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Western Journal of Emergency Medicine:

Integrating Emergency Care with Population Health

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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 technology solutions, is critical to enhancing population health.

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Advertising Emergency Department Wait Times

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Advertising emergency department (ED) wait times has become a common practice in the United States. Proponents of this practice state that it is a powerful marketing strategy that can help steer patients to the ED. Opponents worry about the risk to the public health that arises from a patient with an emergent condition self-triaging to a further hospital, problems with inaccuracy and lack of standard definition of the reported time, and directing lower acuity patients to the higher cost ED setting instead to primary care. Three sample cases demonstrating the pitfalls of advertising ED wait times are discussed. Given the lack of rigorous evidence supporting the practice and potential adverse effects to the public health, caution about its use is advised. [West J Emerg Med 2013;14(2):77-78.]

By now, you've probably seen one – a billboard advertising a hospital, prominently displaying its emergency department (ED) wait time. The billboards have been adopted by hospitals around the country as a means of advertising their services. Often, the displayed wait time is short, and the billboards are designed to steer low-acuity, but insured, patients to the ED by demonstrating convenience. But are these ads truly harmless?

Proponents of this practice state that it is a powerful marketing strategy that can help steer patients to the ED, thus potentially increasing hospital revenue.[1] Likewise, the practice can decompress overburdened hospital systems, as patients with less acute problems are hypothesized to take the additional time to drive to a hospital that may not be closer to them, but has less wait time.[2] One hospital system reported posting wait times of other local EDs in its waiting room, so that if patents wish to leave and go to a nearby affiliated hospital with a shorter wait time they have that possibility.[3] Supporters of this technology state that it smooths the "peaks and valleys" in ED volume that occur throughout the day.[3]

THREE CASES

A 60-year old man decides to leave work early because he experiences chest discomfort. He is a minimizer, and doesn't share his symptoms with his colleagues apart from telling them that he feels unwell and is leaving early. While driving home, he notices a billboard for a local ED, which publishes a wait time of 60 minutes. Not wanting to wait that long, he proceeds to drive another 10 miles up the road where he knows that there is another hospital. His trip is cut short as he develops a ventricular fibrillation cardiac arrest, veers off the road, and dies.

A 25-year old woman sees a sign advertising a wait time of 30 minutes and decides to go to the ED for a sore throat and rhinorrhea she has had for the past 2 days. As soon as she arrives, a multi-car pile-up occurs on the adjacent highway, causing the ED staff to dedicate all of its available resources to multiple acute trauma victims that suddenly present. The woman is finally evaluated 2 hours after arrival, is diagnosed with a viral upper respiratory infection and over-the-counter medications are recommended. She leaves frustrated and unsatisfied.

A 50-year old man with hypertension ran out of his anti-hypertensive medication. The patient neglected to make a follow-up appointment with his physician because he remembered seeing the advertisement for the nearby ED that had a short wait time and did not require an appointment. When he goes, the emergency physician agrees to write a 10-day prescription for his medication, encouraging the patient to follow-up with his physician for routine care. The patient does just that, but his insurance is billed for the cost of his ED visit.

The first case is hypothetical and can never be proven. Still, advertising a single wait time can be misleading. There are no clear standards regarding what the advertised time represents. Is it time from arrival to seeing the triage nurse, to being placed in a room, to quickly saying "hello" to a physician, or to a comprehensive evaluation? Furthermore, advertised wait times

represent an average number and defeat the purpose of triage, where patients are evaluated based on the time-sensitivity of their medical condition and not on the order upon which they arrive to the ED. This fact may not be immediately clear to a layperson that sees a number on a billboard.

Although it can be argued that the second patient should have sought primary care instead of the emergency department, this option is not always possible and it is difficult to determine if the patient had an emergent condition without actually being evaluated. Still, such a patient would undergo standard triage and would have to wait should a patient with a more emergent condition present in the interim. Given the dynamic environment of the ED, it seems impossible to predict a wait time knowing that sicker patients can present at any time.

For the third patient, primary care from the start would have been ideal. The CDC has reported that 7.9% of ED visits are non-urgent.[4] If this patient presents with a request for a medication with normal vital signs and no symptoms, then this visit was probably not appropriate for the ED. Advertising wait times to attract patients such as this one may please the hospital administration and inflate revenue, but it fundamentally undermines the key mission of emergency medicine that predicates being available 24/7/365 for any concern of an emergent or urgent condition that a prudent layperson may have and wastes healthcare dollars.

In actuality, wait times mean little. A patient may be seen in an expeditious fashion, but the workup that the emergency physician orders may take a prolonged time if there are laboratory or radiology inefficiencies. The advertised number doesn't explain that a patient might need to be transferred or have care deferred to a follow-up visit should a certain specialist (e.g. neurosurgeon) or imaging modality (e.g. magnetic resonance imaging) be unavailable. The wait time number does not describe the time a patient who is admitted may have to wait if there is ED crowding as a byproduct of lack of inpatient bed availability. Furthermore, the emphasis on clinicians becomes reducing initial door to first evaluation time, and not on more meaningful markers such as time to admission or discharge.

WHERE'S THE EVIDENCE?

There are limited peer-reviewed studies evaluating the advertising of ED wait times. Only 1 paper from England evaluated accuracy of predicted waiting times.[5] Using a rigorous statistical process, there was a large difference in predicted vs. actual ED wait times. This is different than an ED simply publishing the maximum time a patient is currently waiting in their ED, but highlights that prediction modeling potentially used for advertising may be inaccurate.

GUIDELINES

No formal guidelines exist regarding adverting ED wait times, although the Emergency Medicine Practice Committee of the American College of Emergency Physicians recently published a white paper regarding this topic.[6] This group cited the dearth of available evidence, the lack of standardization of the definition of reported times, and the argument that patients with emergent conditions may have delayed care secondary to seeing a long wait time. The paper recommends that until more evidence is available, advertisements should display the universally defined wait time as "time from door to qualified medical provider time", that wait times contain a disclaimer that they do not apply to potentially life-threatening conditions, and that they should be updated at least hourly. Any such initiative should also be conducted in parallel to hospital initiatives that reduce institutional operational inefficiencies which also ultimately affect ED wait times.

CONCLUSION

Advertising wait times may encourage patients to self-triage in a dangerous way. Published times may be inaccurate based on the dynamic nature of the ED and lack of a standardized definition, and conflict with the core mission of emergency medicine by appearing to cater to low-acuity patients that might be better served in alternative environments. Pending more evidence, caution about their use is advised.

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The Impact on Emergency Department Visits for Respiratory Illness During the Southern California Wildfires

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Introduction: In 2007 wildfires ravaged Southern California resulting in the largest evacuation due to a wildfire in American history. We report how these wildfires affected emergency department (ED) visits for respiratory illness.

Methods: We extracted data from a Kaiser Permanente database for a single metropolitan community ED. We compared the number of visits due to respiratory illness at time intervals of 2 weeks before and during the time when the fires were burning. We counted the total number of patients with chief complaint of dyspnea, cough, and asthma and final international classification of disease 9 coding diagnosis of asthma, bronchitis, chronic obstructive pulmonary disease and respiratory syndrome, and analyzed data for both total number and proportion of ED visits. We evaluated the data using Early Aberration Reporting System software to determine significant single-visit increases compared to expected counts. We also analyzed the average length of ED stay. Data on air quality were extracted from the http://www.airnow.gov site.

Results: There were significant differences between pre-fire and fire period average visit counts for the chief complaints of dyspnea and asthma. Dypnea complaints increased by 3.2 visits per day. During the fire the diagnoses of asthma increased significantly by 2.6 patients per day. Air quality reached air quality index values of 300, indicating very unhealthy conditions. Average ED length of stay times remained unchanged during the fire period compared to the pre-fire period.

Conclusion: The 2007 Southern California wildfires caused significant surges in the volume of ED patients seeking treatment for respiratory illness. Disaster plans should prepare for these surges when future wildfires occur. [West J Emerg Med 2013;14(2):79-84.]

INTRODUCTION

In October of 2007, southern California experienced a wildfire of unprecedented scale, resulting in the destruction of 1400 homes, 500,000 acres of land, and the evacuation of approximately 1 million people, the largest for a wildfire in American history from October 21, 2007 to November 9, 2007.[1] High winds would fan the flames making the fires unmangeable and spread at a rapid rate. As a result, much of San Diego was evacuated to places deemed safe by the California government.[1] However, despite the evacuations away from the fires, the population had no real escape from the resulting pollution that was carried diffusely around the county. Our study investigated the wildfires impact on emergency department visits for respiratory illness.

METHODS

Setting

Data on emergency department (ED) visits were obtained from the Kaiser Permanente electronic database from a single community ED in a large metropolitan city. Annual ED visits were 99,000 for 2007 in an ED with 54 bed capacity and approximately 30% admission rate. Visit counts were extracted from October 1, 2007 to November 6, 2007. Visit data were compared over the following time intervals: the pre-fire period defined as October 1, 2007 to October 20, 2007 and the fire period defined as October 21, 2007 to November 6, 2007 by the State of California.[1] The total number of ED visits were categorized based on international classification of disease (ICD) 9th revision (WHO Geneva) codes for asthma, chronic obstructive pulmonary disease (COPD), bronchitis and from chief complaints of dyspnea, cough, and asthma. A respiratory syndrome category of ICD 9 diagnoses (e.g. COPD, asthma, respiratory failure, congestive heart failure, etc) was defined. ED visit length of stay (LOS) times were obtained from the database for each day of the pre-fire and fire period. They pre-fire period and fire period LOS times were compared as an average for the period.

Data analysis

Data was analyzed based on actual counts and based on proportion of visits. The counts data was compared by chi-square tests over corresponding time intervals two weeks before the fire and the time during which the fires were burning. We ran a logistic regression of data for the time period before and during the fire using Kruskal-Wallis test. Because weekend and weekday visits differ, the pre-fire and fire period weekdays were compared. For the proportions data we used a Poisson Heterogeneity test and Poisson regression on time interval with the offset being the number of patients seen during the time period. To evaluate significant increases in visit counts and LOS times on single days the early aberration reporting system software (EARS) C-2 algorithm supplied publically through the Center for Disease Control was used. Single day counts were compared to visit counts expected on a 7 day moving average. Significance was determined if a daily count had a recurrence interval of > 100 days, corresponding to a $P < 0.01$.

We based sample size calculations on an estimated 50 ED respiratory distress patients per week out of about 2000 ED patients per week, and the ability to detect a difference of about 4 patients per week over a 2 week period, with significance of 0.05 with 80% power. Institutional review board (IRB) approval was granted in September 2008 by the IRB of Kaiser Permanente.

Atmospheric Data

In order to gain an understanding of how air quality changed during the fires and if poor air quality occurred on days ED visits spiked we charted the air quality index (AQI) for San Diego county. We used October 17, 2007 air quality readings as representative of pre-fire air quality. We used October 21, 2007 to November 6, 2007 readings for the fire period. We used November 10, 2007 readings to represent the air quality after the fires were suppressed. The air quality data was acquired from the AIRNow board of San Diego County. There were 9 sites available for viewing and available to the public on the website http://airnow.ca.gov.[2] Daily readings were available. The AQI is comprised of 4 major pollutants which are particulate matter, ozone, carbon monoxide, and sulfur dioxide. The index is broken down into colors and numbers to report air quality. An AQI value of 100 corresponds to the national air quality standard for the pollutant. An AQI of 100 corresponds to 150 micrograms/m^3 ($\mu g/m^3$) of particulate matter < 10 microns (PM_{10}) averaged over 24 hours which defines the yellow index, indicating a moderate health risk. An AQI of 200 corresponds to a PM_{10} concentration of 354 $\mu g/m^3$ averaged over 24 hours. The 24 hour AQI color values were used as a daily measure for each date studied. An AQI calculator supplied by AIRNow can be used to convert AQI to PM_{10} concentration.

RESULTS

We found significant increases in average visits between the pre-fire period and fire period for the chief complaints of dyspnea. (Table 1) During the fire dyspnea as a chief complaint increased by 3.2 visits per day ($P = 0.0105$). Visits with a chief complaint of asthma increased significantly by 1.5 visits ($P = 0.0211$). Visits with a chief complaint of cough did not see a significant difference when comparing the number of visits before and during the fires.

We evaluated the data using the diagnosis of asthma and found significant differences between the pre-fire period and during the fire period for the average number of daily visits (Table 1). A diagnosis of asthma was made in 2.6 more patients per day during the fire period ($P = 0.038$). There were no statistically significant increases in the average number of visits for the diagnosis of bronchitis, COPD, or respiratory syndrome.

Using the EARS software, we found significant single day visit counts during the fire period. Visits for the diagnosis of asthma were significantly elevated (35 visits) on October 28, 2007, more than double the mean number of visits compared to the pre-fire period (15.9 visits) (Figure 1). When the respiratory syndrome category was analyzed, we found significant visit elevations on October 24 and October 28, 2007 (Figure 2). Two days during the fire period had significant spikes for the chief complaint of dyspnea on October 25, 2007 (15 visits) and October 30, 2007 (10 visits) (Figure 3). On October 23, 2007 visits for the chief complaint of asthma spiked significantly (12 visits) (Figure 4).

When we evaluated the ED mean LOS averaged over all visits (LOS) for the pre-fire period and fire period. We found the duration for an average visit remained unchanged at 2.94 hours (Table 3).

Table 1. Number of emergency department visits for selected respiratory disease indicator – October 1 to November 6, 2007.

	Pre-fire period*				Fire period+					
	No. of visits	Mean per day	% visits	Peak no. of visits	Total no. of visits	Mean per day	% visits	Peak no. of visits	Excess no. of visits per day^	*P*-value§
Chief complaint										
Cough	57	3.8	1.19	9	53	4.4	1.46	12	0.6	0.2766
Dyspnea	264	17.6	5.51	26	250	20.8	6.91	31	3.2	0.0105
Asthma	46	3.1	0.96	9	55	4.6	1.52	12	1.5	0.0211
Diagnosis codes										
Respiratory syndrome	939	62.6	4.78	71	751	62.6	4.98	98	0	0.3963
Asthma	230	15.3	1.17	23	215	17.9	1.43	35	2.6	0.0377
Bronchitis	49	3.3	0.2	7	52	4.3	0.34	8	1.1	0.1034
COPD	153	10.2	3.2	18	115	9.6	3.2	13	-0.6	0.6236

COPD, chronic obstructive pulmonary disease
* Pre-fire period includes the 15 weekdays during October 1-October 20, 2007.
+ Fire period includes the 12 weekdays during October 21-November 6, 2007.
^ Mean number of visits during fire period minus mean number of visits during pre-fire period.
§ Loglinear models.

Table 2. Air quality index data for dates of October 17, 2007 to November 10, 2007. Data extracted from www.airnow.gov.

Site	10/17	10/21	10/22	10/23	10/24	10/25	10/26	10/28	10/29	10/30	10/31	11/1	11/2	11/10
Escondido*	g	n/a	p	p	o	o	o	o	y	g	y	y	y	g
El Cajon*	g	y	y	o	o	o	o	y	y	g	y	y	o	g
Alpine*	g	n/a	y	o	y	y	y	y	y	y	y	y	y	y
San Diego*	g	o	y	o	r	o	o	y	y	g	y	y	y	g
Oceanside	n/a	n/a	n/a	n/a	r	r	r	r	n/a	n/a	y	y	o	n/a
Del Mar	n/a	n/a	n/a	n/a	r	p	r	n/a	n/a	y	y	y	o	n/a
Chula Vista	n/a	n/a	n/a	n/a	r	r	o	y	y	y	n/a	o	o	n/a

green (g) = 1-50 good
yellow (y) = 51-100 moderate
orange (o) = 101-150 Unhealthy for sensitive groups
red (r) = 151-200 unhealthy
purple (p) = 201-250 very unhealthy
n/a = data not reported.
*Main reporting centers.

Table 3. Average length of stay.

	Number of emergency department visits total	Mean length of stay (hours)
Pre-fire period	4960	2.94
Fire period	4093	2.94

Pre-fire period is October 1, 2007 to October 20, 2007.
Fire period is October 21, 2007 to November 6, 2007.

Air quality during the fire period between October 21, 2007 to November 6, 2007 reached a level of purple (300) on the AQI scale near the Poomacha fire, interpreted as very unhealthy and corresponding to a PM_{10} level of 424 $\mu g/m^3$, at its peak on Oct 23, 2007. For the week prior the AQI in the San Diego county was diffusely in the 1-50 health range. By 8PM November 10, 2007 the air quality stations all read normal readings in the 1-50 range (Table 2).[2]

DISCUSSION

Our data shows that during this unprecedented event in American history, our ED was affected with a significant increase in visits for respiratory syndromes and respiratory complaints, such as asthma, on numerous days during the fire period. Most notably on October 23, 2007 there was double the amount of asthma visits seen in the ED compared to the mean visit count in the preceding weeks before the fire. This finding of respiratory illness visits increasing during periods of poor air quality is supported by other similar studies.[3-7] The direct impact on our department was the increase in demand on resources that were available at the time. Despite the increase in demand, staff and physicians still maintained similar throughput times compared to the pre-fire period (Table 3).

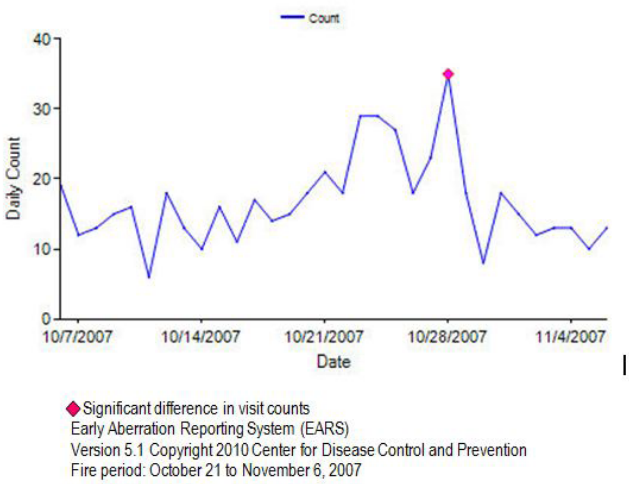

Figure 1. Emergency department visits for the diagnosis of asthma for October 7, 2007 to November 6, 2007.

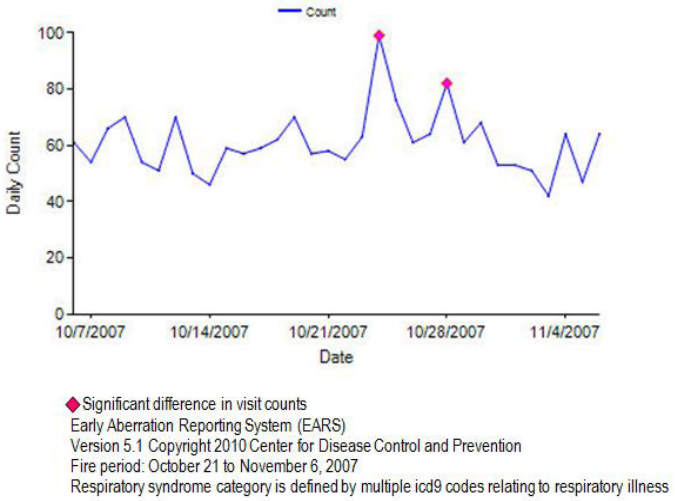

Figure 2. Emergency department visits for the diagnosis of respiratory syndrome for October 7, 2007 to November 6, 2007.

Air pollution has been directly correlated with ED visit increases for asthma.[5] When air quality worsens it impacts certain populations more severely. This population include children, asthmatics, COPD patients, the elderly and pregnant women.[5] Most strongly associated with this is particulate matter and especially PM_{10}.[5]

PM_{10}

In 1987, Particulate matter monitored by the Environmental Protection Agency was restricted to particles with a diameter of < 10 micrometers (PM_{10}).[3] Particles of this size, usually soot, can be deposited in the lungs and cause damage to the airways and gas exchanging portions of the lungs. The particulate matter's biological effects on the respiratory tract are determined by the particulate composition, location of deposit, and the biological response to this particulate.[5] Epidemiological studies have found the effects to be independent of the chemical composition of the particulate matter.[5] Particulate matter from residential wood combustion was studied by Lipsett et al[6], who found that colder temperatures most likely result in more particulate matter in the air with subsequent increases in ED visits. Dockery and Pope[5] extensively studied PM_{10} and found that total mortality increased 1% for every 10 µg/m^3 increase in PM_{10} matter. Even stronger an association was found with respiratory mortality which increased by 3.4% for every increase of 10 µg/m^3 of PM_{10} matter.[5] Prior studies have demonstrated small but significant increases in ED visits during incremental spikes in daily particulate matter readings.[6-8] Other studies evaluating the respiratory health of asthmatics showed increases in lower respiratory illness.[9] Dockery et al[5] showed that increasing levels of PM_{10} in the air results in a decrease in peak expiratory flow rates.

The Environmental Protection Agency (EPA) created the AQI to help the public understand easily the standards of air quality and correlate these numbers with health risk. Using an AQI to concentration conversion calculator supplied by the EPA, it is determined that a color level of purple (very unhealthy), with an numeric AQI between 201-300, corresponds to air having concentrations of PM_{10} ranging from 355 µg/m^3 to 424 µg/m^3. At the purple level the EPA states that there may be a significant increase in respiratory symptoms and aggravation of lung disease, such as asthma.[2] Our study shows that the AQI reached dangerous levels at several different monitoring stations during the fire period. These monitoring stations were located in places within the catchment area of our hospital. Our results show a significant rise in ED visits for respiratory illness and asthma during this period of low air quality. This supports that patients caught in these areas of poor air quality were seeking medical attention at the ED.

Wildfires

When the morbidity caused by the 1991 Alameda County fire in California was studied, they showed that medical patients outnumbered trauma patients by a ratio of more than 2:1.[3] An Australian paper in 2002 examined the relationship between particulate matter readings in Darwin, Australia from brushfires and the number of hospital presentations for asthma.[7] They found that once the level of PM_{10} increased to greater than 40 µg/m^3 there was a significant increase in the asthmatic cases that presented to their EDs.[7] In some locations surrounding our hospital the PM_{10} concentration rose to greater than 300 µg/m^3. Studies from Colorado wildfires show that spikes in particulate matter results in significant elevations in symptom scores.[10] At the time of the 2007 wildfires a Center for Disease Control and Prevention (CDC) program called Biosense, designed to collect chief complaint and diagnosis data for syndromic surveillance, was implemented in several participating hospitals in the San Diego area.[11] We were not a participating federal hospital in the study, however

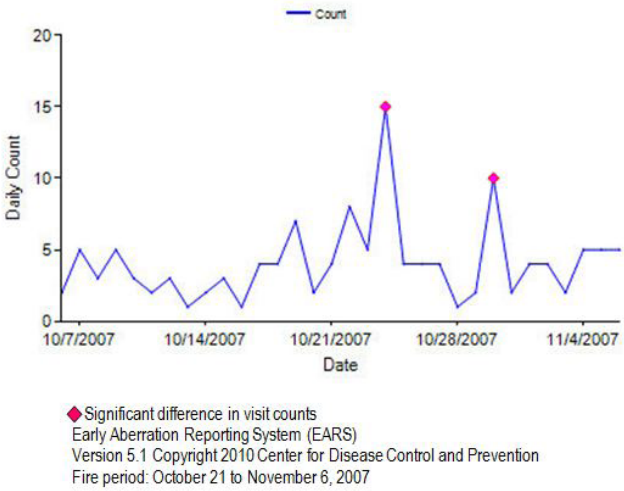

Figure 3. Emergency department visits for the chief complaint of dyspnea for October 7, 2007 to November 6, 2007.

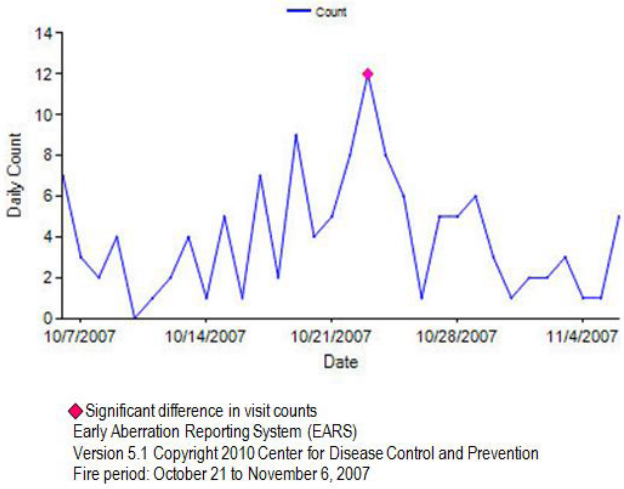

Figure 4. Emergency department visits for the chief complaint of asthma for October 7, 2007 to November 6, 2007.

our data supports their findings of increased asthma visits to the ED.[11] We used the CDC early aberration reporting system (EARS) C-2 algorithm to analyze our counts and found it to be an effective tool in determining the significance of the spikes in counts. The software was able to determine if the spikes were expected or aberrant. Compared to the pre-fire period several single days during the fire period stand out as significant increases in volume. For the physician diagnosis of asthma October 28, 2007 was significantly elevated (Figure 1). For the respiratory syndrome category October 24 and October 28, 2007 were significantly elevated (Figure 2). Looking at the chief complaint of dyspnea we found October 24 and 30 as significant dates (Figure 3). Visits for the chief complaint of asthma were found to be significantly elevated on October 23, 2007 (Figure 4). Looking at this data as a whole we see that after October 21, 2007 our department was significantly affected on numerous days and thus confirms this was a notable 2 week period in our ED operations for respiratory illness.

Delayed Response

The lag time of presentation to the ED after a spike in increased particulate matter is consistent with previous data. Schwartz found data suggesting a delayed response.[12] We found that the spike in PM_{10} was highest on October 22 and 23, 2007 for areas around Escondido, CA and El Cajon, CA (Table 2) and the physician diagnosis of asthma increased sharply on October 23, 2007 and remained elevated the next 2 days (Figure 1). The number of visits for dyspnea then elevated significantly on October 24, 2007 (Figure 3). Westerly towns affected by the Santa Ana winds, like Del Mar, CA, and Oceanside, CA had a decrease in air quality around October 25, 2007. Our ED saw an increase in visits with physicians diagnosing asthma starting again on October 27, spiking on October 28, at nearly double the visits compared to pre-fire mean counts (Figure 1). It is possible these increases in visits are related to delayed presentations to the ED for people affected by the October 25th air quality decrease. A possible explanation for the delay is that patients may attempt home treatment due to logitisitcs of the fire in regards to securing personal safety and structural dwellings. Alternative explanations include the cumulative worsening of the fires from the onset until containment or improvement in winds and weather. The fires were of varying intensities on different days in different geographical areas around the county. This may have contributed to the variable spikes in visitors we observed.

Length of stay

We found that overall LOS for the average visit remained unchanged at 2.94 hours during the fire period and the pre-fire period. We did not find that the increased volume of respiratory patients or the milieu of a historic disaster caused other patients to have increased stay times. ED LOS is affected by many factors such as triage operations, ethnicity, age, inpatient bed availability, and severity of illness.[13,14] Care of the mild to moderate asthmatic requires limited triage time, few imaging studies if any, and most patients are discharged if treatment is successful. The increase in volume of respiratory patients most likely did not impact overall resources to treat sicker patients in the ED who required admission beds, blood work and imaging studies and who would affect LOS times.

LIMITATIONS

Limitations to the study are due to it being a database study. ICD 9 coding and chief complaint are diagnoses entered by staff and could be under or over representing the data if misdiagnosis or triage complaints were erroneous. However, prior studies have shown that database studies are reliable.[15] The effects of a massive evacuation resulting in the dispersion of our hospitals normal patients is not known. As well, government orders to remain off large interstate

roadways, occurring between October 22, 2007 to October 24, 2007 limited traffic in the area for several days.[1] These variables more likely reduced the number of visits, resulting in an underreporting of the numbers of people with respiratory disease to the ED.

CONCLUSIONS

In summary, the wildfires caused an increase in respiratory illness visits to our ED. This was due to the increase in air pollution during the time period the fires burned. This research supports the recommendation that people with respiratory diseases, such as asthma, avoid exposure to the pollutants of wildfires. For emergency providers treating victims of wildfires, the need to augment ED services in particular respiratory services in the wake of future wildfire disasters may be necessary. The clinical impact and significance of our data suggests the need to formulate specific surge capacity policies and procedures to mitigate the effects of wildfires and increased respiratory illness visits to the ED. In addition, respiratory staff and resources may be taxed by outside stressors. In particular, our hospital received transfers of ventilated patents from outllying hospitals and nursing homes that were forced to evacuate. Since our respiratory therapy staff administered the ED nebulization treatments these transfers may have burdened the EDs resources. The authors suggest developing a virtual disaster pack of supplies that can be readily deployed during surges. A virtual disaster pack consists of pre-set inventory of medical supplies to be used in a disaster. The pack does not physically exist until requested from the distributor thereby not taxing already limited physical storage space at facilities. In addition, a specific staffing surge capacity plan for providers, nursing and ancillary staff including respiratory therapists needs to be outlined in anticipation of additional staffing resources. This has been implemented at our facility with incorporation of a web based rapid response notification system. It allows rapid notification via text messages, email and phone call of predetermined personnel during surge capacity needs. Establishing policies and procedures specifically addressing staffing and resource needs should be instituted to mitigate the anticipated increased needs during wildfires.

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Established and Novel Initiatives to Reduce Crowding in Emergency Departments

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Introduction: The American College of Emergency Physicians (ACEP) Task Force on Boarding described high-impact initiatives to decrease crowding. Furthermore, some emergency departments (EDs) have implemented a novel initiative we term "vertical patient flow," i.e. segmenting patients who can be safely evaluated, managed, admitted or discharged without occupying a traditional ED room. We sought to determine the degree that ACEP-identified high-impact initiatives for ED crowding and vertical patient flow have been implemented in academic EDs in the United States (U.S.).

Methods: We surveyed the physician leadership of all U.S. academic EDs from March to May 2010 using a 2-minute online survey. Academic ED was defined by the primary site of an emergency residency program.

Results: We had a response rate of 73% (106/145) and a completion rate of 71% (103/145). The most prevalent hospital-based initiative was inpatient discharge coordination (46% [47/103] of respondents) while the least fully initiated was surgical schedule smoothing (11% [11/103]). The most prevalent ED-based initiative was fast track (79% [81/103]) while the least initiated was physician triage (12% [12/103]). Vertical patient flow had been implemented in 29% (30/103) of responding EDs while an additional 41% (42/103) reported partial/in progress implementation.

Conclusion: We found great variability in the extent academic EDs have implemented ACEP's established high-impact ED crowding initiatives, yet most (70%) have adopted to some extent the novel initiative vertical patient flow. Future studies should examine barriers to implementing these crowding initiatives and how they affect outcomes such as patient safety, ED throughput and patient/provider satisfaction. [West J Emerg Med 2013;14(2):85-89.]

INTRODUCTION

Emergency department (ED) crowding continues to burden patients and providers.[1] ED crowding has led to delays in care, increased mortality, and decreased patient satisfaction.[2-6] The cause of ED crowding is multifactorial and is generally thought to be secondary to input, throughput and output factors.[7] Many initiatives to reduce ED crowding at every level have been described in the literature and include efforts such as ambulance diversion (input), increasing staffing (throughput), and boarding of patients in inpatient hallways.[1,8,9]

Among the many initiatives described to address ED crowding, the American College of Emergency Physicians (ACEP) Task Force on Boarding in particular highlighted high-impact initiatives, such as inpatient discharge coordination (inpatient concerted efforts to discharge patients

before noon), inpatient full capacity protocols (moving admitted ED patients to inpatient areas such as hallways when ED is at full capacity), cancelling elective surgeries, surgical schedule smoothing (spreading elective surgery days over the entire week), fast track unit, bedside registration, observation unit, ED bed expansion, and physician triage.[10] While these ACEP initiatives may be high-impact, some may be difficult to implement because they require systemwide interventions or considerable funds for construction. One key area that is more operationally within the control of the ED is improving ED throughput efficiency through streamlining front-end operations. Certain EDs have adopted front-end solutions addressing crowding, such as immediate bedding (i.e. patients go immediately to treatment room before triage and registration), triage protocols, and implementation of fast-track areas.[8] In particular, some EDs identify patients who can be safely evaluated, managed, admitted or discharged, without occupying ED rooms. In this novel front-end initiative, which we term "vertical patient flow," patients typically sit upright in chairs awaiting treatment or tests. Vertical patient flow has potential to combine many of the best aspects of ACEP's high-impact solutions (evaluation of low acuity, fast-track type patients and physician triage), and can also allow for billing of physician services. However, little research exists describing this initiative, despite being highlighted by the Institute of Healthcare Improvement as a lean healthcare component.[11]

A survey of EDs in 4 states of the United States (U.S.) found ACEP's high-impact solutions were more likely used by hospitals that were overcapacity.[12] However, we do not know the extent to which these initiatives, especially vertical patient flow, have been implemented across academic EDs (defined as the primary site of an emergency residency program) which have higher median annual volume.[13] Furthermore, while studies have examined physicians working in triage, none focus on patients who do not occupy ED rooms.[14-18]

We sought to determine the degree that ACEP-identified high-impact interventions for ED crowding and a newer initiative termed vertical patient flow have been implemented in academic EDs in the U.S.

METHODS

Study Design

We conducted an electronic survey of physician leadership (division chief or department chair) of every U.S. academic ED from March to May 2010. Academic ED was defined by the primary site of an emergency residency program according to the Accreditation Council for Graduate Medical Education (ACGME). We identified physician leaders of these sites from the Society for Academic Emergency Medicine (SAEM) residency list and phone calls to individual programs.

Study Protocol and Measurements

We created an online survey instrument that was piloted on 10 emergency medicine physicians at our institutions and revised following feedback. The revised survey was then e-mailed to ED physician leaders (survey is available online). Non-responders were e-mailed up to 3 more times at 2- and 4-week intervals after initial mailing. Data collected included hospital name, number of hospital and ED beds, annual ED volume, average ED length of stay (LOS), percent of ED patients admitted, and the degree to which various hospital and ED crowding initiatives had been implemented. To improve response rates, we limited survey length to 2 minutes and focused on high-impact solutions outlined by the ACEP Boarding Task Force.[10] We also asked respondents whether, how, and to what degree vertical patient flow had been implemented.

We treated questions not completed as a non-response, rather than a negative response, resulting in fewer responses to certain individual questions than the total number of respondents. We corrected errors (e.g. contact information or abnormal responses for ED size) using data, if available, from hospital websites**.**

Data Analysis

We administered the survey using Surveymonkey.com (Palo Alto, California) and calculated descriptive statistics using Microsoft Excel (2007). We used the Wilcoxon rank-sum test, chi-square, and Fisher exact tests where appropriate to compare responder and non-responders using Stata version 11).

This project was exempted by the university institutional review board. Survey participants were informed that responses were confidential and only aggregate results would be used.

RESULTS

We identified 152 academic sites eligible for inclusion in the study. We excluded 2 sites as correct email addresses could not be located despite phone calls. We also excluded 5 sites where there were discrepancies between what respondents self-reported as their primary institution and the site identified through SAEM. Of 145 (73%) academic ED physician leaders, 106 responded to the survey, of which 103 completed it (97%, [103/106] or 72% [103/145] of total surveys). The median annual visit volume among respondents was 67,085 (interquartile range [IQR] 52,037-85,440). Geographic location was as follows: 31% Northeast, 24% South, 29% Midwest and 16% West; 100% of respondents were urban. Using data extracted from the National Emergency Department Inventory-USA, there were no statistically significant differences between respondents and non-respondents with regards to annual volume, urban versus rural hospitals, or geographic location. The median reported staffed hospital beds was 590 (IQR 450-748), the median annual ED volume was 73,000 (IQR 55,000-86,000) visits and median ED LOS was 4.5 (IQR 3.7-6.0) hours. A median of 24% (IQR 21-29.5) of ED patients reportedly were admitted to the hospital.

Table 1. Proportion of academic emergency departments (ED) who initiated high-impact hospital, ED and vertical patient flow initiatives, n=103.

n = 103 respondents	Yes n (%)	Partial/In progress n (%)	No n (%)
Initiatives			
Hospital initiatives			
Inpatient discharge coordination (%)	47 (46)	44 (43)	12 (12)
Inpatient full capacity protocols (%)	19 (18)	19 (18)	65 (63)
Cancelling elective surgeries (%)	14 (14)	18 (17)	71 (69)
Surgical scheduling smoothing (%)	11 (11)	35 (34)	57 (55)
ED initiatives			
Fast track unit (%)	81 (79)	9 (9)	13 (13)
Bedside registration/eliminating triage (%)	57 (55)	37 (36)	9 (9)
Observation unit (%)	55 (53)	10 (10)	38 (37)
ED bed expansion (%)	51 (50)	10 (10)	42 (41)
Physician triage (%)	12 (12)	28 (27)	63 (61)
Vertical patient flow (%)	30 (29)	42 (41)	31 (30)

Table 1 shows the proportion of respondents who initiated certain hospital- and ED-crowding solutions. The most prevalent hospital-based initiative was inpatient discharge coordination (46%) while the least fully initiated was surgical schedule smoothing (11%), as reported by respondents. The most prevalent ED-based initiative reported was fast track (79%) while the least was physician triage (12%).

Seventy percent of respondents reported either full (29%) or partial/in progress (41%) implementation of vertical patient flow (Table 1). Two-thirds (48/72) of EDs using vertical patient flow stated that implementation occurred by design (i.e. intentionally, as opposed to ad hoc). Of those implementing vertical patient flow by design, 65% (31/48) reported doing so daily. Of the EDs using vertical patient flow, 61% (44/72) reported evaluating urgent patients (i.e. emergency severity index [ESI] of 3, 4, and 5) in this manner, while the remaining 39% (28/72) reserved it for the lowest-acuity patients (i.e., ESI 4 and 5).

EDs using vertical patient flow most frequently reported that physicians (85%, [61/72]) staffed these patients, while a large portion also reported using nurse practitioners (42%, [30/72]) and physician assistants (47%, [34/72]; answers were not mutually exclusive). Half (36/72) of vertical patient flow EDs reported using dedicated space for such patients, 46% reported returning them to the waiting room (46%, [33/72]), and 26% reported leaving them in triage rooms (26%, [19/72]) to await further testing, intervention, and results (answers were not mutually exclusive).

DISCUSSION

We found great variability in the extent academic EDs have implemented ACEP's high-impact ED crowding initiatives, yet most have adopted the novel initiative vertical patient flow to some extent. Regarding hospital-based initiatives, not surprisingly, inpatient discharge coordination was the most frequently adopted, as opposed to implementing a full-capacity protocol or cancelling/changing elective surgical scheduling. These latter strategies require substantial institutional support, and their financial impact can vary among institutions. Among ED-based initiatives, fast-track units were most widely adopted. Initiatives requiring extensive planning, capital investment, and construction, such as an observation unit or expanding the ED, were less likely to be initiated.

Our findings are most directly comparable to Handel's[12] study, which examined implementation of ACEP's crowding solutions across all EDs in 4 states.We found 89% of all academic EDs have implemented (46% initiated and 43% partial/in progress) inpatient-discharge coordination, as opposed to 69% in Handel's study.[12] We found 88% have implemented fast track units and 63% have implemented observation units, as opposed to 51% and 24% found in Handel's study. This greater adoption of crowding solutions among academic EDs may reflect the higher annual visit volume (and likely accompanying degree of crowding) or geographical representation.

Despite being a novel concept, vertical patient flow seems to have been adopted in many academic EDs. It uses the aspects of fast track and physician triage, siphoning off lower-acuity patients from traditional ED rooms. Also, pure physician triage models require staffing with expensive providers; vertical patient flow allows billing for physicians services. Staff acceptance of vertical patient flow may be greater than for physician triage given the ability to provide the full spectrum of care (rather than just front-end triage) and less overt infringement on triage nursing responsibilities. Furthermore, vertical patient flow requires little construction or political cooperation from other hospital services. However, discharging patients without allowing patients to undergo

a full nursing evaluation or wear a gown may increase misdiagnosis.

While no study has focused on vertical patient flow, research shows physician triage decreases ED LOS.[14-18] While the two policies are not synonymous (i.e. if nurse practitioners are evaluating vertical patient flow patients or if physicians are in the front-end of the ED but not triaging), the physician triage literature illuminates how vertical patient flow may also decrease ED LOS. Specifically, Partovi et al[14] found that having additional faculty members at triage reduced ED LOS by 82 minutes. They noted that 46 patients were seen and discharged by physicians directly from triage compared to 4 patients on non-faculty triage days, which likely contributed to the decreased ED LOS finding. White et al[15] also found that a supplemented triage and rapid treatment system was associated with a LOS decrease despite increases in overall patient volume. Holroyd et al[16] found that having a triage liaison physician decreased ED LOS by 36 minutes compared to control days. Subash et al[17] also found that their intervention of team triage (physician and nurse triage) reduced demands for space as more patients are "treated and streeted" and never wait in a cubicle. They found that more patients were treated and discharged within 20 minutes in their intervention group compared with their control group (19% vs. 3%). Rowe et al[18] pooled data from Holroyd and Subash and found that a triage liaison resulted in shorter ED LOS compared to nurse-led triage by nearly 37 minutes.

ED crowding will only become more of an issue in the future and consequently a factor in medical litigation. Pitts et al[19] analyzed data from the National Hospital Ambulatory Medical Care Surveys and found that ED visits increased by 1.9% per year, a rate 60% faster than the population's growth. Furthermore, mean occupancy grew even more at 3.1% per year.[19] As ED crowding has been associated with lower quality of care,it may be increasingly be related to medical legal cases. [2-6] In the case of *Scruggs v. Danville Regional Medical Center of Virginia*, the patient was deemed as "non-urgent" based on a nursing triage. The physician evaluated the patient 11.5 hours later; 30 minutes after that the patient was found to be in respiratory and cardiac arrest. He later sued the hospital for failing to provide an adequate medical screening exam.[20] Crowding was not even mentioned in the judge's decision. It is not even clear that proving an ED is crowded helps or hurts in a lawsuit.[21] Blaming crowding for less-than-ideal outcomes may make the hospital or ED physician appear to have fallen below the standard of care; plaintiff attorneys may question why additional resources were not recruited. On the other hand, jurors may be more sympathetic to physicians who can demonstrate needing to multitask on numerous sick patients simultaneously. While there has been no legal precedent to use crowding as a defense, there may be cases in the future where "too crowded" is used.[21] In the meantime, this indicates that finding methods to manage ED crowding will only grow in importance.

LIMITATIONS

While both survey response and completion rates were high (73% and 71%), non-respondents could have possibly answered in ways that would change our results. In addition to inherent recall bias, the responses reflected 1 site respondent. Given that this survey has not been conducted before, our instrument was not validated. However, we piloted our instrument and revised it accordingly. Our results may not generalizable to many EDs given our focus on academic EDs. Our results also assume academic EDs are crowded and have some level of hospital cooperation to implement these initiatives. Our survey did not specifically ask nor did we get a sense from respondents whether their ED was crowded or whether they lacked hospital cooperation. However, a substantial number (42%, 42/106) of respondents listed ways *beyond* the ACEP policies that they attempted to implement to improve ED flow, suggesting crowding is likely prevalent. Furthermore, our survey could not determine if strategies were ultimately abandoned or effective. Also, physician leaders reported 2009 data; it is possible responses may differ from the present situation. Finally, we could have included other ED crowding initiatives solutions, but thought increasing survey length would decrease response rates.

CONCLUSION

Established high-impact hospital and ED initiatives have been implemented to a variable extent in the academic institutions in our survey sample despite being recommended by ACEP. While there has been momentum to see crowding as a problem requiring hospital-wide solutions, our data show initiatives requiring extensive institutional support and capital investment, such as an observation unit or expanding the ED, were less likely to be initiated. The novel front-end strategy vertical patient flow has been initiated in most academic hospitals and seems to combine the benefits of described crowding solutions without requiring much institution-wide support or capital investment; whether it is a high-impact solution is unclear. Future studies should examine the barriers to implementing these crowding initiatives and how they affect outcomes such as patient safety, ED LOS, and patient/provider satisfaction. However, until there is widespread adoption of high-impact crowding solutions, ED crowding will continue to burden hospitals.

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Comparison Between Emergency Department and Inpatient Nurses' Perceptions of Boarding of Admitted Patients

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Introduction: The boarding of admitted patients in the emergency department (ED) is a major cause of crowding and access block. One solution is boarding admitted patients in inpatient ward (W) hallways. This study queried and compared ED and W nurses' opinions toward ED and W boarding. It also assessed their preferred boarding location if they were patients.

Methods: A survey administered to a convenience sample of ED and W nurses was performed in a 631-bed academic medical center (30,000 admissions/year) with a 68-bed ED (70,000 visits/year). We identified nurses as ED or W, and if W, whether they had previously worked in the ED. The nurses were asked if there were any circumstances where admitted patients should be boarded in ED or W hallways. They were also asked their preferred location if they were admitted as a patient. Six clinical scenarios were then presented, and the nurses' opinions on boarding based on each scenario were queried.

Results: Ninety nurses completed the survey, with a response rate of 60%; 35 (39%) were current ED nurses (cED), 40 (44%) had previously worked in the ED (pED). For all nurses surveyed 46 (52%) believed admitted patients should board in the ED. Overall, 52 (58%) were opposed to W boarding, with 20% of cED versus 83% of current W (cW) nurses ($P < 0.0001$), and 28% of pED versus 85% of nurses never having worked in the ED (nED) were opposed ($P < 0.001$). If admitted as patients themselves, 43 (54%) of all nurses preferred W boarding, with 82% of cED versus 33% of cW nurses ($P < 0.0001$) and 74% of pED versus 34% nED nurses ($P = 0.0007$). The most commonly cited reasons for opposition to hallway boarding were lack of monitoring and patient privacy. For the 6 clinical scenarios, significant differences in opinion regarding W boarding existed in all but 2 cases: a patient with stable chronic obstructive pulmonary disease but requiring oxygen, and an intubated, unstable sepsis patient.

Conclusion: Inpatient nurses and those who have never worked in the ED are more opposed to inpatient boarding than ED nurses and nurses who have worked previously in the ED. Primary nursing concerns about boarding are lack of monitoring and privacy in hallway beds. Nurses admitted as patients seemed to prefer not being boarded where they work. ED and inpatient nurses seemed to agree that unstable or potentially unstable patients should remain in the ED but disagreed on where more stable patients should board. [West J Emerg Med 2013;14(2):90-95.]

INTRODUCTION

Emergency department (ED) crowding, or access block, is a nationwide problem, with 90% of hospitals in the United States reporting it as a major problem.[1,2] It is associated with poor patient outcomes, medication errors, delays in treatment, increased morbidity and deaths.[3-7] It is also associated with decreased patient satisfaction, and higher rates of patients leaving against medical advice (AMA) and left without being seen (LWBS).[8,9] Overall length of stay and boarding time for admitted patients increases during these periods of crowding.[10] Many emergency physicians report excessive boarding times for intensive care unit (ICU) patients and those with specific room requirements (telemetry monitoring, isolation, etc.).[11]

The major component of ED crowding is admitted patients awaiting an inpatient ward (W) bed.[12] One solution is the boarding of admitted patients in W hallways.[13] While patients seem to prefer W boarding based on prior reports, no study of nurses' opinions has been yet published.[14-18] We undertook this survey study of ED and W nurses to determine and compare their opinions on this controversial topic. We were primarily interested if there was a difference in ED versus W nurse preference for W boarding of admitted patients. Our secondary objective was to assess where nurses would prefer to be boarded if they were patients, and finally to present them with clinical scenarios to assess whether special nursing requirements impacted the appropriateness of boarding in a given location.

METHODS

Study Design

This was a survey study of ED and W nurses. The actual survey was printed on paper and manually distributed, then collected after completion. The survey instrument is shown in the Appendix. Informed consent from participating nurses was not required, and since no patient information was obtained, this study received an exemption from our hospital's institutional review board.

Study Setting and Population

The study setting was a single 631-bed academic medical center with 30,000 admissions per year and a 68-bed ED with 70,000 patient visits per year. This hospital is a Level 1 trauma center and tertiary care facility serving an urban community of approximately 2 million. Potential nurse study participants were approached both in the ED and W and asked to participate in the voluntary survey. Inclusion criteria were nurses currently working in the ED or adult W. Excluded were nurses working in the ICU, or pediatric W.

Study Protocol

The authors distributed and collected surveys at random times during the month of November 2011. A convenience sample of nurses were identified as ED or W, and if W, whether they had previously worked in the ED. They were asked whether there were circumstances where admitted patients waiting for a bed could be boarded in the ED or W hallways. Nurses opposed to boarding in the ED or W were queried as to their reasons why. They were also asked where they would prefer to be boarded if they were a patient. Six specific patient scenarios were then presented, and subjects were queried where they believed these patients should board. These scenarios included 1) a 55-year-old woman admitted for elective cholecystectomy (vital signs and medications every 6 hours), 2) a 55-year-old male admitted for syncope (vital signs every 4 hours and on continuous telemetry), 3) a 65-year-old male admitted for vomiting and dehydration (vitals every 2 hours and continuous intravenous fluids), 4) a 65-year-old female admitted for chronic obstructive pulmonary disease (COPD) exacerbation (vitals and nebulizers every 2 hours, continuous 3L/minute oxygen requirement), 5) an 85-year-old male admitted for altered mental status, hypoxia, hypotension (intubated and on pressors), 6) a mass casualty incident (MCI) involving 100 patients en route and 15 patients currently boarding in the ED. Nurses were asked whether the patient(s) in each scenario should be boarded in the ED hallway, W hallway, either, or should remain in a designated ED treatment bed. For the final MCI scenario, remaining in a designated ED treatment bed was not an option.

Data Analysis

With regard to subgroup analysis, we compared current ED nurses (cED) to current W nurses (cW); Nurses with previous ED experience (pED) were compared to those with no ED experience (nED). We analyzed the results using chi square test, and statistical significance is assumed at $P \leq 0.05$.

RESULTS

The survey was completed by 90 nurses after a total of 150 surveys were distributed randomly. With regard to demographics and experience, 71 (79%) were female and 44 (49%) identified themselves as primarily day shift nurses. Sixty-five (72%) had never worked at a hospital with a policy for W boarding. Thirty-five (39%) were cED nurses, and 40 (44%) were pED, which may have included ED experience during nursing school. As a group they had a combined average of 7 years' experience, with cED nurses having 9 years' experience and cW nurses having 6 years' experience (Table 1).

Overall, 46 (52%) approved of boarding admitted patients in the ED. Subgroup analysis (Table 2) revealed 63% of cED nurses approved of ED boarding, whereas only 44% of cW nurses accepted this practice but was not statistically significant ($P = 0.139$). For those nurses opposed to ED boarding, the most common reason given was the lack of monitoring (86%), lack of privacy (81%), concerns for patient safety (79%), patient comfort (74%), fire hazard (70%), lack of appropriate staffing (67%) and other concerns (14%). Overall, 52 (58%) were opposed to W boarding (Table 3),

Table 1. Demographics of nurses surveyed.

		Current workplace		ED experience	
	All	ED	Ward	Prior	No prior
Total	90	35 (39%)	55 (61%)	40 (44%)	50 (56%)
Female	71 (79%)	26 (74%)	45 (81%)	30 (75%)	41 (82%)
Male	19 (21%)	9 (25%)	10 (18%)	10 (25%)	9 (18%)
Years experience	7.4 ± 6.8	9.2 ± 7.3	6.3 ± 6.2	10.1 ± 7.8	5.3 ± 4.9
Day shift	44 (48%)	19 (54%)	25 (46%)	22 (55%)	22 (44%)
Night shift	40 (44%)	12 (34%)	28 (51%)	14 (36%)	26 (52%)
Other shift	6 (7%)	4 (11%)	2 (4%)	4 (10%)	2 (4%)
Prior ward boarding	25 (28%)	13 (37%)	12 (22%)	15 (38%)	10 (20%)
No prior ward boarding	65 (72%)	22 (63%)	43 (78%)	25 (63%)	40 (80%)

ED, emergency department

Table 2. Acceptance of boarding in emergency department (ED) hallways.

	Acceptance	Opposition	*P*-value
All	46 (52%)	43 (48%)	
Current ED	22 (63%)	13 (37%)	
Current ward	24 (44%)	30 (56%)	0.139
Prior ED	25 (62%)	15 (38%)	
No prior ED	21 (43%)	28 (57%)	0.103

Table 3. Acceptance of boarding on ward hallways.

	Acceptance	Opposition	*P*-value
All	37 (42%)	52 (58%)	
Current ED	28 (80%)	7 (20%)	
Current ward	9 (17%)	45 (83%)	< 0.0001
Prior ED	29 (73%)	11 (28%)	
No prior ED	8 (16%)	41 (84%)	< 0.0001

ED, emergency department

Table 4. Preferred boarding location if you were a patient.

	ED hallway	Ward hallway	*P*-value
All	37 (46%)	43 (54%)	
Current ED	6 (18%)	28 (82%)	< 0.0001
Current ward	31 (67%)	15 (33%)	
Prior ED	10 (26%)	29 (74%)	0.0007
No prior ED	27 (66%)	14 (34%)	

ED, emergency department

with 20% of cED versus 83% of cW nurses ($P < 0.0001$), and 28% of pED versus 84% nED nurses opposed ($P < 0.001$). For those nurses opposed to W boarding, the most common reason given was the lack of monitoring (87%), lack of privacy (85%), concerns for patient comfort (83%), patient safety (81%), fire hazard (71%), lack of appropriate staffing (71%) and other concerns (14%). If admitted as patients themselves (Table 4), overall 43 (54%) preferred W boarding, with 82% of cED versus 33% of cW nurses ($P < 0.0001$) and 74% of pED versus 34% nED nurses ($P = 0.0007$).

For the 6 clinical scenarios, statistically significant differences in opinion regarding inpatient boarding existed in all but 2 cases (Table 5): the patient with COPD requiring continuous oxygen and frequent nebulizers, and the intubated sepsis patient on pressors. With regards to the MCI scenario, overall 42% believed patients should be moved to W hallways, 25% condoned ED hallways, and 33% felt either location was acceptable. Among cED nurses 62% believed admitted patients should be moved to W hallways, while only 29% of cW nurses felt this way, while 37% of cW versus 6% of cED nurses felt they should be placed in the ED hallways ($P = 0.001$). This difference in opinion was also detected for pED and nED nurses ($P = 0.04$)

DISCUSSION

To our knowledge, this is the only study to date specifically addressing nursing perspectives on ED and W boarding of admitted patients. In a study of perception of compromised care during ED crowding, Pines[14] and associates surveyed patients, physicians, and nurses and found that nurses identified waiting room time, number of patients in the waiting room, and number of admitted patients waiting for inpatient beds as factors involved in compromised care.[14] Obtaining nursing input is important, as they are most directly impacted by policy changes in the location of admitted patients. Furthermore, the possibility of resistance to the practice of inpatient boarding by W nurses needs to be further explored. Korn and colleages developed an assessment tool to monitor ED nurse workload that took into account care of boarded patients.[19] They concluded that the addition of caring for ED boarders, especially those waiting for ICU and telemetry beds, frequently created an "overload" situation for ED nurses and compromised care of incoming acute patients.

In several prior survey studies, admitted patients given a preference of location prefer boarding in W hallways, as opposed to ED hallways if no inpatient rooms are

Table 5. Boarding preference based on clinical scenarios 1-6.

		Current workplace		ED experience	
		ED	Ward	Prior	No Prior
Scenario 1	ED hallway	4 (11%)	23 (42%)	6 (15%)	21 (42%)
	Ward hallway	22 (63%)	6 (11%)	23 (58%)	5 (10%)
	Either	9 (26%)	11 (20%)	9 (22%)	11 (22%)
	Neither	0 (0%)	15 (27%)	2 (5%)	13 (26%)
	Total	35	55	40	50
	P-value		*P* < 0.0001		*P* < 0.0001
Scenario 2	ED hallway	2 (6%)	7 (12%)	3 (8%)	6 (12%)
	Ward hallway	9 (26%)	1 (2%)	9 (22%)	1 (2%)
	Either	6 (17%)	2 (4%)	8 (20%)	0 (0%)
	Neither	18 (51%)	45 (82%)	20 (50%)	43 (86%)
	Total	35	55	40	50
	P-value		*P* = 0.0002		*P* < 0.0001
Scenario 3	ED hallway	5 (15%)	10 (18%)	6 (15%)	9 (18%)
	Ward hallway	16 (47%)	2 (4%)	16 (41%)	2 (4%)
	Either	6 (18%)	6 (11%)	7 (18%)	5 (10%)
	Neither	7 (20%)	37 (67%)	10 (26%)	34 (68%)
	Total	34	55	39	50
	P-value		*P* < 0.0001		*P* < 0.0001
Scenario 4	ED hallway	1 (3%)	6 (11%)	2 (5%)	5 (10%)
	Ward hallway	2 (6%)	2 (4%)	2 (5%)	2 (4%)
	Either	1 (3%)	1 (2%)	1 (3%)	1 (2%)
	Neither	29 (88%)	46 (83%)	33 (87%)	42 (84%)
	Total	33	55	38	50
	P		*P* = 0.6		*P* = 0.8
Scenario 5	ED Hallway	0 (0%)	3 (6%)	1 (3%)	2 (4%)
	Ward hallway	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Either	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Neither	33 (100%)	52 (94%)	37 (97%)	48 (96%)
	Total	33	55	38	50
	P-value		*P* = 0.6		*P* = 0.9
Scenario 6	ED hallway	2 (6%)	19 (37%)	5 (13%)	16 (36%)
	Ward hallway	21 (62%)	15 (29%)	21 (51%)	15 (32%)
	Either	11 (32%)	17 (35%)	13 (36%)	15 (32%)
	Total	34	51	39	46
	P-value		*P* = 0.001		*P* = 0.04

ED, emergency department

available.[15-18] Many of the reasons cited by patients preferring W boarding concerned privacy, noise, and comfort issues. Viccellio and co-workers at Stony Brook University Hospital successfully implemented W boarding and reported a lower mortality rate for boarded hallway patients compared to those admitted to standard W beds over a 4-year period.[13] In the aforementioned study patients appropriate for inpatient boarding were selected by emergency physicians with the following exclusion criteria: ICU/step-down unit criteria, chest pain with abnormal troponin, need for suction or high flow oxygen, admissions for seizure, diarrhea, neutropenia, high risk of eloping, and respiratory or other isolation. In addition to improving patient satisfaction and safety, inpatient hallway boarding may also significantly impact ED crowding and left without being seen (LWBS) rates, as well as be financially attractive with regard to hospital revenue.[20,21]

While the hypothesis that working in the ED would be associated with greater acceptance of W boarding was confirmed by our data, the high level acceptance of ED boarding (62%) among ED nurses was surprising, although it did not reach statistical significance. In both ED and W settings, nurses' primary concerns about boarding were lack of monitoring and lack of privacy. The preference among ED nurses for W boarding, and W nurses for ED boarding when they are patients may suggest that nurses prefer not to board where they work. This may be understandable from a privacy aspect. The significant differences between cED/pED and cW/nED nurses as to where the clinically stable patients in scenarios 1-3 should board were expected based on our earlier results. Additionally, there was agreement between these groups for the relatively unstable patients in scenarios 4 and 5. However, there was a significant difference in opinion on where to board admitted patients in the ED in anticipation of receiving victims of a large-scale MCI passenger jet crash. One reason for this dichotomy is that W nurses may expect to be called to the ED to help in the care of these incoming patients and would not be able to care for patients boarded in W hallways. There also may be a desire for W nurses who rarely visit or are unfamiliar with the ED to "keep everything in the ED" for focused care without realizing the actual space limitation.

LIMITATIONS

While this study highlights the difference in attitudes towards boarding by ED and W nurses, it also has several limitations. There was a small sample size, and it was performed at a single academic center limiting its generalizability. Also, the 2 groups surveyed had differences in years of experience: cED nurses had an average of 3 additional years' experience compared with cW, and pED nurses had nearly twice the experience of nED. It is not clear if this influenced their answers. Furthermore, this survey was administered at a hospital where inpatient boarding is not allowed, and the majority of nurses surveyed had never worked in an institution that implemented inpatient boarding.

CONCLUSION

Inpatient nurses and those who have never worked in the ED are more opposed to inpatient boarding than ED nurses and nurses who have worked previously in the ED. Nurses admitted as patients seemed to prefer not being boarded where they work. ED and inpatient nurses seemed to agree that unstable or potentially unstable patients should remain in the ED, but disagreed on where more stable patients should board. They also disagreed on where admitted patients should board in the case of a mass casualty incident; ED nurses favored inpatient boarding to make space for a large number of incoming trauma victims, whereas inpatient nurses preferred retaining admitted patients in the ED.

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Education On Prehospital Pain Management: A Follow-Up Study

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Introduction: The most common reason patients seek medical attention is pain. However, there may be significant delays in initiating prehospital pain therapy. In a 2001 quality improvement (QI) study, we demonstrated improvement in paramedic knowledge, perceptions, and management of pain. This follow-up study examines the impact of this QI program, repeated educational intervention (EI), and effectiveness of a new pain management standard operating procedure.

Methods: 176 paramedics from 10 urban and suburban fire departments and two private ambulance services participated in a 3-hour EI. A survey was performed prior to the EI and repeated one month after the EI. We reviewed emergency medical services (EMS) runs with pain complaints prior to the EI and one month after the EI. Follow-up results were compared to our prior study. We performed data analysis using descriptive statistics and chi-square tests.

Results: The authors reviewed 352 surveys and 438 EMS runs with pain complaints. Using the same survey questions, even before the EI, 2007 paramedics demonstrated significant improvement in the knowledge (18.2%; 95% CI 8.9%, 27.9%), perceptions (9.2%; 95% CI 6.5%, 11.9%), and management of pain (13.8%; 95% CI 11.3%, 16.2%) compared to 2001. Following EI in 2007, there were no significant improvements in the baseline knowledge (0%; 95% CI 5.3%, 5.3%) but significant improvements in the perceptions of pain principles (6.4%; 95% CI 3.9%, 9.0%) and the management of pain (14.7%; 95% CI 11.4%, 18.0%).

Conclusion: In this follow up study, paramedics' baseline knowledge, perceptions, and management of pain have all improved from 6 years ago. Following a repeat educational intervention, paramedics further improved their field management of pain suggesting paramedics will still benefit from both initial and also ongoing continuing education on the topic of pain management. [West J Emerg Med 2013;14(2):96-102.]

INTRODUCTION

The most common reason patients seek medical attention is because they are experiencing pain.[1-11] Despite a chief complaint of pain, there may be significant delays in the emergency department (ED) until initiating pain therapy.[12,13] These delays include time to triage and patient assessments, followed by ordering, obtaining, and administration of the medication. As a result, the initial assessment and management of pain must begin in the prehospital setting.[12,13] Knowledge of pain principles, assessment, documentation, and management, both pharmacologic and non-pharmacologic, of pain must be included in both initial and ongoing paramedic educational programs. The institution of quality improvement (QI) programs will serve to assess the effectiveness of prehospital providers' practices.[14]

In 2003, the National Association of Emergency Medical Services (EMS) Physicians produced a position paper solely for prehospital pain management, stating that every EMS system

must be dedicated to the assessment and treatment of pain. To be effective, a comprehensive program must be instituted, which includes education, assessment, documentation, intervention, and QI. This program must be in place in conjunction with a prehospital standard operating procedure (SOP).[15]

In 2001, this EMS system instituted a QI project to assess pain management in the prehospital setting and to evaluate the perception of pain principles and knowledge of pain management. Through our regularly scheduled continuing education (CE) sessions we instituted an education intervention (EI) focused on all aspects of pain. As a result of the EI, paramedics had an increased understanding of pain (17.5% $P < 0.001$), improved perceptions of pain principles (4.2% $P < 0.003$) and improved field management of pain (21% $P < 0.001$). More specifically, paramedics were more likely to provide prehospital non-pharmacologic pain therapy (32.2% improvement $P < 0.001$), and were more likely to document the results of their interventions (repeat vs 14.7% $P < 0.001$, repeat pain score 11.3% $P < 0.001$, pain reassessment 13% $P < 0.001$, pain reassessment on ED arrival 15.4% $P < 0.001$). From this study we approved the addition of a pain management SOP, giving paramedics the authority to manage pain without requiring permission from medical control via telemetry.[16]

As a follow-up to this study, we reassessed the paramedics in our EMS system to measure the long term impact of the EI, to determine if a repeat EI was necessary, and to determine if the new pain management SOP was effective.

METHODS

Study Design

This prospective study assessed the effects of an EI on change in the knowledge base of pain assessment, documentation, and treatment of pain in the prehospital setting. We then compared the results found in this identically designed follow-up study to the original results.

Study Setting and Population

This study included emergency medical technician-paramedic (paramedic) providers from 10 fire departments and 2 private ambulance services, including both volunteer and non-volunteer organizations. The study took place in an EMS system that included both urban and suburban populations. Approximately 800 paramedics participate in the EMS system with a 95% Advanced Life Support (ALS) response. Average transport times for the system are 8 minutes with a maximum of 30 minutes, dependent mostly on traffic patterns in this urban to suburban region.

Study Protocol

This EMS system instituted the same QI protocol as performed in 2001 to evaluate the knowledge and perception of pain management by EMS providers and to assess pain management in the prehospital environment.[16] All paramedics who were present for the regularly scheduled 3-hour CE session were chosen to participate in the EI. The students were blinded to the study. The CE sessions were taught using the same material for PowerPoint presentation with discussion. Nine nurse coordinators who regularly give monthly CE sessions participated in the study. Prior to the CE sessions, the nurses met to review the PowerPoint presentation and discuss the material to standardize the presentation. All nurse coordinators are Illinois emergency communications registered nurse (ECRN) certified. Two also had current Illinois paramedic licenses during the study. Additionally, those paramedics who were present during the 2001 EI were also identified via the questionnaire. All were given 15 minutes to complete an individual demographic survey. All paramedics present for the EI completed and turned in the questionnaire (100%). Some paramedics placed their names on the survey but, for the purpose of the study, anonymity was maintained. A 3-hour EI was then implemented by the nurse educators. Every survey question topic was discussed during the EI session without notifying the paramedics that it was a survey question. A second evaluation was conducted the following month. Paramedics again completed the same questionnaire. Paramedics who did not complete the first questionnaire did not complete the second questionnaire. Following the second evaluation, the same paramedic medical officers performed a repeated 2-month review of run reports for all patients with a complaint of pain.

Paramedic medical officers are appointed a supervisory role within their organizations to maintain paramedic records, assist with education, review competencies, and establish policies and procedures. A paramedic medical officer participated from each organization. All of the paramedic medical officers were given an in-service on the importance of quality improvement projects and EMS research. We educated the paramedic medical officers in the use of the data collection forms. Three of the 12 medical officers participated in the initial EI in 2001. As part of their daily activities, the paramedic medical officers have training and experience in reviewing run reports. The run reports are patient care reports containing demographic data with history, physical exam, and treatment documentation. There was no change in the run report format since 2001.

Approval was obtained for this study from the Institutional Review Board. Communications to medical control via telemetry radio were received by either a physician or a nurse. Morphine sulfate (MS) was the only pharmacologic agent incorporated into the pain management SOP during this study. Paramedics could give MS 2 mg IV every 5 minutes to a maximum dose of 10 mg without obtaining approval from medical control for patients with any complaint of pain except for abdominal pain. These patients must also have a normal mental status and a systolic BP > 100 mmHg. Paramedics could also use non-pharmacologic methods to treat pain such as ice, splinting, repositioning, and communicative support.

Table 1. Pain knowledge of paramedics at baseline and after educational intervention (EI).

Basic knowledge	Answer	Baseline 2001 n=206 (%correct)	Baseline 2007 n=176 (%correct)	*P*-value	2001 Post EI improvement n=191	*P*-value	2007 Post EI improvement n=176	*P*-value
1. Lack of IV access prohibits the administration of pain medication	False	74%	73%	0.816	6%	0.171	19%	< 0.001
2. Patients who are very old or very young have decreased pain receptors and therefore require less medication.	False	11%	24%	< 0.001	6%	0.081	-1%	0.801
3. Respiratory depression is a common side-effect of opiods in all patients.	True	63%	69%	0.244	7%	0.135	-1%	0.909
4. Headache and low back pain are the most common types of pain in the United States.	True	56%	90%	< 0.001	30%	< 0.001	-4%	0.254
5. Unrelieved pain has a negative physiologic consequence.	True	69%	87%	< 0.001	20%	< 0.001	1%	0.747
6. Administration of IV opioids results in a more rapid onset of action than the IM route.	True	84%	87%	0.343	6%	0.076	1%	0.747
7. Anxiety can affect a patient's response to pain.	True	88%	97%	0.001	6%	0.035	-1%	0.557
8. Unrelieved pain can affect the pulmonary, cardiovascular and immunologic systems.	True	73%	93%	< 0.001	20%	< 0.001	0%	1.000
9. Dehydrated patients are at an increased risk for the hypotensive effects of opioids.	True	57%	85%	< 0.001	22%	< 0.001	-2%	0.56
10. Increased pulse and respiratory rates, pallor and perspiration are indicators of pain.	True	73%	93%	< 0.001	16%	< 0.001	-3%	0.251
11. The system involved in the transmission and perception of pain is referred to as the nociceptive system.	True	5%	27%	< 0.001	35%	< 0.001	-3%	0.463
12. Referred pain is the result of stimulation of several sensory nerves that enter multiple segments of the spinal cord, also called visceral pain.	True	34%	76%	< 0.001	37%	< 0.001	-2%	0.622
Composite score of the 12 knowledge questions		57%	75%	< 0.001	18%	< 0.001	0%	0.803

IV, intravenous

Measurements

The paramedic surveys contained the same questions as the initial EI regarding their perceptions and knowledge of basic pain management principles except for the last question asking about their comfort level using the new pain management SOP. During this follow-up study, the initial and repeated EMS run reviews collected data regarding documentation, assessment and prehospital pain therapy given. The 9 characteristics of pain assessment reviewed were pain location, radiation, quality, onset, type, relieving factors, provoking factors, pain timing, and sleep disturbances. We analyzed the percentages of each of these 9 characteristics documented before and after the EI. Paramedic and patient demographic information was also collected.

Data Analysis

Descriptive statistics were used to compare findings before and after EI and between 2001 and 2007. Differences were reported with 95% confidence intervals (CIs) along with P-values from z tests of 2 proportions. All *P*-values were two-tailed. Statistical calculations were performed using Minitab version 12.1 (Minitab Inc., State College, Pennsylvania).

Table 2. Paramedic perceptions before and after educational intervention (EI).

Basic Knowledge	Answer	Baseline 2001 n=206 (%correct)	2007 Baseline n=176 (% correct)	Diff 2001–2007	*P*-value	2001 Post EI improvement n=191	*P*-value 2001 Improvement	2007 Post EI Improvment n=176	*P*-value 2007 Improvement
1. Each patient's perception of pain is unique because of factors that affect the patient's response, such as past experience or culture.	True	91%	93%	2%	0.385	7%	0.004	-67%	< 0.001
2. Paramedics have a restricted role in providing pain relief because Medical Control makes the decision to order pain medication.	False	57%	5%	52%	< 0.001	-8%	0.105	1%	0.645
3. Due to the short duration of a typical ambulance call, there is not enough time for pain medication to be fully effective.	False	7%	4%	3%	0.218	1%	0.836	1%	0.609
4. A patient should not be medicated for pain until a diagnosis is made.	False	36%	24%	12%	0.009	-12%	0.009	-2%	0.662
5. A patient who appears to have ingested alcohol should not be given pain medication.	False	46%	5%	41%	< 0.001	7%	0.177	-1%	0.915
6. Depression is a common complaint of patients experiencing chronic pain.	True	54%	83%	-29%	< 0.001	30%	< 0.001	-1%	0.774
7. Moderate pain (5 on a 1-10 scale) is an acceptable part of the patient's pre-hospital experience.	False	24%	16%	8%	0.04	-4%	0.356	-3%	0.481
8. It is not realistic to relieve most of the pre-hospital patient's pain.	False	22%	11%	11%	0.002	-9%	0.022	-1%	0.737
9. Pain medication should only be given when the pain is severe.	False	18%	9%	9%	0.01	-6%	0.068	-2%	0.593
10. Pain medication should never be repeated during an ambulance call since you will be at the hospital before the medication becomes fully effective.	False	5%	3%	2%	0.213	1%	0.689	0%	1.000
11. Pain may only be relieved with medication administration.	False	5%	4%	1%	0.676	1%	0.688	0%	1.000
12. Overall, paramedics tend to under treat pain.	True	74%	72%	2%	0.642	9%	0.028	-2%	0.638
13. Paramedics should have a standard operating procedure (SOP) for the administration of pain medication.	True	86%	NA	NA	NA	7%	0.02	NA	NA
14. I am comfortable using the standard operating procedure (SOP) for pain management without consulting Medical Control.	True	NA	93%	NA	NA	NA	NA	1%	1.000
Composite Score for questions 1-12	NA	36%	27%	9%	< 0.001	4.2%	0.003	6.4%	< 0.001

IV, intravenous; *NA*, not avaliable, *Diff*, difference

Figure 1. Paramedics' basic knowledge of pain after separate educational interventions in 2001 and 2007 (questions from Table 1 with percent correct answers).

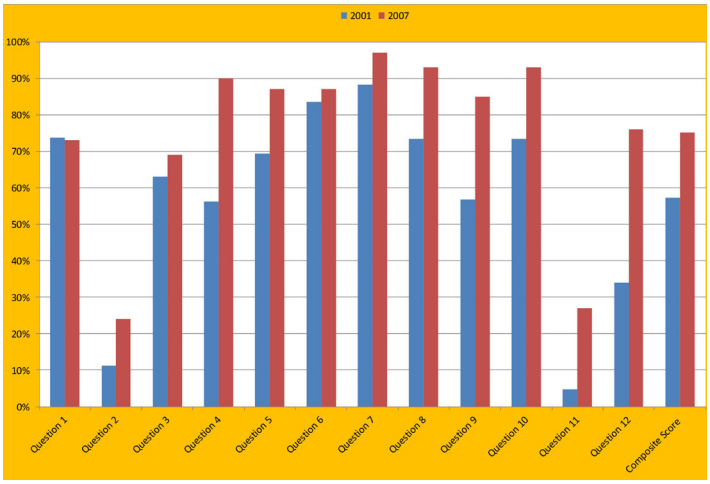
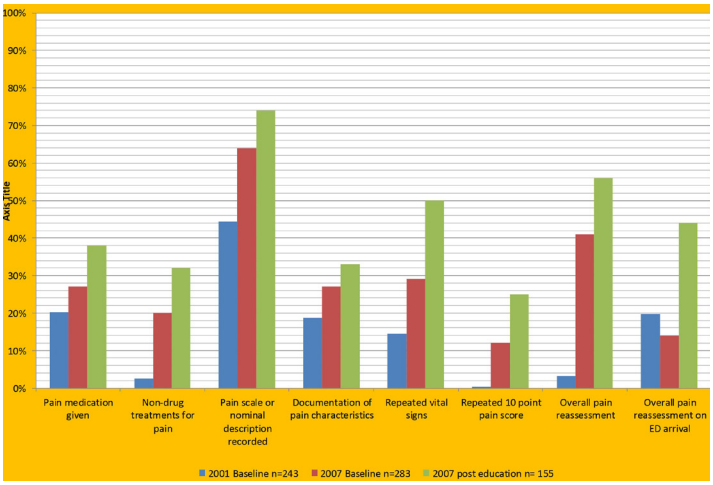


Figure 2. Paramedics' field management of pain (questions from Table 3 with percent correct answers).



RESULTS

There were 176 paramedics involved in the study. The population was 95% male, with a mean age of 38.7 years (range: 20–65) and 11.6 years of paramedic experience (range: 1–31). More than half (54%) of the paramedics received education beyond high school with 16% receiving associate's degrees, 32% having bachelor's degrees and 4% receiving master's degrees. Twenty-six percent of the paramedics attended paramedic school in 2001 or later. On average, the paramedics reported receiving 4.6 education hours on pain, although 26% did not respond to this question. Only 21% of the paramedics stated that they had received the same EI in 2001, although 31% stated that they did not recall if they did or not. Paramedics completed 176 questionnaires before and after the intervention. This study also reviewed 283 EMS runs before the intervention and 155 after the intervention, for a total of 438 runs.

The basic knowledge of the paramedics regarding pain management is shown in Table 1 and Figure 1. There was a significant improvement between the baseline knowledge of the paramedics in 2001 and the baseline knowledge in 2007 (18.2; 95% CI 8.97%, 27.9%). However, in 2001 there were significant improvements of knowledge following the educational intervention, while in 2007 there were hardly any improvements. It is interesting that on the question of IV access, there was much more improvement in 2007 than 2001, even though the baseline scores were the same.

Paramedics were also asked about their perceptions of pain in transported patients. Details of their perceptions are shown in Table 2. In 2007 there were significantly fewer paramedics with incorrect perceptions of pain management. For example, in 2001 57% felt that EMS had a restricted role in pain relief, while in 2007 only 5% had this belief. However, perhaps because of these improved perceptions, there were hardly any significant changes following education in 2007. The one exception concerns patients' unique perceptions of pain. Following education in 2007, many fewer paramedics felt that past experience or culture influenced pain perception, suggesting less cultural bias in 2007.

The effects of the EI on prehospital pain management practice by the paramedics are shown in Table 3 and Figure 2. As compared to 2001, in 2007, there were significant improvements in the baseline field management of pain prior to the EI. However, as opposed to the results on knowledge or perceptions, in 2007 there was almost as much further significant improvement following education as occurred in 2001.

DISCUSSION

Following our last study, we instituted a pain management SOP in our entire region made up of 4 EMS systems. Our goal in this study was to determine if the EI and pain management SOP had long-term effects for paramedics. We also wanted to collect data to determine if a regular EI was helpful to maintain baseline skills regarding pain management. Given that pain is the most common chief complaint of our patients, it must be assessed and managed adequately especially given the delays to treatment that take place on presentation to the ED. [12,13] In this follow-up study, when we reviewed the paramedics' run reports, we again saw significant improvements in baseline documentation and management of pain prior to the EI. There was, however, also significant improvement in prehospital documentation and management of pain following the EI in 2007.

Prior to the EI, in 2007 there were significant improvements in 9 of the 12 baseline knowledge questions. While in 2001 we saw significant improvements in knowledge following the EI, we did not see that in 2007. It is possible that because their baseline knowledge was already so high in 2007, there was little room for improvement. Additionally, the curriculum of current

Table 3. Comparison of paramedics' field management of pain, 2001 vs. 2007 and pre- and post 2007 educational intervention (EI).

EMS field management of pain	2001 Baseline n=243	2007 Baseline n=283	Diff	*P*-value Diff in baseline	2001 Post EI improvment n=196	*P*-value 2001 Improvement	2007 Improvement n=155	*P*-value 2007 Improvement
Pain medication given	20%	27%	7%	0.069	4%	0.027	11%	0.017
Non-drug treatments for pain	3%	20%	18%	< 0.001	32%	< 0.001	12%	0.006
Pain scale or nominal description recorded	44%	64%	20%	< 0.001	51%	< 0.001	10%	0.024
Documentation of pain characteristics	19%	27%	8%	0.022	24%	< 0.001	6%	0.189
Repeated vital signs	14%	29%	15%	< 0.001	15%	< 0.001	21%	< 0.001
Repeated 10 point pain score	0%	12%	12%	< 0.001	11%	< 0.001	13%	< 0.001
Overall pain reassessment	3%	41%	38%	< 0.001	13%	< 0.001	15%	0.002
Overall pain reassessment on ED arrival	20%	14%	-6%	0.087	15%	< 0.001	30%	< 0.001
Composite management score	15%	29%	14%	< 0.001	21%	< 0.001	15%	< 0.001

EMS, emergency medical services; *Diff*, difference

paramedic programs includes more material on the topic of pain. Twenty-six percent of the paramedics in this study may have had a better baseline knowledge base since they attended paramedic school in 2001 or later. With 1 question pertaining to the topic of IV access, we saw significant improvement following the EI.

Our results regarding paramedics' perceptions followed a similar trend. There were significant improvements in 3 of the 12 baseline perceptions questions. While in 2001 we saw significant improvements in perceptions following the EI, we did not see that in 2007, again likely because they already had good perceptions of pain management. More commonly in 2007 paramedics understand the importance of applying pain management principles. Again, there was one question with a significant improvement following the EI on the topic of past or cultural experiences with pain. Cultural backgrounds can affect a person's response to pain.[15,17] while those same cultural biases can affect a prehospital provider's management of pain.[18,19]

Given the noted findings regarding paramedic knowledge and perceptions of pain, we were surprised to identify a different trend in regards to the field management of pain. In addition to there being significant improvements in the baseline field management of pain, there were also further significant improvements following the EI in 2007. Paramedics not only improved their baseline field management of pain but we discovered through this study that further continuing education is effective.

The pain management SOP allows for the administration of MS. Since the institution of the pain management SOP we expected to see a significantly higher administration rate of MS. We did not see that 20% gave pain medication in 2001 prior to the MS protocol, while 27% ($P = 0.069$) gave pain medication in 2007 after the MS protocol. In a similar study where paramedics were allowed to administer MS according to written protocols, a higher percentage of patients were also not given MS after the protocol was implemented.[20] We, however, did see significant increases in the application of non-pharmacologic treatments for pain. These included the use of ice, splinting, repositioning, and communicative support to relieve pain. We believe that because of a more comprehensive understanding of pain management, the paramedics were able to obtain pain relief without the administration of a narcotic pain medication.

As demonstrated in this study, paramedics retained baseline knowledge, perceptions, and field management of pain. We also learned that we can further improve the prehospital management of pain by incorporating this topic into a QI project. This study demonstrates that a fully comprehensive CE program is still warranted to improve prehospital management of pain. It is unique in that we obtained this understanding through the diligent work of the paramedic medical officers who

reviewed every completed run report pertaining to transported patients with pain during a 2-month timeframe before and after the EI. It is also the first follow-up study of its kind to evaluate the long-term effects of an EI focusing on the knowledge, perceptions, and documentation of pain in conjunction with the institution of a pain management SOP.

LIMITATIONS

We reviewed a large number of run reports within one large EMS system located in one geographic region. Expanding this study to the region made up of 4 EMS systems or expanding it statewide would help to reduce potential selection bias. We also reviewed a small number of run reports relative to a large number of paramedics in the system, which may not fully represent the EMS system. Since we retrospectively reviewed run reports and not actual paramedic practice, the same number of non-pharmacologic procedures may have been performed but better documented. The retrospective nature of the chart review also made it challenging to elucidate the specific factors that may have led to the changes in knowledge, perceptions, or documentation.

With the institution of the pain management SOP we studied the number of patients who received any dose of MS. We expected to see a higher number of patients receiving MS. While we did not see an increase in the number of patients receiving MS, we did not study the dose of MS that was given. As a result, the same number of patients may have received MS, but those same patients may have received a higher dose of MS to achieve more effective pain control.

CONCLUSION

In this follow-up study, paramedics' baseline knowledge, perceptions, and management of pain have all improved from 6 years ago. Following a repeat educational intervention, paramedics further improved their field management of pain suggesting paramedics will still benefit from both initial and also ongoing continuing education on the topic of pain management.

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Clinician-performed Beside Ultrasound for the Diagnosis of Traumatic Pneumothorax

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Introduction: Prior studies have reported conflicting results regarding the utility of ultrasound in the diagnosis of traumatic pneumothorax (PTX) because they have used sonologists with extensive experience. This study evaluates the characteristics of ultrasound for PTX for a large cohort of trauma and emergency physicians.

Methods: This was a prospective, observational study on a convenience sample of patients presenting to a trauma center who had a thoracic ultrasound (TUS) evaluation for PTX performed after the Focused Assessment with Sonography for Trauma exam. Sonologists recorded their findings prior to any other diagnostic studies. The results of TUS were compared to one or more of the following: chest computed tomography, escape of air on chest tube insertion, or supine chest radiography followed by clinical observation.

Results: There were 549 patients enrolled. The median injury severity score of the patients was 5 (inter-quartile range [IQR] 1-14); 36 different sonologists performed TUS. Forty-seven of the 549 patients had traumatic PTX, for an incidence of 9%. TUS correctly identified 27/47 patients with PTX for a sensitivity of 57% (confidence interval [CI] 42-72%). There were 3 false positive cases of TUS for a specificity of 99% (CI 98%-100%). A "wet" chest radiograph reading done in the trauma bay showed a sensitivity of 40% (CI 23-59) and a specificity of 100% (99-100).

Conclusion: In a large heterogenous group of clinicians who typically care for trauma patients, the sonographic evaluation for pneumothorax was as accurate as supine chest radiography. Thoracic ultrasound may be helpful in the initial evaluation of patients with truncal trauma. [West J Emerg Med 2013;14(2):103-108.]

INTRODUCTION

Rapid diagnosis and treatment of traumatic pneumothorax (PTX) is important to prevent tension physiology and circulatory collapse in patients with blunt and penetrating trauma. Supine chest radiograph (CXR) is traditionally employed; however, it misses up to 50% of PTXs.[1] Thoracic ultrasound (TUS) was first described in 1995 for diagnosing PTX in humans when Lichtenstein noted that the absence of comet-tail artifacts and lung sliding were associated with PTX.[2] Since then ultrasound has become a validated method of examining the pleura in multiple settings. In 2011 the Eastern Association for the Surgery of Trauma gave a level 2 recommendation for the use of ultrasound to identify PTX in its practice management guidelines.[3]

In most studies TUS has been found to have favorable results. In Lichtenstein's study,[2] TUS had a sensitivity and

negative predictive value of 100% and 96.5%, respectively, for the detection of PTX in the intensive care unit setting.[4] Dulchavsky[5] subsequently demonstrated that this modality has a sensitivity of 95% in the detection of PTX in patients at a Level 1 trauma center. These reports used plain radiography as the gold standard: a diagnostic modality known to be inaccurate in the detection of PTX.[6] In subsequent studies using dedicated chest computed tomography (CCT) as a reference standard, sensitivities of TUS have ranged widely from 49% – 98%, while finding that it is still consistently more accurate than supine CXR.[7-13] Studies in which TUS is performed by emergency physicians (EP) for traumatic PTX have reported even higher sensitivities ranging from 86-97% with specificities of > 99%.[14] While these latter numbers are desirable, they have the potential limitation of being less applicable due to a higher skill level of the sonologists involved. The actual performance of TUS for PTX would likely vary based on the sonologist's skill and experience.

The current investigation set out to determine the test characteristics of TUS for traumatic PTX in the hands of a large heterogenous group of potential sonologists representative of typical clinicians involved in trauma care.

METHODS

This was a prospective non-randomized observational study on a convenience sample of patients with truncal trauma (both blunt and penetrating) who presented to a Level I trauma center with greater than 2,000 trauma patients per year. Patients were enrolled during a 15-month period and the study was approved by the study hospital's institutional review board with a waiver of informed consent and Health Insurance Portability and Accountability Act waiver as authorized by Title 45 Code of Federal Regulations (45 CFR) Part 46.116 (d) and Part 164.512 (i), respectively.

Physicians selected to perform TUS were comprised of trauma attendings and fellows; emergency medicine attendings and residents; and emergency ultrasound fellows. To participate in the study, physicians were required to be competent in the Focused Assessment with Sonography for Trauma (FAST) exam, defined as formal training in this study as mandated by the American College of Emergency Physicians with at least 25 complete proctored examinations.[15,16] Physicians were then required to participate in a 1.5 hour training session that included a pre-test, a 30-minute lecture on pleural ultrasound, structured review of approximately 15 "unknown" video clips of pleural evaluations, a post-test, and a 30-minute proctored lab session in which participants demonstrated the ability to identify the visceral and parietal lung interface (Figure 1) and obtain dynamic images of the pleura in normal volunteers. Physicians were expected to demonstrate the ability to adjust gain and depth settings appropriate for the pleural evaluation on a machine that had just been used to perform the FAST.

A convenience sample of patients was selected on a consecutive basis when a physician with the aforementioned training in TUS was present during a trauma evaluation or resuscitation.

Patients were enrolled if they sustained either blunt or penetrating truncal trauma and received a FAST exam in the trauma bay. Patients were excluded if they were less than 18 years of age, pregnant, were prisoners, or if a tube thoracostomy was performed prior to the ultrasound exam. A retrospective chart review was done to record the Injury Severity Score (ISS), age, sex, and mechanism of injury (blunt *vs.* penetrating).

The TUS examination consisted of the consecutive sonographic interrogation of every intercostal space between the clavicle and the diaphragm on each hemithorax. Scans were performed in the mid-clavicular line. On the left side, if cardiac motion was encountered in the mid-clavicular line, the probe was moved laterally to the left anterior axillary line and the pleura seen in the remaining intercostal spaces was evaluated until the diaphragm/spleen was encountered. To use the ribs to assist in the identification of the rib spaces and the pleura, the probe was placed in a longitudinal plane for the entire exam. Physicians performing the TUS were blinded to the results of any imaging modalities when they recorded the presence or absence of a PTX based upon lung sliding, comet-tail artifacts, and the lung point sign. All examinations were done using the C-15 2-4 Mhz curved array transducer

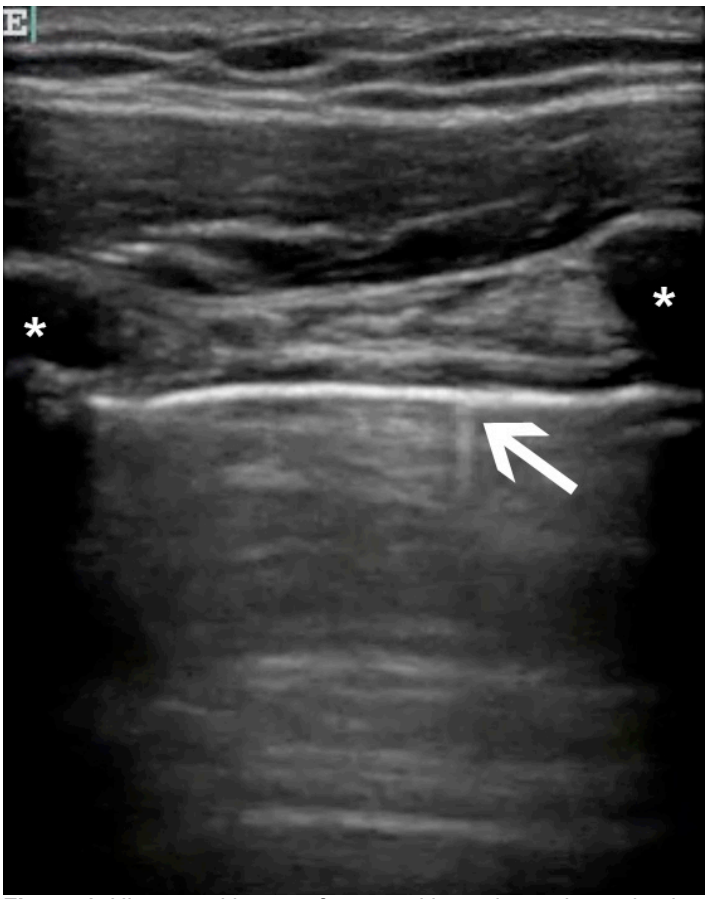

Figure 1. Ultrasound image of a normal lung shows the parietal pleura (arrow) and ribs (asterisks).

Table 1. Training level of physician sonologists.

Sonologists	n=36*	Number of scans (n=549)
Trauma fellow	16	258
Trauma attending	4	69
EM resident	9	70
EM fellow	2	38
EM attending	4	113

EM, emergency medicine
*The training level of a sonologist who had performed 1 scan could not be determined.

Table 2. Mechanism of injury.

Mechanism	Number of injuries (%)
Blunt (N=462)	
Motor vehicle injury	202 (37%)
Fall	102 (19%)
Assault	87 (16%)
Pedestrian injury	41 (7%)
Motorcycle injury	30 (5%)
Penetrating (N=87)	
Gunshot wound	59 (11%)
Stabbing	28 (5%)

Table 3. Performance characteristics of thoracic ultrasound (TUS) and supine chest radiograph (CXR) for detection of pneumothorax.

	TUS (N=549)	CXR (N=365)
Sensitivity	57% (42-72)	40% (23-59)
Specificity	99% (98-100)	100% (99-100)
Positive predictive value	90% (73-98)	100% (73-100)
Negative predictive value	96% (94-98)	95% (92-97)

on a portable ultrasound unit (Titan, SonoSite Inc., Bothwell, Washington).

Because it is the usual practice in our trauma resuscitations to make clinical decisions based upon immediate "wet" readings of CXRs, the CXR interpretation from the trauma attending or fellow rather than the radiologist was recorded. The final diagnosis of a PTX used a composite gold standard of CCT, escape of air on chest tube insertion, or supine plain radiography followed by clinical observation.

We calculated performance characteristics, including sensitivity, specificity, positive predictive value, negative predictive value, and positive/negative likelihood ratios along with 95% confidence intervals (CI), using STATA software (version 11, Stata Corporation, College Station, Texas).

Given an estimated 10% incidence of traumatic PTX and a predicted sensitivity of 0.8 for TUS, 500 patients were enrolled in order to achieve a confidence interval width of 0.3.

RESULTS

Thirty-six different physician sonologists performed TUS on 549 trauma patients during the study period and all were included in the analysis. Table 1 shows the varying training levels of the sonologists. The median age of the patients was 38 years (interquartile range [IQR] 25-51). Seventy- five percent (410) of patients were male. ISS data was available for 96% (518) of patients. The median ISS of the patients was 5 (IQR, 1-14), and 7% (37) of patients had an ISS of > 50. Four hundred sixty-two (84%) patients were victims of blunt trauma. Table 2 shows details of the mechanism of injury for the study population.

Figure 2 shows the 3 different methods for obtaining the final diagnosis of the presence or absence of a PTX. CCT was the most frequently used method and there were a small percentage of cases where patients had an immediate tube thoracostomy prior to other imaging modalities.

The incidence of traumatic PTX in the study population was 9%. TUS was performed on all 549 patients and correctly identified a PTX in 27 out of 47 patients. A "wet" CXR reading was recorded by the trauma resuscitation leader in 365 out of 549 (66%) patients. Table 3 compares the characteristics of TUS and CXR versus the composite gold standard.

Table 4 shows characteristics of the 20 out of 47 patients who had a missed PTX. No patients with a PTX had a CXR identifying a PTX, which was not detected by TUS. Nine out of 20 missed PTXs did not require tube thoracostomies.

DISCUSSION

The current investigation found that thoracic ultrasonography was as sensitive as supine radiography in the detection of traumatic PTX, but still misses more than 40% of PTXs identified on CCT. These findings concur with a large retrospective study which has shown that the supine CXR misses over half of the PTXs identified on CCT.[17] Similar

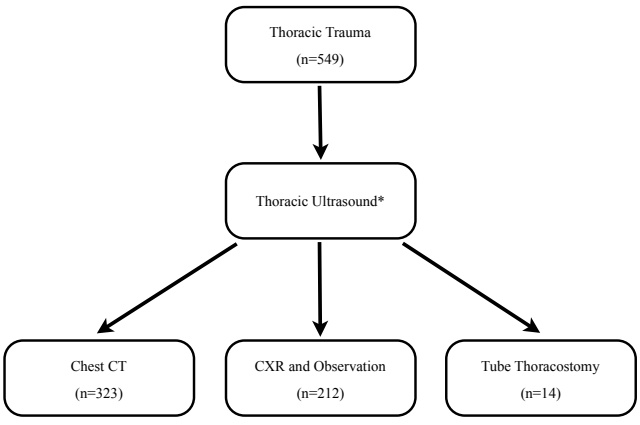

Figure 2. Method of final diagnosis of the presence or absence of pneumothorax in patients with truncal trauma.
*Physician sonologists performed thoracic ultrasound prior to other imaging modalities.

Table 4. Pneumothoraces missed by both thoracic ultrasound and chest radiography.

Patient	Method of final diagnosis	Tube thoracostomy performed?
1	Chest CT	Yes
2	Chest CT	Yes
3	Chest CT	Yes
4	Chest CT	Yes
5	Chest CT	Yes
6	Chest CT	Yes
7	Chest CT	Yes
8	Chest CT	No
9	Chest CT	No
10	Chest CT	No
11	Chest CT	No
12	Chest CT	No
13	Chest CT	No
14	Chest CT	No
15	Chest CT	No
16	Chest CT	No
17	Chest CT	Yes
18	Clinical judgement	Yes
19	Clinical judgement	Yes
20	Clinical judgement	Yes

CT, computed tomography

to the current study, Kirkpatrick et al[8] found that thoracic ultrasound had a greater sensitivity for ruling out a PTX than supine radiography (48.8% vs 20.9%, respectively).

The sensitivity of ultrasound in the current study was much lower than reported in most of the previous studies (Table 5).[8-13] The difference in sensitivities of these studies may be associated with the number and training level of enrolling physician sonologists. Four similar studies have resulted in 95-100% sensitivity[9,10,12,13]; 1 study showed an 86% sensitivity[11], and another similarly found a sensitivity of 59%.[8] These studies are either performed by a small number of highly trained sonologists or do not report the number, background, and training of sonologists performing TUS examination, making it difficult to apply the results to a typical cohort of physicians. The 36 physicians involved in the current study came from varied backgrounds (ranging from residents to attending physicians in both trauma surgery and emergency medicine) and had not performed TUS of the pleura prior to a brief training course at the initiation of this study. It is possible that such a group reflects the gamut of clinicians in the United States whose evaluation of acute trauma includes use of the FAST examination.

We performed TUS on a cohort of patients inclusive of blunt and penetrating trauma after a FAST exam but did not limit the study population to only those who received a CTT (although more than half of the patients in our sample did). Since CCT is the gold standard for the detection of PTX it is possible that a small number were missed in patients after they were discharged from the trauma bay or intensive care unit. However, with the monetary and manpower costs involved in CCT, as well as its exposure of patients to ionizing radiation, it is unlikely that the standard practice of managing many trauma patients who are at low risk for PTX solely with CXR is likely to change. Thus, the protocol followed in the current study reflects clinical practice, and our results suggest that management of low-risk patients with TUS alone, or in addition to CXR, would most likely identify more PTXs than CXR alone. To prevent selection bias we designed the study to include both stable and unstable trauma patients. As a result, 14 patients underwent immediate tube thoracostomy prior to any imaging. TUS correctly identified a PTX in 11 of these 14 cases. If these patients were not included in our study population, then nearly all of the traumatic PTX cases would have involved patients who were stable enough to either wait for a portable CXR or be transported to the CT suite.

The FAST exam is used internationally by both traumatologists and EPs for the detection of traumatic hemoperitoneum.[16] It has largely replaced diagnostic peritoneal lavage, and has proven to be accurate, easily learned, and rapidly deployed.[18-20] Some authorities have advocated that TUS be added as a component of the FAST.[8] Others, based on a study that was retrospective and limited by a small sample size, have argued against this approach on the grounds that the rate of occult PTX is as low as 2.1%.[21] To our knowledge, this report involves the largest sample size of any prospective study of TUS for the diagnosis of PTX in the literature. Our PTX rate was significantly higher, at 9%, although this is much lower than that reported in most series.[7, 9, 12] Based on this study, we advocate that TUS should be incorporated as an extension of the FAST exam because it can identify cases of PTX that would be missed on supine CXR alone, and thereby allow earlier tube thoracostomy. This might be especially important in patients going to the CT suite or for emergent laparotomy where general anesthesia with positive pressure ventilation with undetected PTX might be particularly dangerous.

LIMITATIONS

Limitations to the current study include the possibility of selection bias from enrolling a convenience sample of trauma patients with thoracic injuries. Unstable patients may have been excluded if no one from the resuscitative team was able to enroll the patient due to other resuscitative duties. The potential exclusion of the highly unstable patients may explain the low prevalence of PTX found in our study. TUS may be less relevant in this cohort as algorithms often call for empiric needle decompression in unstable trauma patients.

Not all subjects underwent CCT and instead just had CXR and clinical observation. It is possible that some patients in this latter group had radio-occult PTX that may have been

Table 5. Characteristics of previous studies reporting test characteristics of thoracic ultrasound (TUS) in various patient populations.

Study	N	Type	Sensitivity	Enrolling physicians and training
Dulchavsky (2001)	382	B, P	95%	Unreported number of surgical residents and attendings "familiar with ultrasound for abdominal trauma." Residents also had hands-on demonstration of normal lung model and viewed one pre-recorded exam.
Rowan (2002)	27	B	97%	Exams performed by 4 different sonographers (1 staff radiologist, 3 radiology residents) "trained in ultrasound pneumothorax detection."
Kirkpatrick (2004)	225	B, P	59%	Unreported number of attending trauma surgeons who trained in TUS "through the use of an animal laboratory, review of video-taped images, and proctoring by the most experienced investigator."
Lichtenstein (2005)	195	I	100%	Unreported number of "intensivists specifically trained in general ultrasound."
Blavais (2005)	176	B	98%	Five emergency physicians who had completed the ACEP EUS guidelines, were "trained" in TUS by the director, performed "at least 100 trauma US examinations, and at least ten TUS examinations."
Soldati (2006)	186	B	98%	Two EPs "with over 10 year experience in emergency ultrasounograpy and at least 1 y in chest ultrasound."
Zhang (2006)	135	B, P	86%	Three EPs with previous "formal training on emergency bedside ultrasound." Training in TUS not reported.
Soldati (2008)	109	B, M	92%	Two EPs with "at least 1 year experience in chest ultrasound."

B, blunt trauma; *P,* penetrating trauma; *I*, intensive care unit patients; *M*, mixed trauma patients; *EP,* emergency physician

visualized on CCT leading to misclassification bias. Such a bias could result in a lower sensitivity rate for both TUS and CXR, however would likely not affect the accuracy of these tests for determining clinically significant PTX.

A Hawthorne effect may have occurred since sonologists knew they were being studied. Blinding was attempted to prevent bias. However, it is possible that clinical factors existed (e.g. a stab wound to the chest) that biased the sonologist's TUS interpretation. The test characteristics of CXR for PTX may have been subject to selection bias as only 66% of the patients had an interpretation of the CXR recorded for analysis.

CONCLUSION

TUS is as accurate as portable supine CXR in the diagnosis of traumatic PTX. Because ultrasound can be used by a diverse group of trauma providers and can be done rapidly, it should be considered as part of the routine evaluation of patients with thoracic trauma.

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Use of an Electronic Medical Record "Dotphrase" Data Template for a Prospective Head Injury Study

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Introduction: The adoption of electronic medical records (EMRs) in emergency departments (EDs) has changed the way that healthcare information is collected, charted, and stored. A challenge for researchers is to determine how EMRs may be leveraged to facilitate study data collection efforts. Our objective is to describe the use of a unique data collection system leveraging EMR technology and to compare data entry error rates to traditional paper data collection.

Methods: This was a retrospective review of data collection methods during a multicenter study of ED, anti-coagulated, head injury patients. On-shift physicians at 4 centers enrolled patients and prospectively completed data forms. These physicians had the option of completing a paper data form or an electronic "dotphrase" (DP) data form. A feature of our Epic®-based EMR is the ability to use DPs to assist in medical information entry. A DP is a preset template that may be inserted into the EMR when the physician types a period followed by a code phrase (in this case ".ichstudy"). Once the study DP was inserted at the bottom of the electronic ED note, it prompted enrolling physicians to answer study questions. Investigators then extracted data directly from the EMR.

Results: From July 2009 through December 2010, we enrolled 883 patients. DP data forms were used in 288 (32.6%; 95% confidence interval [CI] 29.5, 35.7%) cases and paper data forms in 595 (67.4%; 95% CI 64.3, 70.5%). Sixty-six (43.7%; 95% CI 35.8, 51.6%) of 151 physicians enrolling patients used DP data entry at least once. Using multivariate analysis, we found no association between physician age, gender, or tenure and DP use. Data entry errors were more likely on paper forms (234/595, 39.3%; 95% CI 35.4, 43.3%) than DP forms (19/288, 6.6%; 95% CI 3.7, 9.5%), difference in error rates 32.7% (95% CI 27.9, 37.6%, $P < 0.001$).

Conclusion: DP data collection is a feasible means of data collection. DP data forms maintain all study data within the secure EMR environment, obviating the need to maintain and collect paper data forms. This innovation was embraced by many of our emergency physicians and resulted in lower data entry error rates. [West J Emerg Med 2013;14(2):109-113.]

INTRODUCTION

Electronic medical records (EMR) are being implemented by many United States (U.S.) healthcare systems. Conversion to EMR throughout the U.S. healthcare system is a stated goal of the federal government. New regulations and incentives are sure to increase implementation in the coming years.[1,2] The use of EMRs in emergency departments (EDs) has fundamentally changed the way healthcare information is collected, recorded, and stored. Necessarily, this movement also impacts the way research data is collected.

Electronic data capture (EDC) refers to direct electronic entry of study data at the site of enrollment. While it is generally accepted that EDC should improve data integrity, decrease costs, and more rapidly transmit study data, implementation has been slow for multiple reasons.[3] Some of the barriers noted previously have been cost, user acceptance, software installation, need for technical support, and regulatory requirements.[3] Electronic data entry has been used previously by primary care research networks (practice-based research networks).[4] However, the use of existing EMRs for research data collection has been noted as problematic as this data is rarely collected according to study protocol.[5] A challenge for future researchers is to determine ways that EMRs may be leveraged to facilitate data collection efforts.

Our multi-center, collaborative emergency medicine (EM) research group recently employed a novel technique for prospective data collection that uses the Epic-based EMR (Epic Systems Corporation, Verona, Wisconsin) in use at our participating medical centers. Our objectives were to describe the use of this unique data collection method, the dotphrase (DP) data collection template, which used EMR technology and to compare its data entry error or omission rate versus a traditional paper data collection instrument.

METHODS

This is a retrospective review of data collection methods during the first 18 months of a multi-center study of ED head injury patients. Patients presenting to one of five study EDs with head injury and taking anti-coagulant medication (warfarin or clopidogrel) were eligible for inclusion. Treating ED physicians identified and enrolled eligible patients. These physicians then completed a prospective data form answering questions related to the primary study objectives. They had the option of completing a paper data collection form or an electronic DP data collection form inserted as a structured note template into the EMR at the end of their ED note. Physicians enrolling a patient (using either data collection form) were given a $10 coffee gift card as a token of appreciation for their participation.

Our hospital system uses an Epic®-based EMR similar to many other hospitals and healthcare systems in the United States. Kaiser Permanente's EMR, powered by Epic, is the world's largest privately owned EMR system, and securely hosts medical records for more than 8.6 million patients.[6] A feature of this system is the ability of clinicians to use DPs to assist in medical information entry. A DP is a structured note template that may be easily inserted into the EMR. A template is populated into the data entry field when the physician types a period followed by a code phrase (in this case ".ichstudy"). We developed an EMR DP that included all of the questions relevant to our study and matched the questions on the paper data collection form. Once this study DP was inserted at the bottom of the electronic ED note, it prompted enrolling physicians to answer study questions before closing the note. The note writer simply uses the tab key to move between sections of the form to complete data entry. Importantly, the DP required physicians to respond to each question on the enrollment form, and offered pre-specified choices for most questions. Using the DP, it is difficult to omit answers although not impossible. Once the ED note (with the embedded data collection section) was completed, the note could easily be "routed" electronically to the study site primary investigator. Study investigators were then able to extract prospectively entered data directly from the EMR at a later time. DP data collection maintains all study data within the secure EMR environment and obviates the need to stock, collect, and store paper data forms.

We retrospectively collected data related to the use of DP versus paper data collection methods. For the purposes of this study analysis, we treated 2 of the participating EDs as a single study site because these departments are managed and staffed by the same emergency physician group (Site C). The study investigators collected data error and omission rates during the course of the study. We defined a data omission or error as any data field that was left empty or was unclear to research coordinators, requiring contact with the site investigator and/or clinician for clarification. Information regarding physician demographics and health plan tenure was abstracted from ED administrative records. Findings are reported using simple, descriptive statistics, with 95% confidence intervals (CI) provided where appropriate. We used multivariate logistic regression to examine the adjusted relationship between physician characteristics and use of the DP enrollment form.

This study was approved by the Kaiser Foundation Research Institute Investigational Review Board.

RESULTS

During the study period (July 1, 2009 through December 31, 2010) 883 patients were enrolled. DP data collection forms were used in 288 (32.6%; 95% CI 29.5, 35.7) cases and paper data forms used in 595 (67.4%; 95% CI 64.3, 70.5) cases. The prevalence of DP data collection use at the respective study centers was 84% (Site B), 29% (Site A), 15% (Site C), and 14% (Site D). There was no correlation between DP usage and overall enrollment rates at the different study sites ($P > 0.05$).

Of 151 physicians enrolling patients into the study, 66 (43.7 %; CI 35.8, 51.6) used DP data entry at least once,

Table 1. Dotphrase versus paper data collection at the particpating study sites.

Enrollment method	Site A	Site B	Site C	Site D
Dotphrase	155	46	55	32
Paper	28	102	306	170
Total enrollment	183 (85%)	148 (31%)	361 (15%)	202 (16%)

Table 2. Data entry error/omission rates with dotphrase versus paper data collection.

	Paper		Dotphrase		Total	
	n	%	n	%	n	%
No correction needed	361	60.7	269	93.4	630	71.35
Error/omission found	234	39.33	19	6.6	253	28.65
Total	595		288		883	

with 80.6% (Site A), 58.8% (Site B), 23.0% (Site C), and 41.7% (Site D) of physicians at the 4 study centers using the DP to enroll 1 or more patients. Using multivariate analysis, we found no significant association between physician age, gender, race, or tenure within the health system and DP use. The physician's medical center was strongly associated with DP use ($P < 0.0001$). Two hundred and thirty-four of 595 paper data forms contained a data error or omission (39.3%; CI 35.4, 43.3),and 19 of 288 DP data collection templates contained data omissions or errors (6.6%; CI 3.7, 9.5). The difference in omissions or error rates was 32.7% (95% CI 27.9, 37.6%, $P < 0.001$) between DP and paper data collection forms. For data regarding enrollment methods at the participating study sites, see tables. We are not aware of any breach of protected health information (PHI) in data collected either by paper forms or by dotphrase templates.

LIMITATIONS

This was a purely observational study without intervention and control groups. Because physicians were allowed to choose between DP and paper data forms, bias is possible. Physicians who declined to accept this innovation might have made errors or omissions at a higher rate. We feel that the selection of data entry method was most influenced by familiarity with the EMR (different sites had used the EMR for varying lengths of time). We were unable to distinguish demographic differences between physicians using the DP and paper data forms. Total automation of DP variables into an analyzable database was not possible due to a lack of systems to support Direct Data Capture at the time of this study.

DISCUSSION

We present our experience with the use of a novel system of prospective data collection, the DP data collection template, which used our EMR for research purposes. Although DP use varied by medical center, we found that use of this data collection system was well accepted by many ED clinicians and yielded fewer missed data points. One barrier to the conduct of prospective research in emergency medicine is the difficulty associated with data collection that is frequently performed by ED staff. These clinicians may simply forget to enroll patients or may see study enrollment as an inconvenience that prevents them from completing study forms. Any system that makes data collection easier is likely to increase study enrollment.[7] We feel that use of DP data collection may be easier for clinicians to access as there is no need to find a paper data form or return it to the primary study investigator. Clinicians can easily access the DP template within the EMR as they write progress notes, while patient details are fresh in memory. Additionally these electronic data forms never run out, alleviating the ongoing task of supplying paper data sheets by the study investigators or coordinator.

While we did not experience any breaches in PHI with either data collection source, another advantage to electronic DP data collection is the additional security associated with it. All data collection forms exist only within the hospital EMR that is password protected and accessible only to health system employees with proper security clearance. Once data forms are completed they are sent directly to the study investigator through the EMR system. This alleviates any need for security measures associated with paper data forms (e.g. locked files). These data collection forms also cannot be lost and do not need to be stored in a separate location during or after the completion of the study. This aspect of the EMR embedded data collection system is important as data security is a known barrier to use of EDC systems.[3,8]

We found that the incidence of missed data points was lower in those cases where the DP data collection instrument was used. Because the EMR system will not allow a note to be "accepted" (closed) until all template prompts have been addressed, note writers must answer all study questions. This substantially improves data collection integrity by reducing rate of data collection omissions. Therefore, it improves researcher efficiency as investigators and/or study coordinators have fewer missed data points to address.

Another important aspect of this system is that it uses existing EMR software for research purposes. Unlike other EDC systems employed in the past, there is no need for additional software or data security systems.[3,8] Physicians also do not need to enter a secondary site for data entry as the DP is entered and remains within the EMR. Researchers whose health systems possess a functioning EMR can implement a similar data collection system almost immediately and with minimal training for site investigators. Additionally, incorporating a study specific DP template was quickly programmed into the EMR with no additional cost to the existing EMR infrastructure and with minimal information technology support. We found, using our Epic-based EMR,

*** indicates a data entry field

Assessment: Head Trauma in Anti-Coagulated Patient

Date of Injury: ***

Time of Injury:
*** (Picklist: AM, PM)

Mode of arrival?
*** (Picklist: Private car, Ambulance)

Transfer from outside hospital/ED?
*** (Picklist: Yes, No)

Vomiting after injury?
*** (Picklist: Yes, No, Unknown)

Headache at time of ED visit?
*** (Picklist: Yes, No, Unknown)

Anticoagulant medications:
*** (Picklist: Warfarin/Coumadin, Clopidogrel/Plavix, Aspirin; When checked then "Last Dose" Picklist: Within 24 hours, 24-48 hours, 48-72 hours, 3-7 days, >7 days, Unknown)

If taking Warfarin, why?
*** (Picklist: Atrial fib/flutter, DVT or PE, Heart valve replacement, In-dwelling catheter, Other, Unknown)

If taking clopidogrel/Warfarin, why?
*** (Picklist: Coronary artery disease, Stroke, Peripheral artery disease, Other, Unknown)

Physical Exam

GCS Eye: *** (Picklist: 1-4)
GCS Verbal: *** (Picklist: 1-5)
GCS Motor: *** (Picklist: 1-6)
GCS <15 due to pre-existing dementia:
*** (Picklist: Yes, No, Unknown)

Was the patient clinically intoxicated at the time of their ED visit?
*** (Picklist: Yes, No, Unsure)

Head Injury Findings

Evidence of head trauma (trauma above the clavicles)? *** (Picklist: Yes, No)
Isolated trauma to face? *** (Picklist: Yes, No)
Isolated trauma to neck? *** (Picklist: Yes, No)
Scalp trauma (from above eyebrows to the occiput)?
***(Picklist: Yes, No; If yes then picklist: Depressed skull fracture, Contusion/hematoma, Signs basilar skull fracture, Laceration, Abrasion, None, Other)
Clinical suspicion for the presence of intracranial hemorrhage on CT
(regardless of whether a CT was obtained): *** (Picklist: <1%, 1-5%, 6-10%, 11-50%, >50%)
Clinical suspicion for intracranial hemorrhage requiring neurosurgery
(regardless of whether a CT was obtained): *** (Picklist: <1%, 1-5%, 6-10%, 11-50%, >50%)

After completion, please route this note to your facility study coordinator:
(Name of study coordinator)

Thank you for your participation. If possible, please answer the questions below, as it will help with our follow-up

Please be sure to select diagnostic code for "Closed Head Injury" within the KP Health Connect System.

Preferred Patient Contact Number: ***
Has the Patient received a Study Information Sheet?
*** (Picklist: Yes, No)

Figure. "Dotphrase" data collection instrument.

that it was easy to design data collection forms that closely resembled our paper instruments.

A possible advantage of an embedded EMR data collection format is the potential for development of direct data capture (DDC) systems in the future. Software could be developed that will directly extract study data from these EMR DP notes, thus alleviating the need for human data transfer from the EMR into central data storage software.

CONCLUSION

DP data collection is a feasible, efficient, and low cost means of study data collection. This innovation was embraced by many of our emergency physicians; however, adoption rates varied by medical center. We found lower error rates associated with DP data forms when compared with paper forms. DP technology used existing EMR infrastructure, required minimal technical support, and was up and running in a short time period. As a participant enrollment tool, a similar DP model could be easily replicated at another Epic-based EMR medical center.

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Implementation of Computerized Physician Order Entry for Critical Patients in an Academic Emergency Department is Not Associated with a Change in Mortality Rate

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Introduction: There is limited literature on the effect of computerized physician order entry (CPOE) on mortality. The objective of our study was to determine if there was a change in mortality among critically ill patients presenting to the emergency department (ED) after the implementation of a CPOE system.

Methods: This was a retrospective study of all critically ill patients in the ED during the year before and the year after CPOE implementation. The primary outcome measures were mortality in the ED, after admission, and overall. Secondary outcome measures included length of stay in the resuscitation area of the ED, length of hospital stay, and disposition following hospitalization. Patient disposition was used as a marker for neurologic function, and patients were grouped as either being discharged to home vs. nursing home, rehabilitation center, or a long-term healthcare facility. We analyzed data using descriptive statistics, chi- square, and Wilcoxon rank sum tests.

Results: There were 2,974 critically ill patients in the year preceding CPOE and 2,969 patients in the year following CPOE implementation. There were no differences in mortality between the two groups in the ED, after admission, or overall. The pre- and post-CPOE mortality rate for the ED, hospital, or overall was 2.52% vs. 2.02% (P = 0.19, 95% confidence interval [CI] -0.3 to 1.3), 7.8% versus 8.29% (P = 0.61, 95% CI -1.9 to 0.9), and 10.32% vs. 10.31% (P = .60, 95% CI -1.5 to 1.6), respectively. There was no difference in hospital length of stay between pre- and post-CPOE patients (3 days versus 3 days), a difference of 0.05 days (95% CI -0.47 to 0.57). Length of stay in the ED resuscitation area was longer in the post-CPOE group (31 versus 32 minutes), a difference of -1.96 minutes (95% CI -3.4 to -0.53). More patients were discharged to home in the pre-CPOE group (66.8% versus 64.3%), a difference of 2.54% (95% CI 0.13% to 4.96%).

Conclusion: The implementation of CPOE was not associated with a change in mortality of critically ill ED patients, but was associated with a decrease in proportion of patients discharged to home after hospitalization. [West J Emerg Med 2013;14(2):114-120.]

INTRODUCTION

"To Err is Human: Building a Safer Health System," a 1999 report by the Institute of Medicine, reported that medical errors contribute to between 44,000-98,000 deaths per year in the United States.[1] Computerized physician order entry (CPOE), a specific component of electronic medical records (EMR), has been touted as an effective tool for decreasing medical errors. The *LeapFrog Group,* initially funded by the Business Roundtable and launched in 2000, includes CPOE as one of its 4 leaps in improving hospital quality, safety, and affordability.[2] Several studies demonstrate a decrease in medication error rates, potential errors, and harmful adverse drug events when CPOE is used.[3-5] In a recent study of 3,364 hospitals, CPOE hospitals outperformed non-CPOE hospitals in medication ordering quality-related measures.[6] There has been an increasing belief that EMRs can improve the quality of patient care, decrease medical errors, and improve healthcare delivery efficiency. As a result, The American Recovery and Reinvestment Act of 2009 set aside approximately $17 billion for healthcare industry incentives to adopt EMR systems for use with Medicare and Medicaid patients.[7]

Only a few studies have examined mortality outcomes related to the introduction and use of CPOE. These studies have conflicting results. Han et al[8] demonstrated an increase in mortality from 2.8% to 6.57% after the introduction of CPOE in a tertiary-level care pediatrics hospital using their critical care transport database to identify1,942 patients in the study. Their conclusion, an unexpected increase in mortality, might indicate that "surrogate outcome measures such as medication error rate or adverse drug events (ADEs) alone may not be sufficient to determine CPOE efficacy." A potentially significant methodology issue in this study was the large difference in observation study periods between the pre- and post-CPOE groups. The pre-CPOE study period consisted of the preceding 13 months, while the immediate post-CPOE study period was 5 months. Sittig et al[9] argued that the primary reason CPOE is prone to failure is because of the profound alteration in patient care workflow processes developed over many years and proven to work. Thus, the 5 months post CPOE was not a long enough period for physicians to adapt to their new routines and responsibilities. Alternatively, Del Beccaro et al[10] found no increase in mortality rates in a 2,533-pediatric-intensive-care patient study after the introduction of CPOE. They concluded that differences in the implementation of CPOE between the 2 institutions were the primary factors affecting the differing mortality rates. Keene et al[11] published a study involving 1,291 pediatric intensive care patients and demonstrated no difference in mortality associated with CPOE implementation. They also concluded that "careful preparation, unit by unit tailoring, and extensive technical support" may have been keys to their results. Only one study to date has demonstrated a decreased hospital-wide mortality rate after implementation of a CPOE.[12] This study involved all admitted pediatric patients to a children's hospital. A total of 80,063 pre-CPOE and 17,432 post-CPOE patients were studied, and the mean monthly adjusted mortality rate decreased by 20%.

The few studies that have looked at mortality pertain only to the limited population of admitted pediatric patients. Our goal was to determine if CPOE was associated with any change in mortality in our diverse critically ill emergency department (ED) patient population.

METHODS

This was a retrospective study of critically ill patients in the ED one year before and one year after implementation of an EMR that uses CPOE. The primary outcome measure was ED, in-hospital, and overall mortality. Secondary outcome measures were length of ED stay in the resuscitation area, length of hospital stay, and patient disposition following hospitalization. We used patient disposition as a gross marker of neurologic function, with discharge to home an indicator of largely independent function, and skilled nursing or rehabilitation center discharge as markers of impaired function.

This study was conducted in the ED of an urban county hospital with an annual patient census of 99,000 in 2008. Critically ill patients were defined as patients undergoing treatment in the stabilization area of the ED. Treatment in this area is at the discretion of the treating physician, and includes patients identified as having an immediate life threat, regardless of age, etiology of illness, or mechanism of trauma. The decision to treat a patient being transported by advanced life support (ALS) ambulances in the ED stabilization room was made by the transporting paramedic team using established protocols and conveyed to the treating physicians before patient arrival. Only ALS-transported patients deemed to be critically ill or injured were placed directly into the stabilization room.

All critically ill patients treated in the ED for one year before and one year after CPOE were included in the study. The post-CPOE phase started immediately after implementation. This was designed to examine the possible increase in mortality associated with lack of gross familiarity of the CPOE system, and associated changes in workflow. Acute respiratory distress, unstable vital signs, known myocardial infarction, penetrating trauma to the torso, blunt trauma from a significant mechanism of injury, marked alteration in level of consciousness, and suspicion of acute stroke are examples of patients treated in our ED stabilization area.

Physician documentation and CPOE were implemented in our ED using EpicCare Inpatient Clinical System ™ (Epic Systems Corporation, Verona, Wisconsin), on February 1, 2007. All other inpatient care areas of the hospital went live with CPOE on February 1, 2007 as well, but physician electronic documentation did not occur in these

areas until August 2007. Prior to EpicCare, our ED used EmStat ™(Allscripts-Misys Healthcare Solutions, Chicago, Illinois), an EMR limited to use in the ED but *without* CPOE capability for critical care patients. EmStat and EpicCare were respectively turned off and on simultaneously.

One of 6 chart abstractors (4 physicians, 1 nurse, and 1 medical student) reviewed all critical care patient charts from these periods. The principal researcher trained each abstractor using a structured data abstraction form. Abstractors were not blinded to the study hypothesis. We did not perform inter-rater reliability testing. All but one study reviewer (representing 100 cases) abstracted pre-CPOE and post-CPOE charts. Data abstraction started in December 2008, 10 months after the last post-CPOE patient was managed in the stabilization room. Data was entered into a Microsoft Access ™ (Microsoft Corporation, Redmond, Washington, version 2003) database.

The primary end point was ED and hospital mortality. Secondary outcomes included time in the stabilization room, length of hospital stay, and place of disposition after discharge from the hospital. The length of stabilization room time was defined as the time from initial patient arrival to departure from the ED stabilization room. It does not include time spent on diagnostic tests outside of the stabilization room, such as computerized tomography, operating room time, or time spent in other parts of the ED.

Descriptive statistics were used as appropriate. We report 95% confidence intervals (CIs) around the differences between groups for continuous data. Differences in proportions were tested by X^2, and differences in medians were tested by Wilcoxon rank sum. We used an *alpha* probability of 0.05 as the threshold for statistical significance. All statistics were performed with Stata, version 10 (StataCorp, College Station, TX).

Description of Pre-CPOE and Post-CPOE Ordering Systems

Personnel staffing for stabilization room cases were the same pre-CPOE and post-CPOE, with a team consisting of an emergency medicine (EM) faculty, a third-year EM resident, a first-year resident, 2 nurses, a nursing assistant, and a respiratory therapist. A medical student, if available, recorded events on a standardized paper form. This form was not part of the patient's medical record, but was utilized after case completion by the physicians and nurses for their medical charting.

Pre-CPOE Ordering System

All physician medication orders were given to the 2 nurses verbally. After the case was completed, the nurses would document the orders in the paper stabilization room medical record log, which the faculty physician would then review and sign. This would become part of the official medical record. Orders for laboratory studies or medical imaging were given verbally to the nursing assistant, who would complete paper ordering forms and send these forms to the appropriate departments. There was no systematic process to ensure verbal order patient safety, such as writing down and verbally repeating physician orders.

The vast majority of medications were stored in the stabilization room, and pharmacy was not involved with checking the orders. For medications stored only in pharmacy, the pharmacy was called by the nurse with the requested medication, which would be checked for appropriateness and accuracy before delivery to the stabilization room. The system for obtaining medications stored in the pharmacy post-CPOE remained the same, although the pharmacy could directly see the order.

Initial Post-CPOE Ordering System

Patients were not entered into the EMR until their physical arrival in the stabilization room, and were not pre-registered. Electronic placement of the patient was performed by either the nurse or nursing assistant after patient arrival. As a result, physicians could not place orders until patient arrival in the stabilization room. This resulted in a delay to CPOE of approximately 3-5 minutes.

The nurses and physicians for critical cases work within the confines of the stabilization room in close proximity. Although not formally studied, there did not appear to be major issues with delayed recognition of physician orders as a result of CPOE.

At the time of initial implementation of CPOE, order sets were available for the physicians. These order sets were specific for the patients' clinical problem. (e.g. major trauma(blunt and penetrating combined), respiratory distress, cardiac arrest, acute myocardial infarction, stroke, or overdose). The order sets contained lists of the commonly prescribed medications, laboratory studies, and radiographic imaging. Clicking in a box for a medication would open another window which would require several clicks to specify the exact dosage, frequency, and method of medication delivery. Medication orders given on a per weight basis required electronic placement of the patients' weight before such an order could be placed. Clicking on the requested radiographic studies would open up a window requiring additional clicks for information, such as indications for the study, pregnancy status of the patient, and whether or not the patient had a contrast allergy. Specific contrast orders were generated automatically by entering a contrast-enhanced computed tomography order itself.

All medication, laboratory, and radiographic imaging orders had at least 2 warning box statements requiring the physician to affirm their desire for the orders in question.

No laboratory or radiographic imaging would be performed without CPOE. The workflow for EM nurses required CPOE prior to administration of medications. Verbal orders were only permitted in cases requiring immediate life-saving medication administration, e.g., epinephrine for severe airway compromise from an allergic reaction. Following the verbal orders, physicians were still required to perform CPOE.

No definitive workflow processes were established dictating who would be entering the physician orders. It was policy that a physician needed to physically place the electronic orders. This was done by any of the physicians in the stabilization room, including faculty and any graduate level of resident.

The CPOE terminals were located immediately adjacent to the patients' stabilization room gurney, and there were enough present for nurses, nursing assistants, and physicians to avoid sharing terminals.

There appeared to be a steep learning curve for physician order entry. Anecdotally it appeared that older EM physicians were more challenged than younger and presumably more computer-savvy physicians. A rough time estimate for physicians becoming acclimated to the electronic order entry was 1-2 weeks. An experienced user of the CPOE system would be able to place all orders for a given case in 5 to 10 minutes, depending on the number and complexity of the orders.

This study was deemed exempt by our Human Subjects Research Committee.

RESULTS

There were 2,974 patients in the year preceding CPOE and 2,969 patients in the year following CPOE implementation. No stabilization room cases were excluded from the study.

Table 1 shows the demographics and baseline presenting variables for the pre-CPOE and post-CPOE groups. There were statistically significant differences between the 2 groups for age, initial blood pressure, and initial respiratory rate. There were no differences in the 2 groups for gender, percent presenting in cardiac arrest, percent intubated, initial Glascow Coma Scales, or initial oxygen saturations.There was a slight decrease in the number of penetrating trauma patients in the post-CPOE group, 10.2% vs. 8.6% (-1.6, 95% CI -3.1 to -0.1).

Table 2 shows the place of disposition of patients from the stabilization room of the ED to the hospital. There was a slight increase in the number of patients discharged from the ED stabilization room to the computerized tomography and intensive care units in the post-CPOE group, and a slight decrease in the number of patients discharged to a hospital floor bed.

Table 3 shows the primary and secondary outcome measure results. There was no statistical difference between the 2 groups in mortality rates in the ED, or at any time after admission. However, more patients were discharged from the hospital to places other than home in the post-CPOE group. The length of time patients were in the ED was statistically higher in the post-CPOE group, but the increase was not clinically important.

Table 1. Demographics and baseline clinical variables before and after implementation of computerized physician order entry (CPOE) (medians with interquartile range).

Category	Pre-CPOE	Post-CPOE	Difference (95% CI)
Total patients	2,974	2,969	-5
Age (median, IQR)	44, 27-59	46, 28-61,	1.15 (-2.2 to -0.6)
% Male	67.4	67.8	0.3 (-2.8 to 2.0)
% Presenting to ED in cardiac arrest	2.62	2.36	-0.23 (0.5 to1.1)
% Presenting to ED already intubated	11.37	10.64	-0.73 (-0.9 to 2.3)
% Intubated in ED	18.64	19.27	0.73 (-2.6 to 1.4)
Initial systolic blood pressure in mmHg	133,113-150	135,115-154	2.78 (-4.7 to -0.8)
Initial heart rate	95, 80-112	95, 79-113	0.82 (-2.59 to 0.95)
Initial respiratory rate	18, 15-23	19, 16-23	-0.5 (-0.92 to -0.08)
Initial Glasgow Coma Scales	15, 10-15	15, 10-15	0.11 (-0.15 to 0.38)
Initial oxygen saturations	99, 96-100	99, 96-100	-0.31 (-0.84 to 0.21)

CI, confidence interval; *ED*, emergency department

DISCUSSION

We found no change in mortality in the critically ill patients presenting to the ED in the year following CPOE implementation in the ED, after admission, or at any point during their stay in our hospital. To our knowledge, this is the first study examining mortality rates of all critically ill patients presenting to an ED before and after the introduction of CPOE. Demonstrating no change in mortality on first glance would appear to be a neutral or even positive result. However, one of the primary reasons for the institution of CPOE is to decrease medical errors that lead to significant morbidity and mortality. The "To Err is Human" report from the Institute of Medicine, demonstrating an additional 44,000 to 98,000 deaths per year due to medical mistakes, is frequently cited among the principal reasons for pursuing CPOE, and in a larger context, complete EMRs.

Our study found a significant decrease in the number of patients being discharged home from the hospital following CPOE implementation. This data was examined as a surrogate method to determine functional outcome. The inference is that patients discharged directly to home from the hospital likely had a better functional outcome than those patients discharged to either a rehabilitation or nursing home facility. Our data would seem to indicate that although a difference in mortality was not observed, the post-CPOE group fared worse as

Table 2. Disposition from the emergency department stabilization room.

Category	Pre-CPOE	Post-CPOE	Difference (95% CI)
Home (%)	0.40	0.13	0.27 (0.0087, 0.53)
Specialist(%)	0.40	0.54	-0.14 (-0.49, 0.21)
CCU (%)	2.05	2.76	-0.71 (-1.5, 0.069)
Morgue (%)	2.52	2.02	0.5 (-0.26, 1.3)
OR (%)	6.93	6.16	0.77 (-0.49, 2.0)
Floor (%)	30.06	26.78	3.3 (0.99, 5.6)
ICU/CT (%)	57.63	61.60	-4.0 (-6.5, -1.5)

CPOE, computerized physician order entry; *CI*, confidence interval; *CCU*, critical care unit; *OR*, operation room; *ICU*, intensive care unit; *CT*, computed tomography

Table 3. Primary and secondary outcome measures (Medians with interquartile ranges)

Category	Pre-CPOE	Post-CPOE	Differences (95% CI)
Died in ED (%)	2.52	2.02	-.5 (-0.3 to 1.3)
Died in hospital (%)	7.80	8.29	0.49 (-1.9 to 0.9)
Died in either ED or hospital (%)	10.32	10.31	-0.01 (-1.5 to 1.6)
Total ED stabilization room time in minutes (median, IQR)	31 (22 to 45)	32 (23 to 47)	-1.96 (-3.4 to -0.53)
Length of hospital stay in days (median, IQR)	3 (1 to 7)	3 (1 to 7)	0.05 (-0.47 to 0.57)
Discharged home versus all other dispositions (%)	66.8	64.3	-2.54 (-0.13 to-4.96)

CPOE, computerized physician order entry; *CI*, confidence interval; *ED*, emergency department; *IQR*, interquartile range

evidenced by less patients being discharged directly to home. Although the difference appears small, if extrapolated to all critically ill patients in the U.S., it represents a large number of discharges. In 2007 and 2008, 3.4% of our 196,291 ED patients were critically ill. In 2006, there were 119.2 million visits to EDs in the U.S. [13] Applying our 3.4% rate of critically ill patients to these 119.2 million patient visits nationally would grossly estimate 4 million critically ill patients cared for in EDs across the country. The discharge home rate after CPOE introduction demonstrated in our study, if applied to these 4 million patients, would estimate an additional 100,000 patients discharged to dispositions other than home.

There was an increase in the number of patients discharged from the ED stabilization room to the computerized tomography and intensive care units in the post-CPOE group, and a decrease in the number of patients admitted to a hospital floor bed. The etiology for these changes is unclear. No significant changes to our management of this patient population were made during the study period. The intensive care unit and computerized tomography unit disposition numbers were grouped together, as a detailed breakdown for each of these 2 units was not available. The post-CPOE increase in disposition to the intensive care unit and computerized tomography group might reflect an increase in use of computerized tomography, an increase in patients admitted to the intensive care unit, or both. Additionally, an initial decision to admit a patient to an intensive care bed might be changed to a floor bed if computerized tomography did not reveal significant illness or injury. This disposition change would occur in the computerized tomography suite, not in the ED, and is not reflected in our reported disposition data.

The post-CPOE group demonstrated a longer stabilization room time. This small difference is not clinically significant (-1.96 minutes). The added time for care of these patients might be attributable to increased or additional time needed for CPOE.

Although there were more self-reported nursing medication errors in the post-CPOE time period, this was not a defined data point included in our abstraction of charts.

Major Issues and Subsequent Improvements in Physician Order Entry

The most consistent complaint among EM faculty with implementation of physician order entry was the perception of time being taken away from the patient's bedside in the critical first few minutes of stabilization room cases for the electronic placement of orders. Instead of focusing on the patient, at least one physician in the room was focused on a computer monitor with his "back to the patient."

The second major complaint was simply related to the ease of use of the system. Physicians went from the easiest method of order entry, i.e., verbal, to a method that required numerous and seemingly extraneous mouse clicks and typing. The initial order design was for the physician to verify, with username and password, every medication order being given, despite already being logged into the EMR as the user of record. This was an initial safety feature designed to prevent another user from entering orders under the name of the signed-on user in the event he had left their terminal without closing the EMR.

A third major complaint involved the consequences of inadvertent lack of electronic order entry. Radiographic or laboratory studies would be delayed until the order was

placed. Early in the post-CPOE time period, it was not uncommon for physicians to be waiting on the results of a study only to discover the study had not yet been performed due to lack of order placement.

A fourth major complaint was that the software was slow to respond to mouse clicks, screen changes, and the opening of new windows. This was the result of an insufficient number of servers, as well as the speed of the servers.

Since the initial implementation of CPOE, there have been numerous process improvements. Critical patients are now electronically pre-arrived prior to their physical arrival in the stabilization room, allowing for orders to be placed prior to actual patient arrival. A rough estimate is that 75% of all orders on critically ill or injured patients can be placed before patient arrival.

Order sets have greatly improved in terms of efficiency. Order sets have become more intuitive and specific, requiring fewer mouse clicks, screen changes, and pop-up windows. A general stabilization room order set, not specific to any individual clinical problem, was developed with pre-clicked checkboxes. This general stabilization room order set contained orders that would be placed on the majority of stabilization room cases, regardless of specific clinical presentations. Any unwanted tests, for example, pregnancy test in a male patient, need to be unchecked before finalizing the order set. Additionally, the requirement for physicians to verify each medication order with their username and password was abandoned.

A number of pre-determined critical medications, typically those used in advanced cardiac life support and rapid sequence intubation, are now handled in an expedited format with verbal orders. These medications were chosen because they are often ordered during a time in a critical care case where physicians need to focus on the patient and not be distracted by CPOE. The nurse administers the medication, and then immediately electronically documents this medication activity. Three separate things happen simultaneously when the nurse does this. First, a physician verbal order is electronically placed for the medication. Second, the electronic Medication Administration Record (MAR) is notified that this medication has been administered. Third, an electronic verbal order message is sent to the physician's In-Basket within the electronic health record. The In-Basket has items requiring physician action on charts, such as documentation, billing, or signing of verbal orders. This verbal order message requires electronic signing before it can be removed from the physician's In-Basket. This can be accomplished after patient care is finished. The number and speed of the servers was addressed and corrected, with improvement in the system.

LIMITATIONS

This is a retrospective chart review, and examines a site specific hypothesis regarding the effects of CPOE implementation. Our experience may not be generalized to other healthcare institutions.

We did not analyze or test for inter-rater reliability, which could result in data collection differences. However, the primary endpoint of stabilization room or hospital death is straightforward. What could be affected by inter-rater variability is the degree to which the 2 patient populations are judged to be similar.

Our ED had been using an EMR without CPOE for critical cases prior to the switch to EpicCare Inpatient Clinical System™ (Epic Systems Corporation, Verona, Wisconsin). It is possible that the transition to CPOE for critical cases in the ED was not as difficult given prior experience. However, CPOE and electronic charting were both new to the in-house physicians.

There were differences in age, initial blood pressure, and initial respiratory rate between the 2 groups. These were judged to be clinically unimportant because of the modest actual difference in medians. However, it is possible this modest difference actually represents a true difference in severity of illness between the two populations.

The presenting clinical complaint showed a slight decrease in penetrating trauma in the post-CPOE group. The reasons for the decrease in penetrating trauma are unknown.

The post-CPOE group demonstrated an increase in the number of patients discharged from the ED stabilization room to the computerized tomography and intensive care units, and a decrease in the number of patients admitted to a hospital floor bed. This might be evidence for the post-CPOE group being a more ill group.

We used patient disposition as a gross marker of neurologic function, assuming a discharge to home indicated independent function and a better neurologic outcome compared to those discharged to either nursing homes or rehabilitation facilities. This is an imprecise measurement of actual neurologic function, and actual measurement using neurologic outcome scales of each patient would have provided better definition of neurologic outcome. However, these data were not available in this retrospective study.

Although our primary endpoint, a difference in mortality, was not observed, our data do suggest that patients in the post-CPOE group had a decrease in functional outcome. Future studies will need to address functional outcomes as a primary endpoint.

Lastly, an unintended consequence of implementation of CPOE is significant changes in previously well established patient care workflow processes, especially for physicians. It is possible that a decrease in mortality rate might occur months to years after CPOE implementation as a consequence of physician adaptation and improvement in patient care workflow within the CPOE system. A follow-up study with the same methodology is warranted.

CONCLUSION

The implementation of CPOE in our hospital did not result in a change in mortality in ED critically ill or

injured patients. There was a decrease in the proportion of patients discharged to home in the post-CPOE group, with a corresponding increase in the proportion of patients discharged to settings requiring higher levels of care.

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Ultrasound Detection of a Molar Pregnancy in the Emergency Department

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CASE

A 32 year-old female presented to the emergency department (ED) with complaints of mild vaginal spotting accompanied by uterine cramping. She was referred to the ED for an "abnormal pregnancy." She was a G1P0 and her last menstrual period was 7 weeks 5 days prior. Physical examination demonstrated a well appearing female with normal vital signs. Speculum exam showed a normal appearing cervix, without active bleeding or cervical discharge. On bimanual exam, the cervical os was closed and there was no uterine or adnexal tenderness. Laboratory testing was significant for an elevated serum beta-HCG of 138,596. Bedside emergency ultrasound (EUS) was then performed and demonstrated multiple grape-like clusters within the uterus (Video). No definitive intrauterine pregnancy was detected. A radiologist performed ultrasound was then ordered and confirmed the diagnosis of a molar pregnancy.

DISCUSSION

Hydatidiform mole is part of a spectrum of gestational trophoblastic disease, which involves the abnormal fertilization of maternal ovum by spermatozoa that can range from a benign to an invasive condition. The hydatidiform mole can be partial (69 XXX or XXY, containing fetal tissue), or complete (46 XX or XY, both derived from paternal chromosomes with a lack of fetal tissue).[1] Molar pregnancy is more common in extremes of reproductive age.[2]

Vaginal bleeding tends to be the most common symptom of a molar pregnancy. The most common physical exam finding of a molar pregnancy is a uterine size that is greater than expected for gestational age.[3] Quantitative beta-hCG levels higher than 100,000 mlU/mL should raise suspicion for a molar pregnancy. However, molar pregnancy with normal beta-hCG levels can exist.[3,4,5]

Ultrasound is the standard imaging modality for identifying molar pregnancy. Classically, a 'snowstorm pattern' has been described, resulting from the presence of a complex vesicular intrauterine mass containing many 'grape-like' cysts. Ultrasound evaluation of the adnexa can also reveal theca lutein cysts, due to ovarian stimulation by abnormally elevated beta-hCG levels.[6]

Work up of a molar pregnancy includes obtaining a chest radiograph, a complete blood count, liver panel, thyroid function tests, coagulation studies, blood type and urinalysis.[3,6,7] The obstetrics and gynecology service should be routinely consulted for a molar pregnancy. In this case, the patient was admitted to this service and emergent suction dilatation and curettage was performed. The operative report noted "cystic heterogeneous sanguineous material, consistent with molar pregnancy". The pathology report confirmed "villi with histological features suggestive of complete hydatidiform mole".

This case demonstrates the utility of bedside EUS in the evaluation of the early pregnant patient presenting to the ED with vaginal bleeding. While molar pregnancy is a relatively uncommon condition, emergency physicians should be aware of the clinical and ultrasound features of this disease in order to make a timely diagnosis and to provide the appropriate treatment.

Video. Ultrasound of a molar pregnancy with long axis view and short axis view.

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Ultrasound Detection of a Renal Mass in a Patient with Flank Pain and Hematuria

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Flank pain with hematuria is a common chief complaint in the emergency department (ED). Patients are often diagnosed with renal calculi or pyelonephritis and discharged with analgesics or antibiotics and follow-up. This case study describes a patient who presented to the ED with a 1 week history of flank pain and hematuria and was subsequently found to have a large renal mass on bedside ultrasound. [West J Emerg Med 2013;14(2):123-126.]

INTRODUCTION

A 45-year-old male with no previous medical history presented to the emergency department (ED) with 1 week of hematuria and left flank pain. The patient had noted that over the preceding 4 days his urine had progressed from a pink color to dark red. He had also experienced left flank pain that was sharp, non-radiating, and increasing in severity over the week prior to presentation. He denied a history of renal calculi, weight loss, fevers, fatigue, or abdominal masses.

Upon physical examination, his vital signs included blood pressure of 157/89 mmHg, heart rate of 64 beats/min, temperature of 97.4 ºF, respiratory rate of 18 breaths/min, and oxygen saturation of 99% on room air. The patient appeared comfortable. His abdomen was soft, non-tender and non-distended. The patient had left-sided costo-vertebral angle tenderness to palpation. There was frank hematuria in the urine sample at bedside. Subsequent microscopic analysis revealed > 50 red blood cells and 4-10 white blood cells. Bedside emergency ultrasound (EUS), initially performed to look for hydronephrosis, showed a large left renal mass (Video). A computed tomography (CT) of the abdomen and pelvis was subsequently obtained, revealing a 13 x 9.5 x 14.7 cm exophytic anterior left renal mass with calcifications and areas of necrosis, consistent with renal cell carcinoma (Figure).

Urology consultation was immediately obtained. The patient was scheduled for a close outpatient appointment for this newly diagnosed renal tumor, which likely would require future surgical resection. In the interim period, he was referred for an outpatient CT urogram with contrast to better delineate the mass. The patient was also scheduled for follow up with oncology service. Unfortunately, the patient did not return for any of his scheduled appointments. Further attempts to reach the patient by phone and by mail were unsuccessful.

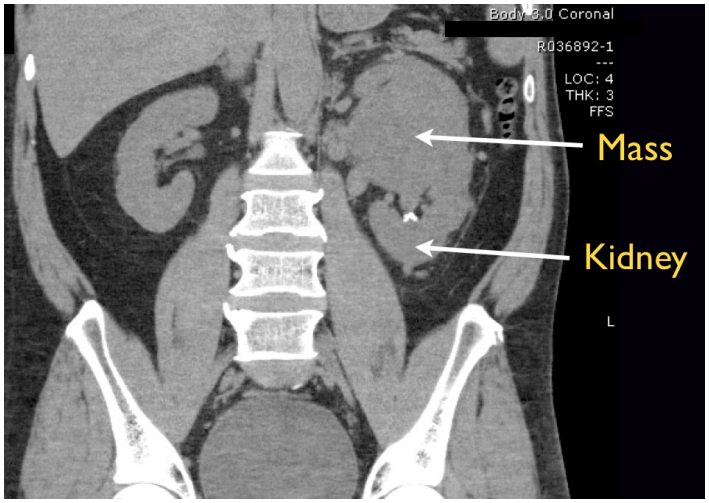

Figure. Coronal computed tomography showing renal carcinoma.

DISCUSSION

Renal cell carcinoma (RCC) constitutes approximately 3% of all adult malignancies and 80-85% of primary renal cancers.[1,3,6] In 2010, an estimated 58,000 persons in the United States (U.S.) were diagnosed with RCC and about

13,000 died from the disease.[6,8,9] Although the incidence of RCC in the U.S. has increased since 1975 (partly due to the increased use of noninvasive abdominal imaging), the 5-year survival rate has more than doubled over the past 50 years from 34% to 69%.[6,8-10] The improved survival rate is partly attributed to earlier diagnosis, with subsequent earlier surgical intervention.[6]

While ultrasound (US) is less sensitive than CT for detecting renal masses, it is a convenient imaging modality with many potential benefits for the initial ED workup of flank pain and hematuria.[7] Its power lies in the ability to accurately detect hydronephrosis, a clinical sign often indicative of renal colic.[1-3] In fact, in prior years, the evaluation of kidney stones was performed with a combination of US and an intravenous pyelogram. However, more recently, the pendulum has moved toward the inclusion of CT imaging in many patients presenting to the ED with potential renal colic. CT has the advantage of being extremely accurate in the diagnosis of renal stones, allowing the clinician to determine both the location and the size of the stone. It also has the advantage of being able to rule out alternative and potentially serious diagnoses. However, with these benefits come some associated drawbacks. The first is the risk of radiation inherent in a CT.[5] More recent data suggests that a CT of the abdomen and pelvis imparts between 10-16 mSv.[14] The conversion rate most commonly used for quantification of radiation dosing, between millisieverts (mSV) and rems or rads, is 10 mSV = 1 rem or rad. While most CTs performed to assess for renal colic are protocoled without intravenous (IV) contrast, some institutions require a comprehensive CT with IV contrast for all patients with abdominal pain. This can increase the amount of radiation given during the scan, due to the CT protocols required to best assess contrast in the body. While 1 CT may not seem like an undue amount of radiation given to any patient, many patients present with repeated occurrences of renal colic and some of these patients will receive a number of CTs over their lives. It should be emphasized that it is this cumulative dose of radiation over a patient's lifetime that has the best correlation to the risk of cancer.[14]

In addition to the radiation dose given during the administration of a CT, there are also economic costs to be considered when ordering all imaging tests. Bedside EUS is now routinely performed in many EDs. Some facilities are currently billing these exams under a limited code and more billing through the ED will likely occur in the future. However, at this time the vast majority of the bedside US exams performed by the emergency physician (EP) are not being billed for. Looking directly at the newest California CPT codes for CTs (74176, 74177, 74178), the California Medi-Cal website shows the following costs: For a non-contrast CT of the abdomen and pelvis (74176), the basic charge is $195.24, for a CT of the abdomen and pelvis with IV contrast (74177), the basic charge is $311.37 and for a focused CT abdomen and pelvis with IV contrast (74178), the basic charge is $395.37.[15] These charges should be interpreted in terms of the relatively lower amounts allowed by Medi-Cal in relation to the billed hospital costs of these tests, as well as the differing coverages provided by other private insurance. Many patients may be forced to pay a significant co-payment out of pocket to cover the expense of a CT. Looking at the costs of US, there is a noticeable decrease in charges in relation to CT. A formal comprehensive abdominal US (76700) has a basic charge of $83.20 and a limited abdominal US (76705) has a basic charge of $60.74. Thus, there is a considerable difference in economic cost to the patient in selecting a CT versus an US.

Considering these facts, US would appear to have many benefits over CT in the initial evaluation of many patients presenting with flank pain and possible renal colic. Many urologists would argue that a first-time presentation of renal colic would best be evaluated with a CT. However, US may potentially be as efficacious in the assessment of renal colic in the younger patient with an uncomplicated case. This is especially true if the patient improves clinically in the ED and can get access to good medical follow-up. Where CT might have more of a role is in the evaluation of the older patient, especially those over 65 years of age, presenting with potential first-time renal colic to exclude alternative serious pathology. However, because many patients presenting to the ED with renal colic are young and healthy and often have repeated presentations of this disease, US offers a less expensive means for their assessment, without the undue added risk of repeated radiation doses.

This case brings up some important learning points as this patient was in the minority of patients presenting with a clinical constellation that was very similar to renal colic, yet ultimately had a more ominous diagnosis. This is why standard training courses in bedside EUS that are now integrated into the current mandated Emergency Medicine Residency Curriculum emphasize the typical findings of renal colic, as well as demonstrating when the findings are abnormal.[4,7] Physicians encountering these abnormal findings on EUS are urged to order a formal study through radiology, as the investigation of renal tumors on bedside US is not within this scope of practice. Especially as physicians learn the skills of bedside US and establish their abilities in this imaging modality, performing US in a quality assurance system with over-reading and review, together with a low threshold for confirmatory testing, is a prudent strategy. However, as with any test performed by the EP in the clinical evaluation of the patients in the ED; like auscultation of the heart and lungs, interpretation of a chest radiograph or reading of an electrocardiogram-most physicians understand that an abnormal finding on patient evaluation should prompt some type of further evaluation. It follows that if the clinician encounters an abnormal finding on bedside US of the kidneys, a formal radiology performed US might be the appropriate next step. CT or MRI could then follow, if an abnormality like renal cell cancer is found and there is a time sensitive

need to establish the spread of the disease to best decide the treatment course. However, the potential to diagnose a cancer sooner, like RCC, through the more widespread use of bedside EUS may contribute to an earlier work-up and potential better patient outcomes.

This case emphasizes that while renal calculi are the most common cause of flank pain and hematuria, it is prudent to also closely examine the kidneys on bedside EUS for abnormal findings beyond the mere presence or absence of hydronephrosis.[1,4,7,12,13] In the patient described above, a left-sided complex renal mass was detected on EUS during the routine evaluation for hydronephrosis. The US demonstrated an upper pole left renal mass with areas of anechoic and isoechoic composition, suspicious for tumor (Video). The normal architecture of the kidney can be seen on the right side, or inferior aspect, of the video image. Anechoic regions of renal masses are fluid-filled or cystic areas, while the isoechoic regions are solid portions of the mass.[1] Renal masses with both solid and cystic structures are considered to be complex. Based on this classification scheme, this complex renal mass would be very suspicious for a renal tumor.[1] In contrast, a simple renal cyst is fluid-filled, or anechoic in appearance, with a bright posterior wall due to the increased through transmission of sound. Simple renal cysts are often located to the periphery of the kidney and distort the outer architecture of the organ. Complex masses, like RCC, often arise peripherally, but grow with time to invade the central portion of the kidney. The follow-up CT (Figure) confirmed the US findings of a large and complex left renal mass, with mixed cystic and solid components. The formal radiology report noted that the mass was invading into the left renal collecting system, likely explaining the presence of gross hematuria. Several renal calculi were noted incidentally to be present in the lower pole of the left renal collecting system.

CONCLUSION

In this case study, EUS helped to identify a renal mass in a patient who presented with hematuria and left flank pain, initially thought to be renal colic on clinical evaluation. While looking for hydronephrosis, a left renal abnormality was recognized and prompted further work-up with a CT of the abdomen and pelvis. Interestingly, this patient denied any weight loss, fevers, fatigue or abdominal masses, which are all recognized clinical features associated with RCC.[1,11] Like most renal tumors, this patient's symptoms overlapped with the typical presentation of renal calculi.[13] It was the findings on EUS that helped to identify the correct diagnosis and prompted the appropriate consultations. While the further evaluation prompted by the EUS did lead to the correct diagnosis and appropriate ED consultations, unfortunately the patient was lost to follow up for further outpatient visits. This course of events highlights the difficulty of current systems based healthcare practice in the United States. Perhaps, in the future an argument should be made to primarily admit such patients who have findings suspicious for RCC for further workup, thereby facilitating timely treatment and avoiding potential delays in care.

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Bedside Ultrasound in a Case of Blunt Scrotal Trauma

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This case study describes a patient who suffered blunt force trauma to the scrotum. Use of bedside emergency ultrasound facilitated early diagnosis of a ruptured testicle and allowed for prompt urological consultation and timely surgical repair. The utility of bedside emergency ultrasound in the evaluation of testicular trauma, as well as the outcome of our case, is discussed here. [West J Emerg Med 2013;14(2):127-129.]

INTRODUCTION

Currently, bedside emergency ultrasound (EUS) has become an important diagnostic tool employed by many emergency physicians (EP).[1,2] For almost a decade EPs have been trained in EUS as a standard part of their residency curriculum, based on guidelines from numerous professional organizations, including the American College of Emergency Physicians, the Society for Academic Emergency Medicine and the American Board of Emergency Medicine.[3] Ease of use, lack of ionizing radiation and increased interaction with patients are only a few of the many desirable qualities of EUS. However, its greatest asset lies in the ability to rapidly make the diagnosis of a time-sensitive medical condition, enabling the EP to mobilize resources and expedite treatment, which might otherwise be delayed. The use of EUS for the evaluation of scrotal injury from blunt trauma exemplifies this point.

Scrotal trauma due to blunt force frequently results in significant injury requiring urological evaluation and surgery.[4] Evaluation by physical exam is often limited, or impossible, due to patient discomfort. A missed diagnosis of testicular rupture has serious consequences. In patients who present with gross testicular swelling following trauma, the incidence of testicular rupture has been reported to be greater than 50%.[4-7] Without surgical repair, the testis is prone to both ischemia and infection and frequently requires orchiectomy. Conversely, if surgical intervention occurs within the first 72 hours after injury, testicular salvage rates approach 90%.[8-10] After 72 hours, this salvage rate decreases to as low as 30%.[11-12]

Within the scrotum, the testes are encased within the tough layer of the tunica albuginea. Surrounding this covering is the thin tunica vaginalis, a serous layer embryologically derived from the processus vaginalis of the peritoneum. A contusion to the scrotum can result in a hematocele, which is bleeding outside the tunica albuginea but within the layers of the tunica vaginalis. Bleeding deep to the tunica albuginea is termed a scrotal, or subcapsular, hematoma. When the inelastic tunica albuginea ruptures due to trauma, the testicular parenchyma may extrude into the scrotal sac. This defines testicular rupture, which should be differentiated from testicular fracture. The latter is a term, which describes a distinct, often linear, divide between two portions of the testicular parenchyma. In the best-case scenario, testicular fracture can exist in the absence of rupture. However, fracture may also lead to testicular rupture, with protrusion of testicular parenchyma, and a correspondingly worse outcome for the patient.

CASE REPORT

A 22-year-old male with no significant past medical history presented to the Emergency department approximately 3 hours after he was in an altercation, during which he sustained multiple blows to the head, stomach, and genital area with a large flashlight. His primary complaint was of severe testicular pain.

Physical examination revealed a calm, well-developed male in mild distress due to pain. Vital signs included a blood

pressure 132/85 mmHg, heart rate of 90 beats per minute, respiratory rate 16 breaths per minute, and temperature 98.9°F. On examination of the genitals, the penis was normal. His scrotum was enlarged to approximately the size of a grapefruit, and the overlying skin was erythematous. The scrotal area was exquisitely tender to palpation, making it impossible to reliably identify or examine either testis, despite the use of parenteral opioid analgesia. A urinalysis was obtained, which was normal and notably negative for blood.

A bedside scrotal ultrasound was then performed utilizing a 10 MHz linear array probe. The right testicle and epididymis appeared normal. Normal perfusion was present within the right testis on Color Flow Doppler ultrasound. The left testis had ill-defined margins and diffuse irregularity of the outer contour. The tunica albuginea was disrupted, with protrusion of testicular parenchyma. A hematocele was present surrounding the defect (Video 1). The testicular parenchyma had a distinct area where poor vascular perfusion was noted on Color Flow Doppler imaging, consistent with ischemia (Video 2).

Urology consultation was emergently requested and a formal ultrasound ordered, which confirmed the diagnosis of testicular rupture, with both sub-tunical and extra-tunical hematoma. Color Doppler Flow on the formal ultrasound also confirmed decreased flow in a portion of the left testis adjacent to the rupture, thought to be an area of infarction.

The patient was admitted by the urology service and promptly taken to the operating room. After dissection through the skin and layers superficial to the tunica, a 4 cm laceration was noted in the tunica albuginea. Necrotic testicular parenchyma was identified and excised. The remaining viable tissue was left and the tunica albuginea was closed. Following surgery, the patient did well post-operatively and was discharged from the hospital. Unfortunately, long-term follow up on the patient's progress was limited by his failure to return for clinic appointments or respond to telephone calls.

DISCUSSION

Blunt scrotal trauma can result in severe testicular injury requiring a time sensitive diagnosis in the setting of testicular rupture. Early surgical exploration has become the standard of care on the basis of data presented in the 1980s by Cass and Luxenberg.[13] This showed a high rate of delayed orchiectomy, due to missed testicular rupture, when conservative management was employed.[5-6] Gross reviewed the literature in 1969 and found an 80% salvage rate when surgical exploration was performed within 72 hours of trauma.[11] Numerous studies have shown that there is often a significant delay in presentation, with one study having a mean delay of 3.5 days.[13-14] This delay in presentation and the resultant decrease in optimal outcomes for the patient with elapsed time make a cogent argument for the use of bedside EUS in facilitating improved care.

Bedside EUS of the scrotum is an advanced use of ultrasonography. However, clinicians already adept at the use of EUS will find this additional modality to be a relatively easy application. Using a high frequency linear array probe, the testes should be individually visualized. Identification of the presence of a heterogeneous echo pattern of the testicular parenchyma, with a loss of definition of the outer contour, is highly correlative with testicular injury. Whereas older studies have indicated a poor sensitivity of ultrasonography in scrotal trauma, more recent literature has shown that using this criterion results in a sensitivity of 100% in identifying significant injury and can avoid delayed orchiectomy for missed testicular rupture.[13,15] Ultrasound in this setting also has great utility in identifying a normal intact testis and avoiding unnecessary surgery.[12]

In conclusion, delayed orchiectomy for missed testicular rupture is a devastating result for a patient. Considering that salvage rates from early surgical intervention can be as great as 90%, accurate diagnosis and timely management by the EP are critical. Furthermore, orchiectomy can have long-term cosmetic, psychological, and reproductive consequences. These factors serve to increase the potential for litigation when the diagnosis is missed, facts that only reinforce the high-risk nature of caring for the patient with blunt testicular trauma. Bedside EUS of the scrotum by the EP can thus serve as an important tool in expediting the evaluation and necessary urological treatment for patients who present with this complaint.

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Ultrasound Diagnosis of a Left Atrial Myxoma in the Emergency Department

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A 61-year-old male with a 1-year history of bilateral lower extremity swelling and a chronic cough was referred to the emergency department (ED) for an abnormal echocardiogram. The patient also reported experiencing intermittent episodes of chest pressure. He stated that he was referred from his doctor after he received a cardiac echocardiography examination that showed possible mitral valve vegetations. On review of systems, he also admitted to intermittent chest palpitations.

On physical examination, his vital signs included a blood pressure of 127/75 mmHg, heart rate of 80 per minute and regular, respiratory rate of 18 per minute, pulse oximetry of 98% and temperature of 98.0°F. The rest of the physical examination was normal. An electrocardiogram demonstrated normal sinus rhythm and the chest radiograph was unremarkable. ED bedside ultrasound (EUS) showed evidence of a cardiac mass moving into the mitral valve (Video). Cardiology was consulted and formal echocardiography confirmed a left atrial myxoma measuring 4.4 cm x 3.2 cm that was attached to the mitral valve near the annulus. Severe mitral regurgitation was present and the left atrium was dilated in size. The patient was admitted to the cardiothoracic surgery service and subsequently underwent successful surgical removal of the myxoma.

DISCUSSION

Cardiac myxomas are the most common primary benign tumor of the heart, accounting for approximately half of all cardiac tumors. Myxomas usually occur sporadically; however, familial forms have been reported.[1] While they have been found to occur in all 4 chambers of the heart, approximately 75% arise in the left atrium and are typically 5-6 cm in size at the time of detection.[2] Myxomas are more common in women (3:1 sex ratio) and are usually found later in life.[2] Myxomas typically present with the following triad of symptoms.[3-5] First, cardiac obstructive symptoms may include chest pain, pulmonary edema, dyspnea on exertion, orthopnea and most ominously, syncope. Second, embolic phenomena may be found, such as visual disturbances, stroke and even myocardial infarction. Third, constitutional symptoms may be manifest with fever, arthralgias, myalgias, malaise and weight loss, often mimicking a vasculitis. The optimal diagnostic method of choice is cardiac echocardiography; however computed tomography and magnetic resonance imaging are other potential options.[1] Prompt surgical removal is necessary, since there is an elevated risk of sudden death in these patients.[6] As demonstrated by this case, EUS may provide a rapid and relatively inexpensive initial means for the detection of cardiac myxomas. This use of EUS would be considered an advanced use and should generally be confirmed by another imaging study, like formal echocardiography, to determine optimal patient therapy.

Video. Bedside ultrasound showing evidence of a cardiac mass moving into the mitral valve.

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Multimedia Education Increases Elder Knowledge of Emergency Department Care

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Introduction: Elders who utilize the emergency department (ED) may have little prospective knowledge of appropriate expectations during an ED encounter. Improving elder orientation to ED expectations is important for satisfaction and health education. The purpose of this study was to evaluate a multi-media education intervention as a method for informing independently living elders about ED care. The program delivered messages categorically as, the number of tests, providers, decisions and disposition decision making.

Methods: Interventional trial of representative elders over 59 years of age comparing pre and post multimedia program exposure. A brief (0.3 hour) video that chronicled the key events after a hypothetical 911 call for chest pain was shown. The video used a clinical narrator, 15 ED health care providers, and 2 professional actors for the patient and spouse. Pre- and post-video tests results were obtained with audience response technology (ART) assessed learning using a 4 point Likert scale.

Results: Valid data from 142 participants were analyzed pre to post rankings (Wilcoxon signed-rank tests). The following four learning objectives showed significant improvements: number of tests expected [median differences on a 4-point Likert scale with 95% confidence intervals: 0.50 (0.00, 1.00)]; number of providers expected 1.0 (1.00, 1.50); communications 1.0 (1.00, 1.50); and pre-hospital medical treatment 0.50 (0.00, 1.00). Elders (96%) judged the intervention as improving their ability to cope with an ED encounter.

Conclusion: A short video with graphic side-bar information is an effective educational strategy to improve elder understanding of expectations during a hypothetical ED encounter following calling 911. [West J Emerg Med 2013;14(2):132-136.]

INTRODUCTION

Little is known about the impact of public education on how emergency departments (ED) function and understanding how care is provided there. Given the expanding elder population, with its medical complexity (e.g. multiple co-morbidities) and tr higher use rates of ED services, it is important to explore educational strategies in order to evaluate methods of improving their understanding of the ED and the care it provides.[1-6]

While patient education in the ED can be challenging, preliminary studies have demonstrated its utility in asthma, myocardial infarction, and trauma.[7] Not only do elderly patients have a 2- to 2.5-fold higher per capita ED use rate, they have a higher prevalence of communication challenges, making education more difficult. Multimedia technology, which can circumvent both receptive and integrative learning challenges, is recognized as an effective tool for patient

education, including elders.[8] We tested the hypothesis that specific learning objectives centered on a hypothetical scenario of a patient with chest pain when presented in a multimedia education program could be assessed using audience response technology and that such a program would be effective in educating elders about ED care. Multimedia education scenarios, like this one, are effective with large groups and could provide a cost-effective method to educate elderly patients about ED encounters.

METHODS

Development of video materials

Following development of 3 overall steps in common emergency care, learning objectives were agreed upon by a multidisciplinary group, which included 2 veteran emergency physicians, a multimedia expert with 30 years of experience, a film producer with 25 years of experience and a Penn State College of Medicine teacher with 35 years of experience who created 5 previous multimedia teaching programs. We focused on 3 major areas related to ED care:

1. To demystify ED encounters

To accomplish this we sought to teach our audience that the ED operates differently in comparison to other out-patient clinic or in-patient, hospital-based care. Our goal was to show that in order to assess rapidly evolving emergency care conditions, a team approach is often required. We addressed this in the video by illustrating an emergency visit as a journey, not disorganized chaos, as the public may commonly believe.

2. To teach the viewer the need for multiple healthcare providers in the ED

Patients' non-ED healthcare usually revolves about a central physician and it is logical for them to expect that their ED care will be more or less the same. We addressed this concept by introducing the viewer to the multiple healthcare providers in the ED and explaining their functions. This was reinforced by a sequential side-bar listing, highlighting the numbers and types of providers involved.

3. To teach the viewer that in the ED the patient and family cannot be in total control

Conflicts may occur when patients and /or their families feel that they do not have the same degree of control of their care as they would have in a non-ED medical encounter, e.g., a visit to their doctor's office. We designed the program to illustrate that unexpected and unplanned incidents are common in the ED and often require immediate attention. This urgency sometimes precludes the full involvement of the patient or family in the decision-making process in order to provide the most rapid ED care. The above concepts were taught by using 5 clinical care domains in the ED that are different from other arenas of medical care that patients may be more familiar with: 1.) the number of anticipated and common procedures; 2.) the number of healthcare providers involved in care; 3.) the number of ED healthcare providers who keep the patients and family members informed; 4.) the role of the patient and others in the ED with respect to decision making, and 5.) and the role of pre-hospital care providers.

The 18-minute video follows 1 patient from development of an emergency need at home, through the 911 call, the ambulance trip, the intake at the ED, and the sequence of evaluations that often follow a patient complaining of chest pain and associated symptoms. It ends with the patient being counseled about transfer to the catheterization laboratory, for a percutaneous intervention. The "patient" is accompanied by his wife and has encounters with an ambulance medic, an ambulance nurse, an ED technician, an ED charge nurse, a primary and a secondary bedside nurse, a radiology technician, an ED resident physician, an attending ED physician, a cardiology fellow, an attending cardiology physician, a member of the registration staff, and a chaplain. Each of the 13 video scenes was scripted to include at least 1 of the learning objectives, and information about each of the 5 learning areas was presented at least twice. The video is opened and closed by a physician describing for the viewers what they will be seeing and asking them to take notice of specific elements of the journey.

Study Subjects

Data Collection

We used an audience response system (ARS*;* Turning Technology Youngstown, Ohio 44503) to obtain immediate and confidential responses before and after the group viewing of the video. All participants were given audience response "clickers" at the beginning of each session and instructed in their use. The ARS program was used to format and project the questions. Three warm-up questions were given to the audience to familiarize them with the use of the clickers. Before the video was shown each audience was asked to respond to 4 categorical demographic questions and to choose 1 of the 4 Likert responses for each of the 5 ED journey-related questions. After the video the audience was asked to respond to the same 5 ED-journey questions. At the end of the program, 1 of the investigators facilitated an open question-and-answer program on ED encounters, and participants were asked to complete a 2-question program evaluation form. The study was approved as exempt from further human subjects review by our institutional review board.

Data Management and Analysis

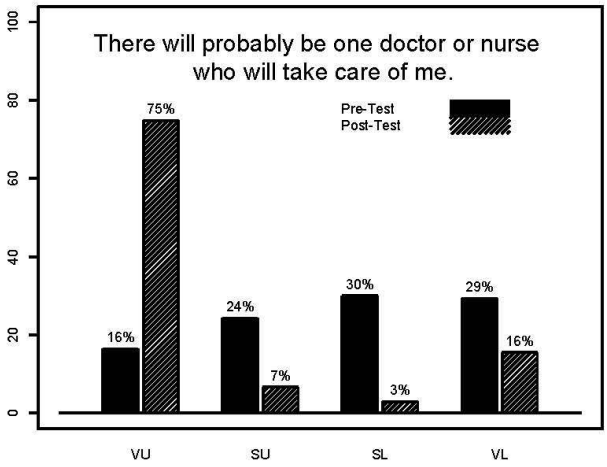
The ARS employs wireless handsets that allow participants to respond to multiple choice or Likert scale questions displayed in interactive (Microsoft PowerPoint) slides. Responses were not displayed to the subjects to prevent group biases in response. The pre- and post-test

data for respondents were exported as an Excel (Microsoft, Bellingham Washington) file for analysis. Data are reported as frequencies and percentages. We used the Wilcoxon signed-rank test to compare the pre-and post-test scores. Analyses were performed using SAS software (version 9.1, SAS Institute Inc., Cary, North Carolina).

RESULTS

The multimedia educational program was run for 5 different groups: twice at local churches and 3 times at local senior centers. We collected usable data were collected from 105 female and 37 male participants. The program was advertised for independently living seniors, ages 60 to 80 (Table 1). Participants (97%) were over age 60. There was a nearly equal distribution of educational background of the study population reporting high school, some college, a college degree, or a graduate degree as their highest educational level. The study population was predominantly Caucasian.

A graphic depiction of the pre- and post- video answers (Figure 1) to 1 of the 5 test statements is shown. In this case the statement is "There will probably be 1 doctor or nurse who will take care of me" and the study subjects used their ARS clickers to choose 1 of the 4 Likert answers: very unlikely, somewhat unlikely, somewhat likely, or very likely. After watching the video the percent of subjects who thought that it was very unlikely that 1 doctor or 1 nurse would take care of them changed from 16% to 75%. Similar results are presented in Table 2, which compares all of the results for the pre- and post- video questions and shows that overall the learning objectives of the video were achieved. Statistically significant shifts in the responses were seen for 4 of the 5 questions. Therefore, post-test responses were more likely to represent the reality of multidisciplinary ED care. The results



VU, very unlikely; *SU,* somewhat unlikely; *SL,* somewhat likely; *VL,* very likely

Figure 1. Elders (%) indicating their response before (pre) and after (post) video review regarding the facilitator's question "There will probably be 1 doctor or nurse who will take care of me."

Table 1. Descriptive statistics of the study population (n=142).

Variable	Number	%
Gender		
Female	105	74
Male	37	26
Age		
< 60	4	3
60 to 69	40	28
70 to 79	59	42
≥ 80	39	27
Education		
Did not graduate high school	3	2
High school	43	31
Some college	35	25
College degree	30	21
Graduate degree	29	21
Ethnicity		
African-American	2	1
Asian	3	2
Caucasian	132	96
Hispanic	1	1

of the program evaluation (Table 3) show that 95% reported that they would recommend the program to their friends. Furthermore, 96% reported that, if they had to go to the ED, what they learned from the program would help them to cope with this unique medical care setting.

DISCUSSION

Clinical experiences in the ED can be especially difficult, as patients generally do not anticipate an emergency medical condition or situation. The central goal of this project was to test the efficacy of a short, multimedia program as a tool to educate senior citizens on a very common ED health issue, chest pain. With the goal of conducting a quantitative study on the use of multimedia for education of patients about the ED, we considered the following overarching concepts prior to development of a video-based program: the age group of our target patients, identification of a common, yet serious, ED experience affecting the target patient group, and the major teaching objectives that would benefit such patients. We found that our study population of 142 seniors showed statistically significant improvement for 4 of the 5 question areas while the overall program impact was positive in over 95% of tested subjects.

This study advances our knowledge about an inexpensive multimedia presentation showing an increased understanding of ED encounters, when judged by seniors, a population with significant use of ED resources and frequent misunderstandings about how ED encounters take place.[10,11]

Table 2. Pre and post Intervention test results.

Test question	Response	Pre test %	Post test %
I expect to have only 1 or 2 tests.			
	VU	19	45
	SU	13	8
	SL	19	6
	VL	49	41
		P = < 0.0001	
I expect only 1 or 2 doctors to care for me.			
	VU	16	75
	SU	24	7
	SL	30	3
	VL	29	16
		P = < 0.0001	
One doctor or nurse will keep me informed.			
	VU	9	53
	SU	11	14
	SL	35	10
	VL	45	24
		P = < 0.0001	
I will have control over decisions for my care.			
	VU	7	18
	SU	22	19
	SL	41	33
	VL	30	30
		P = < 0.16	
The purpose of the ambulance is for transportation not to start medical care.			
	VU	36	63
	SU	21	9
	SL	15	9
	VL	29	19
		P = < 0.0001	

VU, very unlikely; *SU,* somewhat unlikely; *SL,* somewhat likely; *VL,* very likely

Table 3. Program evaluation.

I will recommend this program to my friends.	
Strongly agree	75%
Agree	18%
Neutral	2%
Disagree	1%
If I must go to an emergency room, this program will make me better able to cope with its unique medical care.	
Strongly agree	64%
Agree	31%
Neutral	1%
Disagree	0%

Audience response systems are showing promise in health education and this study confirms their value and adaptability for use by alert, self-selected senior citizens.[12,13] The rapid increase in the number of elder patients in America has contributed to strained ED resources and the potential misuse of ED resources by under-educated patients. Since patient education is instruction directed at increasing a patient's ability to better manage personal health there are several major reasons for developing ways to educate elder patients about care in the ED. First and foremost, adequate patient health knowledge positively influences their health and increases their motivation to follow healthcare instructions. Second, healthcare organizations are mandated by accreditation bodies to provide patient education, and not just at the time of discharge, as is common in ED clinical practice. Third, patient education has been shown to be cost effective. Thus, ED-specific education for elders may improve outcomes and reduce their unnecessary return to the ED.[14-17] The ED presents unique challenges to patient education, the most important of which may be that the ED patient is unlikely to be emotionally or physically receptive to health education during an ED visit. Thus, it is important to consider how to provide appropriate ED scenario education to potential elder patients prior to their needing to use what they have learned.[18-21]

A multimedia approach based on easy-to-follow short videos has several advantages as the mechanism for these educational programs. First, they can be scripted to be both engaging and to carry specific learning objectives. Our use of an ED encounter that begins with chest pain at home is potentially a motivating scenario and may serve as a basis on which other education scenarios could be developed.[18] Second, short videos can be used in a wide variety of venues, including, but not limited to, senior community centers, churches, and patient waiting rooms. Third, they can be tested before release to assess their efficacy. Finally, a library of such programs could be of value to community, academic and for-profit healthcare organizations.

LIMITATIONS

This pilot study was conducted to evaluate the effectiveness of multimedia as an education strategy for to teach elders about selected aspects of emergency medicine care. The study intervention did not evaluate reliability or validity. The results are limited to those elders willing and able to participate, and without an acute emergency medical condition. Elders with more profound neurocognitive or chronic medical conditions may not show benefit and were not included in this study. Furthermore, we did not evaluate prior ED visits among participants, which may have influenced understanding of the material presented. Other, more static

educational materials may have resulted in similar effects. The sustainability of the benefit may be short-lived, and the perception of an improved understanding may not have led to better use of ED services or a better understanding or acceptability of the ED encounter paradigm. However, this preliminary study was not intended to evaluate long-term ED resource use or knowledge retention. Only a single illness scenario was tested, and others may not have had such an improvement. Positive results may have been increased by the presence of a group format emphasizing positives over negatives. To offset this effect, individual ARS responses were not provided to participants in order to reduce the likelihood of group influences on responses.

CONCLUSION

Multimedia based short educational videos are a promising tool for imparting health education to senior citizens regarding the ED. Further research comparing these and other forms of patient education are needed to better understand the long-term effects on healthcare knowledge and ED use among elders.

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Bedside Teaching on Time to Disposition Improves Length of Stay for Critically-ill Emergency Departments Patients

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Introduction: We tested the effect of a brief disposition process intervention on residents' time to disposition and emergency department (ED) length of stay (LOS) in high acuity ED patients.

Methods: This was a quasi-experimental study design in a single teaching hospital where ED residents are responsible for administrative bed requests for patients. Enrollment was performed for intervention and control groups on an even-odd day schedule. Inclusion criteria were ED patients triaged as Emergency Severity Index (ESI) 1 and 2. In the intervention group, the attending physician prompted the resident to make the disposition immediately after the evaluation of resuscitation patients. In the control group, the attending physicians did not intervene in the disposition process unless more than 2 hours passed without a disposition. Main outcomes were time to disposition and total ED LOS.

Results: A total of 104 patients were enrolled; 53 (51%) in the intervention group and 51 (49%) in the control group. After controlling for ESI and resident training year, mean disposition time was significantly shorter in the intervention group by 41.4 minutes (95% CI: 32.6-50.1). LOS was also shorter in the intervention group by 93.3 minutes (95% CI: 41.9-144.6).

Conclusion: Prompting residents to enter administrative disposition orders in high acuity patients is associated with significant reduction in both time to disposition and ED LOS. [West J Emerg Med 2013;14(2):137-140.]

INTRODUCTION

Background

Prolonged length of stay in critically ill patients in the emergency department (ED) is associated with higher complication rates and higher mortality rates.[1,2] This is because often the focus of emergency care is on the initial management of patients (such as immediate resuscitation). Longer term management, such as managing ventilator settings and titrating medications, is sometimes deprioritized because of competing demands and expectation that those tasks will occur in the inpatient setting. Therefore, reducing length of stay (LOS) for this high-risk patient group is important because it may not only reduce overall ED crowding but also improve patient outcomes.[3] A recent American College of Emergency Physicians policy statement on the boarding of intensive care unit patients stated that hospitals have the responsibility to ensure, "…the prompt transfer of patients admitted to inpatient units as soon as the treating emergency physician makes such a decision."[4]

Importance

For emergency medicine training programs, teaching ways to reduce LOS to ED residents is consistent with the Accreditation Council for Graduate Medical Education (ACGME) core competency requirement for training in systems-based practice. One of the key steps in ED care is the

placement of an administrative bed request, which prompts hospital staff to search for available inpatient beds. The timing of the placement of the bed request should ideally come when the decision is made to admit; however, there is provider variation in when the bed requests are entered. Some providers place bed requests early, while others wait for extensive clinical data to justify the admission to the admitting physician or consultant. There is a paucity of research on variation in disposition practices in the ED and how teaching residents to focus early on the disposition might influence actual time to disposition or overall ED LOS.

Goals of this investigation

We tested the impact of a real-time disposition process intervention to prompt ED residents to focus early on the administrative bed request on time to disposition and overall ED LOS. We hypothesized that actively prompting the disposition would be associated with shorter ED LOS.

METHODS

Study Design and Setting

This was a quasi-experimental study design, approved by the institutional review board (IRB) to assess the impact of a brief process intervention on time to administrative bed request and overall ED LOS in high acuity ED patients. The study population was residents in a 4-year ED residency program caring for high-acuity patients – emergency severity index (ESI) 1 or 2 - at an urban community hospital affiliated with their program. Patients were enrolled from August 2009 to March 2010. Eight attending physicians enrolled patients in this study and patients were only enrolled when those attendings were working clinically in the ED. Attending physicians enrolled both intervention and control patients.

Enrollment, Interventions, and Data Processing

Patients were assigned to either the intervention or control arms of the study on alternating odd-even days. This was done because of ED residents overlapped with multiple attendings per day and we did not want to enroll the same resident in the intervention and control arms on the same day. The ED residents and the patients were blinded to the study. In the intervention group, when the ED resident presented the case to the attending physician, the attending delivered bedside teaching in the usual fashion but also deliberately prompted the residents about patient disposition. The attending physicians were trained through a 45-minute lecture reviewing the literature on ED LOS, crowding and the impact on residency training. In the control group, after case presentation, the ED resident was not prompted about disposition status until the resident had not submitted admitting papers for more than 120 minutes. At such time, the attending physician would submit admitting papers for the patient without informing the EM resident to avoid any study-related delays of time to disposition. The resident was still expected to submit the admitting papers.

Table 1. Patient and resident characteristics.

	Control (n = 51)	Intervention (n = 53)	*P* - value
ESI = 1 (vs ESI=2)	15.7% [5.7-25.7]	26.4% [14.5-38.2]	0.18
Disposition time (min)	75 {58-89}	35 {28-43}	< 0.0001
LOS (min)	356 {278-458}	249 {167-367}	< 0.0001
Resident (PGY Year)			
PGY-1	27.4% [15.2-39.7]	18.9% [8.3-29.4]	0.30
PGY-2	29.4% [16.9-41.9]	28.3% [16.2-40.4]	0.90
PGY-3	23.5% [11.9-35.2]	26.4% [14.5-38.3]	0.73
PGY-4	19.6% [8.7-30.5]	26.4% [14.5-38.3]	0.41

ESI, emergency severity index; *LOS,* length of stay; *PGY,* post-graduate year

Range in [ ] represents 95% confidence interval and range in { } represents interquartile range

Data were collected on the resident's post-graduate year (PGY) level, the patient's ESI level, the disposition time, and total length of stay for each encounter. We defined disposition time as the time interval between patient arrival (the earliest administrative time-stamp in the patient's record) and the resident submission of admission papers (which was also time-stamped). ED LOS was defined as time between patient arrival and the time that patient physically left the ED. The data were collected from admission tickets and then entered in a spreadsheet.

Data Analysis

We used appropriate descriptive statistical methods and group comparison tests to compare the outcomes of interest (disposition time, LOS) and the covariates (ESI, PGY level). Controlling for covariates, we constructed separate multivariate linear regression models for both outcomes of interest. Regression diagnostics were performed to confirm good model specification with normal distribution of residuals and without implausible overly influential outlier observations. No formal power calculation was conducted for this study. We performed statistical analysis using Stata version 11.1 (StataCorp, College Station, Texas).

RESULTS

There were 104 encounters available for analysis, 53 (51%) in the intervention group and 51 (49%) in the control group. As disposition time and LOS was not normally distributed, we performed non-parametric tests for group comparisons. Patient and resident characteristics were not significantly different between the two groups (Table 1).

Median disposition time was significantly different between the intervention and control groups ($P < 0.001$), 35 minutes (interquartile range [IQR]: 28-43) and 75 minutes (IQR: 58-89) respectively (Table 1). In multivariate linear regression modeling controlling for residents' level of training

Table 2. Disposition time multivariate linear regression model.

Variable	Coefficient (95% CI)	*P* - value
Educational prompt	-41.4 (-50.1, -32.6)	< 0.001
ESI=1 (vs 2)	4.7 (-11.8, 13.7)	0.89
PGY = 1 (vs 4)	0.9 (-2.7, 21.6)	0.13
PGY = 2 (vs 4)	9.5 (-2.8, 22.1)	0.13
PGY = 3 (vs 4)	9.6 (-6.1, 15.4)	0.39

CI, confidence interval; *ESI,* emergency severity index; *PGY,* post-graduate year

Table 3. Length of stay multivariate linear regression model.

Variable	Coefficient (95% CI)	*P* - value
Educational prompt	-93.3 (-144.6, -41.9)	< 0.001
ESI=1 (vs 2)	6.7 (-56.4, 69.9)	0.83
PGY = 1 (vs 4)	-9.1 (-84.0, 65.8)	0.81
PGY = 2 (vs 4)	-2.1 (-73.4, 69.3)	0.95
PGY = 3 (vs 4)	-5.2 (-78.5, 68.0)	0.89

CI, confidence interval; *ESI,* emergency severity index; *PGY,* post-graduate year

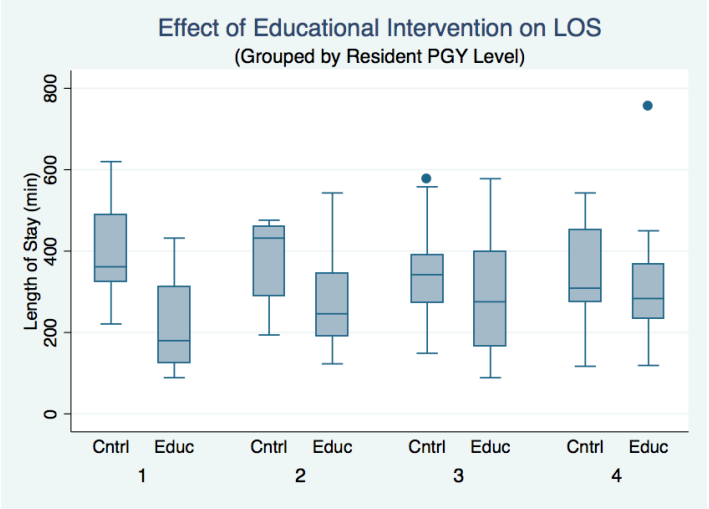

Figure. Effect of educational intervention on length of stay (LOS) grouped by resident post-graduate year (PGY) level.
Cntrl, control; *Educ,* education

and patient ESI level, only the disposition process intervention was significantly associated with patient's disposition time, accounting for a 41.4 minutes reduction (95% CI: 32.6-50.1) (Table 2). Regression diagnostics confirmed good model specification with normal distribution of residuals and without implausible overly influential outlier observations.

Median LOS was also significantly different between the intervention and control groups ($P < 0.001$), 249 minutes (IQR: 167-367) and 356 minutes (IQR: 278-458) respectively (Table 1). Although intervention effect on LOS also appeared to vary by residents' level of training (Figure 1), in multivariate linear regression modeling controlling for residents' level of training and patient ESI level, the process intervention was significantly associated with patient LOS, accounting for a 93.3 minute reduction (95% CI: 41.9-144.6) (Table 3). Regression diagnostics confirmed good model specification.

LIMITATIONS

There are limitations to our study. First, this was a small study of 104 cases, based in one urban academic hospital center and there were only a handful of attending physicians who enrolled patients. It is unclear whether this improvement could be extrapolated into other clinical settings with other physicians. In addition, all attending physicians were instructed on a standardized delivery of the intervention; however, it is unknown whether it was delivered in a uniform manner.

In our study we did not randomize patients; instead, we used an odd-even day enrollment scheme. It is possible that this could have created some selection bias; however, we think that this would likely be non-differential. In addition to administrative bed request times, ED LOS can be influenced by several factors, including the concurrent hospital occupancy that were not controlled for in our study.

Finally, our evaluation only included patients with ESI 1-2 complaints who would clearly be admitted to an inpatient setting based on the acuity of their illness. The study did not include other patients whose disposition may have depended on the results of lab tests, imaging studies, or consultant evaluations. Further work with a brief disposition process intervention spanning all patient acuity levels would be appropriate.

DISCUSSION

Many important tasks are required for ED physicians to deliver optimal patient care.[5] Timely consultation and disposition is one of them and involves navigating the complexities of the inpatient and outpatient system. We found that a disposition process intervention where attending physicians prompt early bed request decision-making by residents was effective in reducing not only time to disposition but also overall ED LOS. Because prolonged ED LOS in critically-ill patients is associated with poorer outcomes, this simple intervention to hasten the admission process may improve quality of care.

The ED literature highlights the importance of timely consultation and disposition yet provides few practical bedside examples about how to teach trainees how to optimize patient flow.[6-9] One study incorporated teaching timely disposition and consultation as one of several systems-based practice criteria in an ED simulation curriculum.[6] Educators in other specialties have described approaches, including dedicated systems-based practice conferences, web-based or electronic

learning modules, and required resident scholarly projects around systems-based practice.[10-17] Our study demonstrated that a deliberate inclusion of early disposition into bedside teaching was not only a feasible approach that influenced resident behavior, but also positively impacted a clinically relevant outcome measure: ED LOS for high-acuity patients.

Adding additional tasks in bedside teaching may not be attractive to some educators in an already crowded ED environment. Faculty-resident interaction time already may occupy as little as 20% of available time in the ED and resident surveys suggest crowding negatively affects training.[18,19] Nevertheless, other studies suggest that effective teaching can still occur in crowded EDs. One study found no relationship between the workload of attending physicians and their student teaching evaluations.[20] Other studies have found that attending workload and overall crowding have no influence on resident perception of their teaching and that individual attending teaching skills and attributes were more important.[21,22]

CONCLUSION

A brief process intervention to prompt residents to enter bed requests earlier was associated with shorter time to disposition and shorter LOS in high-acuity patients. Additional studies are needed to validate this approach for lower-acuity patients and in other ED settings.

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Riding the Escalator: How Dangerous is it Really?

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Introduction: About 10,000 escalator-related injuries per year result in emergency department treatment in the United States. Since the 1990s, a steady increase has been reported, but few statistics on escalator-related injuries have been published worldwide. We have therefore analyzed escalator accident statistics in admissions to our hospital in Switzerland since 2000.

Methods: Using retrospective electronic patient chart analysis, we included in our study patients >16 years treated over an 11-year period. We categorized patients in terms of gender, age and associated risk factors, and classified accidents according to day, time, location and cause. Resulting trauma was categorized according to type and location. We divided post-admission treatment into surgical and conservative, and into treatment as an outpatient, in a short-stay unit, or as a hospital admission. Women and men were compared using Fisher's exact test.

Results: We identified 173 patients with 285 discrete injuries. Of these, 87 patients (50%) were women. Fifty-three (61%) of the women and 38 (44%) of the men were >60 years old ($P = 0.033$). Fifty percent of the men (43/86)of the men, but only 7% (6/87) of the women showed signs of alcohol intoxication ($P < 0.0001$). Accidents in women occurred predominantly on Tuesdays (19/87; 22%) between 12PM and 6PM (35/87; 40%), and in men on Saturdays (16/86; 19%) between 6PM and 12AM (29/86; 34%; $P = 0.0097$). Sixty-two percent (44/71) of the accidents were in public transport facilities and 30% (21/71) in shopping centers. The majority of injuries in women were to the lower extremities (49/87; 56%), while most accidents in men were to the head and neck (51/86; 59%; $P = 0.0052$). About half (90; 52%) of the patients were treated conservatively. Almost half of all patients (76, 44%) required hospital admission. Of those, 45% left the hospital within 24 hours of admission (short stay unit) and 55% stayed longer than 24 hours.

Conclusion: Escalator accidents can result in severe trauma. Significant gender differences in escalator accidents have been observed. Alcohol intoxication and age are significant risk factors in escalator-related accidents and might be possible targets for preventive measures. [West J Emerg Med 2013;14(2):141-145.]

INTRODUCTION

The first operational escalator was patented in 1892 and installed on Coney Island, New York, as an amusement ride. The device, however, was destined to serve as a serious means of transport.[1,2] Remarkably, wood was the key element in the construction of early escalator steps until metal took over in the 1920s, when the first escalator was installed in Germany.[2-4] About 30 years later, in 1958, a

department store in Basle was home to the first escalator in Switzerland.[5]

Today the escalator is everyday common means of transport. With a total length of 800 meters and a 24-hour transport capacity of 210,600 passengers, the longest outdoor escalator system in the world is used by more than 55,000 passengers in Hong Kong each day.[6] The longest individual escalators can be found in St. Petersburg's underground stations, comprising a length of around 142 meters at a height of 71 meters each.[6]

Because escalators are ubiquitous, it is, however, not surprising that they have also attracted negative attention as an accident location. In the United States (U.S.), about 10,000 escalator-related injuries requiring emergency department (ED) treatment are reported annually.[7,8] The first reports of escalator-related injuries in Europe appeared in London in 1969.[4] Twenty years later, 10 patients per month sought medical attention due to escalator accidents.[9] In another study on escalator-related injuries, more than half happened in public transportation facilities and about 33% in shopping malls.[10] There has recently been an increase in escalator-related accidents.[11]

Despite this increase in accidents and the possible severity of the resulting injuries only few statistics on escalator-related injuries have been published worldwide, mostly studies on children and case reports. In contrast, our study is a retrospective analysis with a broad patient age range and a long observation period. To our knowledge, this is the first study to analyze escalator-related accident patients admitted to a European Level I trauma center over an extended period. Our aim was to understand the character of escalator-related accidents and to identify risk factors and groups, in order to contribute to the development of effective preventive measurements.

METHODS

All data were collected prospectively, entered into our ED's centralized electronic database (Qualicare, Switzerland) and analyzed retrospectively. We searched the database for patients presenting to our department (Emergency Department of Bern University Hospital, Level I trauma center) over an 11-year period (Feburary 2000-November 2011). The study comprises patients > 16 years, because at Bern University Hospital patients < 17 years are treated in the Department of Pediatrics.

We scanned patient reports electronically for the key word "escalator" (German "Rolltreppe"). Those containing the word "escalator" anywhere in the record were selected and reviewed twice by the authors AE and LS to ensure that they were escalator-related events.

We categorized patients by gender, age and associated risk factors (intoxication with alcohol or drugs, use of personal items on the escalator, e.g. luggage, pushchair). Age stratification was used to clarify the dependence of the incidence of escalator accidents on the age group. We classified each accident according to day, time, location and cause. The resulting trauma was categorized by type and location. We divided post-admission treatment into surgical, conservative, at the outpatient clinic, in a short-stay unit < 24 hours), or as hospital admission.

Dependent variables were patient age, associated risk factors, time of accident, location of injuries, type of therapy and type of patient management. Gender was the independent variable in our study.

We performed group comparisons with Fisher's exact test. A P-value of < 0.05 was considered significant. We used Prism 5 (GraphPad Software Inc., La Jolla, California, U.S.) for statistical calculations.

Our study did not require institutional review board review.

RESULTS

One hundred seventy-three accidents in 173 patients were identified, 87 (50%) in women and 86 (50%) in men. Sixty-one percent (53/87) of the women and 44% (38/86) of the men were > 60 years ($P = 0.033$; Figure 1). Two fatalities occurred: cardiac event (prior to accident) and intracranial bleeding (result of accident).

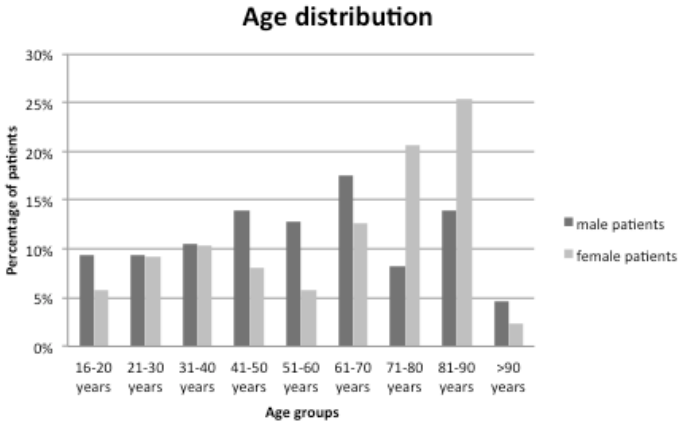

Figure 1. Distribution of age in men and women receiving emergency treatment for escalator-related injuries.

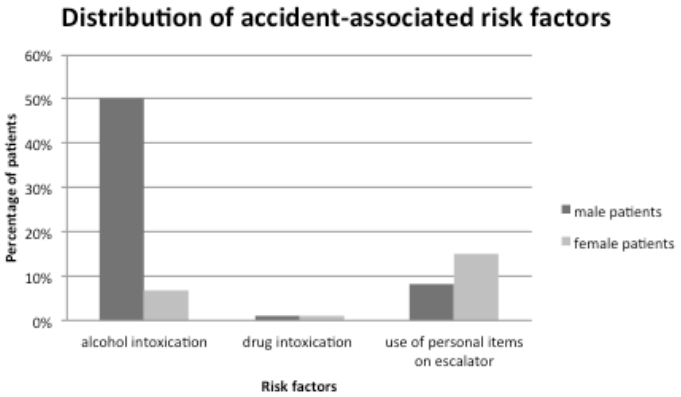

Figure 2. Distribution of accident associated risk factors in men and women receiving emergency treatment for escalator-rrelated injuries.

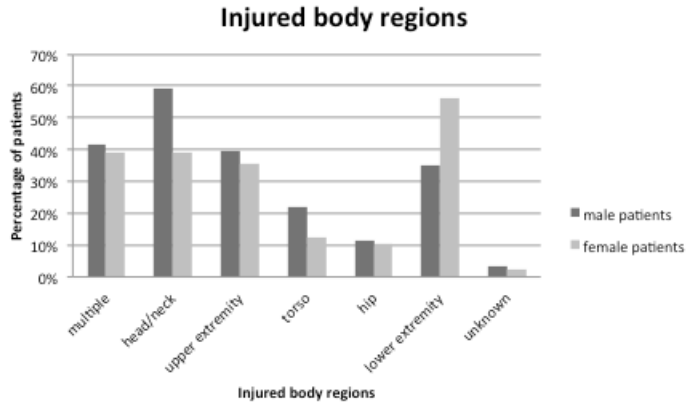

Figure 3. Distribution of injured body regions in men and women receiving emergency treatment for escalator-related injuries.

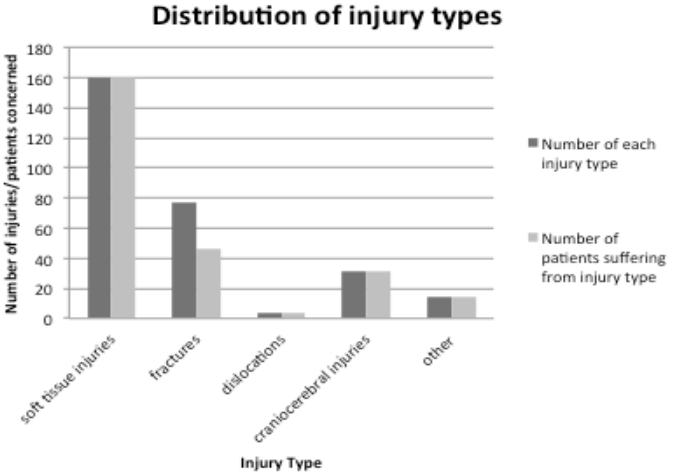

Figure 4. Distribution of injury types in men and women receiving emergency treatment for escalator-related injuries.

Our data demonstrated that 43/86 (50%) of the men and 6/87 (7%) of the women showed signs of alcohol intoxication ($P < 0.0001$; Figure 2). The majority of accidents were caused by slipping or falling (133; 77%). The next most frequent cause was fellow passengers (19; 11%). Twelve percent of the accidents had other causes (personal items, disregarding usage guidelines, or escalator malfunction: each < 6%). Gender differences for drug intoxication and the use of personal items were not statistically significant (Figure 2).

Accidents in women occurred mainly on Tuesdays (19/87; 22%), between noon and 6PM (35/87; 40%), while accidents in men occurred mainly on Saturdays (16/86; 19%) between 6PM and midnight (29/86; 34%; $P = 0.0097$). The accident location was known in 71 (41%) cases. Of those, 44 (62%) were public transport facilities and 21 (30%) shopping centers.

Two hundred eighty-five injuries were reported in 173 patients (Figure 3), with 160 soft tissue injuries seen in 160 (92%) patients, 76 fractures in 46 (27%) patients, 4 dislocations in 4 (2%) patients and 31 craniocerebral injuries in 31 (18%) patients (Figure 4). Fourteen injuries belonged to none of the categories mentioned above. The following types of fractures occurred: 18 (24%) skull/cervical fractures, 16 (21%) upper extremity fractures, 22 (29%) rib fractures, 5 (7%) hip fractures, and 15 (20%) lower extremity fractures. Of 4 dislocations, 2 involved the shoulder, 1 a facet joint of the cervical spine, and 1 of the teeth.

Craniocerebral injuries with cerebral bleeding occurred in 10 (6%) patients, requiring surgery in 2 patients and resulting in death in 1 patient. The majority of injuries in women were lower extremity injuries (49/87; 56%), whereas in men they involved the head and neck regions (51/86; 59%) ($P = 0.0052$; Figure 3). Multiple body regions were involved in 70 (40%) patients. Intracranial injuries were found in 31/85 (36%) and skull fractures in 17/85 (20%) of all head injuries.

The vast majority of patients (135, 78%) were transported to our trauma center by emergency medicine technicians. Thirty-eight (22%) patients were walk-ins (transport by foot or private transport).

Ninety patients (52%) were treated conservatively. No gender differences were observed. Of all surgical patients, 24/83 (29%) underwent surgery and 64/83 (77%) had surgical wound treatment. Almost half of all patients (76, 44%) were in need of hospital admission. Of those, 45% left the hospital within 24 hours of admission (short stay unit) and 55% stayed longer than 24 hours.

The majority of patients with soft tissue injuries (94 patients, 59%) were outpatients. Thirty-three (21%) patients with soft tissue injuries were admitted to our short stay unit and the same number to the hospital. In contrast, the majority of patients with fractures/dislocations (33 patients, 66%) were admitted to the hospital. Six (12%) patients with fractures/dislocations were admitted to our short stay unit and 11 (22%) were outpatients. Most patients with craniocerebral injuries (12 patients, 39%) stayed at out short stay unit. Almost the same numbers of patients with craniocerebral injuries were outpatients or were admitted to the hospital (9 and 10 patients, 29% and 32%, respectively).

DISCUSSION

The results of this study show that only about 1 percent of the patients at our Level I trauma center are victims of escalator-related accidents. In contrast to Chi et al[12], Murphy and Moore[9], and O'Neil et al[13], we observed equal proportions of men and women, independent of age. O'Neil et al[13] analyzed only patients aged 65 and older, the majority of whom were women. In our study, the majority of patients older than 64 years were also women. This may be due to demographic factors.[14,15] In addition, most escalator-related accidents are caused by falls, which occur more frequently in elderly women than in elderly men.[9,12,13,16-18] Fifty percent of our patients were ≥ 65 years, which is consistent with demographic factors, given the fact that most escalator-related accidents were falls and that the rate of nonfatal injuries due

to falls increases with age.[19] Additionally, the prevalence of fear of escalator use, the distress due to insecurity and the disrespect for safety rules increase with age.[20]

Our findings on alcohol consumption were consistent with those of Murphy and Moore.[9] Almost one third of patients showed signs of alcohol influence, the large majority of whom were men.[9] O'Farrell et al[21] and Haberkern et al[22] analyzed alcohol intoxication in Ireland and Switzerland and also identified a preponderance of men (70% and 60% respectively). Chi et al[12] and O'Neil et al[13] reported alcohol use in only 3% and < 1% of all cases, respectively. This might be explained by the national differences in alcohol consumption (Taiwan, U.S, Switzerland), by the age of the patients (> 64) in O'Neil et al's[23] study and by the very strict alcohol consumption laws in the U.S. We are aware of the fact that we only analyzed alcohol consumption in patients from one trauma center while other studies reported national data on alcohol consumption.

As far as the causes are concerned, the results of this study agree with those of Chi et al[12] and O'Neil et al.[13] Falls were the most common cause. Accidental falls have been reported to be the most common cause of nonfatal injury.[17,18,24] In our study and in Chi et al's[12] study, around 10% of accidents were due to fellow passengers, in comparison with O'Neil et al's[13] figure of only 3 %. This might be because O'Neil et al[13] included only patients > 64 years (frequency of falls increasing with age).[13,25]

An increased number of accidents was observed in women on Tuesdays and in men on Saturdays. As 50% of men in our study showed signs of alcohol intoxication and 36% of all male patients suffered from head/neck injuries under alcohol influence, we consider that our peak on Saturdays is consistent with the following studies: Puljula et al[26] reported that alcohol-related head trauma in men occurred predominantly on Saturdays.[27] In a study by O'Farrell et al[21] most male alcohol intoxication patients presented to the ED on weekends. Furthermore, we identified a higher number of accidents in men between 6PM and midnight. A peak incidence at night has also been reported for fatal alcohol-related traffic accidents (77% at night, 22% during the day).[28,29]

The lower extremities and the head were the most frequently injured regions. Most injuries in women involved the lower extremities and in men the head or neck. We interpret our high proportion of head and neck injuries in men as being associated with alcohol intake, for the following reasons. We found a high proportion of men under alcohol influence (50%) and calculated that the risk for head trauma under alcohol intoxication was much higher than that for other types of trauma under alcohol intoxication (73% versus ≤ 30%). Savola et al[30] also reported a strong preponderance of head injuries over other injury types in alcoholically intoxicated patients.

Soft tissue injuries were the major injury type, followed by fractures or dislocations and craniocerebral injuries. The majority of head injuries in our patients, however, were soft tissue injuries. We believe that these injuries are correlated with the escalator design.[31]

In our study, almost half of all patients were in need of hospital admission, of whom 55% stayed longer than 24 hours. We had fewer outpatients (56%) than O'Neil et al[13] (92%) or Murphy and Moore[9] (84%), possibly because many patients used our short stay unit (stay < 24 hours). These patients may not have been immediately discharged due to alcohol intoxication or their distance from home. Our study did not cover cost or length of stay.

LIMITATIONS

This analysis is based on records from a single trauma center and may not be representative on a national level. Furthermore, data were retrieved from the narrative section of patient reports. This information may be poorly formulated, so that there may be gaps in the data or misinterpreted data.

CONCLUSION

Escalator-related accidents can cause significant medical consequences. Even though most patients suffered soft tissue injuries, many suffered severe injuries, injuries to multiple body parts, or had to be admitted to the hospital or undergo surgery. There were even 2 fatalities.

The identification of risk factors or groups at risk might support the development of preventive measures. Age and alcohol intoxication were the major risk factors identified. Furthermore, we found significant gender differences for the risk factors age and alcohol intoxication, as well as for the time of accident and injury location. Consequently, 2 risk groups were identified: Elderly women and men < 60 under the influence of alcohol. The risk factor of age may increase with the aging of the population; perhaps courses for elderly passengers might be introduced in the correct use of escalators. The risk factor of alcohol intoxication might be addressed by limiting escalator use for those under the influence of alcohol, with punishment if this was disregarded.

Our study is a retrospective analysis with a patient sample from 1 Swiss Level I trauma center. In order to better characterize the emerging public health risk of escalator use, additional information would be desirable - ideally from a prospective study for the whole of Switzerland.

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Catastrophic Spinal Injury After Minor Fall in a Patient with Ankylosing Spondylitis

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A 76-year-old man with a history of ankylosing spondylitis presented to the emergency department complaining of neck pain. He stated the pain began when he slipped to the ground from a seated position in his bedroom. On examination his head had adopted a posture so that his chin was resting on his right clavicle, he was noted to have reduced power and altered sensation in his lower limbs. A lateral radiograph of his cervical spine (Figure) shows an acute kyphosis with an associated fracture of the lower cervical vertebra. The vertebras above and below the fracture are rigidly ankylosed.

He was treated with open reduction and internal fixation after a period in halo traction. Unfortunately there was no recovery in neurological function.

This image demonstrates that catastrophic spinal injuries can occur with low energy trauma in patients ankylosing spondylitis because the fused segments act as force amplifying levers. These patients should be accorded extra consideration prior to ruling out a fracture.

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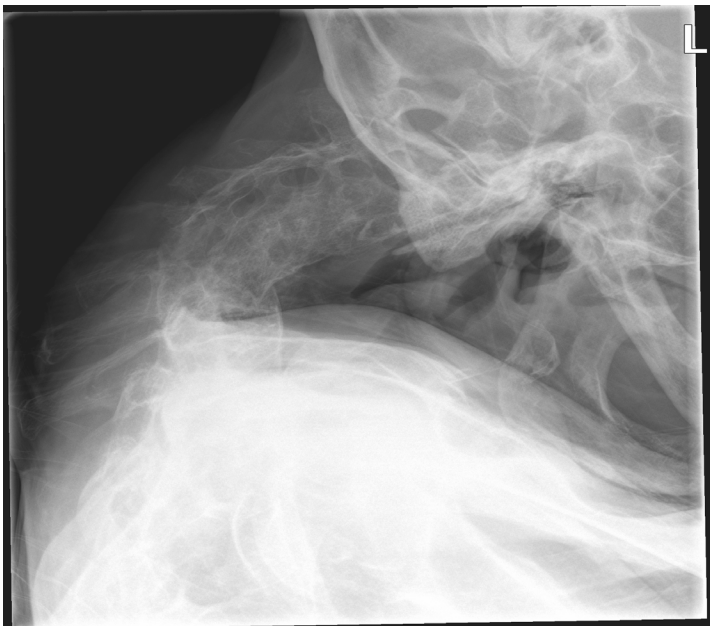

Figure. Acute cervical kyphosis with a fracture in a rigidly ankylosed cervical spine.

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Unique Mechanism of Chance Fracture in a Young Adult Male

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Since the first description of the Chance fracture in 1948, there have been few case reports of unique mechanisms causing this classical flexion-extension injury to the spine in motor vehicle accidents, sports injury, and falls. To our knowledge, this injury has not been reported from a fall with the mechanistic forces acting laterally on the spine and with spinal support in place. We present a 21-year-old male who slid down a flight of stairs onto his side wearing a heavy mountaineering style backpack, subsequently sustaining a Chance fracture of his first lumbar vertebrae. [West J Emerg Med 2013;14(2):147-148.]

INTRODUCTION

Chance fractures are seen usually as the result of flexion-extension injury, most notably during motor vehicle collisions with the advent of lap seatbelts. Case reports have also been reported from an individual who fell 20 feet landing on his feet with forward flexion, an adolescent female who fell from height, and a 25-year-old snowboarder following a backwards fall.[1-3] To our knowledge, this is the first reported case of a Chance fracture sustained after falling onto and subsequently sliding down a flight of stairs.

CASE REPORT

We present a 21-year-old male with no significant past medical history who presented to the emergency department (ED) after a fall down approximately 10 stairs. The patient reported he was wearing a heavy mountaineering style backpack when he tripped, fell onto the side of his low back and then slid down the stairs. On initial presentation, he complained of severe pain to his low back. The patient was deemed reliable, without any propensity for dishonesty or malingering, and there was no identifiable recompense or profitable gain other than correcting his condition.

Physical exam showed normal vital signs and no external evidence of trauma with midline point tenderness from his mid-thoracic to lumbar spine without crepitus. A neurologic exam was normal to include full range of motion and sensation to both his lower extremities with normal rectal tone and no saddle anesthesia. Cervical, thoracic, and lumbar spine radiographs were obtained, which were significant for mild anterior wedging of the first lumbar (L1) vertebrae of uncertain chronicity. The patient's pain was resolved after morphine 12mg IV and ketorolac 30 mg IV. After a period of observation, he was found to be ambulatory and was therefore discharged home with oxycodone/acetaminophen, 72-hour primary care follow-up, and strict return precautions.

The patient returned 30 hours after discharge with continued severe low-back pain that was unrelieved with the prior pain medications. His exam was unchanged from the prior ED visit with normal vital signs. During this visit a magnetic resonance image of the lumbar spine was obtained which revealed a Chance fracture involving the body of L1 extending into the pedicle with probable pars interarticularis involvement without cord compression (Figure 1). Neurosurgery was consulted, and the patient was initially treated by conservative medical management with a thoracolumbar spinal orthosis, and later taken to the operating room for postero-lateral fusion of T12-L2. He was discharged after 7 days in good condition.

DISCUSSION

Mechanical low back pain is one of the most common patient complaints expressed to emergency physicians in the United States accounting for more than 6 million cases annually, with fractures a less common cause of low back

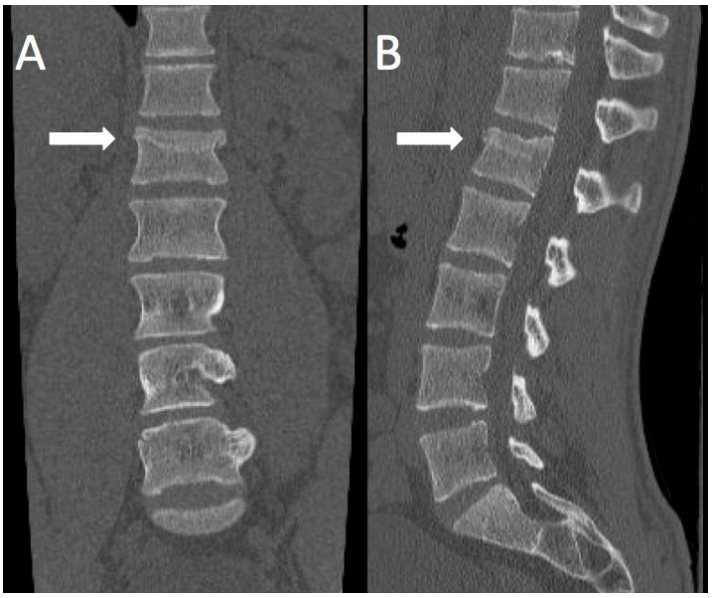

Figure 1. Chance fracture labeled A (antero-posterior view) and B (lateral view)involving body of the first lumbar vertebrae extending into the pedicle with probable pars interarticularis involvement without cord compression.

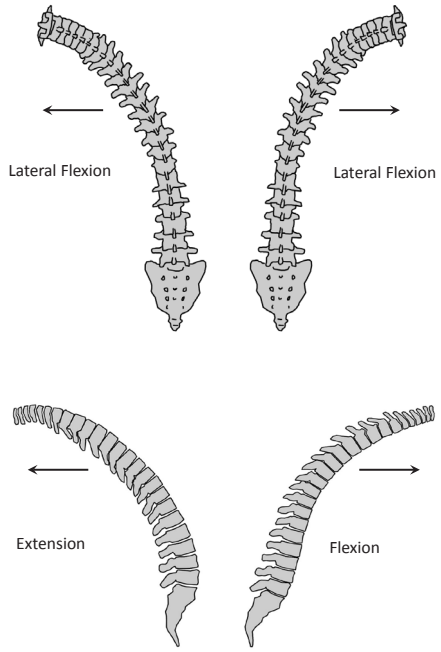

Figure 2. Different depictions of flexion and extension of the spine.

pain. Chance fractures, first described in 1948 by Chance,[4] are fractures caused by simultaneous flexion and distraction forces on the spinal column. The injury, most commonly to the T12-L2 spinal vertebrae, is a transverse fracture of the posterior spinous process, pedicles, and vertebral body. Due to their radiographic appearance, these are sometimes misdiagnosed as compression fractures. Most commonly seen in motor vehicle collisions with the advent of the lap seatbelt due to sudden stopping forces acting on the spine, they have decreased in incidence with the development of shoulder seatbelts.[5,6]

In this case, the mechanism of injury is uncharacteristic of prior descriptions of Chance fractures. This individual was wearing a sturdy mountaineering style backpack with spinal support that should allow for minimal flexion and extension of the spine while falling onto his side causing lateral flexion (Figure 2). Thus, the patient falling onto his side with the supportive backpack in place would most likely cause a lateral compression fracture and less likely a flexion-extension injury making this a unique mechanism of injury for a Chance fracture.

As emergency physicians we are trained to have a high index of suspicion when the mechanism suggests potential life-, limb-, or eye-threatening etiologies. Although this type of injury was initially described as a flexion-extension injury, when moderate to severe shearing forces are placed on the spine, as this case illustrates, the emergency physician must consider a Chance fracture in the differential diagnosis even when the mechanism is less significant.

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Levamisole-adulterated Cocaine Induced Vasculitis with Skin Ulcerations

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CASE REPORT

A 40-year-old man with Hepatitis C and a history of cocaine abuse presented with multiple stages of painful rashes on his extremities and ears. On examination, the patient had several areas of purpuric macules and retiform purpura to his legs and ears (Figures 1 and 2), as well as large ulcerations with erythematous borders on bilateral lower extremities (Figure 3). Laboratory studies revealed mild leukopenia (white blood cell 3.8 K/uL), positive anti-nuclear antibody (ANA), and negative cryoglobulins. Anti-myeloperoxidase antibodies (MPO-ANCA) and anti-proteinase-3 (PR3-ANCA) were also positive. Skin biopsy revealed dermal purpura and thrombi.

DISCUSSION

This patient presented with characteristic findings of levamisole-toxicity. Levamisole is not an inert substance but an antihelmithic drug and potent immunomodulator that was once used for treating cancer and certain autoimmune diseases.[1-2] Levamisole is also an increasingly popular cocaine-adulterant[3] linked to a growing number of cutanous-vasculitis cases characterized by neutropenia or leukopenia, purpuric rash, and production of certain autoantibodies.[4] It was these side effects that caused Levamisole to be withdrawn from the market in 2000. It is unknown why Levamisole has become an increasingly popular cocaine adulterant in the U.S. and Canada. It has been hypothesized that the cutting agent may intensify or prolong the stimulant properties of cocaine by its effects on the metabolism of monoamine neurotransmitters, specifically dopamine.[5,6] Levamisole's chemical properties also make detecting it in street purity tests difficult. Resolution of the cutaneous and hematologic effects often occurs spontaneously with discontinuation of the drug.

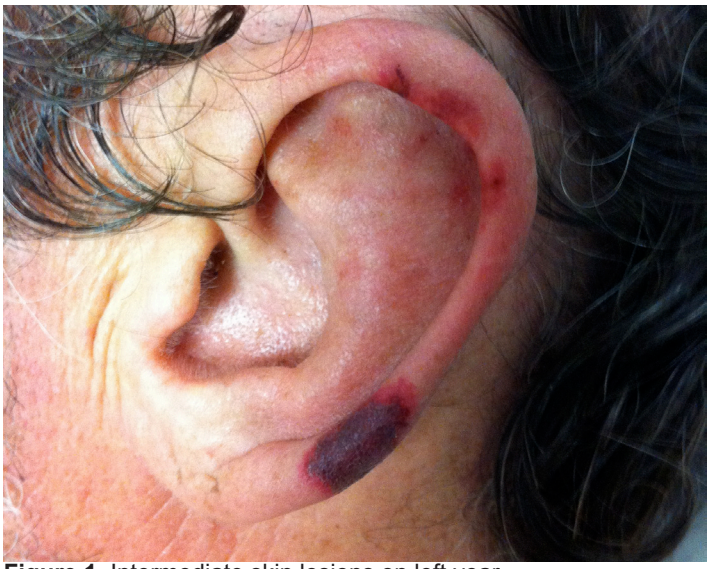

Figure 1. Intermediate skin lesions on left year.

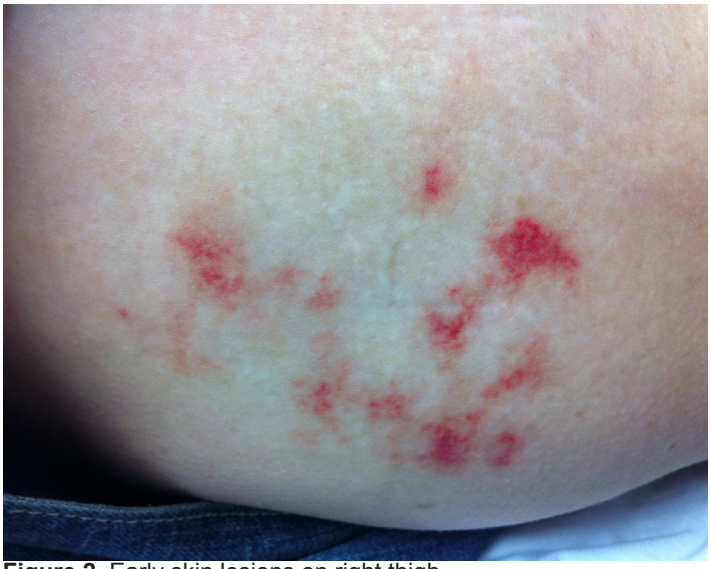

Figure 2. Early skin lesions on right thigh.

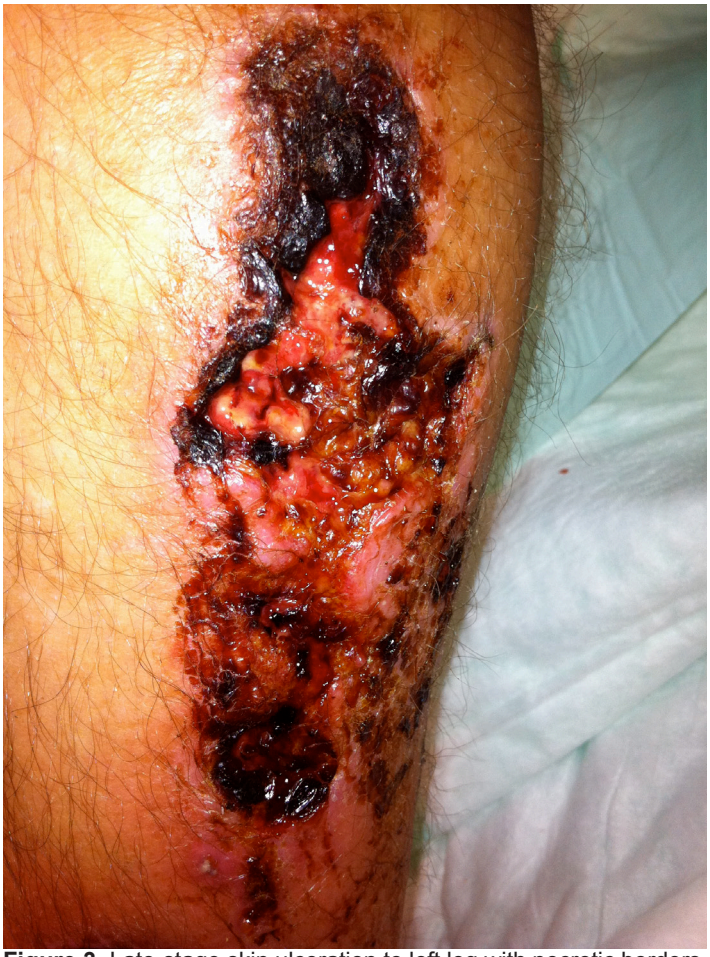

Figure 3. Late-stage skin ulceration to left leg with necrotic borders.

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Acute Vision Change in a 16-year-old Female

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DIAGNOSIS

Idiopathic intracranial hypertension (IIH), also known as pseudotumor cerebri, defined as elevated intracranial pressure with no evident cause found on extensive evaluation. Figures 1 and 2 show bilateral papilledema. Headache is absent in some patients with IIH, especially in the pediatric population.[1,2] Abducens nerve palsy is a common finding. Oculomotor palsy (as in our case) and other cranial nerve deficits are rare symptoms.[1,3,4] Loss of vision is the major morbidity in IIH. While most cases follow a slow and insidious course, some patients experience rapid development of vision loss within a few weeks of symptom onset. Aggressive surgical treatment is indicated in such fulminant cases, often with temporizing measures in place (e.g. serial lumbar puncture, lumbar drain) until surgery can be performed.[5] The patient underwent a lumbar puncture in the ED, with an opening pressure recorded to be over 400 mmH_2O. Magnetic resonance image of the brain was unremarkable. She was admitted to the hospital and started on intravenous methylprednisolone and acetazolamide. A lumboperitoneal shunt was eventually placed and she was discharged home. On follow up 1 year later, her vision was noted to be 20/50 in the left eye and 20/20 in the right eye with correction.

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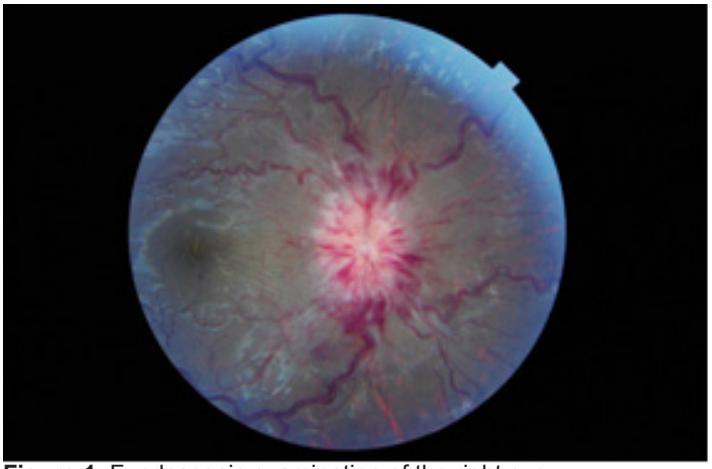

Figure 1: Fundoscopic examination of the right eye.

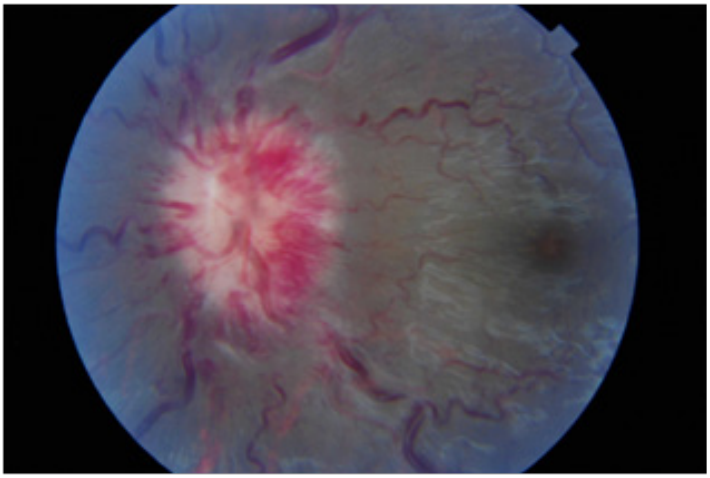

Figure 2: Fundoscopic examination of the left eye.

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Cardiac Tamponade

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A 49-year-old man was brought to the emergency department by ambulance after he sustained a stab wound to the chest. He was alert but diaphoretic, with an initial systolic blood pressure of 90 by palpation and a heart rate of 110. A 1 cm laceration was noted at the left lower sternal border. Lung sounds were clear bilaterally, and heart sounds were muted. His cervical collar was removed, revealing distended neck veins (Figure). A bedside ultrasound demonstrated pericardial fluid (Video).

The patient had a pericardial effusion from penetrating chest trauma, causing cardiac tamponade. Cardiac tamponade is caused by fluid trapped in the pericardial space, compressing the heart, compromising ventricular filling, and therefore cardiac output.[1] Acute traumatic cardiac tamponade presents with chest pain and respiratory distress.[2] Beck's triad may be present on exam, as it was in our case: muffled heart sounds, distended jugular veins, and hypotension.[1] A narrow pulse pressure and pulsus paradoxus may also be observed.[2] The diagnosis can be rapidly confirmed by bedside ultrasound.[3] In traumatic cardiac tamponade, the treatment is thoracotomy in unstable or pulseless patientsor median sternotomy.[4] Pericardiocentesis is indicated only if operative intervention is not immediately available.[5] This patient was transferred directly to the operating room where a median sternotomy was performed. A 1 cm laceration to the right ventricle was identified and successfully repaired. The patient had an uneventful postoperative course and recovered well.

Video. Ultrasound demonstrating pericardial fluid.

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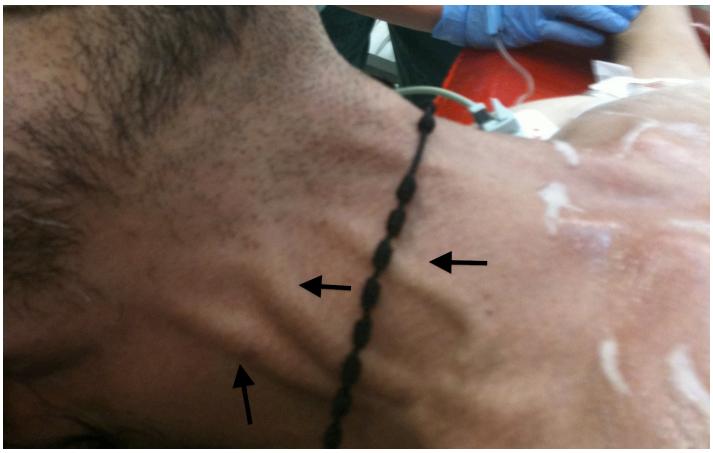

Figure. Distended neck vein.

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Acute Abdominal Pain in an End Stage Renal Disease Patient

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An 81-year-old female with history of end stage renal disease on hemodialysis presented with worsening of abdominal pain of 2 days' duration. The pain started as a dull ache over the lower abdomen 2 months earlier, diffuse but especially prominent over the lower quadrant, and was unrelieved by analgesic medications. On physical examination her whole abdomen was diffusely tender, but the lower quadrant was extremely tender with palpable nodular lesions. Her laboratory work showed a normal amylase and lipase level along with a white cell count of 13.5K/CUMM (3.5-10.6 K/CUMM), calcium of 10.6 mg/dL (8.2-10.6 mg/dL), phosphorus of 5.9 mg/dL (2.3-5.0 mg/dL) and intact PTH 880 pg/mL (18-86 pg/mL).

She had a computed tomography of the abdomen and pelvis (Figure), which showed multiple soft tissue densities in the lower quadrant of anterior abdominal wall, while the ultrasound of her abdomen (Video) revealed subcutaneous nodule with internal septations and calcified vessels. Both these findings in the setting of end stage renal disease were consistent with calciphylaxis, a rare, and often fatal, complication. Although ulceration is considered a hallmark of calciphylaxis, it can also present as non-ulcerative nodular lesions, as in our patient.[1] Various putative risk factors for calciphylaxis include obesity; serum aluminum is greater than 25 ng/mL and serum calcium phosphorus product more than 70.[2] Treatment is multifaceted, including strict control of secondary hyperparathyroidism, maintenance of calcium phosphate product below 55 mg^2/dL^2 using non-calcium containing phosphate binders, administration of intravenous sodium thiosulfate with each dialysis (6-12 weeks), and a trial of prednisone tapered over a period of a couple of weeks.[1] With the above treatment, she had significant improvement of symptoms. Our case highlights the need for emergency physicians to be cognizant of this life-threatening complication in end stage renal disease patients and of the fact that calciphylaxis has different modes of presentation, among which is acute abdominal pain.

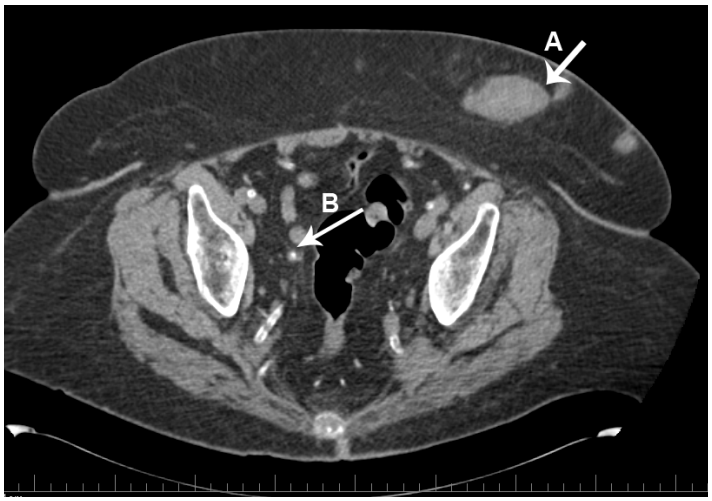

Figure. Computed tomography of the abdomen and pelvis without contrast showing multiple soft tissue densities in the anterior abdominal wall (A). Calcification of blood vessels within the abdomen and pelvis was also noted (B).

Video. Ultrasound of abdomen revealing subcutaneous nodule.

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Hepatic Abscess: Case Report And Review

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Hepatic abscess is an uncommon occurrence in North America, but can be a diagnostic challenge for emergency department physicians. The clinical signs and symptoms may vary, leading to delays in diagnosis and higher morbidity. We present a case of a 35-year old male with a hepatic abscess initially misdiagnosed as pneumonia. On subsequent return to the ED for back pain complaints, a bedside ultrasound led to the appropriate diagnosis. This case report and discussion will attempt to review the literature on the etiology, diagnosis and treatment of hepatic abscess for the emergency physician. [West J Emerg Med 2013;14(2):154-157.]

INTRODUCTION

Hepatic abscesses are a relatively uncommon occurrence in North America. They are seen in approximately 2.3 cases per 100,000 with higher rates found among men than women. They do, however, represent a serious risk to patients. Mortality at one time approached 77%, but newer population based studies have estimated rates at closer to 6%.[1-3] We present a case of a healthy young patient who presents only with upper back pain, underlining the diagnostic challenge inherent in the disease.

CASE REPORT

A 35-year old male presents to the emergency department (ED) with what he describes as right-sided upper back and flank pain, which he attributes to a "cupping" procedure the day prior. The cupping procedure is an alternative medicine practice that uses local suction to theoretically stimulate blood flow and promote healing. He had no previous issues with the procedure. On further history he reported having had approximately 6 weeks of intermittent fevers, cough, anorexia and general malaise. He had seen multiple naturopathic physicians for these complaints, before an urgent care visit one week earlier. At that time, he had been started on azithromycin and doxycycline for a presumptive diagnosis of pneumonia. In the interim week he reported an improvement in his febrile symptoms and overall well-being. He was an otherwise healthy heterosexual male, without drug use or travel outside the country. He had no known sick contacts.

On physical examination his vital signs included a blood pressure of 116/75 mmHg, a heart rate of 119 beats per minute, and a respiratory rate of 20 breaths per minute. His temperature in the ED was 36.2°C. Oxygen (O_2) saturation was 97% on room air. The patient was alert, and appropriate with no signs of respiratory distress. Pertinent physical findings revealed typical, non-tender cupping marks on his back. More concerning was an absence of breath sounds on the right side of the chest on auscultation. His abdomen was soft and non-tender. The remainder of the physical examination was non-contributory.

The initial diagnostic test ordered was a chest radiograph, which showed 80% opacification of the right hemithorax, consistent with pneumonia and associated parapneumonic effusion seen in Figure 1. A bedside ultrasound was subsequently performed in the ED, initially in order to examine the size of the pleural effusion in which a startling discovery was made. The image of the right upper quadrant is shown in Figure 2 and corresponding video clip.

As a result of these abscess findings, the patient underwent a computed tomography (CT) of the chest, abdomen and pelvis to determine the extent of the pulmonary and hepatic disease.

A consultative ultrasound confirms a 10.2 x 8.9 x 12.6 cm abscess in the right lobe of the liver and can be seen in Figure 5. Bloodwork sent after initial examination returned showing a white blood cell count of $25x10^9$/L, creatinine of 92 mmol/L, and lactate of 3.5 mmol/L. Liver transaminases

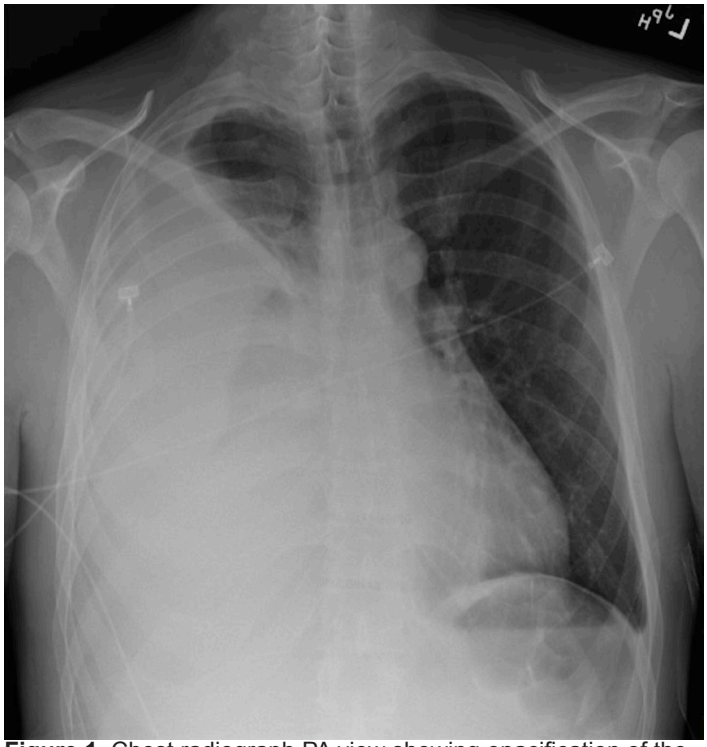

Figure 1. Chest radiograph PA view showing opacification of the right hemithorax.

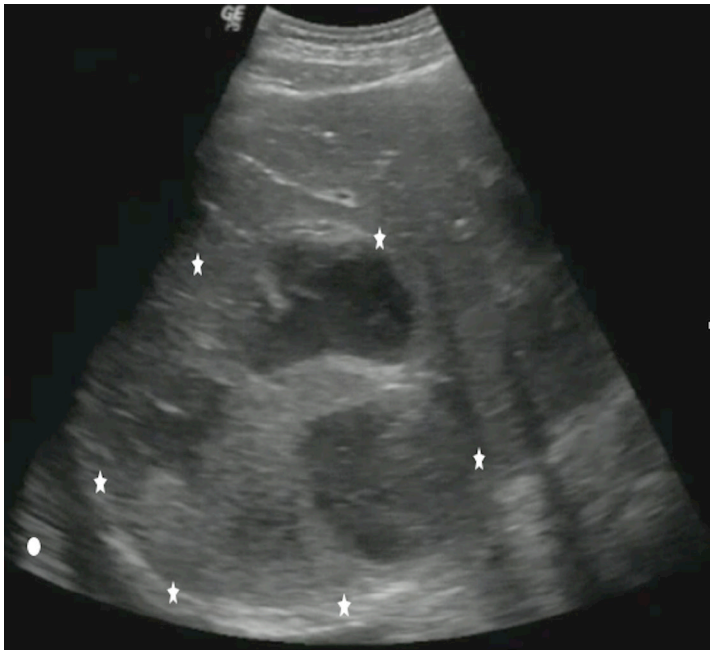

Figure 2. Bedside ultrasound images showing multiple, hypoechoic, loculated fluid collections within the parenchyma of the liver, consistent with hepatic abscesses. The stars show the boundaries of the cavity. An adjacent hypo-echoic pulmonary effusion can also be seen (circle).

and international normalized ratio were within normal limits. While in the ED his O_2 requirements increased to 4L and his blood pressure started to trend down. It dropped to a low of 90/60 with a HR of 108. The patient was treated in the ED with 2 liters of normal saline and started on levofloxacin, vancomycin and piperacillin/tazobactam.

A thoracocentesis was performed showing 33,688 u/L white blood cells with 93% neutrophils although an initial gram stain was negative. Antibiotics were switched to ceftriaxone and metronidazole after infectious disease consultation. The patient was admitted to the surgical intensive care unit where he underwent central line placement and an interventional radiology guided liver abscess drainage with percutaneous drain placement, and tube thoracostomy. He later underwent a video assisted thorascopic surgery (VATS) decortication procedure where a diaphragmatic defect was found, continuous with the hepatic abscess cavity. No microorganisms were found on gram stain, or any subsequent cultures.

Following the VATS procedure the patient made a quick recovery and was discharged from hospital. He continues to recover well. He spent 1 month on intravenous (IV) ceftriaxone and metronidazole administered through a peripherally inserted central catheter line before having the antibiotics discontinued. The etiology of this culture negative abscess has never been identified .

DISCUSSION

The most common cause of hepatic abscess in North America is thought to be from biliary disease.[4,5] Abscesses can also develop from hematogenous spread where intestinal disease such as inflammatory bowel disease, diverticulitis, and appendicitis can all seed to the liver via the portal venous system. Even trauma, both blunt and penetrating, has been shown to result in hepatic abscesses in some rare cases. The great majority of abscesses however, develop without a source ever being identified. These are known as cryptogenic abscesses.[6]

Certain risk factors for abscess development have been described, including recent bowel surgery, diabetes, alcoholism and other immuno-compromised states such as human immunodeficiency virus infections.[7]

While most hepatic abscesses are monomicrobial, it is not unusual to see polymicrobial infections. In North America, the most common pathogens consistenly identified from abscess cultures are *Escherichia coli* and *Klebsiella sp*.[8] Interestingly, in a recent Canadian cohort of patients with hepatic abscesses, *Strepococcus millieri* was the most often cultured organism.[1] For patients who have recently visited, or immigrated from developing nations, abscess formation with *Entamoeba histolytica* can still be seen secondary to fecal-oral contamination.

Generally, patients with hepatic abscess present with fevers and abdominal pain although symptoms can include

a broad range of complaints from nausea and vomiting to malaise and weight loss. In some cases, jaundice may be the first and only clinical manifestation of the disease.[9] Apart from jaundice, physical examination may show hepatomegaly and right upper quadrant pain although this is seen in only about 50% of cases.[6] In some situations hepatic abscess can rupture and spread infection into the thoracic cavity, or even lead to the formation of hepato-bronchial fistulae.[10]

Bloodwork in patients with hepatic abscesses can also vary, although certain features predominate. The most common laboratory abnormalities are hypoalbuminemia, elevated liver enzyme levels, and leukocytosis.[1] Unfortunately no one sign, symptom or laboratory value is specific and the physician must always keep the possibility of hepatic abscess in the differential diagnosis.

The initial radiologic approach to diagnosis often includes a chest radiograph. A chest radiograph may show an elevated hemi-diaphragm, pleural effusion, atelectasis or right lobar consolidation, but is normal in over half of patients.[11] The diagnosis of hepatic abscess has been aided greatly by the increase in availability of ultrasonography and CT in the ED. Both are sensitive tests for the detection of hepatic abscess and have contributed to the trend of reduced morbidity.[12] Contrast-enhanced CT has slightly increased sensitivity compared with ultrasound and may offer benefit in drainage procedures. Ultrasound is ideal in the initial evaluation of the biliary tree.[13] If biliary disease is a suspected source, endoscopic retrograde cholangiopancreatography or magnetic resonance cholangiopancreatography may be indicated. Given these diagnostic options, a multimodal approach is often required for both diagnosis and treatment.

To our knowledge there is only one previous case reporting the use of bedside ultrasound in the diagnosis of a hepatic abscess.[13] While use of consultative ultrasound imaging is a standard part of the work up of a suspected hepatic abscess, the test characteristics of bedside ultrasound for hepatic abscess are unknown. Consultative ultrasound has shown a sensitivity range of 86 to 96%.[14-16] Findings on ultrasound will change depending on the stage of the disease but most commonly include a complex cystic mass with irregular margins and posterior acoustic enhancement. The contents of the structure may take on a more variable echotexture as the untreated abscess progresses where fluid-fluid interfaces and septations become more aparent.[14] When gas forming organisms are present, visualization of the abscess itself can be difficult, as air scatters the ultrasound waves giving off a "dirty" appearing shadow that obscures distal structures. These findings should give the bedside ultrasonographer an even higher degree of concern for serious underlying disease.

Treatment of hepatic abscess should include a multi-disciplinary team approach, ideally involving surgery, interventional radiology, and infectious disease specialists. Main treatment goals include drainage of the abscess and antibiotic eradication of the pathogen involved. Initial ED management should follow a goal-directed sepsis protocol, if indicated. Early broad-spectrum antibiotic therapy aimed at the most commonly responsible organisms should be initiated. While obtaining cultures is ideal, they should not delay therapy. There have been multiple antibiotic regimens described but most often should include an extended spectrum *B*-lactam, or combination of a third generation cephalosporin or fluoroquinolone and metronidazole.[6] Of course, local resistance patterns should be considered when initiating antibiotic therapy. Drainage technique may vary depending on surgical expertise and availability of interventional radiology. Some advocate that large abscesses such as those greater than 5cm may benefit from open surgical drainage.[17,18] Percutaneous drainage by either ultrasound or CT guided is ideal for most other abscesses.[19,20]

CONCLUSION

Hepatic abscess is fortunately a relatively uncommon disease in North America as it can be a difficult diagnosis to make. The presenting complaints, physical findings and laboratory markers can be entirely variable as illustrated by our patient. Our case underlines the importance in keeping hepatic abscesses on the differential diagnosis, especially in those patients with the risk factors described. It also serves as a reminder to the ED physician of the ever-expanding utility of bedside ultrasound in the ED.

Video. Beside ultrasound clip showing a large septated hepatic abscess. An asterisk marks the largest cavity of the abscess.

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Jael's Syndrome: Facial Impalement

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INTRODUCTION

Penetrating injuries to the face or neck can cause difficult airway issues.There is a relative dearth of literature to define the best approach to these patients. Impalement injuries are uncommon, and survivable injuries are most commonly confined to the abdomen or thorax. We report the case of a patient with an obviously difficult airway due to a facial impalement (Jael's Syndrome) injured at a local construction site.

CASE REPORT

A 25-year-old male was working with braided cable under tension at a local construction site when the cable, approximately 2 inches in diameter, snapped without warning and perforated his right cheek, penetrating his right temporal and right parietal lobe. After shortening the cable to 1.5 feet at the construction site, emergency medical services brought the patient to our Level I trauma center. He was transported wearing a cervical spine collar in the sitting position. On arrival, he was awake and alert, unable to speak, and mildly agitated. His initial vital signs were a blood pressure of 159/67 mmHg, heart rate of 54 beats per minute, respiratory rate of 18 breaths per minute, and a pulse oximetry reading of 97% on 15 liters of oxygen. The remainder of his primary and secondary surveys revealed no further injuries.

Because of the position of the cable through his jaw and upward into his brain, the patient was unable to open his mouth more than two centimeters. In the trauma bay he became more agitated and began to pull at the cable that protruded 1.5 feet outside of his mouth. We decided to sedate and intubate him to facilitate further evaluation and treatment of his injuries. After 30 mg of etomidate and 100 mg of succinylcholine administered intravenously, blood and construction site debris was suctioned from his oropharynx, and he was intubated using the GlideScope Portable GVL and a 7.5 endotracheal tube on the first attempt.

The patient was taken for an IV-contrasted computed tomography of his brain, face, and neck to assess vascular injury and define the extent of damage (Figure).

The patient was taken to the operating room for cable removal, neck exploration, facial nerve exploration, right temporal craniotomy, and tracheostomy. He was found to have a cranial nerve XII paralysis, right temporal and parietal lobe traumatic brain injury and intraparenchymal hemorrhage, intraventricular hemorrhage, right cochlea damage, and some general soft tissue damage. On post-operative day 3, he was transferred to the floor on a liquid diet. On post-operative day

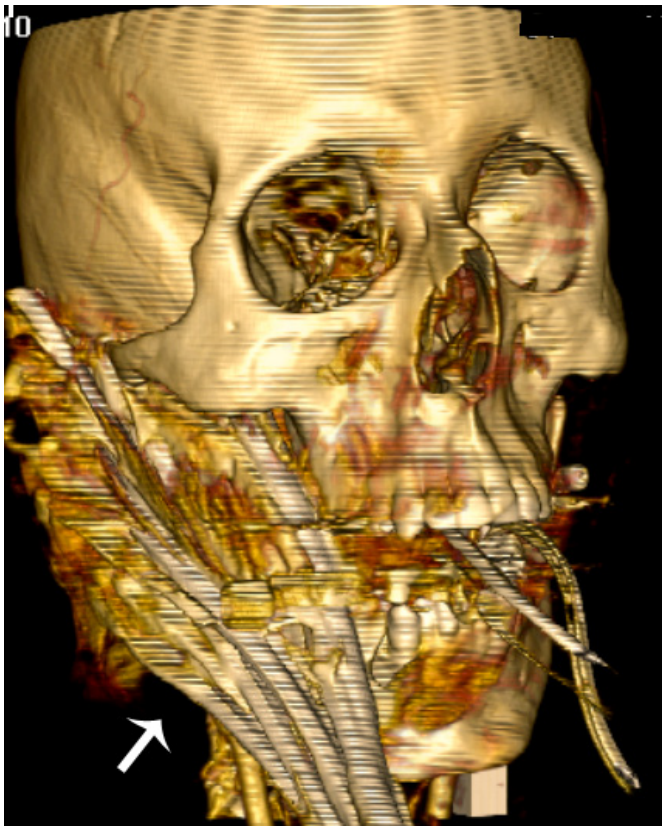

Figure. The cable entered the right mandible at the level of the angle of the mandible and superiorly near the condyle, terminating 3 cm into the right temporal lobe.

7 he was diagnosed with bacterial meningitis after developing a headache, fever, and neck rigidity. On post-operative day 13 he was discharged on oral antibiotics to a rehabilitation facility.

DISCUSSION

This patient clearly had a difficult airway, with a large foreign body inhibiting evaluation, and limiting options for definitive airway choices. Assisted ventilation was not an option with the foreign body in place, and removing his ability to protect his own airway took us down the potential road of not being able to ventilate or intubate. The size of the cable and extent of external damage was daunting; clinically we were most concerned about swelling and hemorrhage into the airway, further pressured by his increasing agitation. Intubation via "line-of-sight" direct laryngoscopy or placement of an laryngeal mask airway was not feasible given the patient's inability to open his mouth.

At our institution, the emergency medicine (EM) junior resident is responsible for patient intubation. Because of the patient's agitation, we felt an awake fiber-optic intubation would have been difficult. We chose the GlideScope® as a method of laryngeal visualization with minimal orofacial manipulation, with the added benefit of having the faculty EM physician and senior anesthesia resident able to directly monitor the procedure. Our backup airway plan included an Eschmann introducer, and our final airway plan was for cricothyroidotomy, with the neck already prepped for the surgical procedure.

Literature reviewing difficult airways suggests an algorithm that considers direct laryngoscopy, awake intubations, surgical airways, various airway adjuncts, and fiberoptic choices, to include videolaryngoscopy.[1-3] Studies examining airway management in penetrating neck and face injury generally recommend direct laryngoscopy when feasible, with rapid progression to surgical airways.[4-10] Medical paralysis to facilitate definitive airway management is controversial, with some recommending against it.[4,11] One large retrospective study suggested lack of neuromuscular blockade increased the risk of difficult intubations, and other small studies have suggested that rapid sequence intubation is the approach of choice.[5-6,12] The American Society of Anesthesiology recommends the awake approach in the difficult airway algorithm.[11]

The leading causes of orotracheal intubation failures in trauma patients are difficult anatomy, a foreign body in the airway, or unrecognized head or neck injury, causing an unanticipated difficult airway.[13] Videolaryngoscopy in the hands of an experienced user (able to manipulate the endotracheal tube based on the video view rather than a direct view) can mitigate the effects of difficult anatomy. The only previous case reports we could find with a similar injury were mixed in their airway approach. One moved directly to a surgical airway when the patient's oxygen saturation began to decline, and the others did an awake or anesthetized fiber-optic nasotracheal intubation.[14-16] Management of the difficult airway is best guided by the urgency of the patient's injuries and the options available to the team doing the intubation; weighing the risks and benefits of awake endotracheal intubation versus rapid sequence intubation in patients with penetrating neck injuries requires special consideration.

We chose what we felt was our best method of laryngeal visualization and orotracheal intubation, to include neuromuscular blockade, with the understanding that a failed first attempt would most likely result in a surgical airway. The intubating physician had previous experience with the GlideScope®, performing two live intubations and 10 mannikin intubations, and was familiar with manipulating the endotracheal tube based on the video picture alone. Given the clinical need for sedation and paralysis, we saw no significant risks to a single attempt at videolaryngoscopy while the patient's neck was being prepared for cricothyroidotomy.

CONCLUSION

The diverse nature of penetrating face and neck injuries precludes a single method for airway management. Emergency physicians are reminded to be prepared for a difficult airway with appropriate equipment and a rapidly executable algorithm. It is important that a backup surgical airway is prepared and available prior to administration of paralytic agents. In this case, the choice of the GlideScope® was successful, suggesting that videolaryngoscopy can be included in the algorithm of a provider who is familiar with the instrument.

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Perforation of Inferior Vena Cava by Inferior Vena Cava Filter

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A 46-year-old male with diabetes, hypertension, and a history of pulmonary embolism (status post placement of a retrievable Celect inferior vena cava [IVC] filter) presented to the emergency department with progressively worsening abdominal pain for 1 month. Physical exam was consistent with right upper quadrant and right lower quadrant abdominal pain and tenderness, without rebound or guarding, and with stable vital signs. A computed tomography (CT) of the abdomen was performed.

CT demonstrated that multiple struts of the IVC filter were located outside the lumen of the inferior vena cava, suggestive of chronic perforation with no evidence of free fluid or hematoma in the abdomen. IVC perforation from removable filters is relatively common, and directly related to how long the filter has been in place.[1] One study noted an 86% perforation rate overall, with all filters imaged after 71 days revealing some level of perforation.[1] This patient's IVC filter had been in place for four and a half months. Complications of IVC filters include filter migration, tilting, strut fracture, strut perforation, and IVC thrombosis.[2] Most strut perforations are discovered incidentally.[2]

The patient's pain was later attributed to cholecystitis based upon his laboratory and imaging study results. The patient subsequently had the IVC filter removed by interventional radiology, and a new filter was placed without complications.

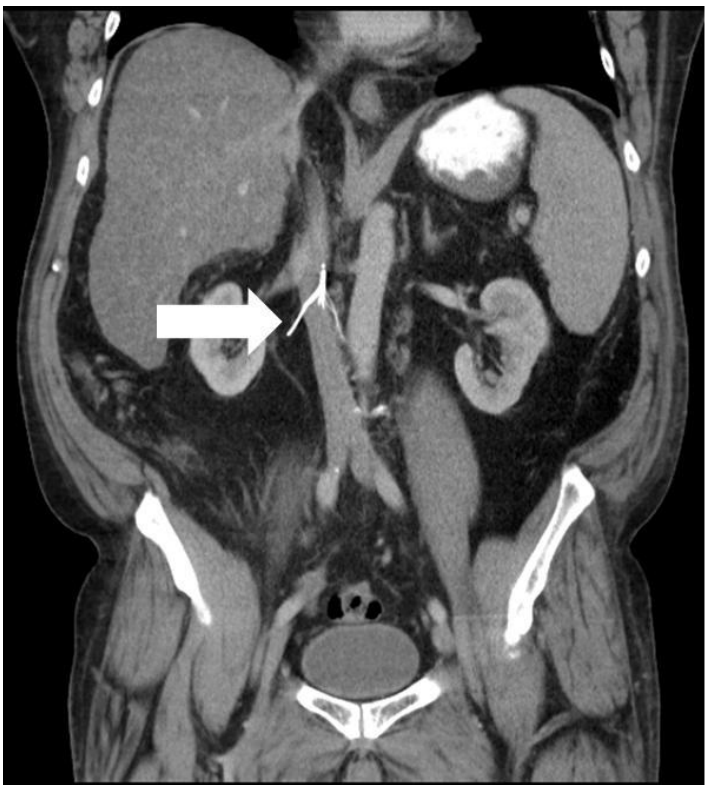

Figure 1. Coronal view of a inferior vena cava (IVC) filter with strut visible outside the IVC.

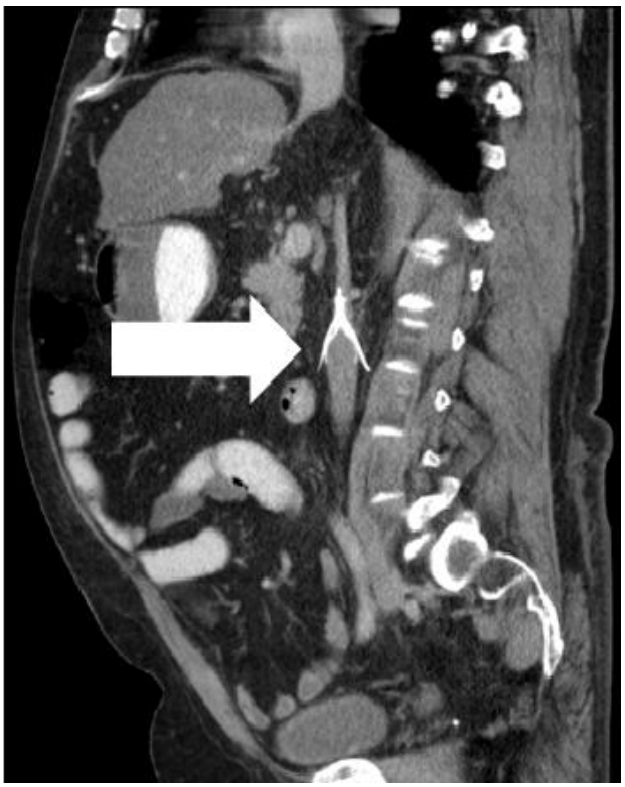

Figure 2. Sagittal view of a inferior vena cava (IVC) filter with strut visible outside the IVC.

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Neonatal Umbilical Mass

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A 41-day-old girl presented to the emergency department with a new dark red mass protruding from the umbilicus noted 3.5 hours prior to presentation. The patient's mother reported the umbilical stump fell off at 4 days of life, but the patient continued to have intermittent clear green drainage from a small mass at the base of the umbilicus. The patient was born full-term with an otherwise unremarkable medical history.

Physical exam revealed a small, moist, erythematous mass protruding from the umbilicus (Figure). The mass was removed with minimal bleeding and no pain while attempting silk ligation. The specimen was sent for pathology, which returned 3 days later with the diagnosis of umbilical granuloma.

An umbilical granuloma is a common benign abnormality in neonates that form from excess granulation tissue remaining at the base of the umbilicus after cord separation. It forms during the first few weeks of life and should not be present at birth. They typically are associated with persistent drainage involving the umbilicus after cord separation.[1] It is a soft, round, moist, usually pink, friable, pedunculated mass, typically 3–10 mm in diameter. Umbilical polyps, urachal tract, and omphalomesenteric duct remnants must be considered.[1,2]

Multiple techniques are available to treat umbilical granulomas. Application of topical antibiotics, elimination of friction, air drying with alcohol wipes, and application of common table salt are conservative measures that may allow for epithelialization.[3-5] Cauterization with silver nitrate is the most common treatment and generally requires multiple applications.[1,6] Ligature, electrocautery, and cryosurgery are other treatment options. Further evaluation for other pathology is warranted if the lesion fails to resolve with silver nitrate and/or ligation.[1,5,7]

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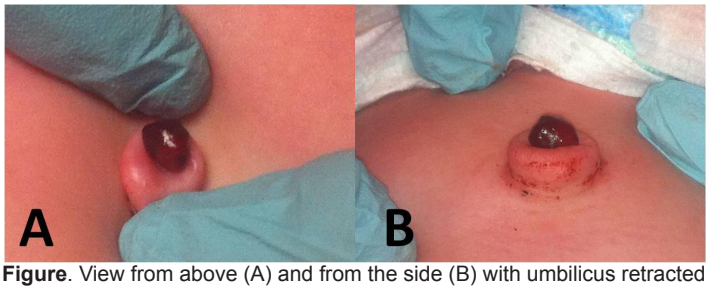

Figure. View from above (A) and from the side (B) with umbilicus retracted to demonstrate pedunculated stump of the umbilical granuloma.

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Hickam's Dictum

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A 15-year-old female presented to the emergency department (ED) with a 1-week history of fevers, vomiting, back pain and dysuria. Her primary care physician started her on cefdinir for a urinary tract infection. On initial evaluation she was febrile, tachycardic, and had an exam notable for tenderness of both the left costovertebral angle and suprapubic region. Her urinalysis had 25 white blood cells, leukocyte esterase 75 leu/μL, and protein 50 mg/dL. While in the ED, the patient continued to experience bouts of emesis despite fluid resuscitation and anti-emetics. Repeat examination showed developing right lower quadrant tenderness without guarding or rebound. An intravenous contrast computed tomography (CT) was performed (Figure).

The CT (Figure) shows residual contrast in the parenchyma of the left kidney (a "striated nephrogram") consistent with pyelonephritis. The appendix contains multiple appendicoliths and is both dilated and inflamed; this is consistent with acute appendicitis. This case illustrates the dulling of Ockham's razor and serves as a reminder that sometimes Hickam's Dictum ("Patients can have as many diseases as they damn well please") prevails over diagnostic parsimony. More importantly, physicians are reminded to pursue alternate or additional diagnoses when the patient's symptoms cannot be explained by a single, unified diagnosis — in this case acute pyelonephritis.[1] Thinking broadly in the face of contradictory data helps to prevent the most common cognitive error in medicine: satisfaction of search. Satisfaction of search refers to the tendency to stop looking once something is found.[2] Attributing the right lower quadrant pain to cystitis conforms to Ockham's razor, but leaves one vulnerable to satisfaction of search, and in this case would have missed an additional diagnosis.

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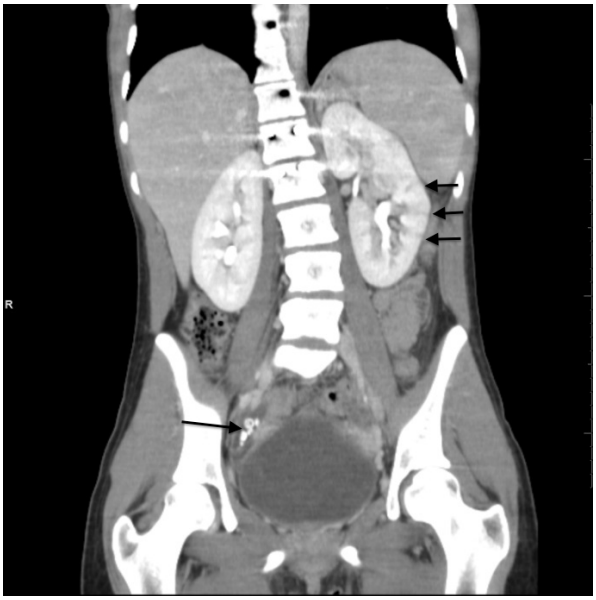

Figure. Intravenous-contrast enhanced computed tomography of the abdomen and pelvis. Three short arrows illustrate residual contrast in the parenchyma of the left kidney. This is a striated nephrogram and is consitent with acute pyelonephritis. The long arrow shows several appendicoliths in a dilated appendix. This is consistent with acute appendicitis.

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Primary Meningococcal Arthritis Leading to *Neisseria Meningitidies* Purpura Fulminans

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INTRODUCTION

Primary meningococcal arthritis (PMA) is a rare infectious disease that occurs in as little as 1% of meningococcal infections.[1] PMA is arthritis without meningitis, fever, rash, and hemodynamic instability.[2] It is usually preceded by an upper respiratory infection in 50-55% of presentations, and patients may appear nontoxic, afebrile, and polyarthralgic. Despite definition they may have a rash.[3-12]

Although PMA is rare, one would expect immunocompromised patients to be more susceptible to develop this disease. However, in areas of high prevalence of human immunodeficiency virus (HIV) infection, just outside the meningococcal belt in the Gabonese Republic of Africa, HIV-infected patients were not found to be at higher risk for Neisseria meningococcal disease.[13] Furthermore, a small study by Skeete et al[14] showed patients with a compromised immune system were not more likely to have normal peripheral white blood cell (WBC) count during septic arthritis.

With such a variable presentation of septic arthritis, it can be extremely difficult to diagnose a septic joint without a high clinical suspicion. Numerous studies indicate that previous joint disease and low socioeconomic class do appear to be risk factors for developing septic arthritis, although N. meningococcal disease was not included.[12] There are no well-studied or validated clinical criteria that can be used when attempting to diagnose PMA. While the literature varies most orthopedists will use a WBC count of 5.0-10.0 x 10^3 cells/μL or greater and no synovial fluid crystals before they will consider the diagnosis of a septic joint. Septic arthritis has been diagnosed by intra-articular cultures in 7-10% of cases with a joint fluid aspirate WBC count of less than 10.0 x 10^3 cells/μL, but none of these studies included N. meningococcal disease. The literature also supports the finding that traditional septic arthritis joints have an elevation in at least 1, if not several, of the following: peripheral WBC count, erythrocyte sedimentation rate (ESR), c-reactive protein (CRP), or joint aspirate WBC.[15-17] Furthermore, when looking at the case studies published, we found that all but 4 cases of PMA had purulent aspirate, with these 4 cases having synovial WBC count ranging from 17-163,000 cells/μL.[6-8,18] We will present a unique case of PMA with non-purulent joint aspirate with normal peripheral WBC and joint fluid WBC count of 8.7 x 10^3 cells/μL in an HIV-positive patient with a CD4 count reflecting a functional immune system.

CASE PRESENTATION

A homeless, 60-year-old man with a history of HIV presented to the emergency department (ED) with chief complaint of bilateral wrist pain and left ankle swelling and pain for a day. Patient stated pain was 10/10, constant, increased with movement and was not relieved by ibuprofen. He stated that he had a history of gout attack and this presentation was similar to previous gouty attacks. He denied intravenous drug abuse, fever, or recent illness. In regards to his HIV status, the patient had a CD4 count of 604 and an HIV RNA PCR quantity of 120,000 1 month prior to presentation. On physical examination his vital signs were positive for a low grade fever of 37.5 °C and tachycardia of 120 beats per minute (bpm). He appeared non-toxic and was without rashes, but showed limitation of active movement of bilateral wrists and left ankle due to pain with warmth and tenderness to palpation in all 3 joints. He had trace edema of the left ankle. No labs were drawn on the initial visit, and he was treated with 1.2 mg colchicine, followed by 4 subsequent doses of 0.6 mg, 800 mg ibuprofen, and 5/325 mg tab of hydrocodone/acetaminophen with significant decrease in his pain and ability to move all joints and bear weight. He was subsequently discharged home with a prescription for ibuprofen and hydrocodone/acetaminophen with diagnosis of HIV and acute gout attack.

The patient returned 3 days after discharge with worsening pain, erythema, and swelling in his left ankle and

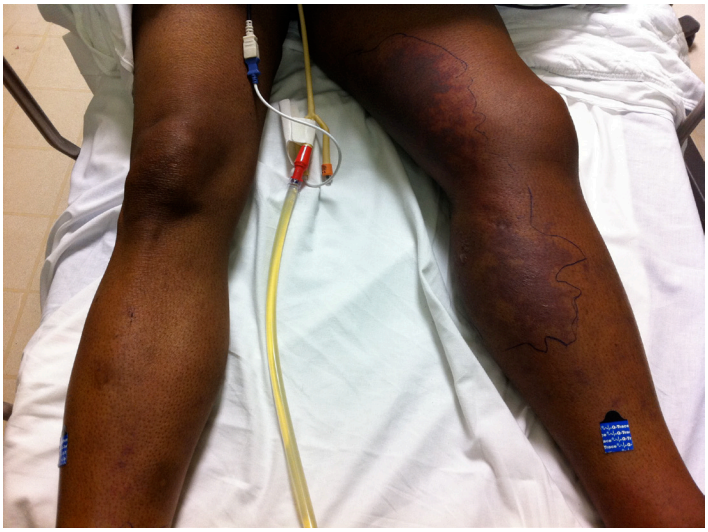

Figure. Purpura fulminans of lower extremity.

new right ankle and left knee pain, erythema, and edema. His vitals were normal without a low grade fever, but tachycardia of 122 bpm. The patient remained non-toxic appearing without a rash. Labs were obtained, arthrocentesis of his left knee was performed, and he was treated with ketorolac for pain with improvement. His laboratory analysis showed a peripheral WBC of 9.4, uric acid of 6.9 mg/dL, and joint aspirate WBC count of 8.7 x 10^3 cells/μL without crystals. He was discharged with nonsteroidal anti-inflammatory drugs, rheumatology follow up and diagnosis of inflammatory arthritis.

Two days after being discharged the second time, the patient was found sitting on a bench across from the homeless shelter unresponsive. He had been there all night. Emergency medical services were called and he was given naloxone without response. On presentation to the ED he was unresponsive with vitals showing hypertension of 151/84, temperature of 36.3°C and tachycardia of 138 bpm. On physical examination he was noted to have entire left lower extremity edema with purpura noted throughout left leg and right ankle (Figure). A computed tomography (CT) of his left leg showed edema only, and a head CT was negative. His labs showed acute renal failure with Cr of 2.2 and a peripheral WBC of 6.6 with 17% bands. His knee cultures from the previous ED visit were growing gram negative coccobacilli. The orthopedic service was consulted and took the patient to the operating room (OR) for washout.

Post-operatively he was admitted to the intensive care unit where he was subsequently intubated for airway protection due to declining mental status. His blood and cerebral spinal fluid cultures grew N. meningitides, and he required xigris and levophed for septic shock. He had a prolonged hospital course that included multiple surgical procedures for debridement/washouts, I&Ds of bilateral lower extremities due to infected wounds from purpura fulminans (requiring wound vac management), and skin grafts to the left lower extremity. He had another episode of acute renal failure due to urinary retention, causing hydronephrosis that required a urology consult without causal finding, and he was taught to perform in-and-out catheterizations.

The patient was diagnosed with mild syndrome of inappropriate antidiuretic hormone and placed on fluid restriction. He experienced left-sided hearing loss due to meningitis After developing a right upper extremity deep vein thrombosis he was bridged from enoxaparin to warfarin for treatment. He also had to be treated for hospital-acquired urinary tract infections, required multiple blood transfusions due to the operations, and was placed on nutritional supplementation for malnourishment.

It should be noted that neurology was consulted due to prolonged altered mental status after extubation. The patient had a negative magnetic resonance image of the brain and electroencephalography. Infectious disease was also consulted and treated the initial infection with a 14-day course of ceftriaxone and the lower extremity wound infections with a course of vancomycin and meropenem. After 62 days of hospitalization, he was discharged to a sub-acute rehabilitation facility for further management.

DISCUSSION

This case presentation represents the only known case of a patient with primary meningococcal arthritis with non-purulent joint aspirate with a WBC count of less than 10.0 x 10^3 cells/μL and a normal peripheral WBC count. While the literature suggests that in septic arthritis the patient can present appearing clinically nontoxic and afebrile with normal labs and a history of previous joint disease, our case represents the perfect storm for missing an infected joint with terrible morbidity resulting to the patient.

On the initial presentation, the differential diagnosis included septic arthritis. However, due to the alleged history of previous gout attack similar to the initial described presentation it was decided to treat the patient for acute gout and if there was no improvement to draw labs and perform an arthrocentesis. Unfortunately for the patient, he improved with gouty management, was able to ambulate, and asked to be discharged from the ED. The decision to not perform arthrocentesis is one that has been discussed at this author's morbidity and mortality conference and was mostly due to playing the odds.

When the patient re-presented to the ED, arthrocentesis was performed, as were peripheral labs; however, peripheral WBC and joint aspirate WBC were well below the reported values that constitute a septic joint in our institution. Given the labs and the nontoxic appearance of the patient he was treated symptomatically and referred to outpatient rheumatology for further evaluation of possible inflammatory arthritis. Fortunately for the patient, cultures of the knee aspirate were obtained prior to discharge, which helped the admitting team

when he presented septic. The decision to discharge with urgent rheumatology follow up was discussed, in addition to having orthopedic surgery evaluate the patient in the ED. However, the circumstances were such that the consulting team would have had little reason to admit, much less take the patient to the OR: he was nontoxic, afebrile, and joint aspirate was non-purulent with less than a WBC count of 10.0 x 10^3 cell/μL. One could argue that quantitative inflammatory markers (ESR and CRP) should have been obtained; however, these results infrequently change management in acute septic arthritis.[19] Additionally, if these markers were hypothetically elevated the next step would have been arthrocentesis. In this case the clinicians elected to skip this intermediate step and proceed to arthrocentesis.

CONCLUSION

We present this case to raise awareness among physicians of the atypical presentations of septic arthritis. More specifically, there are patients with a confirmed diagnosis of septic arthritis even though the synovial fluid WBC is lower than most reported guidelines. Methicillin-resistant *Staphylococcus aureus* and Neisseria are the 2 bacterial infections that have traditionally low synovial fluid WBC, although as stated earlier there has not been a report of Neisseria in a patient with a synovial WBC count of less than 10.0 x 10^3 cells/μL.

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Shock Index and Early Recognition of Sepsis in the Emergency Department: Pilot Study

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Introduction: Screening for severe sepsis in adult emergency department (ED) patients may involve potential delays while waiting for laboratory testing, leading to postponed identification or over-utilization of resources. The systemic inflammatory response syndrome (SIRS) criteria are inaccurate at predicting clinical outcomes in sepsis. Shock index (SI), defined as heart rate / systolic blood pressure, has previously been shown to identify high risk septic patients. Our objective was to compare the ability of SI, individual vital signs, and the systemic inflammatory response syndrome (SIRS) criteria to predict the primary outcome of hyperlactatemia (serum lactate ≥ 4.0 mmol/L) as a surrogate for disease severity, and the secondary outcome of 28-day mortality.

Methods: We performed a retrospective analysis of a cohort of adult ED patients at an academic community trauma center with 95,000 annual visits, from February 1st, 2007 to May 28th, 2008. Adult patients presenting to the ED with a suspected infection were screened for severe sepsis using a standardized institutional electronic order set, which included triage vital signs, basic laboratory tests and an initial serum lactate level. Test characteristics were calculated for two outcomes: hyperlactatemia (marker for morbidity) and 28-day mortality. We considered the following covariates in our analysis: heart rate >90 beats/min; mean arterial pressure < 65 mmHg; respiratory rate > 20 breaths/min; ≥ 2 SIRS with vital signs only; ≥2 SIRS including white blood cell count; SI ≥ 0.7; and SI ≥ 1.0. We report sensitivities, specificities, and positive and negative predictive values for the primary and secondary outcomes.

Results: 2524 patients (89.4%) had complete records and were included in the analysis. 290 (11.5%) patients presented with hyperlactatemia and 361 (14%) patients died within 28 days. Subjects with an abnormal SI of 0.7 or greater (15.8%) were three times more likely to present with hyperlactatemia than those with a normal SI (4.9%). The negative predictive value (NPV) of a SI ≥ 0.7 was 95%, identical to the NPV of SIRS.

Conclusion: In this cohort, SI ≥ 0.7 performed as well as SIRS in NPV and was the most sensitive screening test for hyperlactatemia and 28-day mortality. SI ≥ 1.0 was the most specific predictor of both outcomes. Future research should focus on multi-site validation, with implications for early identification of at-risk patients and resource utilization. [West J Emerg Med 2013;14(2):168-174.]

INTRODUCTION

Severe sepsis poses substantial clinical, financial, and logistical challenges. Annual hospitalizations for septicemia or sepsis have more than doubled over the past decade, from 326,000 in 2000 to 727,000 in 2008, without a corresponding increase in overall hospitalizations for that time period.[1] Although this represents only 2% of admissions to the hospital, these patients comprise an estimated 17% of in-hospital deaths.[1] Up to 46% of hospitalized septic patients are admitted through a dwindling number of emergency departments (EDs).[1,2] Emergency clinicians now must balance two conflicting forces in the care of patients at risk for sepsis: the recognized need for early intensive therapy and an increasingly resource-strained environment.

When sepsis is identified early in the ED and its severe form is treated aggressively with the protocolized care bundle of early goal directed therapy (EGDT), improvements in mortality are significant.[4,5] A number of studies have analyzed the process of implementing EGDT in the ED based on the sepsis definitions outlined in the American College of Chest Physicians / Society for Critical Care Medicine (ACCP/SCCM).[4,6-8] The expert consensus panel defined sepsis as the systemic inflammatory response syndrome (SIRS) with evidence of infection (Figure 1). The panel further asserted that SIRS is the physiologic response to inflammation in the body, regardless of cause.[8] These parameters were selected for their high sensitivity, to represent the lowest threshold for detection of the early response to inflammation during times of physiologic stress.[9]

Critics of SIRS assert that the criteria lack specificity for infectious causes of illness and for clinical outcomes.[10,11] Shapiro et al[12] demonstrated that adult ED patients admitted to the hospital with a suspected infection with 2 or more SIRS criteria were at no greater risk for 28-day mortality than patients with less than 2 SIRS criteria. The non-specific nature of SIRS may in fact hinder the utility of screening practices for the early detection of sepsis; this in turn has implications for enrollment of patients in ED-based sepsis research.

An additional limitation of SIRS to function as an early warning of sepsis is its inclusion of a white blood cell count (WBC). The time required to order, draw, analyze, and report laboratory tests is substantial, particularly when these are used to fulfill criteria for diagnosis or to make clinical decisions. On the one hand, protocol-driven laboratory draws screen low-risk patients, potentially generating many false positives. On the other hand, relying on laboratory information to define treatment strategies causes delays in care. The consequences of delayed recognition of those at risk for sepsis include ongoing volume depletion and microcirculatory inflammation, which lead to end-organ dysfunction.[12] Non-laboratory immediate bedside "red flags" for sepsis may alert providers to initial assessment of those at risk for severe sepsis. Congruently, a clinical basis to re-prioritize those with more benign parameters on presentation would direct resources appropriately.

Two or more of the following:

- Temperature >38° C or <36° C
- Heart rate >90 beats/min
- Respiratory rate >20 breaths/min or $PaCO_2$<32 torr
- WBC >12,000 cell/mm^3, <4,000 cells/mm^3, or >10% immature (band) forms

Figure 1. Criteria for systemic inflammatory response syndrome.[7]

The shock index (SI) is a bedside assessment defined as heart rate divided by systolic blood pressure, with a normal range of 0.5 to 0.7 in healthy adults. Allgöwer and Buri[13] first introduced the concept in 1967 as a simple and effective means of gauging the degree of hypovolemia in hemorrhagic and infectious shock states. Experimental and clinical studies have shown that SI is linearly inversely related to physiologic parameters, such as cardiac index, stroke volume, left ventricular stroke work, and mean arterial pressure.[14] A SI ≥ 1.0 has been associated with significantly poorer outcomes in patients with acute circulatory failure.[14] Furthermore, SI was also shown to indicate persistent failure of left ventricular function during aggressive therapy of shock patients in the ED.[15] In 1994, Rady et al[16] found that a SI ≥ 0.9 predicted higher illness priority at triage, higher hospital admission rates, as well as intensive therapy on admission than pulse or blood pressure alone. This suggests that SI may be a valuable tool for the early recognition and evaluation of critical illness in the ED,[16] as well as a means to track progress of resuscitation.[15]

As an adjunct to established methods, SI may identify and risk-stratify septic patients early in the ED course. One of these established markers for sepsis severity – hyperlactemia (serum lactate ≥ 4.0 mmol/L) - is an entry criterion for EGDT protocols and is associated with significant short-term mortality risk.[5,17] The shock state causes cellular hypoxia, leading to anaerobic metabolism and increased lactate production, as well as decreased clearance, even before vital signs are compromised.[17] Persistently high lactate levels are associated with under-resuscitation and have been shown to down-trend with successful resuscitation.[15] Our objective was to compare the ability of SI, individual vital signs, and SIRS to predict the outcomes of hyperlactatemia as an objective surrogate for disease severity and 28-day mortality in a cohort of adult ED patients screened for severe sepsis.[17-19]

METHODS

Study Design

This was an observational cohort of adult ED patients with a suspected infection who were screened for severe sepsis using a standardized clinical protocol. The computerized order set included obtaining a CBC and venous lactate level

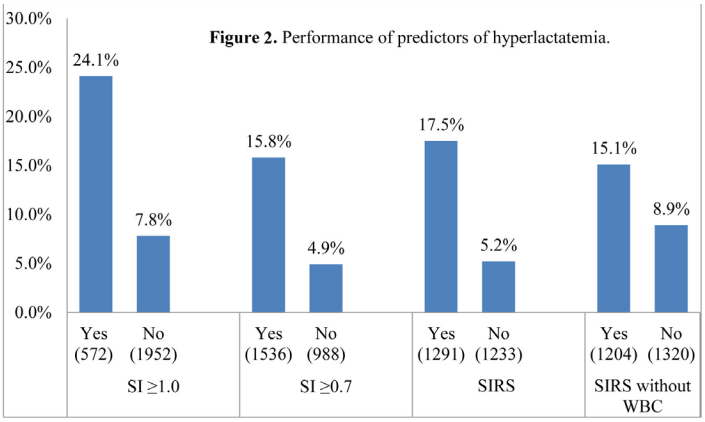

Figure 2. Performance of predictors of hyperlactatemia. *SI,* shock index; *SIRS,* systemic inflammatory response syndrome; *WBC,* white blood cell count

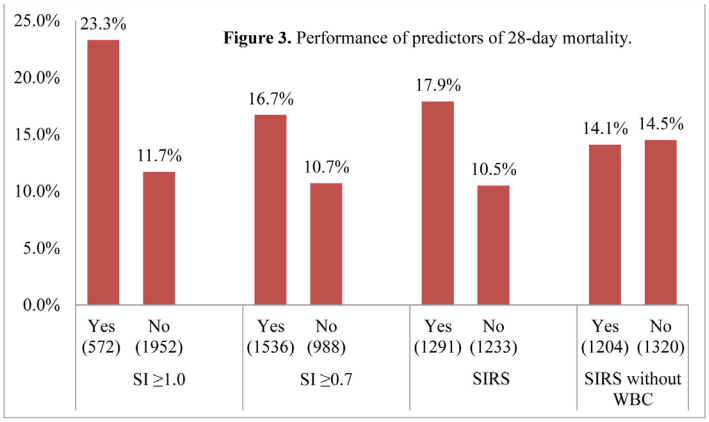

Figure 3. Performance of predictors of 28-day mortality. *SI,* shock index; *SIRS,* systemic inflammatory response syndrome; *WBC,* white blood cell count

on these patients' initial blood draw. The study was conducted from February 1, 2007 to May 28, 2008 at a 450-bed urban teaching hospital with 95,000 ED visits annually. The local institutional review board approved the study with a waiver of informed consent. All data were collected retrospectively by electronic medical record review. The pre-specified primary outcome was hyperlactatemia; the secondary outcome was 28-day mortality.

Selection of Participants

Patients 21 years of age or older were included in the study if screened for severe sepsis by the above protocol. In order not to confound the dataset with repeated measures, the first ED visit was used in patients with mul tiple encounters over the study period. We created and audited a database of patients screened for severe sepsis to confirm inclusion of all potential subjects. A similar cohort from the same data set was analyzed and an examination of markers for sepsis severity has been previously published.[20]

Methods and Measurements

Initial serum lactate levels (mmol/L) were determined using a serum-based immunoassay (Unicel Synchron, Beckman Coulter Inc, Brea, CA). The study site used venous lactate (over arterial lactate) to improve compliance with its established screening protocol. Only initial laboratory studies performed in the ED were used for analysis.

Data Collection

Trained research associates abstracted the medical records of all patients screened for severe sepsis during the study period. Researchers used standardized data abstraction sheets, were routinely audited, and were blinded to the study hypothesis in keeping with accepted chart-review standards.[21] A second blinded reviewer collected all variables on 10% of enrolled subjects to perform inter-rater reliability analysis, which resulted in a Cohen's kappa coefficient of 0.90 or greater for all variables. Initial lactate level and 28-day mortality information was collected on each subject.

Subjects who were inpatients at 28 days and those discharged prior to 28 days from admission who were not reported as deceased in the Social Security Death Index (SSDI) for that time frame were considered "alive" for this analysis. The SSDI is a database of death records created from the United Stated Social Security Administration's Death Master File; it has been validated as an acceptable means of collecting mortality data for ED research.[22]

Data Analysis

For ease of interpretation, we categorized the variables of interest (SI, SIRS criteria, modified SIRS criteria without white blood cell count, and hyperlactatemia) into binary categorical variables. Hyperlactatemia was the primary outcome of interest as a marker for severe sepsis.[17-19] We analyzed 4 distinct predictors of hyperlactatemia.

The variables of interest were categorized into binary categorical variables as follows: SI[1.0] (shock index greater than or equal to 1.0); SI[0.7] (shock index greater than or equal to 0.7); SIRS criteria (2 or more SIRS criteria met); modified SIRS criteria without white blood cell count (2 or more SIRS criteria met with no white blood cell information included); and hyperlactatemia (lactate levels greater than or equal to 4.0).

To compare predictors of hyperlactatemia, we stratified frequency tables by variable. We calculated sensitivity, specificity, and positive and negative predictive values for each of the four measures. To compare sensitivities across predictors we used tests of equivalence. All calculations were performed in R: A Language and Environment for Statistical Computing, version 2.14.0 (R Foundation for Statistical Computing, Vienna, Austria, 2011).

We calculated distinct frequency tables for hyperlactatemia and 28-day mortality, stratified by each of the 4 methods of measurement.

Table 1. Demographics and predictors of the full cohort startified by hyperlacatemia*.

	Lactate < 4.0 mmol/L	Lactate ≥ 4.0 mmol/L
	2234 (86%)	2234 (86%)
Admitted to the hospital [n(%)]	1996 (89.4%)	279 (96.2%)
28-day mortality	267 (12.0%)	94 (32.4%)
Demographics		
Age (years)	72.9 ± 17.0	74.5 ± 15.4
Male gender [n (%)]	1013 (45%)	145 (50%)
Race [n (%)]		
Caucasian	1189 (53%)	151 (52%)
Asian	440 (20%)	68 (23%)
African-American	156 (7%)	17 (6%)
Hispanic	267 (12%)	33 (11%)
Other	182 (8%)	21 (7%)
Vital signs		
Temperature (°C)	37.7 ± 1.2	37.7 ± 1.3
Heart rate (beats/min)	97.1 ± 26.5	109.4 ± 25.7
Respiratory rate (breaths/min)	21 ± 6	23 ± 6
Mean arterial pressure (mmHg)	87 ± 19.9	77.3 ± 21.7
Shock index**	0.8 ± 0.3	1.1 ± 0.5
Laboratory data		
White blood cell count (cells/mm^3)	12.3 ± 8.9	16.1 ± 10.4
Bands (Cells/mm^3)	2.8 ± 6.5	10.3 ± 13.0
Platelets (1,000 cells/mm^3)	257 ± 125	258 ± 138
SIRS criteria***	0.6 ± 0.5	0.8 ± 0.4

SIRS, systemic inflammatory response syndrome
*Continuous data expressed as the mean and standard deviation; categorical data expressed as n (percentage)
**Defined as heart rate / systolic blood pressure
***Defined as 1 point for each: heart rate >90 beats/min; respiratory rate >20 breaths/min; temperature ≥ 38°C or < 36°C; White blood cell ≥ 12,000, < 4,000 or bands ≥ 10%

Table 2. Frequency tables for each measurement method and outcome.

		Hyperlactatemia (≥ 4.0 mmol/L)	28-Day Mortality
Shock index ≥ 1.0	Yes (n=572)	138 (24.1%)	133 (23.3%)
	No (n=1952)	152 (7.8%)	228 (11.7%)
Shock index ≥ 0.7	Yes (n=1536)	242 (15.8%)	256 (16.7%)
	No (n=988)	48 (4.9%)	105 (10.7%)
SIRS	Yes (n=1291)	226 (17.5%)	231 (17.9%)
	No (n=1233)	64 (5.2%)	130 (10.5%)
SIRS without white blood cell	Yes (n=1204)	182 (15.1%)	170 (14.1%)
	No (n=1320)	108 (8.9%)	170 (14.1%)

SIRS, systemic inflammatory response syndrome
All data are presented as n(%) of the total sample.

Table 3. Performance of predictors for hyperlactatemia.

	SI ≥ 1.0	SIRS	SI ≥ 0.7	SIRS without WBC
Positive predictive value	0.24	0.18	0.16	0.15
Negative predictive value	0.92	0.95	0.95	0.92
Sensitivity	0.48	0.78	0.83	0.63
Specificity	0.81	0.52	0.42	0.54

SI, shock index; *WBC,* white blood cell; *SIRS,* systemic inflammatory response syndrome

Table 4. Performance of predictors for 28-day mortality.

	SI ≥ 1.0	SIRS	SI ≥ 0.7	SIRS without WBC
Positive predictive value	0.23	0.18	0.17	0.14
Negative predictive value	0.88	0.89	0.89	0.86
Sensitivity	0.37	0.64	0.71	0.47
Specificity	0.8	0.51	0.41	0.52

SI, shock index; *WBC,* white blood cell; *SIRS,* systemic inflammatory response syndrome

RESULTS

There were 2,824 unique adult patients screened for severe sepsis and admitted for a suspected or confirmed infection during the study period. Of these, 2,524 patients (89.4%) had complete records ,including triage vital signs and initial CBC and lactate levels measured in the ED. Demographic characteristics were similar in the low lactate (< 4.0 mmol/L) and high lactate (≥ 4.0 mmol/L) groups (Table 1).

Shock index performed well as a predictor of hyperlactatemia and 28-day mortality (Figures 2 and 3). Subjects with a shock index of 0.7 or greater (15.8%) were 3 times more likely to have hyperlactatemia than those with a shock index of less than 0.7 (4.9%) (Table 2). Similarly, subjects with a shock index of 1.0 or greater (24.1%) were 3 times more likely to present with hyperlactatemia than those with a shock index of less than 1.0 (7.8%). Hyperlactemia and 28-day mortality frequencies were similar across groups, consistent with previous studies.[17]

Negative predictive values (NPVs) of shock index for hyperlactatemia performed well (Table 3). The NPV for a shock index of ≥ 0.7 was 95%, which was the same for the full SIRS criteria (including WBC). Positive predictive values (PPVs) were consonantly low across predictors (SI[1.0], SI[0.7], SIRS, and modified SIRS).

Negative predictive values of shock index for 28-day mortality performed similarly well (Table 4). The NPV for a shock index of ≥ 0.7 was 89%, also the same NPV for the full SIRS criteria (including WBC).

We compared sensitivity probabilities between the 2 highest-performing measurements: SIRS criteria and SI[0.7]. A test of equality showed no evidence that the 2 probabilities were significantly different ($P = 0.11$). The 95% confidence interval for the difference in performance between the SIRS criteria and SI[0.7] included the null value of 1.0 (-0.4% to 10.4%). That is, there was no statistically significant difference between the sensitivity of SIRS and the sensitivity of SI[0.7] for the primary outcome.

DISCUSSION

To our knowledge this is the first study to explore the relationship between shock index, severe sepsis, and clinical outcome. With the advent of early identification and treatment strategies for sepsis in the context of ever-shrinking resources, fast, reliable screening tools are needed. Haas[23] described the ideal triage tool as simple to use, accurate, rapid, reproducible, and discriminative. In the high-acuity and high-uncertainty setting of the ED, the goal is to avoid potentially dangerous under-triage while appropriately assigning higher priority to sicker patients.[24]

SI emphasizes current physiologic dynamics, rather than static criteria. To illustrate the use of traditional methods of triage and interpretation of vital signs, consider a common presentation: a small-framed, otherwise well elderly woman with a cough and fever arrives to the ED with a heart rate of 88 beats/min and a systolic blood pressure of 110 mmHg. She may not fulfill SIRS criteria on presentation, let alone be "flagged" for sepsis. However, from a clinician's inherently Bayesian perspective, her chief complaint of cough and fever informs him of a high pre-test likelihood of infectious disease; her increased risk for deterioration is instantaneously and objectively recognized. What would otherwise be deemed a fairly benign heart rate and systolic blood pressure now can be viewed through the lens of the shock index – in her case, we refocus our clinical gaze to see a grossly abnormal SI of 0.8 (normal: 0.5 to 0.7). She is identified as being at-risk for severe sepsis on initial presentation, before any laboratory testing is performed.

Since many factors affect abnormal vital signs, sensitivities and positive predictive values will vary. The true reliability of our findings lies in the negative predictive values of the shock index. As screening for sepsis popularizes in our hospitals, many institutions have begun to draw and send laboratory specimens from triage in an attempt to "save time" in disposition and through-put.[25] Screening many for a disease with varying prevalence may introduce many false positives; these "abnormal" tests are followed by a costly and lengthy remediation process. This study shows that patients with a normal SI (less than 0.7) are 95% likely not to present with an established marker for severe sepsis – a high lactate level.

A normal shock index may serve as an adjunct to inform the clinician of which patients to prioritize for care. Since an elevated SI ($SI \geq 0.7$) performed identically to the full SIRS criteria (including WBC), we can report that this no-cost bedside triage tool (SI) predicted absence of a reliable marker of severe sepsis (lactate) at least as well as an established rubric that uses laboratory information as part of its criteria (SIRS). This would suggest that low-risk patients with a normal SI may forgo (or not urgently need) routine triage laboratory screening for sepsis, especially from triage and before full evaluation. Additionally, using SI for triage decisions regarding severe sepsis screening can be made without waiting for results of the WBC. This has corresponding implications for efficiency and cost-effectiveness in ED protocols.

LIMITATIONS

This exploratory study has several important limitations. Providers in the ED identified patients during their initial evaluation based on a suspected infection, and all data were collected via retrospective computerized chart review. To mitigate potential misclassification bias, previously established recommendations were followed for chart abstraction. The main factors studied (vital signs, laboratory data, hospital admission and mortality), however, are less likely to be subject to misclassification.[17] It is conceivable that the ED lactate results affected some downstream diagnostic and therapeutic care decisions (such as admission); however, the predictors studied and primary outcome were all based on initial presentation.

Due to the study's preliminary nature, concurrent medication information was not collected or available to the data extractors, and any potential influence on vital signs is not controlled. Since many of these medications would tend to "normalize" vital signs (e.g. relative bradycardia from beta- or calcium-channel blockade in a nevertheless sick patient), this omission would tend to yield conservative estimates. Furthermore, as this information is frequently not known upon arrival of acutely ill patients, this particular limitation may reflect more closely real-world conditions that affect decision-making and initiating EGDT.

The cohort was elderly, with a mean age of 73 years, reflecting the study setting with many nursing home affiliations. It should be noted, however, that the majority of patients hospitalized for sepsis (approximately two-thirds) in the U.S. are aged 65 and older;[1] in this light, our single site roughly reflects the at-risk population for sepsis. A larger, multi-site, prospective study is necessary to control for multiple confounders and to expand the cohort to younger patients.

CONCLUSION

In summary, the shock index is an effective, no-cost modality in the initial assessment of patients at risk for sepsis. Patients presenting with a presumed infection and a normal SI were found to be at very low risk (high NPV) for occult severe sepsis on presentation (as defined by a surrogate marker for morbidity, hyperlactatemia). SI may be used as an additional bedside assessment tool – a "red flag" for severe disease; this is particularly useful when traditional vital signs are seemingly relatively benign. Multisite prospective work is needed to clarify its role in resource utilization, risk stratification of patients with sepsis, and in tracking resuscitation progress.

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Posterior Communicating Artery Aneurysm in 20-year-old Female with Noonan's Syndrome

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A 20-year-old-female presented to the emergency department (ED) with a chief complaint of a persistent dull headache associated with a 7 mm dilated, non-reactive right pupil, and occasional blurry vision for 4 days. The patient had a past medical history significant for Noonan's syndrome (NS). In the ED the patient's physical examination demonstrated normal vital signs, chronic right divergent strabismus (Figure 1), a dilated right 7 mm pupil (Figure 2), and intact extraocular muscles without visual field cuts or other acute neurological deficits. Computed tomography angiography of the brain demonstrated the diagnosis (Figure 3).

Oculomotor nerve palsy (ONP) in patients with posterior communicating artery aneurysms (PCoA) is known clinically.[1] Direct compression of the oculomotor nerve by the aneurysm itself is considered to be the mechanism causing ONP in patients without subarachnoid hemorrhage.[2] NS is an autosomal-dominant condition of multiple congenital abnormalities, regarded as a type of dwarfism with a reported incidence of between 1 in 1,000 and 1 in 2,500 live births.[3] These abnormalities include craniofacial anomalies, such as ocular hypertelorism, low-set ears, low posterior hairline and webbed neck; shield-shaped chest; cubitus valgus; cryptorchidism; and congenital heart defects.[4] Interestingly, well documented cases of patients with NS and valvular and non-cerebral vascular lesions may show a preponderance for underlying defects in vascular architecture, i.e. Ehlers-Danlos syndrome.[3] Only 4 cases of intracranial aneurysms have been previously reported in individuals with NS.[3] Finally, careful attention must be paid to all patients, not just those with NS, who present with a new onset dilated pupil; and should raise one's suspicion of an underlying PCoA (Figure 4).

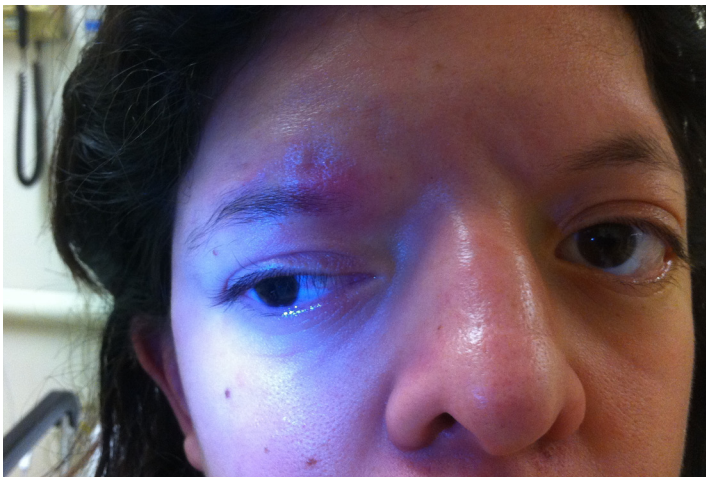

Figure 1. The patient is shown demonstrating right ocular divergent strabismus hypertelorism, low set ears, and craniofacial dysmorphism. The patient's low posterior hairline and webbed neck are not visualized.

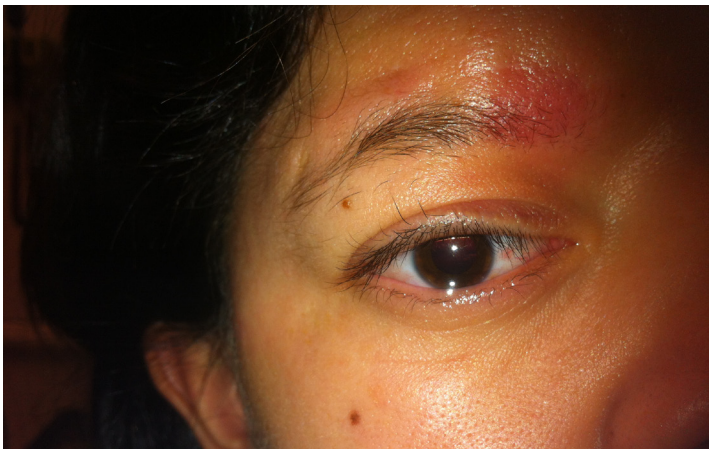

Figure 2. The patient's 7 mm dilated non-reactive right pupil.

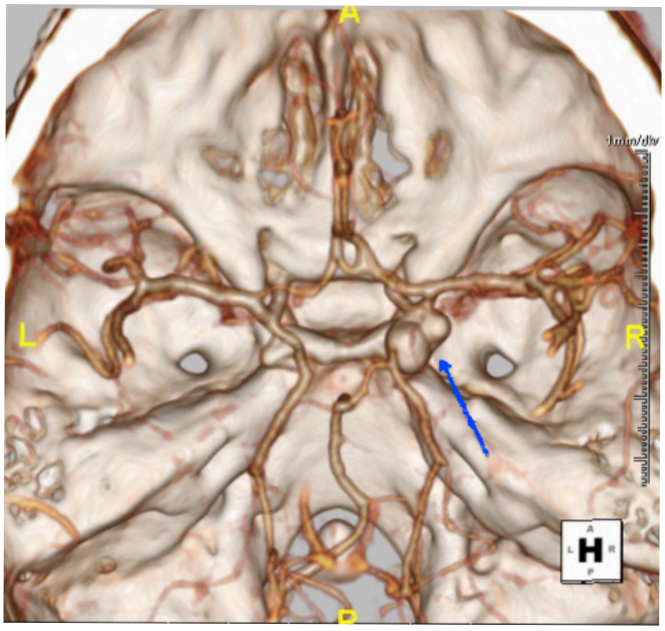

Figure 3. Computed tomography angiography of the brain illustrating homogeneous enhancement of a 1.1 x 0.8 x 0.8 cm bilobed, saccular aneurysm (blue arrow) in the region of the right posterior communicating artery.

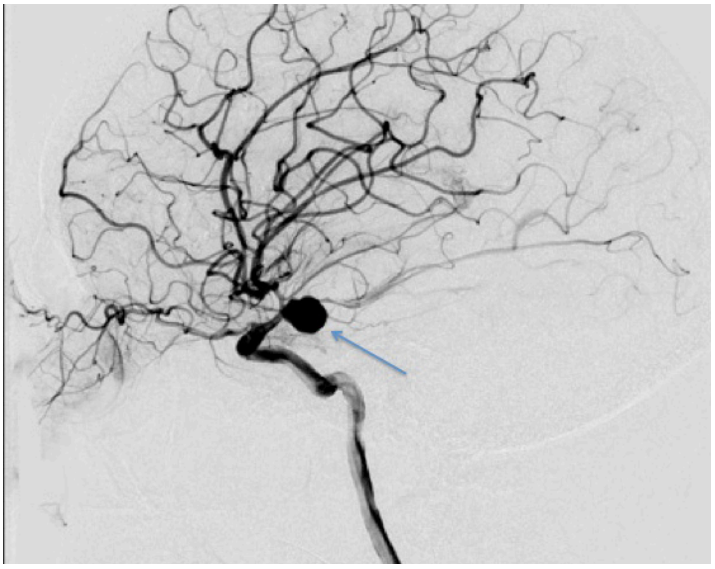

Figure 4. Cerebral angiography of the patient's vasculature demonstrating the right posterior communicating artery aneurysm in lateral view (blue arrow).

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A 37-year-old Woman with Altered Mental Status and Urinary Frequency

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We present a case report of a patient who initially presented with altered mental status and significant urinary frequency. Over the course of her emergency department stay, she then developed tachycardia out of proportion to a new fever along with a respiratory alkalosis. Although each objective finding has a broad differential diagnosis, thyroid storm was the only unifying diagnosis when all findings were present. [West J Emerg Med 2013;14(2):177-179.]

PATIENT PRESENTATION

A 37-year-old woman presented to the emergency department (ED), brought in by her boyfriend, with the chief complaint of altered mental status. The patient was alert but agitated and refusing to answer questions regarding orientation. She would only state, "I don't feel right," "I want to get out of here," and "I need to go to the bathroom to urinate." Because of her inability to provide a history, the initial history was provided by her boyfriend.

The patient had been under stress lately due to the start of a new job that same day after 2 years of unemployment. The patient was last seen normal that morning, just prior to leaving for her job. Her boyfriend received a phone call from the patient in the afternoon, during which she seemed frightened, anxious, and unaware of her surroundings. The boyfriend subsequently brought the patient to the ED, because he was concerned about the patient's behavior and was worried that she might have "taken more than 1 pill of lorazepam."

She had no past medical, surgical, or psychiatric history, no known allergies, and no family history of illnesses. An outside physician had prescribed the patient lorazepam for "anxiety" 1 month prior, but she did not fill the prescription. There was also no history of recreational drug use.

Her initial physical examination included the following vital signs: blood pressure 127/82 mmHg, heart rate 117 beats/min, respiratory rate 22 breaths/min, temperature 36.8°C, and oxygen saturation 100% on room air. She appeared frightened, did not make eye contact, and refused to answer questions. She continued to state, "I don't feel right. I want to go home." She intermittently attempted to climb over the railing of the gurney during the examination, alternating with being in a fetal position. Her pupils were both 5 mm in diameter, round, and reactive. Her mucous membranes were moist, and her neck was supple and without masses**.** Her lungs were clear to auscultation, and her heart was tachycardic without any murmurs, rubs, or gallops. Her abdomen was soft and non-distended. Her neurologic exam was limited due to her lack of cooperation. She could state her name but refused to answer any further questions about orientation. Her cranial nerves were grossly intact, she was moving all 4 extremities, and her gait was normal. Her extremities appeared normal with no edema. Her skin was warm and dry without evidence of trauma or a rash.

The results of her initial laboratory testing are listed in Table 1. The notable findings were a decreased CO_2, accompanied by a primary respiratory alkalosis found on venous blood gas test. The electrocardiogram showed sinus tachycardia at a heart rate of 112 beats/min with normal intervals (including a QTc of 411) and no ST or T changes.

During the initial work-up period, the patient was given 2 mg of lorazepam orally and 2 liters of intravenous normal saline. Even prior to receiving fluids, the patient was making frequent trips to the bathroom, where she produced variable amounts of urine. She had to urinate 6 times during an 8-hour ED stay. Her heart rate continued to rise to as fast as 140 beats/min. Her temperature eventually spiked to 38.2°C.

Because of the patient's escalating heart rate, fever, and progressively worsening confusion, an infectious workup was pursued, which included a chest radiograph (CXR), urine analysis, and non-contrast head computed tomography (CT).

Table 1. Initial laboratory test results.

Test	Result	Normal values
Complete blood count		
White blood cells (x10^9/L)	11.7	4-11
Hemoglobin (g/dL)	14.6	12-16
Hematocrit (%)	42	38-47
Platelets (x10^9/L)	307	150-400
Chemistry		
Sodium (mmol/L)	133	135-145
Potassium (mmol/L)	3.3	3.5-5.1
Chloride (mmol/L)	103	98-107
CO_2 (mmol/L)	15	23-29
Blood urea nitrogen (mg/dL)	12	6-22
Creatinine (mg/dL)	0.5	0.5-1.1
Glucose (mg/dL)	124	70-110
Calcium (mg/dL)	9.4	8.8-10.3
Aspartate aminotransferase U/L)	19	< 35
Alanine aminotransferase (U/L)	19	< 35
Alkaline phosphatase (U/L)	51	25-100
Albumin (g/dL)	4.5	3.2-5
Total bilirubin (mg/dL)	3.9	0.1-1.2
Lipase (U/L)	23	7-60
Toxicology		
Acetaminophen level (mcg/mL)	UND	UND
Ethanol level (mg/dL)	UND	UND
Salicylate level (mg/dL)	UND	UND
Venous blood gas (VBG)		
pH	7.63	7.32-7.42
pCO_2 (mmHg)	14	38-52
pO_2 (mmHg)	43	24-48
HCO_3(mmol/L)	14.3	19-25
Lactate (mmol/L)	0.8	< 2
Human immunodeficiency virus	Negative	Negative

UND, undetectable

Additionally, a lumbar puncture (LP) was performed. The CXR, non-contrast head CT, and LP were all normal. A urine toxicology screen was positive only for benzodiazepines, the urinalysis was normal, and her urine pregnancy was negative.

Thyroid function tests were sent, which revealed abnormal results with a thyroid stimulating hormone level of 0.01 U/mL (normal 0.3-5 U/mL), free T4 of 4.08 ng/dL (normal 0.8-2.8 ng/dL), and T3 of 9 ng/mL (normal 75-200 ng/dL). Combining these results, which demonstrated a hyperthyroid state, with the patient's constellation of signs and symptoms culminated in the diagnosis of a severe thyroid storm.

DISCUSSION

In summary, a 37-year-old female presented with altered mental status, sinus tachycardia, fever, primary respiratory alkalosis, and urinary frequency. We considered many conditions that fit with these features. The top 5 diagnoses on our differential diagnosis included drug or medication not detected on urine toxicology screen, hyperthyroidism, psychiatric illness such as anxiety, pulmonary embolism, and sepsis (Table 2). Each objective finding has a broad differential diagnosis but hyperthyroidism was the only unifying diagnosis when all 5 findings were present. We will further discuss one of the more interesting features of our patient's presentation of hyperthyroidism: urinary frequency.

A notable aspect of the patient's case was how frequently she had to urinate. Within the course of the patient's 8-hour ED stay, she urinated at least 6 times. Her boyfriend had not noticed any urinary issues prior to this ED visit. Most commonly, frequent and urgent urination is caused by a urinary tract infection. Other causes include diabetes mellitus from glucosuria and pregnancy. These were ruled out based on a normal urinalysis, showing no glucosuria or cells, and a negative urine pregnancy test. Mild urinary frequency could also be linked to excessive alcohol or caffeine intake but this history was not obtained.

Table 2: Most likely etiologies and their correlation with the patient's presentation.

Etiology	Altered mental status	Sinus tachycardia	Primary respiratory alkalosis	Fever	Urinary frequency
Drug or medication, not detected on urine toxicology screen	x	x	x	x	
Hyperthyroid	x	x	x	x	x
Psychiatric illness, such as anxiety	x	x	x		
Pulmonary embolism		x	x	x	
Sepsis	x	x	x	x	

Because we were unable to quantify the amount of urine (the patient did not cooperate with urine collection), polyuria was considered. Polyuria is defined as producing at least 3 liters of urine over 24 hours. It was unlikely that the patient had primary polydipsia, which can be caused by either a psychiatric disorder or a hypothalamic lesion, given that there was no reported history or observed increased intake. Central and nephrogenic diabetes insipidus that can lead to symptomatic polyuria were unlikely given the absence of hypernatremia, no history of lithium ingestion, no evidence of hypercalcemia (common causes of nephrogenic diabetes insipidus in adults), and a normal head CT.

The literature on lower urinary tract symptoms in patients with hyperthyroidism is scant but a few studies show that patients with hyperthyroidism have significantly increased micturition frequency and nocturia.[1] Some patients with Graves' disease have significant lower urinary tract symptoms with urinary frequency being the most common symptom.[2] The mechanism of urinary frequency in patients with hyperthyroidism is still somewhat unclear. It could be due to increased thirst and water intake, but it is also thought that hyperthyroidism is associated with a hyperdynamic circulation, including increased cardiac output and blood pressure, as well as decreased peripheral vascular resistance. These changes can lead to increased renal perfusion and increased urine output.[3]

CONCLUSION

Hyperthyroidism should be considered when evaluating a patient with urinary frequency, especially with a normal urinalysis and negative pregnancy test.

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Mondor's Disease of the Penis

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A 36-year-old male presented to the emergency department (ED) complaining of "lumps in my penis." The patient described 2 firm, raised areas on the dorsum of his penis that had been present 1 week. He had no pain at rest or with palpation but mild discomfort with erection. He denied trauma, dysuria, hematuria, or discharge. He had no prior medical history and took no medications.

On physical exam, the patient had 2 palpable, firm cords wrapping around the dorsum of his penis just proximal to the glans (Figure). The affected area was non-tender and without swelling, erythema, or warmth. The skin was intact without lesions or signs of trauma. The rest of his exam was normal.

An ultrasound showed 2 short areas of non-compressibility consistent with superficial venous thrombosis. The urology consult recommended conservative treatment with non-steroidal anti-inflammatory drugs and warm compresses. When the patient was called 2 days after ED presentation, he reported that his symptoms had almost completely resolved.

Penile superficial venous thrombosis is an uncommon and little known benign genital condition; the largest case series in the literature describes 25 patients.[1] The incidence is unknown and the condition may occur more frequently than reported given its benign symptomatology, frequent spontaneous resolution, and the possibly embarrassing nature of the complaint.

Penile Mondor's disease affects sexually active men of any age. No specific cause has been determined, but detailed history frequently reveals prolonged or vigorous sexual intercourse causing stretching and torsion of penile veins. The disease has also been associated with other risk factors for localized and generalized clot formation.[1, 2]

Conservative treatment is effective in the vast majority of patients.[1] For clots persisting longer than 6 weeks or persistent symptoms despite medical management, thrombectomy or superficial penile vein resection may be recommended.[1, 2]

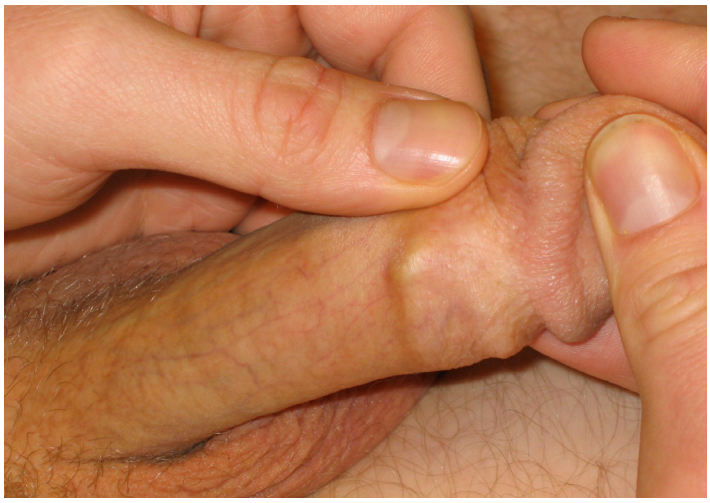

Figure. Visible cords on the dorsolateral penis.

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Death Notification in the Emergency Department: Survivors and Physicians

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When patients die in the emergency department (ED), emergency physicians (EP) must disclose the bad news to family members. The death is often unexpected and the act of notification can be difficult. Many EPs have not been trained in the skill of communicating death to family members. This article reviews the available literature regarding ED death notification training and proposes future directions for educational interventions to improve physician communication in ED death disclosure. [West J Emerg Med 2013;14(2):181-185.]

The death of a loved one is a devastating event that is typically followed by a period of bereavement. Bereavement itself can be complicated by depression, anxiety, suicidal thoughts or behaviors, substance abuse, post-traumatic stress disorder, and an increased risk of heart disease, cancer and high blood pressure. Circumstances that complicate the bereavement process include unexpected or violent death, traumatic death, suicide, lack of a support system, and being unprepared for the death.[1] Deaths occurring in the emergency department (ED) often involve the aforementioned circumstances and therefore would be expected to increase the risk for a complicated grief process.[2-5] This presents a unique challenge for the emergency physician (EP) during death notification in the impersonal, busy space of an ED where there is not a traditionally well-established physician-patient relationship. The amount of time EPs can spend with a bereaved family is limited due to the demands of other patients.[6-8] These factors make death telling in the ED setting particularly difficult for the survivors and increase the risk for a pathological grief process.

While most physicians receive some basic instruction during medical school regarding endof-life issues, most do not receive specific instruction on death notification skills.[9,10] Additionally, many physicians trained in emergency medicine (EM) report that they received very little training on coping with patient death.[11] Since many EM residents lack the training to deal with the intrinsically difficult and stressful task of notifying the family about the death of a loved one, they are ill prepared to deliver the news in a manner that will best facilitate the survivors' grieving process. This is problematic, especially since the notification process, including the words and attitudes of the medical staff, may profoundly affect the survivors' grief response, both positively and negatively. The survivors will recall the events of that day, including the words and attitudes of the staff, for years to come.[12-16]

The death of a patient can also have an emotional impact on the EP. During resuscitation, EPs may be reminded of a death in their own family or the declining health of a chronically ill family member.[17] A 2009 study by Brown et al[18] showed that physicians demonstrate high stress responses when breaking bad news in simulated patient encounters. Increases in heart rate and heart-rate variability were seen when study subjects were delivering bad news, as compared with a control scenario where the subject delivered good news. These changes were most pronounced in physicians who were fatigued and in those who were inexperienced in this task.[18] These biologic stress responses, combined with the emotional reactions that EPs experience with death telling, may make the EP more susceptible to job dissatisfaction and burnout.

A recent study by Strote et al[10] described the effects of

patient death on EP well being. Almost 150 academic EPs were surveyed. Common emotional responses to patient death were sadness (60%) and disappointment (38%). Most EPs had experienced physical responses to patient death with the most common being insomnia (37%) and fatigue (14%).

In a similar study of EM residents, significant stress during death notification was reported. Swisher et al[19] asked residents to rank their stress level during different components of the death notification process. The most stressful issues reported by the physicians were dealing with the grief responses of the family members, including anger and hysteria. It was also stressful for the physician when the cause of death was unknown, a frequent occurrence in ED deaths.[19] These dilemmas highlight the need for improved death notification training for EPs during their training. It is theorized that if physicians were better prepared to deal with this stressful situation and better equipped to cope with the emotions afterwards, it could lead to improved physician well being.[5,10,19] In addition to improved education, another method that physicians have traditionally used to cope with stressful clinical situations such as patient death is debriefing. Team debriefing can help reduce stress among the care providers and provide an emotional outlet.[20,21]

From the surviving family members' perspective, the need for more skillful death notification is also apparent. Parrish et al[16] surveyed 66 family members about their experience after a death in the ED. When asked to rate the ED staff based on their satisfaction withthe care and emotional support they received in the ED at the time of death, one third rated their experience as average or less than average. When asked to describe their impressions of the ED staff, 17% described the staff as unsympathetic, 22% described them as cold, and 30% stated that they were non-reassuring.[16]

Death notification training can occur in many different ways. Modalities that have been described in the literature include didactic lectures, small group discussion, small group role-playing, one-on-one standardized patient encounters ("simulated survivors") and teachable moments in clinical settings.[22] The use of high-fidelity simulators has been recently described as well.[23, 24] High-fidelity simulators are computerized, interactive, life-sized manikins that can be programmed to provide realistic patient responses and outcomes. These are typically used in clinical simulation activities, but these clinical scenarios can be combined with standardized patient death notification exercises.[23] Previous work has shown that medical students prefer to learn communication skills through real-time experiences, such as role-playing, standardized patient encounters or use of simulation rather than in a didactic format.[25]

To date, 6 studies have described death notification education programs specifically designed for EM residents. Schmidt et al[26] was one of the earliest descriptive studies of death notification education for EM residents. In that study, role-playing was the technique used in 3 different ED–specific scenarios in conjunction with a post-experience debriefing.[26] This technique has also been described in a medical student setting.[27]

Pediatric death in the ED can present unique circumstances. In 1998 Hart et al[28] described an educational module for EM residents that involved 4 case studies of simulated pediatric ED deaths that were presented and discussed with the residents. A panel discussion followed with involvement by real-life parents who had experienced loss of a child in an ED setting.[28]

Benenson et al[29] also described an educational program for EM residents that consisted of a didactic session, simulated scenarios and finally a real time, direct evaluation of performance by attending physicians observing residents in actual death- telling encounters. Overall performance evaluations were 55% excellent, 40% satisfactory and 5% unsatisfactory. Residents who were in their senior years of training and female residents were more likely to be rated excellent.[29]

In 2002 Quest et al[30] described and evaluated a one-day educational experience given to 16 EM residents. Methods used included a large-group didactic session, a small-group

Table. The GRIEV_ING Mnemonic.

G	Gather; gather the family; ensure that all members are present.
R	Resources; call for support resources available to assist the family with their grief, i.e., chaplain services, ministers, family and friends.
I	Identify; identify yourself, identify the deceased or injured patient by name, and identify the state of knowledge of the family relative to the events of the day.
E	Educate; briefly educate the family as to the events that have occurred in the emergency department, educate them about the current state of their loved one
V	Verify; verify that their family member has died. Be clear! Use the words "dead" or "died."
_	Space; give the family personal space and time for an emotional moment; allow the family time to absorb the information.
I	Inquire; ask if there are any questions, and answer them all.
N	Nuts and bolts; inquire about organ donation, funeral services, and personal belongings. Offer the family opportunity to view the body.
G	Give; give them your card and access information. Offer to answer any questions that may arise later. Always return their call.

didactic session and 2 standardized patient examinations. Residents reported improvement in comfort levels and high levels of satisfaction regarding the helpfulness of the training, although overall inter-rater agreement was poor.[30] These authors also describe this educational intervention used in a medical student setting.[31]

In a more recent study by Hobgood et al[32], the authors implemented a 2-hour death notification workshop for 20 EM residents. Their teaching module was based on the mnemonic "GRIEV_ING" (table). The authors employed the following learning modalities: a didactic session, small-group discussion, paired role-playing and a standardized patient encounter. They measured 3 variables: self-confidence, competence, and relationship-communication skills. The results indicated a statistically significant improvement in the confidence and competence of the residents' death notification skills. No significant difference was seen in their communication skills, which were already rated highly before the intervention.[32] The GRIEV_ING educational intervention has also been studied in the setting of medical student education.[33]

High-fidelity simulators have recently been incorporated into some newer death-telling educational interventions. Park et al[24] recently described a 5-hour course for EM residents at their institution. The course consisted of didactic lectures, role-playing, and high-fidelity simulators, followed by standardized patient encounters. Residents rated the session as extremely useful and thought that patient care would improve after the experience. Interestingly, the residents rated the simulation session as most useful.[24] Another recent study describing teaching breaking bad news to third-year students on a general surgery rotation used a combination of high-fidelity simulators and standardized patients. The students were presented with a high-fidelity simulator case of a patient who dies from multiple gunshot wounds despite resuscitative attempts. The death-telling simulation subsequently occurs using a standardized patient. Students rated the experience highly and demonstrated marked improvement of self-assessed skills over baseline.[23]

In addition to physician education, death notification in the ED can be improved for survivors and physicians alike through protocols. Several studies have demonstrated increased survivor satisfaction after ED protocols were initiated. Adamowski et al surveyed survivors before and after initiating a multidisciplinary protocol for caring for the survivors.[12] Six phases of the death-notification process were included in the protocol: contacting the survivors, arrival of the survivors, notification of death, grief response, viewing the deceased, and the concluding process. Training was provided to all ED social workers, nurses, and physicians to ensure awareness and understanding of the protocol. A departmental resource pamphlet created for survivors was introduced. Pre- and post-implementation survivor satisfaction was assessed. The results demonstrated that post-protocol implementation, survivors spent less time in the ED, felt more adequate information was provided and felt that more supported by ED staff.

The study mentioned above demonstrated that a multidisciplinary team approach resulted in improved care of the survivors. This concept is familiar to palliative care physicians, but is not as familiar to EPs. The benefits of delivering bad news through a team, which may include spiritual support, social work, the patient's primary physician (not generally feasible in the ED setting) and extended family or friends, are well understood by those working in the palliative medicine field. These concepts should be brought into ED protocols.

Improving ED services provided to bereaved relatives, such as pre-printed information about what to do next, how to deal with the coroner's office, and contact information about bereavement support groups, can have a lasting effect for staff as well as survivors. Delivering this information is often best done by a social worker as part of the team. These services should be designed to provide emotional support to the survivors, as well as information about the grieving process and a mechanism for follow-up care. This may help reduce the incidence of complicated grief and/or post-traumatic stress disorder in surviving family members.[34,35]

The studies regarding physician education in death notification reviewed above have various methodologies, as well as their own internal strengths and weaknesses. Most of the studies use self-assessment by the learners themselves as the primary outcome. Very few studies to date of EP death notification educational techniques look at the impact of an educational intervention through other outcome measures, such as measuring survivor satisfaction or physician performance assessment by non-biased evaluators pre- and post- intervention. A future prospective study might include a pre-intervention objective assessment of the learners by an objective evaluator and a post-intervention assessment. Blinding of the observer to pre- or post-intervention would be necessary to eliminate bias. Some of these methods have been used previously, but all have introduced bias because the evaluator knew that the learners had been through an educational intervention and in some cases had been involved in the pre-intervention assessment.

In summary, there does appear to be a benefit to implementing educational programs designed to improve the death-notification skills of EPs as primarily measured by learner self-assessment. The process of educating and training ED physicians and staff in death-notification can benefit families of the deceased by providing a compassionate and supportive environment in which they begin to grieve as well, as physicians through increasing their confidence in performing this difficult and stressful task. The existing literature does not elucidate which of the currently described methods is most effective. Some of the currently described methods, such as those using high-fidelity simulators or

standardized patients, may not be feasible for many programs/ institutions due to high cost.

The family members and loved ones of the deceased essentially become victims in the immediate time after they are notified of the death. They should be thought of as patients and cared for in that way. Although the studies described above have not used that approach or terminology, it may help learners understand that the death-notification activity is equivalent to any other patient-centered training they receive. Death notification, just like any other medical procedure, can be improved by training. Likewise, when performed inappropriately, death notification increases the risk of complications, in the form of pathological grief processes. Developing and implementing improved training methods, as well as improving the methods of assessing the success and effectiveness of such interventions, would benefit survivors as well as physicians, making them more comfortable and confident to care for families in these unfortunate and trying times.

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Board-Certified Emergency Physicians Comprise a Minority of the Emergency Department Workforce in Iowa

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Introduction: The American College of Emergency Physicians (ACEP) endorses emergency medicine (EM) residency training as the only legitimate pathway to practicing EM, yet the economic reality of Iowa's rural population will continue to require the hiring of non-EM trained physicians. The objective of our study is to better understand the current staffing practices of Iowa emergency departments (EDs). Specifically, we seek to determine the Iowa community size required to support hiring an emergency physician (EP), identify the number of EDs staffed by advanced practice providers (APPs) in solo coverage in EDs, determine the changes in staffing over a 4-year period, and understand the market forces that contribute to staffing decisions.

Methods: Researchers surveyed all 119 hospitals throughout the state of Iowa regarding their ED hiring practices, both in 2008 and 2012. From these data, we determined the mean population that supports hiring EPs and performed a qualitative examination of the reasons given for hiring preferences.

Results: We found that a mean population of approximately 85,000 is needed to support EP-only staffing practices. In 2012, only 14 (11.8%) of Iowa's EDs were staffed exclusively with EPs. Seventy-two (60.5%) staff with a combination of EPs and FPs, 33 (27.7%) staff with FPs alone, and 72 (60.5%) have physician assistants or nurse practitioners working in solo coverage for at least part of the week. Comparing the data from 2008 and 2012, there is no statistical change in the hiring of EPs versus FPs over the 4 years (Chi-square 0.68, p=0.7118), although there is a significant increase in the number of APPs in solo practice (Chi-square 11.36, p= 0.0008). Administrators at hospitals cited several factors for preferring to hire EPs: quality of care provided by EPs, availability of EPs, high patient acuity, and high patient volume.

Conclusion: Many EDs in Iowa remain staffed by family medicine-trained physicians and are being increasingly staffed by APPs. Without the contribution of family physicians, large areas of the state would be unable to provide adequate emergency care. Board-certified emergency physicians remain concentrated in urban areas of the state, where patient volumes and acuity support their hiring. [West J Emerg Med 2013;14(2):186-190.]

BACKGROUND

The availability of emergency medical care is a worldwide necessity and the United States is no exception. As of 2008, there were 4,613 emergency departments (EDs) throughout the country, with over 36,000 physicians staffing these departments.[1] Only a fraction of these EDs are staffed with board-certified emergency physicians (BC-EPs).[2] Many hospitals hire family practice physicians (FPs) to help fill the staffing needs of their EDs. In fact, without the contribution of family physicians, large areas of the country would be unable

to provide adequate emergency care. It is estimated that almost one third of emergency care is provided by family physicians and that 65% of family practitioners practice some type of emergency care.[3] This is especially true in rural communities, where hospitals have smaller and less predictable patient volumes. Rural hospitals, where 42% of national EDs are located, are less likely to staff with an EP and more likely to staff their EDs with available family physicians.[4]

Likewise, nurse practitioners (NPs) and physician assistants (PAs) have been increasingly utilized in EDs. With the number of annual ED visits rapidly increasing, advanced practice providers (APP) have a larger role in the emergency medicine (EM) workforce. In one study, ED visits staffed by APPs increased from 4% of visits in 1993 to 12.9% of visits in 2005.[5] Many of these visits are never staffed with a physician. In a different study, only 54.9% of APP cases were also seen by staff physicians.[6] Furthermore, many EDs have begun to staff with APPs in solo coverage for at least part of the week, particularly in rural areas.

EDs in Iowa have seen similar staffing trends. Being a predominantly rural state, Iowa has traditionally staffed its EDs with family medicine-trained physicians and has seen an increase in APP ED coverage. However, hospitals have been hiring more EPs over the past decade. The number of EPs increased with the founding of the state's only emergency medicine residency program at The University of Iowa Hospitals and Clinics in 2003. Even with this recent increase, smaller communities continue to hire non-EPs to staff their EDs. In the most recent job bulletin distributed by the University of Iowa Carver College of Medicine, 32 communities were currently recruiting physicians for their EDs. Of these, only 6 specified that these opportunities were for EPs only.[7] Additionally, in a survey of hospital administrators throughout the country, the majority of urban administrators indicated that their hospital could attract and retain EPs, whereas the majority of rural administrators were certain their hospital could not retain such physicians.[8] Concordantly, a survey of recent EM graduates suggested that factors which cause an EP to practice in a rural community are difficult to change (lifestyle factors, family connection, and access to specialists).[9]

While Iowa lacks current data concerning the penetration of EPs, other states have published this information. A study performed by The University of Nebraska Medical Center reported that 50.6% of physicians working in EDs in Nebraska, North Dakota, and South Dakota were EPs. The rural nature of the ED affected the proportion of EPs. Specifically, it was reported that 65.2% of urban hospitals were staffed with EPs, while only 30.8% of hospitals serving populations of less than 10,000 were so staffed.[8] Similar statistics were reported in the states of New Mexico and West Virginia, where researchers found 35% and 12% of EDs staffed with EPs, respectively.[10, 11] The study with a design most similar to ours was performed in the state of Washington in 1992. This study examined the staffing practices of rural hospitals, categorizing each hospital as staffing their EDs with local family physicians only (27%), visiting BC-EPs only (27%), and a variety of ED staffing combinations (46%).[12]

Staffing decisions for EDs are not based exclusively on population. The costs of running a small rural ED are significant, especially with low patient loads.[12] These costs can lead to preferential hiring of FPs. However, studies have shown that in some EDs the switch to all EPs did not increase the cost of care, and further, that the number of tests ordered for each patient was actually reduced.[13] Malpractice is another issue that is very pertinent to ED staffing ,and one study of closed malpractice claims from a single insurer showed that the cost per physician per year of malpractice coverage was twice as high for non-EPs as compared to EPs.[14] Moreover, hospitals with low patient acuity rates may choose to hire FPs instead of EPs.[15]

This previous research was performed in states other than Iowa. Thus, the purpose of this study was to describe the demographics of EM providers in Iowa and to identify the market forces influencing the hiring of FPs, EPs, NPs, and PAs. Specifically, we sought to determine the population necessary to support the employment of an EP in Iowa, identify the percentage of EDs staffed by APPs in solo coverage in EDs, and understand the rationale for hiring each type of ED provider.

METHODS

A telephone survey (Table 1) was given to administrators from all 119 hospitals with EDs in Iowa. This was performed once in 2008 and then repeated in 2012. The list of hospitals was obtained from the state medical society. Key measures included the preference in hiring within the specialty of EM and the factors that influence the tendency to hire EPs, FPs, and NPs and PAs . We stratified responses by hospital hiring profile: EP only, combination of EPs and FPs, and FP only. Using a chi-square test, we compared physician hiring practices (EP only, FP only, or both EP and FP) between 2008 and 2012. Similarly, we used a Pearson chi-square to compare the number of EDs hiring APPs in solo coverage between the 2 surveys. We determined the population of the area of care from the population as determined by the 2010 U.S. Census, and we determined a mean population to support hiring EPs only and both FPs and EPs from the data. Additionally, we conducted a qualitative analysis for each practitioner type, with the researchers asking questions regarding the market forces that influence hiring decisions, including quality of care provided, malpractice insurance rates, efficiency, salary, level of patient acuity, patient load, competition with other EDs, ability of physicians to generate higher billing, and availability of qualified applicants.

RESULTS

We received responses from all 119 hospitals in the state

Table 1. Telephone survey given to Iowa hospital administrators.

1. What are the qualifications of your emergency department physicians?
    a. Do you hire emergency physicians only?
    b. Do you hire family physicians only?
    c. Do you hire a combination of family physicians and emergency physicians?
2. If emergency physicians are hired, which of the following best explains the reason for hiring emergency physicians?
    a. Quality of care provided by emergency physicians.
    b. Higher efficiency of emergency physicians.
    c. Availability of emergency physician applicants.
    d. To compete with surrounding communities' emergency departments.
    e. High patient load supports hiring of emergency physicians.
    f. High patient acuity supports hiring of emergency physicians.
    g. Emergency physicians generate higher billing.
    h. Malpractice insurance rates are lower for emergency physicians.
    i. Other
3. If family physicians are hired, which of the following best explains the reason for hiring family physicians?
    a. Quality of care provided by family physicians.
    b. Lower salaries for family physicians.
    c. Low availability of emergency physicians.
    d. To compete with surrounding communities' emergency departments
    e. Low patient load are best covered by family physicians.
    f. Low patient acuity causes decreased need for emergency physicians.
    g. Family physicians generate higher billing.
    h. Malpractice insurance rates are lower for family physicians.
    i. Other
4. Do you utilize nurse practitioners or physician assistants in solo coverage in your emergency department?
5. If nurse practitioners or physician assistants are practicing in solo coverage, which of the following best explains the reason for hiring nurse practitioners/physician assistants?
    a. Quality of care provided by advanced practice providers
    b. Lower salaries for nurse practitioners/physician assistants?
    c. Low availability of doctors.
    d.To compete with surrounding communities' emergency departments
    e. Low patient load are best covered by nurse practitioners/physician assistants.
    f. Low patient acuity causes decreased need for doctors.
    g. Nurse practitioners/physician assistants generate higher billing.
    h. Malpractice insurance rates are lower for nurse practitioners/physician assistants.
    i. Other

(100% response rate) in both 2008 and 2012. In 2012, only 14 (11.8%) of Iowa's EDs exclusively staffed with EPs. Seventy-two (60.5%) hospitals staffed with a combination of EP and FP, while 33 (27.7%) of Iowa hospitals staffed with FP alone. We also found that 72 (60.5%) of Iowa's EDs staffed with physician assistants or nurse practitioners as solo coverage during at least part of the work week. In 2008, 15 (12.6%) EDs were staffed with EPs only, 27 (22.7%) with FPs only, 75 (63.0%) with EPs and FPs, and 2 (1.7%) with internal medicine (IM) physicians only. Forty-six (38.7%) of the EDs were staffed with NPs or PAs in solo coverage in 2008 (Table 2). Using a Chi-Square test, we compared physician staffing practices (FP-only, EP-only, and both FP and EP) between 2008 and 2012. There is no significant difference between the two surveys, with a chi-square of 0.68 ($P = 0.71$). However, there is a significant increase in the number of PAs and NPs practicing in solo coverage in Iowa EDs (Chi-square 11.36, $P = 0.0008$).

Using the data from the 2012 survey, the mean population of communities supporting exclusive EP coverage was 84,787.

Table 2. Number of Iowa emergency departments with each provider type.

Year	EP Only	FP Only	EP & FP	Internal Medicine Only	NP/PA Solo Coverage
2008	15	27	75	2	46
2012	14	33	72	0	72

EP, emergency physician; *FP,* family physician; *NP,* nurse practitioner; *PA,* physician assistant

The minimum population of a town supporting an EP-only ED was 2,968. The mean population that supports a combination of both EPs and FPs was 25,201. The minimum population of a town supporting both EPs and FPs was 1,691.

The most common reasons cited for staffing with FPs included the low availability of EPs,a low patient census that did not warrant EP specialty training, and hospital satisfaction with the quality of care provided by the local FPs (Figure 1). EDs that hired EPs cited factors that included the quality of care provided by EPs, the high availability of EPs, and a high patient and high patient census best supported by EPs (Figure 2). The most common reasons for hiring NPs and PAs in solo coverage were lower salaries and low availability of physicians (Figure 3).

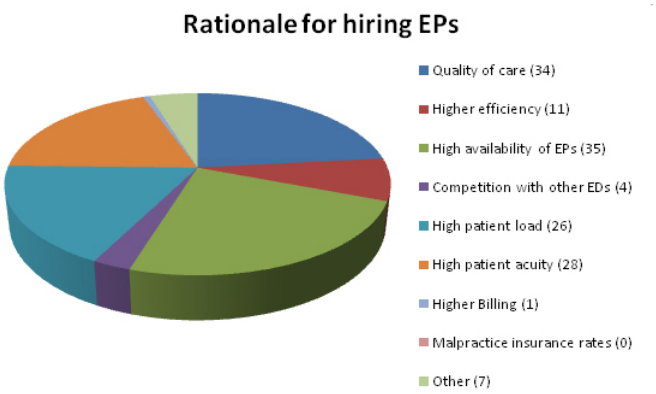

Figure 1. Reasons cited for hiring Board-Certfied Emergency Physicans (EPs).

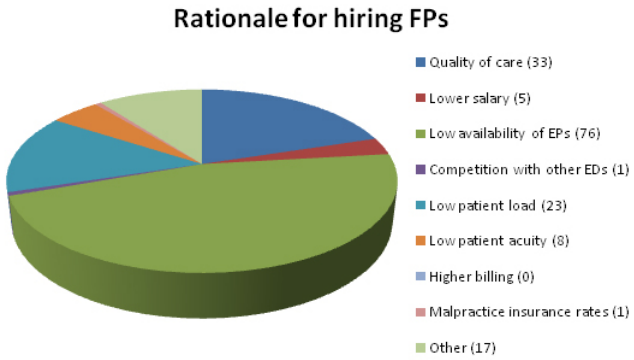

Figure 2. Reasons cited for hiring family medicine physicians (FPs).

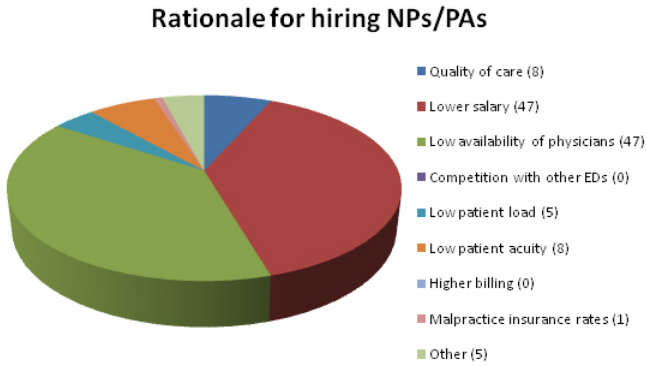

Figure 3. Reasons cited for hiring nurse practitioners or physician assistants (NPs or PAs).

DISCUSSION

We found that that in Iowa a mean population of approximately 85,000 is needed to support an EP-only ED. The minimum population was 2,968, representing the town of West Union, located in Northeast Iowa. A much lower mean population of approximately 25,000 was sufficient to support a combination of EPs and FPs. The minimum population required to support combined EPs and FPs was 1,691. We speculate that this relatively low population supported hiring EPs was because of the availability of staffing services.

Our research indicates that many EDs throughout Iowa rely on staffing services to supply physicians to provide care in their ED. At least 42 EDs use staffing services, and these services usually provide both EPs and FPs. Additionally, some staffing services hire other physician types and may hire APPs as well. The benefit of using these services is that they provide local physicians with much needed time off from ER call, and many hospitals stated that they used this fact as a recruiting tool.

Overall, there was no significant change in physician staffing of EDs in the state between 2008 and 2012. However, there was a large significant increase in the number of APPs. The number of EDs using NP/PAs in solo coverage increased by 56.5% between 2008 and 2012.

This study is limited in that it is a survey and relies on the accuracy of those responding to a research team. There was a great deal of heterogeneity in who responded to the survey. It was usually a non-physician hospital administrator, but the research team also heard from physician ED medical directors and the hospital directors of physician recruitment. The initial survey (2008) was conducted 4 years after the establishment of the EM residency at the University of Iowa and 1 year following the inaugural graduating class. Although the residency would not be expected to have a significant impact with only 12 total graduates, it would have been preferable to have a baseline survey in 2003 to measure the impact of attitudes toward EM as a specialty.

Certification by the American Board of Emergency Medicine (ABEM) has been the accepted standard to practice

EM in the U.S.[16] Since there are indications that the residency training site correlates with the choice of practice location, the addition of the state's sole EM residency training program in 2003 may increase the hiring of EPs in rural Iowa.[17] However, with the lack of change in EP hiring over the past 4 years, it seems likely that many EDs in this scarcely populated state will remain staffed by FM-trained physicians. In fact, without the contribution of family physicians, large areas of the state would be unable to provide adequate emergency care. Board-certified emergency physicians remain concentrated in more densely populated areas of the state, where patient volumes and acuity support their hiring.

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Emergency Physicians' Adherence to Center for Disease Control and Prevention Guidance During the 2009 Influenza A H1N1 Pandemic

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Introduction: Little is known regarding compliance with management guidelines for epidemic influenza in adult emergency department (ED) settings during the 2009 novel influenza A (H1N1) epidemic, especially in relation to the Centers for Disease Control and Prevention (CDC) guidance.

Methods: We investigated all patients with a clinical diagnosis of influenza at an inner-city tertiary academic adult ED with an annual census of approximately 60,000 visits from May 2008 to December 2009. We aimed to determine patterns of presentation and management for adult patients with an ED diagnosis of influenza during the H1N1 pandemic, using seasonal influenza (pre-H1N1) as reference and to determine the ED provider's adherence to American College of Emergency Physicians and CDC guidance during the 2009 H1N1 influenza pandemic. Adherence to key elements of CDC 2009 H1N1 guidance was defined as (1) the proportion of admitted patients who were recommended to receive testing or treatment who actually received testing for influenza or treatment with antivirals; and (2) the proportion of high-risk patients who were supposed to be treated who actually were treated with antivirals.

Results: Among 339 patients with clinically diagnosed influenza, 88% occurred during the H1N1 pandemic. Patients were similarly managed during both phases. Median length of visit (pre-H1N1: 385 min, H1N1: 355 min, $P > 0.05$) and admission rates (pre-H1N1: 8%, H1N1: 11%, $P > 0.05$) were similar between the 2 groups. 28% of patients in the pre-H1N1 group and 16% of patients in the H1N1 group were prescribed antibiotics during their ED visits ($P > 0.05$). There were 34 admitted patients during the pandemic;, 30 (88%) of them received influenza testing in the ED, and 22 (65%) were prescribed antivirals in the ED. Noticeably, 19 (56%) of the 34 admitted patients, including 6 with a positive influenza test, received antibiotic treatment during their ED stay.

Conclusion: During the recent H1N1 pandemic, most admitted patients received ED diagnostic testing corresponding to the current recommended guidance. Antibiotic treatment for ED patients admitted with suspected influenza is not uncommon. However, less than 70% of admitted patients and less than 50% of high-risk patients were treated with antivirals during their ED visit, indicating a specific call for closer adherence to guidelines in future influenza pandemics. [West J Emerg Med 2013;14(2):191-199.]

INTRODUCTION

The unexpected emergence of swine-origin novel influenza A (H1N1) virus in the early spring of 2009 spread rapidly across North America and to the rest of the world, followed by a second wave in the fall. It is estimated that there were 39-80 million cases, 173,000-362,000 hospitalizations and 7,880-16,460 deaths in the United States (U.S.) alone as of mid-December 2009 and approximately 300,000 deaths worldwide.[1-3] Due to the acute and occasionally severe nature of influenza viral infections, emergency departments (EDs) often serve as the frontline for infected patients, especially among children and the elderly.[4] Based on a nationally representative survey study, an estimated 0.3% or 312,000 of all-aged ED visits received a diagnosis of influenza annually from 2002 to 2006.[5] Approximately 40% of visits had antiviral prescriptions provided during their ED visits. During the influenza seasons, the ED may become filled with influenza-like illness (ILI) patients, making it a high-risk medical venue for nosocomial transmission of influenza.[6,7]

The Centers for Disease Control and Prevention (CDC) held the first press briefing to inform the media and guide the public and healthcare response to the novel H1N1 influenza virus on April 23, 2009 after the novel virus was first detected and confirmed by the CDC 8 days prior. This was followed by multiple additional cases identified in several states, as well as in Mexico over the next few days.[8] In response to the emergence of novel H1N1 influenza, both the American College of Emergency Physicians (ACEP) [9,10] and the CDC [11-16] prepared and distributed guidelines and recommendations for clinicians addressing diagnostic testing and antiviral treatment for clinical providers in ED settings for patients with suspected or confirmed influenza in early May 2009 (Table 1; Figure).[8,10] Most key elements from the 2 organizations were similar.

Little is known regarding compliance with management guidelines for epidemic influenza in adult ED settings during the novel H1N1 epidemic, especially in relation to current ACEP and CDC guidance. Understanding patterns of clinical presentation provides baseline data for future pandemic preparedness efforts, while adherence to current clinical management recommendations for patients with a clinical diagnosis of influenza in the ED helps address potential

Table 1. Key current American College of Emergency Medicine (ACEP) and Centers for Disease Control and Prevention (CDC) guidance in emergency department (ED) management for novel influenza A (H1N1) in 2009.

Areas of ED Management	Categories	ACEP	CDC
Diagnostic testing	Should be tested	Not Specified	If patients have an acute febrile respiratory illness or sepsis-like syndrome
	Priority for testing	Not Specified	Patients who require hospitalization or at high-risk for severe disease
	When to test	May consider as part of evaluation of patients with signs and symptoms compatible with influenza, but the results should be interpreted with caution	Should use clinical judgment and local guidance in addition to CDC guidance
Antivirals	Prescription	Should be considered for confirmed, probable or suspected cases	Recommend for all hospitalized patients (confirmed, probable, suspect cases)
		Prioritize hospitalized patients and patients at higher risk for complications	Any patients at higher risk for seasonal flu complications
		Should not be offered for mild illness	Should initiate empiric treatment as soon as possible
		Less effective 48 hours after the onset; Many ED patients beyond the time window for effectiveness	
	High-risk groups	Not Specified	Age: < 5 years or ≥ 65 years; chronic conditions [chronic pulmonary, cardiovascular (except hypertension), renal, hepatic, hematological, neurologic, neuromuscular, metabolic disorders]; immunosuppression (medication, human immunodefiency virus); pregnant women; pediatric patients receiving long-term aspirin; residents of nursing homes/ chronic-care facilities

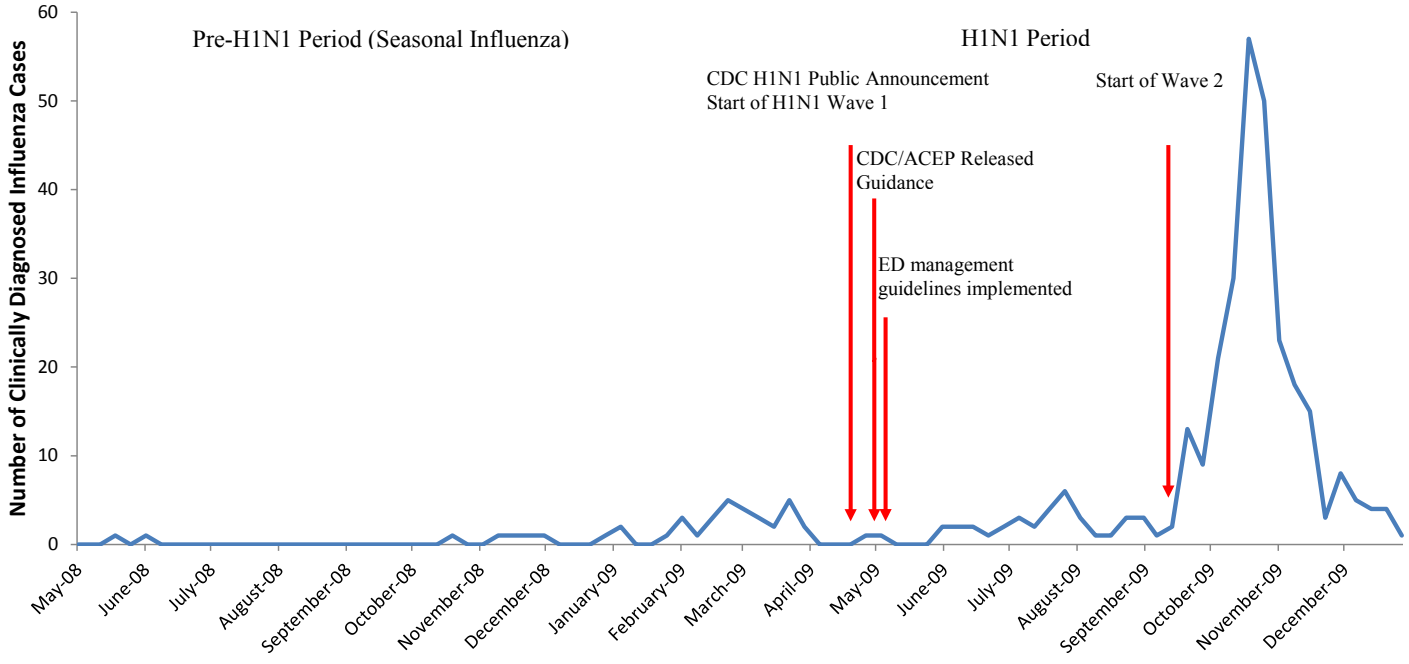
areas for improved adherence. Thus, this study aimed (1) to determine patterns of presentation and management for adult patients with an ED diagnosis of influenza during the H1N1 pandemic using seasonal influenza (pre-H1N1) as reference (where 2008-09 influenza season has a relative mild season)[17] and (2) to determine the ED providers' adherence to ACEP and CDC guidance during the 2009 H1N1 influenza pandemic.

METHODS

We conducted an analysis of all patient visits to an inner-city tertiary academic adult ED that had an annual census of approximately 60,000 visits from May 1, 2008 to December 31, 2009. Hospital Epidemiology & Infection Control (institutional level) and the Adult ED Influenza Administrative Cabinet (departmental level) operationalized novel H1N1 strategic plans designed to synchronize, as much as possible, with the 2009 CDC and ACEP guidance, as it evolved over the course of the pandemic.[9-16] The only key difference between the ED guidelines and CDC/ACEP guidelines was in diagnostic testing. Our institution recommended ED patients being admitted with suspected influenza should be tested for novel influenza virus, while CDC recommended clinicians should test patients with priority given to both those being admitted and those at a higher risk for complications (Table 1). Initial hospital and departmental training for the response to 2009 H1N1 occurred within 1-2 weeks of CDC and ACEP guidelines release in early May 2009 (Figure). More frequent and intensive trainings and interventions were carried out during the dramatic surge of the second wave of H1N1 pandemic in late September 2009. The plans were disseminated to all ED providers via broadcast emails, internal websites and town hall meetings, and were revised according to changing CDC guidance, necessitated by the changing understanding of the pandemic itself. This study protocol was approved by institutional review board of The John Hopkins University School of Medicine.

Data were captured and queried from an ED electronic patient record system, including demographics (age, gender, and race), ED presentation (chief complaint, acuity level of triage severity[18], onset of illness), ED management (chest radiograph, influenza testing, nasopharyngeal specimen collection, nebulized medication, intubation, antibiotic prescription, type of antibiotic prescribed, antiviral prescription, duration of ED visit, and disposition) and final ED diagnosis. Additional laboratory influenza virus typing data and clinical data regarding co-morbid conditions were chart-reviewed and abstracted from the electronic patient record system, specifically including chronic pulmonary, cardiovascular (except hypertension), renal, hepatic, hematological, neurologic, neuromuscular, metabolic disorders, immunosuppression status (medication, human immunodefiency virus [HIV]), pregnancy, and residence in nursing homes or chronic-care facilities. Following appropriate training for this project, chart review and data abstraction was performed by one co-author (K-F C) who is an emergency medicine attending physician.

"Patients with a clinical diagnosis of influenza" in



CDC, Center for Disease Control and Prevention; *ACEP,* American College of Emergency Physicians

Figure. Weekly number of adult emergency department patients given a diagnosis of influenza from May 2008 to December 2009 at Johns Hopkins Hospital.

Table 2. Comparison of demographics, clinical presentations and emergency department (ED) management in patients with an ED diagnosis of influenza before novel H1N1 (May 1, 2008 to April 22, 2009) and during emergence of H1N1 period (April 23, 2009 to December 31, 2009) in an adult tertiary academic ED.

Characteristics	Number of patient visits (%)				*P*-value
	Pre-H1N1		H1N1		
	n = 39		n = 300		
Demographics					
Age (median, interquartile range in years)	33.6 (23.0, 42.0)		28.5 (22.7, 43.9)		> 0.05
Gender					
Male	12	(30.8)	110	(36.7)	> 0.05
Race					
African American	34	(87.2)	248	(82.7)	> 0.05
White	4	(10.3)	29	(9.7)	
Hispanic	0	(0)	13	(4.3)	
Other	1	(2.6)	10	(3.3)	
High risk groups for complications					
Age ≥ 65 years	0	(0)	7	(2.3)	> 0.05
Age ≥ 50 years	3	(7.7)	40	(13.3)	
Asthma	8	(20.5)	77	(25.7)	
Chronic cardiovascular condition (except hypertension)	7	(18.0)	56	(18.7)	
Diabetes	1	(2.6)	27	(9.0)	
Known human immunodeficiency virus infection	3	(7.7)	30	(10.0)	
Pregnant (among Females)	1	(3.7)	3	(1.6)	
Any high risks under CDC guidance [a]	20	(51.3)	158	(52.7)	
ED presentations					
Chief complaint					
Flu	6	(15.4)	140	(46.7)	< 0.05
Cold	2	(5.1)	34	(11.3)	> 0.05
Short of breath	3	(7.7)	32	(10.7)	> 0.05
Cough	7	18.0)	24	(8.0)	> 0.05
Fever	3	(7.7)	19	(6.3)	> 0.05
Onset of illness					
< 48 hours	18	(46.2)	135	(45.0)	> 0.05
Acuity level [18]					
1	0	(0)	1	(0.3)	< 0.05
2	5	(12.8)	47	(15.7)	
3	19	(48.7)	205	(68.3)	
4	15	(38.5)	44	(14.7)	
5	0	(0)	3	(1.0)	

Table 2 continued →

Table 2 continued.

Characteristics	Number of patient visits (%)				*P*-value
ED management	Pre-H1N1		H1N1		
Flu test ordered (rapid or direct flourescent antibody/culture)	15	(38.5)	98	(32.7)	> 0.05
Chest radiograph ordered	29	(74.4)	232	(77.3)	> 0.05
Invasive respiratory procedures					
Nebulizer treatment	13	(33.3)	77	(25.7)	> 0.05
Intubation	0	(0)	1	(0.3)	> 0.05
Antibiotics prescribed	11	(28.2)	49	(16.3)	> 0.05
Flu test – positive[b]	7	(70.0)[b]	11	(22.0)[b]	< 0.05
– negative[b]	0	(0.0)[b]	13	(26.0)[b]	
– not resulting, or not ordered[b]	4	(14.8)[b]	25	(12.5)[b]	
Antivirals prescribed	15	(38.5)	117	(39.0)	> 0.05
Length of visit (median, interquartile in minutes)	385	(184, 583)	355	(201, 560)	> 0.05
Disposition					
Discharge	36	(92.3)	258	(86.0)	> 0.05
Admitted	3	(7.7)	34	(11.3)	
Other[c]	0	(0)	8	(2.7)	

[a] Center for Disease Control and Prevention (CDC) uses age ≥ 65 years as one of criteria for high risk groups for recommended diagnostic testing and antiviral prescription.
[b] The denominators were 10 (flu test positive), 2 (flu test negative), and 27 (flu test not resulting or not ordered) for the pre-H1N1 group and the denominators were 50 (flu test positive), 50 (flu test negative), and 200 (flu test not resulting or not ordered) for the H1N1 group.
[c] Included 2 patients who were "screened" only and 6 patients who left "against medical advice"

this study was operationally defined as a visit with any ED discharge diagnosis of influenza, i.e. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes of 487, 487.0, 487.1 or 487.8. To strictly evaluate provider's adherence to CDC guidance during the 2009 H1N1 pandemic, a patient with an ambiguous indication or diagnosis of ILI was not considered as a cases of influenza. A subsequent visit with an ED diagnosis of influenza was excluded if the later visit occurred < 1 week from the initial visit. Patients were categorized into pre-H1N1 (May 1, 2008 through April 22, 2009; 11.7 months) and H1N1 groups (April 23, 2009 through December 31, 2009; 8.3 months) according to the CDC announcement of the H1N1 outbreak. H1N1 group was further categorized to H1N1 Wave 1 (April 23, 2009 through mid-September 2009) and Wave 2 (late September 2009 through December 31, 2009) according to the epidemic of H1N1 in U.S. (Figure). CDC recommendations on diagnostic testing and antiviral treatment for admitted and high-risk group patients during pre-H1N1 seasonal influenza were highly similar to those during novel H1N1 pandemic. Direct immunofluorescence assays (DFA, D3 ultra DFA respiratory virus ID kit, Diagnostic Hybrids, Athens, Ohio, U.S.), which had a sensitivity of 93% for the detection of 2009 novel H1N1 virus,[19] and/or culture (shell vial & conventional) were the main diagnostic tests used for influenza by the clinical virology laboratory during the study period as the virology director removed the rapid influenza test (Binax) from use on April 28, 2009 due to poor sensitivity, as low as 11%.[20] Any specimen that was H1N1 positive during the H1N1 period was sent to the state laboratory for confirmation of novel H1N1 virus by reverse transcription polymerase chain reaction.

During the H1N1 period, high risk groups for diagnostic testing and antiviral prescription were defined according to CDC guidance for antiviral prescription (Table 1). Basic adherence to key elements of ACEP or CDC 2009 H1N1 guidance was operationally defined as (1) the proportion of admitted patients who were supposed to be tested or treated who actually were tested for influenza or treated with antivirals; and (2) the proportion of high-risk patients who were supposed to be treated who actually were treated with antivirals.

We performed descriptive analysis, followed by chi-square test and Fisher's exact test for categorical data or Wilcoxon rank sum test for continuous data to compare patterns of presentation and care between pre-H1N1 and H1N1 groups and ED management between high risk and non-high risk groups. All statistical analyses were performed by using SAS version 9.1 (SAS Institute Inc., Cary, North Carolina).

RESULTS

During the 20-month study period, there were 103,417 patient visits encountered in this inner-city academic adult ED,

Table 3. List of antibiotic treatment for community-acquired pneumonia in emergency department in 19 admitted patients with a clinical diagnosis of influenza during 2009 novel H1N1 epidemic.

Antibiotic	Number (%)
Azithromycin	9 (47)
Moxifloxacin	7 (37)
Cefepime	4 (21)
Ceftriaxone	3 (16)
Vancomycin	3 (16)
Piperacillin/Tazobactam	1 (5)
Penicillin	1 (5)
Trimethoprim/Sulfamethoxazole	1 (5)
Metronidazole	1 (5)

and of these, 45,881 (44%) visits were during H1N1 period. Overall, 339 patient visits from 331 patients were clinically diagnosed with influenza. Of these, 300 (88%) occurred during the H1N1 outbreak (Figure), an approximately 10-fold increase in the proportion of clinically diagnosed influenza cases (65.0 per 10,000 visits versus 6.8 per 10,000 visits). All 8 influenza repeated visits occurred during the outbreak. Three repeated visits had < 7-day interval after the initial visit.

Comparing the pre-H1N1 and H1N1 group there were no differences in patients' demographics or proportions of high-risk groups as designated by ACEP and CDC (Table 2). More patients in the H1N1 group reported "flu" as their chief complaint, versus those in pre-H1N1 group ($P < 0.05$), but there were no statistical differences between the 2 groups in other common chief complaints for influenza patients. Patients in the H1N1 group had a higher triage acuity, i.e. level 1-3, which reflected higher severity of disease ($P < 0.05$). In both groups, approximately 10% of those who received chest radiograph had confirmed pneumonia (12.1% versus 10.3%, $P = 0.787$). Similar proportions of patients in both groups had nasopharyngeal specimens collected for flu tests. Overall, among 110 patients who received a test, 55 (50%) were positive for influenza with 8 detected by the rapid influenza test. The majority (70%) of positives in the pre-H1N1 group (n = 10) were influenza A followed by 30% with influenza B, while all of the positives in the H1N1 group (n = 45) were influenza A, with one third (33.3%) of these confirmed as novel H1N1.

Regarding antibiotic prescription in the ED for these clinically diagnosed influenza patients, we found that 28% of patients in the pre-H1N1 group and 16% of patients in the H1N1 group were prescribed antibiotics during their ED visits ($P > 0.05$). Further analysis by influenza test results identified that 70% (7/10) patients who tested positive received antibiotics in the pre-H1N1 group, which was statistically significantly higher than the 22% (11/50) who tested positive in the H1N1 group ($P < 0.05$) (Table 2). During the H1N1 pandemic, a significantly higher proportion of patients who tested negative for influenza received an antibiotic prescription than those who did not have the test or whose results were not available (26.0% versus 12.5% $P < 0.05$) (Table 2). Azithromycin (n = 35) was the leading antibiotic prescribed to patients with a clinical diagnosis of influenza, followed by moxifloxacin (n = 15). Noticeably, 19 (56%) of 34 admitted patients during the 2009 novel H1N1 epidemic, including 6 influenza tested positive patients, received antibiotic treatment during their ED stay for community-acquired pneumonia. The list of antibiotics prescribed in ED for these 19 patients is summarized in Table 3. For those 6 patients who were tested positive for influenza and received antibiotic treatment, none had a pulmonary infiltrate on their chest radiograph; 3 received antivirals and 3 did not (all 3 having > 48 hours onset of illness); 1 with asthma had a final discharge diagnosis of pneumonia, 2 were HIV-infected, 2 had asthma and 1 did not have any high risk underlying illness on the chart.

Treatment rates with antivirals were similar at 39%, with oseltamivir given in 93% of those receiving antivirals during pre-H1N1 and 100% during H1N1 period. For 153 patients with onset of illness < 48 hours, 42% of them received antivirals, which had no statistical difference as compared to those 186 patients without (37%, $P > 0.05$). Median length of visit (pre-H1N1: 385 min, H1N1: 355 min) and admission rates (pre-H1N1: 8%, H1N1: 11%) were similar between the 2 groups. There was one patient deceased during hospitalization in each phase. The overall mortality rate was not statistically different (pre-H1N1: 2.6% versus H1N1: 0.3%, $P = 0.231$).

Regarding ED provider's adherence to CDC/ACEP guidance in influenza diagnostic testing and antiviral treatment during H1N1 pandemic, we found that 88% of admitted patients received a testing order, 49% of high-risk group patients were prescribed with antivirals, and 65% of admitted patients were prescribed with antivirals (Table 4). No significant uniform trends in adherence were observed during the study period. If only focusing on admitted patients, 67% were ordered for influenza testing during pre-H1N1, 100% during H1N1 wave 1, and 87% during wave 2. The proportion of high risk group patients who were prescribed antiviral treatment during their ED stay gradually increased from 30% during pre-H1N1 to 39% during H1N1 wave 1, and further increased to 51% during wave 2 (Cochran-Armitage trend test, $P = 0.059$). Among admitted patients, 67% were prescribed with antivirals during pre-H1N1, none of 4 patients during H1N1 wave 1, but significantly increased back to 73% during wave 2 ($P < 0.05$).

DISCUSSION

To our knowledge, there are few studies to date examining ED care and management for adult patients with a discharge diagnosis of influenza before and during the H1N1 epidemic, as well as rates of ED provider adherence with the 2009 ACEP and CDC guidance (for patients with suspected H1N1). Although the demographic profiles of patients

Table 4. Adherence of emergency department (ED) management in patients with an ED diagnosis of influenza to Center for Disease Control and Prevention guidance in diagnostic testing and antiviral treatment before and during the 2009 H1N1 season.

ED management	Categories	Type of patients	Number of patient visits (%)[a]			
			Pre-H1N1[b]	H1N1[b]	H1N1 Wave 1[b]	H1N1 Wave 2[b]
Influenza test (Rapid or DFA/Culture)	Ordered	Admitted	2 (67)[c]	30 (88)	4 (100)[c]	26 (87)
Antivirals	Prescribed	High-Risk	6 (30)	78 (49)	7 (39)	71 (51)
Antivirals	Prescribed	Admitted	2 (67)[c]	22 (65)	0 (0)[c]	22 (73)

DFA, direct immunofluorescence assays

[a] Percentage was calculated according to the denominator in each subgroup of patients.

[b] Pre-H1N1 (May 1, 2008 through April 22, 2009; 11.7 months), H1N1 Wave 1 (Apr 23, 2009 through September 2009), H1N1 Wave 2 (September 20, 2009 through December 31, 2009).

[c] It should be interpreted with caution since the total admitted patients during pre-H1N1 and H1N1 wave 1 was 3 and 4, respectively.

pre and during the H1N1 were similar, our results reveal that significantly different patterns of clinical presentation (including chief complaint and level of acuity) emerged during the H1N1 epidemic. Published studies, which included adult ED encounters, demonstrated some differences in symptom patterns when comparing patients of pandemic novel H1N1 and seasonal influenza.[21,22] Tang et al[21] reported a lower incidence of fever and dyspnea in early H1N1 pandemic in Singapore, while Shiley et al[22] documented cough and myalgias were more common in patients with a diagnosis of pandemic H1N1 at 2 medical centers in Philadelphia. Our findings that rates of hospital admission did not differ between the pre H1N1 and post H1N1 groups is consistent with U.S. CDC surveillance data, which do not show an increase in pneumonia and influenza mortality after the emergence of H1N1.[21]

Although the recommendations of both ACEP and CDC with regard to diagnostic test ordering practices and antiviral prescriptions decisions are only suggestions to begin with, further exploration of ED management found that practices in this ED were in "very good" or "excellent" accordance in diagnostic testing but in "suboptimal" accordance in antiviral prescription with the 2009 ACEP and CDC recommendation. This finding suggests that ED practice yielded from "suboptimal" to "excellent" adherence to recommended care for high-risk patients in ordering diagnostic tests and antiviral prescriptions, even though the practice ultimately is at the discretion of the provider, but influenced by a combination of individual patient features and institutional and national guidance. The adherence in antiviral treatment was much better in more severe subgroup patients, i.e. admitted patients, during wave 2 of the H1N1 pandemic. This is partly supported by the finding from our subgroup analysis that only triage acuity and chief complaint were associated with a provider's order for influenza diagnostic testing or antiviral treatment in high-risk group patients (data not shown). Coupled with our previous finding, which showed a 97% adherence with CDC interim guidelines for antiviral prescription from nationally representative survey data,[5] this study suggests that ED clinicians are potentially appropriately responsive and could be adherent with national guidance for influenza, which will be critical for coping with future influenza pandemics. On the other hand, approximately less than 50% of high-risk patients were prescribed antivirals during their ED visits, indicating that there remains room for improvement with regard to adherence to recommended management strategies among ED clinicians. This is imperative since delays in testing and treatment can quickly lead to increases in preventable deaths due to influenza.[23,24] Further studies are required to develop approaches to improve adherence for future, potentially more virulent pandemics, e.g. direct electronic reminders to providers as suggested by May et al.[25]

Antibiotic overuse for ED patients with acute respiratory infections is still substantial in the Unites States, even though there has been a downward trend in the recent years.[26-29] According to previous work in clinically diagnosed influenza patients by Linder et al[30], antibiotics were inappropriately prescribed to an overall 26% of ambulatory clinics and ED influenza visits (approximately 15% for ED). Our study found that 28% of patients in the pre-H1N1 group, 16% in the H1N1 group, and more than half of admitted patients with ED clinical diagnosis of influenza received antibiotics in the ED. The decreased antibiotic prescription rate seen during the H1N1 outbreak despite an increased patient acuity could represent increased provider confidence in the diagnosis of influenza or increased awareness of antibiotic overuse. Nevertheless, our findings imply that there is additional work needed for reducing potential antibiotic overuse in the ED.

LIMITATIONS

There are some limitations to this study. First, ED clinical diagnosis of influenza could be subjective and is without specific standard criteria. It is possible that some true influenza cases may have been missed during the pre-H1N1 mild influenza season and diagnosed as a viral syndrome, while some "clinically diagnosed" cases of pandemic H1N1 influenza during the more severe influenza season could have been respiratory illnesses from other causes. It is likely that heightened awareness of influenza during a pandemic

increased the proportion of patients with ILI receiving a diagnosis of "influenza" rather than "viral illness," or other nonspecific diagnoses. In addition, we do not have evidence that subgroups of clinical diagnosed influenza patients without laboratory-confirmed infection between 2 periods are similar. However, it is more appropriate to use clinically diagnosed influenza patients as our study subjects rather than more "loose" defined ILI patients in terms of understanding of ED provider's adherence to ACEP and CDC guidance especially in regard to antiviral prescription variables. Second, our findings from this academic inner-city ED were specific to our ED and may not be generalizable to other EDs in U.S. For example, our clinically diagnosed influenza patients were much younger than those in the National Hospital Ambulatory Medical Care Survey in seasonal influenza seasons (median age: 33.6 years versus 41.5 years).[5] However, our data reflect the general trend that young adults and adults are the main population attacked by the 2009 H1N1 pandemic.[1] Finally, we did not account for the lag time between ACEP, CDC, institutional/departmental guidance and provider's practice in our analysis. However, we expect that lag time should be minimal in future influenza pandemics, and that providers must be able to rapidly respond to up-to-date recommendations.

CONCLUSION

In summary, ED management with regard to diagnostic testing and antiviral prescription for admitted patients or those designated as high risk groups by ACEP and CDC ranged from "suboptimal" to "very good" or "excellent" in regard to current guidance during the pandemic. However, only 49% were treated with antivirals during their ED visits, indicating a specific call for closer adherence to guidelines in future influenza pandemics. Despite a decrease in antibiotic prescription rates during the H1N1 period, continued antimicrobial stewardship is required.

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Compliance with an Ordinance Requiring the Use of Personal Flotation Devices by Children in Public Waterways

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Introduction: For children ages 1-14, 21.6% of drowning cases involve swimming, wading, or playing in natural bodies of water, such as rivers and lakes. Personal flotation devices (PFDs) are believed to be an effective prevention measure. We measure compliance with city and county ordinances, publicized but not actively enforced, requiring that PFDs be worn by children accessing public bodies of water in Sacramento County, California.

Methods: During June-August 2010, volunteers conducted 79 observation sessions at three popular local river beaches where PFDs were available for use at no cost. They recorded personal characteristics and PFD use for 1,727 children in or very near the water and believed to be 0-13 years of age (the age covered by the ordinances). We used logistic regression to quantify differences in use by subject characteristics and study site.

Results: The prevalence of PFD use was 29.9% overall, with large and significant differences by age: < 1, 55.6%; 1-4, 37.6%; 5-10, 29.4%; 10-13, 14.6%; $P < 0.0001$. Usage did not vary significantly by sex or race/ethnicity, and was somewhat higher at one study site (33.1%) than at the others (25.9% and 27.3%), $P = 0.009$.

Conclusion: The combination of a statutory requirement and a cost-elimination strategy was associated with moderate rates of PFD use that were highest among young children. [West J Emerg Med 2013;14(2):200-203.]

INTRODUCTION

Drowning is the second leading cause of unintentional injury death among children ages 1-14 in the United States, accounting for 21.2% of such deaths (704 of 3,328) in 2008.[1] On average, 3,427 children ages 1-14 were treated for nonfatal submersion injuries annually during 2001-2010 in United States hospital emergency departments (ED).[1] Of childhood drownings in 2008, 21.6% occurred among children who were swimming, wading, or playing in or near natural bodies of water, such as rivers, lakes, streams, or the ocean. This proportion varies substantially by age: 13.3% for children ages 1-4, 29.0% for children ages 5-9, and 43.1% for children ages 10-14.[1]

The limited available evidence suggests that the use of personal flotation devices (PFDs) may decrease the risk of drowning in natural bodies of water by roughly 50%, for both adults and children.[2-7] Such studies commonly include no control data[2-4] or pertain to boaters.[5,6] One case-control study of childhood drowning in rural China, with 74% of cases occurring in lakes, rivers, or ponds and none in swimming pools, reported PFD use by 8.3% of cases and 15.0% of controls.[7] Educational programs to promote voluntary use of PFDs have had some success.[8,9] A 3-year effort focused on children at beaches, docks, or pools in King County, Washington, increased their use of PFDs from 20% to 34%, as reported by parents who were aware of the campaign. Parents who were unaware of the campaign reported no change in use.[8]

Sacramento County, California, has 2 large rivers and many smaller natural bodies of water; the southwest corner of the county forms part of the second largest river delta in the United States. It has long been recognized as having a

high rate of fatal submersion injuries.[10] During the 10 years 1998-2007, Sacramento County reported 12 drownings in natural bodies of water among children ages 1-14, for a cumulative incidence (using Census 2000 population data for the denominator) of 4.2 per 100,000 persons at risk.[11,12] The state as a whole reported 96 cases, for a cumulative incidence of 1.2 per 100,000.[11,12] In Sacramento County, as elsewhere, such drownings are associated with recreation and occur most frequently during the summer.[13]

Beginning in 2003, the local emergency medical services agency and fire districts, which are responsible for water rescues in the county, made PFDs available for use without charge by swimmers at popular local river beaches. At one beach, volunteers provided properly fitted PFDs to hundreds of beachgoers.[13] In June 2008, Sacramento County enacted an ordinance making it unlawful for a parent or responsible adult to permit his or her child under the age of 13 to access a public waterway without wearing a Coast Guard-approved PFD.[14] The city of Sacramento adopted an essentially identical ordinance that same year.[15] Violations are misdemeanors punishable by a fine of up to $500 or 6 months in jail.

PFDs continued to be provided for use at local beaches. Signs reading "KIDS DON'T FLOAT/GIVE THEM SOMETHING THAT WILL/Life Vest Loan Program" and identifying the sponsors of the program were posted in full view of the public. The signs measured approximately 4 feet in height and 8 feet in width; their lower edges were approximately 3 feet above the ground. Affixed to the lower portion of each sign were straps to which 15 PFDs could be attached. Just above the straps were the instructions "BORROW AND RETURN." Additional signs, measuring approximately 6 feet in height and 4 feet in width, spelled out the requirements of the ordinance in 5 languages. In English, this text read "ATTENTION! City and County of Sacramento ordinances make it unlawful for any parent or guardian to allow children under 13 years of age to enter public waters (rivers, lakes, canals), without wearing a personal flotation device." These signs also identified local fire stations at which PFDs were available for loan.

To our knowledge, no sustained enforcement efforts were implemented; compliance was voluntary. During the summer of 2010, we conducted a field observational study of the prevalence of PFD use among children at 3 popular Sacramento beaches.

METHODS

We collected data collected at 3 sites: Tiscornia Beach, at the confluence of the American River and the Sacramento River; Sand Cove, on the Sacramento River; and Howe Avenue Beach, on the American River. Sand Cove and Howe Avenue Beach are each approximately 100 yards long; Tiscornia Beach is about 300 yards long. These sites were chosen in consultation with a Sacramento fire captain who had made a special study of the problem.[13] Twelve undergraduate volunteer research assistants from the University of California (UC) Davis Medical Center ED collected data on 28 days (7 Fridays, 9 Saturdays, 12 Sundays) from June 5 to August 22, 2010, between 1:30 and 3:30 PM. All volunteers attended a 1-hour training session, conducted by the lead investigator (AA), prior to collecting data. They were instructed to collect data on all children affected by the ordinance (i.e., those estimated to be less than 14 years of age) in the water or within 5 feet of the water. Observations were to be made of the entire site as quickly as possible to avoid data being collected twice on any single child. Only a few minutes were needed to complete an observation session.

Observers recorded estimated age [<1, 1-4, 5-10, 10-13 (because of a typographical error, age 10 was the boundary for 2 strata on the data collection sheet)], sex, and ethnicity of the child, and whether the child was wearing a PFD. These devices are brightly colored to increase visibility. Conditions of observation, such as the child being largely under water, occasionally prevented a determination of demographic characteristics. Observations were recorded on paper at the time they were made and later entered into an Excel spreadsheet. We performed data analysis using SAS version 9.1.3 for Windows. Logistic regression was used to generate odds ratios and 95% confidence intervals for PFD use.

The UC Davis Institutional Review Board approved this study.

RESULTS

A total of 1,739 observations were made during 79 observation sessions (26 each at Howe Avenue Beach and Tiscornia Beach, 27 at Sand Cove). Of these, 12 were excluded because PFD use was not recorded, leaving 1,727 available for analysis. Subject characteristics and the number of observations at each study site are in Table 1.

PFD use was 29.9% overall, with large and significant differences by age and smaller, generally non-significant differences for other personal characteristics (Table 2). Boys were slightly more likely than girls to wear PFDs, and usage rates were lowest among Asian children. PFD use was moderately and significantly more common at Tiscornia Beach, which had 2 PFD distribution stations, than at the other study sites. All these findings persisted, nearly unchanged, in multivariate analysis (Table 2).

DISCUSSION

At our study sites, where PFDs were available but statutes requiring their use were not actively enforced, the prevalence of PFD use was approximately 30% overall and higher among children less than 5 years of age. This is similar to the 34% reported prevalence achieved in King County, Washington, among children whose parents were aware of a public education campaign promoting PFD use.[8]

Experience with PFD use by children on boats suggests that very high rates of use can be achieved when statutory mandates are enforced. According to Safe Kids USA, 46

Table 1. Subject characteristics* and number of observations at each study site.

Characteristic	Number	%
Age		
<1	27	1.6
1-4	553	32.1
5-10	857	49.7
10-13	288	16.7
Sex		
Female	825	48.4
Male	878	51.6
Race/Ethnicitiy		
African-American	221	13.2
Asian	77	4.6
Hispanic	815	48.7
White	539	32.2
Uncertain	22	1.3
Study Site		
Tiscornia Beach	866	50.1
Sand Cove	521	30.2
Howe Avenue Beach	340	19.7

* Conditions of observation precluded data collection as follows: age, 2 cases; sex, 24 cases; race/ethnicity, 53 cases

states require children to wear PFDs while on recreational boats.[16] The U.S. Coast Guard Auxiliary, a largely volunteer organization, shares responsibility for enforcement. A 30-state observational study conducted for the U.S. Coast Guard in 2009 reported prevalences of PFD use among children on boats of 94.7% at age 0-5, 89.1% at age 6-12, and 35.1% at age 13-17.[17]

Higher PFD use among children swimming, wading, or playing in natural bodies of water could likely be achieved if requirements for their use were in place and enforced. PFDs are highly visible; children without them could be fitted with a loaner device on the spot and returned to the water with their recreation only briefly interrupted. These children would likely be accompanied by parents or other responsible adults, providing an immediate opportunity for education. All this could be done at least in part by volunteers, as is the case with boaters.

We are not aware of another similar statute. Both adoption by other jurisdictions and vigorous enforcement should ideally be based on incontrovertible evidence that PFDs are an effective drowning prevention measure. The studies now in the literature do not provide that evidence, unfortunately, though their findings are uniformly positive. The Committee on Injury, Violence, and Poison Prevention of the American Academy of Pediatrics (COIVPP) concludes that PFDs "seem to be effective."[18]

Table 2. Personal flotation device (PFD) use by subject characteristics and study site.

Characteristic	PFD Worn N	PFD Worn %	Crude OR	95% CI	*P*-value	Adjusted OR*	95% CI	*P*-value
Age					<0.0001			< 0.0001
<1	15	55.6	7.7	3.3-18.1		9.1	3.8-21.7	
1-4	208	37.6	3.3	2.3-4.8		3.5	2.4-5.1	
5-10	252	29.4	2.3	1.6-3.3		2.4	1.7-3.5	
10-13	42	14.6	Referent			Referent		
Sex					0.079			0.036
Female	230	27.9	0.8	0.7-1.0		0.8	0.6-1.0	
Male	278	31.7	Referent			Referent		
Race/Ethnicity					0.111			0.066
African-American	64	29.0	0.8	0.6-1.1		0.8	0.6-1.2	
Asian	15	19.5	0.5	0.3-0.9		0.5	0.3-0.9	
Hispanic	238	29.2	0.8	0.7-1.1		0.9	0.7-1.1	
White	4	18.2	0.5	0.2-1.4		0.4	0.1-1.0	
Uncertain	176	32.7	Referent			Referent		
Study Site					0.009			0.004
Howe Avenue Beach	88	27.3	0.7	0.5-0.9		0.7	0.5-0.9	
Sand Cove	142	33.1	0.7	0.6-0.9		0.7	0.5-0.9	
Tiscornia Beach	287	33.1	Referent			Referent		

* All variables in the table are included in the regression model.
OR, odds ratio; *CI*, confidence interval

At the same time, it is clear that teaching children to swim and encouraging close adult supervision are, by themselves, insufficient drowning prevention strategies.[18,19] Only recently has COIVPP relaxed its longstanding advisory against aquatic exposure and swimming lessons for children ages 1-4, and it continues to state that "there is no clear evidence that drowning rates are higher in poor swimmers." [18,19] While adequate supervision of children in the water requires constant vigilance from nearby, surveys of adults who provide supervision report that up to 46% fail to do so adequately.[4,20]

LIMITATIONS

This was a short-term, small-area study with observations made only during certain days of the week. No data on PFD use prior to the intervention were available. Determinations of age and race/ethnicity were based on brief observation. Interobserver variability was not assessed. Inadvertently, age 10 was used to bound 2 age strata; the impact of this error is likely to be minor.

CONCLUSION

Combining multiple prevention strategies, commonly referred to as providing layers of protection, is advisable when no single strategy is sufficient.[4,18,19] While the evidence is not definitive, a recommendation has been made that PFDs be used by children making use of natural bodies of water.[18,19] PFD use is moderate when a requirement is in place and devices are provided but compliance is voluntary.

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Sedation-assisted Orthopedic Reduction in Emergency Medicine: The Safety and Success of a One Physician/ One Nurse Model

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Vinson DR, Hoehn C: Sedation-assisted Orthopedic Reduction in Emergency Medicine: The Safety and Success of a One Physician/One Nurse Model. *West J Emerg Med*. 2013;14(1):47-54.

To the Editor:

We applaud Vinson and Hoehn for eloquently demonstrating that the performance of sedation assisted procedures in the emergency department (ED) does not necessarily require a 2 physician team. From a Canadian perspective, where single physician coverage in smaller EDs is common, this has important implications in terms of efficiency of patient care, reduction in the need for patient transfer and decreasing the time to definitive treatment for ED patients. We would like to draw attention to a model of care practiced in Halifax, Nova Scotia for over 15 years, using a team consisting of an advanced care paramedic (ACP) and a single physician, the former to conduct the sedation, and the latter to do the procedure.[1] The skills of ACPs complement specific supplementary training in Procedural Sedation and Analgesia (PSA) to produce, in our opinion, expert ED sedationists, and our database of over 4000 safely conducted PSAs attest to this. Although performing PSA is primary role of ACPs in our ED, success with this has expanded our use of paramedics to a number of other ED tasks, freeing up other staff to perform what they do best.[2]

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In reply:

Campbell and Froese are to be commended for having designed and implemented an admirable system of care for emergency department (ED) procedural sedation.[1] Their one physician/one paramedic model is akin to our one physician/ one nurse model, as both employ specially trained and supervised personnel to administer sedation medications and give all their skill and attention to monitoring patient status during the procedure and throughout the recovery. The analysis they published demonstrates that in their hands this approach to emergency sedation optimizes patient care, promotes procedural efficiency, and ensures patient safety.[1]

We also appreciate their emphasis on the generalizability of our shared one physician model to the many EDs around the world where single-physician coverage occurs for some portion of the day (or, more likely, night). In this very common setting a department has to put available resources to their best use, having emergency personnel exercise their respective training and skills in a complementary fashion. As Campbell and Froese put it, this allows staff to perform "what they do best." Emergency nurses (and advanced care paramedics in the case of Queen Elizabeth II Health Sciences Centre in Halifax, Nova Scotia) are experienced and facile in parenteral drug administration and careful monitoring of cardiorespiratory parameters. Emergency physicians are trained and adept at ordering the right medications for the situation, performing the necessary procedures, and being prepared for rescue airway intervention if indicated.

The safety of the one physician/one nurse model is further supported by its broad use in non-acute care settings. We cited a number of references in our paper of its safe use by gastroenterologists.[2,3] Casting the net even wider, many dentists in this country are trained to perform procedural sedation, and they include propofol in their pharmacopeia.[4] The American Dental Association requires the presence of one additional person beyond the dentist for moderate sedation and 2 additional persons for deep sedation and general anesthesia.[5] These ancillary personnel are required only to have completed a Basic Life Support course for the healthcare provider. Also, "when the same individual administering the deep sedation or general anesthesia is performing the dental procedure, one of the additional appropriately trained team members must be designated for patient monitoring."[5] And in the dental office, this monitor is customarily a dental assistant, or occasionally a registered nurse.[4] In fact, with additional training, the dental assistant in some states is authorized to

draw up and administer intravenous agents for deep sedation under direct supervision of a dentist.[6] Strangely, the same drug administration that is entrusted to dental assistants is being questioned as unsuitable for sedation-trained registered nurses who specialize in emergency care.[7]

As the evidence suggests, a 2 person team is often all that is needed for sedation-assisted procedures in emergency medicine. Studies show that the one physician/one nurse-equivalent model is both safe and effective. And in these days of limited resources and growing cost consciousness, this leaner approach has even more going for it.

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California Chapter of AAEM (CAL/AAEM)

ORANGE COUNTY SPEAKERS SERIES

Thursday, April 18, 2013 from 6-9PM

Orange County Medical Association
17322 Murphy Ave
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Appetizers and cocktails will be provided.

Speakers:

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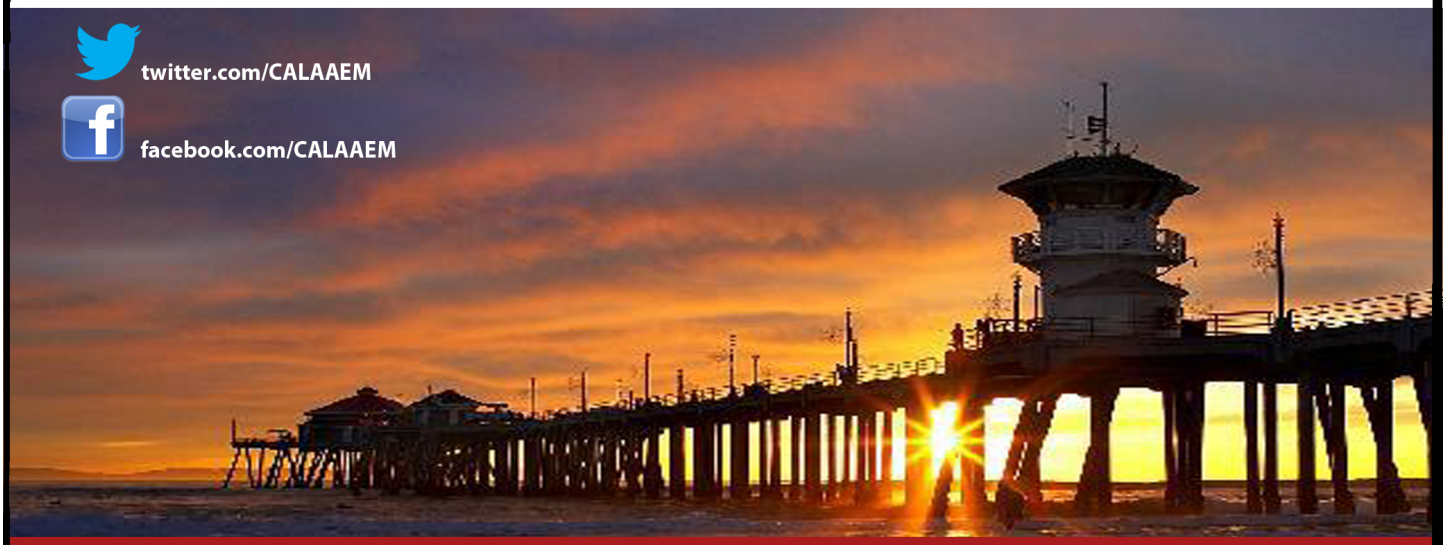
Professor of Pediatric Emergency Medicine at the University of California, San Diego

J. Christian Fox, MD, RDMS
Professor of Clinical Emergency Medicine at the University of California, Irvine

Michael Menchine, MD, MPH
Associate Professor of Emergency Medicine at the University of Southern California

Register online at www.calaaem.org to attend. Space is limited.

See you there!



Online registration will be available at

www.calaaem.org

Call for Papers

Gender-Specific Research in Emergency Medicine:
Investigate, Understand and Translate How Gender Affects Patient Outcomes

The 2014 *Academic Emergency Medicine* Consensus Conference, **Gender-Specific Research in Emergency Medicine** will be held on Wednesday, May 14, 2014, immediately preceding the SAEM Annual Meeting Dallas, TX. Original papers on the this topic, if accepted, will be published together with the conference proceedings in the December 2014 issue of *Academic Emergency Medicine.*

Gender-specific medicine is the "science of how normal human biology differs between men and women and how the manifestations, mechanisms and treatment of disease vary as a function of gender." While gender-specific medicine incorporates advances in reproductive health issues, the AEM consensus conference will focus on broad disease-specific EM issues that are relevant to both women and men. The key domains of the conference are cardiovascular/resuscitation, cerebrovascular, pain, trauma/injury/violence, diagnostic imaging, mental health and substance abuse.

Consensus Goal:
The goal of the 2014 AEM Consensus Conference is to stimulate EM researchers to methodically recognize, investigate and translate the impact of gender on their clinical research outcomes. The conference proposes to build a foundation upon which researchers can build interdisciplinary scholarship, networks of expertise, discussion forums, multicenter collaborations, evidence-based publications, and improved education. The overarching themes of the conference have been guided and informed by NIH research priorities on gender medicine and include study of the lifespan, sex/gender distinctions, health disparities/differences and diversity and interdisciplinary research.

Consensus Objectives:
1) Summarize and consolidate existing data and create a blueprint that furthers gender-specific research in the prevention, diagnosis and management of acute diseases

2) Discuss the conceptual models for designing studies and analysis that incorporate gender as an independent variable.

3) Build a multinational interdisciplinary consortium to study gender medicine for acute conditions.

Accepted manuscripts will describe relevant research concepts in gender-specific areas with priority placed on differential disease risk, vulnerability, progression and outcomes. They may include work in clinical/translational, health systems, policy or basic sciences research. Descriptions of specific research, projects, or collaborations may be used for illustrative purposes but should not comprise the core of the submission. Original contributions describing relevant research or concepts on these or similar topics will be considered, and original high-quality research may also be submitted alone or in conjunction with concept papers. Papers will be considered for publication in the December 2014 issue of *Academic Emergency Medicine* if received by Monday, March 11, 2014. All submissions will undergo peer review and publication cannot be guaranteed.

For queries, please contact Marna Rayl Greenberg, DO, MPH (Marna.Greenberg@lvh.com) or Basmah Safdar, MD (basmah.safdar@yale.edu) the 2014 Consensus Conference Co-Chairs.

Information and updates will be regularly posted in *Academic Emergency Medicine*, the SAEM Newsletter, and the journal and SAEM websites.

Join the Foundation for Osteopathic Emergency Medicine at the 2013 ACOEP Spring Seminar in Fort Lauderdale, FL!

FOEM 5K Run for Research

Wednesday, April 3, 2013 at 6 a.m.
Early bird rate $35.00 until March 4, 2013 (includes t-shirt)
$50.00 after March 4, 2013 (includes t-shirt)

Get up early and get the blood flowing for a good cause! All conference attendees and their families/guests – from walkers and novice runners to seasoned marathoners – are welcome to join the FOEM 5K Run for Research! Proceeds will benefit the Foundation for Osteopathic Emergency Medicine (FOEM).

FOEM Case Study Poster Competition

Wednesday April 3, 2013 from 12:30 – 5:00 p.m.

The Foundation for Osteopathic Emergency Medicine (FOEM) is proud to present the annual Case Study Poster Competition, in which students and residents present interesting or unique cases that have presented at their hospital. Winners receive certificates, cash prizes, and recognition in FOEM publications throughout the year. The deadline for submission of applications and abstracts is January 31, 2013.

For more information or to register for an event, contact Stephanie Whitmer at swhitmer@foem.org, or register online!

Emergency Medicine Fellowship Opportunities

The Department of Emergency Medicine at Baystate Medical Center (BMC), the Western Campus for Tufts University School of Medicine, offers 5 fellowships each year. The BMC ED is a Level 1 trauma center in an urban setting with 112,000 visits annually. We have a 3-year EM residency with 12 residents per year. Clinical responsibilities for fellows are at BMC and affiliate hospitals. Positions are available to BC/BE emergency physicians who have completed an EM residency. Pediatric BC/BE is acceptable for the pediatric EM fellowship. Further information can be found at www.baystatehealth.com. Inquiries can be made to Tara Rivest at (413)794-5999 or at Tara.Rivest@baystatehealth.org.

Research: One-year Certificate Program or two-year Masters Degree fellowship in EM Research. The program integrates training in clinical and basic science research with didactics in clinical and translational science through the Tufts University School of Graduate Biomedical Sciences. The purpose of the fellowship is to provide young investigators with the mentored experience and didactics necessary to become successful independent clinical or basic science investigators. Contact Tara Rivest for an application.

Wilderness Medicine: One-year fellowship that provides training in the care of patients with limited access - often in extreme environments. We hope to recruit enthusiastic fellows interested in providing excellent medical care while traveling and studying in some of the most amazing places on earth. Competitive salary with 8-10 weeks of protected travel time per year. Contact Tara Rivest for an application.

Ultrasound: One-year fellowship focused on expanding basic US skills gained in residency and learning new applications. Development of teaching skills is stressed, as are aspects of US program development including QA processes, hardware/network integration, documentation, billing, and purchase of equipment. The goal is to provide the tools necessary to become an effective US director. Apply online at www.eusfellowships.com.

International EM and Global Health: One-year fellowship provides training in global health and a certificate in tropical medicine. Collaboration with Tufts School of Medicine and the Baystate EM Residency training program, as well as international time for scholarly projects and a capstone experience. The scope of the program is global with special focus on Latin America and Pan-American collaborative projects. Competitive salary, benefits and travel package. Apply online at www.iemfellowships.com.

Pediatrics: ACGME accredited 3-year educational track for pediatric residency trained fellows and a two year track for EM trained fellows. The pediatric ED will move into a brand new 18 bed facility this fall. Applicants are accepted through the Electronic Residency Application Service. Contact Dr. Blake Spirko, Pediatric Fellowship Director, at blake.spirko@baystatehealth.org.

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