a need for training of EPs in this technique.

Address for Correspondence: Brandon H. Backlund, MD, University of Washington School of Medicine, Division of Emergency Medicine, Harborview Medical Center, 325 9th Ave, 3EC-26, Seattle, WA 98104. E-mail: bbswing@u.washington.edu.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Hind D, Calvert N, McWilliams R, et al. Ultrasonic locating devices for central venous cannulation: meta-analysis. *BMJ*. 2003;327:361.
2. Denys BG, Uretsky BF, Reddy PS. Ultrasound-assisted cannulation of the internal jugular vein—a prospective comparison to the external landmark-guided technique. *Circulation*. 1993;87:1557–1562.
3. Hrics P, Wilber S, Blanda M, et al. Ultrasound-assisted internal jugular vein catheterization in the ED. *Am J Emerg Med*. 1998;16:401–403.
4. Miller A, Roth B, Mills T, et al. Ultrasound guidance versus the landmark technique for the placement of central venous catheters in the emergency department. *Acad Emer Med*. 2002;9:800–805.
5. McGee D, Gould M. Preventing complications of central venous catheterization. *N Eng J Med*. 2003;348:1123–1133.
6. American College of Emergency Physicians policy statement: emergency ultrasound guidelines. American College of Emergency Physicians Web site. Available at: http://www.acep.org/WorkArea/DownloadAsset.aspx?id=32878. Accessed July 2, 2010.
7. Shojania K, Duncan B, McDonald K, et al. Making healthcare safer: a critical analysis of patient safety practices. Agency for Healthcare Research and Quality Web site. Available at: http://archive.ahrq.gov/clinic/ptsafety/. Accessed July 2, 2010.
8. British National Health Service, National Institute for Clinical Excellence. Final appraisal determination: ultrasound locating devices for placing central venous catheters. National Institute for Health and Clinical Excellence Web site. Available at: http://www.nice.org.uk:80/guidance/index.jsp?action=article&r=true&o=32460. Accessed July 2, 2010.
9. American College of Surgeons. Statement on recommendations for uniform use of real-time ultrasound guidance for placement of central venous catheters. American College of Surgeons Web site. Available at: http://www.facs.org/fellows_info/statements/st-60.html. Accessed July 2, 2010.
10. Canadian Association of Emergency Physicians. Position statement: emergency department targeted ultrasound: 2006 update. Canadian Association of Emergency Physicians Web site. Available at: http://www.caep.ca/CMS/get_file.asp?id=9da9e78c35ae4fa681b8f98a3bc98794&ext=.pdf&name=Ultrasound_PositionStatement_-_jul21.05.pdf. Accessed July 2, 2010.
11. Hockberger RS, Binder LS, Graber MA, et al. The model of the clinical practice of emergency medicine. *Ann Emerg Med*. 2001;37:745–770.
12. Heller M, Mandavia D, Tayal V, et al. Residency training in emergency ultrasound: fulfilling the mandate. *Acad Emerg Med*. 2002;9:835–839.
13. Moore C, Molina A, Lin H. Ultrasonography in community emergency departments in the United States: access to ultrasonography performed by consultants and status of emergency physician-performed ultrasonography. *Ann Emerg Med*. 2006;47:147–153.
14. Stein JC, River G, Kalika I, et al. A survey of bedside ultrasound use by emergency physicians in California. *J Ultrasound Med*. 2009;28:757–763.
15. Society for Academic Emergency Medicine. Emergency medicine residency catalog. Available at: http://www.saem.org/saemdnn/TestResidencyPage/California/tabid/781/Default.aspx. Accessed July 2, 2010.
16. Ramirez-Schrempp D, Dorfman DH, Tien I, et al. Bedside ultrasound in pediatric emergency medicine fellowship programs in the United States: little formal training. *Pediatr Emerg Care*. 2008;24:664–667.
17. Counselman FL, Sanders A, Slovis CM, et al. The status of bedside ultrasonography training in emergency medicine residency programs. *Acad Emerg Med*. 2003;10:37–42.
18. Baka A, Delgado C, Simon H. Current use and perceived utility of ultrasound for evaluation of pediatric compared with adult trauma patients. *Pediatr Emerg Care*. 2002;18:163–167.

Focused Cardiac Ultrasound for the Detection of a Ventricular Aneurysm

Steven Bailey, MD
Andrew Herring, MD
Michael Stone, MD
Arun Nagdev, MD

Alameda County Medical Center, Highland General Hospital, Oakland, California

Supervising Section Editor: Rick McPheeters, DO
Submission history: Submitted June 15, 2011; Revision received September 14, 2011; Accepted December 19, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.12.6832
[West J Emerg Med. 2012;13(4):326-328.]

INTRODUCTION

Left ventricular aneurysm (LVA) is a rare and dangerous disease process, for which rapid diagnosis can expedite further evaluation and treatment. Here we present the first case of LVA detected by focused cardiac ultrasound in a case of a patient with electrocardiographic findings consistent with a ST elevation myocardial infarction.

CASE REPORT

A 60-year-old male with a history of asthma and diabetes mellitus presented to the emergency department (ED) with two weeks of worsening cough, shortness of breath and wheezing. He reported bilateral lower extremity swelling, orthopnea, paroxysmal nocturnal dyspnea, fatigue, dyspnea on exertion and subjective fevers. He denied chills, chest pain, nausea and vomiting. The patient was unaware of any history of cardiac disease and denied smoking or recreational drug use.

Physical examination on presentation to the ED revealed an uncomfortable appearing male in mild distress. The patient's initial vital signs were: heart rate 112 beats per minute, blood pressure 133/83 mmHg, respiratory rate 17, temperature 99.1°F (37.3°C), and oxygen saturation 97% on room air. He was noted to have 10 cm of jugular venous distension and bilateral pitting edema to his knees. His cardiovascular exam revealed a normal S1 and S2, and a loud S3 with no audible murmurs. The patient's lung examination was significant for crackles in all lung fields, mild end-expiratory wheezing and no accessory muscle use. Neurologic and abdominal examinations were normal.

His electrocardiogram (ECG) was significant for ST segment elevation in leads V1 through V4 consistent with an anteroseptal infarct, age undetermined (Figure 1). Chest radiograph was significant for costophrenic angle blunting and hilar prominence bilaterally (Figure 2). No old studies were available for comparison, leading the emergency physician

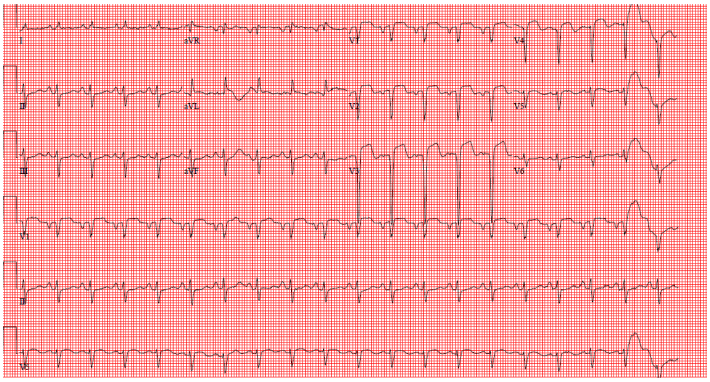

Figure 1. Electrocardiogram on arrival demonstrates Q waves and ST elevation in leads V1-V4.

(EP) to activate the process for urgent PCI (percutaneous coronary intervention).

While cardiology was consulted, the EP performed a bedside focused cardiac ultrasound using a 5-1 MHz phased array transducer (Philips HD11XE, Andover MA) showing reduced left ventricular contractility, as well as thinning and dilation of the anterior left ventricular wall, consistent with an aneurysm of the left ventricle. (Figure 3). An apical 4 chamber view noting thinning and poor contractility of the distal left ventricle. The proximal ventricle are not thinned and demonstrate normal contractility (Video-online only).

Point-of-care laboratory results returned during cardiology consultation. Troponin I was <0.01 ng/ml, myoglobin was 280 ng/ml [normal<106 ng/ml] and B-type natriuretic peptide was 1152 pg/ml [normal<100 pg/ml]. Based on the ECG and ED ultrasound findings, the consulting cardiologist concluded that the ST elevation was related to a recent anteroseptal myocardial infarction resulting in the left ventricular aneurysm. The patient was not transferred directly to the cardiac catheterization lab given his history and focused cardiac ultrasound results, and instead was treated with optimal medical therapy. During the hospital course, the

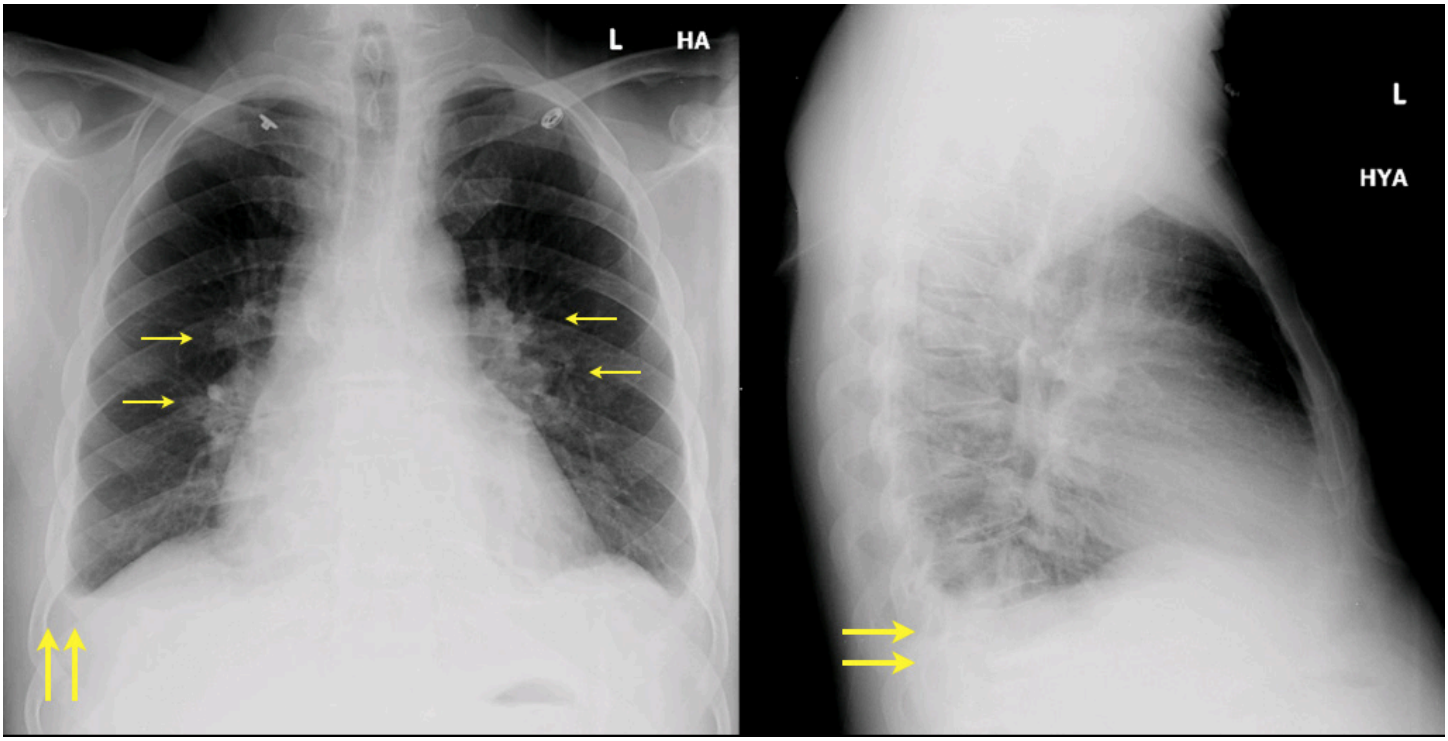

Figure 2. Portable anteroposterior chest radiograph reveals blunting of the costophrenic angles (thick arrows) and hilar prominence bilaterally (thin arrows).

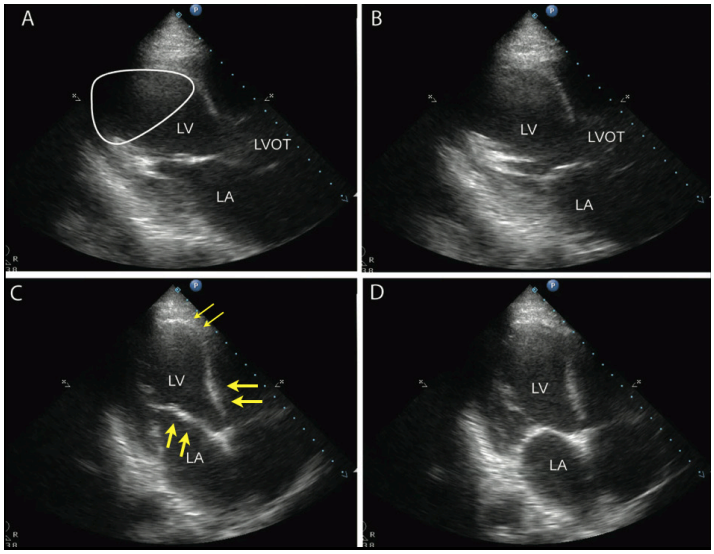

Figure 3. A, Parasternal long, diastole. Left ventricular aneurysm (white line). B, Parasternal long, systole. C, Apical four view, diastole. D, Apical four view, systole. Note the thinned myocardium and broad neck present in both echocardiographic views during systole and diastole.

patient's troponin level never increased. A comprehensive echocardiogram confirmed the ED findings of a ventricular aneurysm.

DISCUSSION

Left ventricular aneurysm (LVA) is a rare but potentially life-threatening condition that can initially present to the EP. A LVA, or "true aneurysm," is described as a localized area of dyskinetic myocardium that bulges outward during both systole and diastole. It is typically located on the anterior wall in the territory of the left anterior descending artery. It occurs in 5% of patients with a recent ST-segment elevation myocardial infarction,but has also been reported in patients with hypertrophic cardiomyopathy and Chagas disease.[1-3]

Patients will typically present to the ED with chest pain, difficulty breathing or a clinical picture consistent with congestive heart failure. Rapid diagnosis in the ED has traditionally centered on a history of recent MI and ST-segment elevation (STE) on an ECG.[4,5] However, both clinical presentation and ECG findings in the ED are often mistaken for other more common disease processes, making the diagnosis of this rare entity difficult.

Focused cardiac ultrasound in the ED has been useful in estimating left ventricular contractility, and in identifying the presence of a pericardial effusion and right ventricular enlargement.[6] With increased integration of bedside ultrasound in the practice of emergency medicine, more clinicians will be identifying pathologic states that were once only in the domain of other subspecialties. Here we present the first reported case where focused cardiac ultrasound was used in the ED to rapidly diagnosis a symptomatic LVA. Rapid visualization of the myocardium can help identify a patient with chest pain and STE who may not need PCI emergently. Chest pain is a Class I indication for comprehensive echocardiography when myocardial ischemia/infarction are considered and the ECG is non-diagnostic.[7,8] However, evaluation of wall thickness

and segmental wall motion analysis are some of the more challenging aspects of echocardiography, and as a result recent guidelines recommend that cardiologic consultation and comprehensive echocardiography are indicated for confirmation of suspected left ventricular aneurysm on ED focused cardiac ultrasound.[6]

Address for Correspondence: Arun Nagdev MD, Alameda County Medical Center, Highland General Hospital, 1411 East 31St, Oakland, CA 94602-101. Email: arunnagdev@gmail.com

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources, and financial or management relationships that could be perceived as potential source of bias. The authors disclosed none.

REFERENCES:

1. Napodano M, Tarantini G, Ramondo A, et al. Myocardial abnormalities underlying persistent ST-segment elevation after anterior myocardial infarction. *J Cardiovasc Med (Hagerstown)*. 2009;10(1):44-50.
2. Mörner S, Johansson B, Henein M. Arrhythmogenic left ventricular apical aneurysm in hypertrophic cardiomyopathy. *Int. J. Cardiol*. 2010. doi:10.1016/j.ijcard.2010.02.071
3. Carod-Artal FJ, Gascon J. Chagas disease and stroke. *Lancet Neurol*. 2010;9(5):533-542.
4. Engel J, Brady WJ, Mattu A, et al. Electrocardiographic ST segment elevation: left ventricular aneurysm. *Am J Emerg Med*. 2002;20(3):238-242.
5. Brady WJ, Perron AD, Chan T. Electrocardiographic ST-segment elevation: correct identification of acute myocardial infarction (AMI) and non-AMI syndromes by emergency physicians. *Acad Emerg Med*. 2001;8(4):349-360.
6. Labovitz AJ, Noble VE, Bierig M, et al. Focused cardiac ultrasound in the emergent setting: a consensus statement of the American Society of Echocardiography and American College of Emergency Physicians. *J Am Soc Echocardiogr.* 2010 Dec;23(12):1225-30.
7. Douglas PS, Khandheria B, Stainback RF, et al. 2007 Appropriateness Criteria for Transthoracic and Transesophageal Echocardiography: a report of the American College of Cardiology Foundation Quality Strategic Directions Committee Appropriateness Criteria Working Group. *J Am Soc Echocardiogr.* 2007;20:787-805.
8. Cheitlin MD, Alpert JS, Armstrong WF, et al. ACC/AHA guidelines for the clinical application of echocardiography: a report of the American College of Cardiology/Amer- ican Heart Association Task Force on Practice Guidelines (Committee on clinical Application of Echocardiography). *Circulation.* 1997;95:1686-744.

Descriptions of Motor Vehicle Collisions by Participants in Emergency Department–Based Studies: Are They Accurate?

Young M. Lee, BSPH* [*]
Timothy F. Platts-Mills, MD† [†]
Joel B. MacWilliams‡ [‡]
Mark R. Sochor, MD§ [§]
Jeffrey S. Jones, MD|| [||]
Robert M. Domeier, MD¶ [¶]
Lawrence W. Schneider, PhD‡ [‡]
Samuel A. McLean, MD, MPH# [#]

* Vanderbilt School of Medicine, Nashville, Tennessee
† University of North Carolina at Chapel Hill, Department of Emergency Medicine, Chapel Hill, North Carolina
‡ University of Michigan, Transportation Research Institute, Ann Arbor, Michigan
§ University of Virginia, Department of Emergency Medicine, Charlottesville, Virginia
|| Spectrum Health Systems–Butterworth Campus, Department of Emergency Medicine, Grand Rapids, Michigan
¶ Saint Joseph Mercy Health System, Department of Emergency Medicine, Ann Arbor, Michigan
# University of North Carolina at Chapel Hill, Department of Anesthesiology, Chapel Hill, North Carolina

Supervising Section Editor: Michael Menchine, MD, MPH
Submission history: Submitted August 4, 2010; Revision received April 16, 2011; Accepted September 12, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.9.6621

Introduction: We examined the accuracy of research participant characterizations of motor vehicle collisions (MVC).

Methods: We conducted an emergency department-based prospective study of adults presenting for care after experiencing an MVC. Study participants completed a structured clinical interview that assessed the number of lanes of the road where the collision took place, vehicle type, road condition, speed limit, seat belt use, airbag deployment, vehicle damage, time of collision, and use of ambulance transportation. Study participant data were then compared with information recorded by Michigan State Police at the scene of the MVC. Agreement between research participant reports and police-reported data were assessed by using percentage agreement and κ coefficients for categorical variables and correlation coefficients for continuous variables.

Results: There were 97 study participants for whom emergency department interviews and Michigan State Police Report information were available. Percentage agreement was 51% for number of lanes, 76% for car drivability, 88% for road condition, 91% for vehicle type, 92% for seat belt use, 94% for airbag deployment, 96% for speed limit, 97% for transportation by ambulance, and 99% for vehicle seat position. κ values were 0.32 for seat belt use, 0.34 for number of lanes, 0.73 for vehicle type, 0.76 for speed limit, 0.77 for road condition, 0.87 for airbag deployment, 0.90 for vehicle seat position, and 0.94 for transport by ambulance. Correlation coefficients were 0.95 for the time of the collision, and 0.58 for extent of damage to the vehicle. Most discrepancies between patients and police about extent of vehicle damage occurred for cases in which the patient reported moderate or severe damage but the police reported only slight damage.

Conclusion: For most MVC characteristics, information reported by research participants was consistent with police-reported data. Agreement was moderate or high for characteristics of greatest relevance to injury biomechanics. These results suggest that research participant report is an acceptable source of collision information. [West J Emerg Med. 2012;13(4):329–334.]

INTRODUCTION

More than 4 million people present to the United States' emergency departments (ED) annually for evaluation after motor vehicle collision (MVC).[1] More than 90% of these patients do not experience any initial life-threatening injury and are discharged from the ED after MVC.[2] However, North American studies indicate that 10% to 20% of these individuals without life-threatening injury nonetheless develop chronic symptoms such as persistent pain, posttraumatic stress disorder, and depressive symptoms.[3–6] These post-MVC outcomes cause substantial disability and are a significant public health problem in the United States and other industrialized countries.[4,7]

Collision characteristics provide useful information to medical providers in judging the potential for severe injury.[8,9] Additionally, collision characteristics are essential information for studies that examine the epidemiology of long-term outcomes of MVC because they allow researchers to understand and adjust for variability in crash characteristics. Previously conducted research assessing the reliability of ED, emergency medical services, and police records compared to an in-depth crash investigation found that these data sources had fair to moderate agreement.[10] However, no studies have assessed the accuracy of collision information collected prospectively from study participants in a research setting. The objective of this study was to assess the accuracy of collision information reported by ED patients enrolled as research participants by comparing their descriptions of the collisions to information recorded by police at the scene of the collisions.

METHODS

Study Design and Setting

This study was conducted as part of a prospective observational study of patients evaluated after MVC at 3 EDs in the state of Michigan (William Beaumont Hospital at Royal Oak; St Joseph Mercy Hospital at Ann Arbor; and Spectrum Health/Butterworth Hospital at Grand Rapids). William Beaumont Hospital Royal Oak is a 1,061-bed community teaching hospital and Level I trauma center with an annual census of 118,000 ED visits. St Joseph Mercy Hospital is a 529-bed community teaching hospital and Level II trauma center with an annual census of 83,635 ED visits. Spectrum Health/Butterworth Hospital is a 731-bed community teaching hospital and Level I trauma center with an annual census of more than 120,000 ED visits. Data were collected between October 2004 and March 2007. At each study site, all patients who presented to the ED for care at times when research assistants were working were screened, and all eligible patients were approached for inclusion. Owing to limited availability of research assistants for this study, the recruitment method resulted in a convenience sample. ED study sites participating in the study received approval from their local institutional review boards, and all study participants gave written informed consent.

Selection of Participants

Patients were eligible for the study if they were 18 years of age or older, alert and oriented, English speaking, and presented to the ED for evaluation of injuries incurred during an MVC that had occurred within the past 24 hours. Patients were excluded if they were judged to be clinically unstable, had potentially life-threatening or severe injuries, had long bone or spinal fractures, were pregnant, or were admitted to the hospital. Patients who were intoxicated were excluded only if they were not alert and oriented. Patients were eligible if they came to the ED via ambulance or if they came via private transportation.

Data Collection

Following patient consent, a structured clinical interview was used to collect data regarding MVC characteristics. Research assistants were trained in data collection and used a standard data collection template. During the data collection, meetings were held with research assistants on a monthly basis to answer questions and review eligibility criteria and interview questions. Demographic information, patient injury characteristics, and ED discharge diagnoses were extracted from the medical record by using another standard data collection template with explicit definitions of all variables. Research assistants were also trained in data extraction, and data extraction was completed for each patient within 1 week of the ED visit.

Collision characteristics reported by police were obtained via the Michigan State Police collision report database (UD-10 Traffic Crash Report), a publicly available online dataset. Traffic Crash Reports were linked by patient name, birthday, and date of collision to study participant ED interview results. Traffic Crash Report data were abstracted by trained research assistants who were blinded to results of study participant interviews. Traffic Crash Report data are completed by police officers at the scene of the MVC. All police officers are trained in the accurate collection of data using the UD-10 Traffic Crash Report and have demonstrated proficiency in completing this form.

Measures

Collision characteristics assessed during the ED interview included responses for number of lanes on the road, patient's vehicle type, road conditions, speed limit, seat belt use, airbag deployment, seat position of the patient, extent of damage to the vehicle (0–4 numeric rating scale), method of patient transport to the ED, and time of collision. Patient-reported information about seat belt included options for use of a shoulder and lap belt or just a shoulder belt or just a lap belt. These results are reported separately, but for comparison with police reports, any seat belt use was regarded as using a seat belt. Patient injury information and discharge diagnoses were used to determine the patient's highest abbreviated injury scale (AIS) score. In this study, the highest AIS score was defined as the highest AIS

score for any of the 6 body regions. The AIS was coded by a research nurse with both trauma care and AIS scoring experience.

Traffic Crash Report data included number of road lanes at the location where the collision occurred, type of vehicle, road conditions, speed limit, seat belt use, airbag deployment, extent of damage to the vehicle (0–7 numeric rating scale), whether the patient was transported to the ED via ambulance, and time of collision. In the police report, no distinction was made between which part of the seat belt was used; the report simply stated whether the patient was or was not using a seat belt.

Data Analysis

Descriptive statistics are reported as mean and standard deviation for continuous variables and frequency and proportion for categorical variables. Accuracy of research participant responses was assessed by evaluating agreement between participant responses and police report data. Agreement was assessed with percentage agreement and κ coefficients for categorical response items. Strength of agreement for κ was assessed as follows: poor (<0), slight (0–0.2), fair (0.2–0.4), moderate (0.4–0.6), substantial (0.6–0.8), and almost perfect (0.8–1.0).[11] A contingency table is used to provide additional information for seat belt use, for which there was a discrepancy between the κ statistic and the percentage agreement. Agreement was assessed with the Pearson product moment correlation for interval and continuous variables. Statistical analyses were performed by using SAS 9.2 software (SAS Institute, Cary, North Carolina). A sample size analysis was not performed, as this was part of an exploratory study.

RESULTS

Interviews were conducted with 156 patients during a 30-month period of data collection. Of these, there were 97 patients for whom police reports regarding the crash were obtained, and these patients formed the study sample. Demographic characteristics of study participants are shown in Table 1. Most study participants were diagnosed with musculoskeletal strain only; fewer than 10% had fractures or minor lacerations. All study participants had a maximum AIS score of 2 or less. Collision characteristics reported via study participant report and police report are shown in Table 2. These results are intended to provide information about the frequency of outcomes. Because they do not include information about agreement or disagreement for individual cases, the numbers in Table 2 are not intended as evidence of agreement. Most participants reported traveling on roads with 2 or more lanes in dry weather. Most reported being drivers and using seat belts. Of the 93 patients who reported using a seat belt, 1 reported using just a lap belt and 1 reported using just a shoulder belt. The remaining 91 patients reported using both a lap and a shoulder belt. About a third of participants reported airbag deployment and around half came to the ED via ambulance transport.

Table 1. Demographic characteristics of participants (n = 97).

Characteristic	
Age, mean (SD)	42 (17)
Female gender, n (%)	62 (64)
Education, n (%)	
High school	20 (21)
Some college	38 (39)
College graduate	18 (19)
Postgraduate degree	11 (11)
Other/missing	10 (10)
Primary employment, n (%)	
Work full time	47 (48)
Work part time	21 (22)
No work outside the home	13 (13)
Student	7 (7)
Disabled	8 (8)
Missing	1 (1)
Annual income, n (%), $	
Below 20,000	40 (41)
20,000 to 30,000	9 (9)
30,000 to 50,000	17 (18)
50,000 to 75,000	11 (11)
>75,000 per year	19 (20)
Other/refused	1 (1)
Marital status, n (%)	
Married or living with partner	51 (53)
Single	28 (29)
Separated/divorced/widowed	18 (18)
Injury type, n (%)	
Musculoskeletal strain only	84 (87)
Fracture	7 (7)
Minor laceration	7 (7)
AIS*, highest score (SD)	
AIS 1 (minor injury)	85 (88)
AIS 2 (moderate injury)	11 (11)
Missing	1 (1)

SD, standard deviation; *AIS*, abbreviated injury scale.
* The abbreviated injury scale is a score from 0 to 6 applied to 6 body regions that assesses trauma severity.

Percentage agreement between study participant and police ratings of MVC characteristics was generally excellent (Table 3). Agreement was greater than 95% for speed limit, ambulance transport, and position in vehicle, and greater than 90% for vehicle type, seat belt use, and airbags deployed. Only 2 characteristics had agreement below 90%: number of lanes (51%) and road condition (88%).

Reliability assessment using κ coefficients also indicated

Table 2. Collision characteristics as reported by patients and police (n = 97).

Characteristic	Patient report	Police report
No. of lanes, mean (SD)	3.5 (1.3)	4.3 (1.7)
Vehicle type, n (%)		
Passenger car, SUV, or station wagon	79 (82)	75 (77)
Van or motor home	10 (10)	10 (10)
Pickup truck or small truck	7 (7)	9 (9)
Other	1 (1)	3 (3)
Road condition, n (%)		
Dry	72 (74)	64 (66)
Wet	20 (21)	23 (24)
Icy	3 (3)	2 (2)
Snowy	2 (2)	2 (2)
Other/unknown	0 (0)	6 (6)
Speed limit, mean (SD)	44.1 (12.6)	44.3 (12.0)
Seat belt use, n (%)		
Yes	93 (96)	93 (96)
No	4 (4)	4 (4)
Airbag deployment, n (%)		
Yes	30 (31)	33 (34)
No	67 (69)	64 (66)
Collision characteristics, n (%)		
Driver seat position	91 (94)	92 (95)
Other seat position	6 (6)	5 (5)
Transported by ambulance, n (%)		
Yes	56 (58)	53 (55)
No	41 (42)	44 (45)
Time of collision, n (%)		
8 AM–12 PM	39 (40.2)	33 (34.0)
12 PM–4 PM	30 (30.9)	24 (24.7)
4 PM–8 PM	12 (12.4)	20 (20.6)
8 PM–12 AM	3 (3.1)	4 (4.1)
12 AM–4 AM	3 (3.1)	5 (5.2)
4 AM–8 AM	10 (10.3)	11 (11.3)

SD, standard deviation; *SUV*, sport utility vehicle.

substantial agreement (0.61–0.80) or almost perfect agreement (0.81–1.0) for most items (Table 3). κ values indicated almost perfect agreement for airbag deployment, position in vehicle, and ambulance transport. Substantial agreement was present for vehicle type, road condition, and speed limit. κ values indicated only fair agreement for number of lanes and seat belt use. There were no cases in which both the patient and the police reported that the patient was not wearing a seat belt (Table 4).

Correlation was almost perfect (0.95) for time of collision

Table 3. Measures of agreement between patient and police report characterization of motor vehicle collisions (n = 97).

Characteristic (categorical)	Percentage agreement	κ (95% CI)
No. of lanes	51	0.34 (0.21–0.47)
Vehicle type	91	0.73 (0.56–0.86)
Road condition	88	0.77 (0.64–0.90)
Speed limit	96	0.76 (0.67–0.84)
Seat belt use	92	0.32 (−0.18–0.81)
Airbags deployed	94	0.87 (0.77–0.97)
Vehicle seat position	99	0.90 (0.72–1.09)
Transported by ambulance	97	0.94 (0.87–1.01)
Characteristic (continuous)		Correlation coefficient
Time of collision		0.95
Extent of damage		0.58

CI, confidence interval.

but moderate (0.58) for the extent of damage to the vehicle. Most of the discrepancies between patient and police reports of the extent of vehicle damage were cases in which the patient described the accident as severe but the police did not. Specifically, among 64 cases for which the police reported the extent of vehicle damage as moderate or heavy (3 or more on the police scale), there were only 2 patients (3%) who reported the extent of damage as mild (2 or less on patient scale). In contrast, among 35 cases in which the police reported the extent of damage as slight or none (2 or less on the police scale), 16 patients (46%) reported the extent of damage to be moderate or severe (3 or more on patient scale). κ and correlation coefficients for patient versus police reports were similar between the subsets of patients brought to the ED by ambulance and those who came by private transportation.

DISCUSSION

Our results demonstrate that patient-reported characterizations of an MVC are accurate for most of the characteristics commonly used in MVC-related research studies and support the use of patient-reported MVC information in the conduct of research studies. The high percentage agreement and κ coefficients for most of the variables suggest that study participant report is an accurate

Table 4. Contingency table for agreement between patient and police reports on seat belt use (n = 97).

		Traffic Crash Report	
Seat belt use		No	Yes
Study participant report	No	0	4
	Yes	4	89

source of MVC information for the following characteristics: vehicle type, road condition, speed limit on the road where the collision took place, airbag deployment, time of collision, and transport by ambulance. Percentage agreement and κ coefficients were less than substantial for the number of lanes. Correlation was also only moderate for extent of damage to the vehicle. Specifically, if we consider the police report as the reference standard, patients tended to overreport accident severity. While patients very rarely described a moderate or severely damaged vehicle as mildly damaged, almost half of patients called a mildly damaged vehicle moderate or severely damaged. It is perhaps not surprising that patients might overreport the severity of vehicle damage, and these results suggest that some caution should be used in interpreting this variable when obtained from patients.

Percentage agreement for airbag deployment (94%), seat belt use (92%), and seat position (99%) from our study is similar to that from previous studies comparing the agreement between the ED medical records and in-depth crash investigator reports.[10,12] Our results extend these findings to ED patients who are providing information as research participants.

Accuracy of data collected was assessed by using both percentage agreement and κ coefficients, because each method has its benefits and limitations. Percentage agreement may not be informative about agreement occurring by chance. In contrast, κ adjusts for the influence of chance, but underestimates agreement when the frequency of an event is either very common or very rare.[13] The low κ for seat belt use ($\kappa = 0.37$), despite a high percentage agreement (92%), is in part a reflection of the limitation of the κ statistic for conditions in which the outcome is either very rare or very common. In this case, using either source of information, almost all patients reported using their seat belt. Given the high percentage agreement, we feel that a patient reporting use of a seat belt remains useful information despite the low κ coefficients for this variable.[14] A previous study found that police overreported the use of seat belts compared to hospital records of patient seat belt use.[15] Our data do not reproduce this finding.

LIMITATIONS

We studied only alert and oriented adult patients involved in MVC not resulting in significant injury but for whom a police crash report was available. It is possible that the accuracy of information obtained from other patient groups such as minors, heavily intoxicated patients, individuals experiencing very minor MVCs not resulting in police reports, or those experiencing life-threatening injuries would differ from the results reported here. Although our analyses compare patient and police reports without identification of a reference standard, in order to draw conclusions about the accuracy of patient reports it is necessary to assume that the police report provides a correct characterization of the MVC. We think this is a reasonable assumption because a previous study comparing ED, emergency medical services, and police reports found that police reports were the most accurate of the 3 sources of information in describing characteristics of MVCs when compared to a crash investigator's report.[10] Additionally, we would not expect that police reports would be exposed to the potential biases associated with litigation, insurance compensation, and post-MVC distress that may affect patient reporting. However, police reports may be inaccurate for some characteristics because the information may not be readily apparent when the police officer arrivers (eg, seat belt use), and this is a limitation of the study.

CONCLUSION

In our sample, most crash characteristics obtained from ED patients participating in a research study agreed closely with information obtained from police reports. These results extend findings from earlier studies comparing ED medical records with crash investigator reports and support the use of information obtained from patients during research interviews as accurate descriptors of MVCs.

Address for Correspondence: Young M. Lee, BSPH, Vanderbilt School of Medicine, 246 Louise Ave, Nashville, TN 37203. E-mail: young.m.lee@vanderbilt.edu.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. This study was supported by a National Institute of Arthritis and Musculoskeletal and Skin Diseases (R01AR056328).

REFERENCES

1. McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2003 emergency department summary. *Adv Data*. 2005;358:1–38.
2. Richmond TS, Jacoby S. Emergency department trauma: The immediate aftermath of motor vehicle collisions. In: Duckworth MP, Iezzi T, O'Donohue WT, eds. *Motor Vehicle Collisions: Medical, Psychosocial, and Legal Consequences*. 1st ed. San Diego, CA: Elsevier; 2008:83–106.
3. Harder S, Veilleux M, Suissa S. The effect of socio-demographic and crash-related factors on the prognosis of whiplash. *J Clin Epidemiol*. 1998;51:377–384.
4. Freeman MD, Croft AC, Rossignol AM, et al. A review and methodologic critique of the literature refuting whiplash syndrome. *Spine (Phila Pa 1976)*. 1999;24:86–96.
5. Hincapie CA, Cassidy JD, Cote P, et al. Whiplash injury is more than neck pain: a population-based study of pain localization after traffic injury. *J Occup Environ Med*. 2010;52:434–440.
6. Barnsley L, Lord SM, Wallis BJ, et al. The prevalence of chronic cervical

zygapophysial joint pain after whiplash. *Spine (Phila Pa 1976)*. 1995;20: 20–25; discussion 26.

7. Spitzer WO, Skovron ML, Salmi LR, et al. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining "whiplash" and its management. *Spine (Phila Pa 1976)*. 1995;20:1S–73S.
8. Jones IS, Champion HR. Trauma triage: vehicle damage as an estimate of injury severity. *J Trauma*. 1989;29:646–653.
9. Knudson P, Frecceri CA, DeLateur SA. Improving the field triage of major trauma victims. *J Trauma*. 1988;28:602–606.
10. Grant RJ, Gregor MA, Maio RF, et al. The accuracy of medical records and police reports in determining motor vehicle crash characteristics. *Prehosp Emerg Care*. 1998;2:23–28.
11. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33:159–174.
12. Bilston LE, Brown J. Accuracy of medical and ambulance record restraint and crash data information for child occupants. *Inj Prev*. 2008; 14:46–50.
13. Feinstein AR, Cicchetti DV. High agreement but low kappa: I, the problems of two paradoxes. *J Clin Epidemiol*. 1990;43:543–549.
14. Viera AJ, Garrett JM. Understanding interobserver agreement: the kappa statistic. *Fam Med*. 2005;37:360–363.
15. Kim K. Lie factor in traffic safety: comparison of police and hospital reporting of seat belt and alcohol use in Hawaii. *Transportation Research Record*. 1999;1665:141–146.

A Survey Study of Institutional Review Board Thought Processes in the United States and South Korea

Si-Kyung Jung, MD, PhD*
Yeon Hee Jeong, MD*
Woon Jeong Lee, MD*
Carol Lee, MD†
Amy H. Kaji, MD, PhD†
Roger J. Lewis, MD, PhD†

* Catholic University of Korea, Department of Emergency Medicine, Seoul, South Korea
† Harbor-UCLA Medical Center, Department of Emergency Medicine, Torrance, California

Supervising Section Editor: Eric R. Snoey, MD
Submission history: Submitted April 1, 2011; Revision received June 6, 2011; Accepted June 28, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.6.6756

Introduction: In the last several decades, South Korea has rapidly adopted Western customs and practices. Yet, cultural differences between South Korea and the United States exist. The purpose of this study was to identify and characterize potential cultural differences in the Korean and US institutional review board (IRB) approach to certain topics.

Methods: A qualitative analysis of a 9-item survey, describing 4 research study case scenarios, sent to IRB members from the United States and South Korea. The case scenarios involved the following issues: (1) the need for consent for retrospective chart review when research subjects receive their care after the study is conceived; (2) child assent; (3) individual versus population benefit; and (4) exception from informed consent in emergency resuscitation research. The free-text responses were analyzed and abstracted for recurrent themes.

Results: Twenty-three of the 45 survey recipients completed the survey, for an overall response rate of 51%. The themes that emerged were as follows: (1) the importance of parental authority among Korean participants versus the importance of child autonomy and child assent among US participants; (2) the recognition of the rights of a proxy or surrogate who can represent an individual's values by all participants; and (3) the importance of the community, expressed by the Korean respondents, versus individualism, expressed by US respondents.

Conclusion: Whereas US participants appear to emphasize the importance of the individual and the autonomy of a child, the Korean respondents stressed the importance of parental authority and benefiting the community, above and beyond that of the individual person. However, there was substantial overlap in the themes expressed by respondents from both countries. [West J Emerg Med. 2012;13(4):335–341.]

INTRODUCTION

Defining the code of ethics in medical research, the Nuremberg code was developed after the Second World War and emphasizes the principles of informed consent, absence of coercion, and beneficence.[1] In 1974, the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research created the institutional review board (IRB) to further help protect the rights and welfare of the human research subjects.[2] In response to the Tuskegee Syphilis Study (1932–1972), the Commission published the "Ethical Principles and Guidelines for the Protection of Human Subjects of Research," or the Belmont Report,[3] which describes a number of basic ethical principles: respect for persons in protecting an individual's autonomy; beneficence in

minimizing harm to research subjects while maximizing research benefit; justice in ensuring that research procedures are reasonable, fair, and equitable; and nonmaleficence in doing no harm. To this day, the Belmont Report provides the moral framework upon which an IRB ensures that human research projects meet ethical regulations.

As Korea begins conducting medical research, clinical researchers are faced with developing the technical infrastructure to conduct sound research but also the moral and ethical infrastructure to provide human subjects' protection. Until mid 1980 in Korea, there were no guidelines for obtaining informed consent, reporting adverse reactions, or compensating research subjects. Shortly thereafter, recognizing the need for regulation in clinical research and drug development, the Korean government formed the Korean Good Clinical Practice Committee (KGCP).[4] In 1995, the KGCP mandated that all IRBs review and monitor clinical trials, and in 2001, the KGCP encouraged the IRBs to adhere to international ethics guidelines. Yet, because there continued to be great variability among IRB practices, the Korean Association of Institutional Review Boards (KAIRB) was formed. Comprised of IRB members from major hospitals, biomedical researchers, medical directors of pharmaceutical companies, and officers from health authorities, KAIRB aimed to help Korean IRBs conform to international medical ethics standards.[5]

Over the last several decades, Korea has rapidly adopted Western customs and practices. However, numerous social and cultural differences between the United States and Korea remain. Given the cultural differences between Korea and the United States, differences in the IRB approach to research between the countries may be expected. Yet, while the interpretation of a given research project may depend upon cultural norms and mores, every research project should nonetheless be ethically sound. The purpose of this study was thus to explore similarities and differences in the evaluations of human subjects' studies between the IRBs in the United States and South Korea.

METHODS

Study Design

This is a qualitative analysis of a 9-item survey, describing 4 research study case scenarios, which were sent to IRB members from the United States and South Korea, via either air mail or US parcel post. The survey instrument was developed to help characterize differences between the 2 countries' approaches to human subjects' protection and consent issues. A Korean bilingual medical professional translated the English version of the survey instrument into Korean, which was then reviewed by another independent Korean medical professional to ensure adequacy of translation. The free-text survey responses from the Korean participants were translated by a single Korean bilingual medical professional.

The survey items, based upon 4 study case scenarios, were aimed at identifying and characterizing potential cultural differences in the Korean and US IRB approach to certain topics: (1) the need for consent for retrospective chart review when research subjects receive their care after the study is conceived; (2) child assent; (3) individual versus population benefit; and (4) exception from informed consent in emergency resuscitation research. Since Korean culture developed out of Confucian traditions, whereas the US was founded upon European, Judeo-Christian philosophies, we expected to identify some differences.

The study protocol was approved by the Human Subjects Committee of the Harbor-University of California, Los Angeles (UCLA) Biomedical Research Institute.

Case Study Scenarios

The 4 scenarios depicted in the survey instrument are described below.

Scenario 1: Study subjects included patients presenting to the emergency department with tissue hypoperfusion and systemic inflammatory response who are to be treated by using the Rivers protocol (ie, early goal-directed therapy).[6] A retrospective chart review is proposed, in which data collection is to begin at a later date, and that will examine the care provided to patients treated with a new sepsis protocol. The study subjects have not yet received care, but will do so before initiation of data collection. Does the primary investigator need IRB approval? Is informed consent required?

Scenario 2: A randomized controlled study comparing 2 antibiotic regimens for group A streptococcal pharyngitis in a pediatric population, aged 3 to 18 years. In one case, the subject would take medication for 10 days, while in the other, the active medication would be taken for 4 days, followed by 6 days of taking a matching placebo to maintain blinding. Assuming written informed consent is obtained from the parents, would this study be acceptable to the IRB? Would child assent be necessary?

Scenario 3: A randomized controlled study comparing diluted vaccine or placebo to determine effectiveness of smallpox vaccination in a pediatric population. The description of the trial noted that smallpox was currently thought to be eradicated in the natural setting, though stocks of virus may exist for use as a biologic warfare agent. Would the study be acceptable to the IRB? How does the IRB perception that smallpox has been eradicated influence such a decision?

Scenario 4: A randomized controlled trial of therapeutic hypothermia following cardiac arrest in which patients receive either external cooling or an indwelling device. Since all subjects are comatose after arrest, and cooling must be instituted within 20 minutes after resuscitation, would consent be necessary? Who would be consenting?

Study Subjects

The study subjects were a convenience sample of members of the IRB from the UCLA Clinical and Translational Science

Institute and its affiliated institutions, as well as from major institutions in South Korea (Table 1). Each IRB member (chairs/vice chairs) was contacted by a personal phone call and via e-mail with a formal invitation letter, consent form, and survey. If there was no response after 2 to 3 weeks, another e-mail reminder was sent. All participating respondents received a 10-dollar gift card. Since the identity of the IRB member was known, the survey response was not anonymous, though the respondents were assured that the results would be deidentified and reported in aggregate.

Data Analysis

All free-text survey responses were carefully reviewed after translation, if indicated. The text was searched for recurrent themes by performing recursive abstraction, which is a technique in which an iterative approach is used to summarize the data.

Numerical data and dichotomous survey responses (yes/no) were also entered into a Microsoft Excel 2003 (Seattle, Washington) spreadsheet, and Database Management Systems Copy (DataFlux Corporation, Cary, North Carolina) was used to convert the file into an SAS version 9.2 (Cary, North Carolina) database. Simple descriptive statistics (eg, the median number of years of IRB experience among respondents and simple proportions or percentages) were tabulated. A priori, we determined that formal hypothesis testing would not be indicated, as this would primarily be a qualitative description of the survey responses.

RESULTS (TABLE 2)

A total of 22 IRB members from South Korea and 23 IRB members from the United States were contacted. Twenty-three of the 45 survey recipients completed the survey, for an overall response rate of 51%. The median number of years served on an IRB for the total group was 5 (interquartile range [IQR], 3–12). The median number of years served on the IRB was 10.5 (IQR, 5.5–14) for the US cohort versus 3 years (IQR, 0–7) for the Korean cohort. None of the Korean responders were US trained or had served on a US IRB.

Regarding the sepsis study scenario, only 1 individual, a Korean researcher, stated that IRB approval was unnecessary. Two respondents, both Korean, felt that the sepsis study should be exempt from human subjects' regulations, if the information was deidentified ("the information of subjects will be recorded in unrecognizable way, like encryption"), whereas 1 US participant stated that exemption would "depend upon the data being collected." Overall, there was great variability regarding whether informed consent would be required. When comparing the 2 cohorts, most members of the Korean cohort (57%) believed that consent should always be obtained, whereas only 1 US respondent felt that consent should unqualifiedly be obtained. Three US respondents (33%) (versus 6 Korean respondents [43%]) did not believe that consent was needed. The 3 US respondents cited "impracticability" of obtaining informed consent under this circumstance, whereas the 6 Korean respondents mentioned the "retrospective" nature of the data collection and the belief that the Rivers protocol was "standard of care." Five of the 9 US respondents (56%) stated that whether or not consent would be required would depend upon the circumstances. All 5 of these US respondents, who qualified the answer, stated that waiver of informed consent would be possible under the code of federal regulations, while 2 also mentioned potential "impracticability" of consent due to the patient's critical status.

Table 1. List of study institutions.

United States institutions
David Geffen School of Medicine at UCLA (DGSOM)
Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center (Harbor-LA BioMed)
Burns and Allen Research Institute at Cedars-Sinai Medical Center
The Charles R. Drew University of Medicine and Science
South Korean institutions
Seoul National University Hospital
Severance Hospital
Daejeon St Mary's Hospital
Seoul St Mary's Hospital
Kyungpook National University Hospital
Chonnam National University Hospital

UCLA, University of California, Los Angeles.

Scenario 2 involved the comparison of 2 different antibiotic regimens for the treatment of pediatric streptococcal pharyngitis: one that was 4 days versus another that was 10 days in duration. There was no mention in the scenario as to what duration of treatment was considered standard of care. Overall, 16 respondents (70%) stated that the protocol would be acceptable to their IRB, whereas 2 (9%) stated that it would not, and 5 (22%) qualified that it would "depend" upon the circumstance. When stratifying by country, among the Korean cohort, 11 (79%) reported IRB acceptability, 1 (7%) did not, and 2 (14%) stated that it would "depend." Of the US respondents, 5 (56%) reported IRB acceptability, 1 (11%) did not, and 3 (33%) stated that it would "depend" upon the circumstances. The reason provided by the US individual who reported unacceptability to the IRB was that "the research does not address the major issue, which is patient compliance. Each (antibiotic) course is still 10 days." In response to the question of necessity of obtaining pediatric assent, all 9 US participants (100%) affirmed its need, while 13 of the Korean participants (93%) believed that assent was necessary. The 1 Korean subject that reported that assent was not necessary stated that "[c]hildren's consent is not required."

Scenario 3, involving a pediatric smallpox vaccine trial, demonstrated a wide range of answers. Overall, 5 (22%)

Table 2. Survey results.

Survey question item	Overall (23)	Korean (14, 61%)	United States (9, 39%)
Scenario 1: sepsis protocol			
Does the PI need IRB approval to conduct this study?	Yes: 22 (96%)	Yes: 13 (93%)	Yes: 9 (100%)
Is the study exempt from human subject regulations?	Yes: 2 (9%) No: 20 (87%) Depends: 1 (4%)	Yes: 2 (14%)	Yes: 0 (0%) No: 8 (89%) Depends: 1 (11%)
Does the study require separate written informed consent from each subject?	Yes: 9 (39%) No: 9 (39%) Depends: 5 (22%)	Yes: 8 (57%) No: 6 (43%)	Yes: 1 (11%) No: 3 (33%) Depends: 5 (56%)
Scenario 2: streptococcal pharyngitis			
If written informed consent is obtained from each child's parents, would this study be acceptable to your IRB?	Yes: 16 (70%) No: 2 (9%) Depends: 5 (22%)	Yes: 11 (79%) No: 1 (7%) Depends: 2 (14%)	Yes: 5 (56%) No: 1 (11%) Depends: 3 (33%)
Would participation require agreement or assent on the part of the child?	Yes: 22 (96%)	Yes: 13 (93%)	Yes: 9 (100%)
Scenario 3: small pox vaccine trial			
Do you believe your IRB would approve this trial?	Yes: 5 (22%) No: 8 (35%) Unlikely: 7 (30%) Don't know: 1 (4%) Defer to Department of Health and Human Services: 2 (9%)	Yes: 4 (29%) No: 6 (43%) Unlikely: 4 (29%)	Yes: 1 (11%) No: 2 (22%) Unlikely: 3 (33%) Don't know: 1 (11%) Defer to Department of Health and Human Services: 2 (22%)
Scenario 4: therapeutic hypothermia			
Cardiac arrest subjects will not be able to provide consent before enrollment, randomization, and treatment. Do you believe your IRB would approve this study?	Yes: 18 (78%) Maybe: 2 (9%) No: 1 (4%) Unlikely 1 (4%) Depends: 1 (4%)	Yes: 12 (86%) Maybe: 0 (0%) No: 1 (7%) Unlikely: 1 (7%) Depends: 0 (0%)	Yes: 6 (67%) Maybe: 2 (22%) No: 0 (0%) Unlikely: 0 (0%) Depends: 1 (11%)
Would consent be required before enrollment? If so from whom would consent be obtained?	Yes: relative/next of kin: 17 (74%); community consent: 1 (4%); community or next of kin: 4 (17%); primary doctor's consent: 1 (4%) No: 1 (4%)	Yes: relative/next of kin: 12 (86%); community consent: 1 (7%); primary doctor's consent: 1 (7%); community or next of kin: 0 (0%) No: 1 (7%)	Yes: relative or next of kin: 5 (56%); community consent: 0 (0%); community or next of kin: 4 (44%) No: 0 Thus, an individual's treatment plan is based upon his or her family's desires and collective welfare.[8] Accordingly, before performance of any medical procedure, Korean researchers must obtain consent from the family, in addition to that of the patient (0%).

IRB, institutional review board; *PI*, principal investigator.

stated that it would be acceptable to the IRB, while 8 (35%) did not think it would be acceptable, and 7 (30%) thought it would be unlikely that the IRB would approve of it. Two US participants (22%) stated that the "IRB would likely refer this trial to the Department of Health and Human Services (DHHS) under child risk category 45 CFR §46.407." One US participant (11%) and 4 Korean participants (29%) believed that the IRB would approve the study. This US participant stated that since the study involved a "vulnerable population, assurance that the risk-benefit ratio was favorable" would have to first be provided. Three of the 4 Korean participants who stated that their IRB would approve provided no reason for why the protocol would be favorably reviewed; however, 1 stated that "since risks could offer important knowledge for children, benefits are expected and would likely be approved." Six Korean participants (43%) versus 2 US participants (22%) did not believe that their respective IRB would approve the study. The reasons cited by the 2 US participants were that the "risks outweighed the benefits," and that there was "insufficient information to approve" the study. Similarly, the 6 Korean participants who did not believe that their IRB would approve cited the fact that smallpox is eradicated, thereby making the risks outweigh any benefit.

For the hypothermia protocol, 78% (18 of 23) of the total cohort stated that their IRB would approve the study. Stratified by country, 86% (12 of 14) of the Korean cohort believed that their IRB would approve, versus 67% (6 of 9) of the US participants. The 1 Korean who stated that their IRB would not approve did not provide a reason, while another Korean respondent who stated that approval "depended" provided several stipulations before approval: "benefits or complications of hypothermia first be described and reviewed. . .and scientific evidence comparing external cooling with indwelling device should be offered." Overall, 22 participants (96%) believed that consent was required, whether it was obtained from next of kin (74%), the community (4%), community or next of kin (17%), or the primary doctor caring for the patient. Of the 14 Korean respondents, 13 (93%) reported that consent was required, either from family or next of kin (12 of 14 or 86%), from the community (1 of 14 or 7%), or from the hospital or primary doctor (1 of 14 or 7%). Consent from the community is acknowledged and accepted only after discussion in several public forums. The 1 Korean member who stated that consent was unnecessary did not provide a reason. All 9 of the US respondents stated that consent was required, either from next of kin or from the community.

Although our objective was not to perform any quantitative statistical testing, we found no notable differences in proportions between groups (Korean vs the US IRB members) in any of the survey item responses. However, there were several comments written by individuals that were indicative of cultural and philosophic differences. The themes that emerged after recursive abstraction are described below (Table 3).

Table 3. Recurrent qualitative themes.

Theme	Korean	US
Parental authority overrides child autonomy	Yes	
Importance of a child's autonomy		Yes
Emphasis upon the family	Yes	Yes
Benefit to the community outweighs risks to the individual	Yes	
Importance of the individual		Yes

Theme 1: Emphasis upon Parental Authority over a Child's Autonomy

This was a theme that was predominant in the Korean responses. Direct quotations from the Korean respondents include the following: "Children's consents are not required" [as long as parental consent was obtained]; "IRB can allow for a waiver of assent if the child is less than 13 years of age"; and "after children become adults, they can make the decision to get vaccinated or not to get vaccinated."

Theme 2: Importance of Child's Autonomy

In contrast to the Korean emphasis upon parental authority, the US IRB members appeared to emphasize the importance of a child's autonomy, and his or her ability to provide assent at a younger age: "Assent of the child would be required. . .for mature teenagers, the investigator may use the adult informed consent form"; "our IRB would require child assent if the child possesses the cognitive capacity to understand the assent process"; "for ages greater than 7, assent of the child would be required; for youths aged 13–18, we would use a youth assent form"; and "assent would be required in this study, which provides no major benefit to the child." According to several US participants, child assent is necessary for persons older than 7 years in the United States, whereas most Korean participants stated that the age recommended for assent was 13 (neither consent nor assent was viewed to be necessary below age 13).

Theme 3: Importance of Family Who Needs an Experimental Treatment

Both Koreans and US respondents recognized the rights of a proxy or surrogate who can represent individual patient values. Direct quotations from US respondents include: "It is possible that other surrogate consent processes could be used"; "Family members could be consulted"; "consent would be required from a family member"; "a legally authorized representative can give consent—a spouse, adult children, parents, or other family members"; "family members or someone with a durable power of attorney would consent"; and

"subject's family members are approached in a descending order of relationship, specified by the state."

Direct quotations from the Korean respondents include the following: "the researcher must obtain consent from the family member, as well as the hospital or primary doctor"; "consent should be obtained from the family"; and "legally authorized representative's consent is required." In Korea, consent is expected from not just the individual, but also from the physician who is caring for the patient at the time the research is conducted. In the context of medical practice, a Korean hospitalist or emergency physician is empowered and expected to provide input into decisions regarding consent for procedures and research on behalf of the patients, despite the likelihood that the patients may never have met these care providers before this encounter. In the United States, while a researcher would be unlikely to enroll and consent a patient without first speaking to the physician caring for the patient, the physician would not necessarily be expected to sign a written consent on behalf of the patient.

Theme 4: Emphasis upon Greater Good for the Group/ Community over the Individual

This was a theme that was apparent among the Korean responses, as seen in the following excerpted quotations: "there are more risks than benefits to each child, but because those risks may offer important knowledge to a great number of children, benefits are expected"; "the benefit of this study is that it could protect the public's health in advance of smallpox being used as a weapon of terror"; "[whether the IRB would approve the vaccine] depends on the potential morbidity of smallpox to our country. If the morbidity is predicted to be high, then the IRB would approve it"; "the vaccine may benefit society, which will benefit children"; "the attitudes of the community should be considered during the review process"; and "if a legally authorized representative is not available at the time that consent is needed, then the researchers could enroll the patient but obtain consent at a later date."

Theme 5: Individualism

More notably, the theme of individualism emerged from the US IRB members: "If any data can identify the individual, then it is unlikely to qualify for exemption"; "private information used is not exempt"; "if the Rivers protocol is considered standard of care, then the rights and welfare of the (individual) subject is not harmed. . . . Requiring consent. . . could even harm (the individual) subject by delaying their treatment. . ."; "[The study is unlikely to be approved because it] "is unlikely to provide any benefit to an individual child"; "since there is no known benefit to the individual child, and the case for societal benefit is rather slim. . ."; "there are no benefits to the individual participants"; and the IRB should assess "the risk of encephalitis versus a potential benefit of protection from a terrorist act for the individual subject."

DISCUSSION

Given the well-known cultural differences between Korea and the United States, between-group differences in the IRB approach to research may have been expected. Yet, there were no clear apparent between-group differences in the dichotomous "yes/no" responses to the survey items. However, no sample size calculation was performed, and our study was not powered to detect any quantitative differences. Moreover, thematic differences emerged when analyzing the free-text responses. While the Korean respondents appeared to emphasize the importance of parental authority and benefiting the community, as well as the importance of the physician's judgment, the US respondents stressed the autonomy of the child and individualism. The one theme that was common to both US and Korean respondents was the recognition of the rights of a proxy or surrogate who can represent the individual's values.

Individualism is a core value in American culture; in fact, the US Constitution and the Bill of Rights are based upon the principle that government exists to protect individual rights.[7] Respect for person is paramount in the Belmont Report, and this theme of the importance of the individual clearly emerged from the US participants' survey responses. In contrast, based upon Confucian principles,[8,9] Korean collectivism serves as a contrast to the "fundamental American ideology of individualism." Thus, in Korea, an individual's treatment plan is based upon his or her family's desires and collective welfare.[8] Accordingly, before performance of any medical procedure, Korean researchers must obtain consent from the family, in addition to that of the patient. The ultimate goal of Confucianism is to achieve social harmony, and to achieve such social harmony, individuals must understand a social order based upon 5 core relationships: ruler to subject, father to son, husband to wife, elder brother to younger brother, and friend to friend. According to Confucian philosophy, individuals are primarily viewed in the context of relationships. For example, a ruler exists to take care of his subjects, whereas a subject exists to follow a ruler's commands. The hierarchy in social and family relationships is also distinct in Confucian beliefs. Knowing this philosophic background helps in understanding how a Korean researcher may approach child assent, a community trial, and a subject's family members.

While Western cultures are obviously not based upon Confucian philosophy, Western Judeo-Christian religions clearly stress the importance of family relationships, as well. Thus, it is not too surprising that the family unit emerged as an important theme among both Korean and US respondents.

LIMITATIONS

Our study has several limitations. First, we had only 23 respondents. Our survey response rate was 51%, and our results are thus subject to a self-selection bias. There were also proportionally more US nonrespondents than Korean nonrespondents, and we were unable to identify the reasons for nonresponse. It is unlikely, however, that respondents would

systematically differ from nonrespondents such that our qualitative analysis would differ. For example, there is little reason to believe that those who emphasize child autonomy would be less likely to respond than those who view child autonomy as a paramount ethical virtue.

Second, the Korean respondents had served on an IRB for a significantly fewer number of years. It is possible that with increasing experience, the Korean IRB members would become more "westernized" in their thought processes and increasingly emphasize the importance of individual autonomy and respect for persons. However, it is unknown how more experience would have influenced a Korean IRB member.

Third, there is the possibility of social desirability bias. As mentioned previously, the Korean government established the KAIRB to help the Korean IRBs meet international medical ethics standards. Korean IRB members therefore most likely know what is written in the Belmont Report, and the respondents may wish to appear to conform to what is perceived to be the "correct" answer. In the absence of social desirability bias, the respective differences in how each IRB views the individual, the child, the family physician, and the community may have been clearer.

Finally, although the survey instrument was translated into Korean by a bilingual medical professional, and both Korean and English versions of the survey were administered to the Korean respondents, the survey has not been validated and it is possible that the respondents did not fully understand the questions.

CONCLUSION

Whereas the US survey respondents appear to emphasize the importance of the individual and the autonomy of a child, the Korean respondents stressed the importance of parental authority and benefiting the community, above and beyond that of the individual person. However, there was substantial overlap in the themes expressed by respondents from both countries. Still, while the interpretation of a given research project may depend upon cultural norms and mores, every research project should nonetheless be ethically sound.

Address for Correspondence: Roger J. Lewis, MD, PhD, Harbor-UCLA Medical Center, Department of Emergency Medicine, Building D9, 1000 W Carson St, Box 21, Torrance, CA 90509-2910. E-mail: roger@emedharbor.edu.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Nuremberg Code. Available at: http://ohsr.od.nih.gov/guidelines/nuremberg.html. Accessed January 15, 2010.
2. Enfield KY, Truwit JD. The purpose, composition, and function of an Institutional Review Board: balancing priorities. *Respir Care*. 2008;53:10–14.
3. The Belmont Report Ethical Principles and Guidelines for the protection of human subjects of research. Available at: http://ohsr.od.nih.gov/guidelines/belmont.html. Accessed January 15, 2010.
4. Lee J, Kim O, Kim S, et al. Current status and problems of Institutional Review Boards in Korea. *Korean J Med Ethics*. 2006:9:203–222.
5. Shin SG. The current status of clinical trials in the Republic of Korea. *Drug Inf J*. 1998;32:S1217–S1222.
6. Rivers E, Ngueyn B, Harstad S, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med*. 2001;345:1368–1377.
7. Bill of Rights. Available at: http://www.archives.gov/exhibits/charters/bill_of_rights_transcript.html. Accessed January 15, 2010.
8. Lee SM. A cross-cultural approach to biomedical ethics: medical decision making. *Korean J Med Ethics Educ*. 2007;10:23–32.
9. Ko E, Lee J. End-of-life communication: ethnic differences between Korean and American and non-hispanic white older adults. *J Aging Health*. 2009;21:967–984.

Sports Medicine for Emergency Medicine Physicians, Too Few to Maintain the Fellowship in Emergency Medicine

Bronson E. Delasobera, MD*
Moira Davenport, MD†
Dave Milzman, MD*‡

* Georgetown University/Washington Hospital Center Emergency Medicine Residency Program, Washington, DC
† Allegheny General Hospital, Pittsburgh, Pennsylvania
‡ Georgetown University School of Medicine, Washington, DC

Supervising Section Editor: Sean Henderson, MD
Submission history: Submitted May 18, 2011; Accepted May 23, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.5.6800
[West J Emerg Med. 2012;13(4):342–343.]

Sports medicine (SM) is a clinical subspecialty concerned with the diagnosis and treatment of injuries and illnesses sustained both in and out of the athletic arena. Historically, orthopedic surgeons provided the bulk of care for the athlete. Since the majority of issues with athletes are nonoperative musculoskeletal injuries, traumatic brain injuries, or general medical conditions, primary care providers have developed an important role in SM. The primary care sports medicine (PCSM) physician has become increasingly popular with amateur and professional teams, as growth of sports participation has created medical demands that far exceed the ability of a single medical specialty to provide care.[1] Orthopedic surgery practices have also realized the benefits of utilizing PCSM physicians to assist in patient care.

The PCSM fellowship started in 1992 when the American Board of Emergency Medicine, the American Board of Pediatrics, the American Board of Family Practice, and the American Board of Internal Medicine made an application to the American Board of Medical Specialties (ABMS) to offer subspecialty certification in SM and received approval. Family medicine (FM) is the administering board and has offered written exams since 1993.

Today, SM is 1 of only 6 fellowships recognized by the ABMS for emergency medicine (EM) physicians. SM should be appealing to emergency physicians, as patients with acute athletic injuries present to the emergency department on a fairly routine basis. Although there is no reliable sports injury tracking system, recent reports estimate over 4 million emergency department visits occur annually for injuries related to participation in sports and recreation.[2]

One could imagine that the demand for sports medicine fellowships would be high. The reality is that there is minimal participation in SM among EM clinicians, and in general there is very little participation in PCSM among any specialty other than FM. The sparse participation is not due to a lack of training opportunities. The majority (62%) of the 97 PCSM fellowship programs allow EM residents to apply. However, only 6 (6.2%) of these fellowships are run by EM, while 83 (85%) are run by FM departments. Currently, 0.5% (n = 101) of all board-certified EM attending physicians and 2.3% (n = 1,486) of all board-certified FM attending physicians are PCSM board certified.[3]

In our recent survey of 2008 to 2009 EM residency program directors with 89% (116/130) response rate, we found that 51% of program directors reported no SM practitioners.[3] Seven percent of departments have 4 or more fellowship-trained attending physicians, while 66% of programs have no one who is fellowship-trained working in their department. In comparison, a mean 1.7 (95% confidence interval: 0.2–3.2) residents per program surveyed were reported to be interested in a career in SM. However, during the last 10 years, 60 EM residents in total have completed a PCSM fellowship following EM residency training. This number is surprisingly small and is inconsistent with the reported interest.

There is no readily apparent answer as to why EM residents fail to pursue SM fellowships. Given the lack of prior penetration by EM physicians into SM, current residents with potential interest in SM have EM mentors to look to for guidance, teaching, and exposure to the field. While there are many SM fellowship positions available to EM residents, most of these fellowships are run by FM departments and, thus, may not appeal as much to EM applicants.

In order to make a significant presence in SM, we must continue to encourage our residents to do SM electives, be involved in sports coverage, and apply to fellowships. For these opportunities to present themselves, programs must continue to hire fellowship graduates in order to mentor residents and train fellows of their own. If more EM based SM fellowships

become available, there will be more EM mentors in the field and more EM resident exposure to SM. This would, in turn, likely lead to more resident participation in fellowship training.

A letter to the editor in *Academic Emergency Medicine* in 2003[4] discussed the EM ultrasound fellowship and said that these fellowships are needed to advance the field and to provide EM physicians the expertise in ultrasound. Similarly, SM fellowship training is also needed in the field of EM to advance research and to develop EM leaders within the subspecialty. Without this type of growth, SM will continue to be dominated by FM, and EM will never gain a presence in a subspecialty that seems to best suit the EM physician.

Address for Correspondence: Dave Milzman, MD, Washington Hospital Center Emergency Medicine Residency Program, 110 Irving St NW, Ste 1177A, Washington, DC 20010. E-mail: davidmilzman@me.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Grindel SH. Sports medicine training in the United States. *Br J Sports Med*. 2000;34:410–412.
2. Gilchrist J, Haileyesus T, Murphy M, et al. Nonfatal sports and recreation heat illness treated in hospital emergency departments—United States, 2001–2009. *MMWR Morb Mortal Wkly Rep*. 2011;60:977–980.
3. Delasobera BE, Davenport M, Milzman D. Sports medicine fellowship training for EM resident graduates: interest, availability, and practice, a niche not being filled. *Ann Emerg*. 2009;54:S126.
4. Jang T, Aubin C, Sinett S, et al. Ultrasound training. *Acad Emerg Med*. 2003;10:1144–1155.

Emergency Physicians Research Common Problems in Proportion to their Frequency

Michael P. Wilson, MD, PhD* * UC San Diego Health System, Department of Emergency Medicine Behavioral Emergencies Research Lab, San Diego, California
Gary M. Vilke, MD*
Prasanthi Govindarajan, MD, MAS† † University of California San Francisco, Department of Emergency Medicine, San Francisco, California
Michael W. Itagaki, MD, MBA‡ ‡ The Queen's Medical Center, Department of Diagnostic Services, Honolulu, Hawaii

Supervising Section Editor: Michael Epter, DO
Submission history: Submitted February 2, 2011; Revision received May 31, 2011; Accepted June 22, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.6.6722

Introduction: Emergency medicine (EM) organizations such as the Society for Academic Emergency Medicine and the Institute of Medicine have called for more clinical research as a way of addressing the scarcity of research in EM. Previous investigations have examined funding and productivity in EM research, but whether EM researchers preferentially concentrate on certain patient-related topics is not known. We hypothesized that at least part of the scarcity of EM research is from the tendency of EM researchers, like researchers in other fields, to focus on rarer conditions with higher morbidity or mortality instead of on more common conditions with less acuity. This study compared the frequency of specific medical conditions presenting to emergency departments nationwide with the frequency of emergency physician research on those same conditions.

Methods: This study is a structured retrospective review and comparison of 2 databases during an 11-year span. Principal diagnoses made by emergency physicians as reported by the National Hospital Ambulatory Medical Care Survey were compared to all first-author publications by emergency physicians as reported in PubMed between 1996 and 2006. Statistics included correlations and linear regression with the number of emergency department (ED) visits per diagnosis as the independent variable and the number of articles published as the dependent variable.

Results: During the study period, there was significant concordance between the frequency of presenting conditions in the emergency department and the frequency of research being performed on those conditions, with a high correlation of 0.85 ($P < 0.01$). More common ED diagnoses such as injury/poisoning, symptoms/ill-defined conditions, and diseases of the respiratory system accounted for 60.9% of ED principal diagnoses and 50.2% of the total research published in PubMed.

Conclusion: Unlike researchers in other fields, emergency physicians investigate clinical problems in almost the exact proportion as those conditions are encountered in the emergency department. The scarcity of EM research does not have to do with a skewed focus toward less common patient problems. [West J Emerg Med. Year;00(0):000–000.]

INTRODUCTION

Published research from the United States in the field of emergency medicine (EM) is rapidly increasing. Between 1996 and 2005, the United States published 58.5% of the world's EM research and also experienced the fastest publication growth of any country.[1] Not surprisingly, the number of EM journals has also rapidly increased. Since becoming a board-certified specialty in 1979, the number of EM journals officially tracked by Thompson Scientific Journal Citation Reports has grown from 5 to 13, with many more "unofficial" journals that have not yet achieved mainstream status.[2] This was paralleled by a 20% increase in

emergency department visits in the United States, up from 96.5 million in 1996 to 115.3 million in 2005.[3]

Previous investigations have examined funding and productivity in EM research, but whether EM physicians preferentially concentrate on certain patient-related topics is not known.[4–7] There are reasons to doubt that EM researchers concentrate on common patient problems. First, EM researchers who are funded by the National Institutes of Health (NIH) are presumably focused on patient problems that the NIH has labeled as high priority, regardless of how commonly these patient problems are found in the emergency department. Second, successful NIH funding requires a focused niche of research, and mentorship in common EM problems may be lacking. Finally, EM researchers may behave similarly to researchers in other fields, such as neurology, in which researchers concentrate their efforts on rarer conditions with higher morbidity and mortality.[8]

This study seeks to assess the relationship between frequency of specific medical conditions presenting to the emergency department and the specific areas of research being performed by emergency physicians. As there is no literature on which to predict a relationship, we hypothesized that EM researchers, like researchers in other fields, would focus a disproportionate amount of research effort on rarer conditions.

METHODS

Study Design

This was a retrospective analysis of publicly available data and was thus exempt from institutional review board approval. Data were obtained from the National Hospital Ambulatory Medical Care Survey (NHAMCS), a long-running, federally sponsored survey of hospital emergency department utilization conducted by the US Centers for Disease Control and Prevention (CDC). The NHAMCS study is a study of nationwide emergency department utilization that uses a 4-stage probability sample of all in-person visits to nonfederal short-stay hospitals. It includes only emergency departments that are open 24 hours a day. Further information about the sampling procedure is available at http://www.cdc.gov/nchs/ahcd/ahcd_scope.htm (accessed November 19, 2011). Briefly, however, the sampling procedure designed by the CDC samples geographic areas, hospital and emergency departments within geographic areas, emergency service areas within emergency departments, and the patient visits by emergency service areas. All data on the estimated number of primary diagnoses were obtained from published data in NHAMCS surveys for years 1996–2006, and no attempt was further made to subdivide or categorize them.[9–19] These diagnoses are based on the International Classification of Diseases – 9th revision system of classification. In the years that the standard error was reported, which is an estimate of the error involved in the number of visits, this was less than or equal to 0.5%.[12–19]

Each diagnosis was then associated with relevant articles from Medline. Selection methods of articles from PubMed for this type of research have been previously reported.[1] EM articles published by US emergency physicians from 1996–2006 were identified from the US National Library of Medicine's Medline database by using the institutional affiliation of the first author, a standard field in bibliographic citations. The affiliation contains the author's department, institution, city, state, and country. Affiliations that contained the word "emergency" were considered to originate from EM departments.

Using only the first author's affiliation for determination of clinical department and country of origin can be potentially problematic in instances in which authors from multiple departments or multiple countries collaborate. Excluding non–first authors could potentially undercount the contributions of these authors. On the other hand, assigning non–first authors full credit could overestimate their contributions. Undeserved, or "honorary" authorship is a problem in the EM literature, as well as the general medical literature, where up to 19% of articles have honorary authors.[20,21] In major articles, the first authors account for a preponderance of work and are most deserving of credit.[22,23] Additionally, 98.9% of first authors meet the International Committee of Medical Journal Editors criteria for authorship versus only 52.8% for middle authors.[24] Therefore, we concluded that using the institution affiliation for the first authors was the best compromise.

Determination of article topic was achieved using medical subject headings (MeSH) terms. MeSH terms are created and assigned by the US National Library of Medicine (NLM) for the sole purpose of creating standardized labels pertaining to the subject matter of articles and permitting search for articles at various levels of specificity.[25,26] There is evidence that searching in Medline using MeSH terms retrieves more relevant articles than searching for articles with free text.[27] Additionally, MeSH terms allow article identification with a limited set of standardized vocabulary. Use of free text to search for articles, in contrast, uses a virtually unlimited set of nonstandardized vocabulary, and as such, runs the risk of including irrelevant articles and missing appropriate articles. MeSH terms are assigned by indexing staff at the NLM, using standardized procedures.[28] Although this assignment is done by hand, the NLM uses computerized programs to check for errors before the record is included in Medline.[29]

Before any data were collected, relevant MeSH headings were associated with diagnoses reported by the NHAMCS, as shown in Table 1. All search terms within a given MeSH tree hierarchy (see Figure 1 for example) were associated with the MeSH term at the highest level possible. However, since articles in Medline are generally assigned an average of 10 to 12 MeSH descriptors each, articles could be associated with more than 1 emergency department diagnosis.[28] This follows Medline classification, and no attempt was made to classify articles as being predominantly more about 1 topic than another. All articles associated with a particular emergency department diagnosis, however, were counted only once.

Table 1. A listing of emergency department diagnoses and their associated MeSH (medical subject headings) used in the study.*

Emergency department diagnosis	MeSH
Infectious and parasitic diseases	C1. Bacterial infections and mycoses
	C2. Virus diseases
	C3. Parasitic diseases
Neoplasms	C4. Neoplasms
Endocrine, nutritional, metabolic diseases, immunity disorders	C15. Hemic and lymphatic diseases
	C18. Nutritional and metabolic diseases
	C19. Endocrine system diseases
	C20. Immune system diseases
Mental disorders	F3. Mental disorders
Diseases of nervous system and sense organs	C9. Otorhinolaryngolic diseases
	C10. Nervous system diseases
	C11. Eye diseases
Diseases of the circulatory system	C14. Cardiovascular diseases
Diseases of the respiratory system	C8. Respiratory tract diseases
Diseases of the digestive system	C6. Digestive diseases
	C7. Stomatognathic diseases
Disease of the genitourinary system	C12. Male urogenital diseases
	C13. Female urogenital diseases and pregnancy complications
Diseases of skin and subcutaneous tissue	C17.800. Skin diseases
Diseases of musculoskeletal system and connective tissue	C17.300. Connective tissue diseases
	C5. Musculoskeletal diseases
Symptoms, signs, ill-defined conditions	C23. Pathologic conditions, signs, and symptoms
Injury and poisoning	C21. Disorders of environmental origin
	D26. Pharmaceutical preparations
	D27. Chemical actions and uses

* Articles associated with a particular emergency department diagnosis were only counted once for each diagnosis. Please see text for explanation.

As there is always a lag between conception of an idea in a clinical setting and the publication of an article based on this idea, averages based on 11 years of data were included in the study. Statistics were calculated by using the Systat13 package (Cranes Software, Chicago, Illinois) and Microsoft Excel 2007 (Redmond, Washington).

Primary Data Analysis

The primary outcome measure of this study was a correlation between the average number of diagnoses made by emergency department physicians in the years 1996–2006, as reported by the NHAMCS, and the average number of first-authored articles per year for each diagnosis, as listed on Medline. The Systat 13 statistical software package was used for all comparisons.

RESULTS

Using the above methodology, 9,690 articles were included in the study. These articles were from 499 unique journals. The CDC data indicated that there were 119.2 million visits to emergency departments in 2006, up from 90.3 million visits in 1996.

During the study period, the most common diagnosis resulting in an emergency department visit was "injury and poisonings." This was also the most common research topic investigated by emergency physicians (please see Figure 2 and Table 2). Across diagnoses, there was a high level of concordance between the frequency of the diagnosis in the emergency department and the frequency of first-author publications, with a simple correlation of 0.85 ($P < 0.01$). In a linear regression analysis, using ED diagnoses as the independent variable and number of articles published as the dependent variable, the number of emergency department diagnoses significantly predicted the number of first-author publications ($b = 0.85$, $r^2 = 0.72$, $t_{11} = 5.3$, $P < 0.01$). The most common emergency department diagnoses, such as injury/poisoning, symptoms/ill-defined conditions, and diseases of the respiratory system, accounted for 60.9% of ED principal

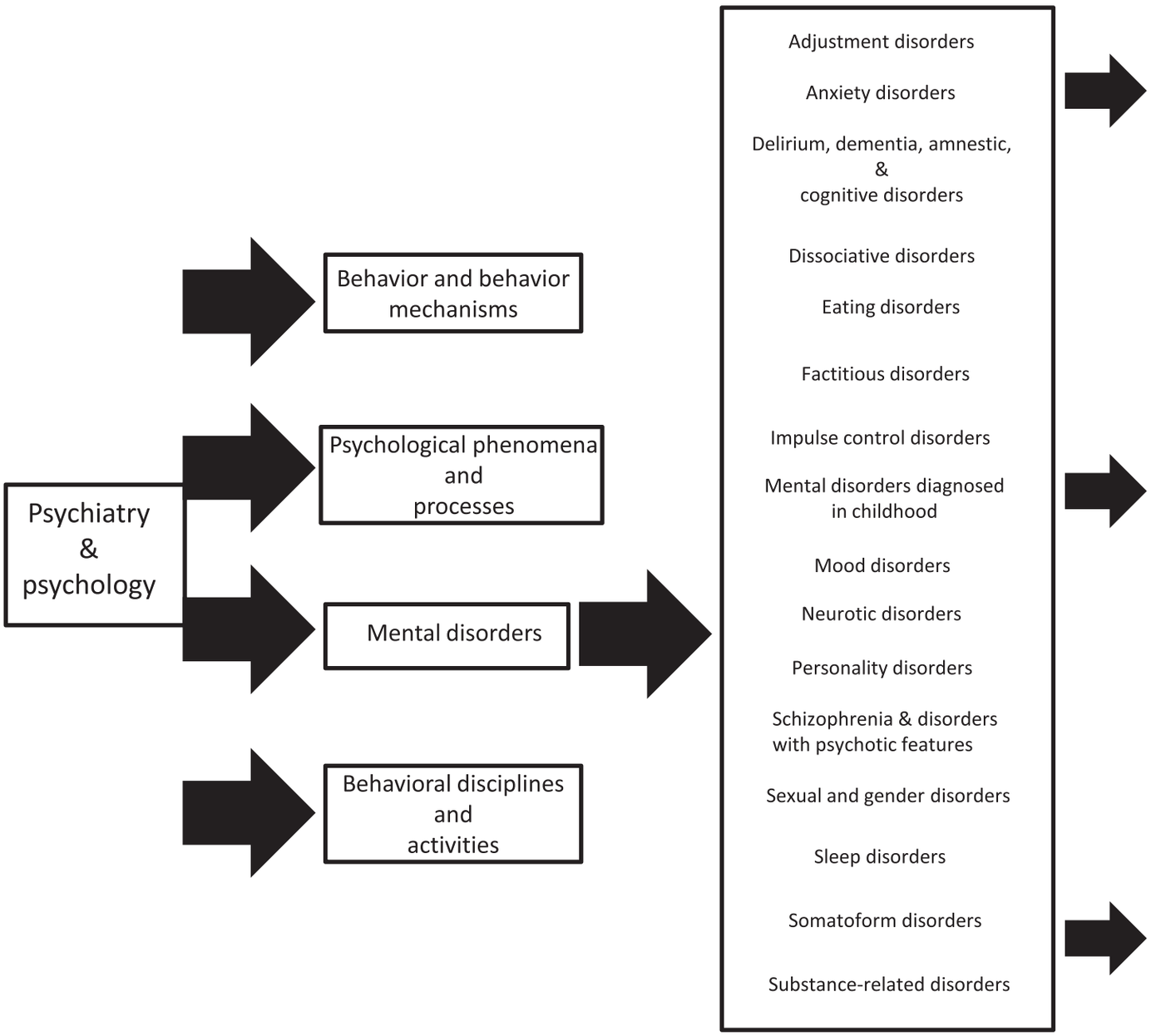

Figure 1. An example of the medical subject heading classification scheme for the term *psychiatry and psychology*. For reasons of space, classification is arbitrarily truncated at the third level of specificity (please see the Appendix, online only). Articles associated with any search term in the tree were associated at the highest level possible, in this instance, *mental disorders*.

diagnoses and 50.2% of the total research published in Medline during the same period. The least common diagnosis, neoplasms, accounted for 0.2% of all ED diagnoses and 0.8% of all published research.

DISCUSSION

Emergency physicians research common patient conditions almost in the exact proportion with which these diagnoses are encountered in the emergency department. This is an unexpected finding, since anecdotal reports and scant research from other fields suggests that researchers in general tend to concentrate on conditions that are only rarely encountered by the average practicing physician. This finding also suggests that the scarcity of EM research does not have to do with misallocation of research resources to less common patient problems.

If EM researchers, when they do perform research, tend to concentrate on patient-oriented problems, why then is there such a scarcity of EM research overall? Although this question was not directly addressed in this study, previous investigations

Table 2. A comparison of emergency department (ED) visits categorized by primary physician diagnosis with first-author publications by emergency medicine researchers, averaged for years 1996–2006.

	ED diagnoses per year, No.	Articles published per year, No.
Injury and poisoning	29,197	276
Symptoms, signs, ill-defined conditions	18,265	186
Diseases of the respiratory system	12,507	71
Diseases of the digestive system	6,243	31
Diseases of the nervous system	5,757	119
Diseases of the musculoskeletal system	5,704	15
Diseases of the genitourinary system	4,765	31
Diseases of the circulatory system	4,313	140
Mental disorders	3,423	31
Diseases of the skin and SQ tissue	3,292	11
Infectious and parasitic diseases	3,211	70
Endocrine, nutritional, metabolic diseases	1,592	69
Neoplasms	266	11
All other	8,077	309

SQ, subcutaneous.

have implicated a lack of NIH funding, as this is the largest contributor to biomedical funding. In a 2007 article, Wilson and Itagaki[1] examined the number of all first-authored articles on Medline from 1996–2005. NIH-funded articles are required to acknowledge this funding on Medline, thus making it possible to track the percentage of NIH-funded articles over time. This study found that an average of 4.5% of all EM articles from 1996–2005 reported receiving NIH grants, with approximately 6.6% of all first-authored EM articles in 2005 and approximately 8.1% of all first-authored EM articles in 2006 reporting funding. Despite the positive growth of NIH funding during the past decade, more than 90% of all EM research is unfunded, with all of the difficulties inherent in trying to sustain a research program without funding.

More controversially, these findings suggest that if the scarcity of EM research does not have to do with the misallocation of research resources, then current NIH efforts to focus research on specific EM conditions may be misguided.[30] Such well-intentioned initiatives may lead to funding for less common patient care conditions instead of more common ones, or may continue to promote research in areas that are already overrepresented. Instead, support should be given for improving emergency research more generally.

LIMITATIONS

This study has a number of important limitations. First, the results reported here are limited by the nature of the Medline index itself. Medline does not index all of the available world literature, containing only approximately 5,200 journals selected by the US National Library of Medicine. A search of Medline for EM articles will therefore have missed abstracts not available on this system, which may be more common for non-English citations.[31] However, given that this study investigated US articles only, this should not influence the results found here. The methodology reported here will also have missed publications from emergency physicians who, by virtue of working in another area of the hospital, do not explicitly include the word "emergency" in their affiliation.

Second, this study rests on an important assumption, namely that the frequency of a presenting condition can be accurately assessed from the final diagnosis listed on the chart. This assumption is further limited by the nature of the categories created by both the National Hospital Ambulatory Care Study and Medline. NHAMCS categories were not constructed by the authors of this article, and the CDC study

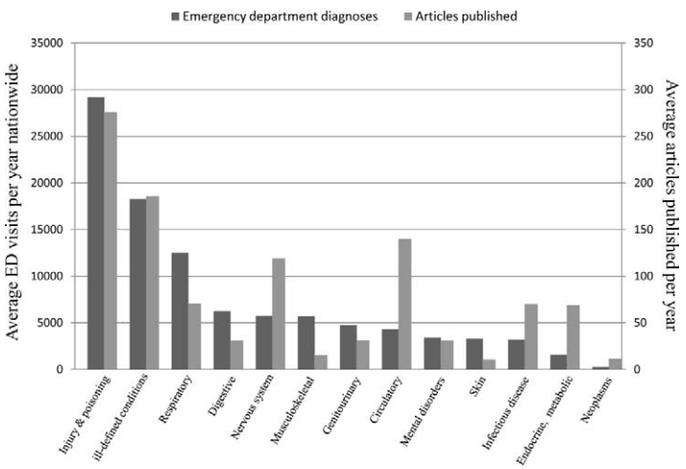

Figure 2. A comparison of articles published in PubMed by emergency medicine physicians on a particular diagnosis, averaged for years 1996–2006. *ED*, emergency department.

makes no allowance for physician error in diagnosis. In addition, to the extent that any sampling bias existed in the original NHAMCS study, which relies on a complicated statistical sampling procedure to derive these data, our estimate of the prevalence of physician diagnoses is incorrect. Furthermore, Medline categories were also not created by physicians, and any systematic indexing error on the part of the US National Library of Medicine could lead to error. This is also true of any error in our mapping of NHAMCS diagnoses to MeSH terms, 2 systems of classification that were not concurrently designed.

Finally, data from the National Hospital Ambulatory Care Survey concern diagnoses of disease only. Thus, the vast body of research published by emergency physicians on topics such as emergency medical services and patient flow is not captured by this methodology. This study is therefore limited to assessments of patient-oriented research only; more specifically, it is limited to the kinds of patient-oriented problems commonly diagnosed by emergency physicians.

Of note, the assignment of multiple MeSH terms to a particular article is not a limitation of this study for 2 reasons. First, articles were only counted once for each relevant emergency department diagnosis. Second, if an article concerns more than 1 potential emergency department diagnosis, it deserves to legitimately be counted in each category.

CONCLUSION

Unlike researchers in other fields, such as neurology, emergency physicians investigate clinical problems in almost the exact proportion as those conditions are encountered in the emergency department. The scarcity of EM research does not have to do with a skewed focus toward less common patient problems.

Address for Correspondence: Michael P. Wilson, MD, PhD, UC San Diego Health System, Department of Emergency Medicine Behavioral Emergencies Research Lab, 200 W Arbor Dr, San Diego, CA 92131. E-mail: mpwilso1@gmail.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Wilson MP, Itagaki MW. Characteristics and trends of published emergency medicine research. *Acad Emerg Med*. 2007;14:635–640.
2. McKenna M. IOM report ignites new debate on who should practice emergency medicine. *Ann Emerg Med*. 2007;49:614–617.
3. Emergency Department Visit Data. National Center for Health statistics. Centers for Disease Control and Prevention Web site. Available at: http://www.cdc.gov/nchs/ahcd/ercharts.htm. Accessed December 13, 2009.
4. Ahababian RV, Barsan WG, Bickell WH, et al. Research directions in emergency medicine. *Am J Emerg Med*. 1996;14:681–683.
5. American College of Emergency Physicians Research Committee. *Report on Emergency Medicine Research*. 2005. Cited by: The Institute of Medicine Committee on the Future of Emergency Care in the United States Health System. *Hospital-Based Emergency Care: At the Breaking Point*. Washington, DC: Institute of Medicine; 2006.
6. Ernst AA, Houry D, Weiss SJ. Research funding in the four major emergency medicine journals. *Am J Emerg Med*. 1997;15:268–270.
7. Birkhahn RH, Van Deusen SK, Okpara O, et al. Funding and publishing trends of original research by emergency medicine investigators over the past decade. *Acad Emerg Med*. 2006;13:95–101.
8. Al-Shahi R, Will RG, Warlow CP. Amount of research interest in rare and common neurological conditions: bibliometric study. *BMJ*. 2001;323: 1461–1462.
9. McCaig LF, Stussman BJ. National Hospital Ambulatory Medical Care Survey: 1996 emergency department summary. *Adv Data*. 1997;293:1–20.
10. Nourjah P. National Hospital Ambulatory Medical Care Survey: 1997 emergency department summary. *Adv Data*. 1999;304:1–24.
11. McCaig LF. National Hospital Ambulatory Medical Care Survey: 1998 emergency department summary. *Adv Data*. 2000;313:1–24.
12. McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 1999 emergency department summary. *Adv Data*. 2001;320:1–36.
13. McCaig LF, Ly N. National Hospital Ambulatory Medical Care Survey: 2000 emergency department summary. *Adv Data*. 2002;326:1–31.
14. McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2001 emergency department summary. *Adv Data*. 2003;335:1–36.
15. McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2002 emergency department summary. *Adv Data*. 2004;340:1–35.
16. McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2003 emergency department summary. *Adv Data*. 2005;358:1–38.
17. McCaig LF, Nawar EW. National Hospital Ambulatory Medical Care Survey: 2004 emergency department summary. *Adv Data*. 2006:372:1–32.
18. Nawar EW, Niska RW, Xu J. National Hospital Ambulatory Medical Care Survey: 2005 emergency department summary. *Adv Data*. 2007;386:1–32.
19. Pitts SR, Niska RW, Xu J, et al. National Hospital Ambulatory Care Survey: 2006 emergency department summary. *Natl Health Stat Report*. 2008;7:1–38.
20. Bennett DM, Taylor DM. Unethical practices in authorship of scientific papers. *Emerg Med (Fremantle)*. 2003;15:263–270.
21. Flanagin A, Carey LA, Fontanarosa PB, et al. Prevalence of articles with honorary authors and ghost authors in peer-reviewed medical journals. *JAMA*. 1998;280:222–224.

22. Slone RM. Coauthors contributions to major papers published in the AJR: frequency of undeserved coauthorship. *AJR Am J Roentgenol*. 1996;167:571–579.
23. Chew FS. Coauthorship in radiology journals. *AJR Am J Roentgenol*. 1988;150:23–26.
24. Hwang SS, Song HH, Baik JH, et al. Researcher contributions and fulfillment of ICMJE authorship criteria: analysis of author contribution lists in research articles with multiple authors published in radiology: International Committee of Medical Journal Editors. *Radiology*. 2003; 226:16–23.
25. Nelson S. Fact sheet: medical subject headings. US National Library of Medicine Web site. Available at: http://www.nlm.nih.gov/pubs/factsheets/mesh.html. Accessed December 13, 2009.
26. National Institutes of Health. Introduction to MeSH-2010. US National Library of Medicine Web site. Available at: http://www.nlm.nih.gov/mesh/introduction.html. Accessed December 13, 2009.
27. Chang AA, Heskett KM, Davidson TM. Searching the literature using medical subject headings versus text word with PubMed. *Laryngoscope*. 2006;116:336–350.
28. Use of MeSH in indexing. US National Library of Medicine Web site. Available at: http://www.nlm.nih.gov/mesh/intro_indexing.html. Accessed December 13, 2009.
29. National Institutes of Health. Fact sheet: online indexing. US National Library of Medicine Web site. Available at: http://www.nlm.nih.gov/pubs/factsheets/online_indexing_system.html. Accessed December 13, 2009.
30. D'Onofrio G, Jauch E, Jagoda A, et al. NIH roundtable on opportunities to advance research on neurologic and psychiatric emergencies. *Ann Emerg Med*. 2010;56:551–564.
31. LSTRC Scientific Review Administrator. Fact sheet: Medline journal selection. US National Library of Medicine Web site. Available at: http://www.nlm.nih.gov/pubs/factsheets/jsel.html. Accessed December 13, 2009.

How Accurately Can Emergency Department Providers Estimate Patient Satisfaction?

Lalena M. Yarris, MD, MCR*†
Brooke Frakes, BS*†
Nathan Magaret, MD‡
Annette L. Adams, MPH*†
Heather Brooks, BS§
Robert L. Norton, MD*†

* Oregon Health & Science University, Department of Emergency Medicine, Portland, Oregon
† Oregon Health & Science University, Center for Policy and Research in Emergency Medicine, Portland, Oregon
‡ Providence St Vincent Hospital, Department of Emergency Medicine, Portland, Oregon
§ Calypte Biomedical Corporation, Portland, Oregon

Supervising Section Editor: Jeremy J. Hess, MD
Submission history: Submitted September 13, 2011; Revision received August 14, 2011; Accepted October 10, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.10.6644

Introduction: Patient satisfaction is an important measure of emergency department (ED) quality of care. Little is known about providers' ability to estimate patient satisfaction. We aimed to measure providers' ability to assess patient satisfaction and hypothesized that providers could accurately estimate overall patient satisfaction.

Methods: We surveyed ED patients regarding satisfaction with their care. Treating providers completed analogous surveys, estimating patients' responses. Sexual assault victims and non-English-speaking or severely ill patients were excluded. Satisfaction responses were categorized as "satisfied" or "not satisfied." Patient satisfaction scores were considered the "gold standard," and providers' perceptions of the patient satisfaction were considered tests. Measures of diagnostic accuracy, such as positive predictive value (PPV) and sensitivity, were used to assess how accurately the provider could estimate his or her patient's satisfaction.

Results: Here, 242/457 eligible patients (53%) completed the survey; 227 providers (94%) completed a corresponding survey. Subject-reported overall satisfaction was 96.6%, compared with a provider-estimated rate of 94.4%. The sensitivity and PPV of the provider's estimate of the patient's satisfaction were 95.2 (95% confidence interval [CI] 91.4, 97.7) and 97.5 (95% CI 94.4, 99.2), respectively, for overall patient satisfaction. The PPV was similar for clarity of communication. The PPV was 78.9 for perceived length of ED stay (99% CI 70.8, 85.6) and 82.6 for quality of pain control (95% CI 68.6, 92.2). Accuracy of attending and resident estimates of patient satisfaction did not differ significantly. The agreement between patient-reported and provider-estimated patient satisfaction was not associated with age, gender, patient disposition, or ED divert status.

Conclusion: Providers are able to assess overall patient satisfaction and clarity of communication with a high accuracy. Physician estimates of pain control and perceived length of stay have a moderate accuracy. [West J Emerg Med. 2012;13(4):351–357.]

INTRODUCTION

Patient satisfaction is one measure of emergency department (ED) quality of healthcare.[1,2] Previous studies have demonstrated that satisfied patients are more likely to comply with discharge instructions, return for future care, and refer friends and family to the same ED.[2–5] Factors that have been shown to be associated with increased patient satisfaction include perceived quality of communication

between provider and patient, provider efforts to enhance patients' understand of their care, perceived and expected waiting times, and higher acuity of illness or triage level.[5–14]

While it is assumed that providers make some assessment of patient satisfaction in the course of their clinical care, little is known about how accurate these assessments are. However, provider perceptions of patient satisfaction may impact patient care. For example, providers who perceive that their patients are satisfied with care are more likely to report a positive work environment thus setting the stage for a positive physician-patient interaction. Likewise, providers who sense that patients are dissatisfied may feel defensive and experience burnout, which may negatively influence patients' overall satisfaction with care.[15] The goal of the study is to explore how well ED providers can estimate patient satisfaction. We aimed to compare patient-reported to provider-estimated overall satisfaction and hypothesized that providers could accurately estimate overall patient satisfaction.

METHODS

Study Design

This study was a cross-sectional survey of patient satisfaction with ED care. We recruited a convenience sample of patients during their visit to our ED and also their healthcare providers, both resident and supervising staff physician, to complete a paper-based, self-administered survey. Participation in this survey was voluntary. This study received approval from our institutional review board.

Study Setting and Population

Our ED is a level 1 trauma center with a volume of approximately 42,000 ED visits per year. The study population consisted of consecutive patients who were evaluated in the ED during the hours that trained research assistants were available (7 AM to 11 PM, 7 days per week) from October 10, 2005, to December 10, 2005. During the study period, ED providers were not regularly receiving feedback regarding patient satisfaction. Eligible subjects included patients aged 18 years and older, those between the ages of 16 and 18 with parental consent, and the accompanying parent or guardian of patients who were younger than 16 years of age. Patients were excluded if they were medically unstable, a victim of a sexual assault, unable to comprehend or complete the survey instrument due to the presenting illness acuity, had difficulty understanding English, had impaired mental status (including drug or alcohol intoxication), or at the attending physician's discretion. The exclusion of non-English-speaking subjects was based on limited financial resources to create translated versions of the survey and to have interpreter time available to conduct the survey and the concern that translated versions may not be comparable with the English version.

Patients who met inclusion criteria were selected for enrollment using a coin flip. Due to the number of other studies being conducted in the ED during this time period, it was not possible to enroll all eligible subjects, and this method of randomization was chosen to minimize selection bias by the research volunteers. Patients who agreed to participate were approached just prior to their discharge or admission for enrollment and verbal consent. Patient satisfaction surveys were self-administered and collected by research volunteers. Patients were informed that survey data was confidential, that it would be used for research purposes only and would not be reviewed by their providers, and they were instructed to place the surveys in a sealed envelope prior to collection by the research volunteers.

For each completed patient survey, the healthcare providers for that patient, both resident and supervising staff physician or nurse practitioner, were approached by the research volunteer at the time of discharge and asked to participate in the provider portion of the survey. There was an option on the survey for providers to opt out of completing the survey if they felt they did not spend enough time with the patient to answer questions regarding how satisfied they thought the patient was with their care. Demographic data, such as age, gender, ethnicity, and insurance status, were abstracted from the medical record by the research volunteer at the time of enrollment. ED length of stay (LOS), respondent disposition, ED divert status, and ED census were abstracted from the ED tracking system as well at the time the patient was enrolled in the study.

Survey Content and Administration

The patient surveys employed four- and five-point Likert-type scales for responses and were designed to assess overall satisfaction as well as factors that likely influence patient satisfaction. These other factors include perceived waiting times, provider communication, treatment of pain, and perceived competence of healthcare providers. Specific wording, format, and content for items were adapted from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). The HCAHPS is a standardized survey instrument and data collection methodology for measuring patients' perspectives on hospital care.[16] As there were no validated versions of this survey for the ED setting at this time, we adapted the hospital version of the survey by including only pertinent items and making minor wording edits, as needed, to reflect the change in setting. The healthcare provider surveys were abbreviated but addressed the same topics as the patient survey from the perspective of estimating patient perceptions of satisfaction. The patient survey was piloted on approximately 10 patients and revised as needed. Selected questions from the patient survey were adapted for the provider survey, asking providers to predict how their patients would respond.

Data Analysis

Patient characteristics were summarized using descriptive statistics. Proportions were calculated for each level of all satisfaction responses for both patients and providers. To

facilitate the assessment of accuracy of a provider's estimate of his or her patient's satisfaction, we dichotomized the satisfaction responses in 2 ways. First, all responses were dichotomized as "satisfied" versus "not satisfied." For overall satisfaction, the 5-point responses were "poor," "fair," "good," "very good," and "excellent." The satisfied subjects were those who reported good, very good, or excellent. The other 2 responses were included in the not satisfied group. For perceived ED LOS, "about right," "shorter than expected," and "much shorter than expected" were categorized as satisfied; and "much too long" and "longer than expected" were categorized as not satisfied. For quality of pain control and clarity of provider communication, "usually" and "always" were categorized as satisfied; and "never" and "sometimes" were categorized as not satisfied.

In the second method of categorization, all responses were dichotomized as "very satisfied" versus "not very satisfied." For overall satisfaction, the excellent group was categorized as very satisfied, and all other responses were included in the not very satisfied group. For perceived ED LOS, shorter than expected and much shorter than expected were categorized as very satisfied; and others were categorized as not very satisfied, partly to ensure adequate sample size in the very satisfied group. For quality of pain control and clarity of provider communication, always responses were categorized as very satisfied; and others were categorized as not very satisfied.

To assess the accuracy of a provider's estimate of his or her patient's satisfaction, providers' perceptions were considered tests, and patients' satisfaction scores were considered the gold standard. Measures of diagnostic accuracy, including sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), were calculated as well as the proportion of agreement between provider's perception and patient's satisfaction. Difference in diagnostic accuracy between attendings and residents was compared using a 2-sample test for independent proportions or Fisher's exact test for each measure.

Associations between patient characteristics and agreement in overall satisfaction between provider and patient were estimated using logistic regression. All comparisons were also assessed for the presence of confounding by patient age and sex. All analyses were conducted using Stata/IC 11.1 (StataCorp LP, College Station, Texas).

RESULTS

Of 457 eligible patients, 242 subjects (53%) completed the survey. Demographic information for respondents and ED characteristics at the time of the study are listed in Table 1. Of the 215 eligible subjects who did not participate, reasons for nonparticipation include: declined participation (85 patients); missed, usually due to early discharge (80 patients); initially eligible, but later excluded due to discharge time after 11 PM (40); and too ill to participate at the time the patient was approached (10). Also, 227 providers (94%) completed a corresponding survey; 52% of the provider surveys were completed by faculty; 48% were completed by residents. Patients reported an overall satisfaction of 96.6%, as compared with a provider-estimated 94.2%. In contrast, about 49.6% of patients reported being very satisfied, while only 13.5% of providers estimated so.

Table 1. Characteristics of respondents and emergency department (ED) at time of enrollment.*

Mean age (years)	34.7
Gender (male)	113 (47%)
Ethnicity	
White	183 (76%)
Black	16 (7%)
Hispanic	6 (2%)
Asian	4 (2%)
Unknown	33 (14%)
Mean ED length of stay (minutes)	242.9
Mean ED census (number of patients in ED)	23.1
Insurance status	
Private or commercial	86 (36%)
Medicare/Medicaid	65 (27%)
Veterans	4 (2%)
Workers' Compensation	5 (2%)
Nonsponsored	41 (17%)
Unknown	41 (17%)
ED disposition (discharged home)	192 (79%)
ED divert status (on divert)	35 (14%)

* All respondent characteristics are reported for n = 242, the total number of completed surveys. All ED characteristics were recorded at the time the respondent was enrolled in the study.

Proportions for each category of all satisfaction responses are reported in Table 2 for both patients and providers. In general, patients tend to be more likely to report being very satisfied than providers predict. For example, a substantially higher proportion of patients than providers responded that they were very satisfied overall and always satisfied with pain control and clarity of communication.

Results for accuracy of provider-estimated satisfaction are reported in Table 3. For each item of satisfaction, only observations that included both patient and provider data were able to be included in the analysis. For overall satisfaction, there was a high agreement of 93.1% between providers and patients, indicating that the providers correctly estimated patients' satisfaction 93.1% of the time. The provider's perception also had high sensitivity (95.2; 95% confidence interval [CI] 91.4, 97.7) and PPV (97.5; 95% CI 94.4, 99.2) to estimate patients' overall satisfaction. Only 7 patients were categorized as not satisfied overall, and providers correctly identified 2 of them (specificity = 28.6; 95% CI 3.67, 71.0). For clarity of communication, the PPV of provider's perception was similar to

Table 2. Proportion of patients and providers in each satisfaction category.

	Patient		Provider	
Satisfaction Category	N	Reported (%)	N	Reported (%)
Overall satisfaction	236		223	
Poor	3	1.3	3	1.4
Fair	5	2.1	10	4.5
Good	40	17.0	75	33.6
Very good	71	30.1	105	47.1
Excellent	117	49.6	30	13.5
Perceived ED LOS	236		223	
Much longer than expected	16	6.8	8	3.6
Longer than expected	62	26.3	84	37.7
About right	106	44.9	110	49.3
Shorter than expected	36	15.3	18	8.1
Much shorter than expected	16	6.8	3	1.4
Quality of pain control	123		94	
Never	11	8.9	9	9.6
Sometimes	21	17.1	27	28.7
Usually	36	29.3	49	52.1
Always	55	44.7	9	9.6
Clarity of communication	240		224	
Never	2	0.8	3	1.3
Sometimes	5	2.1	31	13.8
Usually	30	12.5	129	57.6
Always	203	84.6	61	27.2

ED, emergency department; *LOS*, length of stay.

that for overall satisfaction. For perceived ED LOS, the sensitivity was 68.2 (95% CI 60.1, 75.6), and PPV was 78.9 (95% CI 70.8, 85.6), and results were similar for quality of pain control, which was needed for a fraction of patients. In addition, estimates of specificity and NPV were relatively low for the satisfaction responses, which may be partly due to the small sample size available to estimate these 2 measures.

Table 4 demonstrates the accuracy of providers' estimations of the most satisfied patients, and the results were different from those for satisfaction. Compared to results for satisfaction, the agreement between providers and patients for the very satisfied category was generally lower. In all categories, providers' perception underestimated the satisfaction as reported by patients. The provider's perception also had low sensitivity. For example, the sensitivity was only 19.1% (95% CI 12.2, 27.7) and 19.1% (95% CI 9.2, 33.3) for patients' overall satisfaction and perceived ED LOS, respectively. In contrast, specificity was high, eg, 91.5% (95% CI 84.5, 96.0) for overall satisfaction and 93.5% (95% CI 88.7, 96.7). When accuracy of provider estimated satisfaction was compared between attendings and residents, results were similar, and no significant difference was found between training levels. Based

Table 3. Accuracy of the provider's estimate of the patient's satisfaction.

Satisfaction variable	N	Patient-reported % satisfied	Provider-estimated % satisfied	Percent agreement	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Overall satisfaction	216	96.8	94.4	93.1	95.2 (91.4, 97.7)	28.6 (3.67, 71.0)	97.5 (94.4, 99.2)	16.7 (2.09, 48.4)
Perceived ED LOS	216	68.5	59.3	65.8	68.2 (60.1, 75.6)	60.3 (47.7, 72.0)	78.9 (70.8, 85.6)	46.6 (35.9, 57.5)
Quality of pain control	78	75.6	59.0	62.8	64.4 (50.9, 76.4)	57.9 (33.5, 79.7)	82.6 (68.6, 92.2)	34.4 (18.6, 53.2)
Clarity of communication	222	95.1	84.7	83.3	85.8 (80.3, 90.2)	36.4 (10.9, 69.2)	96.3 (92.5, 98.5)	11.8 (3.3, 27.5)

CI, confidence interval; *PPV*, positive predictive value; *NPV*, negative predictive value; *ED*, emergency department; *LOS*, length of stay.

Table 4. Accuracy of the provider's estimate of the category of very satisfied from patients.

Satisfaction variable	N	Patient-reported % very satisfied	Provider-estimated % very satisfied	Percent agreement	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Overall satisfaction	216	50.9	13.9	54.6	19.1 (12.2, 27.7)	91.5 (84.5, 96.0)	70.0 (50.6, 85.3)	52.2 (44.7, 59.5)
Perceived ED LOS	216	21.8	9.3	77.3	19.1 (9.2, 33.3)	93.5 (88.7, 96.7)	45.0 (23.1, 68.5)	80.6 (74.4, 85.9)
Quality of pain control	78	46.2	7.7	59.0	13.9 (4.7, 29.5)	97.6 (87.4, 99.9)	83.3 (35.9, 99.6)	56.9 (44.7, 68.6)
Clarity of communication	222	83.3	27.0	39.2	29.7 (23.2, 36.9)	86.5 (71.2, 95.5)	91.7 (81.6, 97.2)	19.8 (13.9, 26.7)

CI, confidence interval; *PPV*, positive predictive value; *NPV*, negative predictive value; *ED*, emergency department; *LOS*, length of stay.

on results from logistic regression, the agreement between patient-reported and provider-estimated patient overall satisfaction was not associated with age, gender, time-to-provider, LOS, disposition of the patient, or ED divert status.

DISCUSSION

We began this study with the following question: How accurately can ED providers estimate patient satisfaction? We found that a large percentage of patients reported overall satisfaction with their care and that their providers accurately estimated that they would be satisfied. In our review of the literature, we found only 1 other study that directly evaluated ED personnel accuracy in estimating patient satisfaction.[15] Boudreaux et al found that ED personnel estimated significantly lower satisfaction scores than patients reported and overestimated the average patient LOS. There are important differences in methodology between our study and theirs. The Boudreaux study used telephone surveys administered 7 to 10 days after the ED visit to query patients about their level of satisfaction. Our study surveyed patients immediately after patient care before being discharged from the ED. For the Boudreaux study, the ED personnel were given a blank copy of the patient satisfaction survey 2 to 3 weeks after all patient surveys were completed and were asked to estimate the average score of the group of patients for each question. In contrast, our study assessed providers' estimates of the satisfaction scores from the specific patients for whom they provided ED care at the time of discharge from the ED.

Although providers' ability to gauge overall satisfaction is important, our results suggest that providers may be less accurate at estimating satisfaction with regard to several factors that have been previously shown to be associated with overall patient satisfaction. We found lower sensitivity PPVs from providers' estimations of patients' perceived LOS and satisfaction with quality of pain control. This trend has important implications for those involved in provider education and quality improvement efforts and warrants further investigation since providers' ability to assess how well they are providing these important aspects of quality care may determine the success of interventions to improve overall patient satisfaction. However, we found moderately high sensitivity and high PPVs from providers' estimations of the clarity of communication. Since clarity of communication has been demonstrated to be an important determinant of patient satisfaction, this finding is encouraging, as it suggests that providers may have some insight into how effectively they communicate. Still, further studies to address how accurately providers can estimate the quality of their communication in samples with a larger variation of communication ratings would be helpful to determine if these findings, with a relatively satisfied patient population, can be generalized to other settings.

In considering the categorization of satisfied versus not satisfied patients, we report a NPV of 16.7. However, this value

is based on a small sample size of dissatisfied patients, and further investigation with a population with a greater variation of satisfaction scores is necessary to draw conclusions from this finding. On the other hand, when considering the very satisfied versus not very satisfied categories, we found that in each item providers underestimated patient satisfaction. It appears that providers are able to accurately determine the patients who are satisfied overall, but are reluctant to respond that patients are very satisfied. That providers' accuracy drops when estimating the perceptions of the most satisfied group of patients is an interesting finding. It is not clear whether this is a reflection of physicians' hesitation to give their care the highest grade or that they really do not recognize when they have provided the highest quality of care. As providing this level of care is ultimately the goal of EDs, this finding may warrant further investigation as well.

Our study also considered whether experience level affected provider ability to estimate overall satisfaction and again found similar results between providers and residents. This suggests that experience alone does not improve the ability to assess patient satisfaction but does not exclude that experience may play a role that our study was not able to detect.

LIMITATIONS

The main limitation of this study is the homogeneity of responses. Since the prevalence of being dissatisfied was low, specificity and NPV could not be reliably estimated, and the results of this study may not be generalizable to populations with a different distribution of patient satisfaction scores. In addition, this study was conducted in a single ED and may not be applicable to other populations and settings. Although our research assistants attempted to enroll all selected eligible patients, they were unable to approach some patients, either because of their acute medical condition or because they were unwilling to participate. Also, because our protocol specified that surveys should be provided after patient care was completed but before discharge, some patients were missed due to expeditious discharge immediately after ED care was complete. We cannot determine if the responses of nonparticipants would have differed from those who completed surveys. In addition, this study measured patient satisfaction at the time of the ED visit. To our knowledge, there have been no published studies assessing this method of patient satisfaction assessment compared to mailed surveys, which are more commonly performed.

CONCLUSION

Providers in this study were able to estimate overall patient satisfaction and clarity of communication with a high degree of accuracy as compared with patient reports. PPV was lower for perceived ED LOS and quality of pain control. Future studies should address populations with a greater variation of patient satisfaction scores and seek to further elucidate interventions that providers can successfully implement to improve their patients' experiences when they estimate dissatisfaction with ED care.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Oregon Health & Science University (OHSU) Clinical Research Investigative Studies Program volunteers for their assistance in conducting this study. We would also like to thank the OHSU Department of Emergency Medicine for supporting this study with a Bridge grant.

This publication was made possible with support from the Oregon Clinical and Translational Research Institute, Grant Number UL1 RR024140 from the National Center for Research Resources, a component of the National Institutes of Health (NIH), and NIH Roadmap for Medical Research.

Address for Correspondence: Lalena M. Yarris, MD, MCR, Oregon Health & Science University, 3181 SW Sam Jackson Park Rd, Mailcode CDW-EM, Portland, OR, 97202. E-mail: yarrisl@ohsu.edu.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Yarnold PR, Michelson EA, Thompson DA, et al. Predicting patient satisfaction: a study of two emergency departments. *J Behav Med*. 1998;21:545–563.
2. Hansagi H, Carlsson B, Brismar B. The urgency of care need and patient satisfaction at a hospital emergency department. *Health Care Manage Rev*. 1992;17:71–75.
3. Hostutler JJ, Taft SH, Snyder C. Patient needs in the emergency department. Nurses' and patients' perceptions. *J Nurs Adm*. 1999;29: 43–50.
4. Rydman RJ, Roberts RR, Albrecht GL, et al. Patient satisfaction with an emergency department asthma observation unit. *Acad Emerg Med*. 1999;6:178–183.
5. Björvell H, Stieg J. Patients' perceptions of the health care received in an emergency department. *Ann Emerg Med*. 1991;20:734–738.
6. Hall MF. Keys to patient satisfaction in the emergency department: Results of a multiple facility study. *Hosp Health Serv Admin*. 1996;41: 515–532.
7. Krishel S, Baraff LJ. Effect of emergency department information on patient satisfaction. *Ann Emerg Med*. 1993;22:568–572.
8. Thompson DA, Yarnold PR, Williams DR, et al. Effects of actual waiting time, perceived waiting time, information delivery, and expressive quality on patient satisfaction in the emergency department. *Ann Emerg Med*. 1996;28:657–665.

9. Rhee K, Bird J. Perceptions and satisfaction with emergency department care. *J Emerg Med*. 1996;14:679–683.
10. Thomson DA, Yarnold PR. Relating patient satisfaction to waiting time perceptions and expectations: the disconfirmation paradigm. *Acad Emerg Med*. 1995;2:1057–1062.
11. Hedges JR, Trout A, Magnusson AR. Satisfied Patients Exiting the Emergency Department (SPEED) study. *Acad Emerg Med*. 2002;9:15–21.
12. McMillan JR, Younger MS, DeWine LC. Satisfaction with hospital emergency department as a function of patient triage. *Health Care Manage Rev*. 1986;11:21–27.
13. Waggoner DM, Jackson EB, Kern DE. Physician influence on patient compliance: a clinical trial. *Ann Emerg Med*. 1981;10:348–352.
14. Taylor C, Benger JR. Patient satisfaction in emergency medicine. *Emerg Med J*. 2004;21:528–532.
15. Boudreaux ED, Ary R, Mandry C. Emergency department personnel accuracy at estimating patient satisfaction. *J Emerg Med*. 2000;19:107–112.
16. Centers for Medicare & Medicaid Services, Baltimore, MD. Hospital care quality information from the consumer perspective. HCAHPS Web site. Available at: http://www.hcahpsonline.org. Accessed September 13, 2010.

Successful Introduction of an Emergency Department Electronic Health Record

Douglas A. Propp, MD Advocate Lutheran General Hospital, Department of Emergency MedicinePark Ridge, Illinois

Supervising Section Editor: Mark Langdorf, MD, MPHE
Submission history: Submitted December 12, 2012; Accepted January 23, 2012
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2012.1.11564

Our emergency department had always relied on a paper-based infrastructure. Our goal was to convert to a paperless, efficient, easily accessible, technologically advanced system to support optimal care. We outline our sequential successful transformation, and describe the resistance, costs, incentives and benefits of the change. Critical factors contributing to the significant change included physician leadership, training and the rate of the endorsed change. We outline various tactics, tools, challenges and unintended benefits and problems. [West J Emerg Med. 2012;13(4):358-361.]

INTRODUCTION

In our suburban, academic, emergency department (ED) with 60,000 annual visits, our clinicians had always relied on a paper medical record. The ED has 31 beds, including 3 resuscitation suites. We are a Level I Trauma Center, admitting 30% of our patients; approximately one fourth are under the age of 16. The catalyst for our Electronic Health Record (EHR) adoption was a desire to be "state of the art" with the latest technology, enhanced efficiency for the clinicians and improved documentation, while providing high quality patient care.[1-2] We were invited to be the first site within the hospital with a fully integrated EHR. The financial costs for EHR implementation were assumed by the hospital, which sponsored the new enterprise-wide information system (Cerner FirstNet) rather than an ED-niche application alternative. All of our clinicians (physicians, nurse practitioners, nurses) use the EHR beginning with the initial nursing triage assessment and note. The focus of this article is how our emergency physicians (EP) assimilated this technology and process improvement into their customary work flow.

DISCUSSION

Planning for the Change

Our vision was to implement an efficient, easily accessible, real time, patient centric, technologically advanced, legible resource for optimizing emergency care by clinicians. This vision was consistent with the need to improve workflow with reduced errors and enhanced quality and safety, while promoting documentation of the most important information in the least amount of time.

Many tactics were used to positively impact the tool adoption (Table). Based on their unique attributes, 3 physicians were provided protected time to participate in the extensive design process. One was the department chair, who was ultimately accountable for successful implementation. A second physician was familiar with information technology (IT), based on software design experience that preceded his medical career, while the third was a senior opinion leader whose buy-in from the beginning of the project was felt to be critically important. The design took nearly a year with frequent collaborative meetings with our IT colleagues. The 3 physicians spent approximately 140 hours planning, designing and customizing the tool.

Implementation of the Change

Tiered physician education and corresponding roll out were used to lengthen the adoption time and lessen the slope of the change gradient. For example, the ED chair conducted 2 two-hour computer laboratory classes, separated by approximately 4 weeks, to teach the EPs how to navigate through the tool, do computerized physician order entry (CPOE), and familiarize them with how to create macros, favorite orders and basic precompleted notes. These classes were followed by 90-minute one-on-one tutoring sessions with an IT expert who assisted the EPs in creating their own macros and precompleted notes. Subsequently, one-on-one bedside mentoring was assigned during four-hour clinical shifts, covering only 3 patient rooms during the last phase of implementation when EHR documentation was finally introduced. After implementation, our physicians discussed improvements and nuances at monthly department meetings.

For several weeks after the roll out, the department chair sent e-mail updates to share tips, improvements and plans to address any concerns raised, while maintaining group focus and alignment.

Several weeks ensued between sequential roll out of CPOE, use of the tracking board, departure instructions and prescription writing, voice recognition (Nuance Dragon 10 Medical) and finally integrated, complete electronic documentation. The intent was to permit a hybrid period where the EPs could continue to handwrite some charts as they assimilated computer documentation skills; however, once the system was activated, our EPs physicians rapidly migrated to all-electronic documentation. Once completely implemented, it took approximately 4 months to regain physician productivity of just over 2 patients per physician hour worked. After achieving the new steady state there was virtually no deterioration in various process metrics, such as overall average patient length of stay (225 minutes), patients leaving without being seen (1.2%) or overall Press Ganey patient satisfaction (75%).

Consensus department order sets were created to speed and standardize commonly related orders, such as blood tests, ECG, radiographs, and advanced imaging. Examples included order sets selected by the physicians for chest pain, abdominal pain, TIA/CVA, first trimester vaginal bleeding, lumbar puncture tests, trauma, and pediatric sepsis. In addition, the multiple required fields for the orders, such as reason for the examination, priority of the request (all STAT), transport mode, etc., were precompleted to save the EPs' time.

Fees paid to the vendor for software and licensing are $258,000 per year. Bedside, wall- mounted computer terminals had been installed primarily for registrar use prior to the EHR implementation, but have not been embraced by the clinicians. Attempts at using tablet, hand-held computers were unsuccessful due to small screen size and absence of voice recognition accessibility. Only 1 of 25 EPs uses a workstation on wheels for bedside documentation, although several are available. The hospital added 33 desktop computers and several workstations on wheels at a cost of $83,000,so that each clinician has a dedicated work station. These are the preferred EHR access tools. Voice recognition software added another $62,000 in cost, and $7,500 was spent on printers.

It was always assumed that the design and ongoing changes and enhancements would be an iterative process with continual improvement of the tool. Consensus improvements were regularly forwarded to IT, and many were implemented. For example, soon after our full roll out, a unique generic department template was created to merge the best aspects of voice recognition within the vendor's point and click/ typed template. The EPs developed to varying degrees their own macros, precompleted notes and favorite orders, as they learned how to customize the application to facilitate their individual preferences. The software continues to improve with nuances introduced approximately every 4-6 months based on both vendor-driven changes and user suggestions. Examples include tools to migrate more easily through the electronic data repository, as well as improved individual-driven, customized sorting on the electronic tracking board.

Various techniques were used to incentivize the physicians' adoption. For example, regular non-blinded peer comparisons in use of CPOE and electronic documentation were shared, which accelerated their adoption. Clinical examples of how the new electronic infrastructure assisted efficient, high quality care were regularly shared; this too had a significant positive impact. During the initial roll out, approximately 1% of physician yearly compensation was at risk per physician, based on relative adoption of the EHR technology. The department achieved its objective of 100% EHR adoption by its EPs. All of these efforts helped shorten the adoption time frame, ultimately defined by complete EHR utilization.

LESSONS LEARNED

Given the challenge of migrating to a new department infrastructure, it would be wise to increase staffing to accommodate the expected slow down in patient care throughput for the first 2 to 3 weeks of implementation. Adding an extra physician shift per day during the afternoon-evening hours and having an on-call physician available would be advisable. Also, once we became reliant on our new electronic infrastructure, we recognized some of the challenges that could impede optimal performance.[3] The tool must be reliable and ideally have no unplanned downtimes. Planned downtimes should be infrequent and eventually eliminated. Concerns for secure access to the EHR need to be balanced with easy accessibility. Delays of computer response times of greater than a few seconds result in frustration by the user and the potential to lose cognitive focus. During the design process, the physicians requested that delays be limited to 2 to 3 seconds; this goal has been met with rare exception. All clicks should be value added. Unnecessary forced jumping between display screens should be eliminated. Decision support, a major reason to use the tool, should have contextual relevance and not be overbearing to avoid alert fatigue and unnecessarily interrupting the end user.[4] Our initial experience with too many non-clinically relevant alert interruptions caused us to raise the threshold for alerts. Although it would be ideal to have clinical decision support seamlessly push to the clinician, the current system relies on the end user to pull in needed information. Finally, with regular updates and improvements, we experienced the varied capacity of each user to assimilate changes in their use of the tool.

Using a sophisticated electronic tool also carries some risks that need to be acknowledged and managed. Given the ease that charting by exception can be accomplished within the EHR, one needs to ensure clinicians have performed everything they have documented when using their macros or precompleted notes. One also needs to avoid inappropriate cut

and paste ("copy forward") functionality where inaccuracies from copying other notes can be propagated.[5-7] Ready access to historic information, which could lead to inserting old and inaccurate medication lists into a current note, must be avoided. Time spent in front of a computer screen can detract from the EP's necessary departmental clinical vigilance and situational awareness. The focus on the computer could also be misinterpreted by patients and families as nonprofessional time spent by the provider. Finally, the focus on the computer to facilitate documentation and order completion can detract from that vital part of typical ED culture: the face-to-face provider team communication. For example, lack of appreciation for the prioritization of task completion, and absence of all team members being aware of important clinical information can occur in the absence of the random but meaningful verbal clinical information sharing potentially hindered by the computer focus. On the plus side, the physician CPOE- generated nursing icons on the tracking board provide easily accessible non-verbal task communication with the staff, while the nursing staff also has easy access to the physician's clinical note and assessment.

We have also seen the overall time spent on documentation increase, although it varies based on the individual clinician's preference for using time-saving macros, pre-completed notes, and voice recognition. Our markedly improved legible and more comprehensive charts have driven an almost 6% increase in our billable worked RVUs per patient. Some physicians attempt to complete their documentation at 1 sitting while others add entries to their charts sequentially as they get more information during the patient's visit. Although we request chart completion soon after the patient's discharge from the ED, several physicians spend an extra hour charting at the end of their shifts while a few prefer to use portal access to complete their charting from home. Consequently, our timely chart completion compliance is good.

We have also experienced some unexpected challenges with the tool. The greater the dependence on the new technology, the more difficult it becomes to do without it,. In addition, paper documentation may still have a defined role. Although our legacy paper chart and clipboard still exist and typically hold the patient labels and the initial triage vital signs(which are also in the EHR), bedside paper orders and documentation are still necessary in our ED for time-sensitive care related to STEMI, procedural sedation and trauma resuscitations where data entry into the computer may delay critical clinical care. Given the availability and ease of electronic documentation, clicking momentum may lead to spending too much time over documenting an encounter. Further, it only takes 1 inadvertent click for orders and documentation to be done on the wrong patient. Additionally, some form of back up, such as a shadow tracking board to keep the clinicians aware of ED activities, must be available during downtime. We have a scheduled two- to three-hour regular monthly downtime typically occurring early on a Sunday morning. These downtimes can result from lack of reliability or an upgrade in any of the software that interfaces with the clinical portion of the EHR, such as laboratory results, X-ray, or ADT (admission/discharge/transfer) applications.

The unexpected benefits of EHR have also been illustrative. Time consuming serial-based processing has been transformed to parallel-based processing due to simultaneous access and use of the EHR by many clinicians. Allergy and duplicate order alerts (integrated in the order process), as well as ready access to standardized, clinically correlated protocols

Table. Key Tactics and value for implementation.

Tactics	Cost	Payoff
Enlist physician leaders to participate in design	Moderate	Large
Tiered new skill acquisition and roll out	Low-Moderate	Large
Frequent and regular updates to physicians	Low	Moderate
Consensus department order sets	Low	Large
Voice recognition	Moderate	Large
Financial incentives for adoption	Low	Moderate
Shared peer adoption progress	Low	Moderate
Dedicated personal computers for each clinician	Moderate-High	Large
Consensus department discharge medication favorites	Low	Large
Portal Access to electronic health record	Low	Moderate

(e.g., recommended Antibiotics or Pressors), have improved care. Favorite individual physician orders, department order sets and discharge medications have also been well received as time savers. Having disparate data (labs, radiograph readings, etc.) available for inclusion in the summary EHR provides a focused opportunity to enhance the physician's decision making and documentation. Unfortunately, at this time we are not able to import photos or electronic images such as electrocardiograms. Once the ED encounter was digitized in the EHR, portal access has not only allowed for remote completion of documentation but also continued access to the admitted patient's in-house clinical status, thus enhancing the EP's knowledge base. Our documentation is available to providers outside the ED once they are saved, even before signing.

Of all the tools provided to facilitate the change, 2 stand out in surpassing physician expectations. First, each clinician was assigned a wide screen personal computer formatted to avoid the need for either horizontal or vertical scrolling. Secondly, sign-on only occurs at the beginning of a clinical shift as regular interaction with the computer eliminated the need for recurrent log-ins. In addition, the availability of voice recognition, integrated within EHR documentation allowed rapid and accurate transcription, far exceeding the speed of typing. Training of the voice recognition software takes no longer than 5 minutes. It accommodates most accents and is accurate. Noise cancelling microphones do an excellent job at excluding ambient noise. Finally, each physician has his/her own designated work station.

CONCLUSION

Since migrating to our integrated EHR over 2 years ago, we have received positive Medical Staff acknowledgement of the legibility, easy access and robust nature of our documentation. Our EPs say they would never go back to our prior non-electronic system. We have been invited to share our model of design and implementation with other ED leaders seeking to emulate our success. Although billing and patient satisfaction have both improved, other simultaneous changes that were implemented confound our ability to unilaterally credit the EHR. We continue to make regular improvements in the tool based on both requests from the clinicians and updates from the vendor. Our medical director manages the requests for improvements and serves as the liaison with the IT support staff.

No matter how conscientious you are with EHR design and roll outher you will immediately appreciate the need for modifications once you go live, given the ongoing feedback from stakeholders. Your steady state will thus be time limited as the tool continues to evolve while your colleagues and the vendor work to continuously improve it. In summary, our adoption of the EHR has dramatically improved our ED work product.

Address for Correspondence: Douglas A Propp, MD, Advocate Lutheran General Hospital, Department of Emergency Medicine, 1775 W Dempster Rd, Park Ridge, IL 60068. E-mail: douglas.propp@advocatehealth.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as a potential source of bias. The author disclosed none.

REFERENCES

1. Handel DA, Hackman JL. Implementing Electronic Health Records in the Emergency Department. *The Journal of Emergency Medicine*. Feb 2010; 38: 257-63.
2. Hu SC, Yen DH, Kao WF. The Feasibility of Full Computerization in the ED. *American Journal of Emergency Medicine*. March 2002; 20: 118-21.
3. Feied Craig, Smith Mark, Handler Jonathan. Medical Informatics and Emergency Medicine. *Academic Emergency Medicine*. November 2004; 11: 1118-26.
4. Buller-Close K, Schriger D, Baraff L. Heterogeneous Effect of an Emergency Department Expert Charting System. *Annals of Emergency Medicine.* May 2003; 41: 644-52.
5. Ash J, Berg M, Coiera E. Some Unintended Consequences of Information Technology in Health Care: The Nature of Patient Care Information System-related Errors. *Journal of the American Medical Informatics Association*. 2004; 11: 104-12.
6. Siegler EL, Adelman R. Copy and Paste: A Remediable Hazard of Electronic Health Records. *The American Journal of Medicine*. June 2009; 122: 495-96.
7. Markel A. Copy and Paste of Electronic Health Records: A Modern Medical Illness. *The American Journal of Medicine*. May 2010; 123: 9.

Oral Lesions Secondary to Cocaine Use

Malford T. Pillow, MD*
David Cuthbertson, MD†

* Baylor College of Medicine, Section of Emergency Medicine, Houston, Texas
† Baylor College of Medicine, Department of Otolaryngology, Houston, Texas

Supervising Section Editor: Sean Henderson, MD
Submission history: Submitted December 30, 2011; Accepted January 9, 2012
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2012.1.11697
[West J Emerg Med. 2012;13(4):362.]

A 47-year-old female with a history of hepatitis C and drug abuse presented to the emergency department (ED) with a 3-week history of oral and chin ulcers, productive cough, and dyspnea. Her initial vital signs were BP 80/51, HR 111, RR 20, Temp 97.9°F. Physical exam was notable for oral and chin lesions to the tongue and anterior gums (Figure 1 and 2). Otherwise no other bullous or embolic lesions were noted on the patient. Initial labs were remarkable for white blood cell count 1.2 K/L, sodium 128 mEq/L, bicarbonate 23 mEq/L, blood urea nitrogen 20 mg/dL, creatinine 0.4 mg/dL. Urine drug screen was positive for cocaine and opioids. Human immunodeficiency virus (HIV) test was negative. Dermatology, which was consulted during her inpatient stay to evaluate the cause of the oral lesions, noted only non-specific spongiform pattern of inflammation on biopsy. The lesions began to fall off and heal during her hospital stay, and the team noted that all the lesions were to the anterior mouth. Upon further questioning, she admitted to burning her lips and mouth on a crack pipe.

Cocaine-associated oral lesions can present in a variety of ways, including poor dentition, mouth ulcerations found to the anterior mouth (as in our patient), and lesions in various stages of healing.[1] In this septic patient, the lesions were initially thought to be indicators of severe systemic disease, but were merely a distractor. Interestingly, a study did find a small increased incidence of HIV in patients presenting with crack pipe burns.[2]

Address for Correspondence: Malford T. Pillow, MD, Baylor College of Medicine, Section of Emergency Medicine, 1504 Taub Loop, Mail Stop 25, Houston, TX 77004. Email: tysonpillow@gmail.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Mitchell-Lewis D, Phelan J, Kelley R, et al. "Identifying oral lesions associated with crack cocaine use." J Am Dent Assoc. August 1994; 125(8): 1104-8.
2. DeBeck K, Kerr T, Li K, et al. "Smoking of crack cocaine as a risk factor for HIV infection among people who use injection drugs." Canadian Medical Association Journal. Oct 27, 2009; 181(9): 571-2.

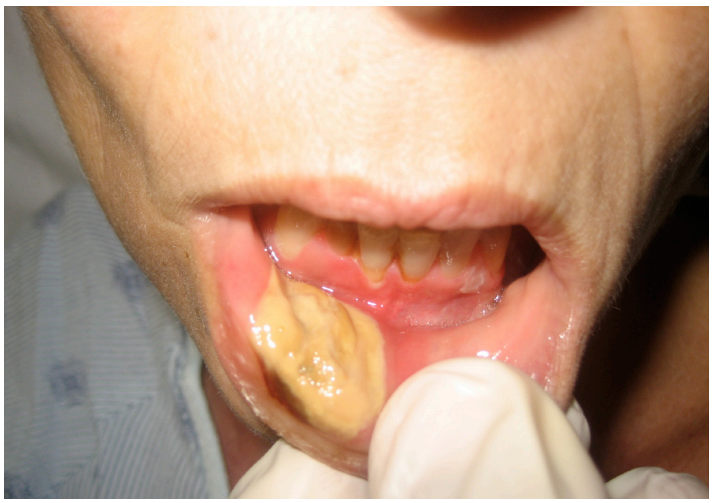

Figure 1. Lesion to mucosa of inner lip.

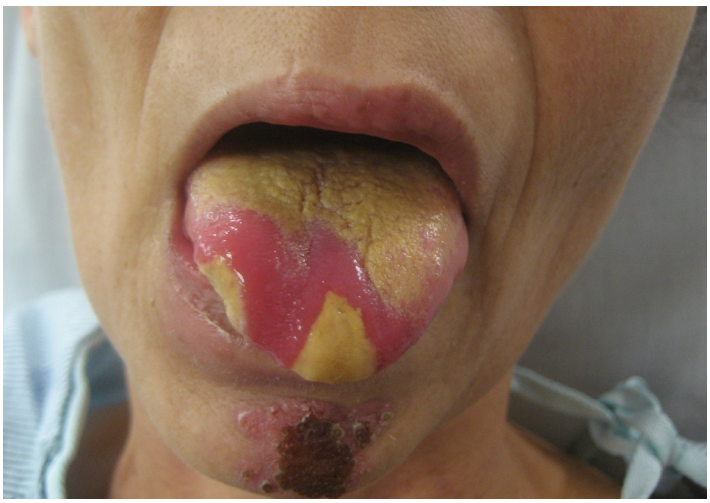

Figure 2. Multiple lesions on tongue.

Therapy Dogs in the Emergency Department

Nickolas Nahm, MD* * Case Western Reserve University, School of Medicine, Cleveland, Ohio
Jill Lubin, MEd† † John Carroll University, Department of Education and Allied Studies, University Heights, Ohio
Jeffrey Lubin, MD, MPH‡ ‡ Penn State Milton S. Hershey Medical Center, Department of Emergency Medicine, Hershey, Pennsylvania
Blake K. Bankwitz§ § Case Western Reserve University, College of Arts and Sciences, Cleveland, Ohio
McAllister Castelaz§ || Case Western Reserve University, Biology Department, Cleveland, Ohio
Xin Chen, BA|| ¶ Texas A&M University, School of Medicine, College Station, Texas
Joel C. Shackson§ # University Hospitals Case Medical Center, Department of Emergency Medicine, Cleveland, Ohio
Manik N. Aggarwal, BA, MPH¶
Vicken Y. Totten, MD, MS#

Supervising Section Editor: Scott E. Rudkin, MD, MBA
Submission history: Submitted May 27, 2010; Revision received November 22, 2010; Accepted May 30, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.5.6574

Introduction: This study examined acceptance by staff and patients of a therapy dog (TD) in the emergency department (ED).

Methods: Immediately after TD visits to a University Hospital ED, all available ED staff, patients, and their visitors were invited to complete a survey.

Results: Of 125 "patient" and 105 staff responses, most were favorable. Ninety-three percent of patients and 95% of staff agreed that TDs should visit EDs; 87.8% of patients and 92% of staff approved of TDs for both adult and pediatric patients. Fewer than 5% of either patients or staff were afraid of the TDs. Fewer than 10% of patients and staff thought the TDs posed a sanitary risk or interfered with staff work.

Conclusion: Both patients and staff approve of TDs in an ED. The benefits of animal-assisted therapy should be further explored in the ED setting. [West J Emerg Med. 2012;13(4):363–365.]

INTRODUCTION

Animal-assisted therapy (AAT) is a therapeutic patient interaction with a domestic "pet-type" animal that is not one's own pet.[1] The documented benefits of AAT include improved physical, emotional, cognitive, and social functioning; reduced blood pressure and triglyceride levels; and even reduced cardiovascular morbidity and mortality.[2–4] Psychiatric patients benefit by reduced stress.[5] Patients with heart failure have lower epinephrine and norepinephrine levels, with systolic pulmonary artery and pulmonary capillary wedge pressure reductions after AAT.[6]

Potential hazards of AAT may include animal bites, allergies, and zoonotic infections.[7,8] Animal-assisted therapy programs minimize these hazards by vaccinating and washing the animals, special training, and the continuous presence of handlers.[4,7] Adverse events are very rare when AAT protocols are followed.[9,10]

There are no reports of AAT in an emergency department (ED). Although there is no reason to suppose that emergency patients would not accrue the usual benefits, the acceptance of AAT in EDs has not been examined.

METHODS

This study was approval by the local institutional review committee.

A survey was offered to each person in the ED immediately after a therapy dog (TD) had left each of 4 adult ED hallways. Therapy dogs visited the ED 6 times between July 2008 and November 2008. The survey asked about the respondent's attitudes toward dogs in general, and about dogs in the ED. A research assistant stayed with the respondent until the

Table. Comparison of patients versus staff.

Attitude toward TD	Patients, No. (%) (n = 125)	Staff, No. (%) (n = 105)
Visiting: visited with TD	87 (69.6)	73 (69.5)
Approval: agreed or strongly agreed that TD should visit EDs	117 (93.3)	100 (95.2)
Location: TDs should visit both adult and pediatric patients	110 (87.8)	97 (92.1)
Fear: TD was a danger to patients	4 (3.4)	2 (2.0)
Cleanliness: did not agree that TD made ED less sanitary	113 (90.7)	95 (90.3)
Interference: TD does not interfere with staff work	120 (95.8)	96 (91.3)

ED, emergency department; *TD*, therapy dog.

survey was collected. This minimized loss due to incomplete responses, but conversely, no data were collected on those who declined to participate.

Setting

The setting was the ED of a large, Midwest, urban teaching hospital. The dog-handler teams were certified by Therapy Dogs International and certified by the hospital's Pet Therapy Program. The 2 TDs in this study were a mixed-breed Labrador Retriever (Quincy) and a Burmese Mountain Dog (Brinkley).

Participants

We obtained a convenience sample of 125 patients and 105 staff members. For analysis, patients included both patients and their visitors; ED staff included physicians, nurses, and others. All were older than 18 years and capable of completing the survey; completion constituted consent. Staff respondents may have completed a survey at more than 1 visit, but because the TDs visit the ED only every 2 to 4 weeks, it is unlikely that many patients had completed more than 1 survey. (One patient was known to be present twice and completed 2 surveys.)

Circumstances

The hospital already had an AAT program, and the ED was part of the TDs rounds. During TD visits, certified TD handlers introduced themselves and the dogs to patients and their visitors, asking those present if they would like a visit from the therapy dog. The handlers and dog entered the room only with the approval of everyone present in the room. During the visit, patients and visitors could interact with the TD. The extent of interactions was dictated by the visit recipients. People could pet the dog, have the dog do tricks, talk about the dog, and sometimes throw a treat to the dog.

RESULTS

Most patients visited with the TD. Most staff (69.5%) observed the dog with a patient. The vast majority of patients and staff (93% and 95%, respectively) thought that TDs should visit the ED. Both patients and staff approved of having a TD in both the adult and pediatric sections of the ED. Only a few respondents felt the TD was dangerous: 4 (3.3%) patients and 1 (1%) staff member. Eleven patients (9.2%) and 11 staff members (10.6%) strongly agreed or agreed that TDs made the ED less sanitary. Few staff (8.6%) and fewer patients (4.2%) worried that the TD interfered with the work of the ED. The 125 patient responses and 105 staff responses are compared in the Table.

DISCUSSION

Therapy dogs are uncommon in EDs. The ED is a more chaotic environment than hospital floors, and ED-visiting animals may require additional training before entering this environment. Although developing a new AAT program can be burdensome, in hospitals where AAT is already present, consideration should be given to including the ED in AAT rounds.

There are reasons to think AAT would be particularly advantageous for ED patients, who are often highly stressed by their unexpected illness and long waits. Animal-assisted therapy may improve patient satisfaction by decreasing perceived waiting time.

One example may illustrate how a TD helped in a pediatric ED. A 4-year-old child with a head injury was frightened and refused to hold still for a computed tomography scan. When the child saw how still the TD could be after a "Down, Stay" command, he exclaimed, "If Quincy [the TD] can lay still like that, I can, too!" In this instance, TD interaction obviated the need for chemical sedation with its attendant risks.

LIMITATIONS

Our study suffered from a number of limitations: potential survey duplicates, Hawthorne effect, animal bias, immediacy, scheduling, and the individual dogs' personalities. The TD did not visit with any critically ill patients. We had not instructed respondents to fill out a survey only once, and at least 1 patient and an unknown number of staff may have completed more than 1 survey. We did not collect data to correct for this limitation. Because 1

of the TD handlers was an emergency physician, the Hawthorne effect was unavoidable. Staff members were aware that these TD visits would be followed by an attitude survey. Most adults have already established their biases about animals. It is possible that people who liked dogs completed more surveys than dog haters. Anecdotally, it seemed that patients who refused a TD visit were also more likely to refuse to answer the survey. We did not collect data on refusers. The short time between the TD visit and the survey may have positively biased responders who were still excited by the TD visit. Staff who disapproved of AAT may have been underrepresented because of patient care duties. Responses may have been different at another time of day. The dogs were both large, weighing more than 65 lb. Attitudes toward smaller dogs or dogs of other breeds may have been different.

CONCLUSION

This is the first study of AAT in an ED. Acceptance by patients and staff was excellent. The specific benefits of AAT in EDs should be further studied.

Address for Correspondence: Vicken Y. Totten, MD, MS, University Hospitals Case Medical Center, Wearn B-17/HMP 5099, 11100 Euclid Ave, Cleveland, OH 44106. E-mail: Vicken.Totten@UHhospitals.org.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Gammonley J. Pet projects. *J Gerontol Nurs*. 1991;17:12–15.
2. Wisdom JP, Saedi GA, Green CA. Another breed of "service" animals: STARS study findings about pet ownership and recovery from serious mental illness. *Am J Orthopsychiatry*. 2009;79:430–436.
3. Anderson WP. Pet ownership and risk factors for cardiovascular disease. *Med J Aust*. 1992;157:298–301.
4. Friedmann E, Katcher AH, Lynch JJ, et al. Animal companions and one-year survival of patients after discharge from a coronary care unit. *Public Health Rep*. 1980;95:307–312.
5. Lefebvre SL, Gola GC, Christensen E, et al. Guidelines for animal-assisted interventions in health care facilities. *Am J Infect Control*. 2008; 36:78–85.
6. Barker SB, Dawson KS. The effects of animal-assisted therapy on anxiety ratings of hospitalized psychiatric patients. *Psychiatr Serv*. 1998; 49:797–801.
7. Cole KM, Gawlinski A, Steers N, et al. Animal-assisted therapy in patients hospitalized with heart failure. *Am J Crit Care*. 2007;16:575–585.
8. Lerner-DurJawa L. Pet visitation: is it an infection control issue? *Am J Infect Control*. 1994;22:112.
9. Khan MA, Farrag N. Animal-assisted activity and infection control implications in a healthcare setting. *J Hosp Infect*. 2000;46:4–11.
10. Jorgenson J. Therapeutic uses of companion animals in health care. *Image J Nurs Sch*. 1997;29:219–254.

The Ottawa Knee Rule: Examining Use in an Academic Emergency Department

Bryan G. Beutel, BS*
Samir K. Trehan, AB*
Robert M. Shalvoy, MD†
Michael J. Mello, MD, MPH*‡§

* Injury Prevention Center at Rhode Island Hospital, Providence, Rhode Island
† Department of Orthopedics, The Warren Alpert Medical School of Brown University, Providence, Rhode Island
‡ Department of Emergency Medicine, The Warren Alpert Medical School of Brown University, Providence, Rhode Island
§ Department of Community Health, The Warren Alpert Medical School of Brown University, Providence, Rhode Island

Supervising Section Editor: Ali S. Raja, MD
Submission history: Submitted September 11, 2011; Revision received December 8, 2011; Accepted February 6, 2012
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2012.2.6892

Introduction: The Ottawa Knee Rule is a validated clinical decision rule for determining whether knee radiographs should be obtained in the setting of acute knee trauma. The objectives of this study were to assess physician knowledge of, barriers to implementation of, and compliance with the Ottawa Knee Rule in academic emergency departments (EDs), and evaluate whether patient characteristics predict guideline noncompliance.

Methods: A 10 question online survey was distributed to all attending ED physicians working at three affiliated academic EDs to assess knowledge, attitudes and self-reported practice behaviors related to the Ottawa Knee Rule. We also performed a retrospective ED record review of patients 13 years of age and older who presented with acute knee trauma to the 3 study EDs during the 2009 calendar year, and we analyzed ED records for 19 variables.

Results: ED physicians (n = 47) correctly answered 73.2% of questions assessing knowledge of the Ottawa Knee Rule. The most commonly cited barriers to implementation were "patient expectations" and system issues, such as "orthopedics referral requirement." We retrospectively reviewed 838 records, with 260 eligible for study inclusion. The rate of Ottawa Knee Rule compliance was retrospectively determined to be 63.1%. We observed a statistically significant correlation between Ottawa Knee Rule compliance and patient age, but not gender, insurance status, or provider type, among others.

Conclusion: Compliance with the Ottawa Knee Rule among academic ED healthcare providers is poor, which was predicted by patient age and not other physician or patient variables. Improving compliance will require comprehensive educational and systemic interventions. [West J Emerg Med. 2012;13(4):366-373.]

INTRODUCTION

Knee pain is a common presenting complaint in the emergency department (ED) and accounts for approximately 1.3 million ED visits annually in the United States (US).[1] Despite the prevalence of acute knee trauma, fractures are only observed in approximately 6% of patients.[2] Knee radiographs to detect fractures, however, remain one of the most commonly ordered studies and account for $1 billion in healthcare spending annually.[3,4]

The Ottawa Knee Rule was published in 1995 by Stiell et al[5] as a tool for determining whether knee radiographs should be obtained to detect a fracture in the setting of acute knee trauma. The rule states that knee radiographs are indicated in these patients if at least one of the following criteria is satisfied: the patient is at least 55 years old, has an inability to bear weight immediately after trauma and in the ED for four steps (regardless of limp), has isolated patellar tenderness, fibular head tenderness, or an inability to flex the knee to 90°.[1,5,6] Stiell et al[1] validated the rule in 2 prospective studies,

which showed the criteria to be 100% sensitive for identifying clinically-significant fractures. Additionally, Bachmann et al[7] published a meta-analysis concluding that the Ottawa Knee Rule was 99% sensitive and 49% specific for knee fracture. While the criteria were initially validated in adults, prospective studies and meta-analyses also demonstrated that they are 99-100% sensitive and 43-46% specific in children over 5 years of age.[8,9]

When used appropriately the Ottawa Knee Rule has been shown to reduce unnecessary imaging. In an implementation trial conducted by Stiell et al[6], educational interventions on the Ottawa Knee Rule targeting ED physicians decreased the proportion of knee radiographs by 26.4%, ED visit costs by $34 per patient, and time spent in the ED by 33.1 minutes.[10] Another prospective trial demonstrated a 35% decrease in knee radiographs.[11]

Despite evidence supporting use of the Ottawa Knee Rule, its adoption has been limited. A multi-national survey of ED physicians 10 years ago investigated this issue.[12] According to the results, self-reported knowledge of the Ottawa Knee Rule was highest in English-speaking countries, yet use of the rule among those with knowledge of the criteria was lowest in the U.S. While the majority of respondents agreed that clinical decision rules are intended to reduce healthcare costs and improve quality of care, physicians in the U.S. were most likely to agree that such rules are oversimplified, increase the likelihood of being sued, and challenge physician authority. These studies suggest that a multitude of factors contribute to limited use of the Ottawa Knee Rule and consequent radiograph overuse. Knee radiographs remain one of the most commonly performed imaging studies and, despite low fracture rates, are obtained in 60-80% of acute knee trauma cases.[3,13,14] While the low adoption rate of the Ottawa Knee Rule is known, there are currently no published studies assessing physician knowledge of the rule, or patient or physician predictors of compliance with it.

In the present study, 15 years after publication of this clinical decision rule, we aimed to (1) evaluate knowledge, attitudes and self-reported practice behaviors regarding the Ottawa Knee Rule among attending academic U.S. ED physicians; (2) determine Ottawa Knee Rule adherence among ED providers; and (3) examine if patient level characteristics predict guideline noncompliance. We hypothesized that Ottawa Knee Rule adherence is poor. Additionally, we hypothesized that systems-based barriers inherent to the ED setting and patient factors prevent appropriate application of the rule.

METHODS

The Institutional Review Boards of the participating hospitals and the university approved all aspects of the study protocol.

ED Physician Survey

To assess ED physician knowledge, and barriers to implementation, of the Ottawa Knee Rule, the authors designed a 10-question online survey. The questions were developed by extrapolating scenarios from the rule criteria, and by phrasing inquiries about basic demographic and other information in plain language agreed upon by all authors. The survey was administered to all 76 ED attending physicians (all board certified in emergency medicine and/or pediatric emergency medicine) who were faculty at one of the nation's largest academic emergency medicine departments in June 2010. The three study institutions' EDs were staffed by members of the same university-based physician group and included an academic trauma center, a community teaching hospital and an academic pediatric specialty hospital with a combined annual volume of approximately 200,000 ED visits.

Of the questions, 2 related to the demographics of the respondents, 5 evaluated knowledge of the Ottawa Knee Rule through case vignettes and guideline questions, one probed for self-reported adherence to the rule, and 2 inquired about potential barriers to implementation (see Appendix for full survey questions). One of the barriers-to-implementation questions asked respondents to identify the top three reasons (out of nine choices) for ordering a knee radiograph in the absence of the Ottawa Knee Rule criteria being met; many of these answer choices were adapted from Graham et al's[12] physician survey. We disseminated the survey link via email. All data were collected with identification of the respondent, and a $5 gift card was offered for survey completion. The survey responses, however, were not linked to the respondent's name.

We evaluated knowledge of the Ottawa Knee Rule by comparing the proportion of participants who answered the 5 vignettes and guideline questions correctly with the total number of participants. Similarly, we calculated simple percentages for the responses to the 2 survey questions relating to the most commonly reported barriers.

Medical Record Review

To corroborate self-reported data on adherence to the Ottawa Knee Rule, as well as collect patient level characteristics that may influence guideline compliance, we conducted a retrospective ED medical record review. The review notes were not directly linked to the physicians who responded to the survey.

Our study population consisted of patients 13 years of age and older who presented with acute knee trauma to the three study institutions' EDs between January 1, 2009 and December 31, 2009. To include the entire teenage population and broaden the potential data set we chose 13 as a lower age limit Patients were initially identified by querying the ED billing database for 16 International Classification of Diseases 9 (ICD-9) codes related to acute knee and lower extremity trauma (716.1, 717, 718.86, 822, 823, 823.1, 823.8, 823.9, 827, 836, 844, 891, 916, 924, 928, 959.7). We then applied the same exclusion criteria used in the Ottawa Knee Rule's

validation studies (except for age less than 18 years), which excluded patients who were referred from outside hospitals with knee radiographs, sustained knee trauma more than seven days previously, returned for reassessment of the same injury, had isolated skin injury, had multiple trauma, were pregnant, were paraplegic or had an altered level of consciousness.[1,5] Two data abstracters then examined medical records of eligible patients for 19 principal variables gathered from ED nursing records, ED physician records and radiology reports. We entered data into Microsoft Excel; any missing data were noted. The authors managed any discrepancies between nursing and physician records by deferring to physician documentation for assessment of principal variables.

We organized the principal variables by categories such as "patient characteristics" (e.g. age, gender, insurance status, previous knee injury), "injury features" (e.g. mechanism, setting, the 5 Ottawa Knee Rule criteria, diagnosis), "radiograph ordering" (e.g. imaging, type of provider ordering films), and "other" (e.g. time spent in the ED, returned to the ED within 2 weeks for reassessment). From these, we evaluated Ottawa Knee Rule compliance by comparing the proportion of patients who had knee radiographs obtained with the proportion of patients in whom knee radiographs were indicated according to the rule. We assessed potential association of Ottawa Knee Rule adherence with patient variables, adjusted for multiple comparisons, using the Fisher's Exact test, which was calculated in Statistical Analysis System 8.2 (SAS, SAS Institute Inc., Cary, NC). Calculations involving time spent in the ED excluded patients who were admitted to the hospital or taken to the operating room, and were made using the Wilcoxon Rank Sum Test. We determined inter-rater reliability between the 2 reviewers by calculating the Cohen's kappa value based upon whether the Ottawa Knee Rule criteria were met from a random subset of 33 medical records.

RESULTS

ED Physician Survey

Forty-seven out of 76 ED physicians responded to our survey (61.8% response rate). On average, respondents worked 22.3 (standard deviation (SD) 7.8, 95% confidence interval (CI) 20.1-24.5) hours per week in the ED and had 8.7 (SD 8.3, CI 6.4-11.1) years of experience.

Physicians scored an average of 73.2% (CI 66.6-79.8) on questions assessing Ottawa Knee Rule knowledge, with 2.1% of respondents correctly answering all of the questions, 78.7% answering all but 1 of the questions correctly, and 0% answering all of the questions incorrectly. Only 36.2% of responding physicians, however, chose to withhold diagnostic imaging in a case vignette that did not satisfy the Ottawa Knee Rule criteria (an ambulatory adolescent with a severe limp who exhibited full range of motion of the knee with no focal tenderness).

Generally, self-reported adherence to the Ottawa Knee Rule was poor. More than one-third (36.2%) of physicians reported never using the guideline, while only 23.4% of physicians used the rule "always" or "most of the time." The most commonly cited barriers to rule implementation were "patient expectations" and "patient satisfaction" (Figure). Other barriers frequently identified included an orthopedics referral requirement and lack of confidence in physical exam findings. Finally, ED physicians reported that the majority (53.2%) of radiographs for knee injury patients were ordered by non-attending physician providers (e.g. residents, triage nurses and physician assistants).

Medical Record Review

The ED billing database query for ICD-9 codes, restricted by target ages and dates, identified 838 patient visits. Upon review of these records, 437 did not have knee trauma, 129 met exclusion criteria, and 12 did not record sufficient information to determine if the Ottawa Knee Rule criteria were met. Consequently, 260 records were eligible for study inclusion. The inter-rater reliability was high (Cohen's kappa = 0.939).The demographics, community setting, and etiology of acute knee trauma in our study population are summarized in Table 1. Of the 260 patients, 198 (76.2%) had a knee radiograph and 1 had a magnetic resonance image (Table 2). Forty-one patients had clinically-significant fractures (39 involving the patella). Only 17 patients returned to the ED within 2 weeks for reevaluation of the same injury. Of these patients, 16 had radiographs at the initial visit and none had a revised diagnosis based on reevaluation. The mean time spent in the ED was 4.1 hours (median 3.4; interquartile range 2.7 hours). Upon excluding the 12 patients who were admitted or taken to the operating room, the mean time was 3.9 hours (median 3.3; interquartile range 2.3 hours). Patients who had a radiograph spent more time in the ED (mean 4.1, median 3.5, interquartile range 2.5 hours) than those who did not (mean 3.2, median 2.8, interquartile range 1.6 hours) ($p < 0.05$).Ottawa Knee Rule criteria fulfillment is summarized in Table 3. While some data were missing from the medical records, all cases had sufficient information to assess rule

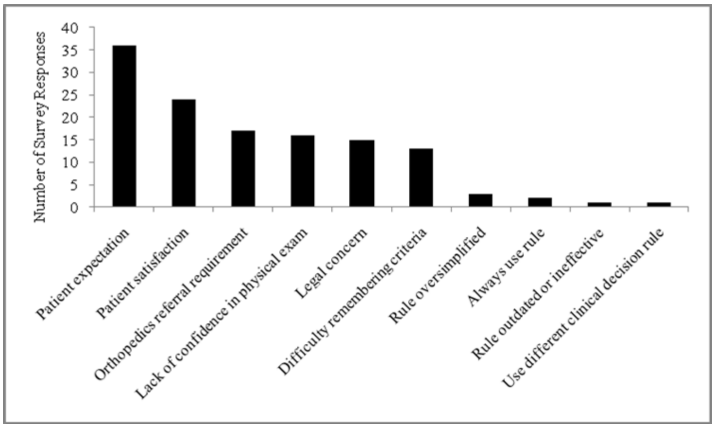

Figure. Self-reported barriers to implementation of the Ottawa Knee Rule.

Table 1. Acute knee trauma patient demographics and injury description.

Characteristic	Value
Age (years)	
Mean (Median)	43.3 (41.5)
Interquartile Range	39
Gender (%)	
Male	51.5
Female	48.5
Insurance (%)	
Yes	80.4
No	19.8
Previous ipsilateral knee injury (%)	7.3
Injury setting (%)	
Home	41.9
Street	24.6
Sports	13.8
Other	10.0
Mechanism of injury* (%)	
Fall	60.4
Twisting	14.6
Direct blow	11.2

*Patient may have more than one mechanism of injury.

Table 2. Acute knee trauma diagnosis.

Characteristic	Value
Radiography performed (%)	76.2
Provider ordering film (%)	
Attending physician	32.3
Resident	21.7
Physician assistant	17.7
Nurse	22.7
Undetermined	5.6
Diagnosis* (%)	
Abrasion	38.8
Fracture	15.8
Ligament injury	14.6
Meniscus injury	10.4
Contusion	9.6
Time spent in ED (hours)	
Mean (Median)	4.1 (3.4)
Interquartile Range	2.7
Returned within 2 weeks (%)	6.5

*Patient may have more than one diagnosis.

fulfillment. Taken together, 65.4% of patients fulfilled at least 1 of the Ottawa Knee Rule criteria and therefore warranted a knee radiograph. Additionally, the rule was 100% sensitive and 40.7% specific for fracture in the 260 cases. We assessed Ottawa Knee Rule compliance by comparing criteria fulfillment with radiograph obtainment (Table 4). Out of 260 cases, 164 had knee radiographs either appropriately obtained or appropriately not obtained, and were therefore considered compliant with the Ottawa Knee Rule. Conversely, 96 cases had knee radiographs either inappropriately obtained or inappropriately not obtained, and were considered noncompliant. Patients who had a radiograph inappropriately obtained spent an average of 3.7 hours (median 3.5; interquartile range 1.7 hours) in the ED. Overall, the rate of Ottawa Knee Rule compliance was 63.1%.

The association between Ottawa Knee Rule compliance and various patient and provider factors is summarized in Table 5. A statistically significant association ($p = 0.01$) was only observed with patient age. Compliance was higher in patients aged 13-18 years old (76.5%) and ≥55 years old (68.7%), as compared to 19-54 year olds (54.0%). No statistically significant ($p<0.05$) differences were noted with provider type, patient gender, patient insurance status, previous ipsilateral knee injury, sports injury or mechanism of injury.

DISCUSSION

To our knowledge, this is the first retrospective record review to analyze Ottawa Knee Rule compliance and potential associations between compliance with provider and patient factors.

The survey response rate was acceptable, and consistent with other surveys targeting physicians.[15] The survey demonstrated that ED physician knowledge of the Ottawa Knee Rule was good, but self-reported adherence was poor. Interestingly, of the 5 vignettes, the scenario with the lowest correct response rate (36.2%) was the only case in which imaging was not indicated according to the Ottawa Knee Rule. That is, despite overall acceptable knowledge of the Ottawa Knee Rule criteria and its application, physicians were still hesitant to withhold imaging. This was also found in our record review, where one-third of radiographs were ordered for patients not meeting any criteria. Furthermore, physicians noted that the primary barriers to Ottawa Knee Rule implementation were related to patient and systems barriers rather than the criteria themselves. The results of our recent survey coupled with the early findings by Graham et al[12] suggest that noncompliance with the Ottawa Knee Rule is currently likely more attributable to systemic concerns, such as orthopedic consultation demands and malpractice implications (as indicated by the "Legal concern" column in Figure), than lack of knowledge. Addressing these systemic concerns is important to maximize adherence to the Ottawa Knee Rule.

Table 3. Ottawa Knee Rule criteria fulfillment.

Criteria	Yes (%)	No (%)	Undetermined† (%)
Age ≥ 55 years	83 (31.9)	177 (68.1)	0 (0)
Isolated patellar tenderness	47 (18.1)	173 (66.5)	40 (15.4)
Fibular head tenderness	4 (1.5)	198 (76.2)	58 (22.3)
Inability to flex knee to 90º	88 (34.2)	157 (60.4)	15 (5.4)
Non-weight bearing after injury and in ED	17 (6.5)	88 (33.8)	155 (59.6)
Criteria met (overall)*	**170 (65.4)**	**90 (34.6)**	**0 (0)**

† Refers to cases where limited or missing data precluded an assessment.
* Indicates cases that met at least one of the Ottawa Knee Rule criteria, thus warranting a knee radiograph.

Table 4. Ottawa Knee Rule compliance as determined by ED medical record review.

Ottawa Knee Rule Criteria	Knee Radiograph	
	Performed	Not Performed
Met	136	35
Not Met	61	28

Poor compliance with the Ottawa Knee Rule, as reported by ED physicians in our survey, was confirmed by retrospective review. This demonstrated a compliance rate of 63.1%. Overall, 76.2% of patients received knee radiographs, consistent with the previously published result of 74% in Stiell et al's[3] retrospective study. Our study population, however, had a fracture rate of 15.8%, which is higher than previously published figures of 6-7%.[2,3] This discrepancy may be due to the fact that 2 of our study hospitals are Level I trauma centers.

Additionally, physician respondents to our survey reported that the majority of radiographs were ordered by non-attending physician providers. Review of medical records confirmed this – only 34.4% of radiographs were ordered by attending physicians, while 24.2% were ordered by residents, 18.8% by nurses, and 22.6% by physician assistants. Recognizing that other healthcare providers influence radiograph ordering, Matteucci et al[16] performed a prospective study in which both physicians and triage nurses were educated on the Ottawa Knee Rule. This training led to 37% and 21% relative reductions in radiograph ordering among physicians and triage nurses, respectively, although triage nurses still ordered 3.6 times more radiographs than physicians. Our hypothesis that rule compliance would be higher when physicians ordered radiographs proved incorrect, as there was no association with provider type. Future educational efforts should target all ED healthcare providers, as well as consulting and follow-up services such as orthopedics, given the significant proportion of radiographs ordered by non-attending physicians.

Table 5. Association of Ottawa Knee Rule compliance with patient and provider factors.

Characteristic	Compliance (%)	N	P (Fisher's Exact)
Provider type*			**0.75**
Attending physician	65.6	64	
Resident	61.9	45	
Nurse	75.6	35	
Physician assistant	71.4	42	
Age			**0.01**†
0-18 years old	76.5	51	
9-54 years old	54.0	126	
>55 years old	68.7	83	
Gender			**0.80**
Male	61.9	134	
Female	64.0	126	
Insurance			**0.75**
Yes	62.5	208	
No	65.4	52	
Previous knee injury			**0.15**
Yes	47.4	19	
No	64.3	241	
Sports-related injury			**0.09**
Yes	75.0	36	
No	61.9	224	
Mechanism of injury**			
Fall	63.7	157	**0.90**
Twisting	65.8	38	**0.86**
Direct blow	65.5	29	**0.84**

* Provider type was undetermined in 12 cases, which have been excluded from above analysis.
† Statistically significant values ($p < 0.05$).
** Patient may have more than one mechanism of injury. Thus, independent p values were calculated.

We further aimed to determine which patient level variables correlated with Ottawa Knee Rule compliance. Patient age was the only factor to have a statistically significant correlation. Compliance was significantly higher in younger (≤ 18 years old) and older (≥ 55 years old) patients, as compared to patients aged 19-54 years. The higher compliance rate in the older group is consistent with the fact that all patients in this age range warrant a radiograph (per rule criteria). Additionally, the higher compliance rate in the

younger group may be attributed to provider hesitation to order imaging in pediatric patients given concerns of radiation exposure.

We also examined whether Ottawa Knee Rule compliance correlated with reduced ED wait times and radiograph ordering. After excluding patients taken to the operating room or admitted to the hospital from the ED, patients who had a knee radiograph spent 53 minutes longer in the ED (mean of 4.1 hours) compared to those who received no radiograph (mean of 3.2 hours). Since this difference was potentially confounded by injury severity, we also performed the analysis after excluding fracture diagnoses. Even after removing these patients, those who had a knee radiograph spent 47 minutes longer in the ED. These figures are comparable to 2 previous studies by Stiell et al,[1,6] which showed that patients receiving knee radiographs spend 33-39 minutes longer in the ED.

Finally, the Ottawa Knee Rule was 100% sensitive and 40.7% specific for fracture in our retrospective study. Our study was not implicitly designed to determine these calculations, as a fracture diagnosis may have been missed in cases where radiographs were not obtained. Of the minority of patients who did return to the ED within 2 weeks with similar complaints, however, none had a missed fracture. These sensitivity and specificity values are consistent with results published in the literature.[7,9]

As noted in multiple reviews, a multi-faceted approach is often the most effective technique in enhancing adherence to clinical guidelines.[17,18] As such, several interventions could be employed to improve Ottawa Knee Rule compliance. For example, reminders could be introduced by incorporating a diagram outlining the Ottawa Knee Rule criteria on ED history and physical examination templates. Alternatively, prompts can be integrated into electronic ordering systems asking the provider whether or not the patient has satisfied rule criteria when ordering a knee radiograph. Similar computerized decision support systems have yielded significant benefits on provider performance outcomes.[19] The results of our study also highlight the importance of focusing these educational and system level efforts not only on attending physicians but all ED providers.

LIMITATIONS

The physician survey and medical record review share certain common limitations. Our ability to generalize our findings is limited since the survey only queried ED attending physicians (it did not query ED nurses, residents, or physician assistants), and the medical records were from three hospitals affiliated with the same academic institution. Additionally, this study investigated an academic emergency medicine population that worked an average of 22.3 clinical hours per week, and consequently may not represent general community emergency physician practices. Specific limitations exist for the online survey. Our response rate of 61.8%, while acceptable for physician surveys, is not ideal.[20] Furthermore, while the questions assessing Ottawa Knee Rule knowledge were carefully designed by the authors, they were not validated or reviewed by a committee to establish face validity. In addition, the clinical vignettes involved patients aged 14-16 years old. Note that although the Ottawa Knee Rule has been validated in the pediatric population, the original study was conducted in patients aged 18 years or older. Additionally, using a more open-ended question when exploring barriers to implementation may have offered more diverse responses, although this would not have necessarily made for a stronger design. Moreover, it is possible that respondents gave socially-desirable answers to the survey that may not reflect their actual practice. This, however, is less likely considering that the survey was administered without being linked to the respondent's name. Several factors also limit our record review. Missing data from records limited our analysis. Furthermore, even in cases where all data was present, it is impossible to determine whether compliance was secondary to coincidence or conscious determination by healthcare providers to employ the decision tool. Nonetheless, this would have the effect of overestimating the adherence rate, suggesting that actual compliance is lower than our results indicate.

CONCLUSION

Compliance with the Ottawa Knee Rule among academic ED healthcare providers is poor. Patient concerns and system issues, rather than issues intrinsic to the rule itself, continue to serve as barriers to proper implementation of this validated decision tool. Addressing these concerns is essential to maximizing guideline adherence and mitigating unnecessary imaging. Improving compliance will require a comprehensive approach involving both education (of attending and non-attending providers alike) and system interventions, such as have been used with other clinical decision rules.

ACKNOWLEDGMENTS

The first two authors contributed equally to this study. Additionally, the authors would like to thank Anthony Nunes for his assistance with the statistical analysis.

Address for Correspondence: Michael J. Mello, MD, MPH, Injury Prevention Center at Rhode Island Hospital, 55 Claverick Street, 2nd Floor, Providence, RI, USA 02903. Email: mjmello@lifespan.org.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Stiell I, Greenberg G, Wells G, et al. Prospective validation of a decision rule for the use of radiography in acute knee injuries. *JAMA.* 1996; 611-15.

2. Tandeter H, Shvartzman P. Acute knee injuries: use of decision rules for selective radiograph ordering. *Am Fam Physician* 1999; 60:2599-608.
3. Stiell I, Wells G, McDowell I, et al. Use of radiography in acute knee injuries: need for clinical decision rules. *Acad Emerg Med.* 1995; 966-73.
4. Verma A, Su A, Golin AM, et al. A screening method for knee trauma. *Acad Radiol.* 2001; 8:392-7.
5. Stiell I, Greenberg G, Wells G. Derivation of a decision rule for the use of radiography in acute knee injuries. *Ann Emerg Med.* 1995; 405-13.
6. Stiell I, Wells G, Hoag R. Implementation of the Ottawa knee rule for the use of radiography in acute knee injuries. *JAMA.* 1997; 2075-9.
7. Bachmann L, Haberzeth S, Steurer J, et al. The accuracy of the Ottawa knee rule to rule out knee fractures: a systematic review. *Ann Intern Med.* 2004; 121-7.
8. Bulloch B, Neto G, Plint A, et al. Validation of the Ottawa Knee Rules in children: A multicenter study. *Ann Emerg Med.* 2003; 48-58.
9. Vijayasankar D, Boyle A, Atkinson P. Can the Ottawa knee rule be applied to children? A systematic review and meta-analysis of observational studies. *Emergency Medicine Journal.* 2009; 26:250-3.
10. Nichol G, Stiell I, Wells G, et al. An economic analysis of the Ottawa Knee Rule. *Ann Emerg Med.* 1999; 438-47.
11. Jenny J, Boeri C, El Amrani H. Should plain X-rays be routinely performed after blunt knee trauma? A prospective analysis. *The Journal of Trauma.* 2005; 1179-82.
12. Graham I, Stiell I, Laupaois A. Awareness and use of the Ottawa knee and ankle Rules in 5 counties: can publication alone be enough to change practice? . *Ann Emerg Med.* 2001; 259-66.
13. McConnochie K, Roghmann K, Pasternack J, et al. Prediction rules for selective radiographic assessment of extremity injuries in children and adolescents. *Pediatrics.* 1990; 45-57.
14. Jackson JL, O'Malley PG, Kroenke K. Evaluation of acute knee pain in primary care. *Ann Intern Med.* 2003; 139:575-88.
15. Balter KA, Balter O, Fondell E, et al. Web-based and mailed questionnaires: a comparison of response rates and compliance. *Epidemiology.* 2005; 16:577-9.
16. Matteucci M, Roos J. Ottawa Knee Rule: a comparison of physician and triage-nurse utilization of a decision rule for knee injury radiography. *J Emerg Med.* 2003; 147-50.
17. Grimshaw JM, Thomas RE, MacLennan G, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technol Assess.* 2004; 8:1-72.
18. Davis DA, Thomson MA, Oxman AD, et al. Changing physician performance. A systematic review of the effect of continuing medical education strategies. *JAMA.* 1995; 274:700-5.
19. Main C, Moxham T, Wyatt JC, et al. Computerised decision support systems in order communication for diagnostic, screening or monitoring test ordering: systematic reviews of the effects and cost-effectiveness of systems. *Health Technol Assess.* 2010; 14:1-227.
20. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. *J Clin Epidemiol.* 1997; 50:1129-36.

Baclofen Withdrawal Presenting as Irritability in a Developmentally Delayed Child

C. Anthoney Lim, MD
Sandra J. Cunningham, MD

Pediatric Emergency Medicine, Jacobi Medical Center/Albert Einstein College of Medicine, Bronx, New York

Supervising Section Editor: Rick A McPheeters, DO
Submission history: Submitted November 29, 2011; Accepted February 2, 2012.
Reprints available through open access at http://escholarship.com/uc/uciem_westjem
DOI: 10.5811/westjem.2011.2.11460

Irritability in children has a broad differential diagnosis, ranging from benign processes to life-threatening emergencies. In children with comorbid conditions and developmental delay, the diagnostic process becomes more challenging. This case report describes a developmentally delayed 14-year-old boy who presented with pain and crying caused by a malfunction of a surgically implanted baclofen pump. We describe recommendations concerning the diagnostic evaluation, medical management, and surgical repair. [West J Emerg Med. 2012;13(4):373-375.]

CASE REPORT

A 14-year-old boy with cerebral palsy, developmental delay and seizures was brought to the pediatric emergency department by his parents for "crying constantly," which began 3 days prior to presentation without apparent reason. The patient had significant cognitive and motor impairment; he was non-verbal and communicated with minimal non-verbal gestures, such as smiles and grimaces. He required assistance for all activities of daily living. Despite administration of ibuprofen at home, his distress increased steadily. Subsequently, he was unable to sleep and had decreased oral intake. The parents denied trauma, fevers, ear discharge, seizure activity, hematuria, dysuria, choking episodes, vomiting, or diarrhea. His last bowel movement on the day prior was soft without any blood. The patient has an intrathecal baclofen pump, which had not alarmed and was examined and refilled two weeks prior by a neurosurgeon at another institution. His parents were unaware of the infusion rate of the baclofen; however, maintenance doses range from 22 micrograms to 1.4 mg daily, depending on patient response. At the time he was taking oxcarbazapine for his seizure disorder; his last seizure was 18 months prior. He had scoliosis and a chronic left hip dislocation. The patient ate a soft pureed diet and some solids by mouth. He had no known drug, food or environmental allergies.

On physical examination, he was crying and appeared uncomfortable, but was intermittently consolable by his parents. His was afebrile, with a heart rate of 145 beats per minute, blood pressure 130/76 mmHg, respiratory rate 18 breaths per minute, and oxygen saturation 99% on room air. His eyes had no excessive tearing; flourescein examination revealed no uptake. No foreign body was visualized in the nares or auditory canals; tympanic membranes bilaterally were normal. The chest was clear and the cardiac examination was only significant for tachycardia. The abdomen was soft, non-tender and non-distended; a baclofen pump was palpable in the right lower quadrant; a rectal examination was normal and stool was guaic negative. Examination of the back revealed scoliosis without pain to palpation along the spine. His penile and testicular examination was normal. His extremity examination revealed a deformity of the left hip and no tenderness to palpation, swelling or erythema along the extremities. No skin lesions were noted. At baseline, he was awake, alert, and responded non-verbally with gestures. He moved his eyes in all four quadrants, had no facial asymmetry, localized sounds and tracked objects by turning his head. He had 5/5 strength in all extremities with minor contractures that could be passively ranged bilaterally. He had 2+ to 3+ reflexes bilaterally without clonus. His neurological examination on the day of presentation was significant for increased tone and spasticity in all four extremities and clonus bilaterally at the ankles.

Complete blood count, urinalysis and serum chemistries were within normal limits. Three milligrams of midazolam was administered intravenously resulting in cessation

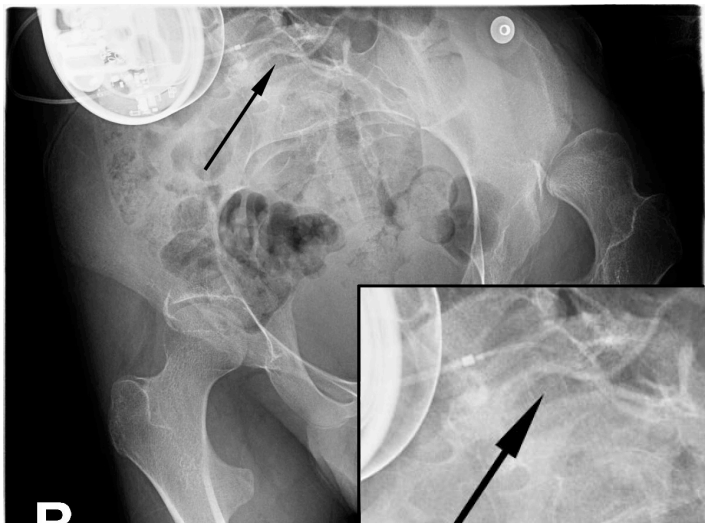

Figure. Radiograph demonstrating chronic left hip dislocation and a discontinuity in baclofen pump catheter (arrow).

of patient's crying, relaxation of the upper and lower extremities, and decreased heart rate and blood pressure. An abdominal and pelvic radiograph revealed a chronic left hip dislocation, and discontinuity of the baclofen pump catheter (Figure). The neurosurgical service was consulted, and computerized interrogation of the baclofen pump via wireless device revealed no recent alarms and a sufficient medication volume in the reservoir. Mechanical interrogation via insertion of a needle into the access port was abnormal, with normal forward flow but an inability to aspirate cerebrospinal fluid. Due to the clinical presentation, radiographic findings, and the results of the mechanical interrogation, the patient was diagnosed with a baclofen pump malfunction secondary to disconnection of the tubing. In the absence of severe withdrawal symptoms, 10 mg of oral baclofen 3 times daily was provided with relief of symptoms, and the patient and family were transferred back to the primary neurosurgeon for definitive repair.

DISCUSSION

In children presenting with irritability, a thorough history and physical examination can often narrow an initially broad differential diagnosis and help the clinician determine the need for further laboratory or imaging studies. Children requiring intrathecal baclofen often have spastic neuromuscular disorders as a result of hypoxic ischemic encephalopathy that occurs at birth or from a significant traumatic brain injury. Additionally, they often have significant comorbid conditions, such as global developmental delay and seizure disorders. These children are also susceptible to respiratory illnesses, complications from previous surgeries, and pathologic orthopedic fractures. Since they may not be able to communicate effectively, the history obtained from caregivers is often limited, and the patient may be unable to respond appropriately to the physician's examination. Therefore, a broad differential diagnosis arises from the common constellation of nonspecific symptoms accompanying irritability. The challenge is compounded by significant comorbidities and the difficulty in obtaining a reliable history and physical examination from a developmentally delayed child.

Infectious processes are often associated with fever; however, localizing signs of infection may be more subtle on physical examination in the significantly impaired child. Evaluation of the tympanic membranes, oropharynx, and skin can identify a child with common infectious causes of pain, such as otitis, pharyngitis, and cellulitis. Special attention should be paid to areas susceptible to decubitus ulcers in children with limited mobility. Critically ill children with meningitis or sepsis may present as toxic and ill appearing with altered mental status and signs of hypoperfusion. It is therefore essential to engage caregivers in the determination of altered mental status, as they will be the best source of the child's baseline status. Intoxications with a wide variety of substances can also cause these concerning symptoms; a history of ingestion or exposure and toxidromic findings on examination can be suggestive of a poisoned child. Intra-abdominal pathologies ranging from constipation to pancreatitis can be associated with symptoms of ileus and localized or peritoneal signs on abdominal examination. A history of decreased and small hard bowel movements, combined with physical findings of stool in the rectal vault, is consistent with constipation. Pancreatitis is diagnosed with a combination of laboratory and radiographic findings in children with a suggestive history and physical examination. Children with surgical conditions, such as appendicitis, intussusception, midgut volvulus, and malrotation, may present with lethargy and ill appearance alone. Along with a history of prior abdominal surgeries and obstructive or infectious symptoms, these conditions are often diagnosed using various radiologic modalities in consultation with pediatric surgeons. In medically complex children with developmental delay, seizures may appear as irritability. Often caretakers will describe alterations in mental status with rhythmic, repetitive movements and post-ictal periods that are consistent with previous seizure patterns in the child. Post-ictal periods will vary among children and include excessive somnolence or a hyperactive agitated state; caregivers may be needed to identify the change from baseline behavior. Renal and reproductive causes of irritability are often acute in onset, severe in quality, and localized to the flank, back, and lower abdomen. It is imperative to perform a genitourinary examination in all impaired boys with irritability, since they will have similar physical findings in testicular torsion but may not localize the pain. The diagnosis of ovarian torsion in non-verbal girls is often directed by a high index of suspicion and consultation with gynecologists. Hematuria and pyuria may accompany pain caused by nephrolithiasis, cystitis, and pyelonephritis. A sterilely obtained urinalysis, culture, and

imaging can differentiate between these causes. Of special note, developmentally delayed children are often diapered or require regular catheterization due to a neurogenic bladder. These populations are especially susceptible to urinary tract infections. In children with limited mobility, pathologic fractures from osteopenia may occur with minimal force, and no history of significant trauma may be elicited. Fractures can be identified in children with swelling, bruising, and pain on palpation at the site of fracture. Ocular trauma, foreign bodies, splinters, and hair tourniquets are common causes of irritability and can be identified by careful examination of the skin and extremities and fluorescein examination of the eyes.

Baclofen is an analog of gaba-aminobutyric acid, which inhibits excitatory neurotransmitter release in the brain and spinal cord.[1,2] Intrathecal delivery of baclofen via a surgically implanted device placed subcutaneously in the abdominal wall with an indwelling spinal catheter, began in the 1990s as a method of reducing spasticity secondary to cerebral palsy. The most common complications include infection and malfunction of hardware, which occur in 9-10% and 21-33% of patients, respectively. Among hardware malfunctions, catheter-related causes predominate.[2-6] Baclofen withdrawal syndrome can occur from 1 to 3 days following cessation of therapy with increased spasiticity, fever, seizures, dysphoria, labile blood pressure, pruritus, and parasthesias. Left untreated, patients may progress to rhabdomyolysis, multi-organ system failure, and death. The differential diagnosis includes sepsis, seizure, neuroleptic malignant syndrome, malignant hyperthermia, autonomic dysreflexia, and other toxic, metabolic, and immune-mediated disorders.[1,7] Diagnosis involves radiographic evaluation of the hardware, computerized interrogation of the device to determine medication volume and presence of any malfunction, and mechanical interrogation via insertion of a syringe transcutaneously into the device port to assay its ability to deliver the medication to the patient. Neurology, neurosurgery, or anesthesia service consultations are often required for the computerized and mechanical interrogation of a suspected malfunctioning device. Treatment includes administration of baclofen and benzodiazepines, orally or intravenously, to reduce symptoms. Because there is no direct conversion from intrathecal to oral or intravenous dosing of baclofen, the dose must be titrated to achieve relief of withdrawal symptoms. Cyproheptadine, a sedating antihistamine with antimuscarinic, serotonin-antagonist, and calcium-channel blocking actions, has also shown some effectiveness among adults in the treatment of acute baclofen withdrawal.[1,8] The usual dose is 4-8 mg every 6-8 hours. In our patient, the initial dose of midazolam resulted in relief of symptoms. Midazolam, a benzodiazepine, is a GABA agonist like baclofen but acts on GABA-A instead of GABA-B receptors; however, it produces a similar effect on spinal reflexes and reduces muscle tone.

Our patient did not have the classic signs of complete bacolfen withdrawal, presenting only with increased spasticity and dysphoria manifested as irritability; more severe signs and symptoms such as hyperthermia, seizures, and labile blood pressures were not present. This may have been due to the partial absorption of baclofen from the discontinuous catheter. Although hardware malfunction must be in the differential diagnosis, a complete examination and careful consideration of other etiologies causing irritability in a nonverbal, medically and cognitively impaired child is warranted. In these children, irritability can be a manifestation of minor to life-threatening conditions, and a concise history and careful physical examination can often determine the underlying cause, and reduce the need for an extensive diagnostic workup.

Address for Correspondence: C. Anthoney E. Lim, MD, Pediatric Emergency Medicine, Jacobi Medical Center/Albert Einstein College of Medicine, 1400 Pelham Parkway South, 1B-25, Bronx, NY 10461. Email: Czer-Anthoney.Lim@NBHN.net

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Salazar ML, Eiland LS. Intrathecal baclofen withdrawal resembling Serotonin syndrome in an adolescent boy with cerebral palsy. *Pediatric Emergency Care*. 2008; 24:691-3.
2. Borowski A, Littleton AG, Borkhuu B, et al. Complications of intrathecal baclofen pump therapy in pediatric patients. *J Pediatr Orthop B*. 2010; 30:76-81.
3. Vender JR, Hester S, Waller JL, et al. Identification and management of intrathecal baclofen pump complications: a comparison of pediatric and adult patients. Journal of Neurosurgery: *Pediatrics*. 2006; 104:9-15.
4. Campbell WM, Ferrel A, McLaughlin JF, et al. Long-term safety and efficacy of continuous intrathecal baclofen. *Dev Med Child Neurol.* 2002; 44:660-5.
5. Awaad Y, Tayem H, Munoz S, et al. Functional assessment following intrathecal baclofen therapy in children with spastic cerebral palsy. *Journal of Child Neurology*. 1998; 88:1009-13.
6. Fjelstad A, Hommelstad J, Sorteberg A. Infections related to intrathecal baclofen therapy in children and adults: Frequency and risk factors. Journal of Neurosurgery: *Pediatrics*. 2009; 4:487-93.
7. Zuckerbraun NS, Ferson SS, Albright AL, et al. Intrathecal baclofen withdrawal: emergent recognition and management. *Pediatric Emergency Care*. 2004; 20:759-64.
8. Meythaler JM, Roper JF, Brunner RC. Cyproheptadine for intrathecal baclofen withdrawal. *Arch Phys Med Rehabil.* 2003; 84:638-42.

Emergency Physician Estimation of Blood Loss

Jeffery C. Ashburn, MD*
Tamara Harrison, BS†
James J. Ham, MD*
Jared Strote, MD, MS‡

* Madigan Army Medical Center, Department of Emergency Medicine, Tacoma, Washington
† University of Washington Medical Center, Department of Medicine, Seattle, Washington
‡ University of Washington Medical Center, Division of Emergency Medicine, Seattle, Washington

Supervising Section Editor: H. Bryant Nguyen, MD, MS
Submission history: Submitted November 9, 2010; Revision received June 13, 2011; Accepted September 19, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.9.6669

Introduction: Emergency physicians (EP) frequently estimate blood loss, which can have implications for clinical care. The objectives of this study were to examine EP accuracy in estimating blood loss on different surfaces and compare attending physician and resident performance.

Methods: A sample of 56 emergency department (ED) physicians (30 attending physicians and 26 residents) were asked to estimate the amount of moulage blood present in 4 scenarios: 500 mL spilled onto an ED cot; 25 mL spilled onto a 10-pack of 4 × 4-inch gauze; 100 mL on a T-shirt; and 150 mL in a commode filled with water. Standard estimate error (the absolute value of (estimated volume – actual volume)/actual volume × 100) was calculated for each estimate.

Results: The mean standard error for all estimates was 116% with a range of 0% to 1233%. Only 8% of estimates were within 20% of the true value. Estimates were most accurate for the sheet scenario and worst for the commode scenario. Residents and attending physicians did not perform significantly differently ($P > 0.05$).

Conclusion: Emergency department physicians do not estimate blood loss well in a variety of scenarios. Such estimates could potentially be misleading if used in clinical decision making. Clinical experience does not appear to improve estimation ability in this limited study. [West J Emerg Med. 2012;13(4):376–379.]

INTRODUCTION

Blood loss in the emergency department (ED) is common. Physicians are frequently required to estimate the loss from hemoptysis, epistaxis, rectal bleeding, vaginal bleeding, and traumatic injury as part of their physical examination and ongoing evaluation. Initial bedside hematocrit can often be a poor indicator of acute blood loss: children have a high physiologic reserve, and many cardiac medications, such as β-blockers and calcium channel blockers, affect the normal response to blood loss. These examples are just a few in which estimation of blood loss can alter the assessment of volume status.

Most prior research on blood loss estimation has evaluated practitioners from other specialties. Obstetricians, general surgeons, trauma surgeons, nurses, and paramedics have all been found to be neither precise nor accurate.[1–6] In a recent study, emergency physicians (EP) and paramedics were given vital signs and mechanism of injury then asked to visually estimate blood loss in trauma scenarios. As in other studies, estimations were again found to be both inaccurate and affected by the patient's presentation.[7]

The objective of our study was two-fold: (1) to examine ED physicians' accuracy when estimating blood loss on different surfaces in a broad and general set of clinically encountered situations; and (2) to perform a pilot study to compare the accuracy of attending and resident physicians in these tasks.

Table 1. Overall performance in blood estimation.

Scenario	T-shirt	Commode	Sheet	Gauze
Actual amount, mL	100	150	500	25
Standard error mean, %	93	160	63	149
Standard error IQ range, %	36–100	33–117	50–82	35–145
Overestimates,* %	34	43	13	34
Mean, mL/percentage error,† %	289/189	605/303	893/79	95/278
Underestimates,‡ %	50	50	84	50
Mean, mL/percentage error, %	43/57	60/60	182/64	13/48
Within 20%,§ %	17	11	11	25

IQ, interquartile; *standard error*, absolute value of ((estimated volume − actual volume)/actual volume × 100).
* Overestimates represent the percentage of respondents guessing above the actual amount.
† The percentage error is the (mean − actual amount)/average amount.
‡ Underestimates represent the percentage of respondents guessing below the actual amount.
§ Within 20% is the percentage of respondents who estimated within 20% of the actual amount.

METHODS

Study Design and Population

A prospective, single-blinded, observational design was used. Participants were emergency physician attending physicians and residents from a single residency program, working in academic hospitals in both urban and suburban settings. Participation was voluntary and a convenience sample of participants was chosen over 4 separate academic meetings.

Study Protocol

Moulage blood was used for all estimations (Ben Nye Stage Blood, Los Angeles, California). Four estimation stations were created: (1) 500 mL of blood spilled onto a standard, white bed sheet, which was spread over an ED bed; (2) 25 mL of blood spilled onto ten 4 × 4-inch gauze sponges; (3) 100 mL of blood spilled on a T-shirt and allowed to dry; and (4) 150 mL of blood added to a commode with 3 L of water. Volumes were chosen to represent a common range of blood loss seen in the ED. Data were collected on 4 separate occasions (grand rounds and faculty meetings) at varying times in order to maximize the number of participating physicians. There was no fundamental difference about the events or the participants at each event.

Physicians were asked to assess each blood loss scenario and estimate the amount of blood loss in milliliters. The same T-shirt and gauze were used for all days. The bed sheet and commode stations were made with fresh blood for each participation group. Subjects were aware of the amount of water that had been in the commode before blood addition. The first bed sheet station created was measured and photographed and subsequent stations were recreated to be as consistent as possible. One researcher interviewed all participants; he presented the scenarios and asked for estimates in the same way for each participant.

Demographic data on gender and years of clinical experience post-MD were also collected.

Verbal consent was obtained; the study was approved by the human subjects division and qualified for exemption from federal regulations for the protection of human subjects at all participating institutions.

Data Analysis

Estimate error for each group was standardized by converting to percentage error (ie, the absolute value of: estimated volume − actual volume/actual volume × 100). Attending physicians' and residents' performances were compared by using the unpaired student *t* test (IBM SPSS Statistics, version 18, Chicago, Illinois).

RESULTS

A total of 56 subjects participated; all verbally consented and completed all 4 stations.

Of the participants, 64% were male (2 did not choose a gender). The median experience among the 30 attending physicians (54%) who participated was 8 years (first/third quartile = 6/21; 3 did not respond) and the median experience among the 26 residents was 2 years (first/third quartile = 0.5/2.5; 7 did not respond).

Overall standard error averages and interquartile ranges for each scenario are listed in Table 1. For all scenarios combined, mean standard error was 116% with a range from the rare correct answer to 1,233%. Only 8% of estimates were within 20% of the correct answer, while 70% of estimates were within 100% of the correct answer.

Other than for the sheet station, there was not a strong trend toward underestimation or overestimation; underestimates were 50% for the T-shirt station, 50% for the commode station, 84% for the sheet station, and 50% for the gauze station. Only 16% of all estimates were within 20% of the true value.

Table 2 compares attending physician and resident performance for each scenario. In general, attending physicians had less mean error and less extremes of error. Although no

Table 2. Comparison of attending physician and resident performance.

Scenario	T-shirt	Commode	Sheet	Gauze
Actual amount, mL	100	150	500	25
Attending mean std error, %	65	114	65	103
Resident mean std error, %	125	213	62	202
Attending std error IQ range,%	29–78	62–100	50–86	40–100
Resident std error IQ range, %	50–188	33–484	50–80	20–300
Std error mean difference,* %	59	99	−3	99
95% CI, %	0–119	−33–230	−17–11	−19–217
P value	0.05	0.12	0.67	0.10

CI, confidence interval; *IQ*, interquartile; *std error*, absolute value of ((estimated volume − actual volume)/actual volume × 100).
* Resident mean standard error – attending physician mean standard error.

significant difference was found, trends toward superior attending physician accuracy were seen in each scenario except the sheet station.

DISCUSSION

This study adds to the literature showing that ED physicians, like other specialists,[1–7] do not estimate blood loss well on a variety of surfaces. The large range of answers seen suggests that physicians are imprecise in addition to being inaccurate. This is consistent with prior studies that have examined other specialties' estimates of blood loss in a variety of scenarios, including active patient blood loss,[1–3, 6] blood spilled on the ground,[5] blood spilled onto drapes and sponges,[4] blood placed in a commode,[8] and blood loss estimated at the scene of trauma.[7]

Estimates ranged widely, averaging more than 100% off from the actual amounts. Prior studies have suggested that health professionals tend to overestimate small losses (<150 mL) and underestimate large ones (>150 mL).[3,5–8] Our study found similar results. Comparing the larger blood loss on the bed sheet scenario (500 mL) to the smaller blood loss in the T-shirt scenario (100 mL), there were considerably more underestimates with the larger loss.

The commode and gauze scenarios present an additional challenge of estimating blood in a larger body of fluid and in a very small quantity, respectively; this led to a greater range of answers and more evenly distributed overestimates and underestimates. Patients with complaints of heavy vaginal bleeding or rectal bleeding frequently report blood loss while on the commode and occasionally ask physicians to evaluate losses. This may have clinical relevance because physicians may be just as inaccurate when making estimations in this scenario. Also, EPs are poor at estimating small losses and gauze saturation. Gauze is frequently used to absorb blood during epistaxis, and we observe that ongoing losses could significantly affect the estimation of cumulative loss. It is worthwhile for practitioners to be aware of the further decreased precision and accuracy in these types of situations.

The present study had similarities to a prior study that examined estimations of blood loss made by ED patients.[9] Nearly identical commode, T-shirt, and gauze scenarios were presented. It is notable that resident and attending EPs had approximately one half and one quarter, respectively, of the average and standard deviation of standard error demonstrated by the patients. This difference makes intuitive sense, as making clinically relevant estimates and observing known quantities of various liquids is part of the day-to-day practice of the emergency physician; it is notably different from a prior study that showed no significant difference between physicians and patients estimating blood in a commode.[8]

No significant difference was found between resident and attending physician performance on each test, consistent with a prior study looking at paramedics with different levels of experience.[5] There was, however, a strong trend toward superior attending physician performance, with residents demonstrating approximately double the mean error in all scenarios but the bed sheet. Also, there was no significant difference when comparing gender within the scenarios, although the small numbers used likely did not have the power to show a difference; other studies have not found a gender difference.[9] Whether there would be utility in instituting some form of training is unclear. In the study by Moscati et al[5], the blood loss was revealed to the subjects in the study, then slide show presentations were used to train subjects on the appearance of various amounts of blood loss. The subjects were retested at a later date and found to have significantly improved. Given that small effort may lead to large estimation improvement, further research should consider training programs for physicians and how to incorporate these into emergency medicine (EM) or advanced trauma life support training.

The potential clinical relevance of misusing estimations of blood does exist, especially in early evaluation when the hematocrit is unreliable, when multiple different observers are making continued mistakes, in children whose total body blood volume is lower, and for the elderly or those taking medications

that may change the physiologic response to blood loss. Given these situations, we feel that there is value in creating awareness about common conditions causing overestimates and underestimates and the overall inaccuracy of EPs in making and using such estimates in clinical care.

LIMITATIONS

Our study has numerous limitations. Our results may not accurately reflect estimations of actual blood loss in the clinical setting. The study also does not reflect real-life situations in which mechanism of injury and vital signs can influence estimates. However, a prior study has shown physicians are no better when given this information.[7]

Because our study was unblinded to the investigators, bias could have been introduced in the way the study was presented to each patient. Also, physicians could not spread the blood or use other hands-on techniques for estimating blood loss because this would affect the scenario for other subjects. Scenarios that were created each day may have had small but important differences, affecting estimates in some way.

The physicians in this study came from 1 residency program in 1 geographic location in the United States; the study may not reflect the estimation skills of physicians in other academic programs, community settings, or other geographic areas.

Finally, this pilot study was not prospectively powered and the sample sizes used may not have been large enough to show a difference between attending physicians and residents.

CONCLUSION

Blood loss estimates are frequently made by EPs. Like all historical findings, such estimates could potentially be useful as 1 piece in an array of historical points, physical examination findings, and laboratory data results, in an effort to create a complete picture of the severity of the process. This and prior studies suggest that blood loss estimates are difficult for patients and healthcare providers alike, and interpretation of these numbers should therefore be made with extreme caution, if used at all. Further study may be warranted on the effect of blood estimation in clinical decision making, as well as the value of adding estimation skills to EM training.

Address for Correspondence: Jared Strote, MD, MS, University of Washington Medical Center, Division of Emergency Medicine, Box 356123, 1959 NE Pacific St, Seattle, WA 98195. E-mail: strote@u.washington.edu.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Brant HA. Precise estimation of postpartum haemorrhage: difficulties and importance. *Br Med J*. 1967;1:398–400.
2. Duthie SJ, Ven D, Yung GL, et al. Discrepancy between laboratory determination and visual estimation of blood loss during normal delivery. *Eur J Obstet Gynecol Reprod Biol*. 1991;38:119–124.
3. Larsson C, Saltvedt S, Wiklund I, et al. Estimation of blood loss after cesarean section and vaginal delivery has low validity with a tendency to exaggeration. *Acta Obstet Gynecol Scand*. 2006;85:1448–1452.
4. Meiser A, Casagranda O, Skipka G, et al. Quantification of blood loss. How precise is visual estimation and what does its accuracy depend on [article in German]? *Anaesthesist*. 2001;50:13–20.
5. Moscati R, Billittier AJ, Marshall B, et al. Blood loss estimation by out-of-hospital emergency care providers. *Prehosp Emerg Care*. 1999;3:239–242.
6. Razvi K, Chua S, Arulkumaran S, et al. A comparison between visual estimation and laboratory determination of blood loss during the third stage of labour. *Aust N Z J Obstet Gynaecol*. 1996;36:152–154.
7. Frank M, Schmucker U, Stengel D, et al. Proper estimation of blood loss on scene of trauma: tool or tale? *J Trauma*. 2010;69:1191–1195.
8. Simpson RR, Kennedy ML, Chew SB, et al. Do patients assess rectal bleeding accurately? *ANZ J Surg*. 2001;71:650–651.
9. Strote J, Mayo M, Townes D. ED patient estimation of blood loss. *Am J Emerg Med*. 2009;27:709–711.

Allergic Dermatitis Due to Topical Antibiotics

Jonathan H. Shahbazian, BS
Tristan L. Hartzell, MD
Amit K. Pandey, BS
Kodi K. Azari, MD

David Geffen School of Medicine at UCLA, Department of Orthopedic Surgery, Los Angeles, California

Supervising Section Editor: Sean Henderson, MD
Submission history: Submitted July 11, 2011; Revision received August 17, 2011; Accepted September 6, 2011
Reprints available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2011.9.6851

In this report we present a case of allergic dermatitis from chronic use of antibiotic ointment mistakenly diagnosed as a localized finger infection. [West J Emerg Med. 2012;13(4):380–382.]

INTRODUCTION

Allergic/irritant dermatitis can commonly be mistaken by healthcare providers as an infection. Dermatologic reactions secondary to use of topical antibiotic ointment are commonly encountered yet scarcely reported. The purpose of this article is to present a case report of allergic dermatitis from chronic use of topical triple antibiotic ointment (neomycin-polymyxin-bacitracin) mistakenly diagnosed as a bacterial cellulitis despite evaluation by multiple physicians.

CASE REPORT

A 45-year-old right hand dominant male carpenter was referred to our hand center with the diagnosis of chronic and refractory infection of the right long finger (Figures 1 and 2). Six months prior to our evaluation he had removed a "large wood splinter" from his fingertip. He self-treated his wound with hydrogen peroxide soaks and topical antibiotic ointment (neomycin-polymyxin-bacitracin). Over the next month, he experienced progressively worsening erythema, edema, and pain in his digit. He sought medical treatment at an urgent care facility where he was diagnosed with localized cellulitis and was prescribed a 10-day oral course of cephalexin.

Several weeks later, concerned with the lack of symptom relief, the patient presented to an emergency department. A bedside incision and drainage of the volar fingertip was performed, and no gross purulence was expressed. However, with suspicion for infection, he was again discharged with an additional course of oral amoxicillin-clavulanate. Over the next 4 months, the patient was evaluated on 3 separate occasions for his persistent finger complaints, and each time was placed on a short course of oral antibiotics for presumed finger infection.

Upon presentation to our facility 6 months after his initial injury, the patient's finger had fusiform edema distal to the metacarpal phalangeal joint. He had virtually no ability to actively flex at the interphalangeal joints secondary to edema and moderate pain. Proximally, the digit had some vesicular blistering with frank skin desquamation distally, giving the finger a beefy red appearance. There were no areas of fluctuance or suspected abscess (Figure 1). Radiographs of the hand revealed no undiagnosed fractures, dislocations, subcutaneous air, or retained foreign bodies. Additionally, there were no signs of bone reaction suggestive of osteomyelitis. Our working diagnosis was a chronic infection from atypical mycobacteria or fungus, herpetic whitlow with bacterial super infection, or contact dermatitis.

Our patient work-up revealed normal inflammatory markers including white blood cell count, erythrocyte sedimentation rate, C reactive protein, and a negative rapid herpes simplex test. In the operating room, routine topical tissue cultures were obtained and additional tissue biopsy specimen for culture and microscopic evaluation was sent to dermatopathology. The desquamated skin was removed and no retained foreign bodies were found within the soft tissues.

The results of the intraoperative Gram stains revealed no organisms and few white blood cells. The final fungal, acid-fast bacilli, varicella zoster virus, aerobic and anaerobic cultures were negative.

The dermatopathology findings were consistent with an allergic contact dermatitis with hematoxylin and eosin stain revealing epidermal hyperplasia with mild spongiosis, lymphocytic and eosinophilic exocytosis, degranulation of eosinophils at the dermoepidermal junction, and moderately

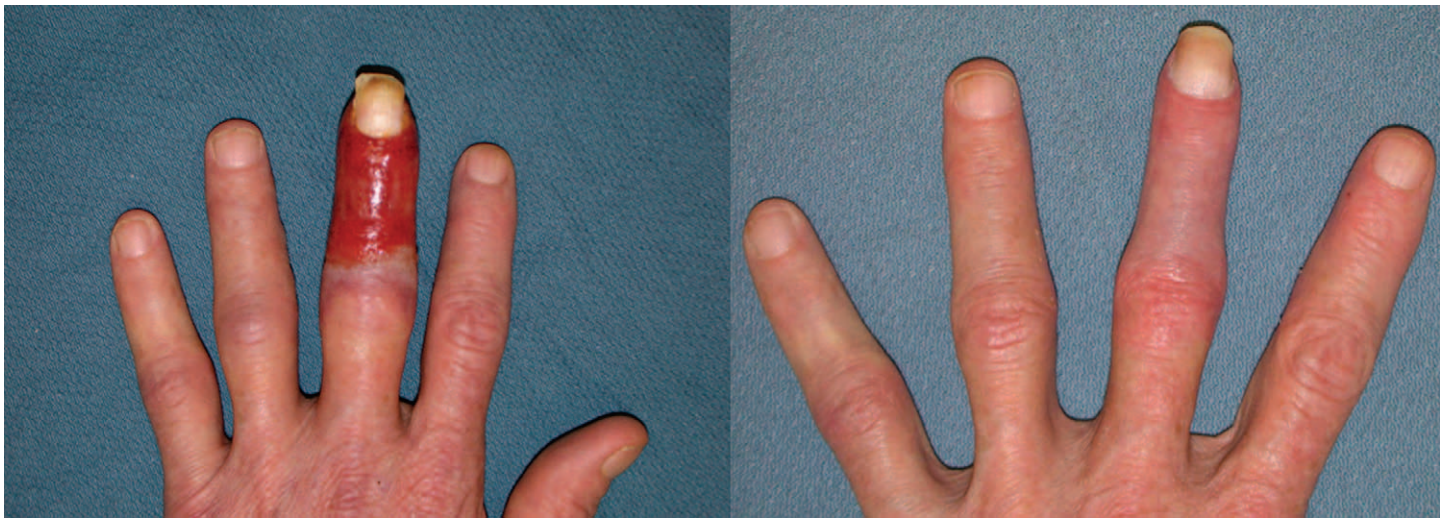

Figure 1. Initial presentation and 2-week follow-up of affected hand. The affected hand at initial presentation to our clinic is shown on the left. The affected hand at the 2-week follow-up is shown on the right.

dense superficial to deep perivascular lymphocytic infiltrate with scattered eosinophils (Figure 2). Additional immunostains for varicella zoster virus, herpes simplex virus, fungi, and bacteria were also negative.

Given these findings, administration of a topical steroid (clobetasol propionate 0.05%) was initiated in addition to cessation of the antibiotic ointment. With these treatment recommendations the patient experienced rapid improvement of his symptoms. At his 2-week follow-up appointment his range-of-motion, edema, pain, and erythema had dramatically improved (Figure 1). At final follow-up 4 weeks following our treatment recommendations, digit range of motion and appearance had completely normalized.

DISCUSSION

Allergic contact dermatitis is a common condition often confirmed by identification of the allergen on patch testing. Exposure to the allergenic substance leads to significant disruption of the skin barrier resulting in localized erythema, pruritus, pain, and edema. Repeated offenses by the causative agent or additional substances prevent the skin from healing and produce a cumulative contact dermatitis that further compromises the protective function of the skin. The incidence of hand involvement is estimated to be 4.1 cases per 10,000 persons.[1]

A number of causes of hand dermatitis have been identified. In 2007, the North American Contact Dermatitis Group performed a cross-sectional analysis of over 950 patients suffering from allergic contact dermatitis of the hand and found neomycin sulfate as well as bacitracin to be 2 of the top 12 causes of hand dermatitis (7.7% and 7.4% of all hand cases, respectively).[2] Sensitization to neomycin may be associated with vehicle type[3] and duration of use.[4,5] Furthermore, simultaneous contact allergy to all 3 ingredients of triple antibiotic ointment has been reported in the literature.[6]

While allergic contact dermatitis is a common entity affecting the hand, it can be misdiagnosed as a hand infection due to several noteworthy factors. First, there is close proximity in time between the inciting trauma and the resulting application of antimicrobial ointment. Over-the-counter topical antibiotic preparations are frequently applied early in the clinical course by patients who are concerned of risk for infection due to skin breakage. Second, the physical signs and symptoms of allergic contact dermatitis, ie, erythema, pruritus,

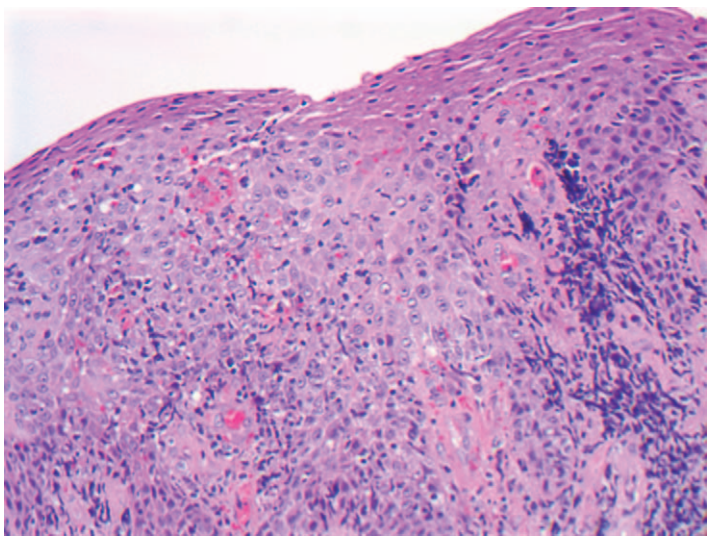

Figure 2. Hematoxylin and eosin stain of tissue biopsy specimen (40×) revealing epidermal hyperplasia with mild spongiosis, lymphocytic and eosinophilic exocytosis, degranulation of eosinophils at the dermoepidermal junction, and moderately dense superficial to deep perivascular lymphocytic infiltrate with scattered eosinophils.

edema, pain, and vesicle formation, can mimic the signs and symptoms concerning for a severe hand infection. To further complicate matters, repeated exposure to an allergenic compound may compromise the barrier function of the epidermis leading to secondary infection of the hand or digits.

The efficacy of topical antibiotic preparations in treating and preventing various skin infections has been well demonstrated in the literature.[7–10] A recent article proposes that triple antibiotic ointment may prove an attractive alternative to oral antibiotics in select cases of skin wound management because resistance does not develop readily.[11] Then again, in a previous study by Smack et al,[12] no clinically significant differences in postoperative infection rates or wound healing were found between those treated with white petrolatum and bacitracin ointment.

The debate about the role for topical antibiotic preparations is unlikely to diminish. Therefore, it is advantageous to outline strategies to avoid the misdiagnosis of allergic contact dermatitis. Especially in cases of chronic, repeat, or relapsing hand infection, it becomes incumbent upon the physician to invest the time necessary to obtain a thorough history detailing the initial event and all treatments, prescribed or otherwise, which the patient has since used. Barring complicating comorbidities, infections treated empirically with oral or parental antibiotics should begin to show clinical response within 48 to 72 hours of administration. In the event that clinical response to treatment is not evident or components of the clinical picture do not seem to fit, the physician should maintain a very low threshold for obtaining a biopsy and sending tissue specimen for pathologic diagnosis.

Address for Correspondence: Jonathan H. Shahbazian, BS, David Geffen School of Medicine at UCLA, Department of Orthopedic Surgery, 10945 Le Conte Ave, Rm 33-55G PVUB, Los Angeles, CA 90095. E-mail: jshahbazian@gmail.com.

Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

REFERENCES

1. Dickel H, Kuss O, Schmidt A, et al. Importance of irritant contact dermatitis in occupational skin disease. *Am J Clin Dermatol*. 2002;3: 283–289.
2. Warshaw EM, Ahmed RL, Belsito DV, et al. North American Contact Dermatitis Group. Contact dermatitis of the hands: cross-sectional analyses of North American Contact Dermatitis Group Data, 1994–2004. *J Am Acad Dermatol*. 2007;57:301–314.
3. Bjarnason B, Flosadottir E. Patch testing with neomycin sulfate. *Contact Dermatitis*. 2000;43:295–302.
4. Leyden JJ, Kligman AM. Contact dermatitis to neomycin sulfate. *JAMA*. 1979;242:1276–1278.
5. Prystowksy SD, Allen AM, Smith RW, et al. Allergic contact hypersensitivity to nickel, neomycin, ethylenediamine, and benzocaine: relationships between age, sex, history of exposure, and reactivity to standard patch tests and use tests in a general population. *Arch Dermatol*. 1979;115:959–962.
6. Grandinetti PJ, Fowler JF. Simultaneous contact allergy to neomycin, bacitracin, and polymyxin. *J Am Acad Dermatol*. 1990;23:646–647.
7. Bass JW, Chan DS, Creamer KM, et al. Comparison of oral cephalexin, topical mupirocin and topical bacitracin for treatment of impetigo. *Pediatr Infect Dis J*. 1997;16:708–710.
8. Ealls LD, Mertz PM, Piovanetti Y, et al. Topical antibiotic treatment of impetigo with mupirocin. *Arch Dermatol*. 1986;122:1273–1276.
9. Davis S, Cazzaniga A, Eaglstein W, et al. Over-the-counter topical antimicrobials: effective treatments? *Arch Dermatol Res*. 2005:297: 190–195.
10. Dire DJ, Coppola M, Dwyer DA, et al. Prospective evaluation of topical antibiotics for preventing infections in uncomplicated soft-tissue wounds repaired in the ED. *Acad Emerg Med*. 1995;2:4–10.
11. Bonomo RA, Van Zile PS, Li Q, et al. Topical triple-antibiotic ointment as a novel therapeutic choice in wound management and infection prevention: a practical perspective. *Expert Rev Anti Infect Ther*. 2007;5: 773–782.
12. Smack DP, Harrington AC, Dunn C, et al. Infection and allergy incidence in ambulatory surgery patients using white petrolatum vs bacitracin ointment. A randomized controlled trial. *JAMA*. 1996;276:972–977.

Exciting Academic Opportunity

FACULTY

The Baylor College of Medicine, a top medical school, has recently developed an Emergency Medicine Program & Residency in the world's largest medical center. We are recruiting stellar Emergency Medicine BC/BE Clinician Educators and Clinician Researchers at all academic ranks who will be an integral part of building the future of Emergency Medicine at BCM. We offer a highly competitive academic salary and benefits.

The program is based out of Ben Taub General Hospital, a busy Level 1 trauma center in the heart of Houston that sees more than 100,000 emergency visits per year. BCM is affiliated with eight world class hospitals and clinics in the renowned Texas Medical Center. These affiliations, along with the medical school's preeminence in research, help to create one of the strongest emergency medicine programs/experiences in the country.

FELLOWSHIPS

The program also recruits annually for the following fellowship programs: Ultrasound, Global Health, Emergency Medical Services/ Disaster Services, and Administration.

Those interested in a position or further information may contact Dr. Hoxhaj via email hoxhaj@bcm.edu or by phone at 713-873-2626.

BCM
Baylor College of Medicine

Excellent Career Opportunity

Academic Emergency Medicine Physician

The Department of Emergency Medicine at the University of Illinois Hospital & Health Sciences System is recruiting a full-time academic Pediatric/Emergency Medicine (EM) Assistant, Associate, or Full Professor/Physician with dual board certification or Pediatric board certification plus EM fellowship training. This position can be tenured/tenured track or non tenured. The successful applicant will play a leadership role in growing a pediatric EM clinical and educational program that spans four Chicago hospitals. Specific responsibilities encompass quality and process improvement, healthcare integration, department design, professional development of pediatric and emergency medicine residents and fellows, competency assessment, outreach and community growth. Applicants with a research background in health outcomes or disparities (e.g. asthma, sickle cell disease, toxicology) will be strongly considered. Our faculty is committed to excellence in quality of care, efficiency of delivery, and continuous process improvement and education. Research efforts focus on the identification and elimination of community health disparities through patient focused, time-sensitive care and preventive emergency medicine. The University of Illinois is the largest university in the Chicago area. With several nationally-ranked health sciences schools, we offer an unprecedented opportunity for multi-disciplinary care, education and research.

Applicants should complete an online application at
https://jobs.uic.edu/job-board/
Job posting will remain open until position has been filled.

The University of Illinois is an AA/EOE and is committed to increasing the diversity of its faculty.

SCHOOL OF MEDICINE
UNIVERSITY of CALIFORNIA • IRVINE
Discover • Teach • Heal

EM FACULTY DEVELOPMENT / EDUCATION FELLOWSHIP

UNIVERSITY OF CALIFORNIA, IRVINE SCHOOL OF MEDICINE

University of California, Irvine, Department of Emergency Medicine (EM) is seeking a HS Clinical Instructor- Faculty Development and Education Fellow for July, 2013. University of California, Irvine Medical Center is a Level I Trauma center with 2800 runs/year, 40,000 ED census with a nationally recognized three-year residency program since 1989. Fellowship concentrations could include residency and /or medical school curriculum design and education, use of instructional technology, *Western Journal of EM* editing and publishing. This two-year fellowship requires completion of a Masters degree in Education, Translational Science or Public Health. One-year fellowship is available for those with a Master degree or starting one during the fellowship. Completion of an ACGME accredited EM Residency required. Salary is commensurate with qualifications and proportion of clinical effort.

Send CV and statement of interest to Fellowship co-Directors:
Shahram Lotfipour, MD, MPH at shahram.lotfipour@uci.edu, 714-456-2326
Bharath Chakravarthy, MD, MPH at bchakrav@uci.edu, 714-456-6986

University of California, Irvine Medical Center
Department of Emergency Medicine
101 The City Drive, Route 128-01
Orange, CA 92868

See the Department of Emergency Medicine's website available at
http://www.emergencymed.uci.edu/fellowships.asp for more details.

The University of California, Irvine is an equal opportunity employer committed to excellence through diversity.

SCHOOL OF MEDICINE
UNIVERSITY of CALIFORNIA • IRVINE
Discover • Teach • Heal

EMS and Disaster Medicine Fellowships

University of California Irvine, Department of Emergency Medicine is seeking applicants for fellowships in EMS and Disaster Medical Sciences for July 1, 2013. UCI Medical Center is a Level I Trauma center with 2800 runs/year and a 40,000 ED census. Fellows serve as HS Clinical Instructors. The programs emphasize: 1) EMS systems practice and research including regionalization of stroke/cardiac care and 2) emergency management/disaster medicine and international response. Completion of American Council of Graduate Medical Education (ACGME) accredited Emergency Medicine Residency required prior to start. One and two year programs are available and will be jointly administered by Director, Emergency Medical Services and Disaster Medicine. The two-year programs require a Masters degree. Salary commensurate with level of clinical work. Send CV, statement of interest and three letters of recommendation to: Carl Schultz, MD.

Department of Emergency Medicine, Rte. 128, UC Irvine Medical Center, 101 The City Drive South, Orange, CA 92868.

The University of California, Irvine is an equal opportunity employer committed to excellence through diversity.

SCHOOL OF MEDICINE
UNIVERSITY of CALIFORNIA • IRVINE
Discover • Teach • Heal

EMERGENCY MEDICINE SIMULATION FELLOWSHIP

UNIVERSITY OF CALIFORNIA, IRVINE SCHOOL OF MEDICINE

University of California, Irvine, Department of Emergency Medicine (EM) is seeking a HS Clinical Instructor- Medical Simulation Fellow for July, 2013. University of California, Irvine Medical Center is a Level I Trauma center with 2800 runs/year, 40,000 ED census with a nationally recognized three-year residency program since 1989. The UC Irvine Medical Education Simulation Center is a new $40 million, 65,000-square-foot facility that provides telemedicine and simulation-based educational programs and CME courses for thousands of healthcare providers each year. The four-story simulation center includes a full-scale operating room, emergency room, trauma bay, obstetrics suite and critical care unit. The Medical Simulation Fellowship is a one year mentored fellowship that offers advanced training in simulation teaching, curriculum design, educational program implementation, study design, and research for a graduate of an accredited Emergency Medicine residency program. Salary is commensurate with qualifications and proportion of clinical effort.

Send CV and statement of interest to Fellowship Director:
C. Eric McCoy, MD, MPH at cmccoy@uci.edu

University of California, Irvine Medical Center
Department of Emergency Medicine
101 The City Drive, Route 128-01
Orange, CA 92868

The University of California, Irvine is an equal opportunity employer committed to excellence through diversity.

SCHOOL OF MEDICINE
UNIVERSITY of CALIFORNIA • IRVINE
Discover • Teach • Heal

University of California, Irvine, Department of Emergency Medicine seeks a Health Sciences Clinical Instructor. This is an ongoing recruitment. University of California, Irvine is a Level I Trauma center with 2800 runs/year, 40,000 ED census. Academic department with Division of Emergency Ultrasound since 2001. Director is fellowship trained and RDMS certified. Three other faculty are RDMS. Outside resident and med student emergency Ultrasound rotation established. Research, teaching and clinical environment. Clinical schedule of eight 10-hour shifts per month. Salary commensurate with level of clinical work. 1200 scans/year anticipated along with tape review of 4000 more. RDMS certification expected upon completion of the fellowship. Prior experience not required. Please send CV, statement of interest and three letters of recommendation to: J Christian Fox, MD RDMS. Department of Emergency Medicine, Route 128, UC Irvine Medical Center, 101 City Drive South, Orange, CA 92868.

The University of California, Irvine is an equal opportunity employer committed to excellence through diversity.

"I'm very fortunate that I chose a group that makes me happy and whose leadership I respect and want to be part of."

"I had a preconceived notion that large groups weren't the best option for new physicians out of residency. But CEP America is definitely different from other large medical practices out there."

—Tiffany Hackett, MD
ED Medical Director
San Leandro Hospital

Find out why CEP America is different.
Hear Tiffany's story by visiting
info.cep.com/tiffanystory

Your Life. Your Career. Your Partnership.

CEP America®

36TH ANNUAL EMERGENCY MEDICINE IN YOSEMITE & ULTRASOUND WORKSHOP

CALIFORNIA ACEP
AMERICAN COLLEGE OF EMERGENCY PHYSICIANS

JANUARY 16–19, 2013
CALIFORNIAACEP.ORG

YOSEMITE LODGE AT THE FALLS
AND THE AHWAHNEE HOTEL
YOSEMITE NATIONAL PARK, CA