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Western Journal *of* Emergency Medicine:

Integrating Emergency Care with Population Health

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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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Effects of a Dedicated Regional Psychiatric Emergency Service on Boarding of Psychiatric Patients in Area Emergency Departments

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Introduction: Mental health patients boarding for long hours, even days, in United States emergency departments (EDs) awaiting transfer for psychiatric services has become a considerable and widespread problem. Past studies have shown average boarding times ranging from 6.8 hours to 34 hours. Most proposed solutions to this issue have focused solely on increasing available inpatient psychiatric hospital beds, rather than considering alternative emergency care designs that could provide prompt access to treatment and might reduce the need for many hospitalizations. One suggested option has been the "regional dedicated emergency psychiatric facility," which serves to evaluate and treat all mental health patients for a given area, and can accept direct transfers from other EDs. This study sought to assess the effects of a regional dedicated emergency psychiatric facility design known at the "Alameda Model" on boarding times and hospitalization rates for psychiatric patients in area EDs.

Methods: Over a 30-day period beginning in January 2013, 5 community hospitals in Alameda County, California, tracked all ED patients on involuntary mental health holds to determine boarding time, defined as the difference between when they were deemed stable for psychiatric disposition and the time they were discharged from the ED for transfer to the regional psychiatric emergency service. Patients were also followed to determine the percentage admitted to inpatient psychiatric units after evaluation and treatment in the psychiatric emergency service.

Results: In a total sample of 144 patients, the average boarding time was approximately 1 hour and 48 minutes. Only 24.8% were admitted for inpatient psychiatric hospitalization from the psychiatric emergency service.

Conclusion: The results of this study indicate that the Alameda Model of transferring patients from general hospital EDs to a regional psychiatric emergency service reduced the length of boarding times for patients awaiting psychiatric care by over 80% versus comparable state ED averages. Additionally, the psychiatric emergency service can provide assessment and treatment that may stabilize over 75% of the crisis mental health population at this level of care, thus dramatically alleviating the demand for inpatient psychiatric beds. The improved, timely access to care, along with the savings from reduced boarding times and hospitalization costs, may well justify the costs of a regional psychiatric emergency service in appropriate systems. [West J Emerg Med. 2014;15(1):1–6.]

INTRODUCTION

The growing number of patients seeking psychiatric care in hospital emergency departments (EDs) in the United States is well documented, and mental health presentations are now estimated to comprise between 6% and 9% of all ED visits.[1-3] However, many EDs have limited, if any, onsite mental health

services. As a result, patients presenting to EDs for psychiatric issues will often have no alternative but to endure long holding periods while staff search for an available inpatient psychiatric bed—a practice known as "boarding."[4]

Mental health patients boarding for long hours, even days, in EDs has become a considerable and widespread problem throughout the United States (U.S.), attracting attention in recent articles in the general news media.[5-7] A 2008 American College of Emergency Physicians (ACEP) survey determined that 79% of EDs board patients with psychiatric emergencies.[4] Further, patients presenting at the ED with mental health needs wait significantly longer than those presenting with physical health needs.[8-11]

Many studies have sought to quantify the length of time psychiatric patients remain in a state of limbo in the ED, with average boarding times ranging anywhere from 6.8 hours[12] to 34 hours[13] (Table 1). The 2008 ACEP survey found that more than 60% of EDs board patients needing admission for over 4 hours, 33% board for over 8 hours, and 6% board for over 24 hours.[4] Boarding times for psychiatric patients in Georgia EDs averaged 34 hours.[13] A 2008-2009 study of ED length of stays for patients receiving psychiatric evaluation in 5 hospitals found that the median time from disposition decision to discharge from the ED was about 6 hours.[14] Patients transferred to another hospital in one study experienced boarding times averaging 6.8 hours.[12] A 2004 survey in California found that the average length of stay for suicidal patients awaiting transfer was 7 hours.[15]

A more recent study, published in 2012, reported that in a survey of ED directors in California the average wait time for adult patients with a primary psychiatric diagnosis in the ED, from the decision to admit until placement into an inpatient psychiatric bed or transfer to an appropriate level of care, was 10.05 hours.[9] As these data could be considered to be of similar parameters, including being under the same state laws and regulations as the metrics in our proposed study, these results were chosen for comparison to our outcomes.

Such prolonged boarding times are a reflection of the time required in finding a placement and transferring patients to inpatient psychiatric beds, which is a frequent disposition for mental health patients in EDs.[8] In one study, between 52% and 71% of patients receiving psychiatric evaluation in the ED were admitted for inpatient psychiatric care.[14] Visits to the ED related to mental health and substance abuse issues have been found to be 2.5 times more likely to be admitted to a hospital than visits related to non-mental health related conditions.[3] Lack of available psychiatric clinicians to evaluate patients, requirements for pre-authorization of insurance prior to admission, lack of resources to conduct psychiatric evaluations, and lack of appropriate lower levels of outpatient care have also been cited as causes of boarding of psychiatric patients in the ED.[4,9,16] Other factors that have been shown to increase the length of time a patient may be boarded in the ED include patient characteristics, such as homelessness and having public insurance, and hospital factors such as the lack of onsite psychiatric beds and use of restraints or sitters.[17]

Table 1: Studies of boarding times for psychiatric patients in the emergency department (ED).

Study	Setting	Boarding time for adult patients*
Baraff et al 2006[15]	California	7 hr (average)
ACEP 2008[4]	National	≥4 hr (60% of EDs) ≥8 hr (33% of EDs) ≥24 hr (6% of EDs)
Tuttle 2008[13]	Georgia	34 hr (average)
Chang et al 2011[12]	Massachusetts	6.8 hr (median, to other facility) 2.5 hr (median, to in-house unit)
Stone et al 2012[9]	California	10.05 hr (average)

*Time from decision to admit until discharge from ED.

Boarding is a costly practice, both financially and medically. The average cost to an ED to board a psychiatric patient has been estimated at $2,264.[10] The psychiatric symptoms of these patients often escalate while they are boarded in the ED.[18]

More appropriate evaluation and treatment of psychiatric emergencies can take place when these patients are promptly referred from the general ED to a more specialized setting.[18] Over 80% of ED directors surveyed in 2008 by the ACEP indicated a preference for *regional dedicated emergency psychiatric facilities nationwide*.[4] Consumers of mental health services, reporting negative experiences receiving psychiatric care in general EDs, have also expressed a clear preference for treatment in specialized psychiatric emergency services.[19]

Dedicated Psychiatric Emergency Services

A dedicated psychiatric emergency services (PES) unit is a stand-alone ED specifically for psychiatric patients. Although many are independent or on a separate campus, most PES units in the U.S. are affiliated with an adjacent medical ED.[20] Rather than merely triaging and transferring psychiatric patients as is common in a standard ED, in a PES unit, patients are evaluated, receive intensive treatment, and are allowed time for observation and healing (typically, up to 24 hours is permitted onsite in these programs, which are considered to be outpatient services).[21] A common goal of PES programs is stabilization of acute symptoms and avoidance of psychiatric hospitalization when possible; the added time for onsite treatment and observation (which has led such operations to be known as "23-hour facilities") is what typically makes these results feasible.

The PES model is hailed as an important method of reducing boarding of psychiatric patients in the ED[22] and enhancing patient care.[18] In comparison to the more prevalent "consultant model" in EDs, PES is associated with more timely psychiatric emergency care and increased safety and access.[23] A PES unit can effectively treat to the point of

discharge, or provide alternatives to hospitalization, which can reduce demand for psychiatric inpatient beds.[24] However, research demonstrating the role of emergency psychiatric units in reducing psychiatric hospitalization has been limited, likely due to the wide variability in patient demographics, acuity, and program designs making relevant comparisons difficult. One community study did show that transferring patients to a crisis stabilization program from EDs, rather than to psychiatric hospitalizations, led to a 50% reduction in psychiatric hospitalizations.[32] A 1989 study of a PES with 23-hour treatment capacity decreased inpatient utilization by 44%.[24]

The Alameda Model

Alameda County, California, with a population of approximately 1.5 million, covers over 800 square miles in the East Bay region of the San Francisco Bay Area.[25] It includes such cities as Berkeley, Oakland, Pleasanton and Fremont. To provide emergency psychiatric care for this wide area with dense population centers, the county evolved what will herein be described as the Alameda Model.

California Welfare and Institutions Code sections 5150-5152 grant authority to police and other designated personnel to detain, transport, and involuntarily hold for up to 72 hours an individual deemed to be, due to a psychiatric condition, either a danger to self, a danger to others, or "gravely disabled" (wherein a mental condition makes one unable to provide for their own food, clothing and/or shelter).[26] In Alameda County, when law enforcement officers initiate an involuntary psychiatric detention (known in California as a "5150") on an adult, rather than transport the patient themselves for evaluation (as is common in other locations) they call for an ambulance instead. The arriving ambulance crew does a field screening, then determines if the patient is medically stable; if yes, they will transport directly to the PES at the stand-alone John George Psychiatric Hospital (approximately 60% of cases). If considered medically unstable, the patient is taken to the closest of 11 medical EDs in the county for evaluation and medical clearance.

Once such a patient taken for medical clearance is deemed stable for psychiatry, the attending physician at the medical ED contacts the psychiatrist at the John George PES for immediate transfer, rather than needing to seek an onsite consult. As this is considered a transfer from an ED to a dedicated emergency department for a higher level of care (comparable to transferring from a general ED to a trauma center), transfers are accepted regardless of inpatient bed availability. This means that once the referring ED has medically cleared a patient with an acute psychiatric condition, the John George PES will accept the patient for psychiatric evaluation without delay, whether or not the John George hospital has a bed, and irrespective of the patient's reasons for involuntary detention or previous psychiatric history. (There are no exclusions for specific individuals, no "no-admit" list, and no declining based upon an individual being "too violent" or "sociopathic.") Further, patients are accepted whether or not they have health insurance, and without any distinctions based on insurance carrier.

The Alameda Model thus provides for a 24-hour-a-day crisis mental health service that can be accessed either via ambulance from the field, or by direct transfer from any county ED. (Patients may also self-present for care.) As a result, areas EDs have a constant disposition for acute, involuntary psychiatric patients, and do not have to devote resources to providing immediate onsite psychiatric consultation or trying to obtain a psychiatric hospital bed. Once at the PES, patients receive intensive treatment with psychiatrists, nurses, and other affiliated personnel for up to 24 hours onsite, with the goals of rapid stabilization of the acute mental health crisis, and avoiding inpatient hospitalization when possible and appropriate.

This design suggests it should logically reduce psychiatric patient boarding times while also decreasing the percentage of patients admitted for inpatient care; yet the extent of such improvements had previously not been quantified. In this paper, we describe the results of a study of boarding times and psychiatric hospitalization rates in 5 hospital EDs operating under the Alameda Model for managing psychiatric emergencies.

METHODS

Of the 11 hospital EDs in Alameda County, we selected 5 for this study because they were all general community hospitals with no other urgent psychiatric options but to transfer to the John George PES. This makes the sample a fair comparison to the EDs in the 2012 California survey,[9] where there would also be little alternative to transferring out for psychiatric care.

The medical directors of each ED agreed to participate in data collection, but they were not told the nature or design of the study. Similarly, no staff members at the John George Hospital PES were informed that a study was underway.

Each of the EDs tracked the time when each patient in their facility on an involuntary 5150 mental health hold was deemed stable for psychiatric disposition, measured as the first minute the attending physician would attempt to telephone the John George PES for transfer. The second data point was the moment the patient exited the ED for transfer to the John George PES. Data were collected for all patients during the 30-day period from 10am January 15, 2013, to 10AM February 14, 2013.

We determined the boarding time for each patient by finding the difference in time between discharge from the ED and time the initial call was made to PES to request a transfer. We then calculated the average boarding time for all patients. Each patient was tracked in PES to determine whether they were discharged or admitted to inpatient psychiatric services. We calculated the percentage of admissions by dividing the number of patients admitted by the number of patients tracked.

After completion of the 30-day study, a retroactive chart

Table 2. Boarding time and psychiatric hospitalization rates under the Alameda Model.

Number of patients	n=144
Average boarding time*	107.6 min (1 hr 48 min)
Patients admitted to inpatient psychiatric services from psychiatric emergency services (PES)	24.8%
Patients discharged from PES	75.2%

*Time from patient determined to be stable for transfer to discharge from the emergency department.

Table 3. Boarding times and disposition, by hospital.

	Average Boarding Time (minutes)*	Patients admitted to inpatient psychiatric services from PES	Patients discharged from PES
Hospital A (n=25)	109.6	16% (n=4)	84% (n=21)
Hospital B (n=34)	101.9	20.6% (n=7)	79.4% (n=27)
Hospital C (n=28)	107.4	32.14% (n=9)	67.9% (n=19)
Hospital D (n=51)	113.8	27.45% (n=14)	72.6% (n=37)
Hospital E (n=6)	88.7	50.0% (n=3)	50.0% (n=3)
Total (n=144)	107.6	24.8% (n=37)	75.2% (n=107)

PES, psychiatric emergency services
*Time from patient determined stable for transfer to discharge from the emergency department.

Table 4. Comparison of average boarding times, Alameda model versus 2012 California (CA) study.

	2012 CA study	This study (Alameda Model)
Average boarding time in hospital medical EDs in patients awaiting psychiatric transfer	10 hr, 03 min	1 hr, 48 min

ED, emergency department

review was performed at John George Psychiatric Hospital for each patient identified, solely to determine if the patient was admitted for inpatient care after evaluation and treatment in the PES or was discharged. Patients were only identified to the extent that aggregate data could be collected, and the study did not influence the care of any patient involved. The institutional review board governing the John George Hospital approved the study as exempt from review.

RESULTS

A total of 150 patients were tracked over the data collection period. Data from 6 patients were incomplete and, therefore, discarded, resulting in a sample of 144 patients (Table 2).

The average length of boarding time for psychiatric patients was 107.56 minutes, or approximately 1 hour and 48 minutes. Of the 144 patients tracked, 24.8% were admitted to inpatient psychiatric services from PES while 75.2% were discharged from PES. Table 3 shows the average boarding times and admission rates for each of the 5 hospitals in this study.

DISCUSSION

The quandary of psychiatric patient boarding in EDs has garnered nationwide media attention.[5-7] In an effort to reduce boarding, the Centers for Medicare and Medicaid Services (CMS) responded by creating the Emergency Psychiatry Demonstration Project, allowing more inpatient psychiatric hospitals to accept Medicaid payments.[27] The Joint Commission has also emphasized the problem, even recommending that boarding in EDs should not exceed 4 hours.[28]

To date, most proposed solutions on this issue have emphasized a call for more psychiatric inpatient beds or better access to existing beds. Very little attention has been given to alternative treatment designs, specialized outpatient emergency psychiatric care, or methods to reduce the demand for inpatient beds. However, since reducing hospital inpatient admissions and re-admissions is a goal of present healthcare reform efforts,[29] it would follow that the most rational approach to this problem would be to provide prompt access to crisis services that can help avoid inpatient care altogether.

Unfortunately, too often the only options for mental health patients in EDs are either inpatient psychiatric admission or discharge home. For those under involuntary psychiatric detention, it can be assumed that in some jurisdictions, pending available beds, hospitalization rates for these individuals approach 100% — because there is often no other possible destination. This appears to be an unnecessary, time-consuming and expensive outcome, roughly equivalent in nature to hospitalizing every patient who went to an ED with chest pain.

The Alameda Model appears to be a potential alternative for systems in which the volume of patients with emergency psychiatric conditions far exceeds available psychiatric inpatient beds. By providing patient care in a PES both directly from the field and by self-presentation, the model avoids medical EDs altogether for most medically stable patients in a psychiatric crisis. For patients requiring medical stabilization, the PES permits swift transfer from medical facilities lacking appropriate mental health treatment options to an emergency care facility designed solely for psychiatric care. In a dedicated PES operating with a goal of avoiding hospitalization when possible, unnecessary inpatient admissions are avoided, and inpatient psychiatric beds are reserved for those who truly need them.

Compared with the most analogous published data, a study of boarding times in California EDs[9] (published in 2012 with one of this study's authors as lead author) that

found an average boarding time of over 10 hours, the EDs in the Alameda Model boarded psychiatric patients for only 1 hour and 48 minutes—a difference of over 80% (Table 4). Based on the assumption that many systems transfer nearly all of their involuntarily detained psychiatric patients to inpatient psychiatric hospitals, application of the Alameda Model may reduce psychiatric inpatient hospitalization by as much as 75%.

The relatively high rates of discharge and low rates of hospitalization under the Alameda Model can be largely attributed to the delivery of intensive treatment onsite, while these patients might have been provided with little or no treatment during the time spent boarding in other systems. The average patient at the John George PES spends between 16 and 22 hours in treatment; the discharges from the PES are, for the most part, not because the patient did not need acute crisis stabilization but rather that most psychiatric crises can be stabilized in less than 24 hours with appropriate interventions, obviating the need for inpatient hospitalization.

Interestingly, opportunities to develop the Alameda Model elsewhere in the U.S. may not need special funding or expensive new initiatives. The authors posit that the Alameda Model is currently possible across California (and indeed there are numerous analogous PES programs in California), because California Medicaid (Medi-Cal) has a unique facility-based billing code for "Crisis Stabilization." With this code an hourly rate is paid to a facility, with a minimum of 2 hours and a maximum of 20 hours. No additional professional fees are permitted; rather, the PES-type facility must pay for all staff, operations, medications and laboratory studies from this reimbursement. However, the rates (typically between $97-$140 per patient per hour)[30] are sufficient, with a high enough census, to pay for all services and professionals, including physicians, nursing, security, and social services/case management.

CONCLUSION

In conclusion, the authors suggest that investigating the establishment of a national billing code for Crisis Stabilization may be a worthy goal. Such a code, available across the U.S. for both Medicare and Medicaid, might encourage the free market to create self-sustaining programs, without the need for new government projects or separate funding. Essentially, adding the code would promote the formation of the services without any new targeted monies—while the overall system would actually save dollars, from less utilization of psychiatric inpatient beds and reduction of expensive boarding in medical EDs. Even the maximum PES visit of 20 hours at $110 per hour would cost less overall than the current estimate of $2,264 for an average ED boarding— not to mention the thousands of dollars saved by avoiding a psychiatric hospitalization. Such a confluence appears well-aligned with the healthcare reform goals of improving access and lowering costs.[31]

Indeed, there are a number of private organizations that have created psychiatric emergency or crisis stabilization units in the U.S., but a major difficulty in further expansion has been in finding means to support such operations financially.[32,33] Instituting a national billing code for crisis stabilization might facilitate development of more programs such as the Alameda Model, which the results of this study demonstrated can reduce system delays and improve access to acute psychiatric care.

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The Alameda Model: An Effort Worth Emulating

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Because the mental health care system in California is fragmented and chronically under-funded, the burden of psychiatric care has predictably fallen on emergency physicians. Community mental health resources and funding have decreased steadily over recent years, with the number of acute inpatient psychiatric beds per capita decreasing by over 30% since 1995.[1] In 1995, there were over 9,000 acute inpatient psychiatric beds, only to decrease each year to just 6,367 beds statewide in 2011.[1,2] In addition, 25 of California's 58 counties have no adult beds, and 45 have no pediatric beds, largely affecting rural counties and making post-discharge care nearly impossible – all while the number of acute psychiatric discharge diagnosis has been steadily increasing since 2007.[2] As a result, the struggle to find resources to care for this challenging patient population has become all too familiar to most emergency physicians.

The "Alameda Model" described by Zeller et al[3] is an example of a regional solution to the increasing problem of mental health patients boarding in emergency departments (ED). Zeller et al[3] provides an answer to the ubiquitous question in emergency medicine…Where is this patient going? Too often for our mental health patients the answer is nowhere fast. Alameda County has established a dedicated psychiatric hospital with an accompanying crisis stabilization unit. The regionalization of psychiatric care in Alameda allows expedited transfers from local EDs to the psychiatric hospital. The authors report an average time to transfer of 1 hour 48 minutes after completion of medical clearance. This is a considerable achievement, in comparison to the 6 to 16 hours noted in Stone et al.[4] In addition, Alameda's dedicated psychiatric hospital also accepts patients directly from EMS without an initial evaluation in an ED, which the authors note is a majority (60%) of their patient population. It would be interesting to know how many of the patients discharged in less than 23 hours were transferred from local EDs versus direct admissions from the field.

Furthermore, John George Hospital, Alameda's dedicated psychiatric hospital, meets its EMTALA obligation by accepting all transfers for emergency stabilization of the acute psychiatric emergency. It is time that all of our hospitals treat mental health patients with the same urgency as our trauma and medical patients. Regionalization of psychiatric care may prove to have outcome benefits as it has with regionalized trauma centers.

The Alameda model focuses on providing timely, specialized care to patients with mental health emergencies. Many times this care is given with the reality that no inpatient beds exist, and operate "with a goal of avoiding hospitalization when possible." Zeller et al[3] reports 75% of patients transferred to the dedicated regional psychiatric hospital were discharged – a high percentage. The authors attribute their high discharge rate to superior, timely care provided at the dedicated hospital, rather than on overall patient acuity. However, no data are provided to support these claims. For example, according to the Office of Statewide Health Planning and Development (OSHPD), Alameda County places more involuntary holds per population than any other county in California. In 2009 Alameda placed 11.0 involuntary holds per 1,000 population, while the next highest county in California only placed 6.4 per 1,000 population.[5] This may suggest instead that some of Alameda's mental health patients would not have been placed on an involuntary hold in other California counties in the first place, increasing the proportion of lower acuity psychiatric emergencies and thus accounting for the high discharge rate.

As a response, Zeller et al[3] propose two solutions: to increase the number and/or access to inpatient psychiatric beds, or to provide more access to crisis services "to help avoid inpatient care altogether." The authors highlight a specialized Medi-Cal billing code to encourage the establishment of more crisis stabilization centers. Certainly, a specialized stabilization center is preferable to a neglected corner of a busy ED where many mental health patients languish while awaiting transfer. But who will provide the funding and staffing to initially establish these centers? As the authors alluded to, this is an area that needs further exploration.

Reference is also made to the Medicaid Emergency Psychiatric Demonstration, which was established under Section 2707 of the Affordable Care Act as a means to

improve quality of care at a lower cost by reimbursing freestanding private psychiatric hospitals, referred to as "Institutions for Mental Disease" (IMD). California is one of 11 states participating. The federal definition of an IMD is "a hospital, nursing facility, or other institution of more than 16 beds, that is primarily engaged in providing diagnosis, treatment, or care of persons with mental diseases, including medical attention, nursing care, and related services." Historically, IMDs are ineligible for Medicaid/Medi-Cal reimbursement for acute psychiatric services for beneficiaries aged 22-64. Because of this federal exclusion, California counties currently pay for 100% of the associated costs for acute psychiatric care in IMDs. In California, IMDs together comprise 60 facilities and 6,200 additional acute psychiatric beds, which would provide a substantial boost to California's depleted psychiatric resources. The intent of this federal three-year project is to test whether this increased coverage improves access to care and reduces ED boarding times.[6,7] Only time will tell if this will provide relief to California's mental health care needs.

Although implementation of the Affordable Care Act presents many uncertainties, both new opportunities and challenges related to mental health care service are undoubtedly ahead, especially in California. The decentralization of the state's public mental health delivery structure, and subsequent financial responsibility shifted to individual counties, has led to a wide variation in program operations, quality, and availability. Certainly the Alameda model is a feasible alternative to the situation of other counties struggling with limited resources to provide care for mental health patients. Also, creating and expanding a national billing code for crisis stabilization is a worthwhile goal. Until more funding is achieved, it is also our hope that more of our counties and psychiatric hospitals would accept their responsibility to provide quality care to our patients with psychiatric emergencies. Regardless, emergency physicians will continue to care for these patients and fight for them to receive the most appropriate and timely care for their condition and state.

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Response to Moulin and Jones: "The Alameda Model: An Effort Worth Emulating"

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We sincerely appreciate the thoughtful discussion of our study from Drs. Moulin and Jones. However, we would like to provide clarification on several of the points they raised.

As Moulin and Jones correctly indicate, there is no delineation of the relative acuity of the study patients to those seen in other emergency settings in California. However, we are unaware of any established metric to provide such a comparison for this patient population, and no such categorization was noted in any of the other boarding time studies cited in the article.

And while Alameda County does have an elevated number of involuntary psychiatric holds, the county also has a disproportionate share of California's chronic and persistently mentally ill residents – out of which arise a significant percentage of the psychiatric emergencies. This might be attributable to the agreeable local climate and the tolerance of Berkeley and Oakland for those with alternative and transient lifestyles. But also, the county has a great number of psychiatric boarding homes and nursing facilities into which other Bay Area counties place many of their most severely psychiatrically disabled. We postulate that it is these population factors, along with persisting inner-city dilemmas like crack cocaine and concentrated poverty (which are less an issue in most other parts of the state), that lead to the increased involuntary detentions.

Further, the greatest percentage of the patients brought to the study site are detained by police in Oakland, a city recently described as the second most-dangerous in the United States (U.S.), due to its high incidence of violent crimes.[1] Yet Oakland has a police officer to population ratio less than half of the nation's most dangerous city, Detroit.[1] The idea that the relatively overwhelmed Oakland police would be taking time away from intervening in violent crimes, to instead detain sub-acute psychiatric patients that other counties would not find in need of treatment, seems contrary to common sense.

The Federal Demonstration Project allowing more psychiatric hospitals to accept Medicaid has two major shortcomings which we propose may limit its impact on boarding. For one, it fails to recognize that many of these hospitals may already be at or near capacity with otherwise-insured patients, and would be unlikely to suddenly accept large numbers of low-reimbursement Medicaid instead. Secondly, this approach would still only be continuing the status quo of shunting patients directly from EDs to inpatient psychiatric beds, rather than attempting outpatient-level stabilization. A medical analogy to this would be skipping ED interventions in patients with asthma attacks, admitting to the inpatient floor instead, and only then beginning inhaler treatment – hardly the most efficient paradigm.

We suggest the most impactful way to reduce ED boarding of psychiatric patients would be to facilitate treatment alternatives which lower demand for scarce inpatient beds; one possible such design is described in our study. There is nothing magic or extraordinary about the methods used at the study site, nor are its percentages of patients discharged within 24 hours unusual for crisis stabilization programs across the U.S. The important factor is that with prompt treatment, the majority of psychiatric emergencies can be stabilized in less than a day, often in less time than patients currently spend boarding in EDs awaiting hospitalization. Just as surgeries which formerly required hospitalization are now done in ambulatory centers, and uncomplicated childbirth can have discharges the following morning rather than after several days, so too can acute psychiatric treatment be converted from the tradition of days to hours. This redefinition could lead to improved access to appropriate, timely care, while greatly reducing costs and unnecessary hospitalizations -- all consistent with the goals of healthcare reform.

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Vital Signs
from the Centers of Disease Control and Prevention's MMWR

Increasing Suicide Rates Among Middle-age Persons and Interventions to Manage Patients with Psychiatric Complaints

In conjunction with the Morbidity and Mortality Weekly Report published by the Centers for Disease Control and Prevention

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The Centers for Disease Control and Prevention (CDC) has published significant data and trends related to suicide rates in the United States (U.S.). Suicide is the 10th leading cause of death in U.S. adults, and rates are increasing across all geographic regions. There is a significant increase in the suicide rate among adults in the 35-64 age range. We present findings from the CDC's Morbidity and Mortality Weekly Report (MMWR) with commentary on current resources and barriers to psychiatric care. [West J Emerg Med. 2014;15(1):11–13.]

CDC MMWR FINDINGS

In the May 3, 2013, issue of Morbidity and Mortality Weekly Report (MMWR), the Centers for Disease Control and Prevention (CDC) published data and trends related to suicide rates in the United States (U.S.). The MMWR article examined rates by sex, age group, race/ethnicity, state and region of residence and mechanism of suicide. The report concluded that there is an age-adjusted increase in the suicide rate among middle-aged adults. Traditionally, suicide prevention efforts have been focused on young persons and older adults. This report underscores the need for suicide prevention measures directed toward middle-aged adults.

To gather data related to suicide rates, the CDC used the National Vital Statistics System (NVSS) and queried all reported suicides in U.S. residents who were 10 or more years old from 1999 to 2010. Age-group specific suicide rates, as well as age-adjusted annual rates, were calculated using the U.S. standard 2000 population from the U.S. Census Bureau. Percentage changes in observed suicide rates from 1999 to 2010 were calculated with corresponding 95% confidence intervals.

From 1999 to 2010, the age-adjusted suicide rate for adults aged 35-64 years increased significantly by 28.4% from 13.7 per 100,000 to 17.6 ($p<0.001$). Age-adjusted suicide rates in other age groups (10-34 and >65 years) were comparatively small and not statistically significant. The report further stratifies the 35-64 years age group into subsets with the greatest increases among men aged 50-59 years, and in women aged 60-64 years.

When examining the population as a whole, suicide rates increased significantly across all age demographics and in all geographic regions (Table 1). By mechanism, the greatest increase was observed for the use of suffocation (81.3%, from 2.3 to 4.1), followed by poisoning (24.4%, from 3.0 to 3.8) and firearms (14.4%, from 7.2 to 8.3). By racial/ethnic population, the greatest increases were among American Indian/Alaska Natives (65.2%, from 11.2 to 18.5) and whites (40.4% from 15.9 to 22.3).

The report offers that possible contributing factors in the rise in suicide rates among middle-aged adults include the recent economic downturn, a cohort effect of the "baby boomer" generation, which had unusually high suicide rates as adolescents, and the rise in intentional overdoses related to the availability of prescription opioids.

The CDC states that there were significant limitations to this evaluation. Suicide rates are likely an underestimate of the actual prevalence because these may be undercounted in NVSS. The findings are subject to variation in how coroners and medical examiners record manner of death and errors in classification of race and ethnicity. The NVSS lacks information about physical and mental health history limiting the context of this information.

COMMENTARY

It's 7PM on a Friday evening and a 45-year-old woman presents to the emergency department (ED) with worsening depressive symptoms and passive suicidal ideation. She was formerly treated by an outpatient psychiatrist but has not seen them for several months due to "insurance issues." She has

one prior suicide attempt but was able to contract for safety and was cleared by her psychiatrist for outpatient therapy at that time. Your patient appears to have capacity and has good insight into her illness. You are relieved for a moment that she is not agitated or aggressive. You consider your options. Is it possible to contact this patient's former psychiatrist? Do you have access to a psychiatrist in the ED to assist in the appropriate disposition of the patient? What you are convinced of is that your patient will most likely wait hours until a clear treatment plan and disposition is achieved. This clinical scenario is not unfamiliar to most EDs, and we are intimately aware of the impact that lengthy stays or aggressive patients have on the ED work environment.

Emergency physicians (EPs) throughout the country, in all practice settings, share the challenge of finding an appropriate disposition for patients presenting with mental health complaints. The MMWR is useful in identifying middle-aged persons as an increasingly at-risk demographic with regards to suicide but provides little insight into etiology or clinical significance. Additionally, the report indicates that the rate of suicide has risen across broad demographics and geographic regions. Because of a lack of adequate outpatient services and access to care to these services, more mental health patients turn to EDs for care. EPs are under increasing pressure to identify patients at the highest risk and provide care that allocates limited resources to sub-segments of this population with the most emergent need.

Suicide is the 10th leading cause of death in the U.S. and resulted in the loss of 38,364 lives in 2010.[2] Alarmingly, studies conducted outside of the U.S. suggest that high rates (19%) of suicide attempters presenting to EDs will reattempt within 6 months and 39% of those who complete suicide presented to an ED in the year prior to their death.[3,4] Although these ED visits may not be for primary mental health complaints, they do represent an opportunity for identification of at-risk individuals and early intervention. Several studies have examined the prevalence of suicidal ideation in the general medical population of EDs and have found rates varying from 3%-11.6%.[5,6] The question remains, can we develop adequate assessments to identify those at risk for self-harm?

There have been several studies to develop and validate screening tools to identify patients at risk for future self-harm.[7-9] Despite these efforts, these tools have failed external validation and we still lack a universally accepted risk-stratification tool or decision rule.[8,10] It is possible that the regional variation in substance abuse and culturally specific stressors limits the generalizability of these tools. To maximize the sensitivity, EPs may have to "cast a wider net." Studies have examined the effect of universal screening for depression.[5,6,11] But there is insufficient evidence to support universal screening in a general medical population.[12]

The Joint Commission National Patient Safety Goal (NPSG) 15 calls for risk assessment, appropriate treatment, and resource referral upon discharge for all patients presenting with an emotional or behavioral disorder to a general hospital.[13] In response to the NPSG the Emergency Department Safety Assessment and Follow-up Evaluation (ED-SAFE) study has been designed to evaluate the rate of usual practice screening and treatment in 8 representative EDs, as well as the effect of universal suicide-risk screening either alone or with a brief self-directed intervention.[11] The results from this study are pending but should provide useful information to answer these questions.

Unfortunately psychiatric services are almost always limited, especially after office hours, and in many hospitals they may not be accessible at all. Improvements in our ability to identify patents at risk are only helpful if we have effective services at all hours. Standard of care is face-to-face evaluation of a patient by a mental health professional. For most EDs, the practical logistics of achieving this type of evaluation can take hours or even days to complete, and patients may need to be transported off-site for evaluation. Emerging treatment modalities give promise of tools for time and cost-effective care. Some have suggested that system-wide approaches by implementing regionalized psychiatric care could be helpful.[14,15]

The ED-SAFE study will evaluate the efficacy of a self-administered tool for preventing suicide by reinforcing coping strategies and developing a safety plan. This brief intervention will be followed by 7 telephone-based sessions to help promote outpatient treatment engagement. This trial is currently enrolling patients. Additionally, videoconferencing between the patient and provider is emerging as a modality for implementing psychotherapy and initial assessments in remote areas.[16,17] This may prove useful in hospitals and regions with limited psychiatric resources. While studies have showed variable results for simple contact or limited interventions, more intensive care and case management can prevent future episodes of self-harm.[18-20] It is possible that quality care in a time of crisis may reduce the need for inpatient admission and the need to board in the ED. Although "tele-psychiatry" is a promising tool that may eventually extend delivery of care after office hours and in a broader geographic area, its efficacy has yet to be validated.[21] It is unclear if linkage to outpatient care will reduce the need for emergency services.[22]

There are several practical points the ED physician should remember when treating patients with self-harm. Corroborative information from the patient's family and friends is crucial. The patient's social ties and access to care are helpful in assisting ED physicians in patient dispositions. As with any patient, clear and precise documentation of the patient visit and encounter is always prudent. The phrase "contracting for safety" is debated among ED physicians, psychiatrists and in the legal world. Although having this conversation with the patient is germane, it may not afford legal protection in the event of a suicide attempt.[23]

EDs are facing remarkable increases in patient volume and it is anticipated that with the implementation of the

Affordable Care Act the patient volume will grow. Patients coming to the ED with self-harm are particularly challenging in that there is no simple way to risk stratify them and in turn their lengths of stays are alarmingly high.[24] With the recent MMWR that identifies a sub-segment of the population with increased risk for self-harm, EPs should be aware of the special circumstances of these patients and push their hospital and regional systems to improve care for their patients. Lengthy stays impact EDs and contribute to sub-optimal psychiatric care and ED crowding, which restricts access to care for all patients. The increasing number of patients with psychiatric complaints places a significant onus on EPs to allocate limited psychiatric resources appropriately. Currently, our options are few and in many areas inadequate. We must seek tools and evoke changes in policy that will extend our limited resources and provide practical and effective interventions.

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Patient Attitudes Regarding Consent for Emergency Department Computed Tomographies

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Introduction: Little is known about patient attitudes towards informed consent for computed tomography (CT) in the emergency department (ED). We set out to determine ED patient attitudes about providing informed consent for CTs.

Methods: In this cross-sectional questionnaire-based survey study, we evaluated a convenience sample of patients' attitudes about providing informed consent for having a CT at 2 institutional sites. Historically, at our institutional network, patients received a CT at approximately 25% of their ED visits. The survey consisted of 17 "yes/no" or multiple-choice questions. The primary outcome question was "which type of informed consent do you feel is appropriate for a CT in the Emergency Department?"

Results: We analyzed 300 survey responses, which represented a 90% return rate of surveys distributed. Seventy-seven percent thought they should give their consent prior to receiving a CT, and 95% were either comfortable or very comfortable with their physician making the decision regarding whether they needed a CT. Forty percent of the patients felt that a general consent was appropriate before receiving a CT in the ED, while 34% thought a verbal consent was appropriate and 15% percent thought a written consent was appropriate. Seventy-two percent of the ED patients didn't expect to receive a CT during their ED visit and 30% of the ED patients had previously provided consent prior to receiving a CT.

Conclusion: Most patients feel comfortable letting the doctor make the decision regarding the need for a CT. Most ED patients feel informed consent should occur before receiving a CT but only a minority feel the consent should be written and specific to the test. [West J Emerg Med. 2014;15(1):14–19.]

INTRODUCTION

From 1995 to 2007, the number of emergency department (ED) visits that included a computerized tomography (CT) examination increased from 2.7 million to 16.2 million, and the percentage of visits associated with CT increased from 2.8% to 13.9%.[1] With this increase in the number of scans and the associated radiation doses from these commonly performed diagnostic examinations, concern regarding radiation exposure has increased.[2] Problems from dye allergies, renal failure, expense, length of ED stay, and the burden of false positives are other associated risks.[3-7] At a time when the federal government is encouraging physicians to reduce unnecessary tests[8], and with physicians' and laypersons' increasing awareness regarding the radiation risks associated with CT, it is unclear what patient's attitudes are regarding a formal patient consent process for CTs ordered from the ED. It is reported that only 15% of academic medical centers inform patients about possible radiation risks and 9% about alternatives to CT.[9] Additionally, the existing

literature does not reflect the current attitudes of emergency patients regarding this important issue.

Patients can give informed consent for CTs in different ways. A common process is the general consent in which a patient signs to request treatment before their ED visit. Physicians and patients operate on the presumption that it includes any CTs that might be recommended. If during the course of treatment a patient tells the healthcare provider that they agree to have the CT this would be considered verbal consent. Patients might be required to sign a form right before they have the CT. This is a written consent specific to the CT. We set out to assess patient expectations about CTs in the ED and attitudes about which type of informed consent they felt was most appropriate. Secondarily we set out to determine if demographic factors correlated with the perception of appropriate consent.

METHODS

We obtained expedited Institutional Review Board approval for this cross-sectional, questionnaire-based survey study. The survey was developed and refined by the study team and piloted with 50 surveys distributed over a 2-month period in 2010. We used these pilot surveys to power the study; they were not used in the final data analysis. Subject criticisms and common concerns from this pilot were used to further revise and contribute to the survey validation. Analysis of the pilot data led to adding a second site for data collection to increase the yield and shorten the data collection period as well as potentially expand the diversity of our population cohort. The pilot data also led to powering the sample size to 300 responses (alpha=0.05; power of 0.80) to discriminate a difference of 5 percentage points between responses on the primary outcome question (#12) on the survey.

Surveys were distributed over an 11-month period in 2010 by approaching a convenience sample of patients during weekday hours (8:30AM–4:00PM) at 2 of our institutional sites. The first, a tertiary, suburban, Level 1 trauma center, has a yearly census of 74,000 patients, while the second, an urban freestanding ED has a yearly census of 33,205. Historically, this urban second site has demographically had more diversity in patient ethnicity and educational level. Previously, in this same fiscal year at these sites, patients received a CT at approximately 25% of their ED visits. Our primary outcome measure was to determine if ED patients feel informed consent is required for CTs ordered from the ED. Our secondary outcome measure was to determine how much a patient trusts the doctor to make the decision for them about whether they need a CT.

A research team member gave the paper survey to the patient to complete. If the patient was not able to make medical decisions themselves (for example, children), their surrogate (for example, parent) was given the survey. The survey instructed surrogates to choose the answer that reflected their demographics and opinions (not the patient's). Surrogates were allowed to participate as appropriate because the study team felt their involvement was representative of the common clinical scenario in which a family member provides consent. Team members included research assistants (no volunteers), coordinators, and physicians (EM residents and attendings). The survey was administered to subjects in the treatment bay. Inclusion criteria included any ED patient (or their surrogate), without regard to acuity or chief complaint, who agreed to participate and was able to understand and respond to the survey questions in English. No incentives were provided to subjects for participation.

The survey instrument stated that participation was voluntary and anonymous. The study team member was aware of the study's purpose, but no patient education about the risks of CT was provided or questions answered in this regard by survey administrators. A brief definition for each of the different types of consent was imbedded in the survey. The survey consisted of 17 "yes/no" or multiple-choice questions, 5 of which were demographic questions (Appendix).

We computed frequencies of responses for each question. This was followed by a series of cross-tabulations and logistic regressions that examined the potential relationships between selected socio-demographic factors (age, gender, race/ethnicity, language, educational level, and the relationship between the respondent and the patient seen during that visit) and questions relating to the use of informed consent for CT administration. We used Chi-square and students t-test to determine significance and unless otherwise noted, all comparisons were statistically significant at $\geq$0.05. We used SPSS version 18 (IBM Corporation, Armonk, NY) for analysis.

RESULTS

We analyzed 300 surveys, 90% of surveys distributed. For demographics of survey respondents, see Table 1. Forty-five percent of the ED patients were age $\geq$50 and 55% were female. Eighty percent of the ED respondents were white and 84% were non-Hispanic. Forty-five percent of these respondents had at least some college education. Ninety percent primarily spoke English, and 9% primarily spoke Spanish. Seventy-one percent of the responses to the survey were from the patient themselves, while a parent or guardian of the patient provided 11% of the responses. A son or daughter responded 7% of the time, other relative, 9%, or a friend, 2% of the time.

Survey response rates are shown in Table 2. Seventy-two percent of the ED patients did not expect to receive a CT during their ED visit that day. Thirty percent of the ED patients had provided consent prior to receiving a CT in the past. Seventy-seven percent of the ED patients thought they should give their consent prior to receiving a CT. Ninety-five percent of the ED patients also responded they were either comfortable or very comfortable with their physician making the decision regarding whether they needed a CT. Prior to CT in the ED, 40% of patients reported that general consent was sufficient, while 34% required verbal and 14% written.

We correlated age, race/ethnicity, education level and

patient relationship to the respondent with the patient's expectation of a CT during their ED visit. Surrogates for minors were less likely than other adults to expect a CT during the ED visit (4% versus 33%, 34%, 29% and 25%, respectively according to age category, p<0.001).

Hispanics were somewhat less likely than non-Hispanics to expect a CT (20% versus 29%, p<0.01). Persons of other races were less likely than whites or African Americans to expect a CT (15% versus 30% and 26%, respectively, p<0.01). The parent/guardian of the patient or the son/daughter of the patient also were less likely than the patient to expect a CT during the ED visit (11% versus 26%, p<0.001).

Perspectives on the necessity of informed consent are in Table 3. Age, race/ethnicity, language and patient relationship were also correlated with the patient's perceptions of informed consent. Surrogates of persons under age 18 were less likely than other adults to indicate that patients should give their informed consent prior to CT (60% versus 84%, 82%, 77%, 73% and 79%, respectively according to age category, p<0.01). Whites were less likely than African Americans or other ethnicities to indicate that patients should give their informed consent (74% versus 87% and 91%, respectively, p<0.01). Hispanics were more likely than non-Hispanics to indicate that patients should give their informed consent (87% versus 75%, p<0.01). The parent/guardian of the patient was less likely than the son/daughter of the patient, some other relative, or a friend of the patient to indicate that patients should give informed consent (57% versus 73%, 88%, 75% and 81%, respectively according to relationship category, p<0.01).

Race was correlated with the degree of comfort patients felt with the physician making the decision regarding whether a CT should be administered during an ED visit. Whites were more likely than African Americans to indicate that they feel comfortable with the physician making the decision (95% versus 87%, p<0.01), while Hispanics had a similar comfort level as whites. Adjusting for socio-demographic factors, educational level was also correlated with the patient's comfort with the physician making the decision regarding the administration of a CT. Persons with 9-11 years of schooling or with some college education were more likely than others to feel comfortable with the physician making the decision (p<0.01).

Lastly, race/ethnicity and language were correlated with the type of consent the patient felt was appropriate for having a CT. Whites were less likely than African Americans to feel that a written consent was needed for a CT (15% versus 26%, respectively, p<0.01).

Table 1. Demographics of survey respondents

	Percent (95% CI)	N
Patient's age		
<18	8 (05-11)	24
18-29 years	18 (14-22)	54
30-39 years	13 (09-17)	39
40 to 49 years	16 (12-20)	48
50 to 59 years	14 (10-18)	42
60+ years	31 (26-37)	93
Gender		
Female	55 (50-60)	165
Male	45 (40-50)	135
Hispanic/Latino		
Yes	16 (12-20)	48
No	84 (74-84)	252
Not sure		
Race		
White	80 (75-84)	240
Black or African-American	8 (05-11)	24
Other	12 (08-16)	36
What language do you speak most often?		
English	90 (87-94)	270
Spanish	9 (05-13)	27
Other	1 (00-02)	3
Relationship to the patient		
Parent/Guardian	11 (07-15)	33
Son/Daughter	7 (03-11)	21
Other relative	9 (05-13)	27
Friend	2 (00-04)	6
Self	71 (66-76)	213
Highest grade of schooling completed		
Grades K-8	3 (02-06)	9
Grades 9-11	12 (08-16)	36
GED/12 years	37 (32-42)	111
Some college	26 (21-31)	78
4 years of college or more	19 (15-23)	57
Pregnant		
Yes	7 (05-09)	21
No	93 (90-97)	279
ESI		
1	0	0
2	34 (29-40)	102
3	49 (44-54)	147
4	15 (11-19)	45
5	2 (00-04)	6
N		300

CI, confidence interval

DISCUSSION

Little is known about emergency patients' feelings concerning CTs and the need for informed consent. This study sought to evaluate current attitudes of patients regarding the appropriateness of and/or need for informed consent for CTs in the ED. The majority were either comfortable or very comfortable with the physician making the decision regarding whether they needed a CT. Of those, whites and Hispanics were more likely than African Americans to indicate feeling comfortable with the physician making the decision regarding whether they need a CT during their ED visit. This is similar to prior studies that have shown ethnic variations and disparity in trust levels of physicians.[10,11]

Table 2. Patient survey responses.

	Percent (95% CI)
What is your chief complaint?	
Abdominal pain	21 (17-25)
Injury (trauma)	12 (08-16)
Fever	2 (02-04)
Headache	4 (02-06)
Other	62 (56-67)
Do you expect to receive a CT on today's visit?	
Yes	28 (23-33)
No	72 (67-77)
Do you think patients should give their informed consent before they get a CT in the ED?	
Yes	77 (72-82)
No	23 (18-29)
How much do you trust the doctor to make the decisions for you about whether you need a CT?	
Very comfortable	59 (54-65)
Comfortable	35 (30-41)
Uncomfortable	5 (02-09)
Very uncomfortable	1 (00-02)
What type of informed consent do you feel is appropriate for a CT in the ED?	
General consent	40 (35-46)
Verbal consent	34 (29-40)
Written consent	15 (11-19)
I don't think the patient's consent is necessary	11 (07-15)
Have you ever given consent prior to a CT?	
Yes	37 (32-42)
No	44 (39-49)
Don't know	19 (15-23)
Which type of informed consent did you give?	
General consent	32 (27-38)
Verbal consent	41 (36-47)
Written consent	15 (11-19)
I did not given informed consent	12 (08-15)
For your most recent CT, to whom did you give your informed consent?	
Physician	48 (43-53)
Nurse	12 (08-15)
CT technologist	9 (06-13)
I did not give informed consent	12 (08-15)
I gave informed consent, but don't know to whom	19 (15-23)
Have you or anyone you know ever had a problem that was caused by having a CT?	
Yes	5 (03-07)
No	95 (92-98)
What was the problem caused by having a CT?	
Allergic reaction to the CT dye	38 (33-44)
Kidney failure	4 (02-06)
Local skin irritation	15 (11-19)
Other	42 (37-48)
N	300

CI, confidence interval;
ED, emergency department;
CT, computed tomography

Table 3. "Patients should give their informed consent" by selected demographic characteristics.

	Yes (95% CI)	No (95% CI)	p
Patient's Age			
<18	60 (55-66)	40 (35-46)	0.262
18-29 years	84 (80-89)	16 (12-20)	
30-39 years	82 (78-87)	18 (14-22)	
40 to 49 years	77 (72-82)	23 (17-28)	
50 to 59 years	73 (68-78)	27 (22-33)	
60+ years	79 (74-83)	21 (17-26)	
Gender			
Female	78 (73-82)	21 (17-26)	0.632
Male	76 (71-81)	24 (19-30)	
Hispanic/Latino			
Yes	87 (83-91)	13 (10-17)	0.001
No	75 (70-80)	25 (20-31)	
Race			
White	74 (69-79)	26 (21-32)	0.038
Black or African-American	87 (83-91)	13 (10-17)	
Other	91 (88-95)	9 (06-13)	
What language do you speak most often?			
English	76 (71-81)	24 (19-30)	0.08
Spanish	93 (90-97)	7 (04-11)	
Other	50 (45-55)	50 (45-55)	
Relationship to the patient			
Parent/Guardian	57 (62-63)	43 (38-49)	0.04
Son/Daughter	73 (68-78)	27 (22-33)	
Other relative	88 (84-92)	12 (09-16)	
Friend	75 (70-80)	25 (20-31)	
Self	81 (77-86)	19 (15-23)	
Highest grade of schooling completed			
Grades K-8	80 (76-85)	20 (16-25)	0.945
Grades 9-11	74 (69-79)	26 (21-32)	
GED/12 years	76 (71-81)	24 (19-30)	
Some college	80 (76-85)	20 (16-25)	
4 years of college or more	79 (74-84)	21 (17-26)	
N	230	68	

The majority of the patients surveyed in our study thought consent should occur before a CT. Of those, the majority stated a general consent, such as that signed by the patient at the beginning of the visit for all treatments, was acceptable. Approximately one third surveyed felt a more specific verbal consent should occur before receiving a CT. African Americans were more likely to feel a written consent was appropriate.

Although layperson-accessible media supports the increased awareness of radiation exposure from CT, it is perceived to be emphasized without including the other, equally problematic potential adverse events associated with CTs, including allergic reaction to the CT dye, kidney failure and local skin irritation at the intravenous site. Our study supported this, as 95% of those surveyed had not had

or known anyone to have had a problem caused by having a CT. Of the small subset that did, the majority reported the problem to be allergic reaction to the CT dye. Of note, adverse outcomes are distinctly different between CT with and without contrast and were not evaluated separately in our study design.

Approximately 25% of patients in the ED received CT during the fiscal year in which the surveys were distributed. Interestingly, 28% of the respondents answered that they expected to receive CT during his/her ED visit. Men and women showed no difference in expectations in regard to receiving a CT . In contrast, Hispanics were less likely to expect to receive a CT than Whites or African-Americans. More importantly, 72% of those participating in this study did not expect to receive a CT. When these patients signed their registration and general consent to treat paperwork, they signed it, not expecting to receive a CT.

Some ethicists might argue this refutes the ability for our generalized consent to be used as implied consent for CT studies. Further detailed exploration of how this expectation plays into attitudes could be considered.

Past literature regarding consent reported that the majority of CT informed consent was obtained by a CT technologist.[9] In contrast, our study revealed almost half (48%) of patients recalled being consented by a physician before getting a CT in the ED. Only 9% reported getting consent from a CT technologist. Future cost analysis projections should include the variations in outcome potentials when responsibility for consent is ascribed to differing personnel.

The authors intend these findings to be a catalyst for discussion about the need and specific type of informed consent that should be provided as standard of care for patients receiving a CT in the ED. This is a complex topic and involves risk to the patient, to the institution and even prevailing legal precedent. There is a marked difference in the sheer practicality of having general consent for treatment encompass permission for CT versus a specific unique consent forms for all CTs in the ED. Factored into the discussion must be surrogate opinions, and the necessity of their verbal or written specific consent for those who are vulnerable by age, dementia, or critical illness. Policy makers must consider the burden in an emergency setting of mandating specific written consent and balance this with the potential benefits.

Future studies may want to compare and contrast the attitudes between providers and patients about informed consent for CTs in the ED, as well as actual cost benefit analysis associated with different formats of consent.

LIMITATIONS

Several limitations deserve discussion. This study was performed at a single healthcare network in Pennsylvania and thus may not be geographically generalizable. Potential sampling bias may have been introduced by surveying a convenience sample of patients only during regular weekday hours. While the response rate was high, it is unknown what differences exist between those who responded to the survey and those who did not. It should also be considered that there was no verification of patient's responses to prior CT questions (potential recall bias) or pre-assessment of the patient's knowledge of the dangers of CT. Although the survey instrument defined the different types of consent there was no verification that the patients knew the difference between the various types of consent. Furthermore, there was a broad nature of chief complaints with "other" being the most commonly (62%) captured. This limited information on chief complaint may have impacted the patients' perceptions that they would not receive a CT. Additionally, potential social desirability bias may have influenced some survey responses.

Either the patient or guardian needed to read and understand English at approximately the eighth grade level to read the survey. This may limit the external validity of the study, especially if more urban settings are included in future studies, as a larger variety of ethnicities and educational levels generally reside in large urban areas.

CONCLUSION

A minority of patients expect to get a CT during their ED visit. Most patients feel comfortable letting the doctor make the decision regarding the need for a CT. Most ED patients feel informed consent should occur before receiving a CT, but only a minority feel the consent should be written and specific to the test.

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Prognosis for Emergency Physician with Substance Abuse Recovery: 5-year Outcome Study

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Introduction: Emergency physicians (EPs) are reported to have a higher rate of substance use disorder (SUD) than most specialties, although little is known about their prognosis. We examined the outcomes of emergency physician compared to other physicians in the treatment of substance use disorders in Physician Health Programs (PHP).

Methods: This study used the dataset from a 5-year, longitudinal, cohort study involving 904 physicians with diagnoses of SUD consecutively admitted to one of 16 state PHPs between 1995 and 2001. We compared 56 EPs to 724 other physicians. Main outcome variables were rates of relapse, successful completion of monitoring, and return to clinical practice.

Results: EPs had a higher than expected rate of SUD (odds ratio [OR] 2.7 confidence interval [CI]: 2.1–3.5, $p<0.001$). Half of each group (49% of EPs and 50% of the others) enrolled in a PHP due to alcohol-related problems. Over a third of each group (38% of EPs and 34% of the others) enrolled due to opioid use. During monitoring by the PHPs, 13% of EPs had at least one positive drug test compared to 22% of the other physicians; however, this difference was not significant ($p=0.13$). At the end of the 5-year follow-up period, 71% of EPs and 64% of other physicians had completed their contracts and were no longer required to be monitored (OR 1.4 [CI: 0.8-2.6], $p=0.31$). The study found that the proportion of EPs (84%) continuing their medical practice was generally as high as that of other physicians (72%) (OR 2.0 [CI: 1.0–4.1], $p=0.06$).

Conclusion: In the study EPs did very well in the PHPs with an 84% success rate in completion and return to clinical practice at 5 years. Of the 3 outcome variables measured, rates of relapse, successful completion of monitoring, and return to clinical practice, EPs had a high rate of success on all variables compared to the other physician cohort. These data support the conclusion that EM physicians do well following treatment of SUD with monitoring in PHPs and generally return to the practice of emergency medicine. [West J Emerg Med. 2014;15(1):20–25.]

INTRODUCTION

The prevalence of substance abuse disorders (SUD) among physicians has been estimated between 10% and 14%.[1,2] This is similar to the prevalence in the general population.[3] More importantly, it has been reported that several specialties appear to have a higher than expected rate of SUD.[1,4,5] Anesthesiology, emergency medicine, and psychiatry are the 3 specialties most commonly reported as being over-represented. In the most recent AAMC manpower survey, emergency medicine accounted for 2.9% of physicians,[6] whereas, reports in the literature suggest that EPs (EP) account for 7% to 18% of physicians treated for SUD and managed by Physician Health

Programs (PHPs).[4,5,7] Despite their reported higher rates of SUD and participation in PHPs, there are no published data focusing specifically on the prognosis and recovery of EPs in these programs.

As a group, physicians who are enrolled in PHPs do well, with a reported 75% to 90% abstinence rate at 5 years after treatment.[2,5,8] However, there are observed differences among specialties as to type of disorder and recovery success. Anesthesiologists, for example, suffer disproportionately from opioid dependence than alcohol dependence.[9] Surgeons appear to have a lower rate of return to clinical practice, although having a comparable 5-year successful completion rate.[10] It is unclear whether the subset of EPs served by PHPs have similar 5-year outcomes differences.

In this study, we use data from 16 state PHPs that followed participants with SUD for 5 or more years. The objective of the present study is to compare outcomes of EPs versus non-EPs EPs enrolled in state PHPs. To date, there are no reports regarding whether EPs perform as well as other physicians. It is also important to determine if there are any characteristics within the EP cohort that differ significantly from the non-EPs. We sought specifically to identify rates of relapse, monitoring contract completion, and successful return-to-clinical-practice after 5 years.

METHODS

Design

The study used the dataset from a 5-year, longitudinal, cohort study reported previously, involving 904 physicians with diagnoses of substance abuse or dependence consecutively admitted to one of 16 state PHPs between 1995 and 2001.[5] The characteristics and outcomes of a subset of 56 EPs were compared to those of 724 other physicians. We restricted the comparisons to objective data from official records (for example, treatment services, attendance, sanctions by the program, reports to licensing boards) and from laboratory records (urine tests and other specimens). To protect the confidentiality of the physicians, members of each program's medical records department collected the data. Data were collected between November 2006 and January 2007 under training, supervision, and monitoring by the authors (GS). All components of this study were reviewed and approved by the Institutional Review Board of the Treatment Research Institute.

Participant Sample

Of the 904 participants in the original study, 42 (4.6%) were residents, all of whom were excluded from this study since they constituted a population of physicians who were both younger than the average practicing physician and therefore at higher risk of substance abuse and, although there were no significant differences between residents and practicing physicians on any outcome variables measured, their numbers were deemed too small to be conclusive. Residents excluded from the study included 1 in emergency medicine and 41 in other specialties.

Of the remaining 862 participants, 64 (7.4%) were EPs. As stated previously, at the time these participants enrolled in PHPs, EPs account for 2.9% of the approximately 749,000 physicians (excluding residents) providing patient care in the U.S. The overrepresentation of EPs in the participant sample (odds ratio [OR] 2.7; confidence interval [CI]: 2.1–3.5, $p<0.001$) is consistent with findings from previous studies of physician enrollment in substance abuse treatment programs.

Lost to Follow up

During the study period, 82 of the 862 participants (9.5%) moved out of their state program's jurisdiction. We had no access to any continuing records for those participants so they were not included in the analyses for this study. Those lost to follow up included 8 EPs and 74 other physicians. Comparisons between those lost to follow up and those retained in the study revealed no significant differences between groups on gender, age, primary substance of abuse at admission, history of prior treatment, or treatment participation status (mandatory vs. voluntary). Among those lost to follow up, there were no significant differences between EPs and other physicians on these same variables. We therefore carried out analyses comparing 56 EPs to 724 other physicians for whom 5 years of follow-up data were available.

Statistical Analysis

We analyzed demographic and outcome variables for EPs and other physicians using chi-square and t-test statistics for comparisons of proportions and means, respectively. We computed univariate ORs with 95% CIs to compare the 2 physician groups on selected binomial characteristics and outcomes. All ORs are the odds of the outcome in EPs compared to other physicians. We used SPSS for Windows version 15 (SPSS, Inc., Chicago, IL) for the analyses.

RESULTS

The study was based on treatment records from 16 programs that had previously participated in a survey of 42 PHPs conducted by the authors.[5] That original study described the structure, function, funding, and overall characteristics of the PHPs, as well as the intervention, evaluation, referral for treatment, and monitoring activities after treatment provided. We contacted the 26 PHPs that did not participate in the phase II record review, and all claimed lack of resources and/or regulatory impediments as the reason for declining to participate. The programs that did and did not participate in the follow-up study were not statistically or clinically significantly different for evaluation, referral, treatment, supervision, support, and monitoring practices. The 16 participating programs tended to be large: 31% were in the largest quarter of programs. The mean number of physicians in each program was 56 (range 11–119). Although these 16 programs may not

Table 1. Characteristics of emergency physicians and other physicians participating in state physician health programs for substance use disorders.*

Characteristic	Emergency physicians (n = 56)	Other physicians (n = 724)	p-value**
Age at enrollment			
Mean ± SD	42 ± 7	44 ± 8	0.008
Range	27–63	26–75	
Gender			
Male	49 (91)	621 (86)	0.41
Female	5 (9)	102 (14)	
Enrollment status			
Mandatory	33 (60)	409 (57)	0.67
Voluntary	22 (40)	315 (43)	
History of prior treatment			
Yes	26 (46)	272 (38)	0.20
No	30 (54)	450 (62)	
Type of agreement			
Dependence (5-year)	48 (86)	639 (88)	0.52
Diagnosis/Abuse	8 (14)	85 (12)	
Primary drug of abuse			
Alcohol	27 (49)	357 (50)	
Opioids	21 (38)	242 (34)	
Stimulants	5 (9)	52 (7)	0.89
Sedatives	0 (0)	27 (4)	
Other	2 (4)	39 (5)	
Intravenous drug use history			
Yes	8 (16)	88 (13)	0.53
No	43 (84)	587 (87)	
Number of substances			
Single	25 (45)	357 (49)	0.58
Multiple	31 (55)	367 (51)	
Months in testing period			
Mean ± SD	48 ± 25	47 ± 25	0.97
Range	3–111	0–155	
Number of tests			
Mean ± SD	82 ± 77	86 ± 75	0.72
Range	2–364	1–662	

* Values are number (percentage) unless otherwise indicated.
† From t-test for independent means or chi-square test for comparison of proportions (two-tailed) as appropriate.

be considered nationally representative, they showed no obvious clinical, administrative, or organizational differences from those not participating.

The 780 participants in the present study were distributed among the 16 programs so that on average, there were 4 EPs (range 0 to 12) and 45 other physicians (range 9 to 98) per PHP. EPs did not constitute more than 14% of the participants in any of the 16 programs. Examination of demographic, treatment, and outcome variables across PHPs did not reveal significant clustering by program. Nor was a relationship found between any of these variables and the year of enrollment in a PHP. Since there was no evidence of clustering by time or program, we compared the 56 EPs to 724 other physicians on a wide range of demographic, drug use, and outcome measures.

Descriptive characteristics of EM and other physicians are presented in Table 1. On average, program enrollees were in their forties with males comprising at least 86% of each group. The majority of physicians in both groups were mandated to participate in the program. According to intake records, 46% of EPs and 38% of the other physicians had a history of prior treatment for substance use when they enrolled in the program. In each group at least 86% of enrollees signed a 5-year dependence agreement, indicating that a diagnosis of substance dependence had been made and the physician agreed to be monitored for at least 5 years. The others signed a diagnostic monitoring agreement, a more limited and shorter-duration agreement used when the diagnosis was substance abuse only or there was no diagnosis of SUDS.

The 2 groups did not differ regarding the primary substance of abuse as recorded in their intake records. Half of each group (49% of EPs and 50% of the others) enrolled in a PHP due to alcohol-related problems (p=1.00). Over a third of each group (38% of EPs and 34% of the others) enrolled due to opioid use (p=0.56). Physicians in both groups were equally likely to have a history of intravenous drug use (EPs, 16%; others, 13%) p=0.53, and the majority of physicians in both groups (EPs, 55%; others, 51%) had been abusing more than one substance immediately prior to enrollment (p=0.058.) These findings indicate that the overall pattern of substance abuse prior to enrollment in PHPs was no different for EPs than for their peers.

Random drug testing was required of physicians participating in the programs. Data presented in Table 1 show that both EPs and other physicians were subject to testing for an average period of about 48 months. During this time, the mean number of tests (82) administered to EPs was not significantly lower than the number (86) administered to other physicians (t=0.36, df=766, p = 0.72).

Table 2 compares EPs and other physicians on primary outcome measures examined in this study: positive drug tests during monitoring, physicians reported to the licensing board, program status at 5-year follow up, occupational status at follow up, and deaths. The PHP records, which chronicled each instance in which a program participant tested positive for drugs, revealed that 13% of EPs had at least one positive test compared to 22% of the other physicians; however, this

Table 2. Drug-testing outcomes and program and occupational status of emergency physicians and other physicians at 5-year follow up of being in a state physician health program for substance use disorders.*

Outcome	Emergency physicians (n = 56)	Other physicians (n = 724)	p-value**
Positive drug test			
Yes	7 (13)	158 (22)	0.13
No	49 (87)	559 (78)	
Reported to board			
Yes	9 (16)	146 (20)	0.60
No	47 (84)	577 (80)	
Program status			
Completed contract	40 (71)	464 (64)	0.40
Contract extended	9 (16)	118 (16)	
Failed to complete	7 (13)	142 (20)	
Occupational status			
Licensed and practicing medicine	47 (84)	524 (72)	0.19
Licensed & working (not clinical)	4 (7)	35 (5)	
Retired or left practice voluntarily	1 (2)	30 (4)	
License revoked	2 (4)	82 (11)	
Died	0 (0)	29 (4)	
Unknown	2 (4)	24 (3)	

* Values are number (percentage).
† From chi-square test for comparison of proportions (two-tailed).

difference was not significant (p = 0.13). Similarly, the percentage of EPs (16%) reported to their state licensing agencies due to non-compliance with the terms of the PHP agreement or relapse was no different than the percentage for other physicians (20%) (p = 0.60).

At the end of the 5-year follow-up period, 71% of EPs and 64% of other physicians had completed their contracts and were no longer required to be monitored (OR 1.4 [CI: 0.8-2.6], p = 0.31) (Table 3). Another 16% of both groups had their contracts extended beyond the initial monitoring period (OR 1.0 [CI: 0.5-2.1], p = 1.00). The reasons for continued monitoring included relapse; failure to comply with requirements, such as group attendance or therapy; or, in some cases, voluntary continuance to help prevent relapse and/or demonstrate continued recovery to others. Thirteen percent of EPs failed to complete the program, as did 20% of other physicians (OR 0.6 [CI: 0.3-1.3], p = 0.22). These results indicate that EPs were no more or less likely than other physicians to complete the program, to fail to complete, or to extend the monitoring period beyond the original 5 years specified in their agreements.

The final outcome examined was participants' occupational status at follow up. A primary category of interest was the extent to which physicians who had participated in the programs were licensed and practicing medicine at the 5-year follow-up. The study found that the proportion of EPs (84%) continuing their medical practice was not significantly different than that of other physicians (72%) (OR 2.0 [CI: 1.0–4.1], p = 0.06). Nor was there a statistically significant difference between EPs (4%) and other physicians (11%) in regard to the percentage who had their licenses revoked (OR 0.3 [CI: 0.1-1.2], p = 0.08).

Table 3. Odds ratios (OR) for selected characteristics and outcomes of emergency physicians and other physicians in state physician health programs for substance use disorders.*

Characteristic/Outcome	Emergency physicians (n = 56)	Other physicians (n = 724)	OR (95% CI)	p-value**
Primary drug of abuse				
Alcohol	27 (49)	357 (50)	1.0 (0.6-1.6)	1.00
Opioids	21 (38)	242 (34)	1.2 (0.7-2.1)	0.56
Program status				
Completed contract	40 (71)	464 (64)	1.4 (0.8-2.6)	0.31
Contract extended	9 (16)	118 (16)	1.0 (0.5-2.1)	1.00
Failed to complete	7 (13)	142 (20)	0.6 (0.3-1.3)	0.22
Occupational status				
Licensed and practicing medicine	47 (84)	524 (72)	2.0 (1.0–4.1)	0.06
License revoked	2 (4)	82 (11)	0.3 (0.1-1.2)	0.08

* Values are number (percentage); all odds ratios are emergency physicians/other physicians.
† From chi-square test for comparison of proportions (two-tailed).

DISCUSSION

This is the first published report examining the performance and outcomes of EPs enrolled in PHPs for SUD. Our study found EPs with SUD to be significantly over-represented in PHPs. This is consistent with previous research findings of higher rates of SUD by EPs when compared to other physicians.

In this study, we examine the performance of EPs compared to other physicians with SUD in PHPs. It appears EPs did very well in the PHPs with an 84% success rate in completion and return to clinical practice at 5 years. Of the 3 outcomes variables measured, rates of relapse, successful completion of monitoring, and return to clinical practice, EPs had similar rates of success on all variables compared to the other physician cohort. Although not statistically better, EPs trended towards higher return-to-clinical-practice rates. There was also a trend in less license revocation in the EP cohort. These data support the conclusion that EPs do well following treatment of SUD with monitoring in PHPs and generally return to the practice of emergency medicine.

The higher rate of SUD in EPs found in this, as well as other studies, is an important bellwether of physician well-being for the specialty of emergency medicine. The reason for over-representation by EPs in PHP is unclear. It has been hypothesized that job stress, personality-type selection bias, and access to controlled substances, may be contributing factors.[11] Most of this is conjecture as there is no published evidence substantiating the cause.

Other specialties with high substance abuse prevalence, anesthesiology in particular, have examined this issue much more closely.[9,12–16] Anesthesia has unique practice variables that may make long-term recovery from substance abuse more challenging (i.e. unrestricted access to narcotics); as such, the specialty has incorporated the understanding of physician SUD in anesthesia practice and training. Some specialties, such as pediatrics, have a much lower rate of SUDs in published results; consequently, specialty choice may be a variable in the development of SUDs.[5] It is important for emergency medicine to examine potential situations and risk factors in EM practice that may contribute to the development of SUD. Numerous genetic, psychological and social factors contribute to the development of SUD. However, evidence of higher rate of EPs with SUDS is concerning and an important area for examination. It can be hypothesized that EPs enjoy and are rewarded by high stress situations. Given the neurochemical nature of SUDs and the malfunction in the brain's reward center, the practice of emergency medicine may actually place individuals with a genetic potential for SUD at higher risk. Discussion of this particular issue is beyond the scope of this paper.

The results of this study are encouraging for the prognosis of EPs who enter PHPs. Addiction produces significant negative biologic, psychological, economic, and social consequences for the physician. It is a progressive and fatal disease if left untreated. As with all diseases, early detection and intervention is important. Physicians need early and effective intervention to help recovery and prevent the negative consequences of addiction. However, the stigma, shame, and guilt associated with addiction frequently prevent physicians from seeking care. Many state licensing boards understand that a physician in recovery remains an excellent physician, which is why they often mandate participation in PHPs. This study indicates that physicians who fully embrace the lifestyle changes necessary for healthy recovery can go on to have happy and successful careers.

LIMITATIONS

There are several limitations to the study. First, it is a retrospective cohort design. Unfortunately, given that there is no state, regional, or national registry of PHPs, data of this scope are difficult to obtain in a prospective manner. A second limitation is the small sample size of EPs. Although this study uses the largest existing dataset of physicians in PHPs followed for 5 years, the sample size prevents drawing some conclusions that may be more clearly seen with a larger study. Given the small sample size, the loss of 8 physicians to follow up may have affected the results. Some outcome variables trended towards significance, but the sample size precluded drawing a definite conclusion. Thirdly, there is the limitation in whether each participating state PHPs had an equivalent penetration into its medical community in the acquisition of physicians for monitoring. We were unable to determine the degree to which physicians from each of the states came forward and received intervention relative to the medical community at large.

CONCLUSION

The study supports the conclusion that EPs with SUD who participate in PHPs for 5 years of monitoring do well and have a similar relapse rates, program completion rates, and successful return-to-practice as compared to non-EPs. EPs have a high degree of success in PHPs. The study also supports previous research that has found that emergency medicine has a higher prevalence of substance abuse over other specialties. Further research is needed into the factors contributing to a higher prevalence of substance use disorder in emergency medicine and areas for education and early intervention. Given the significant patient care implications and the potential negative physical, psychological, and legal consequences of SUD, the emergency medical community needs to raise awareness of this problem and the resources available for treating affected physicians.

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Social Media Guidelines and Best Practices: Recommendations from the Council of Residency Directors Social Media Task Force

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Social media has become a staple of everyday life among over one billion people worldwide. A social networking presence has become a hallmark of vibrant and transparent communications. It has quickly become the preferred method of communication and information sharing. It offers the ability for various entities, especially residency programs, to create an attractive internet presence and "brand" the program. Social media, while having significant potential for communication and knowledge transfer, carries with it legal, ethical, personal, and professional risks. Implementation of a social networking presence must be deliberate, transparent, and optimize potential benefits while minimizing risks. This is especially true with residency programs. The power of social media as a communication, education, and recruiting tool is undeniable. Yet the pitfalls of misuse can be disastrous, including violations in patient confidentiality, violations of privacy, and recruiting misconduct. These guidelines were developed to provide emergency medicine residency programs leadership with guidance and best practices in the appropriate use and regulation of social media, but are applicable to all residency programs that wish to establish a social media presence. [West J Emerg Med. 2014;15(1):26–30.]

INTRODUCTION

The term "social media" encompasses a wide variety of Internet-based resources to share content among users. This term includes social networking sites, video- or picture-sharing sites, forums, blogs, and other tools. Information is predominantly user generated and can be shared openly or with select groups. Social media has become a staple of everyday life among over one billion people worldwide.[1-3]

A social networking presence has become a "hallmark of vibrant and transparent communications."[4] In emergency

medicine (EM), "…use of social media among emergency physicians is unusually strong… emergency physicians have embraced the healthcare side of social media in a way not seen among other specialists."[5] In addition to the various EM blogs and sites covering daily practice issues, there has even been a call for integrating social media into emergency-preparedness efforts.[6] Social media has now become a preferred method of communication and information sharing. It offers the ability for various entities, especially residency programs, to create an attractive Internet presence and "brand" the program.[7]

Social media, while having significant potential for communication and knowledge transfer, carries with it legal, ethical, personal, and professional risks.[8-14] The negative side of social media is highlighted in multiple publications, which illustrate problems including disclosure of private information and lapses in professionalism.[15-20] Due to the unique climate of social media, even simple actions like "friending" (a function of social media platform Facebook®, whereby one user can request to be a "friend") can be misinterpreted as violations of professional or personal boundaries. Despite the dangers, social media offer tremendous benefits for recruiting, communication, and education.[21-24] Implementation of a social networking presence must be deliberate, transparent, and optimize potential benefits while minimizing risks.

These guidelines are designed to provide guidance to EM residency programs not only for the development and use of a program-specific social media presence, but also for the education of residents in potentially problematic use of social media that may impact professional functions in their private life. They are designed to complement and do not supersede any institutional guidelines or local, state or federal laws. The social media guidelines outlined in this paper constitute an expert consensus opinion for best practices and are approved by the Council of Emergency Medicine Residency Directors (CORD) Board of Directors as of November 2012.

METHODOLOGY

Several hundred EM residency directors and other academic faculty members attended a lecture on the issues of social media in resident selection at the March 2011 CORD Academic Assembly. Following that session, a Social Media Task Force was assembled consisting of 14 geographically diverse educational leaders. The group met regularly over the next 14 months to review available literature and policies.

Policies from the institutions represented on the task force were reviewed when they existed (including Mayo Clinic,[25] Regions Hospital,[26] University of Michigan,[27] Baylor University,[28] Eastern Carolina University,[29] and Carolinas Medical Center[30]). In addition, policies from national organizations were obtained and reviewed including those from Society of Academic Emergency Medicine (SAEM),[31] American Medical Association (AMA),[32] and Indiana State Bar Association (ISBA).[33] A literature search was performed for additional resources using search terms of social media, education, graduate medical education and professionalism.

There was considerable variation among these institutions as to the presence and content of a social media policy. While many universities and professional organizations had social media policies designed to restrict employee activity to protect the institution, few if any encouraged social media use. None addressed the unique needs of residents and residency leadership. Much of the literature reports residents unintentionally or unknowingly violating institutional policies and suffering professional consequences.

After review of the literature and existing institutional and organizational guidelines, the task force developed a graduate medial education (GME)-specific set of recommendations. These were then independently reviewed by Tobi Tanzer, J.D., vice president of integrity and compliance for Health Partners-Regions Hospital. The guidelines were then submitted to the CORD Board of Directors for review and endorsement.

RECOMMENDATIONS

It is our strong recommendation that each residency program develop a social media policy and education effort.[34-35] Institutional officials should be involved in the development of these materials. The initial discussions should be held with the designated institutional officer (DIO), public affairs, legal or privacy officer, and information technology (IT) departments for consideration of any existing policies and procedures, as well as subtleties of law relevant to public versus private institutions.

CONTENT MANAGEMENT

When a program initiates a sponsored social media site, it should designate a content manager (moderator) who is a permanent employee (i.e. not a trainee) who will assume responsibility for the maintenance and monitoring of posted content. That content manager needs to be proficient in the operation of the chosen platform as it pertains to administrative issues regarding posting, access, and privacy. That person also needs to ensure routine updating and monitoring of the site. In addition, plans for transfer of content management should be made in advance to facilitate a smooth transition. Areas of responsibility for the content manager include:

1. Ensuring that content is current, accurate, and in accordance with the communications plan. (See below)
2. Ensuring communications that are acceptable in the medical workplace. This includes respecting copyrights, intellectual property and protected health information (PHI), as well as similar sensitive or private information.
3. Ensuring consent of all involved parties for the use of recordings, photos, images, video, text, slideshow presentations, artwork and advertisements is obtained and

whether those rights are purchased or obtained without compensation. Included in this should be prospective consent for use of any photographs or images of residents or other personnel in the residency program.

Site management is an evolving realm with unforeseen risks. Content managers may be responsible or liable per individual institutional requirements, for all content posted on the sites.[36-37] It is recommended that content managers frequently communicate with the institution regarding site content and any questions be vetted by the institution before posting. It is important to note that once content is placed on an institutionally sponsored site, it is then owned by the institution and not the posting individual or the content manager.[36]

COMMUNICATION PLAN

A program should have a communications plan/policy that proactively addresses the use of social media and potential issues. This should encompass:

- Target audience
- Purpose of the site, including educational objectives and explicit consideration of the function of the site such as degrees of access and interactivity planned
- Level of privacy and security required
- Issues of medical advice and redirection of patients to appropriate venues
- Plans to deal with adverse events, including spam, negative comments, complaints, and unprofessional behavior.

RESIDENCY PROGRAM-SPECIFIC ISSUES

Education

Residency programs should provide guidance and education to residents, fellows, faculty, and other personnel under their supervision regarding appropriate social media use. Particular attention should be paid to professionalism issues, including personal reputation and medical privacy.[38] Direct policing of individual resident or personnel activities on the Internet (aside from on the department-sponsored social media site) is discouraged as it represents a significant intrusion into resident privacy and is beyond the capability and purview of a residency program. However, should an issue involving a personal site be brought to the attention of a program, it is the responsibility of the program to take appropriate action to protect privacy and professionalism standards.

Professionalism and privacy

Professionalism and privacy issues are accentuated on social media. The same standards of professionalism and privacy are required online as in person, but normal standards may not be sufficient to avoid misperceptions or legal issues. Residents should familiarize themselves with the American Medial Associations' Professionalism in the Use of Social Media guidelines.[39-40] Posted content must be assumed to be permanent, public, and even if deleted may still exist in an archive, database, or download formats. Information may prove to be damaging to an individual's reputation among colleagues and patients, and may affect future relationships and employment.[41] Privacy settings are relatively easy to circumvent and should not be relied upon to protect postings from public disclosure. Respect for patient confidentiality is essential as federal and state confidentiality laws apply to social media sites.[36,41-43] Even de-identified discussion of patients and specific medical cases on social media sites should be avoided.

Recruitment & Educational Relationships

A program should recognize the potential for inequitable relationships to exist through social media. Institutional guidelines with regard to harassment and appropriate relationships should be applied to interactions on social media as in other venues. It is our strong recommendation that people in a position of power/authority not initiate a personal on-line relationship with an individual in a subordinate position. Exceptions may be made for situations where it is appropriate for monitoring a remediation/probationary circumstance or for primarily educational group experience, such as with an online journal club hosted on a social media platform.

A program director or other individuals in positions of authority (e.g. chief resident) should apply a consistent action to requests for a social media relationships to avoid favoritism or perception of such. It is recommended that individuals in a position of authority maintain a separate public presence that may be used for residency purposes such as facilitating online educational interactions (e.g. Facebook® journal club) or monitoring a trainee for remediation purposes, including monitoring of professionalism if previous issues have existed.

Significant controversy exists with regard to whether a program should search for online information about prospective residents.[44] Each program should individually decide whether and how they will use online information and consistently apply the same standard to all applicants. This decision should encompass consideration of:

- Search limitations (e.g. different names, common names, variation in presence on the Internet)
- Lack of knowledge of context of posting, including whether or not an individual was aware of or had control of the image or information
- Detection of information that is, under federal employment guidelines, considered off-limits for consideration for hiring purposes, including such issues as marital status, sexual orientation, religious beliefs, or health conditions
- Pre-emptive determination of how potentially "illegal" or damaging information may be used in consideration of an applicant
- Bias toward particular types of activities being posted
- Generational differences in acceptability of postings
- Whether a program will disclose searches to applicants

CONCLUSION

Every residency program should develop a social media policy and educational effort for learners with early involvement of institutional personnel. The program should designate a content manager who is responsible for the site, including compliance with institutional regulations. The program should also have a communications plan that addresses the use of social media in an anticipatory manner. Proper use of social media is a key professionalism issue, and it is the responsibility of the program to provide education to residents, fellows, faculty, and other staff under their supervision. Although social media can be a powerful tool, programs should recognize that the potential for inequitable relationships exist. Individuals in a position of authority, in general, should not initiate an online relationship with an individual in a subordinate position.

These guidelines were developed to assist residency program leadership with appropriate use of social media platforms. Additional resources are being made available online through CORD to assist with educational efforts. These will be found at http://cord.sharepointsite.net/default.aspx.

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Betrayed Mood in Public View: Taking a MySpace History

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Social networking sites (SNS), the modern mainstay of adolescent expression, may provide vital information to physicians. The emergency department (ED) is a setting where SNS may be helpful. A reticent 19-year-old in the ED prompted a search for pertinent information on the Internet, where a profile on www.myspace.com relayed a troubled post. The patient was admitted for psychiatric evaluation due to intentional overdose. These SNS may provide a venue for physicians to learn about risky behaviors and life stressors that would help identify underlying medical issues in young adults. We provide a guideline on how to utilize SNS with privacy rights in mind. [West J Emerg Med. 2014;15(1):31–34.]

INTRODUCTION

Social networking sites (SNS) are popular among adolescents. Teens use SNS for a variety of reasons, such as to weblog (blog), to find and maintain relationships, to be entertained, to locate information, and to secure an emotional outlet.[1-7] According to a national survey, 87% of adolescents aged 12-17 confirmed Internet use, and about 51% admitted to daily use.[1] MySpace, a once-popular SNS, contains 200 million web profiles, and a quarter of these are owned by minors.[2] Online interaction has been reported to be a safe and effective means for adolescents to mature; it is a place where they learn self-control, find it easier to express feelings, and see varying viewpoints.[1,8] Studies and anecdotal experience have found that online profiles often reveal personal details regarding relationships, health risk behaviors such as substance abuse and sexual practices, and mental health issues such as depression.[9,10] When adolescents post this information publicly, concerns of safety arise as the information may be accessible to anyone, including cyber-bullies, sexual predators and criminals, especially if privacy concerns were not addressed at the time of opening the account.[1,2]

Physicians have more recently started to use these websites to interact with patients to provide information regarding disease and to keep in touch in a more effective manner.[11] However, a previously unrecognized utility exists; there have been no reports of physicians employing this tool to obtain historical data when patients are not able to provide a history. The following case depicts a clinical scenario where visiting a MySpace public profile provided information regarding an uncommunicative patient's mood and potential motives for drug intoxication. Concerns regarding patient privacy may deter the use of these profiles by health practitioners; however, these profiles are published on the web with the inferred permission of their owners.

CASE REPORT

A 19-year-old male was brought to the emergency department (ED) by the fire department after he was found wandering in the bus terminal, combative and agitated. He provided us with 2 different names and his city of origin but would not divulge any details such as family history, past medical or surgical history, current medications, social history or whether he had ingested any medications or taken any drugs prior to arrival. Among his belongings was an empty pill bottle labeled cyclobenzaprine, which had been prescribed to someone other than the name provided. He had 3 different identification cards in his possession, yet none of them had any photographs resembling him.

On examination, he was well-appearing, disoriented, agitated and mumbling anxiously. His heart rate was 130 beats per minute, blood pressure was 96/60 mmHg, temperature was 35.9°C (96.7°F), respiratory rate was 24 breaths per minute with an oxygen saturation of 96% on room air. His skin was flushed, warm and dry without

obvious trauma or any other abnormalities. The pupils were mid-range and sluggish to light. Cardiac examination revealed tachycardia without murmurs, and the lung examination was clear to auscultation bilaterally. He had no abdominal tenderness. He displayed no focal neurologic deficits and moved all extremities spontaneously with 5/5 strength. Reflexes were +2/4 bilaterally. He was disoriented to place and time and after persistent requests to state his name, he gave the same name consistently as time progressed.

A chest radiograph showed clear lung fields, and an ECG showed sinus tachycardia without QRS widening or QT prolongation. The patient became increasingly anxious, attempting to leave the room and becoming more hostile with medical personnel even after multiple trials of reorientation, reassurance and calming techniques. He would not provide us with any family contacts for further information. He was restrained for his own safety. A basic metabolic panel, a complete blood count, acetaminophen and aspirin levels, and a urine drug screen were ordered.

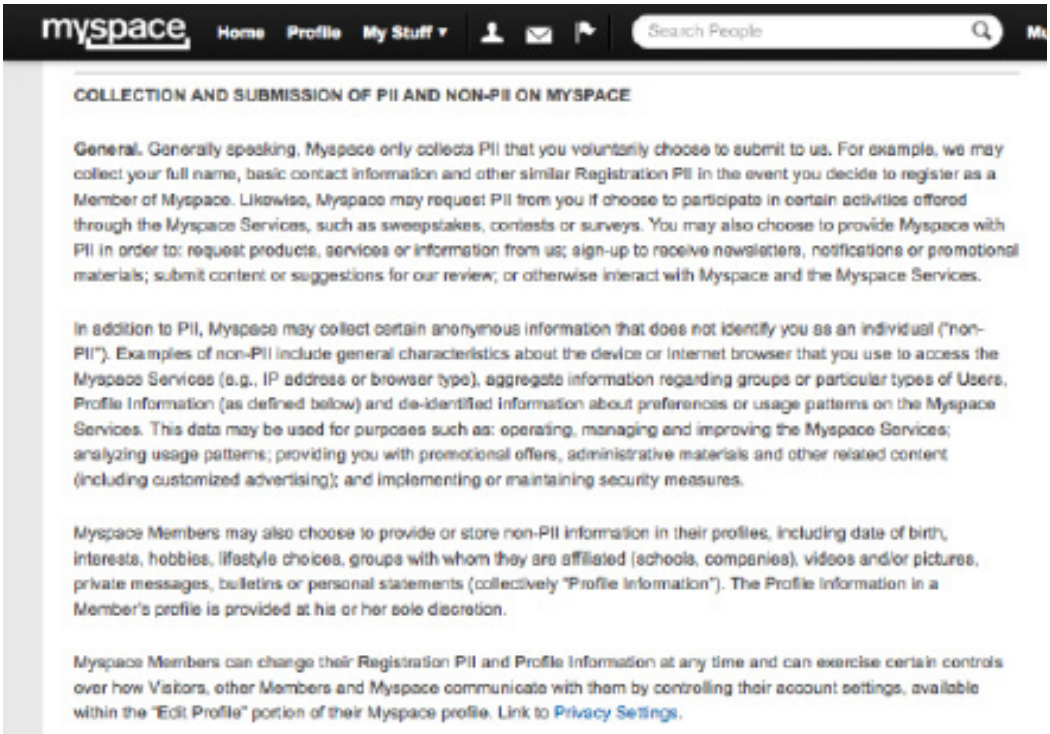
As we were unable to determine his true identity, we used the names he had given us to search the Internet. Upon entering one of the names on www.myspace.com, an account that displayed a picture of our patient appeared. Positive identity was made after reviewing several photographs while matching his hometown to what was included as "location" on his profile. On his public profile, 3 days prior to presentation , he stated that he was "chillin in [a] motel room," and his mood was "betrayed." This enabled us to determine that he might have suffered a life stressor recently that eventually led to his visit to the ED that night.

DISCUSSION

SNS have been underused by the medical profession for historical data when faced with a difficult patient. These websites may represent a previously overlooked yet easily accessible domain that could provide meaningful information at a moment's notice for recalcitrant adolescents and young adults in the ED suffering from emotional turmoil. These sites are often mired with privacy issues; however, those who set up these profiles determine how much information they would like to publish in their privacy settings. Thus, it may be argued that the information published in the public domain is viewed with the inferred permission of its owner.

The blog is an important service provided through SNS.[3] Studies have shown that adolescents who live in households earning less than $50,000 per year and those who live with a single parent are more likely to blog on the Internet.[12] Blogs have become more prevalent with the advent of frequently updated websites, such as Twitter, where a change in status is portrayed in reverse chronological order for others to see and make commentary. With regard to truthful disclosure, sufficient evidence has shown that bloggers tend to post accurate portrayals of themselves on their profiles.[1]

An important function blogging provides for users is an outlet to share emotions with a community and receive feedback.[3] Prior to the advent of blogs, journals were used as a coping strategy, and multiple studies have shown that this remains an effective therapeutic tool, leading to a revitalization of the author's physical, emotional, and psychological health, and improving social functioning.[13-17] In 2006 a study found that 70% of blogs were considered


myspace Home Profile My Stuff Search People

COLLECTION AND SUBMISSION OF PII AND NON-PII ON MYSPACE

General. Generally speaking, Myspace only collects PII that you voluntarily choose to submit to us. For example, we may collect your full name, basic contact information and other similar Registration PII in the event you decide to register as a Member of Myspace. Likewise, Myspace may request PII from you if choose to participate in certain activities offered through the Myspace Services, such as sweepstakes, contests or surveys. You may also choose to provide Myspace with PII in order to: request products, services or information from us; sign-up to receive newsletters, notifications or promotional materials; submit content or suggestions for our review; or otherwise interact with Myspace and the Myspace Services.

In addition to PII, Myspace may collect certain anonymous information that does not identify you as an individual ("non-PII"). Examples of non-PII include general characteristics about the device or Internet browser that you use to access the Myspace Services (e.g., IP address or browser type), aggregate information regarding groups or particular types of Users, Profile Information (as defined below) and de-identified information about preferences or usage patterns on the Myspace Services. This data may be used for purposes such as: operating, managing and improving the Myspace Services; analyzing usage patterns; providing you with promotional offers, administrative materials and other related content (including customized advertising); and implementing or maintaining security measures.

Myspace Members may also choose to provide or store non-PII information in their profiles, including date of birth, interests, hobbies, lifestyle choices, groups with whom they are affiliated (schools, companies), videos and/or pictures, private messages, bulletins or personal statements (collectively "Profile Information"). The Profile Information in a Member's profile is provided at his or her sole discretion.

Myspace Members can change their Registration PII and Profile Information at any time and can exercise certain controls over how Visitors, other Members and Myspace communicate with them by controlling their account settings, available within the "Edit Profile" portion of their Myspace profile. Link to Privacy Settings.

Figure 1. MySpace privacy policy.

personal journals where daily activities, thoughts and feelings were expressed. However, what was once a private diary is now open to public feedback, an attribute that is unique to the blog experience.[3,7] The practice of blogging engages authors in cathartic venting of psychological frustration and effectively reduces distress through self-reflection and constructive feedback from the community.[7] In addition, new bloggers may have signed up with SNS for the sole purpose of sharing with their community the life stressors they are facing.[3,7]

LIMITATIONS

There are limitations in the use of the Internet as sources of information regarding patients. Although studies have found most blog entries to be quite truthful, some bloggers may embellish life events heavily or even lie about high-risk behaviors. However, such exaggerated claims on the Internet may serve as a platform for physicians to further educate our troubled teens and young adults about high-risk behaviors, regardless of how embellished they may be. Finally, the ethics of patient privacy is a concern. Those opening an SNS account must agree to a "Terms of Use Agreement and Privacy Policy." The privacy policy at MySpace states that information posted on a profile, both "personally identifiable" and non-identifiable information, is posted at the sole discretion of the account-holder.[18] Control of who is able to access and view this information is determined by the privacy settings of the account-holder.[19] Figures 1 and 2 portray the privacy policy and demonstrates the available privacy options.

Even with implied consent from this policy, it is uncertain whether adolescents are aware of the consequences of not adequately placing controls on their privacy settings. Guidelines would be helpful in safeguarding the privacy of account holders while providing physicians with the ethical means to seek information on these sites. Figure 3 demonstrates a guideline that may aid physicians in determining when it would be appropriate to seek SNS profiles.

Every patient has unique needs that need to be addressed, but risks, benefits, and ethics should be assessed. If patients are unable to communicate their needs to a physician due to intoxication or incapacitation, physicians must decide whether an SNS profile could help in understanding patient needs to improve patient care and outcomes. Although permission may not necessarily be granted, the ethical dilemma is one that must be weighed and judged by the physician with the best interests of the patient in mind.

CONCLUSION

During a period of observation of 4 hours, the patient received 3 liters of normal saline boluses, in addition to 2 doses of intravenous lorazepam and haloperidol. He eventually became more oriented and his restraints were removed.

The laboratory studies returned within normal range, and his urine drug screen was positive for benzodiazepines alone. Due to the information obtained from the patient's public profile, concerns for intentional overdose and depression prompted urgent psychiatry consultation. Psychiatric evaluation revealed that the patient had a history of bipolar disorder, was noncompliant on treatment, and had a history of suicidal ideation one year prior. He also admitted to the psychiatrist that his girlfriend had betrayed him and confirmed

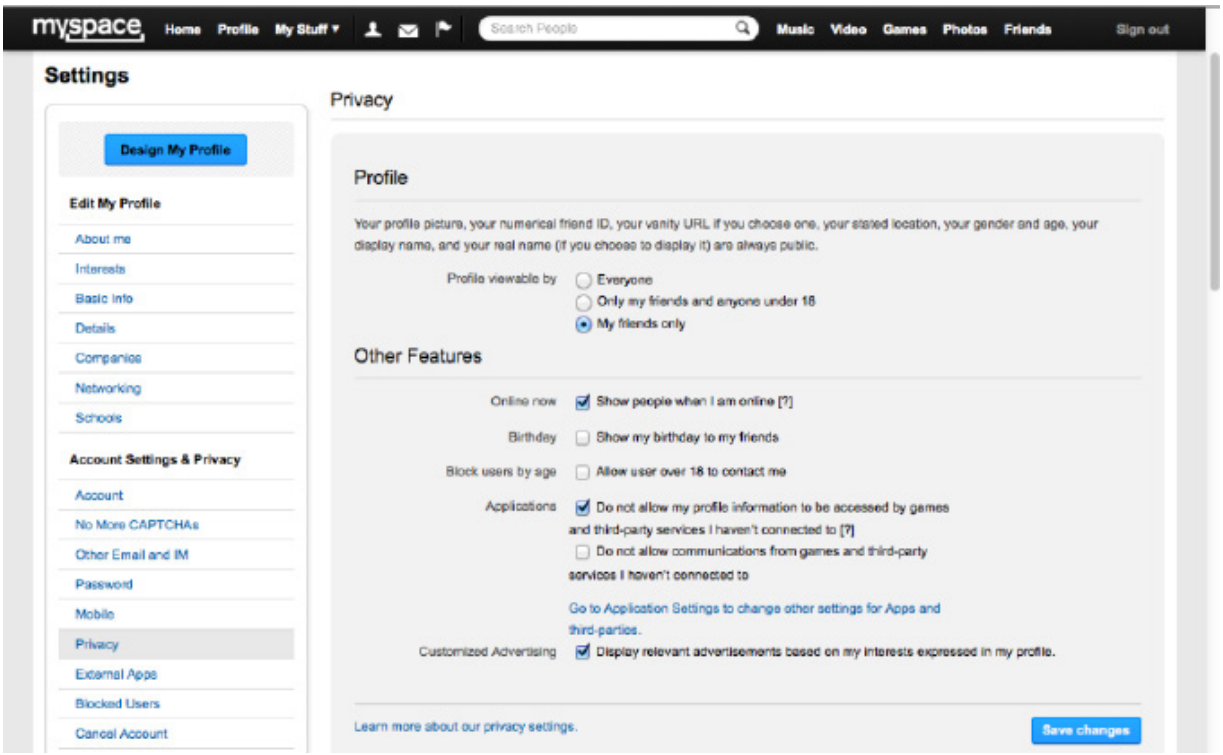


Figure 2. Available privacy options in account settings.

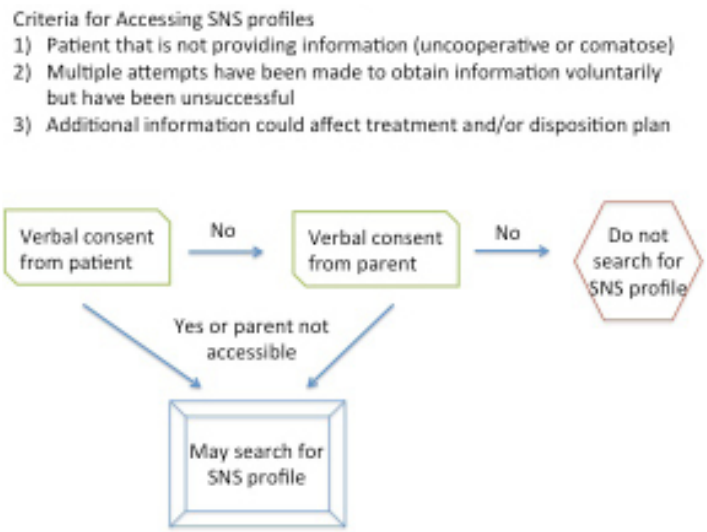


Figure 3. Guideline on when to access social network site (SNS) profile.

current suicidal ideation after taking cyclobenzaprine pills, which he had not revealed to ED physicians. His vital signs remained stable and he continued to be asymptomatic during the remainder of his time in the ED. He was admitted to a psychiatric facility for suicidal ideation and was placed on his bipolar medications again.

SNS have become a controversial issue, as concerns for exposure to a hostile group of predators run rampant.[1] However, we believe that there are benefits to adolescents using these sites not only for their own personal development,[3,8] but also as a reference for the medical community. Our patient did not reveal many details of his at-risk behaviors on his profile, but these behaviors are prevalent in this age group and many of these activities are more openly displayed on blogs.[2,9] The information our patient provided through his public profile led us to view his drug use in a more intentional rather than recreational light, and spurred a psychiatric evaluation that further revealed a depressed individual who was seeking dangerous avenues to take away the pain of betrayal. Our patient's public profile led to his admission to a psychiatric facility for suicidal ideation. SNS can prove to be useful in situations where little information is available to healthcare practitioners and time is of the essence in determining the need for more than just supportive care.

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Patient Impression and Satisfaction of a Self-administered, Automated Medical History-taking Device in the Emergency Department

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Introduction: We evaluated patient impressions and satisfaction of an innovative self-administered, hand-held touch-screen tablet to gather detailed medical information from emergency department (ED) patients in the waiting room prior to physician contact.

Methods: Adult, medically stable patients presenting to the ED at Los Angeles County Hospital used the PatientTouch™ system to answer a series of questions about their current history of present illness and past medical/surgical histories in English or Spanish. Patients then completed a survey rating their experience.

Results: Among 173 participants, opinion of PatientTouch™ was strongly positive; 93.6% (95%CI 90.0–97.3%) felt the physical product was easy to hold and handle, and 97.1% (94.6–99.6%) felt the questions were detailed enough for them to fully describe their condition; 97.8% (95.4–100.0%) felt using PatientTouch™ would help them organize their thoughts and communicate better with their physician, 94.8% (91.4–98.1%) thought it would improve the quality of their care, and 97.1% (94.6–99.6%) expressed desire to use the product again in the future.

Conclusion: The study was conducted at a largely Hispanic county ED, and only patients with 1 of 6 pre-determined chief complaints participated. We did not include a control group to assess if perceived improvements in communication translated to measurable differences. In this pilot study, patients were highly satisfied with all aspects of the PatientTouch™ self-administered, hand-held, touch-screen tablet. Importantly, subjects felt it would help them better communicate with their doctor, would improve their overall quality of care and overwhelmingly expressed a desire to use it in the future. [West J Emerg Med. 2014;15(1):35–40.]

INTRODUCTION

Eliciting a reliable medical history is perhaps the most critical element of doctor-patient communication that contributes to diagnosis, prognosis and treatment decisions.[1] There are several recognized barriers to history taking during a patient encounter: 1) Patients can be inconsistent in their recollection of events, due to difficulties in comprehension, recall, evaluation and verbal communication;[2,3] 2) Respondents may provide misleading face-to-face reports because of fear or embarrassment;[4] 3) Physicians frequently interrupt patients and use medical jargon that can intimidate or confuse patients, leading to incomplete problem presentation and reticence to offer details; 4) Physician bias based on gender, race and/or culture may lead to inappropriate variation in questions and constitute a barrier to collecting a more salient medical history.[2,5] Each of these barriers may be amplified in an

emergency setting where patients and physicians do not have a pre-existing relationship, and medical decisions are made under intense time pressures. Illustrating this point, a recent prospective comparative study found that non-medical research assistants with no time constraints obtained more accurate medical histories than busy emergency department (ED) physicians.[6] The traditional method of taking and recording medical histories involves serious problems for both the practicing physician and the clinical research worker.

Presently, the United States government plans an unparalleled investment in health information technology (HIT) aimed at improving healthcare quality and decreasing costs.[7] A central component of these new HITs are computerized clinical decision support systems (CDSS), which can help practitioners with recall, organization, efficiency and potentially reduce diagnostic errors. Clinical evidence suggests that CDSSs can improve practitioner performance.[11] For example, computer-generated coronary risk profiles can assist physicians in case identification and risk factor reduction.[12] Similarly, a CDSS formatted to aid in the diagnosis of small bowel obstruction resulted in significantly less time needed to establish the correct diagnosis.[13]

We theorized that patients may also benefit from an electronic support system that elicits the clinical history from the patient directly, thereby 1) reducing or eliminating variability in questions asked by busied ED physicians; 2) allowing for a more complete problem presentation; and 3) preparing the patient for the actual patient-physician interaction.

Goals of this Investigation

We evaluated patient satisfaction and impressions of PatientTouch™, an innovative, hand-held touch-screen tablet developed by Humantouch Inc., among ambulatory ED patients. Our objective was to allow ambulatory ED patients to use the device to self-administer a clinical history (detailed chief complaint history, comprehensive past medical history, medication history and review of symptoms) and determine patient perceptions of the physical characteristics of the device, time required to complete the session, appropriateness and detail of the questions, potential impact and overall satisfaction.

METHODS

Study Design and Setting

We conducted a cross-sectional study of a consecutive sample of ambulatory ED patients with 1 of 6 chief complaints in the minor treatment area of a public, urban ED with annual census of 170,000 patient visits. The hospital treats a low-income, predominantly Hispanic patient population.

Study Population and Procedures

English- or Spanish-speaking patients presenting to the minor treatment area of the ED with any of the pre-specified chief complaints (see Content Development section below) between 9a-5p Monday through Friday from August to September 2008 were invited to participate by a trained research assistant. Eligible subjects signed written consent to participate. Patients were excluded if they were not English- or Spanish-speaking, critically ill or otherwise unable to provide written informed consent. The local institutional review committee approved the study protocol.

Subjects used the PatientTouch™ system on a hand-held tablet personal computer (PC). Eligible patients selected their chief complaint on the tablet. They then completed a series of medical questions specific to their selected chief complaint (see below for full description of medical content and development). Regardless of which chief complaint they used to enter the system, all patients were then asked questions about their past medical and surgical history, current medication use and review of symptoms. After using the product, patients were asked to complete a satisfaction survey to rate their experience on a 4-point Likert agreement scale, from "Strongly Agree = 4" and "Somewhat Agree = 3" to "Somewhat Do Not Agree = 2" and "Strongly Do Not Agree = 1." In the analysis, responses of "3" and "4" were grouped together as a positive response, and "1" and "2" were grouped as a negative response. The satisfaction scale was designed to evaluate physical features of the device, completeness of the history-asking program, ease of interaction, potential impact and global satisfaction.

Medical Content Development

Medical content for PatientTouch™ was developed by a panel of 5 board-certified emergency medicine physicians through an iterative process, and was available in English and Spanish. We identified the 10 most common patient presenting complaints from the National Hospital Ambulatory Medical Care Survey (NHAMCS). Of these, we developed content for the 6 most likely to be triaged to our minor treatment area: low back pain, upper extremity injury, lower extremity injury, abdominal pain, headache and motor vehicle collision. Questions were written at a fifth-grade reading level and were designed to be similar to those asked during a thorough ED physician evaluation. Special emphasis was added to "red-flag" questions that might signify a rare but serious condition. The device was programmed according to chief-complaint specific algorithms wherein response to previous questions drove subsequent lines of questioning. Pertinent positive and negative responses (e.g., presence of incontinence, fever, or saddle anesthesia in the back pain algorithm) were recorded, and the constellation of responses were highlighted to alert their treating physician (Figure).

Statistical Analysis

The satisfaction and experience survey was completed on the tablet and exported to a Microsoft Excel (Microsoft Corp., Richmond, WA) data base and analyzed using Stata 10.0 (Statacorp., College Station, TX). Data are largely descriptive and 95% CI are displayed as appropriate. We determined a

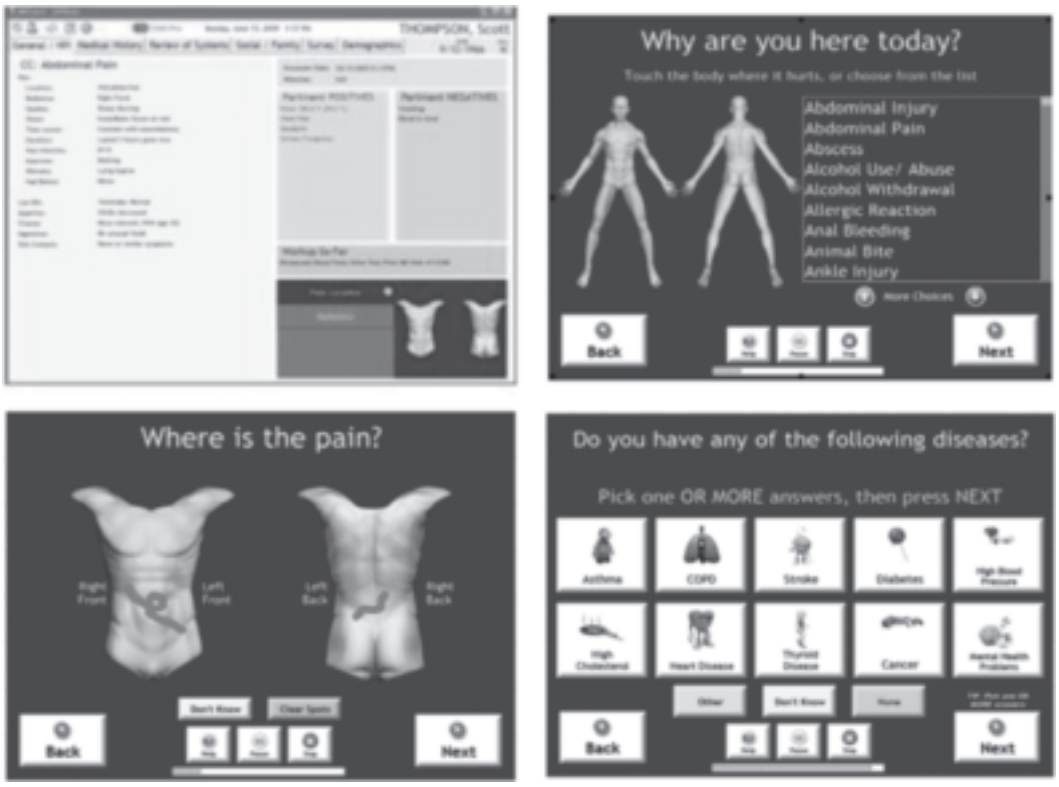

Figure. Screenshot of PatientTouch™, a handheld self-administered history-taking device.

sample size of 173 subjects would be sufficient to yield a point estimate of overall satisfaction with +/- 3% error.

Technical Specifications and System Description Hardware
The PatientTouch™ system consists of 3 hardware components: 1) a local Windows Server 2003™ computer for application and database services (the server); 2) a Panasonic Toughbook™ CF-08 Wireless Tablet running Microsoft Terminal Services™ (the tablet); and 3) a secure local router for wireless connectivity between the server and the tablet (the router).

Software. The PatientTouch™ Software (the Application) is a security-enabled Microsoft Visual Studio. NET™ expert system application, using a Microsoft SQL Server™ database to store the content of the patient questionnaires and the patient responses. The application and all data reside on the server. No information other than that required for connectivity to the server was maintained on the wireless tablet. The application was accessed via a Windows Terminal Services™ session run on the tablet, which connected through the router using a secure WPA authentication. PatientTouch™ stored answers on the server in the secure SQL server database, and PatientTouch™ determined which question to present next, based on the answer given by the patient.

Server. Operating System: Microsoft® Windows® Server 2003 for Small Business Server. Manufacturer: Dell. Model: PowerEdge SC1430. Processors: (4) x86 Family 6 Model 15 Stepping 6 Genuine Intel @ 1596 MHz. Bios: Dell Inc. 1.1.0, 10/18/2006. Total Physical Memory: 4,094.99 MB. Total Virtual Memory: 5.84 GB. Drives: Local Fixed Disk, NTFS, 97.65 GB, D: CD-ROM Disc, E: Local Fixed Disks, NTFS, 3 drives in RAID 5 configuration, total 464.50 GB. The Tablet establishes a secure, password-protected Terminal Services™ connection which runs the PatientTouch™ application. Operating System: Microsoft® Windows® CE5.0 Professional. Processor: Intel® PXA270 312-MHz. Manufacturer: Panasonic. Wireless Internet connection (IEEE 802.11b/g). RAM: Standard 64 MB. TFT color LCD: 10.4" supporting XGA resolution.

RESULTS

Of the 174 patients who used the PatientTouch™ system, 173 completed the medical questionnaire and satisfaction and evaluation survey completely (one subject completed the medical questionnaire but did not complete the satisfaction survey). Seventy-five point one percent of respondents completed the study in English, 24.9% in Spanish. With regard to satisfaction with the physical product, 93% (95%CI 90.0–97.3%) of patients indicated the product was easy to hold and use, and 96.5% (92.6–98.7%) noted the text was easy to read.

Table. Questions administered to patients who used the PatientTouch™ and results of their level of satisfaction with it. In the analysis, responses of "3" and "4" were grouped together as a positive response, and "1" and "2" were grouped as a negative response.

Question	Positive	%
I feel comfortable using a computer	145/173	83.8%
The screen was bright enough	159/173	91.9%
The screen size was acceptable	165/173	95.3%
The touch-screen worked	166/173	95.9%
The weight was acceptable	164/173	94.8%
It was easy to hold and handle	162/173	93.6%
The text was large enough/easy to read.	167/173	96.5%
I liked the overall appearance of the individual screens	167/173	96.5%
I thought the animations were enjoyable/ helpful.	167/173	96.5%
The amount of time it took was just about right.	163/173	94.2%
I understood all the questions	167/173	96.5%
The questions were detailed enough for me to fully explain my condition.	168/173	97.1%
Did you need to use the "Help" screen?	0	0%
(if yes): I found the "Help" screen to be helpful	32	-
Using this product now will help me organize my thoughts and communicate better when I talk to my physician later.	167/173	96.5%
I think when my physician reads the information I provided now he or she will better understand why I am here	169/173	97.6%
I was able to tell this product a greater level of detail (tell my story better) than I typically can when I talk to a doctor	156/173	90.2%
I felt more comfortable answering sensitive/ questions here than I would with my nurse/ physician.	144/172	83.7%
I felt like my answers were kept private from other people around me.	167/172	97.1%
I think using this product will improve the quality of my care.	163/172	94.8%
I would recommend this product to other patients.	163/172	94.8%
I would use it again	167/172	97.1%

Content satisfaction revealed that over 96.5% (92.6–98.7%) of patients understood all questions, and 97.1% (94.6–99.6%) indicated the PatientTouch™ questions were detailed enough for them to fully describe their condition.

With regard to medical communication, 98% (95.4–100.0%) of patients indicated that using PatientTouch™ helped them organize their thoughts and felt it would improve communication with their ED physician, and 90.2% (84.7–94.2%) of patients thought they could "tell their story better" when using PatientTouch™ than they typically can while talking directly to a physician. Ninety-four point eight percent (91.4–98.1%) of patients responded that they believed the device would improve the quality of their care and indicated they would recommend use of the product to other patients. More than 4 of 5 patients (83.7%(77.3–88.9%)) indicated that they were more comfortable answering sensitive questions via the tablet than they would have been speaking with a nurse or physician, and nearly all patients (97.1% (94.6–99.6%)) expressed desire to use the product again in the future. See Table 1 for a complete list of satisfaction and evaluation survey questions administered and results.

DISCUSSION

The ED presents unique challenges to doctor-patient communication as healthcare workers and patients meet typically meet in crowded conditions during times of acute illness, and do not have a pre-existing relationship. The unfortunate reality of the ED environment is in direct contrast with health communication literature, which advocates "not making the patient interaction seem rushed or incomplete" as a critical skill for physicians.[15] Moreover, Bradley et. al argue that difficulties in the effective delivery of healthcare most often arise from problems in communication between patient and provider, rather than from any failing in the technical aspects of medical care.[14–16] To enhance healthcare delivery in the ED we must develop innovative strategies to improve meaningful communication between healthcare providers without further taxing limited ED time and resources. PatientTouch™ appears to offer a

technological opportunity to improve history taking and communication between patients and their physicians.

In our study, subjects were overwhelmingly satisfied with the handheld PatientTouch™ experience. It should be noted that users speaking both English and Spanish were equally enthusiastic about the product. Specifically, more than 90% of all subjects were satisfied with the physical characteristics of the device, time required to complete the session, appropriateness and detail of the questions and potential impact on the quality of the encounter. Almost all (97.1%) of the patients felt their answers were kept private from other people around them and, interestingly, 83.7% felt more comfortable answering sensitive questions with the PatientTouch™ system than they would have been with a physician or nurse. However, we do not know if this added level of comfort leads to more truthful information sharing.

From a quality perspective, the chief complaint-based algorithms may reduce variability in history taking and ensure that critical questions are never omitted. Physician factors, such as fatigue or inappropriate biases based on age, gender and race that may result in errors of omission or recall, are mitigated. Moreover, this form of self-administered, structured questioning may allow physicians and other providers to focus on more critical questions and/or developing a rapport with the patient rather than simply data gathering. This device may eventually allow a physician to streamline his history taking, and lead to more rapid diagnosis and treatment. We are currently conducting a trial to evaluate physician satisfaction with the output produced by the PatientTouch™ system. The next step for future research in this area would be to evaluate the effect of tablet or kiosk history gathering on ED throughput metrics.[16] Although there is more work to be done, our study indicates that patients are able and willing to use such technologies as adjuncts to current healthcare delivery models.

Patient-computer dialogue was initially studied during the 1960s.[17] The use of large machines, which took up significant office space, and unfamiliar interfaces have contributed to the lack of widespread adoption in current clinical practice. Touch-screen interfaces, once limited to ATM machines and movie ticket kiosks, have now engulfed the public through mobile phones and a resurgence of the tablet PC. A strength of our study is that we did not restrict enrollment based on age, gender or computer experience. We tested this new software on an inner-city, largely Spanish-speaking patient population in a busy public ED, and lack of computer literacy did not affect the usability and likability of the device. In fact, in our study more patients wanted to use the PatientTouch™ device again (97.1%), than those who felt comfortable using a computer in general (83.8%).

LIMITATIONS

The major limitation to this pilot study is that the population was from a single center and only included patients with 1 of 6 pre-determined chief complaints. We do not know if these results are generalizable to other patient populations with different chief complaints, severities of illness or language preference. Still, this pilot work was a first step in assessing the acceptability of a patient-centered automated history-taking system and ensuring it did not pose a barrier to communication. Although the eligible chief complaints were quite limited in this pilot, they were chosen as they represent the top chief complaints observed in EDs in the United States. We did not select the content on the basis of ease of programming. Comparative examples of electronic history-taking devices in the ED are limited. Two of the only interactive models for history taking in the ED reported are the "Asthma Kiosk," which gathered information for one, previously diagnosed chief complaint and the "ParentLink," a data entry system for parents to report their child's allergies and to describe any witnessed symptoms after an episode of head trauma.[16,18,19] The PatientTouch™ is the only patient-centered device that interacts with the patient as opposed to caretakers and witnesses. Programming of PatientTouch™ has since grown, and now there are more than 100 chief complaints and algorithms programmed for the tablet. Further research will assess the system with a much broader array of chief complaints.

Another significant limitation is that although patients predicted an easier and more thorough interaction with their physician, we do not know if this occurred. We did not query patients after their physician encounter to determine if their expected improvement in quality of care was realized, nor did we ask treating physicians if patients who used PatientTouch™ provided a truly cogent and more focused history. This could have been accomplished had we conducted a larger randomized controlled trial, but as one of the first studies of its kind in the ED, our goal in this pilot project was to assess user acceptance and satisfaction.

CONCLUSION

In this pilot study, patients were highly satisfied with all aspects of the PatientTouch™ self-administered, hand-held, touch-screen tablet. Importantly, subjects felt it would help them better communicate with their doctor, would improve their overall quality of care and overwhelmingly expressed a desire to use it in the future. In light of the high user satisfaction and the pressing need to improve healthcare quality and efficiency, technologies such as PatientTouch™ are deserving of further study.

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provided the equipment and personnel to conduct the study at no charge but had no role in the design of the study. They also had no role in management, analysis or interpretation of the data, not the preparation, review or approval of the manuscript. Dr. Goldberg has no disclosures.

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Impact of Learners on Emergency Medicine Attending Physician Productivity

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Introduction: Several prior studies have examined the impact of learners (medical students or residents) on overall emergency department (ED) flow as well as the impact of resident training level on the number of patients seen by residents per hour. No study to date has specifically examined the impact of learners on emergency medicine (EM) attending physician productivity, with regards to patients per hour (PPH). We sought to evaluate whether learners increase, decrease, or have no effect on the productivity of EM attending physicians in a teaching program with one student or resident per attending.

Methods: This was a retrospective database review of an urban, academic tertiary care center with 3 separate teams on the acute care side of the ED. Each team was staffed with one attending physician paired with either one resident, one medical student or with no learners. All shifts from July 1, 2008 to June 30, 2010 were reviewed using an electronic database. We predefined a shift as "Resident" if > 5 patients were seen by a resident, "Medical Student" if any patients were seen by a medical student, and "No Learners" if no patients were seen by a medical student or resident. Shifts were removed from analysis if more than one learner saw patients during the shift. We further stratified resident shifts by EM training level or off-service rotator. For each type of shift, the total number of patients seen by the attending physician was then divided by 8 hours (shift duration) to arrive at number of patients per hour.

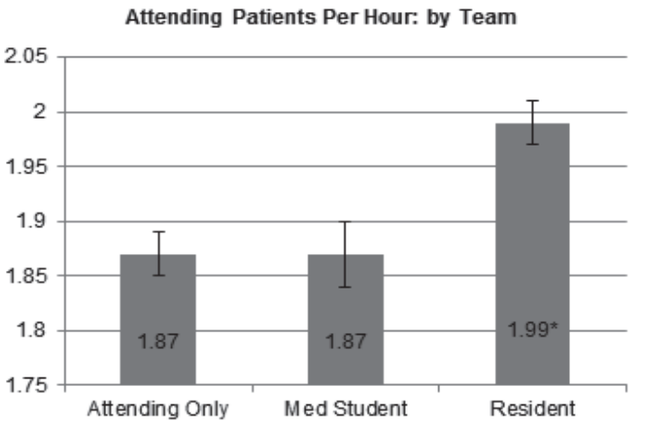
Results: We analyzed a total of 7,360 shifts with 2,778 removed due to multiple learners on a team. For the 2,199 shifts with attending physicians with no learners, the average number of PPH was 1.87(95% confidence interval [CI] 1.86,1.89). For the 514 medical student shifts, the average PPH was 1.87(95% CI 1.84,1.90), p = 0.99 compared with attending with no learner. For the 1,935 resident shifts, the average PPH was 1.99(95% CI 1.97,2.00). Compared with attending physician with no learner, attending physicians with a resident saw more PPH (1.99 vs 1.87, p<0.005). There was no statistically significant difference found between EM1: 1.98PPH, EM2: 1.99PPH, EM3: 1.99PPH, and off-service rotators: 1.99PPH.

Conclusion: EM attending physicians paired with a resident in a one-on-one teaching model saw statistically significantly more patients per hour (0.12 more patients per hour) than EM attending physicians alone. EM attending physicians paired with a medical student saw the same number of patients per hour compared with working alone. [West J Emerg Med. 2014;15(1):41–44.]

INTRODUCTION

Academic emergency departments (ED) have various staffing models for emergency medicine (EM) attending physician coverage. Those that do not alter EM attending physician coverage based on presence or absence of learners (medical students or resident physicians) may have varying

rates of productivity when learners are present or absent. Several prior studies have examined the impact of learners on overall ED flow, as well as the impact of resident training level on the number of patients seen per hour.[1-8] Four studies examined the difference in patients per hour for residents at varying post graduate training levels, and found a somewhat higher rate for each additional year of training.[1,2,7,8] Other studies examined the effect of learners on overall department throughput, and while one study found that residents slowed throughput, another found that residents had no impact, while medical students did not affect throughput in two studies.[3-6] No study to date has specifically examined the impact of learners on EM attending physician productivity, with regards to patients per hour (PPH). The purpose of this study was to examine whether learners are associated with an increase, decrease, or no effect on productivity of EM attending physicians.



*Statistically significant

Figure 1. Attending patients per hour by team: attending, 1.87 (95% confidence interval [CI] 1.86, 1.89), attending with medical student. 1.87 (95%CI 1.84, 1.90), p=0.99, and attending with resident 1.99 (95% CI 1.97, 2.00), p<0.005.

METHODS

This was a retrospective database review examining the number of new patients seen per hour by EM attending physicians and was institutional review board approved with an exempt designation. The study setting was the main (acute care side) ED at an urban, academic, tertiary care, level 1 trauma center with a post graduate year (PGY) 1-3 residency program. Annual census during the study period was approximately 82,000 patients per year, with a 26% admission rate and about 50% of all hospital admissions coming through the ED. Nearly all patients are adults and non-trauma, as trauma patients are cared for in a separate unit and children are cared for in an adjacent children's hospital. There is also a separate fast track side of the ED for low acuity patients, with about 25% of total daily volume seen on this side.

In the main ED (acute care side), patients are sequentially assigned to one of 3 teams each led by an EM attending physician. Each team cares for patients of roughly equal acuity. We estimated that about 30% of the time, the attending physician is paired with one learner, either one resident physician (generally an EM resident or a rotating PGY-2 internal medicine or PGY-1 general surgery resident) or one fourth-year medical student. Using the Amalga electronic database (Microsoft, Redmond, WA), a query was used for each EM attending physician during the course of 2 academic years (July 1, 2008 to June 30, 2010) evaluating the total number of patients seen for each shift. Each EM attending physician's total number of patients per shift was then divided by 8 hours (the length of time during each shift when new patients are seen and evaluated) to arrive at the number of patients per hour (PPH). Each shift's calculated PPH was then averaged and categorized as EM attending with no learners, EM attending working with a resident, or EM attending working with a medical student. Medical student shift times did not always match attending and resident start/stop times resulting in shifts with multiple learners. We excluded shifts with multiple learners, as there was no way to assess the impact of each learner on attending productivity. The category of EM attending working with a resident was then further analyzed by a predetermined subgroup analysis to evaluate whether there was a significant difference in PPH when working with first-, second-, or third-year EM residents (EM-1, EM-2, EM-3 respectively), as well as off-service residents.

Sample Size

To obtain adequate power to detect a difference in PPH, we made the following assumptions: During the study period, the standard deviation of PPH in our ED was 0.28. In practice, the lowest meaningful difference in number of patients seen during a shift was 1 patient, which meant that the lowest meaningful detectable difference in PPH was 0.125. Using an alpha of 0.05 and a power level of 80%, we needed to evaluate 80 EM attending shifts working with a resident. On average, the number of acute care shifts per month per EM attending physician in our department is 12. Based on our estimate of each attending working 30% of his/her shifts with a single learner, each attending would work 4 shifts with 1 learner per month. This meant we needed to evaluate 20 months of data to adequately power the study to have at least 80 shifts in each group. To reduce the impact of bias introduced by months with new resident physicians (July, August), we evaluated 2 entire years of data. We then compared the average PPH in each group using a two-sample, two-tailed t-test to determine significance.

RESULTS

We analyzed a total of 7,360 shifts with 2,778 removed due to the presence of multiple learners on a team. The remaining 4,582 shifts were then divided into EM attending with no learners, EM attending with a resident, or EM attending with a medical student. For the 2199 shifts with EM attending physicians with no learners, the average number of PPH was

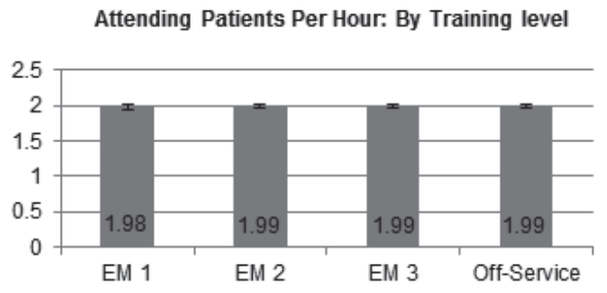


Figure 2. Attending patients per hour by resident training level, p=0.82.

1.87 (95% confidence interval [CI] 1.86,1.89). For the 514 shifts with a medical student, the average attending PPH was 1.87(95% CI 1.84,1.90), p=0.99. For the 1935 shifts with a resident, the average attending PPH was 1.99 (95% CI 1.97,2.00), p<0.005, which was statistically more when compared with attending physician with no learners (Figure 1). In the subgroup analysis of EM attending with a residents of different training level, we found no statistically significant difference between EM1: 1.98, EM2: 1.99, EM3: 1.99, or off-service resident: 1.99, p=0.82 (Figure 2).

DISCUSSION

To date, this is the first study that has specifically looked at the productivity impact of learners in a one-on-one teaching model. The average PPH seen by each solo attending physician (1.87) was somewhat lower than the 2.07 average patients per hour seen in departments with greater than 45,000 annual visits (insert additional book references here) and on the lower end of the average 1.5 to 2.5 PPH quoted in the 2009 American College of Emergency Physicians salary survey.[9,10] Likely, the reason for this difference is that patients seen in this department are adult only, with a separate fast track, leaving higher acuity patients of higher complexity seen on each team on the main side. Very few patients are seen and dispositioned prior to going to a team as there is only a limited area for triaged patients to be seen by physicians. Additionally, during the study period, our department suffered from "exit block," with 61.8% of admitted patients classified as boarding with an average of 2.8 boarding hours per admitted patient.

In our study, increasing resident training level did not contribute to more PPH for attending physicians. Prior research has indicated that higher training level is associated with greater resident PPH; however the effect on attending PPH has not been studied.[1,2,7,8] It may be that in a one-on-one teaching model, despite senior residents seeing more patients than junior residents, the attending physician does not see proportionately more patients. The implications for an academic training center are unclear, as clinical productivity of attending physicians is only one of many parameters affecting attending reimbursement. The results of this study may, however, be useful in determining necessary attending coverage for staffing the department.

LIMITATIONS

The notable limitations of this study were its retrospective design and that data obtained were from a single site. In addition, we used PPH as our productivity metric instead of RVUs because our ED is largely a medical ED with few procedures on the main (acute care) side. Thus the RVU/hour metric would reflect PPH and would not add additional information. In an ED where many procedures are done, learners may increase or decrease RVU productivity depending upon level of the learner and attending time involved to supervise the key portion of any procedure.

CONCLUSION

EM attending physicians paired with a resident in a one-on-one teaching model saw statistically significantly more patients per hour (0.12 more patients per hour) than EM attending physicians alone. EM attending physicians paired with a medical student saw the same number of patients per hour compared with working alone. The results of this study may help guide EDs seeking to expand or establish a residency-training program to assess the productivity impact of this decision.

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Correlation of the Emergency Medicine Resident In-Service Examination with the American Osteopathic Board of Emergency Medicine Part I

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Introduction: Eligible residents during their fourth postgraduate year (PGY-4) of emergency medicine (EM) residency training who seek specialty board certification in emergency medicine may take the American Osteopathic Board of Emergency Medicine (AOBEM) Part 1 Board Certifying Examination (AOBEM Part 1). All residents enrolled in an osteopathic EM residency training program are required to take the EM Resident In-service Examination (RISE) annually. Our aim was to correlate resident performance on the RISE with performance on the AOBEM Part 1. The study group consisted of osteopathic EM residents in their PGY-4 year of training who took both examinations during that same year.

Methods: We examined data from 2009 to 2012 from the National Board of Osteopathic Medical Examiners (NBOME). The NBOME grades and performs statistical analyses on both the RISE and the AOBEM Part 1. We used the RISE exam scores, as reported by percentile rank, and compared them to both the score on the AOBEM Part 1 and the dichotomous outcome of passing or failing. A receiver operating characteristic (ROC) curve was generated to depict the relationship.

Results: We studied a total of 409 residents over the 4-year period. The RISE percentile score correlated strongly with the AOBEM Part 1 score for residents who took both exams in the same year ($r = 0.61$, 95% confidence interval [CI] 0.54 to 0.66). Pass percentage on the AOBEM Part 1 increased by resident percent decile on the RISE from 0% in the bottom decile to 100% in the top decile. ROC analysis also showed that the best cutoff for determining pass or fail on the AOBEM Part 1 was a 65th percentile score on the RISE.

Conclusion: We have shown there is a strong correlation between a resident's percentile score on the RISE during their PGY-4 year of residency training and first-time success on the AOBEM Part 1 taken during the same year. This information may be useful for osteopathic EM residents as an indicator as to how well prepared they are for the AOBEM Part 1 Board Certifying Examination. [West J Emerg Med. 2014;15(1):45–50.]

INTRODUCTION

The Basic Standards for Residency Training in Emergency Medicine of the American College of Osteopathic Emergency Physicians (ACOEP) requires all osteopathic emergency medicine (EM) residents to annually participate in the Resident In-Service Examination (RISE).

Table 1. The distribution of American Osteopathic Board of Emergency Medicine (AOBEM) Part 1 test takers by post graduate year-4 residents who took the Resident In-Service Examination (RISE) from 2009 to 2012. These residents (n=409) were the subjects on whom data were reported.

Year of Examination	RISE (n= 884)	AOBEM part 1 (n = 409)	RISE and AOBEM part 1 (%)
2009	210	67	31.9
2010	212	98	46.2
2011	221	113	51.1
2012	241	131	54.4

Residency training programs in other specialties have demonstrated correlations between their specialty in-service examinations and passing future board certification examinations.[1–14] In 2009, the American Osteopathic Board of Emergency Medicine (AOBEM) began offering the option of taking Part 1 of the certifying examination to eligible EM residents in their fourth postgraduate year (PGY-4) of EM residency training. Prior to 2009 only EM residency graduates were permitted to participate in the examination.

We wish to demonstrate a correlation between the percentile score on the RISE with corresponding scores and the dichotomous outcome of passing or failing on the AOBEM Part 1 exam. We also sought to find a point whereby the likelihood of passing the AOBEM Part 1 was greatest. This will help residency program directors and residents gauge the progress a resident is making towards board certification.

METHODS

We obtained data from the National Board of Osteopathic Medical Examiners (NBOME). The NBOME is an organization that independently grades and performs statistical analyses on both the RISE and AOBEM Part 1. The hospital's institutional review board approved the project. In the United States there are 45 osteopathic EM residency programs comprised of a total of 1,777 EM residents during our study period. Of this, there was an average of 221 PGY-4 EM residents who participated in the RISE.

We studied the correlation of RISE percentiles with the scores and pass rate of the AOBEM Part 1 when both examinations were taken during the same year. We used RISE percentile rather than the RISE raw score since raw scores varied from year to year. The AOBEM Part 1 scores are equated from year to year.

We measured the performance of all fourth-year osteopathic EM residents who took both the RISE and AOBEM Part 1 examinations in the same year from 2009 to 2012. The number of PGY-4 osteopathic EM residents that took the RISE and AOBEM examinations in the same year are listed by year in Table 1.

We used the following units of measurement: RISE percentile (of all residents at every level of training taking the examination), AOBEM Part 1 score, AOBEM Part 1 Pass/Fail.

Data Analysis

We calculated Pearson's correlations (r) of RISE percentiles with AOBEM Part 1 scores.[15,16] A receiver operating characteristic (ROC) curve was generated to compare the RISE percentile with the probability of passing or failing the AOBEM Part 1. We performed statistical analysis using SPSS Version 12.0.

RESULTS

From 2009 to 2012, 409 (46.3%) of the 884 PGY-4 residents who took the RISE also took the AOBEM Part 1. (Table 1)

There was a good correlation between both the RISE percentiles and the AOBEM Part 1 scores for each year (Table 2).[15,16] The overall correlation between the RISE percentile and the AOBEM Part 1 score was 0.61 (95% confidence interval [CI] 0.54 to 0.66). The scatter plots and correlation for each year are listed in Figure 1.

An ROC curve was generated with RISE percentile and AOBEM Part 1 Pass/Fail (Figure 2).[9] The ROC curve is a graphical plot that illustrates the performance of a binary classifier system as its discrimination threshold is varied. If the curve reached the left upper corner, where sensitivity=1 and specificity=0, then the prediction is perfect (100% correct). Practically speaking, the point on the curve, which is closest to the left upper corner, would be considered as the best cut-off with the greatest sensitivity and specificity. The sensitivity and the specificity of different percentiles as cut-off points for predicting pass or fail on the AOBEM Part 1 are listed in Table 3. These data demonstrate that lower percentile scores had higher sensitivity and lower specificity while higher percentile scores produced lower sensitivity and higher specificity. It was found that the 65th percentile was the best cut-off point, which maximized the sensitivity (0.81) and specificity (0.88) together.[15] The area under the curve was 0.885 (95% CI = 0.834 to 0.936).

Table 2. The Pearson correlation between Resident In-Service Examination (RISE) percentiles and American Osteopathic Board of Emergency Medicine (AOBEM) Part 1 scores for post graduate year-4 residents who took both exams in the same year from 2009 to 2012.

		RISE Percentiles vs. AOBEM scores	
	Sample Size	Coefficient	95% CI
2009	67	0.75	0.62 to 0.84
2010	98	0.63	0.49 to 0.74
2011	113	0.68	0.56 to 0.76
2012	131	0.58	0.45 to 0.68
Overall	409	0.61	0.54 to 0.66

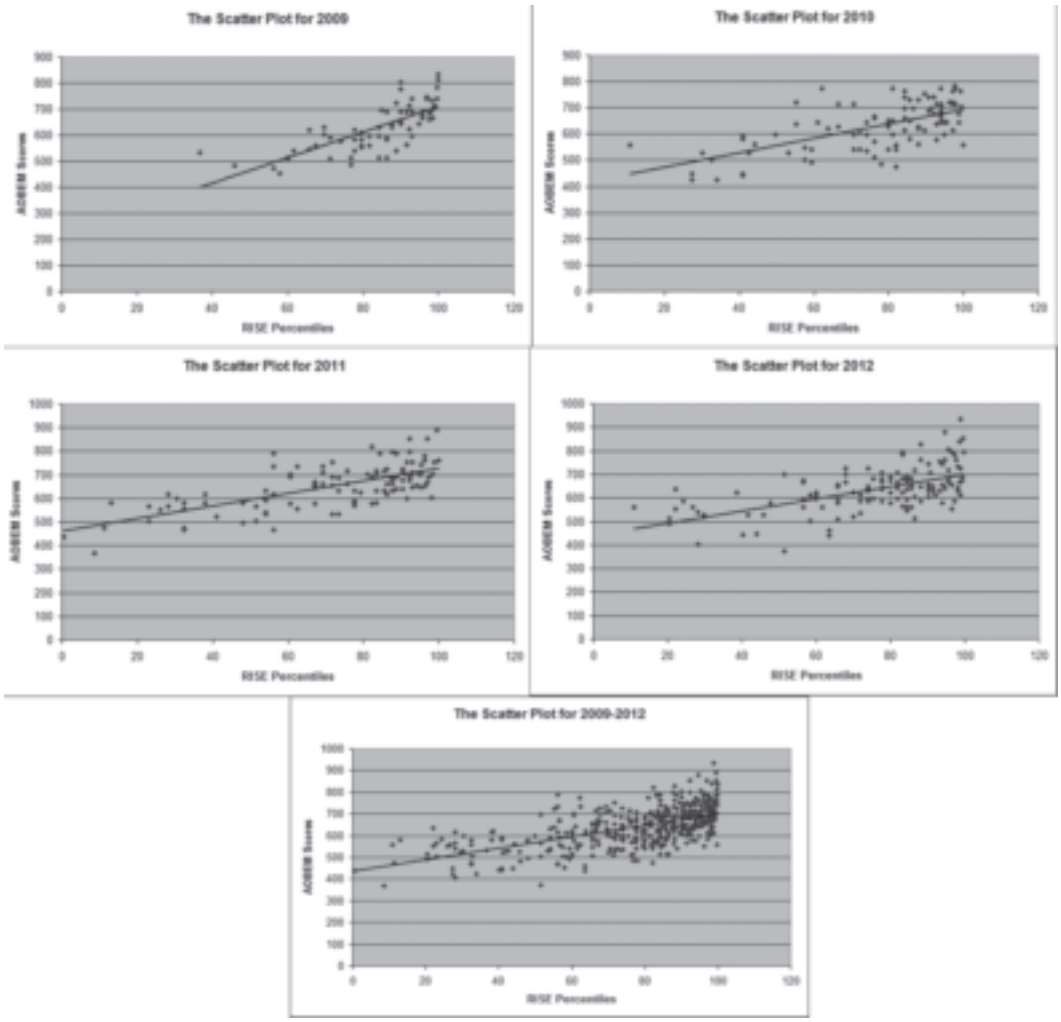

Figure 1. Scatter plots for the Resident In-Service Examination (RISE) Percentiles vs. the American Osteopathic Board of Emergency Medicine (AOBEM) Part 1 score for each of four years and all four years combined. Correlation coefficients and 95% confidence intervals are in Table 2.

The analysis of RISE percentile vs. AOBEM Pass/Fail is presented in Table 4 as descriptive statistics. The average percentile by the Pass group was significantly higher than that by the Fail group by independent T test (78.0 vs. 43.4; $p<0.001$).

The 22 of 26 residents who failed the AOBEM Part 1 scored below the 65th percentile on the RISE exam. The group that passed the AOBEM Part 1 had more residents distributed in the higher percentile area than in the low percentile area (Figure 3).

The ROC analysis (Figure 2) demonstrated that the 65th percentile on the RISE was the most sensitive inflection point for predicting a resident's outcome of pass or fail on the AOBEM Part 1. The residents whose RISE scores were at the 7th decile and above ($\geq$60th percentile) had a pass rate of greater than 95%. The passing rates for the 7th, 8th, 9th and 10th deciles were >95% for each decile. The passing rate for the 6th decile (51st - 60th percentile) dropped to 84.4%, which was substantially higher than the lower deciles (Table 5).

Figure 4 uses logistic regression analysis to generate a graph that can be used by residents and program directors as a rough estimate of the probability of passing the AOBEM Part 1 based on RISE percentile. This estimate is based on the past data that we had available to us.

DISCUSSION

Other medical specialties have found that correlations exist between their resident in-service examinations and resident performance on board certification examinations.[1–14] These specialties for the most part have shown that moderately strong correlations exist between scores on their in-service exams and their board certifying specialty exams.

Our results show correlation that an osteopathic EM resident's RISE percentile during their PGY-4 year of residency training correlates strongly with their AOBEM Part 1 score.

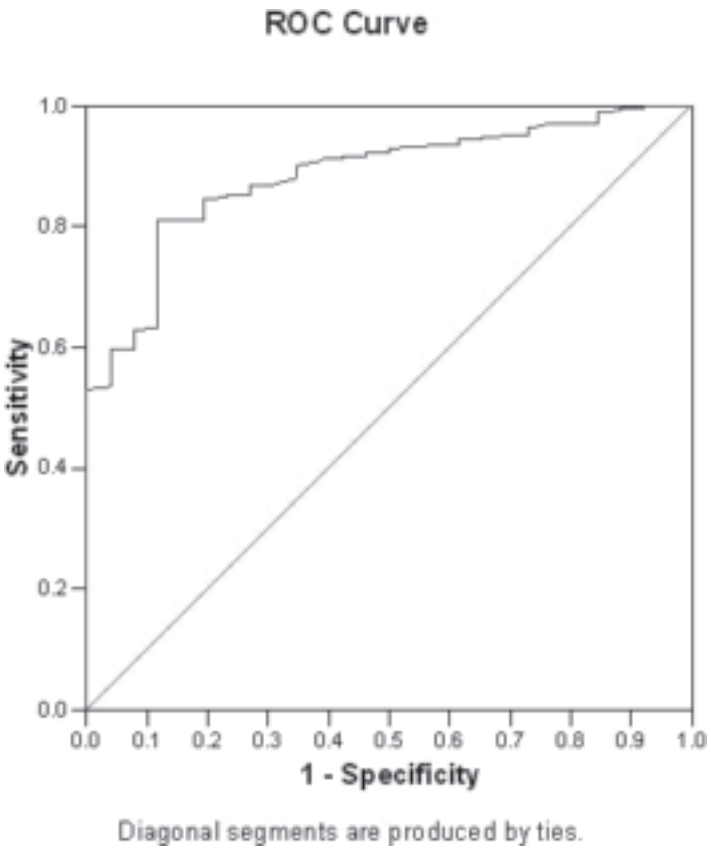

Figure 2. The receiver operating curve analysis. When 0.65 was selected as the optimum cut-off point the area under curve was 0.89 (95% confidence interval 0.75 to 0.85).

Table 3. The sensitivity and the specificity of different Resident In-Service Examination percentiles as cut-off points for predicting pass or fail on the American Osteopathic Board of Emergency Medicine Part 1 for the pooled data on the 409 subjects. The 65th percentile (in bold) was the cut-off point, which maximized the sensitivity (0.81) and specificity (0.88).

Positive if Greater Than or Equal To	Sensitivity	Specificity
5th percentile	1.00	0.04
10th percentile	1.00	0.08
20th percentile	0.99	0.15
30th percentile	0.96	0.27
40th percentile	0.93	0.42
50th percentile	0.91	0.62
60th percentile	0.84	0.81
65th percentile	**0.81**	**0.88**
70th percentile	0.74	0.88
80th percentile	0.58	0.96
90th percentile	0.33	1.00
100th percentile	0.00	1.00

Table 4. The mean percentile scores of the residents that failed the American Osteopathic Board of Emergency Medicine (AOBEM) Part 1 were significantly lower than the scores of the residents who passed the AOBEM Part 1 ($p<0.001$).

	N	Mean	Std.	Min	Max
Fail	26	43.4	21.2	0.4	82.1
Pass	383	78.0	19.4	10.9	100

Our results also correlate that the rate of passing the AOBEM Part 1 increases with higher percentile scores on the RISE. By describing the RISE percentiles as deciles, we showed correlation that the pass rate on the AOBEM Part 1 generally increases by decile. For our study period, scoring in the top decile on the RISE virtually guaranteed first-time success on the AOBEM Part 1 certifying examination. This information can potentially be very useful to fourth-year residents who are debating whether or not they are ready to sit for the AOBEM Part 1 before they graduate residency. Based on the results of this study, PGY-4 residents who score in the top 4 deciles on the RISE exam could be encouraged to take the AOBEM Part 1 before finishing residency. This recommendation is based on historical data, and statistics may change from year to year.

Although most people in the upper 8 deciles on the RISE do pass the AOBEM Part 1, the pass rate generally improves with each higher decile. We also used the ROC curve to identify the RISE percentile score that could best predict success or failure on the AOBEM Part 1. Using this analysis, the 65th percentile was determined to be the most significant percentile as a breakpoint in performance prediction. According to our

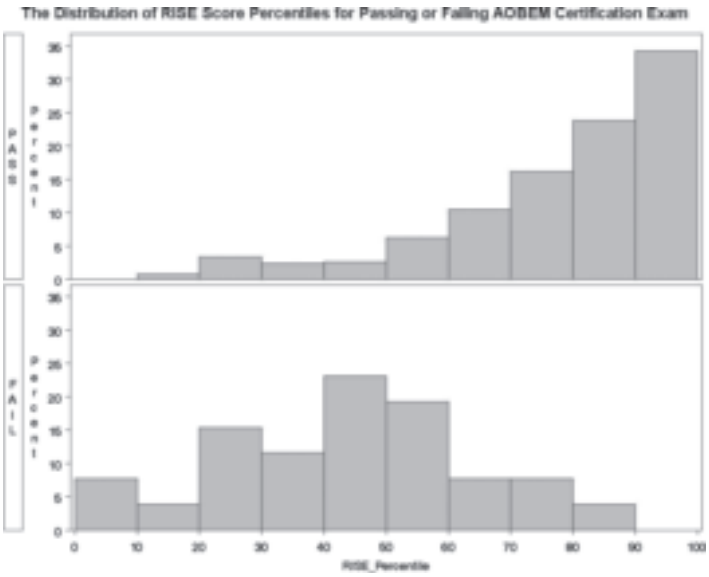

Figure 3. The American Osteopathic Board of Emergency Medicine (AOBEM) Part 1 fail and pass rates for each decile score on the Resident In-Service Examination (RISE).

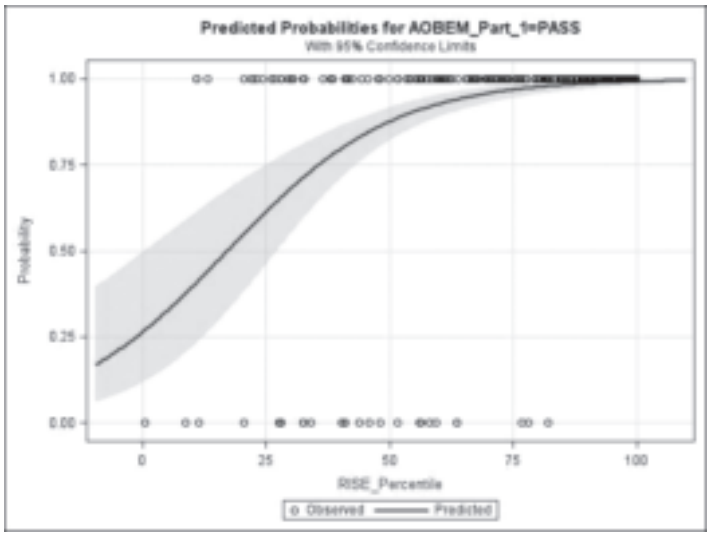

Figure 4: A logistic regression analysis curve predicting the probability of passing the American Osteopathic Board of Emergency Medicine (AOBEM) Part 1 based on Resident In-Service Examination percentile according to the analyzed data.

data, examinees who scored greater than this percentile passed the AOBEM Part 1 approximately 99% of the time while examinees who scored below this percentile on the RISE passed the AOBEM Part 1 only 76% of the time. This is a metric that program directors and examinees may use to determine examinee preparedness for the AOBEM Part 1.

The majority of the examinees who took the AOBEM Part 1 before graduating residency scored in the upper 2 deciles on the RISE, while 22 of 26 residents who failed scored below the 65th percentile on the RISE exam.

When examining the data, we showed correlation that the overall pass rate for the AOBEM Part 1 was higher for the PGY-4 residents when compared to the overall exam pass rate. The PGY-4 residents who opted to take the exam may have chosen to take it at a time when they felt most prepared. Another possible reason for this result is that included in the overall exam pool are examinees who had previously failed the AOBEM Part 1. There are other possibilities that may have influenced a resident's decision to postpone taking the AOBEM Part 1.

We chose to focus our analysis on PGY-4 residents who took the AOBEM Part 1 because the RISE and AOBEM Part 1 are offered only several weeks apart and reflect the most consistent knowledge base. Additional learning or forgetting of concepts would be minimized by this short time span. Additionally, this information would be most useful for residents as a predictor of their need to further prepare themselves for the AOBEM Part 1. Program directors can also use this information to modify training programs to better prepare their residents for first-time success on the AOBEM Part 1 exam. Future studies could analyze other post-graduate years and provide performance information earlier in the residency training period.

LIMITATIONS

This was a retrospective study, which permits only associations rather than cause and effect. Since only PGY-4 residents who opted to take the AOBEM Part 1 during the same year were used, this limits the generalizability to other post-graduate years.

Osteopathic PGY-4 EM Residents have only been allowed to participate in the AOBEM Part 1 during their residency training since 2009. Each year an increasing number of PGY-4 residents have chosen to take the AOBEM Part 1. Future results may not have the corresponding predictive power as more PGY-4 residents opt to take the AOBEM Part 1.

The number of failures (26) of total examinees (409) was relatively low. Even though we included the entire population, the future predictive value of any percentile score on the RISE would at best be approximate.

We only analyzed correlations between the RISE percentiles and AOBEM Part 1 performance and did not look at other variables such as age, sex, race, and size of training program. We did not include people who took the test more than once. Therefore this correlation may be limited to first time test takers only.

The study group was a convenience sample and captured less than 50% of graduating resident performance. Selection bias may exist in residents choosing to take AOBEM early.

CONCLUSION

The RISE is a useful tool for both osteopathic EM residents and program directors to gauge a resident's

Table 5. The American Osteopathic Board of Emergency Medicine (ABOEM) passing rate for each decile on the Resident In-Service Examination (RISE). The greatest change in association between RISE percentile and ABOEM pass rate occurred from the 50th to 70th percentiles.

Decile	1	2	3	4	5	**6**	**7**	8	9	10	
Range (%)	0 to ≤10	>10 to ≤20	>20 to ≤30	>30 to ≤40	>40 to ≤50	>50 to ≤60	>**60** to ≤**70**	>70 to ≤80	>80 to ≤90	>90 to ≤100	overall
N	2	4	17	12	16	**32**	**41**	69	85	131	409
Passing rates	0	75.0	76.5	75.0	62.5	**84.4**	**95.1**	97.1	98.8	100	93.6

preparedness for the AOBEM Part 1 as shown by a strong correlation between performances on both exams. The number of residents who opted to take the AOBEM Part 1 as a PGY-4 increased each year of our study period. Continued analysis of subsequent exams should be performed. Future studies can provide residents and program directors with ongoing analysis so they may effectively use the RISE as a tool to gauge a resident's future performance on the AOBEM Part 1 Board Certifying Exam.

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Meta-analysis of Protocolized Goal-Directed Hemodynamic Optimization for the Management of Severe Sepsis and Septic Shock in the Emergency Department

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Introduction: To perform a meta-analysis identifying studies instituting protocolized hemodynamic optimization in the emergency department (ED) for patients with severe sepsis and septic shock.

Methods: We modeled the structure of this analysis after the QUORUM and MOOSE published recommendations for scientific reviews. A computer search to identify articles was performed from 1980 to present. Studies included for analysis were adult controlled trials implementing protocolized hemodynamic optimization in the ED for patients with severe sepsis and septic shock. Primary outcome data was extracted and analyzed by 2 reviewers with the primary endpoint being short-term mortality reported either as 28-day or in-hospital mortality.

Results: We identified 1,323 articles with 65 retrieved for review. After application of inclusion and exclusion criteria 25 studies (15 manuscripts, 10 abstracts) were included for analysis (n=9597). The mortality rate for patients receiving protocolized hemodynamic optimization (n=6031) was 25.8% contrasted to 41.6% in control groups (n=3566, $p<0.0001$).

Conclusion: Protocolized hemodynamic optimization in the ED for patients with severe sepsis and septic shock appears to reduce mortality. [West J Emerg Med. 2014;15(1):51–59.]

INTRODUCTION

The incidence of sepsis and the absolute number of sepsis-related deaths have progressively increased in the United States over the last decade, and an increasing number of critically ill patients are managed in the emergency department (ED).[1–3] An estimated 571,000 cases of severe sepsis, or roughly two-thirds of the nation's burden, present annually to an ED and spend nearly 5 hours therein.[4] Given the significant mortality associated with this patient population,[5] an important determinant of outcome is conceivably the care provided in the ED prior to intensive care unit (ICU) admission. If so, a grave responsibility rests upon ED systems to create and provide evidence-based management strategies targeting severe sepsis and septic shock.

Previous studies have examined the effect of therapeutic interventions on outcome in septic shock, such as immunotherapeutic agents, hemodynamic optimization, or pulmonary artery catheterization but have enrolled patients up to 72 hours after ICU admission.[6–9] The lack of efficacy noted in hemodynamic optimization trials, in particular, prompted editorials emphasizing that future studies target patients early in their presentation and begin intervention at a more reversible stage of organ dysfunction.[8,10–12]

Rivers et al examined whether early goal-directed therapy (EGDT) in the ED before ICU admission effectively reduces

multi-organ dysfunction and mortality rates in patients with septic shock by using specific criteria for early identification, establishing goals of resuscitation, and implementing a treatment protocol.[13] Since publication there have been other trials evaluating the impact of ED management on patients with severe sepsis and septic shock. This systematic review provides an analysis of studies instituting protocolized hemodynamic optimization for patients with severe sepsis and septic shock in the ED to determine if there is a significant reduction in mortality.

METHODS

We modeled the structure of this analysis after the QUORUM and MOOSE published recommendations for systematic scientific reviews.[14–17] A computer search to identify articles was performed by 2 investigators (KD, CW) from 1980 to December 4, 2011 using the following databases: MEDLINE, EMBASE, and CINAHL, Cochrane DSR, DARE, CCTR, and ACP Journal Club. Medical subject headings (MeSH) used were as follows: early goal-directed therapy, goal-directed therapy, goal-oriented therapy, hemodynamic optimization, sepsis bundles, supranormal oxygen delivery, sepsis oxygen delivery, resuscitation endpoints, cardiac optimization, supranormal resuscitation, mixed venous saturation, mixed central venous oxygen saturation, sepsis quality improvement, and sepsis protocol. We screened references in reviews and relevant trials to identify further pertinent articles. We performed an Internet search with the Google search-engine to identify unpublished abstracts at national and international emergency medicine and critical care conferences. And we contacted a clinical expert in the field for further assistance (JS).

Studies included for analysis were adult controlled trials implementing protocolized hemodynamic optimization in the ED for patients with severe sepsis and septic shock. Exclusion criteria were studies published prior to 1980, non-English articles, studies not reporting the outcome of short-term mortality, studies not enrolling any patients from the ED, studies excluding septic patients, preliminary studies with later manuscripts reporting the same data, and series with fewer than 10 patients. Of note, we included studies if a portion of patients were enrolled from the ED, with the remainder being enrolled from hospital floors or intensive care units. Studies were also included if the treatment protocol administered the following additional treatment interventions: activated protein C, tight glycemic control, low tidal volume ventilation, or corticosteroid administration. To reduce publication bias, we also performed a systematic search for published abstracts that had not been published in manuscript format, even though critical appraisal of such publications is limited. Our methodology was to review all published abstracts related to "sepsis" or "goal-directed therapy" in national emergency medicine (SAEM, ACEP) and critical care (SCCM, ACCP) conferences from 2001 to 2008/2010 (we searched EM national conferences through 2010, and national critical care conferences through 2008). We also included published abstracts identified as references in relevant review papers. Abstracts explicitly stating that the location of the protocolized hemodynamic optimization intervention was performed only in the ICU and not in the ED were excluded, while all others were included for analysis.

Two reviewers (CW, KD) independently applied inclusion/exclusion criteria and used a customized data-collection form and glossary of terms to systematically identify relevant trials and outcome measures. On the data collection form each recorded the primary outcome measure of short-term mortality, secondary outcome measures, and applied a level of evidence score to each study. Secondary outcome measures included: research protocol, administration of other treatments, severity of illness scores, serum lactate levels, Scv02, and hospital length of stay. Disagreements were solved by discussion. We scored articles with a methodologic quality assessment derived from prior literature.[15–18] Level 1 studies were randomized, controlled trials with all of the following criteria being fulfilled: concealed treatment allocation, similar groups at baseline, blinding to the intervention, acceptable drop-out rate, similar timing of the outcome assessment in all groups, and incorporation of an intention to treat analysis. Level 2 studies were randomized, controlled trials without >1 of the listed level 1 criteria. Level 3 studies were prospective un-randomized trials (prospective observational studies, including before/after analyses). Level 4 studies were not fully prospective, including but not limited to use of a historical or retrospective control group. Level 5 studies were published abstracts or short reports.

We used Fisher's exact test and a two tailed p-value to determine statistical significance for the primary endpoint of short-term mortality. A p-value of <0.05 was considered significant. We performed meta-analysis using Comprehensive Meta-Analysis version 2.0[19]. Odds ratios were used as effect size estimates and presented for each study along with 95% confidence intervals. Pooled estimates are presented within publication type and across all studies. The estimate of heterogeneity was moderate (i-squared=35) and was not explained by publication type, so random effect estimates are described. The random effect model assumes that the true effect size can vary from study to study and the pooled effect size is the average.

RESULTS

Database searches identified 1,323 articles (Figure 1). After combination of MeSH headings and removal of duplicates (n=614), we identified 709 articles. Six hundred forty-four articles met exclusion criteria on electronic review yielding 65 articles that were manually evaluated for clinical relevance. We identified 15controlled studies[13,20–33] fulfilling inclusion and exclusion criteria (n=3277). There was 93.3% agreement between investigators for article level-of-evidence

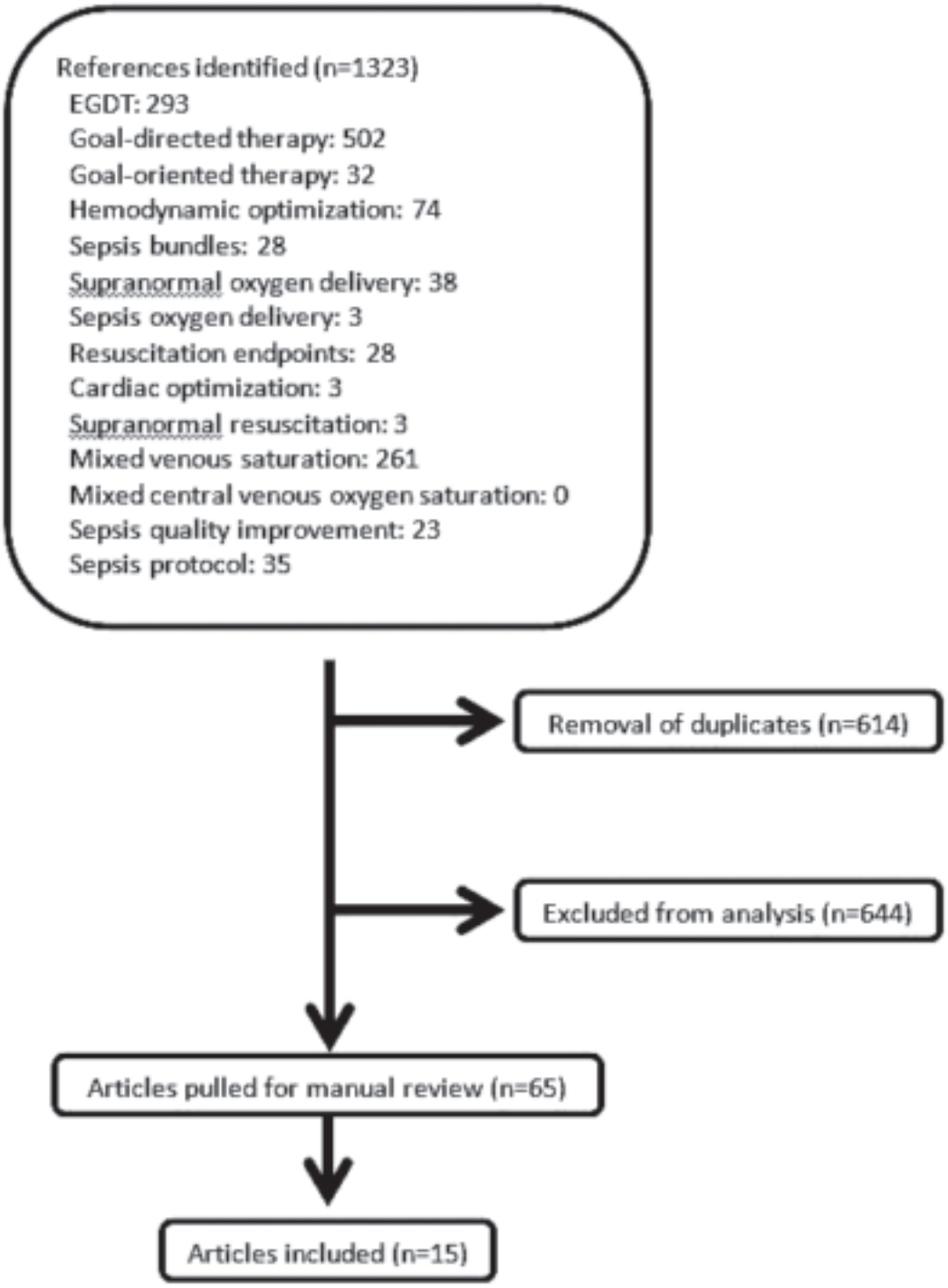

Figure 1. Flow chart of article extraction. *EGDT*, early goal-directed therapy.

scoring (Table 1), and 96.6% agreement for primary outcome data extracted from published manuscripts (Table 2). The sample size for all studies ranged from 38 to 511. An abstract search also identified 10 studies[34–43] (n=6320) with sample sizes ranging from 50 to 5,080. Cumulatively, among 25 studies and abstracts identified (n=9597) 1 study received a level 1 methodological score, 7 received a level 3 score, 7 received a level 4 score, and 10 received a level 5 score (Table 3). One study was excluded[44] because it had data reported in a later study that was included for analysis.[25]

Among published controlled studies four studies enrolled patients from both the ED (Table 2) and ICU with only one reporting the number of patients enrolled from the ED[20] (11%), while another gave a qualitative estimate[31](80%). The remaining studies (n=11) appeared to enroll patients only from the ED. Among studies reporting APACHE II scores[13,20–23,25,27,30–33] in

Table 1. Overall mortality for protocolized versus non-protocolized hemodynamic optimization for both published studies and published abstracts.

		Protocolized care mortality			Non-protocolized care mortality		
Author	N	N total	N Died	%	N total	N Died	%
Abstracts							
Gaieski, 2005	58	16	4	25	42	20	47.6
Ikeda, 2006	314	266	50	18.9	48	19	40.1
Kinsella, 2006	185	103	18	16.7	82	19	23
Mullon, 2006	196	124	43	34.5	72	29	40.3
Antro, 2006	64	36	13	36.1	28	18	64.3
Stenstrom, 2006	50	30	5	16.7	20	8	40
Armstrong, 2005	131	63	17	27	68	35	51
Tanios, 2007	96	62	17	27	34	19	55
Cannon, 2008	5080	3488	916	26.3	1592	624	39.2
Gunaga, 2008	146	48	11	23	98	37	37.8
Sub-Total	6320	4236	1094	25.8	2084	828	39.7
Manuscripts							
Rivers, 2001	263	130	38	30.5	133	59	46.5
Gao, 2005	101	52	12	23	49	24	49
Trzeciak, 2006	38	22	4	18.2	16	7	43.8
Shapiro, 2006	130	79	16	20.3	51	15	29.4
Micek, 2006	125	61	19	31.1	64	33	51.6
Jones, 2007	156	77	14	18	79	21	27
Nguyen, 2007	330	77	16	20.8	253	100	39.5
Sebat, 2007	511	426	50	11.8	85	34	40
El Sohl, 2008	174	87	34	39	87	48	55.1
Puskarich, 2009	285	206	77	37.3	79	39	49.4
Crowe, 2009	306	183	63	34.4	123	53	43.1
MacRedmond, 2010	74	37	10	27	37	19	51.4
Patel, 2010	112	59	12	20.3	53	32	61.1
Coba, 2011	498	202	75	37.1	296	140	47.3
Sivayoham, 2011	174	97	22	22.7	77	33	42.9
Sub-Total	3277	1795	462	25.7	1482	657	44.3
Total	9597	6031	1556	25.8	3566	1485	41.6

the treatment and control groups, the values were $24.8 + 6.5$ and $24.9 + 6.9$ respectively (P=0.97, paired t-test).

All studies used hemodynamic optimization pathways (Table 2) with a mean arterial pressure (MAP) threshold for vasopressors. All studies but one[20] reported mixed central venous (Scv02) or mixed venous (Sv02) oxygen saturation monitoring. All but two[32,33] had transfusion thresholds for red blood cells. In several studies, selected patients in the protocolized hemodynamic optimization group and control group were permitted to receive Activated Protein C, low tidal volume ventilation ventilation, tight glycemic control, and corticosteroids (Table 2). The mortality rate for patients receiving protocolized hemodynamic optimization (n=1795) was 25.7% contrasted to 44.3% in control groups (n=1482, $p<0.0001$, Fisher's Exact test).

Among the 10 published abstracts[34–43] identified, the mortality rate for patients receiving protocolized hemodynamic optimization (n=4236) was 25.8% contrasted to 39.7% in control groups (n=2084, $p<0.0001$, Fisher's Exact Test). Cumulatively, among all identified published studies and published abstracts (n=9597), the overall mortality rate for patients receiving protocolized hemodynamic optimization (n=6031) was 25.8% contrasted to 41.6% in control groups (n=3566, $p<0.0001$, Fisher's Exact Test). In each identified study there was a lower mortality rate in the protocolized hemodynamic optimization group compared to control groups

Table 2. Location of study and interventions performed.

Manuscript	ED only	Sv02	Early abx	Steroids	APC	Glycemic control	Vent. prot.
Rivers, 2001	X	X	X				
Gao, 2005			X	X	X	X	X
Trzeciak, 2006	X	X	X	X	X		
Shapiro, 2006	X	X	X[c]	X	X	X[a]	X
Micek, 2006	X	X	X[c]	X[b]	X		
Jones, 2007	X	X	X	X[a]	X		
Nguyen, 2007	X	X	X[ac]	X[a]	X[a]		
Sebat, 2007		X	X[c]	X	X	X	
El Sohl, 2008	X	X	X	X[a]	X	X	X
Puskarich, 2009	X	X	X	X[a]	X[a]		
Crowe, 2009	X	X	X	X			
MacRedmond, 2010	X	X	X				
Patel, 2010		X	X[c]	X	X	X	
Coba, 2011		X	X[a]	X	X	X	X
Sivayoham, 2011	X	X	X[a]				

ED, emergency department; *Abx,* antibiotics; *Sv02,* mixed venous or central venous oxygen saturation monitored; *APC,* Activated Protein C (drotrecogin alpha); *Vent Prot,* ventilation protocol
[a]Protocol group received more ($P<0.05$)
[b]Control group received more ($P<0.05$)
[c]Antibiotics administered significantly faster in protocol group ($P<0.05$)

(Table 1). The cumulative odds ratio for all studies was 0.51 (95% CI 0.47 to 0.56) (Figure 2).

DISCUSSION

This meta-analysis evaluates the impact of protocolized goal-directed hemodynamic optimization on short-term mortality in patients with severe sepsis and septic shock when initiated in the ED. Pooled data from the 25 included studies contain 9,597 subjects and demonstrate a 15.8% overall reduction in mortality. Our results underscore the importance of creating ED systems capable of identifying patients and delivering this care at the time of disease recognition.

A mounting body of evidence highlights the unacceptably high mortality rate among patients with severe sepsis and septic shock and suggests that an early quantitative resuscitation strategy can have a substantial survival benefit. Rivers et al first demonstrated the significant reduction in multi-organ dysfunction and mortality from septic shock that may be achieved with an ED-based protocol emphasizing early recognition and goal-directed therapy.[13] The Surviving Sepsis campaign, led by an international collaboration of critical care groups, endorsed the implementation of such a management strategy within the first 6 hours following recognition of septic shock and severe sepsis but did not mandate the involvement of the ED.[45]

Significant challenges confront the specialty of emergency medicine as it attempts to translate these research interventions and consensus guidelines to the bedside in the ED.[46] Indeed, some have suggested that EGDT trials are, in essence, a sepsis quality initiative challenging the existing paradigm of management, moving beyond the science and components of early hemodynamic optimization.[25] A pervasive question when considering how to deliver care based on the EGDT model in the ED is not simply whether the impact on outcomes is replicable but whether implementation of the protocol itself is. Of note, several of the trials identified in this systematic review appear to have been quality improvement initiatives in the ED based upon existing recommendations, with 2 of the trials performed in community hospital EDs.[26,31] However, when considering "feasibility" of translation to the bedside it is important to note we could only quantitatively extract the overall proportion of eligible patients receiving protocolized hemodynamic optimization from the following studies: Sebat et al[26] in their community hospital reported 100% sensitivity, Shapiro et al[22] missed 10 out of 138 eligible patients thus providing treatment to 92.7% of eligible patients, Patel et al in their community hospital reported that 19 of 78 patients didn't received bundled care in their hospital, thus providing treatment to 75.6% of eligible patients[31], and Sivayoham et al[33]—albeit in a retrospective cross-sectional study—reported that only 55.7% of eligible ED patients received EGDT.[33] Of note, results from the 2 community hospitals appear promising for the translation of protocols in that environment.

Perhaps influential on the results from the cumulative trials, there appears to be an increased awareness regarding severe sepsis and septic shock in the specialty of EM. Of note,

Table 3. Methodologic scores of identified trials that analyzed adult controlled trials implementing protocolized hemodynamic optimization in the emergency department for patients with severe sepsis and septic shock.

Author	Design	LOE Score
Rivers, 2001	Randomized control trial	1
Gao, 2005	Prospective observational study	3
Gaieski, 2005	Published abstract	5
Armstrong, 2005	Published abstract	5
Trzeciak, 2006	Prospective observational study with historical control	4
Shapiro, 2006	Prospective observational study with historical control	4
Ikeda, 2006	Published abstract	5
Kinsella, 2006	Published abstract	5
Mullon, 2006	Published abstract	5
Stenstrom, 2006	Published abstract	5
Antro, 2006	Published abstract	5
Micek, 2006	Prospective before and after study	3
Jones, 2007	Prospective before and after study	3
Nguyen, 2007	Prospective observational study	3
Sebat, 2007	Prospective observational study	3
Tanios, 2007	Published abstract	5
El Sohl, 2008	Prospective observational study with historical controls	4
Cannon, 2008	Published abstract	5
Gunaga, 2008	Published abstract	5
Puskarich, 2009	Prospective before and after study	3
Crowe, 2009	Prospective observational study with historical control	4
MacRedmond, 2010	Prospective observational study with historical control	4
Patel, 2010	Prospective observational study with historical control	4
Coba, 2011	Prospective observational study	3
Sivayoham, 2011	Retrospective before and after observational study	4

LOE, level of evidence

over the past decade the number of sepsis-related published abstracts have increased at EM national congresses with a 10-fold increase since the publication of the seminal EGDT trial in 2001 (Figure 3). Likewise, many of the identified small studies have attempted to replicate the Rivers study or implement the Surviving Sepsis Campaign guidelines and describe the impact of protocolizing hemodynamic optimization in the ED for patients with severe sepsis and septic shock. Our study systematically reviews this published body of literature in an effort to determine the overall impact of protocolized management when initiated *in the ED* on outcomes in severe sepsis and septic shock. In reporting the successful implementation of a sepsis protocol in the cited institutions, this meta-analysis offers the most compelling evidence to date that the EGDT model in the ED setting is potentially feasible and may improve patient outcomes. Of note, 2 of the trials were performed in community hospitals, suggesting that translation to that environment is also possible and yielding of better outcomes. Our results suggest the importance of creating systems capable of delivering hemodynamic optimization at the time of disease recognition in the ED.

However, the heterogeneity of the studies included in this meta-analysis with respect to both subject identification and management strategies yield a number of limitations that present challenges for future research and implementation. In developing an ED-based protocol for sepsis management, the identification strategy must clearly define whom to target for the management protocol. Rivers et al included patients with infection, 2 or more SIRS criteria, and shock as defined by a lactate $>$ 4mmol/L or hypotension despite plasma of volume expansion of 20cc/kg. Among published studies it is not possible to determine if patients with severe sepsis (ie—organ failure without lactate elevation or vasopressor dependence) benefit from protocolized hemodynamic optimization in the ED, or whether the outcome improvement was imparted only to those with septic shock. The impact of protocolized hemodynamic optimization in sepsis is not marginalized, but the patient population that EM must target remains to be

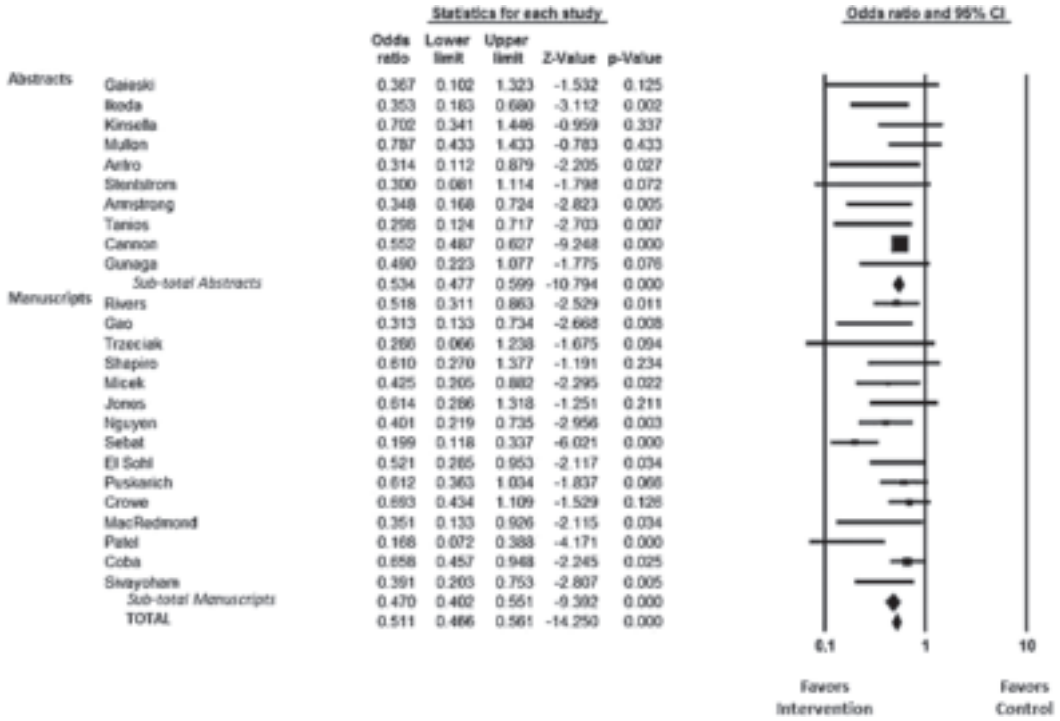

Figure 2. Relative risk of individual trials. Error bars indicate 95% confidence intervals. The pooled risk estimates are shown as diamonds.

defined with precision, as do the methods employed to reliably do so. Nevertheless, institution of early antibiotics as many of the protocols cited by identified studies have, is a critical intervention.

Likewise, a marked heterogeneity exists with respect to the elements of the protocolized care delivered in the studies included. All of the studies implemented a form of EGDT, but many included additional interventions such as low tidal volume ventilation, glycemic control, steroid administration, pulmonary artery catheter derived variables and/or the use of drotrcogin alfa outside the timeframe of the ED. It is not possible in these studies to discern which of the protocolized elements conferred the greatest mortality benefit and, as such, must be incorporated in an effective ED-based protocol initiative. Nor is it possible, in the case of studies with historical controls, to determine whether the mortality benefit was solely due to enhanced identification of patients with severe sepsis or shock. Nonetheless, many studies cite they were implementing other interventions consistent with the existing standard of care—which in many cases were also given to the control groups. Also, given that every identified study had an improvement in outcomes, the implementation of ED protocolized hemodynamic optimization appears to have an impact on mortality reduction for patients with severe sepsis and septic shock.

LIMITATIONS

This meta-analysis is limited by publication bias. However, to mitigate this potentially confounding variable we performed a systematic review of published abstracts at select national critical care and EM conferences. Nevertheless, if a study was not accepted as an abstract at a national conference, we did not have a mechanism for identification. Also, 4 of the studies enrolled patients from the floors or ICUs in addition to the ED, with only 2 of the 4 articles quantitatively reporting or estimating the number/proportion of patients enrolled from the ED without giving the exact number—Patel et al[31] stated in general terms that 80% of their patients are identified in the ED, with 20% being identified upon ICU admission. Gao et al[20]

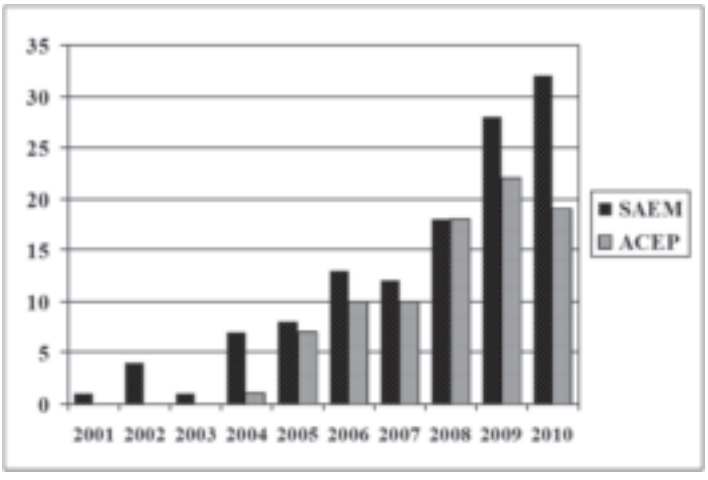

Figure 3. Number of sepsis abstracts at SAEM and ACEP national conferences since 2001. *SAEM*, Society for Academic Emergency Medicine Annual Meeting; *ACEP*, American College of Emergency Physicians Research Forum.

only had 11% enrolled from the ED. We have cited in the manuscript which studies only enrolled from the ED contrasted to others permitting ICU or medical/surgical floor enrollment. Interestingly, in the Coba et al article ED patients had greater compliance with interventions contrasted to the ICU environment.[32] We feel there is some merit to including these "hybrid" studies in our analysis—because many hospitals implementing sepsis protocols do so simultaneously in the ED, floors, and ICUs. Also, another limitation of this systematic review is that only one study was a randomized control trial with the others being either a before-after design, having a historical or retrospective control group, or having a cross-sectional design. Thus, many of these trials were subject to selection bias, length bias, completeness of data collection, and variability in practice patterns.

CONCLUSION

Implementation of protocolized hemodynamic optimization in the ED for patients with severe sepsis and septic shock appears to reduce mortality. The development of ED protocols to identify patients with severe sepsis and septic shock and achieve resuscitative endpoints merits strong consideration given the results from this meta-analysis. However, further confirmatory randomized control trials are necessary to determine which treatment components of a protocolized pathway are most beneficial and which specific patient population warrants these interventions in the ED setting.

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The Shock Index as a Predictor of Vasopressor Use in Emergency Department Patients with Severe Sepsis

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Introduction: Severe sepsis is a leading cause of non-coronary death in hospitals across the United States. Early identification and risk stratification in the emergency department (ED) is difficult because there is limited ability to predict escalation of care. In this study we evaluated if a sustained shock index (SI) elevation in the ED was a predictor of short-term cardiovascular collapse, defined as vasopressor dependence within 72 hours of initial presentation.

Methods: Retrospective dual-centered cross-sectional study using patients identified in the Yale-New Haven Hospital Emergency Medicine sepsis registry.

Results: We included 295 patients in the study with 47.5% (n=140) having a sustained SI elevation in the ED. Among patients with a sustained SI elevation, 38.6% (54 of 140) required vasopressors within 72 hours of ED admission contrasted to 11.6% (18 of 155) without a sustained SI elevation (p=0.0001; multivariate modeling OR 4.42 with 95% confidence intervals 2.28-8.55) . In the SI elevation group the mean number of organ failures was 4.0 ± 2.1 contrasted to 3.2 ± 1.6 in the non-SI elevation group (p=0.0001).

Conclusion: ED patients with severe sepsis and a sustained SI elevation appear to have higher rates of short-term vasopressor use, and a greater number of organ failures contrasted to patients without a sustained SI elevation. An elevated SI may be a useful modality to identify patients with severe sepsis at risk for disease escalation and cardiovascular collapse. [West J Emerg Med. 2014;15(1):60–66.]

INTRODUCTION

Severe sepsis and septic shock are the 10th leading cause of death in the United States (U.S.) with mortality rates ranging from 28–50%.[1,2] Over the past several decades the incidence of each has progressively increased[3,4] with roughly two thirds of patients initially presenting to the emergency department (ED).[2,5] Of the 2.3 million annual visits to U.S. EDs, severe sepsis represents about 1–3% of all people presenting with an infectious disease related illness[6,7] and accounts for 1 in 10 admissions to the intensive care unit,[8] culminating in healthcare costs around 16.7 billion dollars per year.[2]

Currently for emergency physicians (EP) or other healthcare providers responsible for initial management, there are limited modalities to risk-stratify patients at risk for short-term cardiovascular collapse and escalation of disease (i.e. vasopressor dependence). The shock index (SI, heart rate divided by systolic blood pressure)[9] is a simple formula useful for detecting changes in cardiovascular performance before the onset of systemic hypotension.[10–17] A SI elevation greater than

0.8 has a reported 95% sensitivity for predicting shock.[10] It is an easily accessible, non-invasive, and non-costly risk stratification tool that may enhance current EP methods for differentiating severe sepsis patients at risk for imminent cardiovascular collapse. While several studies have evaluated the initial SI value upon presentation to the ED,[9,11,16] no studies to our knowledge have evaluated the influence of a sustained SI elevation in any clinical environment.

The objective of this preliminary study is to evaluate the role of a sustained SI elevation as a predictor of short-term cardiovascular collapse, defined as vasopressor dependence within 72 hours of ED initial presentation. We hypothesize that severe sepsis patients with a sustained SI elevation greater than 0.8 are at greater risk for short-term vasopressor use, and, that a sustained SI elevation is one instrument that may help to risk stratify patients with severe sepsis at risk for progression to shock.

METHODS

Study Setting and Design

The study was performed at a dual-site teaching hospital ED with nearly 100,000 patient visits annually. It was a retrospective cross-sectional study using patients identified prospectively in the Yale-New Haven Hospital Emergency Medicine sepsis registry. The study was approved by the Yale Human Investigation Committee for the review of medical records by study personnel. The registry is comprised of a patient list created between July 1, 2005, and July 31, 2007. In a systematic and standardized fashion, we prospectively and consecutively identified sepsis registry patients during pre-defined time periods at 2 EDs as a quality improvement initiative tracking sepsis outcomes (i.e., short term mortality) and quality measures (i.e.–lactate measurement, time to antibiotics, implementation of EGDT) for ED patients in the Yale Health System. Over the 2-year time period there were 189,867 cumulative visits at both sites (155,757 patient visits in the Adult Section of the Yale-New Haven Hospital ED; 34,110 visits at the Shoreline Medical Center ED). We screened 5,228 patients, generating a list of 359 septic patients in the registry over the cited time period.

Study Population and Measurements

Inclusion criteria for the study were as follows: at least 18 years of age, fulfillment of at least 2 of the 4 systemic inflammatory response syndrome (SIRS) criteria[18], a documented clinical source of infection, and fulfillment of at least one type of organ dysfunction (i.e.–severe sepsis) at the time of presentation to the ED.

We defined end-organ dysfunction[19–21] as having at least one of the following: transient hypotension defined as at least one documented systolic blood pressure reading below 90 mmHg in the ED; lactate level greater than 2.0 mmol/mL; unexplained acidosis defined as either an arterial blood gas pH below 7.35 or serum bicarbonate below 21 mg/dl; documented change in mental status from baseline; a serum platelet count less than 150,000/mm^3 with no history of prior thrombocytopenia; a total bilirubin elevation greater than 1.2 mg/dl in the absence of underlying chronic liver disease; an elevation of serum coagulation factors in the absence of chronic liver disease or anticoagulant medications (PT $>$12sec, PTT$>$45 sec, INR$>$1.8); evidence of acute kidney injury defined as a serum creatinine increase above 0.5 mg/dl from baseline or greater than 1.2 mg/dl if no baseline was available; documented hypoxemia with at least one oxygen saturation less than 90%, or an elevated serum troponin above 0.04 mg/dl. We calculated cumulative organ dysfunction scores (i.e., Physiology and Chronic Health Evaluation II [APACHE II], Mortality in Emergency Department Sepsis [MEDS] score) from physiologic parameters and laboratory results acquired in the ED.

We excluded patients from the study if they were discharged to home or to another facility from the ED, if they arrived at the hospital in extremis (defined as having an initial systolic blood pressure less than 80 mmHg and being administered a vasopressor medication within 15 minutes of arrival to the ED), or if they had a pre-existing advance directive for the implementation of comfort care measures prior to ED presentation.

We calculated the SI for each set of vital signs that was documented until admission from the ED or the initiation of a vasopressor in the ED. The percentage of SI elevation for each patient was determined by taking the total number of SI values greater than 0.8 and dividing this number by the total number of vital signs taken. We then used this calculation to estimate the total percentage of time that each patient maintained a SI elevation in the ED. The sustained SI elevation group was defined as having a SI greater than 0.8 for at least 80% of the ED vital sign measurements. The non-sustained SI elevation group was defined as having a SI greater than 0.8 for less than 80% of the vital sign measurements in the ED. As an alternative analysis, we further sub-divided patients based on the total percentage of time each patient had an elevated SI. We also looked at the initial SI for all study patients and compared it to our outcomes of short-term vasopressor use and hospital mortality.

Study Protocol and Measurements

Data were extracted in a standardized and systematic fashion[22] from medical records by two medical students (MW, SB) under the supervision of a faculty investigator (CW) with internal procedures to ensure extraction accuracy $>$90%. Medical students used a customized data collection form and glossary of terms to extract pre-defined demographical and clinical data points. Both electronic and paper records were used for abstraction. We obtained electronic records using MD Link™, Sunrise Clinical Manager™ and Lynx Medical Systems.™ All hard-copy medical charts were reviewed in the Yale-New Haven Hospital office of medical records. Collected

Table 1. Baseline characteristics comparing patients with and without a sustained shock index (SI) elevation in the emergency department.

Chronic Co-morbidities - ± SD, n (%)	Sustained SI elevation (n=140)	Non-sustained SI Elevation (n=155)	P-value
Age	56.5 ± 18.7	67.9 ± 16.6	0.00
Female	76 (54.3)	66 (42.6)	0.05
Congestive heart failure	36 (25.7)	36 (23.2)	0.68
Coronary artery disease	27 (19.3)	47 (30.3)	0.03
Hypertension	57 (40.7)	96 (61.9)	0.00
Chronic obstructive pulmonary disease	21 (15)	30 (30.0)	0.36
Asthma	6 (4.3)	13 (8.4)	0.16
Diabetes (Type 1 or 2)	43 (30.7)	61 (39.4)	0.14
Chronic liver disease	16 (11.4)	11 (7.1)	0.23
History of end stage renal disease	17 (12.1)	17 (11.0)	0.86
Chronic immunosuppression	23 (16.4)	17 (11.0)	0.18
Human immunodeficiency virus or acquired immunodeficiency syndrome	10 (7.1)	10 (6.5)	0.82
History of cancer	41 (29.3)	34 (21.9)	0.18
History of ischemic stroke or transient ischemic attack	15 (10.7)	26 (16.8)	0.18
Chronic altered mental status	13 (9.3)	21 (13.5)	0.28
Extended care facility	28 (20)	49 (31.6)	0.02

data were transcribed from data collection forms into a customized Microsoft Excel database created by the faculty investigator. Patient subjects were randomly assigned study ID numbers to protect personal health information according to guidelines established by our Human Investigation Committee. We conducted weekly meetings to review extracted data and to ensure internal consistency in data extraction. To demonstrate internal accuracy in data extraction, the two medical students collected 551 overlapping data points with 95% agreement.

Data Analysis

Investigators performed statistical analysis in consultation with a statistical consultant from the Yale Department of Emergency Medicine. In performing a 2-tailed post-hoc power calculation (using a Type I error rate of 5%, the total sample size of 295–140 in the sustained SI group; 155 in the group without a sustained SI elevation) we calculated that our study has 100% statistical power, and that it has the appropriate sample size to detect a 12% difference between each group (80% power threshold). Continuous data were reported as the mean and standard deviation. We performed a comparison of means using an unpaired t-test. Fisher's exact test was used to compare groups with categorical variables, including the rates of vasopressor use among patients with a sustained SI elevation contrasted to those without a sustained SI elevation. Statistical significance was indicated by a p-value (or alpha error) <0.05. To perform statistical analyses', investigators initially used Graph Pad Quick Calcs, GraphPad Software, (San Diego California USA, www.graphpad.com). Multivariate modeling was performed by a Department of Emergency Medicine faculty member and statistical expert who adjusted for potential confounding variables using SAS software (Cary, NC).

RESULTS

Of the 359 patients identified in the Yale sepsis registry, 82.2% (n=295) met study inclusion criteria. Of the 64 patients excluded from the study, no patients were excluded for age, 7.8% (n=5) were excluded for being in extremis at presentation, 12.5% (n=8) were excluded for having pre-existing comfort measures prior to ED presentation, 23.4% (n=15) were discharged to home or to a facility from the ED, and 57.8% (n=37) were excluded for having fewer than 2 SIRS criteria in the ED or no evidence of end organ dysfunction.

In our cumulative sample, 47.4% (n=140) patients had a sustained SI elevation. Forty-eight percent (142 of 295) were female and the mean age at presentation for all patients was 62.5 ±18.5 years (Table 1). Of the 16 co-morbid conditions reviewed, patients with a sustained SI were less likely to have a history of coronary artery disease (19.3 versus 30.3%, p=0.0319) and hypertension (40.7 versus 61.9 %, p=0.0003). Patients in the sustained SI elevation group had a lower initial systolic blood pressure (102.6 ± 22.5 versus 127.4 ± 29.7 mmHg, $p<0.0001$), and higher initial heart rate (112 ± 21.0 versus 96 ± 19.7 beats per minute, $p<0.0001$, Table 2).

The mean number of organ dysfunctions at initial presentation was greater in patients with a sustained elevated SI (4.0 ± 2.1 versus 3.2 ± 1.6, p=0.0001) compared to those without a sustained SI (Table 3). In contrast, there was no

Table 2. Vital signs, systemic inflammatory response syndrome (SIRS) criteria, and localized source of infection in patients with a sustained shock index (SI) elevation and patients without a sustained SI elevation. Results are either reported as the mean ± SD, or the absolute number (%) of patients with a specific source of infection.

Clinical variables	Sustained SI elevation (n = 140)	Non-sustained SI elevation (n =155)	P-value
Vital signs and SIRS criteria (mean ± SD)			
Initial systolic blood pressure – (mmHg)	102.6 ± 22.5	127.4 ± 29.7	0.0001
Initial heart rate – (beats per minute)	112.0 ± 21.0	95.5 ± 19.7	0.0001
Temperature – (degrees Fahrenheit)	99.2 ± 2.3	98.8 ± 2.8	0.1574
Respiratory rate – (breaths per minute)	20.6 ± 5.0	20.8 ± 4.2	0.3268
White blood cell count – ($x10^3$ per mL)	12.7 ± 8.3	14.1 ± 7.9	0.1454
Glasgow Coma Scale (3–15)	14.2 ± 1.8	13.9 ± 2.3	0.2302
Localized source of infection- n (%)			
Respiratory	42 (30.0)	47 (30.3)	1.0000
Urinary system	21 (15.0)	23 (14.8)	1.0000
Abdominal	16 (11.4)	18 (11.6)	1.0000
Soft tissue	9 (6.4)	17 (11.0)	0.2178
Line infection	11 (7.9)	2 (1.3)	0.0084
Other - Not otherwise specified	10 (7.1)	6 (3.9)	0.3036

difference in the mean APACHE II (18.8 ± 7.2 versus 18.1 ± 6.8, p=0.3187) or MEDS score (11.6 ± 4.8 versus 11.5 ± 4.4, p=0.88 between patients with a sustained elevated SI compared to those without.

Initial laboratory data showed no difference between groups except that there were higher initial lactate levels (2.8 ± 2.6 versus 2.3 ± 1.7 mmol/dl, p=0.0426) in the sustained SI elevation group. Patients with a sustained SI elevation were more likely to receive blood products in the ED, and they also received a greater amount of crystalloid fluid volume resuscitation (3.6 ± 2.4 versus 2.7 ± 3.9 liters, p=0.0267). 42.1% (n=59) with a sustained SI elevation underwent central line placement in the ED compared to 27.1% (n=42) without a sustained SI elevation (p<0.005).

There was no difference in the mean ED length of stay between the sustained SI elevation group and the non-sustained SI elevation group respectively: the time in the ED was 6:27 hours ± 3:48 hours versus 7:07 hours ± 4:18 hours (p=0.287).

Table 3. End-organ dysfunction in patients with a sustained shock index (SI) elevation versus a non-sustained SI elevation.

End organ failure measures	Sustained SI elevation n=140	Non-sustained SI elevation n=155	P-value
Cumulative organ failure scores			
Total number of organ failures	4.0 ± 2.1	3.2 ± 1.6	0.0001
APACHE II	18.9 ± 7.2	18.1 ± 6.8	0.3187
MEDS	11.6 ± 4.8	11.5 ± 4.4	0.8814
End organ failure - n (%)			
Transient hypotension (SBP<90mmHg)	101 (72.1)	50 (32.3)	0.0001
Lactate elevation >2.0 mg/dl	63 (45.0)	60 (38.7)	0.2891
Unexplained acidosis	74 (52.9)	73 (47.1)	0.3519
Altered mental status from baseline	52 (37.1)	63 (40.6)	0.5522
Platelets <150,000 mm^3	35 (25.0)	26 (16.8)	0.0862
Total bilirubin >1.2 mg/dl	80 (57.1)	57 (36.8)	0.0007
Elevation of coagulation factors	31 (22.1)	20 (12.9)	0.0448
Acute kidney Injury	62 (44.3)	65 (41.9)	0.7245
Hypoxemia	38 (27.1)	42 (27.1)	1.0000
Troponin elevation >0.04 mg/dl	28 (20.0)	34 (21.9)	0.7750

APACHE II, Acute Physiology and Chronic Health Evaluation II; *MEDS*, Mortality in Emergency Department Sepsis

In our total sample, 24.4% (72 of 295) received a vasopressor agent within 72 hours of initial presentation. Of the 140 patients with a sustained SI elevation, 38.6% (n=54) were placed on vasopressors within 72 hours of presentation, compared to 11.6% (n=18) of the 155 patients who did not have a sustained SI elevation (p=0.0001). The proportion of patients placed on vasopressors appeared to be directly related to the total percentage of time patients had a shock index elevation (Figure). Multivariate modeling with correction for potential confounding variables resulted in an OR of 4.42 for vasopressor use within 72 hours among patients with a sustained SI elevation (95% CI 2.28 to 8.55).

In the initial ED presentation, 83.0% (n=245) had an early systolic blood pressure greater than 100 mmHg defined as having at least one of the first 3 systolic blood pressure measurements greater than 100 mmHg. In this subgroup, there was also a significant difference in rates of 72-hour vasopressor use between patients with a sustained SI elevation (n=98) compared to those without a sustained SI elevation (n=147)–30.6% versus 8.2% respectively, ($p<0.0001$).

In further analyses', the isolated initial shock index elevation did not correlate with rates of vasopressor use, in-hospital mortality, or ICU admission. Overall, for our total sample the in-hospital 28-day mortality rate was 15.6% (46 of 295). Patients with a sustained elevated SI had a 19.3% (n=27) mortality, compared to 12.3% (n=19) in patients who did not have an elevated SI (p=0.1093). Regardless of SI elevation, all patients placed on vasopressors within 72 hours had higher 28-day mortality rates compared to those who did not receive vasopressors (41.7% versus 7.2%, p=0.0001).

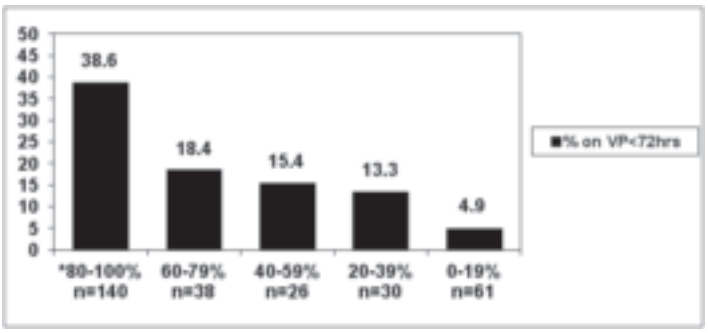

Figure. The rate of vasopressor use within 72 hours in relation to the total percentage of emergency department vital sign measurements with an elevated shock index.(*P<0.05 when the 80–100% group is compared to all other groups).

DISCUSSION

The SI was first described in the 1960s as the ratio of heart rate to systolic blood pressure.[23] While it was originally designed to identify apparently stable yet critically ill trauma patients, the SI has since been shown to be a simple, non-invasive risk stratification tool useful for detecting changes in cardiovascular performance before the onset of systemic hypotension and cardiorespiratory collapse.[11] Since its original description, the SI has been evaluated for this purpose in patients with cardiogenic shock,[12] sepsis,[13] ectopic pregnancy,[14] gastro-intestinal hemorrhage,[24] and pulmonary embolism.[15]

In a precursor study,[13] Rady et al. looked at patients with apparently stable vital signs and divided them into 2 groups based on whether the patient had a SI elevation. The study associated an elevated SI with higher admission rates to hospital floor beds and to ICUs, as well as poorer outcomes. Authors concluded that when used alone, an elevated SI was more sensitive than using heart rate or systolic blood pressure alone to predict the severity of illness, and had a higher specificity.

What is considered an abnormal SI elevation? The reported range in the literature is between 0.8 to 1.0.[10,13,25] One study from Mexico showed an improvement in sensitivity to 95% when using a SI of 0.8, although their population evaluated surgical patients and did not focus specifically on sepsis.[10] Given the variable definition of an elevated SI, there is no established cut-off for an elevated SI above normal (0.5-0.7) that has been routinely applied to critical care literature.

Several areas of focus differentiate our study from others. This is the first study to our knowledge evaluating the impact of a sustained SI elevation. All prior studies evaluating the SI have evaluated single, isolated, initial values rather than taking into account the trajectory of change once fluid resuscitation, antibiotics, and other therapies are instituted. Many have suggested that the SI is potentially a macro-endpoint to resuscitation—but to our knowledge this has also never been studied. We believe there is great merit for the EP using the simple, non-costly, and non-invasive SI measurements to risk stratify patients who are at risk for potential cardiovascular collapse. Also, the sustained SI elevation is something that could be incorporated into future scoring systems aimed at differentiating patients at risk for decompensation versus those that aren't. Furthermore, given the pressure to reduce healthcare costs—a non-costly risk stratification tool for determining which patients truly need the costly resources of an ICU admission is needed.

What further differentiates our research is that while prior studies evaluating the SI have used hospital admission and mortality rates as primary endpoints, we used the endpoint of short-term vasopressor dependence to represent escalation of disease because, for initial providers, progression to vasopressor dependence is a more relevant outcome measure contrasted to overall 28-day mortality. Furthermore, given that the SI is a hemodynamic variable, we believed that short-term vasopressor use was a good marker of hemodynamic decompensation. Although it is still unclear whether the SI is a useful tool when used alone to aid EPs in treatment decisions and triage[13,25], it may prove useful in combination with predictors of illness severity and other information routinely available to practitioners.

In this study we identified that a sustained SI elevation in the ED was indeed associated with higher rates of short-term vasopressor use. We also observed a potential relationship between the total percentage of time that patients maintained a SI elevation in the ED and vasopressor use, suggesting that the longer a patient maintains an elevated SI, the more likely they are to require vasopressors within 72 hours.

Similar to the Jones et al study[25] we did not find discerning value predictive of outcome when looking only at the initial SI value. There was no difference in vasopressor use or mortality between patients with an initial SI elevation contrasted to those without. Thus, from our data we surmise that a sustained SI elevation may be a more useful measure for risk stratification rather than a single initial SI elevation.

We also found that patients with a sustained SI elevation had a higher mean number of organ failures than those without a sustained elevated SI (4.0 versus 3.1, p=0.0001), although there was no difference in APACHE II and MEDS score. This observation does suggest, however, that a sustained SI elevation may serve to identify patients with a potentially greater number of organ failures in the ED, and, could prove to be valuable in clinical settings where laboratory turn-around times for results may approach 60 to 90 minutes.

Looking at other initial vital signs as a predictor of vasopressor use, we found that the initial systolic blood pressure of patients who were placed on vasopressors was lower than those who were not placed on vasopressors (101 versus 120 mmHg). There was also a difference in systolic blood pressure between patients who had a sustained SI elevation and those who did not (102 v. 127 mmHg). While common sense suggests that patients with lower systolic blood pressures would have higher rates of vasopressor use, we identified several points underscoring the potential value of also looking at the SI as a predictor of disease progression. First, nearly 60 percent of the patients with a sustained SI had an initial SBP>100 mmHg. This finding suggests that a proportion of patients with normal blood pressures and an elevated SI may be at risk for hemodynamic decompensation. Second, the non-sustained SI group had a proportion of patients who were hypertensive in the ED, thus skewing the blood pressure comparison between groups (systolic blood pressure >170 mmHg, n=14, range 170 to 224 mmHg). Third, when we performed a sub-group analysis on patients with an early systolic blood pressure above 100 mmHg (n=245), we still found a significant difference in vasopressor use between patients with a sustained SI elevation and those who did not have a sustained SI (30.6% versus 8.2%, p<0.0001). Thus, our data suggest that the SI is potentially a valuable and non-costly marker to enhance existing methods to risk stratify septic patients.

LIMITATIONS

General limitations of this study were retrospective data extraction and a relatively small sample size. Additionally, patient selection came from a registry that was not all-inclusive but did implement procedures (i.e., prospective and consecutive enrollment during predefined time periods) to reduce inclusion or selection bias. There was temporal variability, and variability in the total number of vital sign measurements performed in the ED by the initial providers – the mean number of ED vital sign measurements in our total patient population was 8.06 ± 4.38, but in a separate analysis this did not depend upon normal or abnormal values. The retrospective data extraction was limited by many factors inherent to the process, including possible errors in the medical record. The 95% accuracy among the 2 data extractors confirmed overall accuracy.

CONCLUSIONS

ED patients with severe sepsis and a sustained SI elevation appear to have higher rates of short-term vasopressor use contrasted to patients without a sustained SI elevation. A sustained SI elevation may be a promising simple, cost-efficient, and non-invasive measurement to help risk stratify patients who present to the ED with severe sepsis, and may complement other predictors of disease progression. A sustained SI elevation may be a useful modality to identify patients with severe sepsis at risk for disease progression.

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Predictors of Unattempted Central Venous Catheterization in Septic Patients Eligible for Early Goal-directed Therapy

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Introduction: Central venous catheterization (CVC) can be an important component of the management of patients with severe sepsis and septic shock. CVC, however, is a time- and resource-intensive procedure associated with serious complications. The effects of the absence of shock or the presence of relative contraindications on undertaking central line placement in septic emergency department (ED) patients eligible for early goal-directed therapy (EGDT) have not been well described. We sought to determine the association of relative normotension (sustained systolic blood pressure >90 mmHg independent of or in response to an initial crystalloid resuscitation of 20 mL/kg), obesity (body mass index [BMI] ≥30), moderate thrombocytopenia (platelet count <50,000 per μL), and coagulopathy (international normalized ratio ≥2.0) with unattempted CVC in EGDT-eligible patients.

Methods: This was a retrospective cohort study of 421 adults who met EGDT criteria in 5 community EDs over a period of 13 months. We compared patients with attempted thoracic (internal jugular or subclavian) CVC with those who did not undergo an attempted thoracic line. We also compared patients with any attempted CVC (either thoracic or femoral) with those who did not undergo any attempted central line. We used multivariate logistic regression analysis to calculate adjusted odd ratios (AORs).

Results: In our study, 364 (86.5%) patients underwent attempted thoracic CVC and 57 (13.5%) did not. Relative normotension was significantly associated with unattempted thoracic CVC (AOR 2.6 95% confidence interval [CI], 1.6-4.3), as were moderate thrombocytopenia (AOR 3.9; 95% CI, 1.5-10.1) and coagulopathy (AOR 2.7; 95% CI, 1.3-5.6). When assessing for attempted catheterization of any central venous site (thoracic or femoral), 382 (90.7%) patients underwent attempted catheterization and 39 (9.3%) patients did not. Relative normotension (AOR 2.3; 95% CI, 1.2-4.5) and moderate thrombocytopenia (AOR 3.9; 95% CI, 1.5-10.3) were significantly associated with unattempted CVC, whereas coagulopathy was not (AOR 0.6; 95% CI, 0.2-1.8). Obesity was not significantly associated with unattempted CVC, either thoracic in location or at any site.

Conclusion: Septic patients eligible for EGDT with relative normotension and those with moderate thrombocytopenia were less likely to undergo attempted CVC at any site. Those with coagulopathy were also less likely to undergo attempted thoracic central line placement. Knowledge of the decision-making calculus at play for physicians considering central venous catheterization in this population can help inform physician education and performance improvement programs. [West J Emerg Med. 2014;15(1):67–75.]

INTRODUCTION

Central venous catheterization can play a critical role in the management of patients with severe sepsis and septic shock.[1-3] Central venous access is necessary for the administration of vasopressors, which can be damaging to smaller peripheral veins and result in extensive tissue necrosis in the event of extravasation. Catheterization of a thoracic central vein, either the internal jugular or subclavian, also allows the direct measurement of central venous pressure and central venous oxygen saturation. Abnormalities of these measures can be used to grade the severity of sepsis and their normalization can serve as a goal of resuscitation.[4]

Thoracic central venous catheterization, however, is a time- and resource-intensive procedure associated with serious mechanical complications, including pneumothorax and hemorrhage. Thoracic central venous catheterization has been identified by both physicians and nurses in busy urban emergency departments (EDs) as one of several barriers to the implementation of national sepsis treatment guidelines.[5,6]

The decision to pursue central venous catheterization for the administration of vasopressors may seem more compelling than when the line's only purpose is directing protocolized management. In the latter case, especially, weighing indications and relative contraindications can be a difficult calculus. This is due to the fact that the precise incremental benefit of a thoracic central line in early goal-directed therapy (EGDT) among various subpopulations of septic patients has yet to be quantified. It is unclear how much weight should be given to various relative contraindications to central line placement. For example, the risk of complications with thoracic central venous catheterization in septic patients with abnormal hemostasis in an age of ultrasound guidance is not well characterized. Absent evidence of this kind, physicians are guided by clinical judgment informed by training, experience, and local practice patterns.[7] How this works out in clinical practice in terms of procedures attempted and procedures averted has not been described. We undertook this cohort study of septic ED patients eligible for EGDT to determine to what extent, if at all, relative normotension, obesity, and abnormal hemostasis were associated with failure to attempt central venous catheterization.

METHODS

Study Setting and Design

We analyzed a cohort of adult septic patients who met criteria for EGDT between August 1, 2009, and August 31, 2010, in 5 community EDs within Kaiser Permanente Northern California (KPNC). KPNC is a large integrated healthcare delivery system that provides comprehensive care for more than 3.4 million members and receives over 900,000 annual ED visits. KPNC health plan members represent approximately 25-30% of the population in areas served and are similar to the general population with respect to race/ethnicity, socioeconomic status, and education, with the exception of a slight underrepresentation of the extremes of income.[8,9] The study was reviewed and granted formal exemption by the KPNC Health Services Institutional Review Board.

The study EDs are staffed by emergency medicine residency-trained and board-certified (or board-eligible) physicians. The departments vary in volume. During the study period, 3 EDs each had an approximate annual census of 75,000. The other 2 had an annual census of 35,000 and 25,000, respectively. Two of the 5 EDs are affiliated with a university emergency medicine residency training program. One ED is a Level II trauma center. All medical centers have adult intensive care units with bed capability ranging from 12 to 32.

The study period followed the implementation of a standardized version of EGDT as part of a region-wide quality improvement initiative that included a training program at each facility on sepsis diagnoses, management, and ultrasound-guided thoracic central venous catheterization. The other components of our medical group's performance improvement program have been described elsewhere.[10] Sepsis management during the study period followed a modified Rivers protocol that did not require arterial catheterization.[4] The modified protocol also allowed $ScvO_2$ monitoring to occur continuously through a specialized $ScvO_2$ catheter or intermittently through centrally drawn venous blood gases.

We explore unattempted thoracic central venous catheterization, because EGDT calls for thoracic line placement. But we know from experience that physicians who avoid placing a thoracic central line for whatever reason may nonetheless attempt femoral venous catheterization. We chose therefore to study patient variables associated with both unattempted thoracic central vein catheterization as well as unattempted placement at any site, thoracic or femoral.

We hypothesized that 3 patient variables might prove a significant deterrent to thoracic central venous catheterization even when otherwise clinically indicated and encouraged by an active quality improvement program: (1) relative normotension, which might imply that thoracic central venous access was not really necessary despite a serum lactate level ≥4 mmol/L; (2) obesity, which might dissuade a physician from attempting such a procedure because of its perceived technical difficulty; and (3) abnormal hemostasis (either moderate thrombocytopenia or coagulopathy), which might suggest that the risk of bleeding from a venous (or accidental arterial) puncture is greater than the benefit gained from thoracic central venous access.

We assumed that in higher risk situations the clinical decision making would tilt more favorably toward femoral venous access than thoracic venous access because femoral lines might be perceived to be less technically difficult to accomplish and easier to directly compress in the case of excessive post-procedural bleeding. We hypothesized then that obesity and abnormal hemostasis would not be associated with unattempted central venous access when attempted femoral vein catheterization was included in the analysis.

Relative normotension in this study is defined as a sustained systolic blood pressure (SBP) >90 mmHg, either independent of or in response to initial fluid resuscitation of 20 mL/kg of intravenous crystalloids over one hour. Obesity is defined as a body mass index (BMI) ≥30. Moderate thrombocytopenia is defined as an ED platelet count <50,000/μl. An ED international normalized ratio (INR) ≥2.0 constitutes coagulopathy. The latter 2 are referred to as disorders of hemostasis.

Selection of Participants

We identified the cohort from a larger KPNC sepsis database (the Quality database) created retrospectively and managed by the data consulting team of the Quality and Accreditation, Regulation and Licensing Division of Kaiser Foundation Hospital, Inc. We included adult non-gravid patients (≥18 years of age) from KPNC's 21 EDs in the Quality database if they had an inpatient diagnosis of severe sepsis or septic shock (ICD-9 codes: 003.1, 036.2, 038.0-038.9, 785.52, 995.91, 995.92), major infection in the ED (known or suspected), and either 2 or more systemic inflammatory response syndrome (SIRS) criteria or an altered level of consciousness.[10] Excluded were ED patients with comfort care status, those admitted directly to the operating suite, and patients with hypotension or lactate elevation that the treating emergency physician (EP) ascribed to a non-infectious etiology, e.g., a patient with a massive lower gastrointestinal bleed without evidence of infection.

Our study cohort was a subpopulation of the Quality database, limited to patients with severe sepsis or septic shock treated at 1 of the 5 study EDs during the study period. We excluded from the cohort patients who had declined central venous catheterization (either directly or through their caregiver or family), as well as those with a pre-existing thoracic central venous catheter or port.

Patients who met eligibility criteria were then categorized for study purposes as having severe sepsis or septic shock as follows: patients in the severe sepsis category had metabolic evidence of tissue hypoperfusion (an elevated ED serum lactate level ≥4 mmol/L) combined with relative normotension (defined above). Patients in the septic shock category had refractory hypotension (a SBP ≤90 mmHg that failed with initial volume resuscitation to stay above the 90 mmHg threshold), regardless of the ED serum lactate value.

Methods and Measurements

Two investigators (MDS, DRV) used a computerized data abstraction tool to abstract demographic, clinical, and management variables from the electronic health records. After confirming the patient's study eligibility, we collected the following variables related to the index ED visit: patient age, sex, weight, date and site of ED visit, and SBP, both initially and after initial fluid resuscitation. Patient weight was taken in nearly all cases from measurements obtained either at the time of the ED admission (often for stable ambulatory patients) or during the inpatient intake assessment (particularly for unstable and non-ambulatory patients). In only a few cases, when a measured weight was not identified, it was taken at face value from the patient or family report.[11,12] Values obtained through electronic databases included patient height, initial ED serum lactate level, initial ED platelet count, and initial ED International Normalized Ratio (INR) (when performed). Missing values are reported as such.

The primary outcome of interest was attempted central venous catheterization (either thoracic or any site) during the ED stay. We reviewed EP and nursing notes for documentation of attempted central venous access. We also reviewed radiology reports of ED chest radiographs for evidence of films ordered to assess for post-procedural complications, as patients with an attempt (successful or not) at thoracic central line placement routinely undergo chest radiographs to detect iatrogenic pneumothorax. To reduce abstraction bias, both abstractors confirmed eligibility on all cases. Both abstractors also reviewed and confirmed all cases that failed to receive an attempted central line. A third investigator arbitrated any ambiguities encountered during electronic chart review (e.g., in eligibility, sepsis classification, or central line attempts).

Statistical Analysis

Continuous variables are presented as means with standard deviation and categorical data are presented as the percentage of frequency of occurrence (p-values are shown for t-test or chi-squared test). A p-value of less than 0.05 was considered to indicate statistical significance. We performed bivariate analysis to compare patients with attempted central venous catheterization with patients without attempted central venous catheterization. Adjusted odds ratios were calculated using multivariate logistic regression to determine independent predictors of unattempted thoracic and any-site central line placement. The 4 variables that drove our hypotheses (BMI ≥30, SBP >90 mmHg, platelet count <50,000 per μL, and INR ≥2.0) were included in the model. Standard errors in the model were adjusted for clustering by

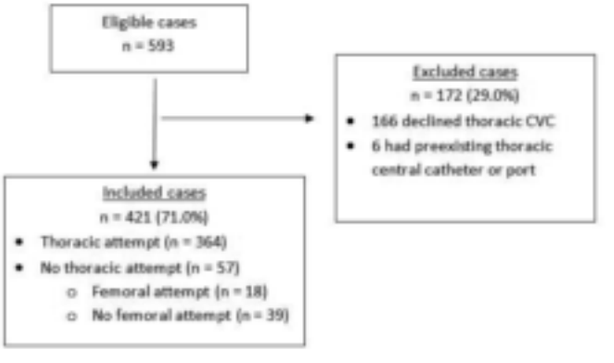

Figure. Flow of study patients. *CVC,* central venous catheterization

Table 1. Characteristics of septic emergency department patients eligible for early goal-directed therapy (n=421).

	Thoracic* Central Venous Catheterization			Any-site Central Venous Catheterization (Thoracic or Femoral)		
	Attempted n=364	Unattempted n=57	p-value	Attempted n=382	Unattempted n=39	p-value
Age (yr)						
Mean ± SD	66.1 ± 16.1	65.3 ± 16.8	0.72	66.1 ± 16.0	64.6 ± 17.6	0.58
Sex						
Male (%)	198 (54.4)	28 (49.1)	0.46	205 (53.7)	21 (53.9)	0.98
Body mass index						
Mean ± SD	27.5 ± 8.4	28.2 ± 7.7	0.56	27.5 ± 8.4	28.5 ± 7.2	0.48
≥30 (%)	100 (27.5)	18 (31.6)	0.71	102 (26.7)	16 (41.0)	0.08
Missing (%)	9 (2.5)	2 (3.5)		9 (2.3)	2 (5.1)	
Systolic blood pressure						
>90 mmHg† (%)	121 (33.2)	30 (52.6)	<0.01	129 (33.8)	22 (56.4)	<0.01
Initial serum lactate (mmol/L)						
Mean ± SD	4.1 ± 3.1	4.4 ± 3.6	0.50	4.1 ± 3.1	4.5 ± 3.5	0.43
Value ≥4.0 (%)	211 (57.5)	36 (63.2)	0.42	222 (57.7)	25 (64.1)	0.44
Platelet count (k per μL)						
Mean ± SD	221.2 ± 124.0	209.1 ± 136.8	0.50	219.1 ± 123.8	224.1 ± 144.9	0.81
<50 (%)	15 (4.1)	8 (14.0)	<0.01	18 (4.7)	5 (12.8)	0.03
International normalized ratio						
Mean ± SD	1.7 ± 1.3	3.1 ± 4.1	0.02	1.9 ± 2.1	1.7 ± 1.2	0.50
≥2.0 (%)	39 (10.7)	13 (22.8)	0.03	49 (12.8)	3 (7.7)	0.48
Missing	139 (38.0)	16 (28.1)		142 (37.2)	13 (33.3)	

*Thoracic central venous catheterization includes access via the internal jugular or subclavian veins.
†Systolic blood pressure >90 mmHg either independent of or in response to initial crystalloid bolus of 20 mL/kg.

attending physician. We conducted sensitivity analysis among patients without repeated ED visits during the study period and found comparable results. We also conducted sensitivity analysis by including age and gender in the regression models, as well as by changing the BMI cut-off to ≥40 or excluding BMI altogether. With all these analyses we found the results to be comparable, i.e., these changes did not affect the direction or statistical significance of the findings. We included missing responses as a separate category for each variable. Analyses were performed using Stata statistical software, version 10 (StataCorp LP, College Station, TX).

RESULTS

During the 13-month study period, 593 septic ED patients were recognized by their EPs in the study EDs as having a known or suspected major infection and met eligibility criteria for EGDT. Of these, 166 (28.0%) declined central venous catheterization and 6 (1.0%) patients had a pre-existing central vein access port, leaving 421 patients in the cohort.

One hundred fifty-one (35.9%) had severe sepsis and 270 (64.1%) had septic shock as previously defined. (See Figure for the flow of patients). Overall, 226 (53.7%) were men; mean age was 66 ± 16.1 years (range 18-96). The sources of sepsis were as follows: pulmonary 192 (45.6%); urinary 91 (21.6%); intra-abdominal 43 (10.2%); skin/soft tissue 24 (5.7%); other 71 (16.8%). Of the total cohort, 364 (86.5%) patients underwent attempted thoracic central venous catheterization and 57 (13.5%) patients did not. Of these 57 patients, 18 (31.6%) underwent attempted femoral venous catheterization, leaving 39 patients who did not undergo an attempt at either thoracic or femoral central venous catheterization.

Demographic and clinical characteristics of the patients are shown in Table 1. The groups were comparable in bivariate analysis in age, sex, mean BMI, mean serum lactate level, and mean platelet count. The only variables with missing values were BMI (11 [2.6%] patients had no height recorded in the medical record) and INR (155 [36.8%] patients did not have INR measured in the ED). Missing values for these two variables were equally distributed between the groups.

We found that relative normotension, moderate thrombocytopenia, and INR≥2 were significantly associated

Table 2. Adjusted associations between patient characteristics and unattempted thoracic central venous catheterization in septic emergency department patients eligible for early goal-directed therapy (n=421).

	Unattempted thoracic central venous catheterization	Unattempted any-site central venous catheterization (thoracic or femoral)
	Adjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Body mass index ≥30*	1.2 (0.7, 2.4)	2.0 (1.0, 4.2)
Systolic blood pressure >90 mmHg† vs. ≤90 mmHg	2.6 (1.6, 4.3)‡	2.3 (1.2, 4.5)§
Platelet count <50k/μL versus ≥50 k/μL	3.9 (1.5, 10.1)‖	3.9 (1.5, 10.3)‖
International normalized ratio ≥2 versus <2*	2.7 (1.3, 5.6)‖	0.6 (0.2, 1.8)

*We included in the analysis an indicator for missing values.
†Either independent of or in response to initial crystalloid bolus of 20 ml/kg
‡p<0.001 §p<0.05 ‖p<0.01

with unattempted thoracic central venous catheterization (see Table 2). With regard to any-site access, relative normotension and moderate thrombocytopenia were associated with unattempted catheterization, but an elevated INR was not (Table 2).

Fourteen patients of the cohort met eligibility criteria on 2 different dates throughout the study period and were included in the analysis. Since each visit represented a different medical decision-making process about risks and benefits of central line placement, they were retained in the study. We adjusted for clustering of patients using sensitivity analysis and found comparable results. Likewise, the results were comparable when these 14 second visits were dropped entirely from analysis.

Seventeen patients met diagnostic criteria for septic shock in the ED but failed to receive attempted ventral venous catheterization during their ED stay. The probable causes were as follows: immediate transfer to the intensive care unit where a central line would be placed in a timely fashion (n=2), awaiting response to ED blood transfusion (n=2), disorders of hemostasis (n=6), transient SBP response to volume resuscitation (n=4), and continued fluid administration despite failure of SBP response (n=3).

DISCUSSION

This multi-center cohort study found that septic ED patients eligible for EGDT are less likely to undergo attempted thoracic central venous catheterization when relatively normotensive or when presenting with moderate thrombocytopenia (platelet count <50,000/mL) or coagulopathy (INR≥2.0). Also, septic patients are less likely to undergo central venous catheterization at any site, thoracic or femoral, when relatively normotensive or when presenting with moderate thrombocytopenia. Identifying which patient variables are associated with procedural avoidance helps demonstrate how physicians calculate the risk/benefit ratio when weighing explicit indications against relative contraindications for internal jugular, subclavian, and femoral venous catheterization.

We found that EGDT-eligible patients with sustained relative normotension (following volume resuscitation if indicated) were less likely to receive attempted central venous access. This result is consistent with Mikkelson et al[13] who found in multivariable analysis that normal blood pressure was independently associated with a failure to initiate EGDT. Similarly, Kakebeeke et al[14] reported that septic ED patients with only biochemical signs of organ failure, i.e., hyperlactatemia, were less likely to receive the full recommended resuscitation bundle compared with those who had overt, clinically recognizable signs of organ failure, i.e., hypotension. The disinclination to attempt an invasive procedure in normotensive patients with severe sepsis who are not in overt shock could be attributable to the generally less ill appearance of this population. It could be that the clinical gestalt of the physicians tells them the central venous catheter may be unnecessary to the resuscitation since vasopressors are unlikely to be indicated.[15] Anecdotal reports suggest this is true. Further stratification of the ED sepsis population may well demonstrate that a one-sized approach does not fit all comers.[16]

Irrespective of the need for vasopressors, the EGDT protocol for sepsis management calls for thoracic central venous catheterization in order to measure and monitor central venous oxygen saturation and central venous pressure. But recent research in noninvasive approaches to resuscitation monitoring suggests that central venous catheterization may have fewer indications in sepsis management than proposed by the original Rivers protocol.[4] Central venous pressure, as either a static or dynamic measure of intravascular volume status, has repeatedly been shown to demonstrate poor correlation with fluid responsiveness (as determined by a predetermined increase in cardiac output immediately following fluid administration).[17] Lactate clearance is being explored as an alternative to central venous oxygen saturation monitoring as a marker of adequate tissue perfusion.[18-22] Likewise, noninvasive assessments of intravascular volume status are being studied as alternatives to traditional invasive monitoring devices.[20,23-26] Among the more promising means of detecting preload responsiveness are dynamic echocardiographic measures of cardiac output and changes

in ultrasonographic venocaval dimensions in response to respirophasic physiology and passive leg raising.[27]

Several large, multicenter trials are currently underway that seek to clarify the role of central venous catheterization (and other components of the EGDT bundle) in the management of ED patients with severe sepsis and septic shock.[28] These include the Australasian Resuscitation in Sepsis Evaluation (ARISE) trial,[29] the Protocolized Care for Early Septic Shock (ProCESS) trial centered in Pittsburgh, and the Protocolised Management in Sepsis (ProMISe) trial in the United Kingdom. Perhaps select patients with relative normotension can be successfully managed without thoracic central line placement. There may be a noninvasive protocol for patients with severe sepsis soon to emerge in which EPs' central venous catheterization hesitancy in the subpopulation with relative normotension finds justification.

This study also demonstrated that obesity, contrary to our expectation, was not significantly associated with unattempted thoracic central venous catheterization. An enlarged body habitus has historically been thought to make thoracic central venous access more difficult and dangerous, which is why obesity is often listed as a relative contraindication for this procedure. Our results, however, support a shift in perceptions and evidence. For example, prospective studies of thoracic central venous catheterization have yielded mixed results regarding BMI effects, even in those using an anatomic landmark technique. Earlier anatomic landmark studies reported that BMI extremes (either too high or too low) were associated with increased central venous catheterization complications.[30,31] More recent anatomic landmark studies, however, have found that BMI had no bearing on complication rates.[32,33] Several studies of the complications attending thoracic central venous catheterization have not even reported or controlled for BMI.[34,35] Emergency medicine studies using real-time ultrasound guidance further support the contemporary irrelevancy of patient weight.[36] Even if extremes of BMI are perceived by physicians to be associated with an increased risk of thoracic central venous catheterization failure or complications, obesity (and even morbid obesity) did not prove in our study to deter physicians from attempting thoracic catheterization when indicated. We did find suggestion of an association with obesity and unattempted central line placement at any site, although this association did not reach statistical significance.

We also found that physicians were more likely to forego attempted thoracic and femoral central line placement in septic ED patients with disorders of hemostasis, even among patients with septic shock. Moderate thrombocytopenia predicted both unattempted thoracic and any-site central venous catheterization. Coagulopathy INR (≥2.0) independently predicted unattempted thoracic venous catheterization but not any-site central venous catheterization.

It appears that EPs are prone to avoid any-site central venous catheterization in patients with moderate thrombocytopenia. Yet in patients with INR levels of 2 or greater physicians are not averse to placing a central line in general, just one located in the thoracic region. This femoral vein preference in coagulopathic patients could well be explained by the site's easier compressibility in case of iatrogenic hemorrhage. Femoral vein access, however, is not altogether free of significant hemorrhagic complications.[37-40] Why a femoral vein preference was not also observed for patients with moderate thrombocytopenia is not clear.

It seems reasonable to think that placement of a large-bore catheter into a potentially difficult-to-compress thoracic vein in patients with abnormal hemostasis would increase the risk of major hemorrhage, including intrathoracic and mediastinal bleeding. But the consensus of observational data on this topic suggests that that may not actually be the case.[41-54]

Though the bleeding risk increases as the platelet count drops and as the INR and partial thromboplastin time (PTT) rise, the risk remains relatively low and the bleeding complications are minor in nearly all cases. Platelet counts below 50,000/mL and an INR above the 3.0–5.0 range have been shown to confer a small risk (generally less than 5%) of minor bleeding at the catheter's percutaneous insertion site. These local minor bleeds are most often controllable with direct pressure or a surgical stitch in the skin.[43-51,53] This small risk for minor bleeds is insufficient to warrant a denial or delay in the placement of a thoracic central venous catheter when clinically indicated.

Major bleeding in these circumstances is remarkably rare. Aggregating data from 13 diverse studies over the past 30 years—some retrospective and others prospective, some using the anatomic landmark technique and other ultrasound guidance, some with residents-in-training and others with experienced clinicians—found major hemorrhage to be a rare occurence among more than 4,000 thoracic central venous catheterizations in patients with varying degrees of altered hemostasis.[41-45,47-54] Nearly all of these thoracic central lines were performed without pre-procedural correction of the thrombocytopenia or coagulopathy. In fact, attempted correction of hemostatic abnormalities in patients without active bleeding may incur greater risks than benefits.[42,44,55] The diverse clinical conditions represented in these studies do not directly mirror our clinical situation, however, as few patients in these case series were septic and few proceduralists were EPs. Our Kaiser Permanente CREST Network (http://www.kpcrest.net) recently completed a large retrospective cohort study of septic patients with thrombocytopenia (platelet count <100,000/mL) or coagulopathy (INR ≥1.3 or aPTT ≥35 seconds) who received central venous catheterization in the ED. Analysis of the first 700 patients, nearly all of whom received thoracic lines, suggests that major hemorrhagic events are rare; we found only one case (95% upper confidence limit: 0.8%) of major bleeding: a hemothorax from a misplaced subclavian line in a patient with an INR of 1.4.[56]

In light of this large body of research, moderate

thrombocytopenia and coagulopathy may be less important relative contraindications for central line placement than assumed. It would follow then that the level of procedural risk aversion we demonstrated in the face of abnormal hemostasis may be overly cautious. The mortality benefit from thoracic central venous catheterization in some patients with septic shock and concomitant abnormal hemostasis is likely to outweigh the associated small risk of minor and treatable puncture-site bleeding and the very low risk of major bleeding. It has been shown that physicians are prone to overestimate risk, especially hemorrhagic risk.[57] Physician education is needed to lower misinformed risk estimates of major bleeding to more accurately match evidence from the literature. Education could also address our innate omission bias, in which we are prone to more strongly avoid complications we actively cause (e.g., iatrogenic procedural bleeding) than complications we might passively allow (e.g., the increased morbidity associated with withholding central venous catheterization).[57-59] The results of this study could help physicians recalculate the risk/benefit ratio of central venous catheterization in septic patients and thus recalibrate their management decisions in ways that improve their practice patterns.

LIMITATIONS

The major limitation in using health records as primary data sources for a retrospective study is missing, inconsistent, or erroneous documentation. We think the risk is negligible in regards to our dichotomous outcome measure—attempted or non-attempted central venous catheterization—since this documentation is both explicit and redundant. In addition to searching for documentation of attempted central venous access in the physicians' notes, we also searched the nursing notes. As a third source, we reviewed the radiography reports, since post-procedural chest radiographs are ordered commonly as a matter of course to assess for iatrogenic pneumothorax in patients who undergo successful or failed thoracic central venous catheterization. Although we believe the study's data are fairly complete and accurate, we cannot ensure the absence of error or systematic bias to which observational studies are prone.

A second limitation of this retrospective design is that other patient variables not studied herein may also predict unattempted central venous catheterization or may have confounded our associations. Also, we restricted our predictors to patient-related variables. Physician variables, such as comfort and experience with thoracic central venous access, likely influence the risk/benefit decision to attempt thoracic central venous catheterization, but are not reported in this study.

Thirdly, though we had over 400 patients in our cohort, our analysis yielded imprecise estimates, as noted by the broad confidence intervals around our adjusted odds ratios. Fourth, we do not report rates of successful line placement, use of adjunct ultrasonography, or complications of placement. Such information is interesting but beyond the scope of this study. Lastly, this study was conducted in 5 community EDs in Northern California and may not be generalized to other practices and locations. Nevertheless, we included a diversity of EDs with varying patient volumes in different cities throughout the state. Included are small and large community EDs, adjunct training centers for emergency medicine residents, and one Level II trauma center. These variations help to enhance the study's external validity.

CONCLUSION

This multi-center cohort study found that most ED patients eligible for EGDT underwent attempted thoracic central venous catheterization. Patients with relative normotension, as well as those with abnormal hemostasis, were less likely to receive attempted central line placement, both thoracic and femoral. Knowledge of the variables associated with central venous catheterization avoidance can inform physician education and performance improvement programs on the emergency management of patients with severe sepsis and septic shock.

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Comparison of Procedural Sedation for the Reduction of Dislocated Total Hip Arthroplasty

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Introduction: Various types of sedation can be used for the reduction of a dislocated total hip arthroplasty. Traditionally, an opiate/benzodiazepine combination has been employed. The use of other pharmacologic agents, such as etomidate and propofol, have more recently gained popularity. Currently no studies directly comparing these sedation agents have been carried out. The purpose of this study is to compare differences in reduction and sedation outcomes, including recovery times, of these 3 sedation agents.

Methods: We performed a retrospective chart review examining 198 patients who presented with dislocated total hip arthroplasty at 2 academic affiliated medical centers. The patients were grouped according to the type of sedation agent. We calculated percentages of reduction and sedation complications along with recovery times. Reduction complications included fracture, skin or neurovascular injury, and failure of reduction requiring general anesthesia. Sedation complications included use of bag-valve mask and artificial airway, intubation, prolonged recovery, use of a reversal agent, and inability to achieve sedation. We then compared the data for each sedation agent.

Results: We found reduction complications rates of 8.7% in the propofol, 24.7% in the etomidate, and 28.9% in the opiate/benzodiazepine groups. The propofol group was significantly different from the other 2agents ($p \leq 0.01$). Sedation complications were found 7.3% of the time in the propofol , 11.7% in the etomidate , and 21.3% in the opiate/ benzodiazepine group, ($p = 0.02$ propofol vs. others) . Average recovery times were 25.2 minutes for propofol, 30.8 minutes for etomidate, and 44.4 minutes for opiate/ benzodiazepine ($p = 0.05$ for propofol vs. other agents).

Conclusion: For reduction of dislocated total hip arthroplasty under procedural sedation, propofol appears to have fewer complications and a trend toward more rapid recovery than both etomidate and opiate/benzodiazepine. These data support the use of propofol as first line agent for procedural sedation of dislocated total hip arthroplasty, with fewer complications and a shorter recovery period. [West J Emerg Med. 2014;15(1):76–80.]

INTRODUCTION

Hip dislocations are a common complication after total hip arthroplasty but the reported frequency of hip dislocation varies widely. Previous reports found the dislocation rate to be 2.25% for those with a primary total hip arthroplasty versus 7.4% in patients with a revision hip in place.[1,2] Patients who experience this complication most often present to the emergency department (ED) with a great deal of discomfort and an inability to ambulate. The majority of patients with a dislocated total hip need rapid closed reduction as the first step in their treatment. These reductions most likely occur in the setting of the ED with procedural sedation or in the operating room under general anesthesia.[3–5]

Procedural sedation for a prosthetic hip reduction in the ED commonly involves the use of an opiate and benzodiazepine combination, etomidate, or propofol. All 3 forms of procedural sedation have been documented as safe to be used in an ED setting.[5–7] . Opiates and benzodiazepines have been used for years as a sedative combination. Fentanyl and midazolam are used often due to their fast onset; however, the duration of sedation (30–60 minutes) can lead to prolonged resource consumption in the ED. Etomidate, a carboxylated imidazole, and propofol, a phenolic compound, have gained popularity for their quick onset combined with a relatively short duration of action. Both are sedative hypnotics that provide no analgesia. Midazolam and fentanyl, as well as propofol can cause profound hypotension and hemodynamic instability. Etomidate carries a lower risk of hemodynamic compromise; however, it can cause myoclonus and adrenal suppression. Currently, limited literature exists comparing these 3 forms of procedural sedation for dislocated hip prostheses reduction.

When performed in the ED, procedural sedation commonly requires "one-to-one" physician and nursing monitoring for a prolonged period of time. It consumes many resources that can directly affect the efficiency and throughput of an ED. Identifying the most effective sedation agent to decrease reduction failure, reduction complication rates, and recovery times is of great interest to the emergency medicine community. This study is designed to compare the use of an opiate and benzodiazepine combination, etomidate, and propofol for procedural sedation for closed reduction of dislocated hip prostheses in the ED.

METHODS

We performed a retrospective chart review[8] for all patients presenting to the ED with total hip arthroplasty dislocations at 2 academic affiliated medical centers during a 5-year period. These 2 450-bed community teaching hospitals have approximate total of 120,000 annual ED visits. Closed reductions of total hip arthroplasty dislocations at each facility are initially handled in the ED with procedural sedation managed by a board-certified ED physician and the reduction procedure managed by an orthopedic resident and/or attending surgeon. Decisions for reduction in the OR suite or by surgical means are decided by attending orthopedic surgeons. Patients were identified using CPT codes for total hip arthroplasty dislocation. Diagnosis of hip dislocation was made by plain film. Our local institutional review committee reviewed and approved this project.

We classified patients into 3 groups based on the type of sedation administered at time of reduction; 1) propofol, 2) etomidate, or 3) opiate/benzodiazepine. These classifications were performed based on what was given immediately prior to the reduction procedure. It is standard of care at both facilities to provide immediate pain control upon presentation of hip dislocations, most commonly in opiate form. Standard weight-based dosages are part of the sedation protocols at each facility and are given in bolus form (Table 1). Redosing is performed at the discretion of the ED physician. We excluded patients who were immediately admitted for a revision surgery or taken directly to the operating room. The primary outcome of interest was reduction of procedure complications including failure to reduce in the ED, fracture, neurovascular injury, and skin injury. Secondary outcomes measured were sedation complications including bag/valve mask utilization, artificial airway placement, intubation, hypotension (defined as a mean arterial pressure of less than 65mmHG or requiring intravenous fluid bolus replacement during sedation), prolonged recovery, use of anesthesia reversal agents, inability to adequately sedate, and time from initial sedation induction to cognitive recovery. Recovery was evaluated and documented by the ED nursing staff after the patient was able to correctly answer his name, the name of the facility he was at, and the date, including day, month, and year.

Data were collected and recorded into an Excel database and then transferred into a statistical program for analysis. We compared a variety of outcome measures between the 3 groups. The reduction complication rates and sedation complications rates were compared using chi-square analysis. We analyzed the recovery times using an ANOVA. Statistical analysis was performed with SAS version 9.2 statistical software (SAS Institute, Cary, North Carolina).

RESULTS

During the 5-year data collection period, 2005–2009, we identified 329 hip arthroplasty dislocations. After excluding those patients taken directly to the OR, 198 patients were available for comparison. Of the available 198 who received procedural sedation in the ED, 69 received propofol, 77 received etomidate, and 52 received opiate/benzodiazepine for conscious sedation in the ED. The average patient age was 68 ± 14.0 (S.D.) years (25^{th} percentile=57, median=71, 75^{th} percentile=78.5) and 65.0% were female.

A reduction complication rate of 8.7% was identified for those patients who received propofol, with 2 of 6 events being reduction failures that required transfer to the OR for successful closed reduction under general anesthesia. In patients who received etomidate and opiate/benzodiazepine, reductions

Table 1. Sedation agent dosage guidelines.

Agent	Standard Dosage Guidelines	Re-dosing Guidelines
Midazolam	0.02-0.1 mg/kg initial bolus IV	25% of initial dose in 3–5 minute bolus
Etomidate	0.1-0.2 mg/kg bolus IV	given as single bolus dose
Propofol	0.5-1.0 mg/kg initial bolus IV	repeat dosing 0.5mg/kg q3-5 minutes bolus

IV, intravenous

complication rates were 24.7% and 28.9%, respectively. Midazolam in combination with dilaudid, morphine, or fentanyl were most commonly used. In only 1case was diazepam used in addition to midazolam. Significantly lower reduction complication rates were observed in patients receiving propofol when compared to either etomidate (−16%, p=0.01) or opiate/benzodiazepine (−20.2%, p< 0.01) (Table 2).

Sedation complications were observed in 21.2% of patients who received opiate/benzodiazepine. Sedation complication rates after propofol (7.3%) and etomidate (11.7%) were significantly lower when compared to opiate/benzodiazepine conscious sedation. The majority of the sedation complications in patients who received opiate/benzodiazepine were related to prolonged sedation recoveries. In addition, respiratory depression requiring reversal with naloxone was observed in patients who received opiate/benzodiazepine while the majority of the sedation complications for patients who received propofol and etomidate involved the required use of bag valve mask ventilation for respiratory depression. Patients who received propofol were found to be the only group with the sedation complication of hypotension requiring intravenous fluid replacement. This occurred in 2 of 69 patients (2.9%) who received propofol. There was a statistically significant difference in the rate of sedation complications between patients who received propofol and opiate/benzodiazepine groups (p=0.02) (Table 3).

The average lengths of sedation for patients who received propofol, etomidate, and opiate/benzodiazepine were 25.1, 30.8, and 44.4 minutes, respectively (Table 4). The recovery times were significantly shorter for patients who received propofol when compared with the opiate/benzodiazepine combination (p<0.05).

DISCUSSION

The use of procedural sedation for closed reduction of dislocated hip prostheses in the ED is an accepted practice. Reductions can occur more quickly than awaiting general anesthesia.[4] Currently, there are numerous sedative agents that may be used, including propofol, etomidate, and an opiate/benzodiazepine combination. Since each of these sedative agents has advantages and disadvantages, physicians across the country have used varying agents and combinations of agents to help patients. Opiate/benzodiazepine combinations have been used in EDs the longest, and thus are possibly preferred because of familiarity. Propofol has a rapid onset and recovery with anti-emetic effects, but may cause hypotension and metabolic acidosis. Etomidate also is fast acting and has a recovery profile with no clinically significant hemodynamic effects, but it is associated with myoclonus, adrenal insufficiency[9], and immunosuppression. None of these sedative agents have analgesic affects, which may require the addition of a short or ultra-short acting opiate, such as fentanyl for painful procedures.

The physician's choice of sedative agent should be evidenced based to provide patients with a safe and efficient means of sedation. The risks of airway compromise and hemodynamic instability must be balanced with the depth of sedation for successful closed reduction. In addition, length of recovery and length of stay are of great interest from both the perspective of patient safety and patient throughput initiatives in the ED.

The reduction and sedation complications and recovery times of patients who received the opiate/benzodiazepine

Table 2. Observed hip reduction complications.

Sedation Agent	# complications site 1	# complications site 2	# total complications	% total complications	Notes
Propofol	6/63	0/6	6/69	8.7	1 Greater trochanter fx, 3 multiple attempts, 2 failures required general anesthesia
Etomidate	0/0	19/77	19/77	24.7	19 failures required general anesthesia (1 associated skin tear)
Opiate/ Benzodiazepine	14/44	1/8	15/52	28.9	1 unstable admitted for rev, 14 failures required general anesthesia

Table 3. Observed sedation complications.

Sedation Agent	# complications site 1	# complications site 2	# total complications	% total complications	Notes
Propofol	5/63	0/6	5/69	7.3	2 IVF for BP, 1 BVM, 1 prolonged recovery, 1 unable to achieve sedation
Etomidate	0/0	9/77	9/77	11.7	4 BVM, 4 prolonged recovery, 1 unable to achieve sedation
Opiate/ Benzodiazepine	9/44	2/8	11/52	21.2	3 naloxone, 6 prolonged recovery, 2 unable to achieve sedation

BVM, bag-valve-mask

combination were greater compared to patients who received propofol or etomidate. Despite the higher reduction complications associated with opiate/benzodiazepine agents in our study, the reduction success rate is similar to findings reported by Frymann and colleagues.[3] However, they reported a mean time to reduction using procedural sedation of 1.83 hours, which is much longer compared to our findings with this sedative combination.[3]

We found respiratory complications with the use of all 3 sedative agents. While propofol was the only agent to produce clinically significant hypotension requiring intravenous fluid administration, the 2 patients who experienced hypotension were easily managed with fluid replacement. Overall, propofol had less reduction and sedation complications and required fewer trips to the operating room for reduction under general anesthesia. Thus, the data found in our study support the use of propofol for procedural sedation in the reduction of dislocated hip prostheses.

LIMITATIONS

There are several limitations to this study. Sample size for each treatment group was relatively small and the patients were not randomized to treatment groups. A large number of patients were excluded as they were directly taken to the OR for reduction. It is unknown why this proportion is so high; however, it could be associated with the preferred orthopedic practices of that time in the area. The majority of sedations with each agent were hospital-specific. The majority of propofol sedations were performed at Site 1 and all the etomidate sedations were performed at Site 2. It is standard practice at both sites for the ED attending to be overseeing the sedation while an orthopedic resident performs the reduction. Although the majority of all reductions were performed by the same resident service, practice differences at each hospital could have skewed the sedation complication rates and recovery times. We could not perform further analysis to account for these variables by comparing these agents at a single site due to the small number of cases available. As noted previously, it is standard of care at both facilities to receive analgesia upon initial presentation to the ED. Essentially, all patients in this study cohort received a form of a narcotic (morphine, dilaudid, fentanyl) prior to initiation of sedation. What could not be extrapolated from the medical record information was the exact timing of when those medications were given prior to procedural sedation. Data on time of order placement were available; however, reviewers could not state with confidence or consistency when those medications were received. The timing and use of these adjuncts could affect the reported complication rates and length of recovery times. In addition, analysis on patient co-morbidities including ASA and Mallampati classification were not performed as these data were not available for review. It is unknown if the differences in complication rates found may have been skewed more because the patient population that received certain sedation agents were already at higher risk.

Table 4. Length of procedural sedation.

	Average minutes from initiation to alert & oriented (mean ± SD)
Propofol	25.17 ± 18.2
Etomidate	30.83 ± 21.5
Opiate/ Benzodiazepine	44.35 ± 25.8*

* statistically significant compared to Propofol, $p < 0.05$

CONCLUSION

For procedural sedation during reduction of a dislocated total hip prosthesis, propofol provides a greater success rate than etomidate or an opiate/benzodiazepine combination. Although there was no advantage with regard to sedation complications and time to recovery when compared to etomidate, there was an advantage when comparing propofol to opiate/benzodiazepine. Our study suggests that propofol may be the agent of choice for the reduction of THA. It may lead to less reduction failures, decreased reduction and sedation complications, and shorter recovery times, which could relate to decreasing consumption of staff resources and improved throughput times. Further prospective studies with greater sample size are recommended and should include long-term

outcomes and monitoring for subsequent ED readmission for dislocation.

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Importance of Hospital Entry: Walk-in STEMI and Primary Percutaneous Coronary Intervention

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Introduction: Patients with ST elevation myocardial infarction (STEMI) require rapid identification and triage to initiate reperfusion therapy. Walk-in STEMI patients have longer treatment times compared to emergency medical service (EMS) transported patients. While effective triage of large numbers of critically ill patients in the emergency department is often cited as the reason for treatment delays, additional factors have not been explored. The purpose of this study was to evaluate baseline demographic and clinical differences between walk-in and EMS-transported STEMI patients and identify factors associated with prolonged door to balloon (D2B) time in walk-in STEMI patients.

Methods: We performed a retrospective review of 136 STEMI patients presenting to an urban academic teaching center from January 2009 through December 2010. Baseline demographics, mode of hospital entry (walk-in versus EMS transport), treatment times, angiographic findings, procedures performed and in-hospital clinical events were collected. We compared walk-in and EMS-transported STEMI patients and identified independent factors of prolonged D2B time for walk-in patients using stepwise logistic regression analysis.

Results: Walk-in patients (n=51) were more likely to be Latino and presented with a higher heart rate, higher systolic blood pressure, prior history of diabetes mellitus and were more likely to have an elevated initial troponin value, compared to EMS-transported patients. EMS-transported patients (n=64) were more likely to be white and had a higher prevalence of left main coronary artery disease, compared to walk-in patients. Door to electrocardiogram (ECG), ECG to catheterization laboratory (CL) activation and D2B times were significantly longer for walk-in patients. Walk-in patients were more likely to have D2B time >90 minutes, compared to EMS- transported patients; odds ratio 3.53 (95% CI 1.03, 12.07), p=0.04. Stepwise logistic regression identified hospital entry mode as the only independent predictor for prolonged D2B time.

Conclusion: Baseline differences exist between walk-in and EMS-transported STEMI patients undergoing primary percutaneous coronary intervention (PCI). Hospital entry mode was the most important predictor for prolonged treatment times for primary PCI, independent of age, Latino ethnicity, heart rate, systolic blood pressure and initial troponin value. Prolonged door to ECG and ECG to CL activation times are modifiable factors associated with prolonged treatment times in walk-in STEMI patients. In addition to promoting the use of EMS transport, efforts are needed to rapidly identify and expedite the triage of walk-in STEMI patients. [West J Emerg Med. 2014;15(1):81–87.]

INTRODUCTION

Patients with ST elevation myocardial infarction (STEMI) require rapid identification and triage to initiate reperfusion therapy. In the United States, primary percutaneous coronary intervention (PCI) is favored over thrombolytic therapy as the mode of reperfusion.[1] However, delay to performing PCI is associated with worse clinical outcome.[2] Various factors are associated with prolonged treatment times, and nationwide efforts are underway to address these issues.[3-6]

In 2008, the Los Angeles County Emergency Medical System (EMS) established a regionalized care system for patients with STEMI. Patients with a pre-hospital electrocardiogram (ECG) showing STEMI are transported to designated STEMI receiving centers for primary PCI.[3] Patients with STEMI may also present directly to the emergency department (ED) via self or family transport and are referred to as "walk–in" patients. Prior studies suggest that walk-in STEMI patients have longer treatment times compared to EMS-transported patients.[7-9] While effective triage of large numbers of critically ill patients in emergency departments is often cited as the reason for treatment delays, additional factors have not been adequately evaluated.

The goal of this study was to evaluate baseline demographic and clinical differences between walk-in and EMS-transported STEMI patients and identify factors associated with prolonged door to balloon (D2B) time in walk-in STEMI patients.

METHODS

Study Population

Patients were included in this study if they had chest pain (or an angina equivalent), an ECG showing 1 mm of ST segment elevation in 2 contiguous leads consistent with STEMI and were referred for emergency coronary angiography and primary PCI. This study was performed at an urban academic medical center from January, 2009 through December, 2010. Patients were identified for this retrospective, observational study using the Los Angeles County + USC Medical Center Cardiac Catheterization Laboratory STEMI database. Data abstraction was performed by one physician (EB) and all data was reviewed as part of our ongoing institutional quality assessment and quality improvement STEMI program. For EMS-transported patients, the diagnosis of STEMI was made by paramedics when a pre-hospital ECG showed STEMI. For walk-in patients, the diagnosis of STEMI was made by the emergency physician (EP) when the initial or subsequent ECG showed STEMI. The cardiac catheterization laboratory was activated for presumed STEMI patients by EPs using a bundle-paging system. If the pre-hospital ECG or initial ECG was later interpreted by the interventional cardiologist as not showing STEMI and if the patient did not undergo emergent coronary angiography, they were excluded from the study. Patients were also excluded if they did not undergo primary PCI, died in the ED prior to receiving coronary angiography, were transferred-in from another institution for primary PCI or if they were transferred out to another institution during their index hospitalization.

Primary Percutaneous Coronary Intervention

Procedures were performed by 4 experienced interventional cardiologists. Use of mechanical or rheolytic thrombectomy devices prior to stent placement, the decision to place a bare metal or drug eluting stent, the choice of the anticoagulation used for the procedure and the use of vascular closure devices were left to the discretion of the treating interventional cardiologist. Following the procedure, all patients received aspirin (325 mg once daily) and either clopidogrel (300 mg or 600 mg orally followed by 75 mg once daily) or prasugrel (60 mg orally followed by 10 mg once daily). Clopidogrel or prasugel was continued for at least 1 month following placement of a bare metal stent and for 12 months following placement of a drug-eluting stent. Life-long aspirin therapy was recommended. Ejection fraction was assessed prior to hospital discharge by transthoracic echocardiography.

Study Parameters and Outcome Measures

We defined EMS-transport as patients being transported by EMS services. Walk-in patients were defined as those arriving to the hospital by self or private transportation, taxis, public transportation or walking to the hospital. The demographic and clinical parameters of the study population included age, gender, ethnicity, initial complaint and medical history. We defined hypertension as systolic blood pressure >140 mm Hg or diastolic blood pressure >90 mm Hg or receiving anti-hypertensive medications. Hyperlipidemia was defined as a total cholesterol level >220 mg/dl or receiving medications for hyperlipidemia. Diabetes mellitus was defined as a hemoglobin A1c level >6.5% or treatment with insulin or an oral hypoglycemic medication. We defined chronic lung disease as the use of medications for chronic obstructive pulmonary disease. Peripheral vascular disease was defined as a claudication, prior history of peripheral angioplasty, stent placement or atherectomy, prior history of lower extremity bypass surgery or prior history of carotid endarterectomy.

Presentation variables included congestive heart failure or cardiogenic shock at the time of hospital admission, admission heart rate and systolic blood pressure and the initial troponin value. We defined congestive heart failure as physical findings consistent with congestive heart failure and radiographic evidence of pulmonary edema. Cardiogenic shock was defined as a systolic blood pressure of less than 90 mmHg for at least 30 minutes following adequate fluid resuscitation of at least 1 liter of normal saline or the need for inotropic agents to maintain a systolic blood pressure of at least 90 mmHg. Clinical signs of hypoperfusion, including decreased urine output, altered mental status and peripheral vasoconstriction were also required to establish the diagnosis

of cardiogenic shock. For patients with a swan ganz catheter in place, we defined cardiogenic shock as a pulmonary capillary wedge pressure >18 mmHg and a cardiac index <2.0 liters/minute. Angiographic variables included the number of coronary vessels diseased with luminal diameter stenosis >70% by visual assessment. Left main coronary artery disease was defined as ≥50% luminal diameter stenosis by visual assessment. Procedures performed during the index hospitalization included coronary artery bypass grafting surgery (following 24 hours from coronary angiography) and placement of an intra aortic balloon pump. Ejection fraction was measured by transthoracic echocardiography prior to hospital discharge.

We studied the following time intervals: door to ECG time, ECG to cardiac catheterization (CL) activation time, CL activation to balloon time and D2B time. The primary endpoint of this study was D2B time. In-hospital clinical events included cardiogenic shock, cerebrovascular accident, congestive heart failure, reinfarction, respiratory failure, blood transfusion and in-hospital mortality. We defined reinfarction as subsequent elevation in cardiac biomarkers associated with angina requiring repeat emergent coronary angiography following the initial PCI procedure.

Statistical Analysis

We compared baseline demographic and clinical characteristics, treatment time intervals, in-hospital clinical events and in-hospital mortality between the EMS-transported and walk-in groups. We used chi-square test for comparing proportions, and the Student t-test or the Wilcoxon ranked sum test, wherever appropriate, was used for comparing means. We used non-parametric analysis of covariance to compare the D2B time between the two groups adjusting for significant baseline characteristics found between the two groups. Mean ± standard deviation are reported for continuous variables and number (percentage) are reported for categorical variables. We included significant risk factors identified in the univariate analysis in the stepwise logistic regression analysis from which significant independent factors were derived. Statistical significance was defined as a p-value <0.05. We used the Statistical Analysis System (SAS version 9.1) for all analysis.

RESULTS

Study Population

Between January 2009 and December 2010, 136 patients undergoing emergent coronary angiography for STEMI were evaluated. We excluded 21 patients because PCI was not performed (left main and/or multivessel disease requiring surgery n=5, cardiomyopathy n=12, no culprit lesion identified n=4), yielding a study population of 115 patients. Fifty-one patients (44%) arrived as walk-in (Walk-in group) and 64 (56%) were transported by EMS (EMS-transport group). EMS-transported patients were older and more likely to be white compared to walk-in patients (Table 1). Walk-in patients were more likely to be Latino, had a higher prevalence of diabetes mellitus and presented with a higher heart rate and higher systolic blood pressure than EMS-transported patients. A higher proportion of the walk-in patients presented with an

Table 1. Baseline demographics and presenting characteristics of emergency medical services (EMS)-transport and walk-in STEMI patients undergoing primary percutaneous coronary intervention.

	EMS-transport n=64	Walk-in n=51	p-value
Age[1]	60 ± 11	56 ± 7	0.03
Gender, % (n)			
Male	75% (48)	78% (40)	0.6
Female	25% (16)	22% (11)	
BMI[1]	28 ± 6	28 ± 4	0.37
Ethnicity, % (n)			
White	20% (13)	4% (2)	0.02
African-American	13% (8)	4% (2)	0.10
Asian	14% (9)	10% (5)	0.49
Latino	50% (32)	77% (39)	0.004
Other	3% (2)	6% (3)	0.47
Initial Complaint, % (n)			
Chest pain	83% (53)	94% (48)	0.07
Other	17% (11)	6% (3)	0.06
Medical history, % (n)			
Hypertension	58% (37)	55% (28)	0.75
Hyperlipidemia	42% (27)	33% (17)	0.33
Diabetes mellitus	27% (17)	49% (25)	0.01
Current smoker	20% (13)	29% (15)	0.26
Dialysis	3% (2)	0% (0)	0.20
Chronic lung disease	6% (4)	4% (2)	0.69
Prior MI	11% (7)	8% (4)	0.75
Prior CHF	2% (1)	0% (0)	1.00
Prior PCI	11% (7)	10% (5)	0.84
Peripheral vascular disease	3% (2)	0% (0)	0.50
Atrial fibrillation	2% (1)	0% (0)	0.37
Presentation, % (n)			
Congestive heart failure	3% (2)	8% (4)	0.40
Cardiogenic shock	8% (5)	0% (0)	0.07
Heart rate (bpm)[1]	75 ± 22	91 ± 21	0.001
Systolic blood pressure (mm Hg)[1]	135 ± 34	151 ± 32	0.041
Elevated troponin, % (n)	64% (41)	88% (45)	0.005

[1]Mean ± standard deviation; *BMI*, body mass index; *MI*, myocardial infarction; *CHF*, congestive heart failure; *PCI,* percutaneous coronary intervention; *CABG*, coronary artery bypass graft surgery; *BPM*, beats per minute

Table 2. Angiographic findings and procedures performed of emergency medical service (EMS)-transported and walk-in STEMI patients undergoing primary percutaneous coronary intervention.

	EMS-transport n=64	Walk-in n=51	p-value
No. of vessels diseased, % (n)			
One	28% (18)	24% (12)	0.50
Two	34% (22)	45% (23)	0.24
Three	38% (24)	31% (16)	0.49
Left main disease[1]	22% (14)	8% (4)	0.04
Stent, % (n)	92% (59)	94% (48)	1.00
Bare metal stent	64% (41)	57% (29)	0.66
Drug eluting stent	28% (18)	37% (19)	0.30
CABG, % (n)	0% (0)	4% (2)	0.19
Intra aortic balloon pump, % (n)	9% (6)	12% (6)	0.68
Ejection fraction[2]	51 ± 18 (n=29)	46 ± 8 (n=11)	0.11

[1]Left main disease defined as >50% diameter stenosis; *CABG*, coronary artery bypass graft surgery. [2]Mean ± standard deviation.

elevated troponin value, compared to EMS-transport patients, 88% versus 64%, p=0.005, respectively. The number of diseased coronary vessels was similar between EMS-transport and walk-in patients (Table 2). A higher proportion of EMS-transport patients had significant left main disease compared to walk-in patients, 22% versus 8%, p=0.04, respectively. The use of bare metal stents and drug eluting stents, the need for coronary artery bypass surgery, use of intra aortic balloon pump and ejection fraction prior to hospital discharge were similar between the groups.

Treatment Times and In-hospital Clinical Events

Door to ECG and ECG to CL activation times were significantly longer in the walk-in compared to EMS-transported patients (Table 3). CL activation to balloon time was similar between both groups. D2B time was significantly longer in the walk-in versus EMS-transported patients, 136±169 versus 60±31 minutes, p<0.0001, respectively. The proportion of patients with D2B time ≤ 90 minutes was significantly higher in the EMS-transport versus the walk-in patients, 91% versus 59%, p<0.0001, respectively. In-hospital clinical events, including cardiogenic shock, cerebrovascular events, congestive heart failure, reinfarction, respiratory failure, blood transfusion and mortality, were similar between both groups.

Comparison of D2B time between Walk-in and EMS patients

Univariate analysis comparing walk-in and EMS-transport patients identified the following significant risk factors: mode of entry, age, Latino ethnicity, left main disease, initial troponin elevation, admission heart rate, admission systolic blood pressure, and diabetes mellitus. These variables were included in the logistic regression model to derive an adjusted odds ratio for D2B time >90 minutes. Table 4 provides the unadjusted and adjusted odds ratio for D2B time >90 minutes for walk-in as compared to EMS-transport patients.

Table 3. Treatment times and in-hospital clinical events of emergency medical service (EMS)-transported and walk-in STEMI patients undergoing primary percutaneous coronary intervention.

	EMS-transport n=64	Walk-in n=51	p-value
Treatment Times[1]			
Door to ECG	6 ± 15	40 ± 147	<0.0001
ECG to CL activation	2 ± 20	40 ± 87	<0.000
CL activation to balloon	54 ± 16	56 ± 16	0.43
Door to balloon	60 ± 31	136 ± 169	<0.0001
Door to balloon ≤90 mins, % (n)	91% (58)	59% (30)	<0.0001
In hospital clinical events, % (n)			
Cardiogenic shock	11% (7)	4% (2)	0.29
Cerebrovascular event	0	0	
Congestive heart failure	3% (2)	6% (3)	0.65
Reinfarction	3% (2)	0% (0)	0.50
Respiratory failure	11% (7)	6% (3)	0.51
Blood transfusion	2% (1)	0% (0)	1.00
Mortality	11% (7)	4% (2)	0.29

[1]Mean ± standard deviation; *ECG*, electrocardiogram; *CL*, catheterization laboratory.

Identification of independent risk factors for D2B time >90 minutes

Univariate analyses comparing patients with D2B time ≤90 minutes and D2B time >90 minutes identified hospital entry mode, Latino ethnicity and history of diabetes mellitus as significant risk factors. Stepwise regression analysis identified hospital entry mode (walk-in versus EMS-transport) as the only independent factor associated with D2B time >90 minutes (data not shown).

LIMITATIONS

This study has several limitations. The number of patients included is small given that the study period was only 23 months. We excluded 21 patients from the analysis because

Table 4. Odds ratios (OR) from logistic regression model for D2B time >90 minutes.

	D2B>90 No./Total no. (%)	OR (95% confidence interval)	p-value
Univariate model			
Walk-in	21/51 (41.18)	6.78 (2.47, 18.55)	0.0003
EMS-transport	6/64 (9.38)	1 (Reference)	
Multivariate model*			
Walk-in	18/47 (38.3)**	3.53 (1.03, 12.07)	0.04
EMS-transport	6/59 (10.17)	1 (Reference)	

*Adjusted for (variables with p<0.05) age, Latino ethnicity, left main disease, initial troponin elevation, admission heart rate, admission systolic blood pressure, and diabetes mellitus.
**Sample size decreased due to missing values in the covariates.

they did not undergo PCI. Although the primary endpoint of this study was D2B time and therefore required inclusion of patients undergoing PCI, exclusion of 21 patients represents a loss of data and a decrease in the overall sample size. Patients were evaluated by numerous different physicians, nurses and staff in the ED during the study period. While there is a standard triage for patients presenting with non-traumatic chest pain, variations in the triage process may have altered time to ECG acquisition, time for ECG interpretation and time to CL activation. Inherent in the retrospective nature of the study are issues related to the inability to collect information not available in the medical records. The use of a single data abstracter reduces heterogeneity but may also have introduced some bias into data collection. The current study was performed at a large, urban academic teaching hospital with activation of the CL done by EPs using a single bundle-paging system, and as such our results may not be applicable to other hospital systems.

DISCUSSION

In the present study of STEMI patients undergoing primary PCI, 64% arrived via EMS-transport and 44% by walk-in transport. As observed in prior studies, walk-in patients had a significantly longer D2B time compared to EMS-transported patients, 136 ± 169 versus 60 ± 31 minutes, p<0.0001, respectively. Although there were significant baseline differences between walk-in and EMS-transported patients undergoing primary PCI, we found that hospital entry mode was the most important predictor for prolonged D2B time. In evaluating the treatment processes for walk-in STEMI patients, we found that prolonged door to ECG and ECG to CL activation times contributed to the prolonged D2B time.

The evaluation of walk-in patients with chest pain in the ED is multifaceted and requires a complex number of decisions at multiple levels throughout the triage process.[10-12] Patients arriving via walk-in transport to ED fail to receive a number of components that EMS-transported patients routinely receive. The most essential of these is a pre-hospital ECG that allows rapid identification of a STEMI, thus mandating rapid triage on arrival. Use of a pre-hospital ECG reduces door to needle time in those receiving thrombolytic therapy and reduces D2B time in those undergoing primary PCI.[13,14] Current American College of Cardiology/American Heart Association Guidelines indicate that an ECG should be obtained within 10 minutes of hospital arrival for patients with chest pain or an anginal equivalent or other symptoms suggestive of STEMI.[15] The ability to identify walk-in patients with chest pain who require an ECG at the time of initial triage is critical. Several recent studies have explored various methods in an attempt to reduce this arrival or door to ECG time.[16-19] Takakuwa et al[16] found that use of registration clerks to screen patients for chest pain followed by expedited orders for an ECG improved the percentage of patients receiving an ECG within 10 minutes of arrival from 16% to 64%. Zarich et al[17] performed routine ECGs on all males >35 years of age or women >40 years of age with nontraumatic chest pain and reduced the door to ECG time from 15 to 7.6 minutes, p<0.001. Caputo et al[18] reduced door to ECG time from 8.4 to 3.7 minutes by obtaining a "more rapid ECG assessment of patients presenting with a complaint consistent with angina;" additional details on how these patients were identified at the time of triage were not described. Purim-Shem-Tov et al[19] used a dedicated ED greeter stationed in the triage area who screened all patients for chest pain, shortness of breath, acute mental status change in nursing home patients and dizziness and nausea in diabetic patients. Use of this protocol reduced the door to ECG time to 8.8 minutes. In addition to obtaining an ECG within 10 minutes of hospital arrival, rapid and accurate interpretation of the ECG and prompt activation of the STEMI team by EPs using a bundle paging system are additional essential components.[20,21]

Given the documented benefits of EMS-transport for STEMI patients, few studies have specifically evaluated walk-in STEMI patients undergoing primary PCI.[7-9] Canto et al[8] evaluated over 300,000 patients enrolled in the National Registry of Myocardial Infarction (NRMI) database and compared baseline characteristics and management between EMS and self-transport (walk-in) patients. While use of EMS was associated with shorter treatment times, only 10% of the study cohort underwent primary PCI, and factors associated

with prolonged treatment times in the walk-in cohort were not explored. So et al[7] evaluated STEMI patients arriving via EMS versus self-transport to 2 hospitals in Canada. Three hundred twenty- three of the 356 patients (91%) received thrombolytic therapy and 33 of the 356 patients (9%) received primary PCI; the reasons for prolonged treatment times in the self-transport (walk-in) primary PCI cohort were not explored. Despite nationwide efforts to promote the use of EMS-transport, walk-in patients constitute approximately 40% of STEMI patients.[7,9] A recent study from the National Cardiovascular Data Registry Acute Coronary Treatment and Intervention Outcomes Network Registry – Get With the Guidelines (ACTION Registry-GWTG) found that older patients, those living farther from the hospital and those with hemodynamic compromise were more likely to use EMS-transport.[9]

CONCLUSION

In addition to promoting the use of EMS-transport for STEMI patients, efforts are needed to rapidly identify and expedite the triage of walk-in STEMI patients. Prolonged door to ECG and ECG to CL activation times contribute to treatment delays in walk-in STEMI patients and should continue to be a focus of the quality improvement process.

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The July Effect: Is Emergency Department Length of Stay Greater at the Beginning of the Hospital Academic Year?

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Introduction: There has been concern of increased emergency department (ED) length of stay (LOS) during the months when new residents are orienting to their roles. This so-called "July Effect" has long been thought to increase LOS, and potentially contribute to hospital overcrowding and increased waiting time for patients. The objective of this study is to determine if the average ED LOS at the beginning of the hospital academic year differs for teaching hospitals with residents in the ED, when compared to other months of the year, and as compared to non-teaching hospitals without residents.

Methods: We performed a retrospective analysis of a nationally representative sample of 283,621 ED visits from the National Hospital Ambulatory Medical Care Survey (NHAMCS), from 2001 to 2008. We stratified the sample by proportion of visits seen by a resident, and compared July to the rest of the year, July to June, and July and August to the remainder of the year. We compared LOS for teaching hospitals to non-teaching hospitals. We used bivariate statistics, and multivariable regression modeling to adjust for covariates.

Results: Our findings show that at teaching hospitals with residents, there is no significant difference in mean LOS for the month of July (275 minutes) versus the rest of the year (259 min), July and August versus the rest of the year, or July versus June. Non-teaching hospital control samples yielded similar results with no significant difference in LOS for the same time periods. There was a significant difference found in mean LOS at teaching hospitals (260 minutes) as compared to non-teaching hospitals (185 minutes) throughout the year ($p<0.0001$).

Conclusion: Teaching hospitals with residents in the ED have slower throughput of patients, no matter what time of year. Thus, the "July Effect" does not appear to a factor in ED LOS. This has implications as overcrowding and patient boarding become more of a concern in our increasingly busy EDs. These results question the need for additional staffing early in the academic year. Teaching hospitals may already institute more robust staffing during this time, preventing any significant increase in LOS. Multiple factors contribute to long stays in the ED. While patients seen by residents stay longer in the ED, there is little variability throughout the academic year. [West J Emerg Med. 2014;15(1):88–93.]

INTRODUCTION

"July Effect" or "July Phenomenon" is a well-known entity among the medical community. Many hold the belief that one would never want to have a family member in the hospital during July, when trainee doctors are beginning their new roles.

As medical students become interns and junior residents become senior in July, the amount of collective experience among trainees in the hospital is significantly less than the month prior. This effect is postulated to be responsible for increased errors resulting in poor outcomes. Previous studies

have evaluated morbidity and mortality, surgical outcomes, hospital length of stay, and hospital charges early in the academic year as compared with non-academic hospitals or other times of the year.[1-16] To date, these studies have yielded mixed results.

Little information exists on this effect within the emergency department (ED). While there are studies of length of stay (LOS) in the hospital during the month of July, it is unknown if the ED LOS varies throughout the academic year. ED LOS data is becoming increasingly important as ED usage rates increase, contributing to increasing ED crowding and boarding of patients. The objective of our study was to assess if length of stay varies throughout the year at teaching and non-teaching EDs.

METHODS

We used publicly available micro-data files of the 1996-2009 National Hospital Ambulatory Medical Care Survey (NHAMCS). NHAMCS is a national probability sample survey of visits to hospital outpatient and emergency departments, conducted by the National Center for Health Statistics (NCHS) of Centers for Disease Control and Prevention (CDC). Data is gathered for approximately 25,000 visits a year from approximately 600 EDs and outpatient centers.[17] As this data is public and no patient identifiers are used, we were granted an exemption from our institutional review board review.

We performed a cross-sectional analysis of NHAMCS data. Pursuant to NHAMCS specifications, we weighted data by patient visit weight (patwt) and used the "cstratm" variable to reflect the multi-stage sampling design of the survey for variance estimation.

The "Length of visit" variable is calculated in the NHAMCS ED micro-data file from 2001 through 2009 and was used to define ED LOS in this analysis (n=295,870). We examined distribution of LOS using descriptive statistics, histograms, and Shapiro-Wilk W test for normal data. Both means and medians were calculated for this study population. Medians may be a more accurate way to represent ED LOS; a skewed distribution can affect the mean, favoring the direction of more lengthy ED stays, given the high frequency of patients boarding in the ED.[19] Because of skewness in LOS data (for example, for January at non-teaching hospitals, mean=193.7 minutes with 95% confidence interval (CI) from 184.5 to 202.9; median=139, IQR=80-230), for the purpose of regression analysis, we transformed LOS to natural logarithm of LOS.

We defined "teaching hospital" by proportion of ED visits seen by residents and interns as specified by "resint" variable in NHAMCS. Per precedent, using methodology from a previous large NHAMCS study,[18] a hospital was defined as a "teaching hospital" if the provider was recorded as ED resident/intern in more than 25% of ED visits in that hospital per year.

We compared LOS in "teaching" and "non-teaching" hospitals by month and year using descriptive statistics. We then compared LOS in the month of July vs. LOS in all other months, July versus June, July and August versus May and June, and July and August vs. all other months in teaching and non-teaching hospitals. We performed bivariate and multivariate analysis of log-transformed LOS in teaching vs. non-teaching hospitals including the following variables: year of visit, admission to the hospital, metropolitan/non-metropolitan status area, and safety-net status of the hospital, according the definition promulgated by the Centers for Disease Control and Prevention. All analyses were performed using STATA 11.0 (STATA Corp., College Station, Texas, USA) and a p-value equal to or greater than 0.05 was considered to be non-significant.

RESULTS

Using NHAMCS data, 295,870 ED visits from 2001 to 2009 were examined. These visits provide a purposeful and representative sample of ED visits within the United States (U.S.) during that timeframe. The majority (252,360) of these visits occurred at non-teaching hospitals. The remainder of these visits (43,510) occurred at teaching hospitals.

At teaching hospitals, the July and August median LOS was 169 min (IQR 95-288 min). During May and June, the median LOS was also 165 min (IQR=94-273). In the month of June, the median LOS was again 165 min (IQR 95-276 min).

When comparing teaching to non-teaching hospitals (Table 1), we did find a significant difference in LOS. LOS is significantly shorter at non-teaching hospitals throughout the year (median LOS=140 min, IQR 81-232 min at non-teaching hospitals, median LOS 165, IQR 94-276 min at teaching hospitals.

Adjusting for all covariates (Table 2), we found that teaching hospitals have 15% longer ED LOS throughout the year compared to non-teaching hospitals (95% CI=11-20%). We noted no difference in July and August LOS as compared to the rest of the year controlling for all covariates (adjusted LOS ratio=1.01, 95% CI=0.98-1.04).

Examining both means and medians by month, we found little variation in LOS throughout the academic year among teaching hospitals (Figure). Given that previous studies of the July Effect used several different timeframes to compare the earlier to later academic year, we computed linear regression coefficients for July versus June, July versus the rest of the year, and July and August versus May and June, all with and without adjustment for covariates. We failed to find any significant differences using any of these calculations.

Linear regression coefficients were estimated controlling for a variety of factors that could influence LOS. Admitted and non-admitted patient visits, urban and rural hospitals (defined by Metropolitan Statistical Area), and safety-net and non safety-net hospitals (as defined in NHAMCS) were all examined. Of note, adjusting for all other covariates, the

Table 1. Length of stay (LOS) in minutes in teaching* and non-teaching hospitals by month, emergency department NHAMCS (N= 262,382), 2001-2009.

	Teaching (n=43,510)		Non-teaching (n= 252,360)	
Month	Mean LOS (95% CI)	Median LOS (IQR)**	Mean LOS (95% CI)	Median (IQR)
January	223.5 (196.4, 250.5)	159 (82-265)	193.7 (184.5,202.9)	142 (82-232)
February	222.0 (196.3, 247.6)	163 (96-270)	200.7 (188.9,212.5)	145 (84-242)
March	227.2 (202.7, 251.7)	160 (93-266)	207.4 (192.4,222.4)	147 (82-245)
April	230.1 (211.0, 249.3)	165 (95-275)	187.1 (178.8,195.4)	137 (81-225)
May	216.8 (194.6, 239.3)	168 (95-268)	189.3 (179.5,199.2)	139 (81-227)
June	228.4 (196.5,260.4)	165 (94-272)	188.7 (179.2,197.2)	135 (79-224)
July	248.5 (206.4,290.6)	164 (90-278)	191.8 (182.8,200.7)	140 (82-232)
August	254.4 (209.8,299.1)	171 (101-295)	195.1 (184.8,205.4)	144 (83-239)
September	241.3 (215.2,267.3)	170(98-290)	191.7 (182.6,200.9)	143 (83-236)
October	212.6 (188.8,236.4)	154 (90-263)	184.6 (175.6,193.6)	135 (79-226)
November	210.2 (190.4,230.0)	153 (90-245)	189.8 (175.6,193.6)	143 (83-233)
December	219.8 (189.7,249.8)	163 (88-273)	190.1 (179.7,200.5)	137 (78-228)

IQR, interquartile range
*A teaching hospital is a hospital where >25% of visits are performed by resident/intern as reported in NHAMCS survey

Table 2: Factors associated with length of stay (LOS)*, 2001-2009.

Characteristics	Unadjusted LOS regression coefficient (95% confidence interval [CI])	Adjusted LOS regression coefficient** (95% CI)
Teaching (vs. non-teaching)	1.17(1.12, 1.23)	1.15 (1.11, 1.20)
Visit month		
July (versus June)	0.97 (0.93, 1.01)	0.97 (0.93,1.00)
July and August (versus May and June)	1.03 (1.00, 1.07)	1.03 (1.00,1.06)
Year of visit (2001-2009)[$]	1.03 (1.02, 1.04)	1.03 (1.02,1.03)
Admitted (versus not admitted)	1.95 (1.89, 2.01)	1.90(1.84,1.96)
Metropolitan statistical area (versus non-MSA)[&]	1.47 (1.38, 1.56)	1.42 (1.34,1.51)
Safety-net hospital (versus non-safety-net)	1.03 (1.00, 1.06)	1.01 (0.99,1.04)

*LOS was transformed to natural logarithm of LOS in linear regression models. Coefficients were exponentiated to calculate ratio of LOS associated with 1 unit change in each covariate;
**Models included teaching status, visit month (one comparison at a time), visit year, hospital admission, MSA and safety-net;
[$]LOS ratio is associated with each year change from 2001- 2009;
[&]Based on actual location in conjunction with the definition of the Bureau of the Census and the United States Office of Management and Budget.

LOS of admitted patients was 91% longer than non-admitted patients (95% CI=81%-98%). Also, the LOS of patient visits at urban hospitals were 42% longer than at rural hospitals, controlling for all other covariates (95% CI=34%-51%).

LIMITATIONS

Several limitations exist within our study. As with other retrospective studies, we were not able to control for a variety of factors which may have influenced the outcomes measured.

Teaching EDs also may increase staffing in July, using physician assistants and nurse practitioners to provide coverage as new residents acclimate to their roles. Also, hospitals may increase the number of attending physicians and senior providers working in the ED in July to provide closer supervision to new residents and interns and facilitate greater efficiency.

It is important to note that not all academic years begin in July. While the preponderance start in July, some teaching programs begin the academic year in mid-June or August, or rarely, have variable start dates, incorporating one resident at a time into the program throughout the year.

Our definition of teaching hospital was one in which more than 25% of patient visits were seen by residents/interns. This does not encompass all teaching hospitals by any means. We

were not able to separate those hospitals with an emergency medicine (EM) residency program or those who had non-EM residents working in the ED. Also, NHAMCS does not record year of training of the resident for the patient visit, thus did not allow us to assess length of stay based on level of training, which may have played a role in our findings.

Another limitation within our study is inability to control for the multitude of factors influencing LOS, beyond academic year cycles. Length of stay has been associated with elective surgical admission, number of ED admissions, and hospital occupancy.[20] Seasonal trends in ED usage may exist, such as in flu season or in warm weather when more trauma patients are seen in EDs, which could contribute to LOS. By comparing teaching to non-teaching hospitals directly, we hope to control for some of these factors.

Crowding within the ED has been demonstrated to correlate with increased LOS in several studies. A recent study showed that in patients with asthma who were ultimately discharged, length of stay increased as the ED became more crowded.[21] Crowding also influences LOS in higher acuity patients who require admission.[22] Within our study, crowding and patient boarding could be responsible for increases in LOS throughout the year within both types of EDs. It is unclear if crowding varies between academic and non-academic EDs based on the current body of literature.

DISCUSSION

According to NHAMCS data, the number of ED visits in 1992 in the U.S. was approximately 90 million.[23] Data from 2008 demonstrated 124 million visits,[24] a 38% increase over that 16 year interval. compared with a 19% increase in U.S. population over the same period.[25] EDs have become the safety net for the medically underserved, such as patients with Medicaid.[26] These growing patient volumes give new urgency to patient wait times, crowding, and the need to board patients in the ED; all issues that may have been seen as less important in an earlier era.

Given the increased patient volumes, it is not surprising that ED LOS has steadily increased within the U.S. over the last several years.[27] With patients staying longer in the ED, sick patients in the waiting room may wait longer to been seen, and patients may leave the ED without being seen.

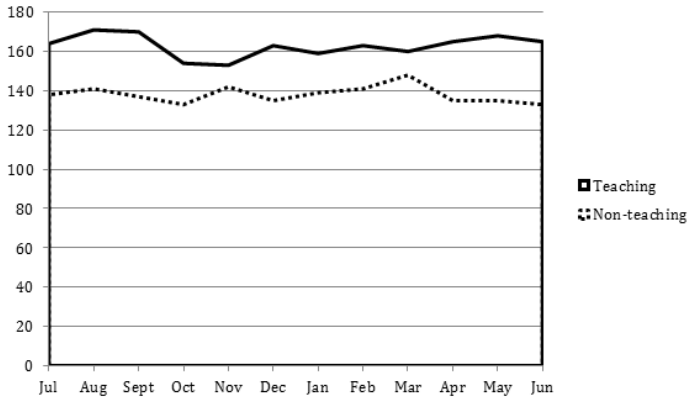

Figure. Comparing emergency department length of stay medians (in minutes) for teaching and non-teaching hospitals throughout the year.

Whether the "July Effect" actually exists or is simply a belief based on anecdote is hard to definitively establish. Previous studies have yielded mixed results. While it seems intuitive that there must be a measurable outcome of performance that is affected by the beginning of the academic year, previous research has yielded conflicting results. There are no studies to our knowledge examining the "July Effect" in the emergency department.

A recent study examined preventable complications and deaths in the first two months of the academic year as compared to the last two months of the year at an academic level I trauma center.[10] This study showed increased rates of preventable complications early in the year, however these complications had no impact on mortality.

Similar results have been found in studies of surgical outcomes. For example, a retrospective review compared outcomes for patients undergoing appendectomy at two public teaching hospitals early in the academic year and found no difference in wound infection or length of hospitalization.[16] Other studies of similar outcomes in surgical patients also demonstrate no change in morbidity and mortality early in the year.[5]

While there appear to be some variables that do change early in the year based on these studies, such as longer operative times, ultimately, patient-centered outcomes were not affected.[5,16] This argues against the July Effect as a clinically significant entity. However, these results are in conflict with other studies of surgical outcomes which have found small differences early in the year for hip fracture mortality and pediatric shunt placement outcomes.[1,11]

The "July Effect" has been examined as an entity outside of the realm of surgical outcomes as well. Within the obstetrical literature, a single study using a national database showed no difference in rates of cesarean section, bladder injury, perineal lacerations or shoulder dystocia early in the academic year.[6]

This finding disagrees with a retrospective cohort study which examined undesired events among new anesthesia trainees at a single institution. In this study, an increased rate ratio of undesired effects such as nerve injuries, patient de-saturation, and endotracheal tube mis-placement.[8]

Medication errors have also been studied for the month of July. U.S. death certificates were used to evaluate observed number of deaths and compared to expected number of deaths for the month of July. Using counties with and without teaching hospitals throughout the U.S. to measure effect, percentage of fatal medication errors was significantly higher in counties with teaching hospitals than those without in the month of July.[12]

Among several studies on length of hospital stay as a marker for the July Effect, authors have reached different

conclusions. In one study, hospital mortality and LOS in the intensive care unity was examined retrospectively at multiple hospitals in one region of the U.S. Adjusting for illness severity, no differences in mortality were found early in the academic year. Intensive care unit LOS was unchanged throughout the year.[3] A study at a single center yielded similar results. Analyzing hospital LOS and ancillary charges, no differences were found.[4] In comparison, a study in a single institution over many years demonstrated a steady decline in LOS over the academic year.[13]

Our study adds to the argument that the July Effect is more colorful lore than observable phenomenon. We found that patients spent the same amount of time in the ED no matter what time of year. While a short LOS does not necessarily mean better care, it is an important factor when considering ED quality. A functional and efficient ED leads to shorter stays, which do not vary much throughout the year in our study.

Given little EM literature exists in this area, further research could include rate of test ordering, experience level of providers, length of patient sign outs at change of shift, or unexpected return visits to the ED.

CONCLUSIONS

A variety of factors contribute to ED LOS, but the July Effect does not appear to be among them. In teaching hospitals, which we define as hospitals in which 25% or more of patient visits in the ED involve a resident, the length of stay does not vary throughout the year. Our study did show a significantly shorter LOS in non-academic as compared to teaching hospitals. Thus, when a higher proportion of residents are responsible for patient care (more than 25% versus less than 25%), length of stay is increased. Our study, using a large sample size, adds to the current body of literature that argues the "July Effect" is not a clinically significant entity.

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Electronic Medical Record Utopia May Be Right Before Our Eyes

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Envision a shift years from now. You treat patients but never sit at a computer to document or enter orders. You wear a set of clear glasses with a computer screen built into the lens. Navigation of medical records occurs by voice command into a nearly invisible speaker built into your eyewear's frame. No lag exists between your spoken command and the instantaneous flash of information desired. Patient notes and orders are entered immediately and hands free from voice controlled dictation before you leave a patient's room. You finish your procedure note for a central line or intubation before you remove your gloves because you verbally entered that information as it was performed. During physical exam, you command the photo of a patient's wound or bedside ultrasound findings from a miniscule camera inconspicuously situated into the frame of your eyewear. The images are uploaded and available immediately. Your lens alerts you the second critical lab values result. Electrocardiograms are transmitted to your lens too, and previous tracings are retrieved automatically. To page a consultant, you simply demand it from your hands free mobile command post. Prescriptions are sent electronically to and instantly received by local pharmacies once you speak the words. Drug doses, side effects, mechanism of action, and retail costs are all linked seamlessly from your order menu. For every fleeting query, you state what you want from which source, and it appears immediately. This is the future of medicine.

Google Glass is a voice controlled wearable head mount display smart-phone-like computer currently tested by select applicants for $1500 (Figure 1).[1,2] Such hardware may be our first glimpse of a spectacle-based computer-integrated future. Apache helicopter pilots have had display mounts built into their helmets that stream night vision imagery for years. Dragon Dictation is a program that permits hands free patient encounter documentation. The iPhone5's Siri searches for answers to our questions by voice command. Epocrates, Lexicomp, Sanford's Antibiotic Guide, and Pub Med yield

Figure. Google glasses.

valuable information we need every day to function optimally in our respective fields. Current microprocessors can deliver information as fast as we can request it. Wireless networks remotely link us to the internet. Google Fiber is supposed to provide internet connections 100 times faster than broadband.

Physicians are bogged down by the inefficiencies of data retrieval and transcription. The average emergency physician (EP) spends 30-40% of total shift time in a medical record.[3] One study found EPs spend only 25% of total shift time in direct patient care.[4] The technology already exists for the aforementioned vision. The individual constituents just need to be seamlessly integrated on a convenient interface. Wait times and costs could decrease. Improved efficiency could amplify profits. Physician experience and knowledge could accelerate. If this brighter future is not desired, it is needed. The quantitative and qualitative demand for medical care burdened to every provider seems only to increase. I encourage you to push us to this bright, more efficient, and

more capable future. Advise your electronic medical record carrier to mold their interface into new applications for hardware such as the Google Glass and inevitable subsequent comparable models, integrate highly useful software adjuncts, and foster the adoption of these progressing technologies.

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Sensitivity of Emergency Bedside Ultrasound to Detect Hydronephrosis in Patients with Computed Tomography-proven Stones

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Introduction: Non-contrast computed tomography (CT) is widely regarded as the gold standard for diagnosis of urolithiasis in emergency department (ED) patients. However, it is costly, time-consuming and exposes patients to significant doses of ionizing radiation. Hydronephrosis on bedside ultrasound is a sign of a ureteral stone, and has a reported sensitivity of 72-83% for identification of unilateral hydronephrosis when compared to CT. The purpose of this study was to evaluate trends in sensitivity related to stone size and number.

Methods: This was a structured, explicit, retrospective chart review. Two blinded investigators used reviewed charts of all adult patients over a 6-month period with a final diagnosis of renal colic. Of these charts, those with CT evidence of renal calculus by attending radiologist read were examined for results of bedside ultrasound performed by an emergency physician. We included only those patient encounters with both CT-proven renal calculi and documented bedside ultrasound results.

Results: 125 patients met inclusion criteria. The overall sensitivity of ultrasound for detection of hydronephrosis was 78.4% [95% confidence interval (CI)=70.2-85.3%]. The overall sensitivity of a positive ultrasound finding of either hydronephrosis or visualized stones was 82.4% [95%CI: 75.6%, 89.2%]. Based on a prior assumption that ultrasound would detect hydronephrosis more often in patients with larger stones, we found a statistically significant (p=0.016) difference in detecting hydronephrosis in patients with a stone ≥6 mm (sensitivity=90% [95% CI=82-98%]) compared to a stone <6 mm (sensitivity=75% [95% CI=65-86%]). For those with 3 or more stones, sensitivity was 100% [95% CI=63-100%]. There were no patients with stones ≥6 mm that had both a negative ultrasound and lack of hematuria.

Conclusion: In a population with CT-proven urolithiasis, ED bedside ultrasonography had similar overall sensitivity to previous reports but showed better sensitivity with increasing stone size and number. We identified 100% of patients with stones ≥6 mm that would benefit from medical expulsive therapy by either the presence of hematuria or abnormal ultrasound findings. [West J Emerg Med. 2014;15(1):96–100.]

INTRODUCTION

Computed tomography (CT) is widely accepted as a gold standard imaging modality for the detection of renal calculi and hydronephrosis.[1] Unfortunately, CT is costly, adds time to the total emergency department (ED) visit and exposes patients to ionizing radiation. This last factor is of particular concern as renal calculi tend to recur and the mutagenic risks of radiation are cumulative in patients who undergo multiple studies.[2,3]

In contrast, ultrasound (US) is non-invasive, can be performed quickly at the bedside and emits no ionizing radiation. Focused bedside renal US for the detection of hydronephrosis by emergency physicians (EP) is an established practice and is now integrated within the core emergency medicine curriculum of residency training programs.[4] The finding of hydronephrosis on emergency bedside US is an indirect sign of a ureteral stone and has a reported sensitivity of 72-83% when compared to CT.[5,6]

The presence of hydronephrosis on US in the clinical setting of suspected renal colic can provide sufficient information to guide the treatment and disposition of the patient, obviating the need for further imaging.[7,8] Nonetheless, CT imaging, alone or in addition to bedside US, remains near-universal in the evaluation of patients with suspected renal colic in the United States.

Because rates of spontaneous stone passage (e.g., without medical or surgical intervention) are closely correlated to stone diameter, treatment algorithms often hinge upon stone size as a branch point in decision making. The purpose of this study was twofold. First, we aimed to determine the overall sensitivity of bedside US performed by EPs and to compare this to previously reported sensitivities. Second, we sought to determine how sensitivity varied with stone size and number.

METHODS

Study Design and Setting

We performed a structured, explicit, retrospective chart review, closely following previously published criteria for medical record reviews.[9,10] The study was based at an urban academic ED with an annual census of approximately 160,000 patient visits and was approved in advance by the local institutional review board committee.

Selection

All adult patients (≥18 years) from July 1, 2009, to January 31, 2010, with an ED diagnosis of renal colic were queried. ICD-9 codes including kidney calculus (592.0), ureter calculus (592.1), urinary calculus unspecified (592.9), bladder calculus (594.1), ureteral calculus (594.2) and renal colic (788.0) were included. Of these charts, those with a CT from the selected visit showing evidence of renal calculus by attending radiologist read were examined for results of bedside US performed by a resident or attending EP during the same visit. All bedside US studies in the ED are performed by EPs who have successfully completed a 2-day course in bedside US. Only those patient encounters with both CT-proven renal calculi and documented bedside US results from the same ED visit were included. Patients were excluded for no other reasons.

Methods of Measurement

We used a set of precise operational definitions of relevant variables. An ultrasound was considered positive if the EP recorded a notation of hydronephrosis [e.g., mild, moderate, severe, small, stage I, stage II, or stage III] or if there was a documented finding of sonographically evident stones. The number of stones was recorded from attending radiologist CT read. When a specific number was not given,we interpreted the words "several," "few," and "multiple" as ≥3. In patients with multiple stones, we used the size of the largest stone recorded by attending radiologist read.

Data Collection and Processing

Abstractors were trained during dedicated sessions using mock medical records. Two investigators, each blinded to the study hypothesis, used a standard data abstraction form to independently review charts. The abstractors' performance was monitored by a third investigator throughout the data abstraction process by reviewing the computerized database for invalid entries. To ensure good inter-rater reliability, we independently screened a random sample of 5% of the study records by both reviewers and compared for all data fields. Inter-rater reliability was 100%. For each patient, an electronic copy of the written ED chart, electronic laboratory results, electronic radiology reports, and electronic clinic follow-up notes were reviewed when available. We resolved coding conflicts by consensus among the authors.

Primary Data Analysis

We compared the final CT report and the results of bedside US demonstrating either hydronephrosis or sonographically visible stones. We used STATA 10 software (College Station, TX) to analyze data. We estimated that a sample size of 100 patients would be necessary to establish a sensitivity of 80.0% and 200 patients for a sensitivity of 90.0%, respectively, assuming 100% prevalence of ureteral stones.[11] Sensitivity of ultrasound is reported with 95% confidence intervals. The differences between sensitivity for larger stones versus smaller stones were done using two-sample test of proportions with the *a priori* condition that the difference would be greater than zero (Ha diff >0). We used a chi-squared test for trend to evaluate the relationship between stone number and sensitivity of ultrasound.

RESULTS

There were 511 subjects during the study period with a diagnosis of renal colic, of which 198 subjects had CT-proven stones. One hundred twenty-five subjects had both CT-proven stones and documentation of a bedside ultrasound performed by the treating physician; this is our study population (Table 1).

Table 1. Characteristics of study subjects.

Subjects with emergency department (ED) diagnosis of renal colic	511
Subjects with computed tomography (CT) evidence of stone	198
Subjects with CT evidence of stone and ED bedside ultrasound (US) performed	125
Gender (% female)	37%
Mean age (years)	40.5
Bedside US evidence of stone	98
Mean stone size	7.66 mm
Mean number of stones	1.26

Table 2. Sensitivity of ultrasound (US) in all patients.

n=125	US hydronephrosis	US stone	Overall positive finding (hydronephrosis or stone)
ED bedside US evidence	98	11	103
Sensitivity	78.4%	8.8%	82.4%
95% CI	70.2-85.3%	3.8-13.8%	75.6-89.2%

ED, emergency department; *CI,* confidence interval

Table 3. Sensitivity of ultrasound (US) by stone size.

Stone size	<6 mm	≥6 mm
Total patients	65	60
Positive emergency department bedside US (hydronephrosis or stone)	49	54
Sensitivity	75%	90%
95% CI	65-86%	82-98%

CI, confidence interval

Table 4. Sensitivity of ultrasound (US) by stone number.

Number of stones	1	2	≥ 3
Total patients	100	17	8
Emergency department bedside US evidence	75	16	8
sensitivity	75%	94%	100%
95% CI	65-83%	82-100%	63-100%

CI, confidence interval

Table 5. Sensitivity of either hematuria or ultrasound by stone size.

Computed tomography proven stone size	<6 mm	≥6 mm
Total patients	65	60
Patients with microscopic hematuria	46	50
Sensitivity	70.0%	83.0%
95% confidence interval	58.0-81.0%	71.0-91.0%
Total number of patients with either microscopic hematuria or positive emergency department (ED) bedside US	58	60
Combined sensitivity of hematuria or positive ED bedside US	89.0%	100%
95% confidence interval	78.0-95.0%	93.0-100%

The prevalence of US detection of hydronephrosis was 78.4% (95% CI: 70.2, 85.3%). There were 5 subjects with a stone size greater than 10 mm and absence of hydronephrosis on bedside ultrasound. Stones were visualized on ultrasound among 8.8% (95% CI: 3.8%, 13.8%) of subjects. The overall sensitivity of a positive ultrasound finding of either hydronephrosis or visualized stones was 82.4% (95% CI:75.6%, 89.2%) (Table 2).

Based on a prior assumption that US would detect abnormalities more often in patients with larger stones, we found a statistically significant difference (p=0.016) in patients with a stone ≥6 mm (sensitivity=90% 95% CI=82%-98%]) compared to a stone <6 mm (sensitivity=75% [95% CI=65%, 86%]) (Table 3). For those with 3 or more stones, sensitivity was 100% (95% CI=63-100%). Sensitivity in patients with 2 stones was 94% (95% CI=82%-100%) and 75% (95% CI=65-83%) with a single stone (Table 4). The chi-squared test for trend was statistically significant (p=0.048).

Microscopic hematuria was absent in 23% of cases, including 4 patients with stones greater than 10 mm in diameter. When combining both microscopic hematuria or positive ED bedside ultrasound, sensitivity improved based on stone size from 89% (95% CI=78%-95%) in patients with a stone <6 mm to 100% (95% CI=93%-100%) in patients with a stone ≥6 mm. All patients with a stone size greater than 5 mm had either a positive ultrasound or microscopic hematuria (Table 5).

DISCUSSION

Historically, ultrasound has been shown to be effective in guiding the diagnosis and management of suspected renal colic. Kartal et al[7] showed that more than 50% of patients with acute flank pain were safely discharged from the ED without further investigations based on urinalysis and hydronephrosis on bedside US. Using a combination of IVP, CT, or passage of stone as the standard, bedside US showed a sensitivity of 81% for the detection of hydronephrosis in the setting of

renal colic. Using a similar standard, Rosen et al.[5] found a sensitivity of 72%. When using the CT read of the attending radiologist as the gold-standard, Gaspari and Horst[6] showed bedside US to be 83% sensitive.

In our study, 100% of patients with stones ≥6 mm were identified by either the presence of hematuria or abnormal bedside US findings. Moreover, we have demonstrated that the sensitivity of bedside US improves with increasing stone size and number. We are unaware of any previous studies looking at statistical trends in sensitivity of EP-performed bedside US based on size or number of stones. Because stones ≥6 mm are less likely to pass, the improving sensitivity of US with larger stones may help EPs select patients that require treatment.[12,13] Prospective studies, however, are needed to better define the test characteristics of bedside US in the emergency management of patients with undifferentiated flank pain.

In a recent study that used bedside US as part of an algorithm to evaluate patients with suspected renal colic, Kartal et al[7] found that 11 of 27 patients with both negative urine results and the absence of hydronephrosis on ED bedside US had stones demonstrated on subsequent pyelography or CT imaging. However, they did not include stone size in their analysis. In our study, patients without evidence of stones on ED bedside US and without hematuria could be safely assumed to have stones less than 6 mm if detected on CT. Given that these smaller stones typically do not require surgical intervention and do not appear to benefit from medical expulsive therapy, we hypothesize that clinical assessment followed by urinalysis and bedside US could obviate the need for CT in this subset of patients.[14]

LIMITATIONS

Limitations of our paper include those inherent in any retrospective chart review performed at a single institution. Although we used strict criteria for our chart review, incomplete documentation, missing charts, unrecoverable or unrecorded information, difficulty interpreting acronyms, and variance in the quality of information recorded are all limitations.

Our cohort includes only patients with a final diagnosis of renal colic and not all patients presenting to the ED with flank pain. Inclusion of patients with CT-proven stones only may have introduced bias. Over half of the patients with a diagnosis of renal colic did not receive CT imaging; those who did may have had more severe symptoms and subsequently a higher grade of obstruction. This may have led to an overestimation of the frequency of hydronephrosis. Nonetheless, our reported sensitivities compare favorably to prior published studies.

We based US data only on what was recorded in the chart, so it is possible that some of the 73 patients with no record of US received one that was not documented. Although all EPs performing bedside US met a minimum standard for training, there was significant variation in the US experience among them. Finally, patient characteristics, such as body habitus or body mass index, were not considered and may have limited the both the acquisition and interpretation of CT and bedside US studies.

CONCLUSION

In our population with CT-proven urolithiasis, ED bedside ultrasonography had similar overall sensitivity to previous reports but showed better sensitivity with increasing stone size and number. We identified 100% of patients with stones ≥6 mm that would benefit from medical expulsive therapy by either the presence of hematuria or abnormal ultrasound findings.

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Should Osteopathic Students Applying to Allopathic Emergency Medicine Programs Take the USMLE Exam?

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Introduction: Board scores are an important aspect of an emergency medicine (EM) residency application. Residency directors use these standardized tests to objectively evaluate an applicant's potential and help decide whether to interview a candidate. While allopathic (MD) students take the United States Medical Licensing Examination (USMLE), osteopathic (DO) students take the Comprehensive Osteopathic Medical Licensing Examination (COMLEX). It is difficult to compare these scores. Previous literature proposed an equation to predict USMLE based on COMLEX. Recent analyses suggested this may no longer be accurate. DO students applying to allopathic programs frequently ask whether they should take USMLE to overcome this potential disadvantage. The objective of the study is to compare the likelihood to match of DO applicants who reported USMLE to those who did not, and to clarify how important program directors consider it is whether or not an osteopathic applicant reported a USMLE score.

Methods: We conducted a review of Electronic Residency Application Service (ERAS) and National Resident Matching Program (NRMP) data for 2010-2011 in conjunction with a survey of EM residency programs. We reviewed the number of allopathic and osteopathic applicants, the number of osteopathic applicants who reported a USMLE score, and the percentage of successful match. We compared the percentage of osteopathic applicants who reported a USMLE score who matched compared to those who did not report USMLE. We also surveyed allopathic EM residency programs to understand how important it is that osteopathic (DO) students take USMLE.

Results: There were 1,482 MD students ranked EM programs; 1,277 (86%, 95% CI 84.3-87.9) matched. There were 350 DO students ranked EM programs; 181 (52%, 95% CI 46.4-57.0) matched (difference=34%, 95% CI 29.8-39.0, p<0.0001). There were 208 DO students reported USMLE; 126 (61%, 95% CI 53.6-67.2) matched. 142 did not report USMLE; 55 (39%, 95% CI 30.7-47.3) matched (difference=22%, 95% CI 11.2-32.5, p<0.0001). Survey results: 39% of program directors reported that it is extremely important that osteopathic students take USMLE, 38% stated it is somewhat important, and 22% responded not at all important.

Conclusion: DO students who reported USMLE were more likely to match. DO students applying to allopathic EM programs should consider taking USMLE to improve their chances of a successful match. [West J Emerg Med. 2014;15(1):101–106.]

INTRODUCTION

Board scores represent an important aspect of a medical student's application for an emergency medicine (EM) residency position.[1,2] United States Medical Licensing Examination (USMLE) scores have been shown to correlate with overall success in EM residency[3] and with in-training scores.[4] Therefore, residency directors use these standardized tests to objectively evaluate an applicant's potential and help decide whether to interview a candidate.[1,2]

While allopathic students take the USMLE as part of their licensing process, osteopathic students take the Comprehensive Osteopathic Medical Licensing Examination (COMLEX). Since allopathic and osteopathic students take different examinations, it is difficult to compare board scores between these applicants. This may make it difficult for allopathic programs to decide whether to offer osteopathic students an interview. Although previous literature has suggested a correlation between COMLEX and USMLE scores,[6] and proposed an equation to predict USMLE scores based on COMLEX scores, more recent analyses suggested that this conversion may no longer be accurate.[7-9] A recent study of osteopathic applicants to one allopathic EM residency program showed no correlation between COMLEX-1 and USMLE Step I scores.[10] Therefore, to overcome this potential disadvantage, some osteopathic students will also take the USMLE. A recent survey of graduating osteopathic medical students found that 59.5% reported taking at least one step of the USMLE, of which 35.3% stated the primary reason they took USMLE was "to enhance my chances of getting into an allopathic residency."[11] In the same survey, 70.2% of graduates also recommended that students take at least one step of the USMLE.

The first objective of this study was to compare the likelihood of osteopathic applicants who reported a USMLE score to match in an allopathic EM residency to osteopathic applicants who did not report a USMLE score. The second objective was to clarify how much emphasis is placed by program directors on whether an osteopathic applicant reported a USMLE score.

METHODS

This study had two components: 1. A review of ERAS and NRMP data, and 2. A survey of all EM residency program leadership. This study was approved by our local institutional review (or human subjects) committee. Waiver of informed consent was granted.

Review of ERAS and NRMP data

Application and match data were collected for allopathic and osteopathic applicants to all allopathic EM residency programs for application season 2010-2011. This season began September 1, 2010 and continued through match day March 17, 2011. Application and match data are published annually by the National Resident Matching Program (NRMP) in "National Resident Matching Program, Results and Data," (www.nrmp.org). This publication was reviewed to obtain the number of allopathic and osteopathic applicants and the percentage of successful match. Additional unpublished data was obtained through NRMP and the Electronic Residency Application Service (ERAS). NRMP representatives queried their database and supplied the number of osteopathic and allopathic students who ranked allopathic EM programs, the number of osteopathic and allopathic students who successfully matched in an allopathic EM program, and whether the osteopathic students reported a USMLE score. ERAS representatives queried their database and provided the number of osteopathic students who applied to allopathic EM programs and how many reported a USMLE score.

Survey

To clarify how much weight is placed by program directors on whether or not an applicant reported a USMLE score, we sent a questionnaire to all allopathic EM residency programs accredited by the Accreditation Council for Graduate Medical Education (ACGME). Each program was allowed one response to the survey. Osteopathic EM residency programs approved by the AOA were excluded. Programs with dual ACGME and AOA accreditation were not excluded. The survey is presented in Figure 1. It was sent electronically (www.surveymonkey.com) to all EM programs via the Emergency Medicine Association of Residency Coordinators

Is your residency an osteopathic (DO) residency program?
Yes No
How would you describe your hospital's location?
Urban Rural Suburban
Which geographic area is your hospital in?
Northeastern Central Southern Western
What is the structure of your residency program?
1-2-3 1-2-3-4 2-3-4
How many residents are in your EM program?_____
Does your program consider applications from osteopathic (DO) students?
Yes No
How many osteopathic (DO) residents are in your EM program?_____
How many residents are in your incoming EM class for academic year beginning July 2011?_____
How many osteopathic (DO) residents are in your incoming class for academic year beginning July 2011?_____
How many osteopathic (DO) students prematched at your residency program for the academic year beginning July 2011?_____
How many osteopathic (DO) students matched at your residency program through NRMP for the academic year beginning July 2011?_____
When applying to your program, how important is it that osteopathic (DO) students take USMLE?
Not important at all Somewhat important Extremely important
Please Comment _____

Figure 1. Survey.

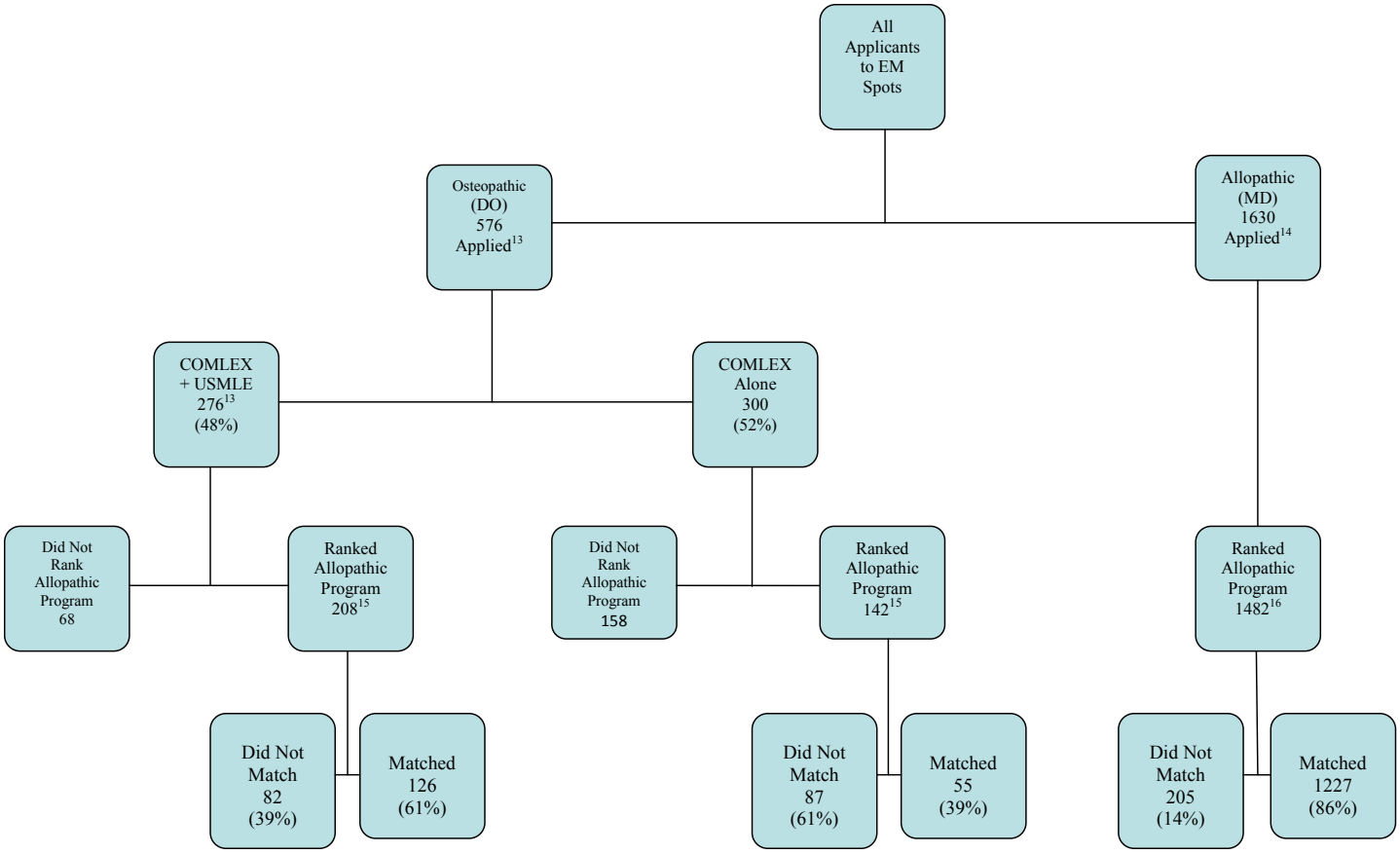

Figure 2. Flow of applicants.

(EMARC) Listserv. Program directors were subsequently contacted individually by e-mail to encourage completion of the questionnaire.

To prevent duplicate responses from the same program, we encouraged program directors to complete the survey together with their program coordinators. In addition, internet protocol (IP) addresses of respondents were reviewed. Where IP addresses were the same, duplicate responses were excluded. Where these responses differed from each other, the "worst case scenario" response was kept. For example, if two responses were received from the same IP address, one responded "Not important at all" and one responded "Extremely important", the "Not important at all" response was kept and the "Extremely important" response was excluded.

Outcome measures

The primary outcomes were the percentage of osteopathic students who matched in allopathic EM residencies, and percentage of osteopathic applicants who reported a USMLE score matching in an allopathic EM residency in application year 2010-2011. The secondary outcome was the percentage of allopathic EM residency program directors responding to the survey who feel it is important for osteopathic applicants to take USMLE.

Data Analysis

Categorical data are presented as percentages with 95% confidence intervals (CI). The percentages of osteopathic and allopathic students matching in allopathic EM residency programs and the rates of osteopathic students with or without a reported USMLE score who matched in an allopathic EM program were compared by Fisher's exact test. Statistics were calculated using GraphPad InStat (Version 3.05, for Windows 95/NT, GraphPad Software, San Diego California USA, Copyright 1992-1998 GraphPad Software Inc.).

Sample size analysis was performed. In previous match years, the overall match rate for EM applicants was approximately 85%. Assuming this match rate, to show a 10% decrease for osteopathic applicants 131 subjects would be required (90% power, alpha 0.05).

RESULTS

ERAS and NRMP data

In application year 2010-2011, 153 allopathic EM programs participated in NRMP for 1,626 positions.[13] The number of allopathic and osteopathic applicants, how many reported a USMLE score, and how many matched is displayed in Figure 2. Among allopathic students, 86% (95% CI 84.3-87.9) successfully matched compared to 52% (95% CI 46.4-57.0) of osteopathic students (difference=34%, 95% CI 29.8-39.0, $p<0.0001$).[13]

Table 1. Demographics of programs responding to survey.

Hospital type	n (%)
Urban	75 (77%)
Suburban	21 (21%)
Rural	2 (2%)
Geographic location	
Northeast	36 (37%)
South	22 (22%)
West	13 (13%)
Central	27 (28%)
Residency length	
1-2-3	75 (77%)
1-2-3-4	20 (20%)
2-3-4	2 (2%)
No response	1 (1%)
Residency size	number
Minimum	6
Maximum	60

Table 2. Survey results.

Does your program consider applications from osteopathic students?	n (%)
Yes	92 (94%)
No	6 (6%)
When applying to your program, how important is it that osteopathic students take USMLE?	
Extremely Important	36 (39%)
Somewhat Important	35 (38%)
Not At All Important	20 (22%)
No Response	1 (1%)
Comments	n
Somewhat Important	
USMLE Step I is required, Step II preferred	1
"We highly recommend taking USMLE but do not make it mandatory"	1
"If an osteopathic student expects to compete with an allopathic student they should take USMLE"	1
USMLE allows them to better compare applicants	6
Prefer USMLE	4
A strong USMLE score is more meaningful than a strong COMLEX score	2
Not At All Important	
We don't require it but it sure is helpful	1

USMLE, United States Medical Licensing Exam; *COMLEX,* Comprehesnive Osteopathic Medical Licensing Exam

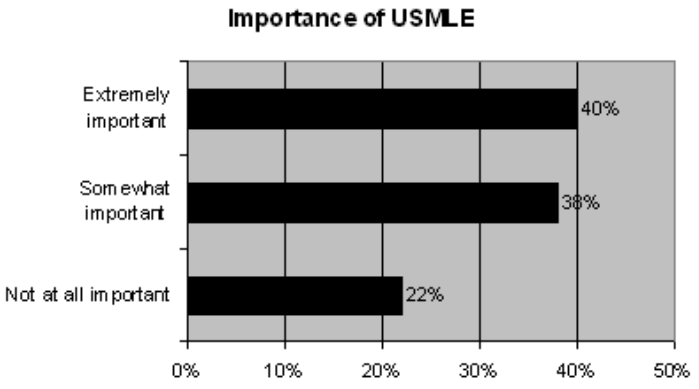

Figure 3. Importance of the United States Medical Licensing Exam.

Among osteopathic students who reported a USMLE score, 61% (95% CI 53.6-67.2) matched compared to 39% (95% CI 30.7-47.3) of those who did not report a USMLE score (difference=22%, 95% CI 11.2-32.5, p<0.0001).

Survey

One hundred thirty survey responses were received. Duplicate IP addresses were identified for 16 responses and an additional 16 responses were from osteopathic programs. These were excluded. The remaining 98 programs formed our data set, and represent 64% of all allopathic programs. Programs responding to the surveys had a total of 106 (59%) osteopathic applicants who successfully matched through NRMP and 14 pre-matched applicants. Demographics of the programs are presented in Table 1.

Six programs (6%) stated they do not consider applications from osteopathic students. One program stated they ask osteopathic students to complete a transitional year before applying to their program. Seventy-seven programs (79%) had osteopathic residents in their residency program.

Programs were asked, "When applying to your program, how important is it that osteopathic students take USMLE?" and 91 responses were received. Survey results are reported in Table 2 and Figure 3. Thirty-nine percent of program directors reported that it is extremely important that osteopathic students take USMLE, 38% stated it is somewhat important, and 22% responded not at all important.

DISCUSSION

In the 2010-2011 application season, allopathic students were more likely than osteopathic students to match in an allopathic EM program. Osteopathic students who reported a USMLE score were more likely to match into an allopathic EM residency position than those who did not.

In our survey sample, 94% of allopathic programs consider applications from osteopathic applicants and 79% have osteopathic residents in their program. Seventy eight percent stated it is somewhat important or extremely

important that osteopathic students take USMLE. Even among those who said "somewhat important," several commented that they recommend or prefer it.

Residency directors evaluate many aspects of an applicant's file when deciding how high to place them on their rank list. Whereas course grades may have different meaning in different medical schools, USMLE scores reflect performance on a standardized examination taken by all students across the country. This allows program directors to better compare students across the entire spectrum of applicants. This may be the reason that program directors feel it is so important for osteopathic students to take USMLE.

It would be helpful for allopathic residency directors to have a conversion between COMLEX and USMLE scores. Previous literature reported such a conversion factor,[6] however subsequent studies suggested this conversion factor is not accurate.[8,9] In a letter to the editor, the president and chief executive officer of the National Board of Osteopathic Medical Examiners stated, "it is not possible—or even desirable—to make a direct numerical comparison between the scores of the COMLEX-USA examination series and those of the USMLE."[7]

Osteopathic students applying to allopathic EM programs frequently ask if they should take USMLE to be more competitive. The findings in this study will help advisors answer that question.

LIMITATIONS

Our study represents data from a single application season. It is possible that the likelihood of an osteopathic student to match varies from year to year. Future studies can examine several years of match data.

Many factors other than board scores affect a student's likelihood of matching. This study did not look at the actual score the students received on USMLE or COMLEX since these were not available to us. It is possible that the students who took USMLE also had better overall applications and interviewed better. Similarly, it is feasible that some osteopathic students took USMLE but did not report their scores via ERAS. Students who did not report their scores may have had weaker overall applications. Thus, it is possible that we are observing association rather than causation.

Some programs have dual accreditation from both the ACGME and the AOA. These programs were not excluded from the ERAS and NRMP data. In addition, some of these programs may have been included in our survey. Respondents were asked, "Is your residency an osteopathic residency program?" If they responded yes, they were excluded. Programs with dual accreditation may not have answered yes and would have been included in our data. However, we believe this makes our results even stronger. Programs with dual accreditation would be more comfortable with COMLEX scores and would be more likely to accept applicants without USMLE scores. So, including these programs in our study would make it more difficult to show that applicants with only COMLEX scores were less likely to match and would skew our results in the direction of less program directors stating it is important for osteopathic applicants to report a USMLE score. Despite including these programs in our study group, we still showed that applicants with only COMLEX scores were less likely to match and a majority of program directors still felt it is important for applicants to report a USMLE score.

We assessed the number of osteopathic students who matched as a percentage of those that ranked EM programs in NRMP. We did not include osteopathic students who obtained positions outside the match. In the 2011 match, osteopathic students were eligible to accept positions directly from program directors prior to the match (known as "pre-match"). From the sample set of our survey respondents, approximately 13% of osteopathic students who began allopathic residency in 2011 pre-matched. Osteopathic students may also have obtained unfilled positions after the match (known as "the scramble"). In 2011, only five EM positions at two programs were available in the scramble period. However, we were specifically studying the effects of reporting a USMLE score on the chances of that student to obtain a position in the NRMP match. Future studies can include applicants who pre-matched and those who obtained positions in the scramble period.

It is possible that some students ranked other specialties higher than EM and matched in those specialties. We included all applicants who ranked EM positions, not only those for whom EM was their first choice. In the 2010-2011 application season, approximately 90% of applicants who ranked EM ranked it as their only choice or their first choice.[17]

The survey was sent out via the EMARC Listserv. It is possible that some residency programs are not members of EMARC. However, in academic year 2010-2011, all 153 allopathic EM residencies were members of EMARC.[18] In addition, all program directors were contacted directly by e-mail, thus ensuring that all programs had the ability to complete the survey. The response rate to our survey was 64%. It is possible that programs that do not consider osteopathic applicants were less likely to complete the survey. It is also possible that programs who did not respond to the survey do not consider osteopathic students who have not taken USMLE.

CONCLUSION

In the 2010-2011 application season, allopathic students were more likely than osteopathic students to match in an allopathic EM residency. Osteopathic students who reported a USMLE score were more likely to match into an allopathic EM residency than those who did not. Osteopathic students applying to allopathic EM programs should consider taking USMLE to improve their chances of a successful match.

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Asymptomatic Chronic Dislocation of a Cemented Total Hip Prosthesis

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Dislocation of a total hip prosthesis is a painful and mentally stressful orthopaedic emergency.[1] It may be long-standing and asymptomatic, typically involving the femoral portion.[2-4] This report describes a peculiar chronic dislocation of both components of a total hip prosthesis. A 93-year-old female patient, thin and of short stature, had come to our attention for recent onset of lumbar pain at the orthopaedic department. She walked with significant unequal lengths of the lower limbs. She had previously been operated on for bilateral total hip replacement, in which the left hip, a Brunelli version (Brescia, Italy, 1977), was performed 30 years ago for dysplasia.[5] At the emergency department, lumbar spine and pelvis radiographs were taken, showing scoliosis and vertebral arthrosic deformations, along with dislocation of both total left hip replacement components (Figure). It was detected that the femoral stem was loosened. Patient denied any fall injury or accident to the operated left hip. It was decided not to perform surgery because of the patient's age. Many case reports have discussed hip dislocations in which a femoral component was involved. To our knowledge, this is the first case of dislocation of both prosthetic elements of a hip replacement that was completely asymptomatic while walking.

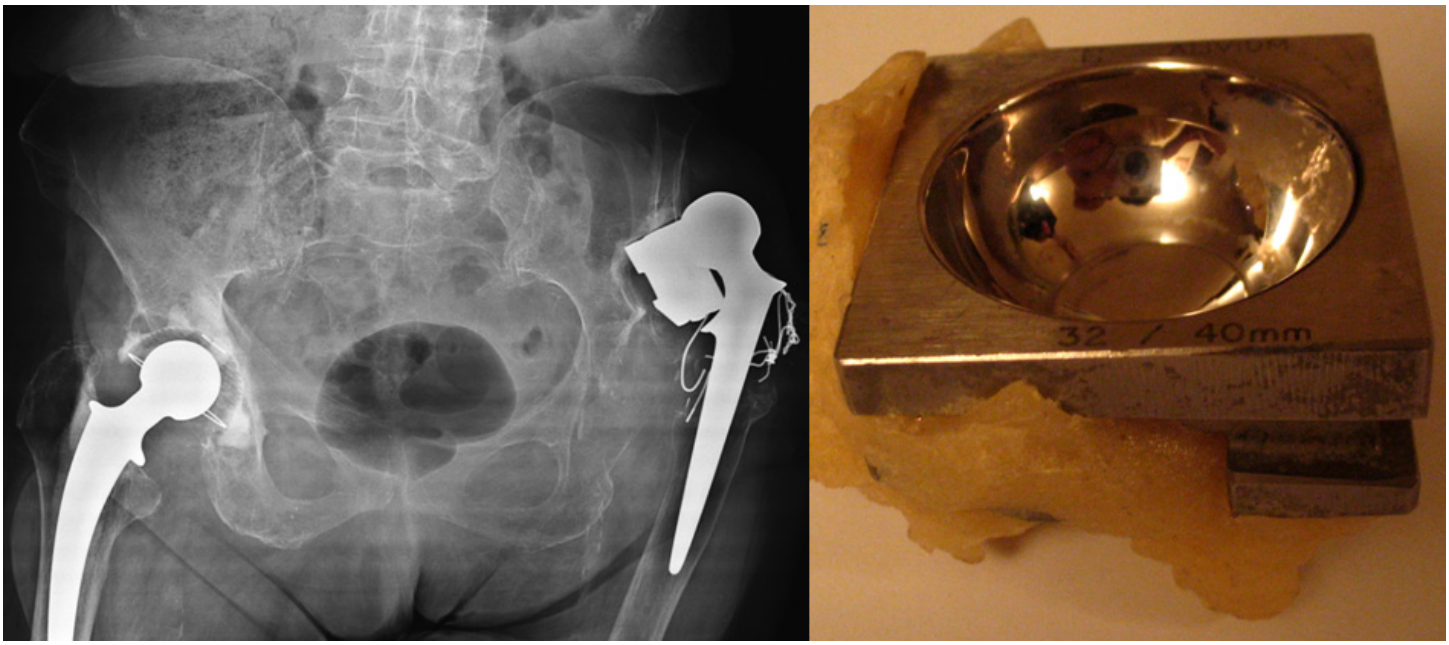

Figure. Bilateral hip prosthetization with dislocation of both prosthetic components of the left hip. This is a Brunelli THR version, peculiar for the squared and cemented socket. On the right is visible a color photo of an explanted cup. The cemented socket is rotated and the cemented straight stem is loosened. Surgical approach used was the Watson-Jones (wire cerclage is visible around greater trochanter).

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Usefulness of Computed Tomography Perfusion in Treatment of an Acute Stroke Patient with Unknown Time of Symptom Onset

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A 43-year-old Caucasian male with history of mechanical mitral valve was found down outside a recreational park shortly after daybreak. Examination on arrival to the emergency department revealed altered mental status, right hemiplegia, forced leftward gaze, and complete aphasia. Patient was ineligible for tissue plasminogen (TPA) therapy due to unknown time of symptom onset. Computed tomography angiogram (CTA) revealed occlusion of the left middle cerebral artery (MCA) with acute thrombus (Figure 1). Computed tomography perfusion scan (CTP) revealed a large ischemic penumbra with no evidence of infarcted brain tissue (Figure 2). The patient was taken for emergent endovascular therapy with successful retrieval of left MCA thrombus. The patient had almost complete resolution of symptoms with a

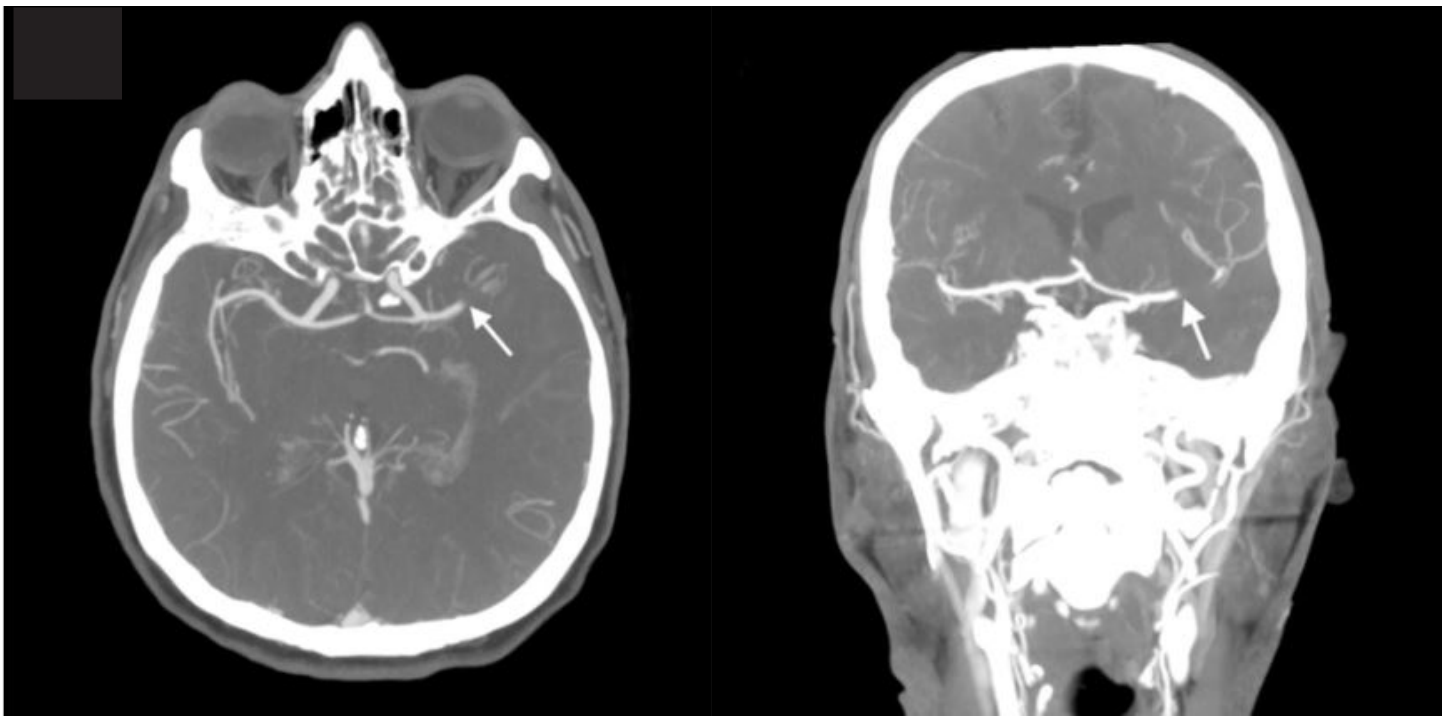

Figure 1. Transverse (left) and coronal (right) computed tomography angiogram demonstrating abrupt cutoff of the left middle cerebral artery at the site of the thrombus (marked by arrows).

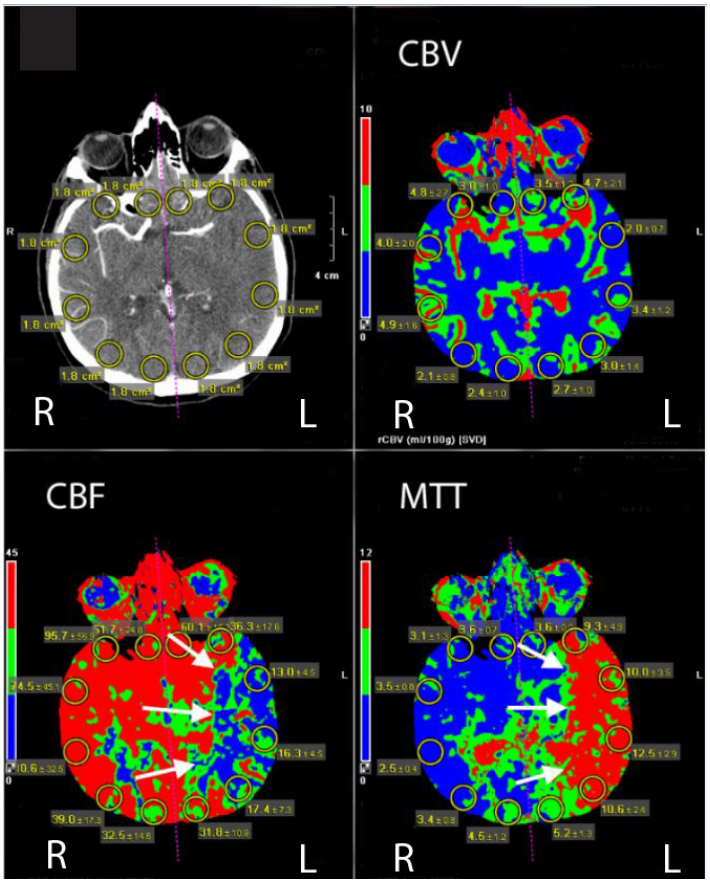

Figure 2. Computer-generated perfusion map demonstrating the region of the left cerebral hemisphere (CBF) with decreased cerebral blood flow and prolonged mean transit time (MTT) (marked by arrows). Note that this region of the brain has normal cerebral blood volume (CBV) indicating potentially salvageable brain tissue.

pre-discharge National Institute of Health Stroke Scale of 1. History prior to discharge revealed that the patient was non-compliant and had been off of his warfarin therapy for months prior to the stroke. The patient was discharged home on warfarin and statin therapy.

Acute stroke patients with unknown time of symptom onset are traditionally excluded from acute interventional therapy due to increased rates of fatal intracranial hemorrhage when patients with infarcted brain are treated with TPA or endovascular therapy beyond the recommended time windows.[1,2] CTP of the brain is a rapid means of distinguishing between viable and non-viable brain tissue.[3] Early in the course of stroke, there is prolonged mean transit time (MTT), decreased cerebral blood flow (CBF), and equal or greater cerebral blood volume (CBV) in ischemic areas of the brain. As brain tissue infarcts, both the CBF and CBV decrease. Assessment of differences between CBF and CBV in areas of brain with prolonged MTT allows one to determine both the size of the stroke as well as the amount of salvageable brain tissue. CTP has the potential to guide acute stroke interventional therapy in patients with unknown time of symptom onset.

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Diagnosis of Necrotizing Faciitis with Bedside Ultrasound: the STAFF Exam

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The early diagnosis of necrotizing fasciitis is often ambiguous. Computed tomography and magnetic resonance imaging, while sensitive and specific modalities, are often time consuming or unavailable. We present a case of necrotizing fasciitis that was rapidly diagnosed using bedside ultrasound evaluating for subcutaneous thickening, air, and fascial fluid (STAFF). We propose the STAFF ultrasound exam may be beneficial in the rapid evaluation of unstable patients with consideration of necrotizing fasciitis, in a similar fashion to the current use of a focused assessment with sonography for trauma exam in the setting of trauma. [West J Emerg Med. 2014;15(1):111–113.]

INTRODUCTION

Necrotizing fasciitis is a severe soft-tissue infection with significant morbidity and mortality, reported between 25% and 75%.[1] In the United States, the annual age-adjusted incidence is approximately 4.3 infections per 100,000 of the population. This produces a heavy financial toll, with a mean hospital length of stay of 36 days, resulting in an average cost per patient of $62,846.[2]

Although necrotizing fasciitis is primarily a clinical diagnosis, patient presentations can be ambiguous. While a computed tomography (CT) is traditionally used to confirm the diagnosis prior to surgery in uncertain cases, newer research shows ultrasound may be a specific modality in confirming the diagnosis and preventing delays in definitive surgical treatment.[3]

CASE REPORT

A 44-year-old female presented to the emergency department (ED) with a 3-day history of left groin and inner thigh redness, pain, and swelling; associated with fever, chills, and vomiting. The patient was seen the prior day in a local urgent care at which time she was treated with intravenous vancomycin for cellulitis and discharged on oral antibiotics. The patient presented to the ED within 24 hours of discharge from the urgent care. The initial ED vitals revealed an afebrile (36.9°C), normotensive (126/63) patient with tachycardia (124) and mild tachypnea (22). On physical exam, the patient had left inner thigh and groin induration measuring 12 cm x 12 cm. The patient was morbidly obese with a BMI>45 kg/m^2, making crepitus difficult to appreciate on physical exam. Her initial labs were as follows: lactate 3.5 mmol/L, WBC 18.2 x 10^3 per mm^3, hemoglobin 12.3 g/dL, sodium 136 mmol/dL, glucose 225 mg/dL (12.5 mmol/L), and creatinine 1.8 mg/dL (159 μmol/L). This gave her a laboratory risk indicator for necrotizing fasciitis (LRINEC) score of 6, C-reactive protein (CRP) excluded. (CRP was not ordered in the ED). A bedside ultrasound was performed, which showed positive **s**ubcutaneous **t**hickening, **a**ir, and **f**ascial **f**luid (STAFF) concerning for necrotizing fasciitis (Video 1). The patient's soft tissue ultrasound findings are significantly different when compared to normal soft tissue ultrasound (Video 2). The patient was started on intravenous vancomycin and piperacillin/tazobactam empirically, and surgery was consulted.

Based on the LRINEC score, ultrasound findings, and physical exam, the patient was taken immediately to the operating room for presumed necrotizing fasciitis and forwent either CT or magnetic resonance imaging (MRI). In the operating room she underwent operative debridement of the left groin and perineum, resulting in excision of 15 cm x 23 cm of tissue with extensive washout. At the close of the surgery the patient was admitted to the surgical intensive care unit post-operatively for septic shock requiring vasopressors and ventilator dependence. The patient underwent repeat washouts with minor debridements daily for 3 days, with lactate normalization and a down-trending WBC to 13.5 x

10^3 per mm^3 on post-operative day 3. She was extubated and transferred to a step-down unit on post-operative day 5, after which plastic surgery was consulted to evaluate for possible skin graft. Over the course of 9 days and 4 additional operative washouts, the patient was deemed to be a poor graft candidate. A wound vacuum-assisted closure (V.A.C.) device was placed, and the patient was transferred to the plastic surgery service on day 9. The decision was made to forgo skin graft during her immediate hospital stay. The patient was fully ambulatory and discharged home with a wound V.A.C. on post-operative day 28. The patient subsequently received a skin graft, and has been recovering well since.

DISCUSSION

The diagnosis of necrotizing fasciitis is initially suspected by clinical findings classically characterized by erythema with ill-defined borders, rapid progression in size, and association with severe pain and tenderness beyond the apparent area of involvement.[4,5] While blisters, hemorrhagic bullae, drainage, skin discoloration, and crepitus are important diagnostic clues in more advanced cases, they are unfortunately associated with poor sensitivity, late onset, and severe disease.[4,5] While the literature has stressed high fever, hypotension, and multi-organ failure as indicators of possible necrotizing fasciitis[6-8], a review found that only 53% were febrile and 18% were hypotensive at presentation.[5]

Often, the early stage of necrotizing fasciitis is clinically indistinguishable from soft tissue infections such as cellulitis and erysipelas, making the early diagnosis difficult.[4,5] While more subtle, this presentation is associated with a similar mortality if not treated by early aggressive surgical debridement.[1] In the case discussed, the patient presented a day earlier to an urgent care with only redness and pain, lacking crepitus, discharge, fever, or other classic findings on physical exam. The speed at which her symptoms progressed attests to the virulence of the disease and importance of early recognition.

Diagnostic criteria have been developed due to frequent ambiguity of the clinical diagnosis. These include the use of decision rules (LRINEC score),[9] CT, MRI, and ultrasound; with CT and MRI being the mainstays of diagnosis in ambiguous cases. While studies have shown that CT and MRI provide a higher sensitivity and superior evaluation of disease extent compared to ultrasound,[10] these imaging modalities can be time consuming, thus delaying definitive treatment.[1,7]

The diagnostic ultrasound findings consistent with necrotizing fasciitis include fascial and subcutaneous tissue thickening, abnormal fluid accumulation in the deep fascia layer, and, in advanced cases, subcutaneous air.[6,8] These criteria can be recalled using a proposed "STAFF" mnemonic. A retrospective review of 32 pathologically confirmed necrotizing fasciitis showed that ultrasound revealed changes in subcutaneous fat (87.5%), underlying fascia (56%), and muscle (46.8%), but did not reveal histologically apparent inflammation in the subcutaneous tissues (9.3%) or muscle (25%) in several cases.[11] However, while it is not recommended to exclude necrotizing fasciitis on the basis of ultrasound,[3] it has been shown to be specific for soft tissue infections, with one study reporting sensitivity of 88% and specificity of 93% using ultrasound.[8] The sensitivity of ultrasound varies depending on the location and extent of necrotizing fasciitis; current ultrasound technology is thus unable to safely rule out the diagnosis. Here, a case is presented where bedside ultrasound allowed providers to forgo time intensive tests such as CT or MRI, which would have delayed definitive operative management in an unstable patient with necrotizing fasciitis.

CONCLUSION

The early diagnosis of necrotizing fasciitis is often ambiguous and carries a high rate of morbidity and mortality if the diagnosis is missed. Although more sensitive, CT and MRI are time consuming and might not be readily available. Since a delay in treatment results in significantly increased morbidity and mortality; prompt diagnosis is crucial. The diagnostic ultrasound findings consistent with necrotizing fasciitis can be easily recalled by remembering to do an exam for STAFF. It warrants a special reminder, however, that ultrasound is not sensitive enough to exclude the diagnosis. Given clinical suspicion, and a negative ultrasound study, a more sensitive study such as CT, MRI or in advanced cases surgical exploration, is warranted.

While further study is required, this case supports that the early use of ultrasound in the form of a STAFF exam is an appropriate adjunct in those patients in whom there is a clinical suspicion of necrotizing fasciitis, with the goal of expediting operative debridement in much the same way as a focused assessment with sonography for trauma (FAST) exam is used to expedite laparotomy in unstable patients with abdominal trauma.

Video 1. Ultrasound video demonstrating Subcutaneous Thickening, Air, and Fascial Fluid (STAFF).

Video 2. Soft tissue ultrasound findings are significantly different when compared to normal soft tissue ultrasound

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Recurrent Priapism from Therapeutic Quetiapine

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Priapism is rarely related to use of non-erectile related medications. The objective was to educate about the multiple possible causes of priapism and to provide treatment recommendations for the different types of priapism. We present the case of a 43-year-old African American male with a history of schizoaffective disorder who presented to our emergency department multiple times over a three year period with priapism, each episode related to the ingestion of quetiapine. Following penile aspiration and intercavernosal injection of phenylephrine, this patient had resolution of his priapism. This case demonstrates an unusual case of recurrent priapism. [West J Emerg Med. 2014;15(1):114–116.]

INTRODUCTION

Priapism is defined as persistent penile erection or clitoral engorgement not accompanied by sexual desire or stimulation, usually lasting more than 4 to 6 hours. It is considered a urologic emergency that should be treated promptly as it can lead to erectile dysfunction in 30-90% of patients.[1] In general, priapism is divided into 2 types: high-flow and low-flow. High-flow priapism is non-ischemic and is often caused by increased flow through arteries due to trauma. Low-flow priapism is a result of blood collecting within the corpora and is caused by erectile dysfunction medications, hyperviscosity syndromes, trauma, tumor, neurologic conditions, and medication side effects. Variouos psychoactive medications are also known to cause low-flow priapism, with trazodone the most commonly implicated member of this group. Quetiapine is an atypical antipsychotic originally designed for use in schizophrenia, but it is now also used to treat a multitude of other psychiatric disorders, including schizoaffective disorder, bipolar disorder, anxiety, and depression.[2] We report the first case of recurrent priapism as a result of standard doses of quetiapine after first use and with multiple subsequent uses.

CASE REPORT

A 43-year-old African American man with a history of schizoaffective disorder and ulcerative colitis presented to the emergency department (ED) for a painful erection lasting 15 hours. He reported noncompliance with sulfasalazine for ulcerative colitis but intermittent use of quetiapine, 100 mg every morning and 200 mg every evening, for his schizoaffective disorder. Prior to the ED visit, previous doses of quetiapine resulted in erections lasting 3 hours every morning that resolved spontaneously. He denied any history of trauma, sickle cell disease or trait, illicit drug use, vasoactive agents, including nitrates, recent intercourse, or use of any medications or devices for sexual enhancement. Examination demonstrated a tender and erect phallus without evidence of injury, fibrosis, angulation, lesions, or discharge. Testicles were normal, and no hernias were present.

Subcutaneous terbutaline and oral pseudoephedrine were administered with no effect. Aspiration of 10 cc of intracavernosal blood followed by intracavernosal phenylephrine injection led to successful detumescence. The patient was advised to discontinue use of quetiapine and arrange follow-up with his primary care physician.

The patient returned to the ED 4 times over the course of the next year. Each time the patient had a morning erection lasting 6 to 9 hours following 200 mg of quetiapine ingestion the prior evening. Detumescence was achieved successfully with aspiration and intracavernosal phenylephrine injection. The patient was ultimately transitioned from quetiapine to ziprasidone and amitriptyline with resolution of his recurrent priapism.

Three years after his initial presentation, the patient returned to the ED with yet another episode of priapism. He reported accidentally taking 100 mg of quetiapine instead of his normal dose of amitriptyline the evening prior to presentation. He awoke with an erection and came to the ED after the erection failed to resolve spontaneously after 8

hours. Detumescence was again achieved with intracavernosal aspiration and injection of phenylephrine. Intracavernosal blood was found to contain quetiapine with a level of 502 ng/ml. The patient was discharged home and advised to dispose of any excess quetiapine.

DISCUSSION

The case presented is the first reported case of recurrent priapism due to therapeutic doses of quetiapine. There have been several previous case reports implicating quetiapine as a cause of priapism. Quetiapine was initially approved by the U.S. Food and Drug Administration for the treatment of schizophrenia in 1997. The first report of priapism was in 2001 by Pais and Ayvazian;[3] a 45-year-old male attempted suicide by ingesting 27 quetiapine (65 mg/tablet) pills, which resulted in priapism requiring a cavernosal-glanular shunt to achieve detumescence.

Du Toit et al reported priapism due to therapeutic doses of quetiapine in 2004.[4] Their patient developed priapism 24 hours after being transitioned from risperidone and trazodone to quetiapine. Symptoms resolved after being started on loxapine, an antipsychotic with minimal alpha1 adrenoreceptor blockade. The patient had no difficulty with risperidone and trazodone for 2 years prior to the event but developed diabetes over the course of his 2 years of treatment. Thus, Du Toit et al concluded that the "risk of ischemic (low-flow) priapism from a range of atypical antipsychotics is aggravated by diabetes."

In a letter to the editor, Harrison et al describe a 46-year-old African American/Native American man on mirtazepine and quetiapine who developed priapism requiring surgical intervention after taking amphetamines 24 to 48 hours prior to presentation.[5,6]

The case presented by Davol and Rukstalis provided the best evidence for therapeutic quetiapine alone as a cause of priapism.[7] They described priapism in a 25-year-old African American man without a history of sickle cell disease or trait, who had been taking quetiapine for over a year, was taking no other medications, and received his medications at the prison infirmary.

The pharmacologic mechanism of drug-induced priapism is believed to be related to the blockade of alpha1 adrenoreceptors. Alpha-adrenergic blockade allows for relaxation of cavernosal trabecular smooth muscle resulting in engorgement of the corpora cavernosa. Examples of medications that act via this mechanism include yohimbine or delequamine.

Antipsychotics are also believed to cause priapism by blocking alpha1 adrenoreceptors. A study of reports of antipsychotic-induced priapism in the United Sates Adverse Event Reporting System database found that high alpha1 affinty antipsychotics (quetiapine, chlorpromazine, risperidone, ziprasidone) were associated with priapism requiring medical intervention (reporting odds ratio 13.7; 10.1-18.5) while low and medium affinity antipsychotics such as loxapine, haloperidol, and aripiprazole were not associated with priapism requiring intervention (reporting odds ratio 2.2; 0.9-4.1).[8]

Our patient developed recurrent priapism after taking relatively low (100 to 200 mg) doses of quetiapine. Transition to another antipsychotic resulted in resolution of symptoms. After not using quetiapine and being symptom free for over two years, the patient developed priapism after a single dose of quetiapine. The expected therapeutic serum steady-state level of quetiapine is 100-1000 ng/ml. While an intercavernosal level is not directly comparable to serum levels and serum levels were not measured in this case, the intracavernosal level of 502 ng/ml demonstrates the presence of quetiapine within the corpora after only a single dose.

One possible difficulty in interpretation of reported cases is that most cases of priapism due to quetiapine use are African American patients. All of the patients described denied a history of sickle cell disease or trait and any other symptoms consistent with such a history, yet none of the case patients were ever tested for sickle cell trait or disease. However, development of priapism during adulthood in sickle cell disease is uncommon: 75% of male sickle cell patients have the first occurrence of priapism before the age of 20 with a mean age of 12 to 15 years.[9] In vitro studies of quetiapine metabolism have shown that quetiapine is metabolized by both CYP3A4 and to a lesser degree CYP3A5, which is expressed in 60% of African Americans versus only 10-30% of whites.[10] This raises the possibility that priapism due to quetiapine use may be affected by differences in metabolism.

Knowing that priapism is rare, practitioners may be unfamiliar with the standard therapeutic treatment plan for priapism. High-flow versus low-flow states may be established by history and physical exam, cavernosal blood gas or color duplex ultrasonography of the penis.[11] High-flow priapism is most commonly caused by penile arterial laceration and resultant excessive inflow of arterial blood. Low-flow priapism presents with a painful erection, engorged corpora cavernosa and (in contrast to normal erection) a flaccid corpus spongiosum and glans penis. While the diagnosis and treatment of priapism is similar in both adults and children, causes of low-flow priapism that must be elucidated through careful history and physical examination in children include bleeding disorders, Kawasaki disease, leukemia, and sickle cell disease. For cases in which differentiating high- versus low-flow priapism is challenging, intracavernosal blood gas analysis will demonstrate arterial blood in high-flow priapism versus low pH, low oxygen tension, and high carbon dioxide in low-flow priapism.

Initial treatment should include analgesia. Opioids and anxiolytics may be used parentally. A dorsal penile nerve block using local anesthesia using a wheal of lidocaine *without* epinephrine dorsally one centimeter distal to the pubic bone and scrotal insertion may be a helpful adjunct in pain control.

Treatment of any primary disorder that may be causing the priapism is integral to the initial therapy. In sickle cell disease, this treatment includes hydration and oxygenation.

For high-flow priapism, arterial flow is maintained and there is no concern for immediate ischemia; as a result, a period of observation is appropriate prior to selective arterial embolization.[12] Another option that has been attempted successfully in case reports includes applying direct pressure to the arteriovenous fistula under Doppler ultrasound guidance.[13,14] Regardless, urologic consultation should be made from the ED and will likely guide treatment in high-flow priapism.

For low-flow priapism, the most proven treatment requires aspiration of cavernosal blood and direct caversonal injection of phenylephrine (or epinephrine in some reports).[15,16] For phenylephrine, 1 mg of 1 mg/mL phenylephrine can be mixed into a syringe with either 9 or 99 cc of normal saline thereby creating a 100 mcg/1cc or 100 mcg/10cc concentration respectively.[17] A butterfly needle should be placed perpendicularly to the penis into the corpora cavernosa (the two corpora cavernosa are connected and therefore only a single side approach is necessary). Five to 10 cc of blood should be aspirated using an empty syringe, and 100-200 mcg of phenyephrine should be injected. This can be repeated every 5-10 minutes to a maximum dose of 1000 mcg. Vital signs including blood pressure should be monitored, as some phenylephrine will be absorbed systemically. If aspiration fails, the next step is surgical intervention and the creation of a cavernosal-corpora spongiosa shunt.

Consultation with a urologist is recommended in all cases of pediatric priapism, persistent low-flow priapism, and high-flow priapism. Patients with persistent priapism or underlying disorders such as leukemia or sickle cell disorder require inpatient hospitalization. If the priapism is treated successfully, then the patient can be observed and discharged home with urologic specialist follow-up as an outpatient.

CONCLUSION

Use of quetiapine continues to increase. While initially approved for schizophrenia, quetiapine is now approved for mania-associated bipolar disorder, and has also been used in the treatment of myriad disorders including depression, obsessive-compulsive disorder, post-traumatic stress disorder, restless leg syndrome, Tourette's syndrome, and as a sedative. Given past case reports and our case of recurrent priapism, it is important that physicians come to recognize priapism as a serious side effect of quetiapine and are prepared to treat it appropriately when diagnosed.

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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

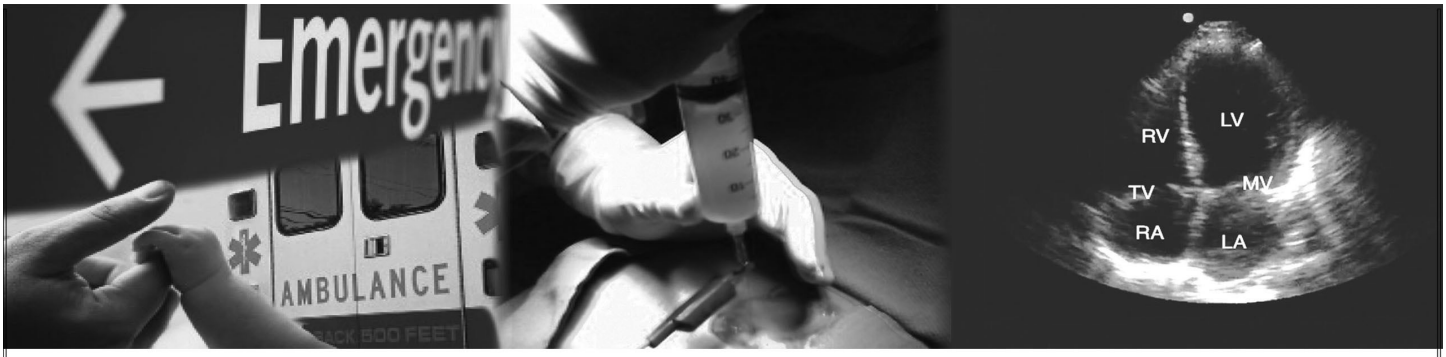
2) Discuss the conceptual models for designing studies and analysis that incorporate gender as an independent variable.

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.



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Academic-affiliated Community Physicians

The Division of Emergency Medicine at the University of Utah Health Sciences Center is recruiting for a number of physicians to staff University-affiliated community hospital emergency departments in western Wyoming and Utah regions. These hospitals are located in rural community sites that will also be used for training medical students, residents, and fellows. Direct access to the main University hospital will be available by EMR, telemedicine, and air medical transport. Opportunities for part-time work, off-site CME, and blended academic practices are also available.

The University of Utah is the primary medical teaching and research institution in the state. Candidates must be board certified/prepared and have an interest in education of residents and medical students. A competitive salary with an excellent benefits package is offered. The University of Utah is an EEO/AA employer and encourages applications from women and minorities.

Interested parties must apply online: http://utah.peopleadmin.com/postings/28004
or if you need more information, please contact:

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UC Irvine Health
School of Medicine

The University of California, Irvine, School of Medicine, invites applicants for **Chair** of the **Department of Emergency Medicine.**

The University of California, Irvine, has a vibrant scientific community with outstanding collaborative opportunities. The Emergency Department is a 35-bed clinical unit with 7 resuscitation bays, caring for more than 47,000 patients per year. The ACS-verified Level I trauma center has 3600 activations per year, and the ACS-verified Burn Center cares for more than 300 patients. UC Irvine was recently verified officially as a Level II Pediatric Trauma Center. In addition, the department is designated as a Base Hospital, Joint Commission and Orange County Cardiac and Stroke Receiving Center. The department is the most capable in the area for disaster preparedness and response, and is one of only nine comprehensive emergency departments in California.

The department houses 19 full-time faculty (2 Ph.D.), four Clinical Instructor fellows, and a fully accredited PGY 1, 2, 3 EM residency (since 1988). The research effort is focused in the Center for Trauma and Injury Prevention Research and the Center for Disaster Medical Sciences. The Division of Emergency Ultrasound is internationally known, as UC Irvine was the first medical school to adopt a four-year integrated ultrasound curriculum. Other faculty in the department lead significant efforts in educational technology and simulation, and EMR implementation. The department publishes the Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health, an open-access peer reviewed international journal.

Applicants for this position must have an M.D., or M.D./Ph.D. degrees, with Master's degree and/or subspecialty fellowship training desirable. Board certification in Emergency Medicine is required, as is an academic record sufficient for appointment in the Clinical X (Scholar) Line or In-Residence series at the full professor level. Candidates must have a strong record of scholarly activity and peer reviewed publications, including a research program with extramural funding. The candidates should also hold, or be eligible for, a medical license in the State of California. The successful candidate will be responsible for the effective management of all administrative and operational processes of the department, providing not only comprehensive, interactive clinical services, but also supporting the teaching, educational and research missions of the department, school and university. The candidate must have strong interpersonal skills, and be able to work cooperatively and congenially within a diverse academic and clinical environment. Candidates with leadership skills and vision for enhancing the clinical and academic components of a multi-disciplinary department are especially encouraged to submit applications to:

Applicants should complete an online application profile and upload their Curriculum vitae electronically to be considered for the position: https://recruit.ap.uci.edu/apply/JPF02153.

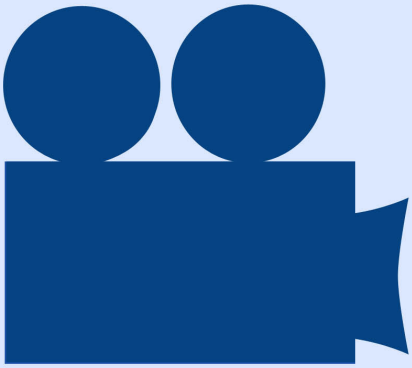
UCI is an equal opportunity employer committed to excellence through diversity and strongly encourages applications from all qualified applicants, including women and minorities. UCI is responsive to the needs of dual career couples, is dedicated to work-life balance through an array of family-friendly policies, and is the recipient of an NSF ADVANCE Award for gender equity.

REC

WestJEM CALL FOR VIDEO SUBMISSIONS

We are looking for recordings on:

- Ultrasound
- CT reconstruction
- MRIs
- Instructional/clinical techniques

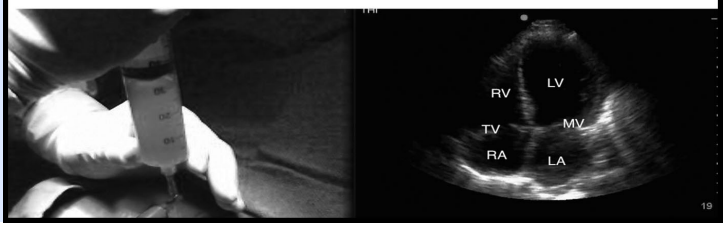


For inquiries & submission guidelines please contact: editor@WestJEM.org

As the scope of the *Western Journal of Emergency Medicine* expands, we are actively seeking section editors for the following areas of interest:

Disaster Medicine
Geriatrics
Resident Student Forum
Neuroscience
Trauma

*West*JEM is also seeking reviewers in all topics of emergency medicine. Please email your CV to Mark Langdorf at editor@westjem.org



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—Ellis Weeker, MD
Division Vice President

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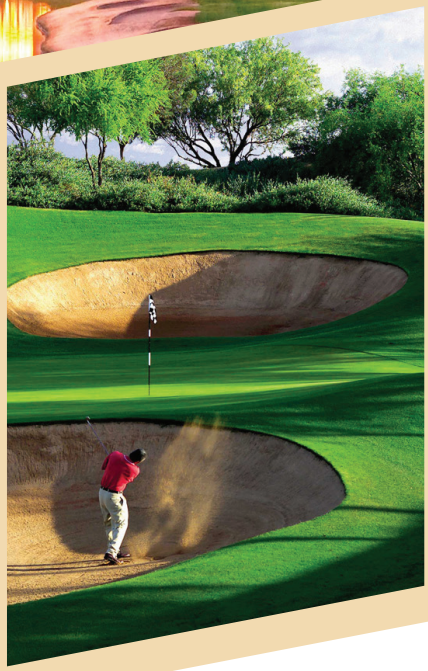
SPRING SEMINAR



SAVE THE DATE

***The Edge* - Spring Seminar 2014**
The Westin Kierland Resort & Spa
Scottsdale, Arizona

April 22 - 26, 2014

For More Information Visit:
www.acoep.org/edge

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