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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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Use of Physician-in-Triage Model in the Management of Abdominal Pain in an Emergency Department Observation Unit

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Introduction: Given the nationwide increase in emergency department (ED) visits it is of paramount importance for hospitals to find efficient ways to manage patient flow. The purpose of this study was to determine whether there is a significant difference in success rates, length of stay (LOS), and other demographic factors in two cohorts of patients admitted directly to an ED observation unit (EDOU) under an abdominal pain protocol by a physician in triage (bypassing the main ED) versus those admitted via the traditional pathway (evaluated and treated in the main ED prior to EDOU admission).

Methods: This was a retrospective cohort study of patients admitted to a protocol-driven EDOU with a diagnosis of abdominal pain in a single university hospital center ED. We obtained compiled data for all patients admitted to the EDOU with a diagnosis of abdominal pain that met EDOU protocol admission criteria. We divided data for each cohort into age, gender, payer status, and LOS. The data were then analyzed to assess any significant differences between the cohorts.

Results: A total of 327 patients were eligible for this study (85 triage group, 242 main ED group). The total success rate was 90.8% (n=297) and failure rate was 9.2% (n=30). We observed no significant differences in success rates between those dispositioned to the EDOU by triage physicians (90.6%) and those via the traditional route (90.5 % p) = 0.98. However, we found a significant difference between the two groups regarding total LOS with significantly shorter main ED times and EDOU times among patients sent to the EDOU by the physician-in-triage group (p< .001).

Conclusion: There were no significant differences in EDOU disposition outcomes in patients admitted to an EDOU by a physician-in-triage or via the traditional route. However, there were statistically significant shorter LOSs in patients admitted to the EDOU by triage physicians. The data from this study support the implementation of a physician-in-triage model in combination with the EDOU in improving efficiency in the treatment of abdominal pain. This knowledge may spur action to cut healthcare costs and improve patient flow and timely decision-making in hospitals with EDOUs. [West J Emerg Med. 2017;18(2)181-188.]

INTRODUCTION

In a 2015 American College of Emergency Physicians (ACEP) poll, 75% of surveyed emergency physicians felt that patient volume had increased since implementation of the Affordable Care Act (ACA) in 2014.[1] To address this, many emergency departments (ED) have formed observation units (EDOU) in an effort to expeditiously manage patients with an expected length of stay (LOS) less than 24 hours. EDOUs

have been shown to reduce healthcare costs via reduction in both initial hospital admissions as well as overall patient hospital LOS.[2-7] One recent study showed a mean annual cost savings of $108 million from avoidance of 235,000 hospital admissions for patients presenting to the ED with a chief complaint of syncope.[3] A 2012 study also projected that a nationwide adoption of EDOUs would lead to a projected annual cost savings of $3.1 billion.[7]

In an effort to further improve throughput and decrease patient LOS, some hospitals have implemented physician-in-triage models in which an EP evaluates, treats and at times dispositions patients in the triage area, bypassing the main ED. The physician-in-triage model has also been shown to decrease patient LOS within the ED.[8,9]

Studies have shown that highly subjective conditions such as abdominal pain are potentially difficult to manage in EDOU settings.[10-12] Abdominal pain is also the most common chief complaint among ED visits, comprising 8% of total visits in the most recent available National Hospital Ambulatory Medical Care survey in 2011.[11] The average failure rate among EDOUs on a national level is between 20-30%. If admission rates far exceed this percentile, suspension of the hospitals EDOU privileges may occur.[13]

Increased usage of both EDOUs and a physician-in-triage model may lead to a significant number of patients with chief complaints of abdominal pain being admitted to the EDOU by a triage physician. There is currently limited literature on clinical outcomes and the relative success rates of patients admitted to the EDOU by a triage physician versus those admitted via the main ED.

The purpose of this study was to look at patients admitted to the EDOU with a diagnosis of undifferentiated abdominal pain to determine whether there is a significant difference in success rates (disposition home) of these patients admitted directly to the EDOU by a triage physician (bypassing the main ED) versus those admitted via the traditional pathway (evaluated and treated in the main ED prior to EDOU admission). Our study additionally sought to examine the effects of gender, age, and insurance payer status on success rates. We also examined the impact of physician-in-triage evaluation and subsequent EDOU admission on patient LOS.

METHODS

This was a retrospective cohort study of 327 patients admitted to the EDOU under an abdominal pain protocol from July 1, 2015, to January 14, 2016, in a single university hospital center ED. We obtained institutional review board approval prior to data extraction and analysis. The total population was divided into two cohorts, those dispositioned to the EDOU by an attending physician working in triage and those dispositioned by an attending physician in the main ED.

We determined that the sample size necessary to obtain significant results in the study was 61. This was calculated using a 95% confidence interval, 10% margin of error, response distribution of 26% (85/237) and our known population size 327. Response distribution was 26% (85/327). Our sample achieved was 85 patients.

All patients admitted to the EDOU under the EDOU protocol of abdominal pain who met the departmentally set criteria were included in this study (Figure 1). The EDOU abdominal pain protocol includes strict exclusion criteria, interventions, disposition criteria, and a timeframe. The exclusion criteria are surgical abdomen, immunocompromised status, and a fever of >103F. Interventions per the protocol are NPO, intravenous hydration, serial exams and vital signs every four hours. Imaging (radiograph, computed tomography and ultrasound), consultations, and repeat labs are all decided by both main ED and triage physicians as indicated. The protocol establishes the criteria for disposition to home as improvement of pain, completion of diagnostic work up, and exclusion of surgical disease. The criteria for admission to the hospital are deterioration or no improvement, or diagnosis established. Lastly, the protocol establishes the time frame for treatment as 6-23 hours.

The EDOU is run primarily by nurse practitioners with attending EPs in the main ED and triage area available if clinical questions arise or a change in patient status arises. The protocol is decided by the treating EP and the plan and presumed course is discussed in detail on sign out to the nurse practitioner. Prior to the initiation of the EDOU, all clinicians were provided with training that included information on EDOU operations, step-by-step instructions on how to admit patients to the EDOU, and copies of the current protocols. This training was provided via live faculty meetings and email. All current protocols are available in several locations in the main ED, electronic medical record, and in the EDOU. Variation from the protocol is rare but can occur when a clinician deems it necessary.

The physician in triage at the study site evaluates patients within the triage area between 10 a.m. and 1 a.m. The physician in triage is a board certified/board eligible EP and clinical instructor. Staff members who work as the physician in triage also work in the main ED, and triage shifts comprise a portion of each faculty member/fellow's monthly clinical shift requirement.

We obtained compiled data for all patients admitted to the EDOU with a diagnosis of undifferentiated abdominal pain who met EDOU admission criteria, along with whether the admission outcome was a success or failure. We further stratified the data for each cohort gender (male or female), age group (16-40, 41-60, 61-100), and payer status (self, private, Medi-Cal, Medicare, VA). Data on length of main ED time, EDOU time, and total time were also collected. We analyzed the success rates, LOS, and subgroup data for each cohort using STATA analytical software for significant differences using a two-sample

Emergency Department Observation Unit (EDOU) Management of Abdominal Pain	
Exclusion Criteria	Surgical Abdomen Immunocompromised patient Temperature > 40°C
EDOU Interventions	NPO IV hydration Serial exams and vital signs every 4 hours Repeat labs as indicated Imaging as indicated Consultations as indicated
Disposition Criteria - To Home	Symptomatic improvement of pain Completion of diagnostic work-up Exclusion of surgical disease
Disposition Criteria - To Hospital	Deterioration of (or no improvement in) symptoms Diagnosis made by serial exams or diagnostic testing

Figure 1. Emergency department observation unit (EDOU) management of abdominal pain.

t-test. To assess for significant findings in the overall success rates, multiple groups were compared using chi-square and Fisher's exact tests.

RESULTS

A total of 327 patients admitted to the EDOU with a diagnosis of abdominal pain were eligible for this study. Of these, 85 were seen by triage physicians and 242 were seen via the traditional route in the main ED. Overall, the total success rate was 90.8% (n=297) and failure rate was 9.2% (n= 30) (Figure 2). The largest percentage of patients grouped by gender, age, and payer status were female 63% (n=187), age range of 16-40- 50.5% (n=150), and Medi-Cal 54.5% (n= 162), respectively. The oldest patient included in the study was 90 and the youngest was 16.

When comparing between the two cohorts, we observed no significant differences in success rates between those dispositioned to the EDOU by triage physicians (90.6%) and via the traditional route (90.5 % p = 0.98) (Figure 2). In looking at the total population, we observed significant differences among groups only regarding gender p=0.03 and payer status p=0.03 when a chi-square test and Fisher's exact test were used to compare subgroups (Figure 3). When comparing the subgroups among the cohorts, statistically significant differences were found in the private pay groups and the 61-100 age group (Figure 4).

We used a t-test of times assuming unequal variances to analyze any significant differences in overall total stay (main ED time + EDOU time), EDOU time, and main ED time. The mean times for the total stay, EDOU time, and main ED time were 16.32 hours, 11.56 hours, and 5.00 hours respectively for the main ED and 14.16, 10.11, 4.27 for the triage group respectively. In all three categories we found significant difference in times with the patients who were sent to the EDOU directly from triage versus those sent from the main ED p< .001 (Figure 5). Given that the mean total LOS for the EDOU from triage group was two hours less than the traditional group, a total of more than 170 bed hours were saved by admitting that group straight from triage over a period of six and a half months.

DISCUSSION

As the number of EDOUs nationwide increases, there will be a growing need to safely use them to positively impact patient care and improve allocation of hospital resources. The primary purpose of this study was to examine whether the physician-in-triage model could be safely applied in dispositioning patients with a highly

	Comparison of overall success rate of main ED vs triage	
Area	Success rate	Confidence interval
Triage	0.906	.844-.968
Main ED	0.905	.969-.942
Overall	0.908	
	Comparison p=.98	

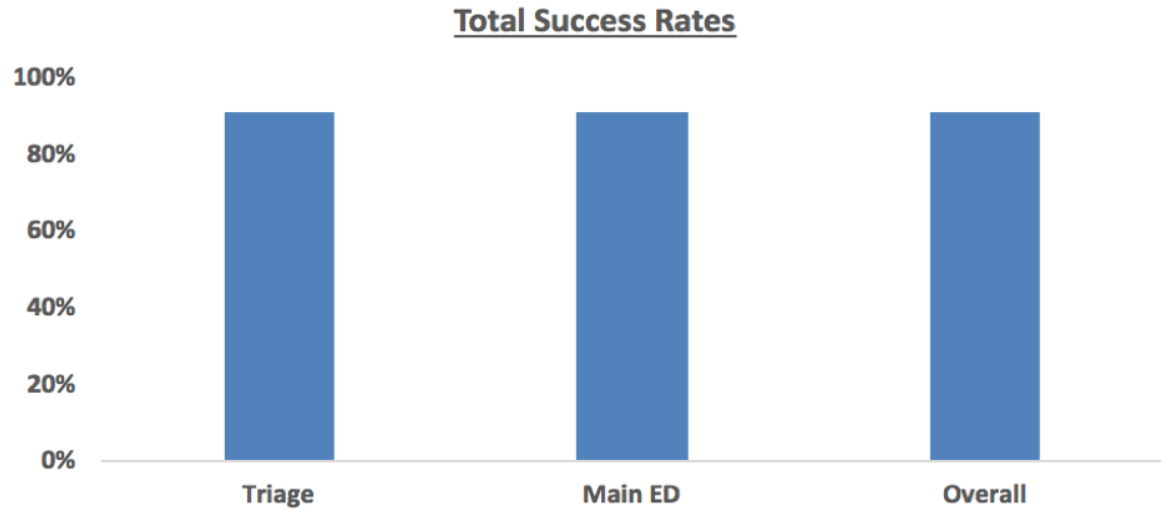

Figure 2. Comparison of overall success rate (discharge home within 24 hours) of main ED vs triage.

subjective and difficult-to-manage complaint to the EDOU. Also, we aimed to unmask any significant differences in time and resources saved as well as assess any significant differences in gender, age, and other demographic data that may have existed between the cohorts.

In this study, there were no significant differences in the EDOU disposition outcomes in patients admitted to an EDOU from triage or via the traditional route. Additionally, we also discovered a significant difference in LOS between the two cohorts of patients admitted from triage versus those admitted from the main ED. The triage patients in fact had shorter lengths of stays in each phase of their hospitalization: total stay, EDOU time, and main ED time. These two findings of equal success achieved with shorter lengths of stay, suggest that the EP's clinical intuition of assessing highly subjective complaints such as abdominal pain can be relied upon to make rapid EDOU disposition decisions for our patients. This can have a significant impact on patient flow through the ED, in turn having significant impact on resource allocation, efficiency, costs, and even patient satisfaction.

There is a growing body of research regarding the innovation of the EDOU. Currently, however, this research is focused on the EDOU and looks at operation designs within the units themselves such as protocols and success rates, and does not address the interplay between the physician-in-triage model with EDOUs. As both the physician-in-triage model and the EDOU are fairly new system designs in emergency medicine that are gaining in popularity but have yet to garner unanimous and ubiquitous support, this study adds support to the implantation of both systems, the physician-in-triage model and the EDOU, to further decrease LOS in patients with abdominal pain.[2-7]

Our findings of equal EDOU success rates between triage patients and main ED patients was surprising. Traditionally, it has been thought that more accurate disposition decisions would have been achieved after a thorough workup in the main ED rather than through a brief triage assessment. However, this study showed that triage physicians, even with their limited time with the patient and lack of objective data, are able to make equivalent disposition decisions. This would suggest that perhaps the physician's clinical gestalt is highly sufficient in making quick disposition decisions.

We also found that patients admitted to the EDOU from triage had a shorter LOS then those from the main ED. Several explanations are proposed for this. Presumably, the triage-to-EDOU path is more efficient and less time is spent with the patient simply waiting for a main ED bed to open. Perhaps the triage group received medications sooner because they were quicker to get to

Category	Success rates between genders, ages, and payer sources: Success rate	p value
Male	0.866	0.3
Female	0.935	
Age 16 to 40	0.932	0.23
Age 41 to 60	0.891	
Age 61 to 100	0.875	
Self	0.944	0.03
Private	0.942	
MediCal	0.880	
MediCare	1	
VA	0	

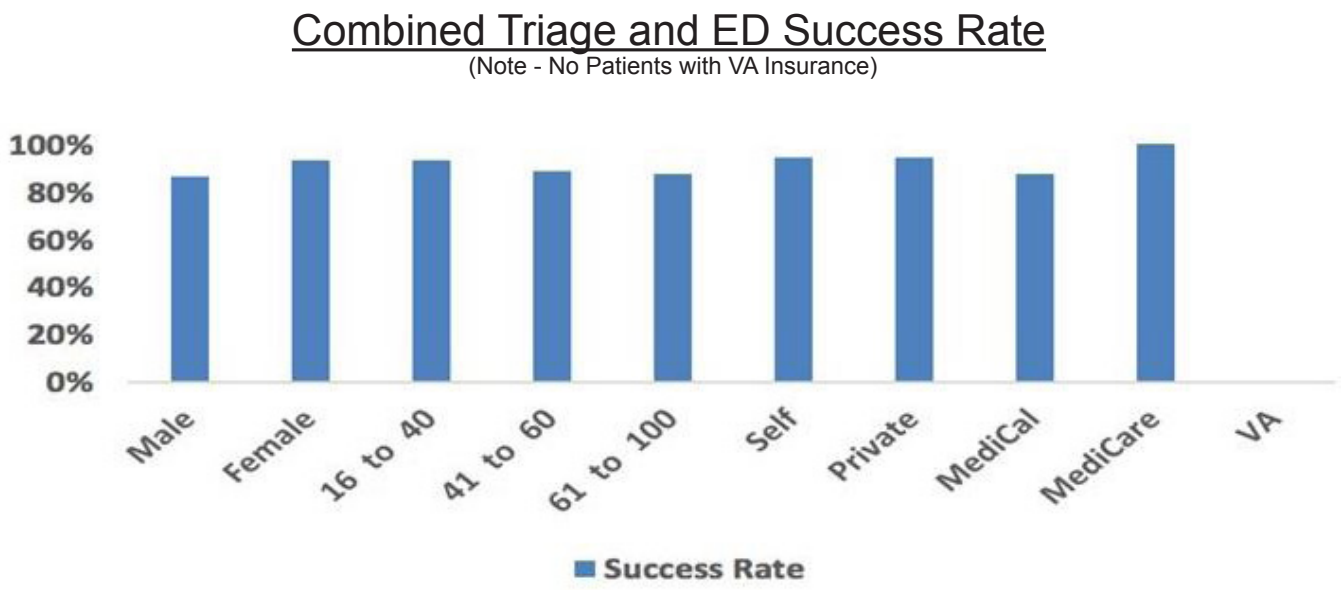

Figure 3. Success rates (discharge home within 24 hours) between genders, ages, and payer sources. *VA,* Veterans Administration.

providers who had time to administer medications. Or perhaps the patients in the triage group were able to receive stronger medications not available to their main ED cohorts because those patients were still in the waiting room. Many similar mechanisms could be proposed. Regardless of the underlying reason, the increase in patient flow and efficiency is an undeniable improvement.

When considering the influence of a patient's insurance on outcome, this study showed a statistically significant improved success rate of triage versus main ED in the private-pay group. One reason for this difference may be the fact that patients in the private-pay group likely have more reliable follow-up options in place and easier access to primary care/specialty follow up, allowing for a quicker and easier discharge. The other-payer groups did not have any differences in outcome.

LIMITATIONS

Potential limitations of this study include its size and patient population. The control group was much larger than the study group (85 from triage versus 242 from the main ED) because in practice it is more common for a triage physician to quickly see a patient and send the patient to the main ED for a more complete evaluation, workup, and decision, than for the triage physician to admit the patient directly to the EDOU. Those patients who are briefly seen by triage are only counted in the control group, not in the triage group because they were not *admitted* from triage. With only 327 total patients, 85 of whom were admitted from triage, this is still a relatively small study and it should

Category	Success rates between genders, ages, and payer sources		p value
	Main ED success rate	Triage success rate	
Male	0.87	0.815	.51
Female	0.930	0.948	.62
Age 16 to 40	0.939	0.915	.63
Age 41 to 60	0.888	0.867	.79
Age 61 to 100	0.854	1	.01
Self	0.933	1	.33
Private	0.930	1	.03
MediCal	0.865	0.867	.97
Medicare	1	1	1
VA	0	0	0

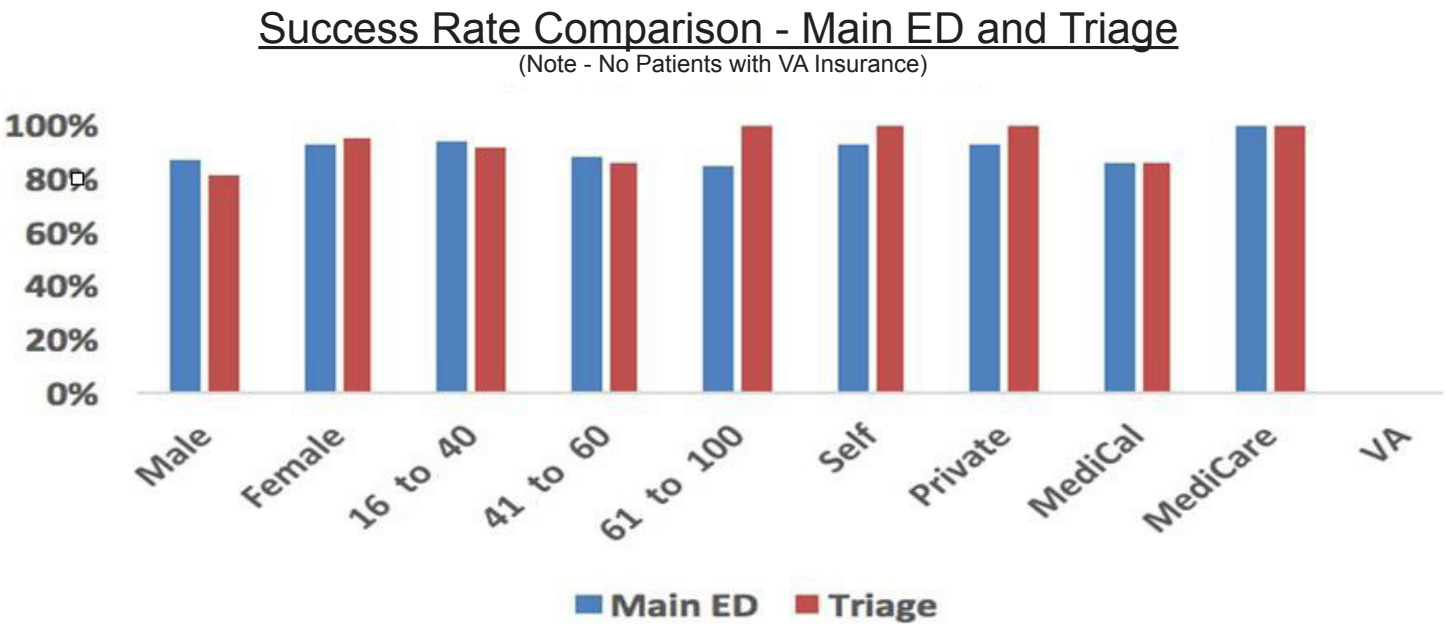

Figure 4. Comparison of success rates (discharge home within 24 hours) of ages, gender, and payer sources betwen main ED and triage. *VA,* Veterans Administration.

be acknowledged that with small sample sizes data obtained may be less valid. It is highly likely that the significant findings regarding age, gender, and payer status may be explained due to small populations within each group.

The specific patient population for this study should also be considered. Our most represented patient group was females aged 16-40 with Medi-Cal insurance, which is most likely not representative of the entire population. It is important to consider whether this skew in patient population could have altered our findings and, importantly, whether our findings would be pertinent to a facility that did not share similar population characteristics. We also recognize that this study looks solely at one protocol and findings may vary significantly depending on protocol. Clinicians from triage and the main ED used imaging as was indicated, but this study did not collect data on the frequency or type of imaging used between the groups of clinicians.

Additionally, because triage physicians are only evaluating and dispositioning patients between the hours of the 10 a.m. and 1 a.m., the results of our study may be subject to an element of selection bias. Our study did not specifically examine data on variation in acuity or change in EDOU success rates based upon presentation during the hours within which no physician in triage is present. While our study did examine total lengths of stay as an outcome measure, we did not examine the specific time of placement within the EDOU/time of discharge

Category	Length of stay		p value:
	Main ED (ST Dev)	Triage (ST Dev)	
Total LOS (EDOU LOS + ED LOS)	16.32 (1.72)	14.16 (3.13)	</= .0001
EDOU LOS	11.56 (1.74)	10.11 (2.21)	</= .0001
EDOU LOS	5.00 (0.59)	4.27 (1.57)	</= .0001

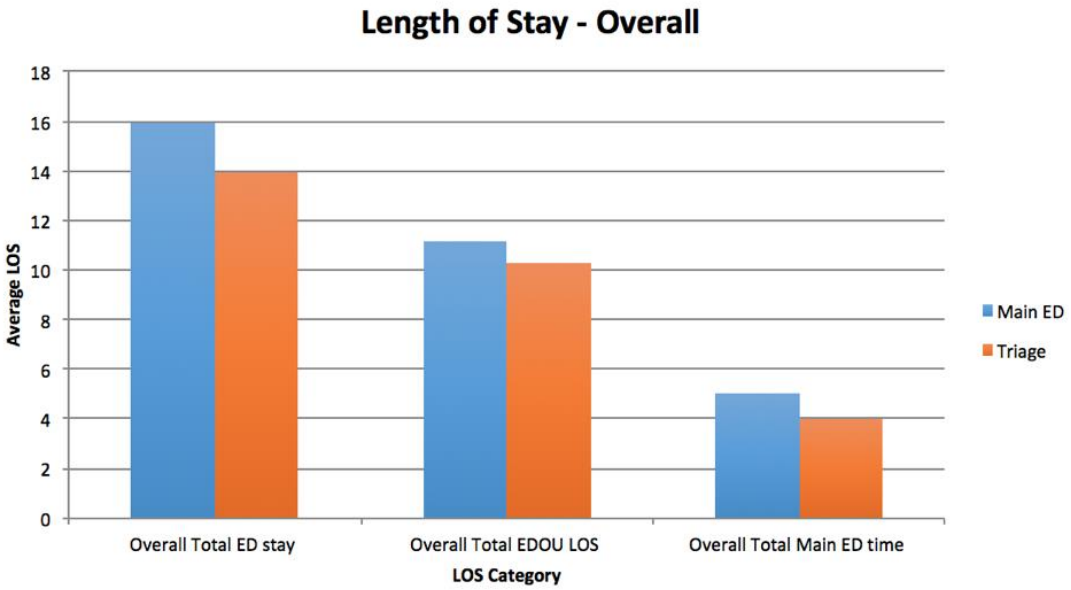

Figure 5. Data comparing length of stay (LOS) data in main emergeny department (in hours) vs emergency department observation unit (EDOU).

and the influence of this measure on total LOS. Future studies may benefit from only examining patients admitted to the EDOU between 10 a.m. and 1 a.m.with presentation between 1a.m. and 10 a.m. acting as an exclusion criteria. Future studies may also benefit from examining specific time of placement in and discharge from the EDOU to determine whether a greater proportion of patients are discharged from the EDOU at certain times and if, accordingly, placement within the EDOU at particular times influences LOS within either group. This also may represent a future direction of study given that patient satisfaction is an important quality measure that is being increasingly emphasized nationwide. Lastly, we acknowledge that some of the EDOU lengths of stay included main ED boarding time as they awaited bed availability in the EDOU.

CONCLUSION

The data from this study serve to support that the use of the physician-in-triage model in combination with the EDOU can improve ED efficiency and, most importantly, safely treat a highly subjective complaint such as abdominal pain. This finding will likely have beneficial effects on patient flow, cutting departmental costs, and improving patient satisfaction. Given the prevalence of abdominal pain complaints as well as the potential cost savings associated with successful use of the EDOU and decreased patient LOS through use of the physician-in-triage model, there is a significant need for further investigation on this topic and for identification of factors leading to or detracting from increased success rates. Future studies should also aim to look at other EDOU protocols to see if similar conclusions can be drawn. As continued support for EDOUs is often predicated upon maintaining a low failure rate, it is of paramount importance that predictors of EDOU success/failure be investigated in order to better predict successful disposition at time of admission to the EDOU.

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Cross-Continuum Tool Is Associated with Reduced Utilization and Cost for Frequent High-Need Users

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Introduction: High-need, high-cost (HNHC) patients can over-use acute care services, a pattern of behavior associated with many poor outcomes that disproportionately contributes to increased U.S. healthcare cost. Our objective was to reduce healthcare cost and improve outcomes by optimizing the system of care. We targeted HNHC patients and identified root causes of frequent healthcare utilization. We developed a cross-continuum intervention process and a succinct tool called a Complex Care Map (CCM)© that addresses fragmentation in the system and links providers to a comprehensive individualized analysis of the patient story and causes for frequent access to health services.

Methods: Using a pre-/post-test design in which each subject served as his/her own historical control, this quality improvement project focused on determining if the interdisciplinary intervention called CCM© had an impact on healthcare utilization and costs for HNHC patients. We conducted the analysis between November 2012 and December 2015 at Mercy Health Saint Mary's, a Midwestern urban hospital with greater than 80,000 annual emergency department (ED) visits. All referred patients with three or more hospital visits (ED or inpatient [IP]) in the 12 months prior to initiation of a CCM© (n=339) were included in the study. Individualized CCMs© were created and made available in the electronic medical record (EMR) to all healthcare providers. We compared utilization, cost, social, and healthcare access variables from the EMR and cost-accounting system for 12 months before and after CCMs© implementation. We used both descriptive and limited inferential statistics.

Results: ED mean visits decreased 43% ($p<0.001$), inpatient mean admissions decreased 44% ($p<0.001$), outpatient mean visits decreased 17% ($p<0.001$), computed tomography mean scans decreased 62% ($p<0.001$), and OBS/IP length of stay mean days decreased 41% ($p<0.001$). Gross charges decreased 45% ($p<0.001$), direct expenses decreased 47% ($p<0.001$), contribution margin improved by 11% ($p=0.002$), and operating margin improved by 73% ($p<0.001$). Patients with housing increased 14% ($p<0.001$), those with primary care increased 15% ($p<0.001$), and those with insurance increased 16% ($p<0.001$).

Conclusion: Individualized CCMs© for a select group of patients are associated with decreased healthcare system overutilization and cost of care. [West J Emerg Med. 2017;18(2)189-200.]

INTRODUCTION

Healthcare Overutilization is a Costly Problem

As the United States grapples with steeply rising healthcare cost, payers, providers, and policymakers seek to improve the efficiency of healthcare delivery.[1] We are challenged by the problem of costly healthcare overutilization

by high-need, high-cost (HNHC) patients – those requiring complex and multifaceted care with frequent access to the healthcare system.[1] Although these patients represent a relatively small proportion of the population, their care is associated with disproportionately high expenditures. For example, the top 1% of patients accounts for more than a fifth of all healthcare spending, and the top 5% accounts for nearly half.[2, 3] Effective intervention in this population has the potential to reduce waste and improve millions of lives.[4] We tested the development and use of CCMs© to reduce overutilization in high-need patients.

High-Need, High-Cost Patients

The complexity of HNHC patients often extends beyond medical diagnoses to include community, behavioral, cultural, addiction, and socioeconomic challenges.[1, 2] Compared to the general population, these patients have a higher prevalence of chronic physical and psychiatric illnesses that require both immediate interventions and long-term care, present with complaints more appropriate for primary care, have higher rates of hospitalization and mortality, are ethnically diverse, have varied health and personal histories, and are more likely to have enduring problems such as poverty, homelessness, hunger, loneliness, illiteracy, lack of transportation, limited mental capacity, legal problems, and substance addiction.[4-6] Studies suggest that the complexity of these patients' medical and/or socioeconomic maladies hinders their ability to navigate the healthcare system, contributing to the cycle of overutilization.[7] Fragmentation in the healthcare system also drives overutilization. The increasing number and complexity of visits in a healthcare system that are not organized around meeting the multifaceted physical, behavioral, and social needs of these high-need individuals results in fragmented and episodic care.[4, 8] Patients cycle through multiple institutions (such as emergency departments [ED], inpatient [IP] units, outpatient clinics, detox centers, homeless shelters, and jails) that are often disconnected from one another, leading to an expensive, inefficient healthcare environment that fails these patients.[4, 9]

Seeking a Solution to Overutilization

A "best practice" approach has proven elusive, with the majority of care remaining fragmented, uncoordinated, and reactive.[2] Interventions to improve management and reduce utilization have largely focused on adding care managers to directly work with the patient to enhance access and care coordination. Approaches have included individualized care plans and intensive case management,[10-22] healthcare education, improving access to primary care,[23-25] patient home follow up,[26, 27] triaging patients and routing non-urgent cases to alternative services, and managed care-level interventions.[28] Several models, such as the Commonwealth Care Alliance, CareMore, CareOregon, the Everett Clinic, and Marshfield Clinic, have adapted a range of approaches that include medical homes in safety-net clinics, multidisciplinary case management, patient stratification to better target care delivery, early intervention strategies, and vigorous discharge follow up.[4] Although many programs have improved quality or reduced care utilization, their impacts on costs have been inconsistent.[31, 32]

A growing need remains for initiatives with an innovative model that improves care delivery and beneficiary experience, while reducing unnecessary spending for all patients, especially for this vulnerable population with complex medical and social needs.[4] The lack of a consistent understanding of the characteristics of this heterogeneous high-need population, which underlying issues drive high-utilization behavior and which subgroups offer the greatest opportunity for impact, all hamper efforts to innovate and implement effective interventions that improve healthcare delivery.[2, 4] Much remains unknown about how HNHC patients interact with the healthcare system, what services they receive, and what outcomes result.[4] If we can understand more about the care they need and what is working, we can design more targeted, coordinated, and effective clinical services.[4]

Our Approach and Goals

Whereas most interventions focus on *changing the patient,* our approach to improve the effectiveness, efficiency, and value in care was to focus on innovating a replicable intervention that *changes the system of care around these patients* to effectively identify and target the true root causes driving the high-utilization behavior.

The CCM© is a cross-continuum succinct tool that addresses fragmentation in the system by linking providers to a consistent cohesive individualized analysis of a patient's root causes for frequent use of costly acute health services. The CCM© is linked to a pop-up alert that fires the first time a provider opens the medical record. It is a guide that demystifies the complexity of a frequent user's clinical presentation and utilization pattern. The provider is thus equipped with a comprehensive analysis of underlying root causes contributing to return visits with supporting data. The CCM© allows each provider to examine the history and considerations for care from the patient's cross-continuum of healthcare providers, so that he/she can be better informed regarding how to provide the most appropriate and consistent care for patients with complex issues. The CCM© captures the patient's longitudinal story and brings forward considerations to improve delivery of care.

In this article, we describe 1) a system-focused, root cause-based intervention, 2) our process for creating and implementing CCMs©, 3) the profile of our patient population, and 4) utilization, financial, social, and healthcare access outcome measures after the CCM© was administered.

Our aim for sharing our approach is to advance understanding of the heterogeneous HNHC patient population.

CREATION OF THE COMPLEX CARE MAP© TOOL

A master's prepared clinical nurse leader (CNL) created a Complex Care Resource Center where, under her leadership, tools were developed to complete a record review, uncover root causes of instability, capture the cross-continuum team, and identify key drivers that may improve outcomes for the patient. The CNL and ED medical director co-led an interprofessional Complex Care Committee to develop and maintain the CCMs© (Figures 1, 2, and 3).

METHODS

Context

Our analysis was designed to explore if a CCM© would improve quality of healthcare delivery, reduce inappropriate overutilization of costly acute care services, and improve social and healthcare access and patient outcomes. A Complex Care nurse chaired the intervention and oversaw the interdisciplinary team.

Study of the Intervention

Study Design

The intervention was designed as a quality improvement project that followed high health system users for 12 months pre- and post-intervention where each subject served as his/her own historical control. We used retrospective data for comparison. This project was deemed as a Clinical Quality Improvement Initiative by the Mercy Health Institutional Review Board (IRB) and as such was not formally supervised by the IRB per their policies.

Setting

The analysis was conducted between November 2012 and December 2015 at Mercy Health Saint Mary's in Grand Rapids, Michigan, an inner city tertiary care hospital with greater than 80,000 annual ED visits. Because of its location, a large number of patients are homeless, unemployed or receiving social assistance, have complex and/or chronic medical, psychiatric, and substance use problems.

Subject Population

Any patient referred to have a CCM© was enrolled in the project. Referrals could be made by any hospital, emergency, or community health professional who believed a patient could benefit from a Complex Care Map© based on their perception of the patient's pattern of healthcare service utilization. Additional inclusion criteria included three or more visits to the hospital within the prior 12 months and age of 18 years or older. There were no exclusion criteria. Subjects were withdrawn from the analysis prior to completion if they died or were known to have moved away within 12 months after initiation of a CCM©. In total, 355 cases were enrolled, and 16 cases were withdrawn due to death prior to 12 months after implementation of the intervention.

Measures

Outcome Variables

The present analysis investigated whether implementing CCMs© could reduce healthcare service utilization and costs (primary objectives) and improve social and healthcare access issues (secondary objectives).

Primary Outcome Variables

Our analysis had two sets of primary outcome measures. One set focused on Healthcare Service Utilization: Emergency Department / Urgent Care (ED/UC) Visits, Observation / Inpatient (OBS/IP) Admissions, OBS/IP Length of Stay (LOS), Computed Tomography scans Ordered. We obtained healthcare service utilization data from the hospital's inpatient and outpatient utilization databases and cost accounting system. The other set focused on healthcare service costs: Gross charges and expenses, ED service charges and expenses, IP service charges and expenses, outpatient service charges and expenses. Healthcare cost data were retrieved from the cost accounting system.

Secondary Outcome Variables

Our study had one set of secondary outcome measures. These measures focused on social and healthcare access issues: lacks safe housing, lacks medical insurance, lacks primary care. We obtained social and healthcare issues data from extensive review of the patient's EMR and reports of collateral contacts/patient's healthcare providers. "Lacks safe housing" was defined as living on the streets, in shelters, or in an abandoned building for the majority of the time.

Descriptive Variables

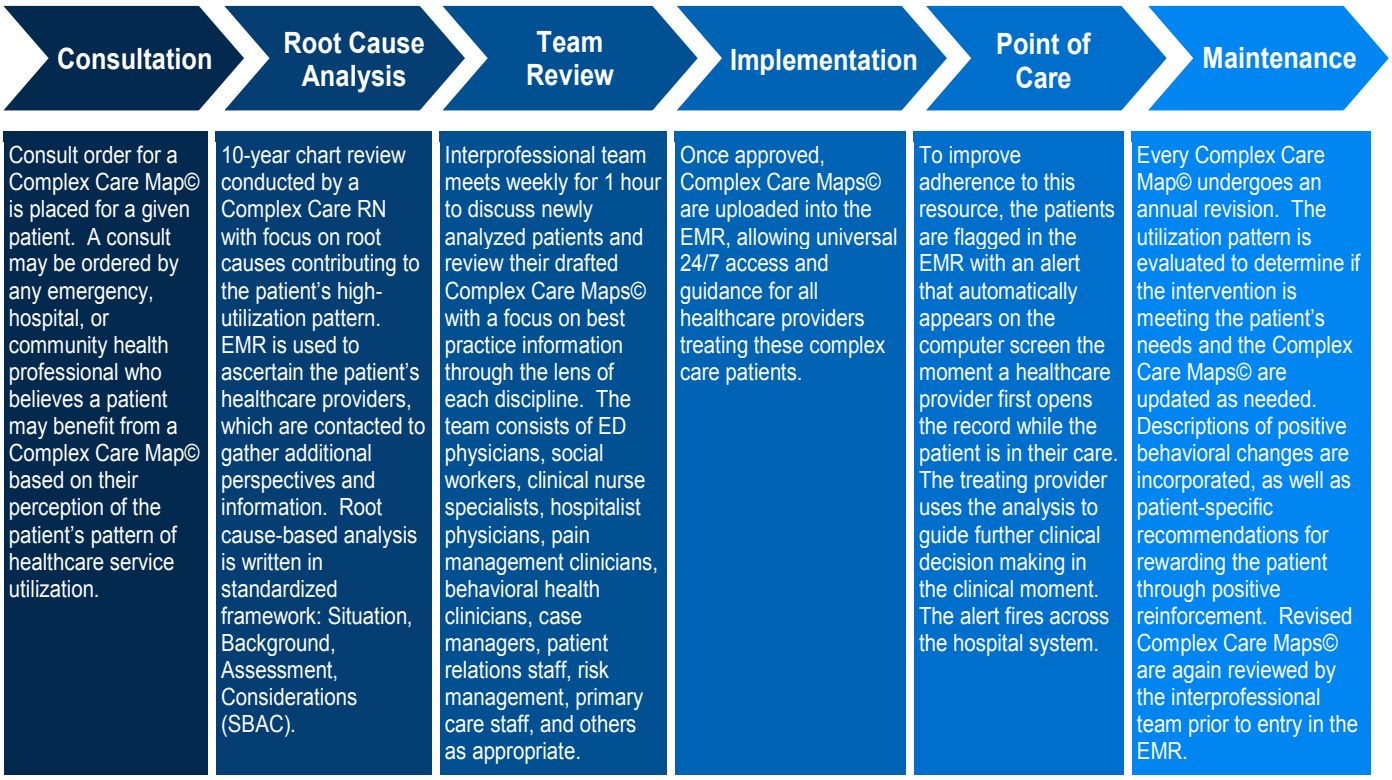
We describe a comprehensive set of baseline characteristics for the high-frequency complex patient population in our analysis grouped into several categories (Table 1): demographic, social, healthcare access, mental illness, and healthcare utilization variables. History of trauma was defined as history of a severely distressing event that caused overwhelming stress or psychological trauma such as, although not limited to, physical or sexual assault, serious bodily harm, natural disasters, or witnessing fatalities. Baseline patient characteristics were obtained from extensive review of each patient's EMR.

Analysis

Statistical Procedures

All data were extracted from the hospital's EMR system, compiled in a Microsoft Excel spreadsheet, and then stored as de-identified data in REDCap prior to being transported to

(a)



(b)

Root Cause Analysis:
Steps on how to Identify and Communicate Patient-Specific Root Causes that Drive High-Utilization Behavior

Goal

Perform comprehensive health assessment to identify problems that, if addressed through effective interventions, will improve care and reduce the need for expensive services. Extends beyond medical issues to address, to the extent possible, how patients' psychosocial circumstances and social determinants of health affect their ability to follow treatment recommendations and achieve stabilization. Different patients become high-utilizers for different reasons, and thus approaches must be tailored to their unique presentation.

Step 1: Ten Year Electronic Chart Review

ED records, inpatient hospital notes, results of investigations, number of visits, medical problems, psychosocial issues, social determinants of health, and cross continuum team identification.

Step 2: Engage the Patient's Existing (Yet Often Fragmented) Continuum of Care

The EMR is used to ascertain the patient's healthcare providers and pattern of access. Further information is gathered from the patient's Primary Care Physician and any other relevant practitioners. A conference may occur with the patient's primary care, specialty, behavioral health, and social service providers to create a shared plan.

Step 3: Bring the Patient's Story Forward from a Root Cause Perspective

When gathering this information, a story emerges of the root cause(s) underlying the frequent use of emergency and/or inpatient services. Many factors that were previously neglected or overlooked become apparent contributors to patient's health challenges and can include but are not limited to a high prevalence of trauma in their lives, inability to connect with primary care services, inadequate access to psychiatric assessment and mental health services, cognitive and health literacy challenges, or social isolation and depression. System fragmentation, patient strengths, key relationships, and opportunities to improve care delivery and coordination are identified and organized into a Complex Care Map© for the patient to support the provider in delivering comprehensive care and linking the cross continuum to strengthen the intervention across systems.

Figure 1. Creating and implementing Complex Care Maps©: (a) General overview (b) process for conducting root cause analysis of drivers that underlie high-utilization behavior.

IDENTIFYING INFORMATION
Describes the patient's identifying information.

Care Plan #: 0000001
Patient Name, MRN, DOB: John Smith, 123456789, 01/01/1980
Creation Date: 01/01/2013
Date of Last Revision: 01/01/2016

WARNING/SAFETY ALERT
Statement of safety issue or guardian information (appears in red font).

Example: Patient has brought in a weapon previously (reference note with specific details of encounter)
Example: Patient has a guardian (reference their name and contact information)
Example: Patient drinks hand sanitizer as a form of alcohol abuse. Remove hand sanitizer from room.

SITUATION
Succinctly describes the core issue and why this Complex Care Map© was created.

Example: Patient has high frequency healthcare visits related to unstable COPD.
Example: Patient has high frequency healthcare visits due to unstable behavioral health issues.
Example: Patient has high frequency healthcare visits related to chronic back pain and substance overuse

BACKGROUND
Describes pertinent past medical and social history, significant testing and results, root cause drivers, and pattern of access that contribute to the patient's care complexity.

Root Cause Medical Problems List: Medical diagnoses that trigger ED visits or inpatient admissions
Root Cause Psychosocial Problems List: Psychiatric diagnoses that trigger ED visits or inpatient admissions, information about suicidality and addiction history for safety
Root Cause Social Determinants of Health (SDOH): SDOH that affect ED visits or inpatient admissions such as housing, safety, history of or current trauma, financial barriers to care, decision-making capacity, access issues
Incidence of Testing: If over-testing is an issue, pattern and type of testing with information about significant or negative results is included. Identification of access to multiple hospitals is indicated.
Pattern of Access: Number of visits to ED/UC, IP/OBS and LOS Days in previous 12 months

ASSESSMENT
Describes the root causes driving the high-utilizer behavior. Takes into account gaps in care, patient activation, behavioral health needs, social services, and barriers to care. Identifies patient strengths and key relationships contributing to stabilization.

Associated Concerns: highlight key areas of concern
Associated Strengths: highlight strengths of patient story
Key Contacts & Phone Number (as of Month/Day/Year): Medical home/PCP; Specialists (that would be helpful to contact); CNL/CM (from the ED or inpatient unit); Homecare Agencies, Case Managers (include Insurance CM and Psych CM), Community Health Worker or Health Coach.

CONSIDERATIONS
Considerations suggest actions to change provider behavior and suggest evidence-based treatment and strategies that are specific to the patient situation. Key notes in the EMR are identified for provider reference.

What helps: Include evidence-based recommendations; recommended persons for contact via phone call from the ED/IP for recommendations in directing care if appropriate; reminders to fax note to agencies in the circle of care that do not auto-receive the consult (i.e., key specialists).
What doesn't help: Highlight historical failures in patient's care
References: Include links to valuable notes in the EMR with dates (i.e., Pain and Palliative Care Consult Note 9/28/2012)

Figure 2. Complex Care Map© architecture.

Stata version 14SE (STATA Corp). As this was a paired sample study with data collected on the same patients (before and after CCM© implementation), we used Wilcoxon signed rank tests and McNemar's chi-square test to examine whether the difference in pre- and post-outcome measures were statistically significant. McNemar's chi-square test is used for binary variables and the Wilcoxon test is used for count data. Tests were two-sided and a p value < 0.05 was considered statistically significant. In an effort to examine distributional differences in utilization changes from the pre- to post-period, we conducted an analysis using patients in the 25th and 75th percentiles of the distribution for each utilization outcome.

Examining costs from the hospital's perspective is an essential step because it is unlikely that any hospital would implement a new program that was not cost effective at the health system level.[30] We report financial data (rounded to the nearest dollar) and acknowledge that hospital charges,

Figure 3. (a) Complex Care Map© Guiding Principles

System-Based Intervention: Focus of the intervention and considerations is on improving the system around the patient and is thus independent of a patient's level of insight, motivation for self-care, or participation.
Patient-Centered Root-Cause Analysis: Comprehensive/Holistic and individualized assessment based on patient's characteristics, utilization patterns, needs, and perceived challenges with focus on the whole person; rather than a single disease process.
Utilization-Focused: Identifies factors that drive ED/UC visits and IP admissions.
Cost-Effective, Sustainable, and Replicable Structure: Links information about providers already in the patient's circle of care and uses existing resources/infrastructure common to most US hospitals, allowing implementation in all settings with an EMR.
Multidisciplinary: Integrates physical health information with behavioral health recommendations to improve quality and safety of care.
Improved Care Coordination: Enables providers to better coordinate care during the clinical moment by linking contact information for established care providers and relevant resources to the root-cause analysis.
Benefits Providers: Empowers treating practitioners with time-saving information that demystifies the patient's complexity and maximizes their ability to address the patient's core needs. *Example: providers report increased satisfaction and time efficiency in caring for these patients.*
Humanistic: Deliberate phrases used to improve the culture of provider language by avoiding judgment or labeling patients while honoring their strengths and bringing forward complex information that is important for patient safety. *See Figure 3b for examples.*
Patient-Provider Relationship Strengthening: Includes recommendations on patient-specific engagement strategies to build trust. *Example: traumatized patient whose anxiety is triggered by physical touch.*
Easily Accessible: All providers caring for the patient are alerted of the Complex Care Map© when opening the patient's chart where it is also available 24/7 in the EMR.
Preventative Impact: Identifies patients at the point of care who are perceived to be at high risk for poor outcomes and developing a pattern of unnecessary utilization.
Rewards Positive Behavior Change: Includes recommendations for positive reinforcement.
Culture-Shifting: Intentional design of the analysis impacts provider perceptions of and approaches to complex patients. *Example: Providers now enter consults using "over-utilization" or "over-prescribing" as a reason for referral.*
Uses Technology: Uses the EMR to alert providers and improve integration.
Information Sharing: Assessments of a patient's high-utilization pattern from across the continuum of care are collected and shared within the Complex Care Map©.
Interprofessional Collaboration: Interdisciplinary information gathering and team-based review

Figure 3. (b) Humanistic Emphasis on Descriptive Language in Complex Care Maps©

Previous Terminology	Recommended Improvement
"Narcotic/Drug Seeking"	Concern for Narcotic Overuse
"Do not prescribe narcotics"	Consider non-narcotic treatment absent acute trauma
"Do not order additional CT scans"	At risk for over-testing. Check previous scans/results in the medical record.
"History of sexual abuse as a child"	Significant childhood trauma (see __ note dated __)
"Abuse of the ED – visits frequently with no medical cause"	At risk for overtreatment. Consider previous testing and evaluations. Consider MSW consult for resources and support.
"Non-compliant"	Pattern of poor follow-through on recommended care
"Doctor shopping"	Accesses multiple healthcare systems/providers
"Psych concerns"	Behavioral health complicates care
"Addict", "Drunk"	Substance use complicates care, Polysubstance abuse (list substances)

Figure 3. Distinguishing features: (a) Guiding principles. The Complex Care Map© incorporates several important and distinguishing features, some of which are known to be shared by high-performing approaches; (b) humanistic emphasis on descriptive language in Complex Care Maps©.

billing, and revenue figures may vary widely among hospitals because of unique combinations of patient mix, payer mix, and institutional mission, although it is the changes in these variables that we emphasize.

RESULTS

Baseline Patient Characteristics:

Table 1 reports characteristics of the sample. In many respects, patients were typical of most high-utilizer groups: a large proportion had Medicaid (42%), were dual-eligible Medicare/Medicaid (17%), or were uninsured (17%). A high percentage of patients also had history of mental health diagnoses, including suicidality (40%), trauma (48%), substance use disorder (66%), and/or psychiatric diagnosis (75%). Eighteen percent of high-utilizers were homeless.

Patients in this study also had characteristics that differ

from most other studies. The mean age was 40 years (not shown in Table 1), with 72% of patients less than 50 years old. Furthermore, 35% were from healthcare systems outside of Mercy Health (home-based primary care provider (PCP), other PCP, and one-third of the Resident Clinic), while 46% were from PCPs inside the Mercy system. Twenty-five percent of patients had three or more years of prior frequency. In our work with complex patients, we have found the characteristics of those with multiple years of frequency require a comprehensive approach for stabilization; except for Johnson et al. (2015), who included data on frequency for one year prior to intervention, we are not aware of any other studies that consider past utilization.[34]

Patient Outcomes of Intervention

Table 2a reports the difference in both primary and secondary outcomes pre- and post-implementation of the CCM©. The primary outcomes include measures of healthcare utilization and healthcare costs. Using data from cost-accounting classifications, total visits decreased by 37%, with ED visits decreasing 43%, IP visits decreasing 44%, and OP visits decreasing 17%. Using data from the quality improvement database, ED/UC visits decreased 30% and IP/OBS utilization decreased 49%. The number of CTs decreased 62% and LOS decreased 40.5%. All p-values for healthcare utilization outcomes were <0.001. Gross charges decreased 45%, ED charges decreased 48%, IP charges decreased 43%, and OP charges decreased 47% ($p<0.001$). Total direct expenses decreased 47%, as did expenses for ED (50%, $p<0.001$), IP (45%, $p<0.001$), and OP (50%, $p<0.001$). The total contribution margin increased 11% ($p<0.001$), with the ED contribution margin increasing 76% ($p<0.001$) and the OP contribution margin increasing 86% ($p<0.001$). The total operating margin increased 73%, with the ED operating margin increasing 58% ($p<0.001$) and the OP operating margin increasing 60% ($p<0.001$). The differences between the pre- and post-intervention IP contribution margin and operating margin were statistically insignificant.

The secondary outcomes include social and healthcare access variables. Differences for all secondary outcomes were statistically significant, with a p-value <0.001. After intervention, the number of patients with housing increased 14%, patients with an identifiable PCP increased 15%, and patients with insurance increased 16%.

Distributional Analysis of Patient Outcomes

To examine the extent to which our results may be driven by regression to the mean and not to the intervention itself, we divided our sample into quartiles based on each outcome and repeated the pre- to post-period analyses reported in Table 2a. For this distributional analysis, we chose to focus on utilization outcomes, as those would provide the clearest evidence of the influence of natural variation in our findings.

Table 1. Baseline characteristics (n = 339) for the high-frequency complex patient population.

	% (No.)
Demographic variables	
Age group	
18-29	17.40 (59)
30-39	31.56 (107)
40-49	23.60 (80)
50-59	18.58 (63)
60-69	6.49 (22)
70-79	2.06 (7)
80+	0.29 (1)
Gender	
Male	59.29 (201)
Female	40.71 (138)
Race	
White	63.72 (216)
Black or African American	30.09 (102)
Hispanic or Latino	5.01 (17)
Asian	0.00 (0)
American Indian or Alaska Native	1.18 (4)
Native Hawaiian or Pacific Islander	0.00 (0)
More than 1 race	0.00 (0)
Social variables	
Housing*	
Yes	81.42 (276)
Housed	73.45 (249)
AFC/AL	3.24 (11)
Long-term care	0.59 (2)
With family & friends	2.95 (10)
Transient hotel	1.18 (4)
None	18.58 (63)
Crisis house	0.29 (1)
Homeless	18.29 (62)
Healthcare access variables	
Identifiable PCP*	
Yes	81.12 (275)
MHPCMH	22.71 (77)
Resident clinic	8.26 (28)
Community benefit clinic	17.11 (58)
Home based PCP	0.88 (3)
Long term care PCP	0.59 (2)
Other PCP	31.56 (107)

Hx, history; *AFC/AL,* adult foster care or assisted living; *MHPCMH*, Mercy Health patient-centered medical home; *ED*, emergency department; *PCP*, primary care physician.
*Designates Variable with 12-mo After Comparison.

Table 1. Continued.

	% (No.)
None	18.88 (64)
Insurance Type*	
Insured	83.48 (283)
Private/commercial	12.09 (41)
Medicare	12.09 (41)
Medicaid	42.18 (143)
Dual-eligible (Medicare/Medicaid)	17.11 (58)
Uninsured	16.52 (56)
Healthcare utilization variables	
Years of prior frequency	
1	35.99 (122)
1-2	21.83 (74)
2-3	17.40 (59)
>3	24.78 (84)
Type of frequency	
ED	43.95 (149)
Inpatient	2.36 (8)
Both	53.69 (182)
Mental illness variables	
Hx of suicidality (yes)	40.1 (136)
Hx of trauma (yes)	48.1 (163)
Hx of substance use disorder (yes)	66.1 (224)
Hx of any psychiatric diagnosis (yes)	74.6 (253)

Hx, history; *AFC/AL,* adult foster care or assisted living; *MHPCMH*, Mercy Health patient-centered medical home; *ED*, emergency department; *PCP*, primary care physician.
*Designates Variable with 12-mo After Comparison.

Results are presented in Table 2b and, while not definitive, do provide evidence that regression to the mean in our sample is minimal. The first four columns display pre- and post-intervention mean utilization rates for the lowest utilizers in the sample, while the last four columns include the same information for the highest utilizers. Unsurprisingly, the highest utilizers experience the largest post-intervention reductions in the utilization outcomes, many on the order of 50%, while the lowest utilizers appear to be largely unaffected by the intervention. Importantly, we see little indication of movement towards the mean for the lowest utilizers in the post-period, lending support to the effectiveness of the CCM©. Four of the outcomes for the lowest utilizers show no statistically significant change from the pre- to post-period, and the remaining changes – while statistically different from zero – are small in magnitude.

DISCUSSION

Summary

We implemented an interprofessional, replicable, cost-effective process to intervene with HNHC patients. In this article, we share information about the people with the most significant healthcare needs and the services they use. We describe an EMR-based care delivery intervention that is associated with lower-than-average costs. We improved social and healthcare access outcomes by changing the system around complex patients.

Interpretation of Key Findings

Intervention:

This paper describes a successful approach to stabilize HNHC patients. The CCM© is unique in that it combines the power of the patient story with interprofessional input and focuses on cross-system collaboration to improve outcomes. This intervention, which was associated with a 72.5% increase in operating margin, may prove particularly valuable as health systems shift further into risk-based contracts. Rather than creating another care management and cost infrastructure, the intervention is primarily managed by existing resources in the healthcare system and operates by improving efficiency through coordination of existing providers. Cost for implementation is minimal because it uses existing technology available to most healthcare systems. Keeping referral criteria open allows providers to identify at-risk patients at the early stages of high-utilization behavior, hopefully preventing patients from becoming consistent frequent users. We believe this is significant because the greatest long-term cost savings will come from reducing the development of new high-utilizer patients. Although not quantified in this analysis, providers report a high level of satisfaction with having an easy process to identify at-risk patients in the moment of interaction without having burdensome documentation to complete to generate intervention.

In addition to reductions in utilization, patients in the study experienced reductions in length of stay and in the number of CTs performed. Providers report that CCMs© save time and help them link with the cross-continuum team already caring for the patient. Efficiency in delivery may contribute to reduction in length of stay but this was not explored in the analysis. Quantity of CTs and previous results are specifically included in the CCMs© because a pattern of frequent investigations was noted in the population. Providers now make referrals of patients specifically due to noted "over-testing." Additional investigation into the drivers of these changes in practice warrant future study.

Description of the Sample

Predominant characteristics of our sample include prevalence of fragmentation between cross-continuum providers and prevalence of mental illness, substance use, and

Table 2. (a) Patient outcomes of intervention (n=339) pre- and post-implementation of the Complex Care Map©.

Outcomes	Means				p-value
	Pre	Post	Difference	% Change	
Healthcare utilization			Means (no.)		
Visits					
Total	14.903	9.322	-5.581	-37.4	<0.001
ED	10.245	5.862	-4.419	-43.1	<0.001
IP	1.295	0.720	-0.575	-44.4	<0.001
OP	3.362	2.780	-0.582	-17.3	<0.001
Total	11.826	7.997	-3.829	-32.4	<0.001
ED/UC	10.319	7.233	-3.086	-29.9	<0.001
OBS/IP	1.507	0.764	-0.743	-49.3	<0.001
CT scans					
Total	1.481	0.563	-0.918	-62.0	<0.001
			Means (days)		
LOS					
OBS/IP	5.850	3.481	-2.369	-40.5	<0.001
Healthcare costs			Means ($)		
Gross charges					
Total	39,254	21,491	-17.764	-45.3	<0.001
ED	13,121	6,831	-6,290	-47.9	<0.001
IP	20,768	11,795	-8,973	-43.2	<0.001
OP	5,365	2,864	-2,501	-46.6	<0.001
Direct expenses					
Total	10,956	5,788	-5,168	-47.2	<0.001
ED	3,009	1,492	-1,517	-50.4	<0.001
IP	6,556	3,597	-2,959	-45.1	<0.001
OP	1,390	699	-691	-49.7	<0.001
Contribution margin					
Total	1,134	1,253	119	10.5	0.002
ED	-770	-182	589	76.4	<0.001
IP	2,172	1,472	-700	-32.2	0.338
OP	-268	-37	231	86.0	0.004
Operating margin					
Total	-2,573	-707	1,866	72.5	<0.001
ED	-2,244	-948	1,296	57.7	<0.001
IP	475	562	87	18.3	0.771
OP	-803	-321	482	60.0	<0.001

Pre (12-mo before); Post (12-mo after).
ED, emergency department; *IP,* inpatient; *LOS,* length of stay; *OP,* Outpatient, Observation Admissions and Urgent Care Visits and Outpatient Radiology.

Table 2. Continued.

Social variables						
Housing	Yes	81.4	92.9	11.5	14.1	<0.001
Healthcare access						
Identifiable PCP	Yes	81.1	93.2	12.1	14.9	<0.001
Insurance type	Insured	83.5	96.5	13.0	15.6	<0.001

Pre (12-mo before); Post (12-mo after).
ED, emergency department; *IP,* inpatient; *LOS,* length of stay; *OP,* Outpatient, Observation Admissions and Urgent Care Visits and Outpatient Radiology.

Table 2. (b) Distributional analysis of patient outcomes.

	25th Percentile				75th Percentile			
	Pre	Post	Difference	p-value	Pre	Post	Difference	p-value
Healthcare utilization	Values (no.)				Values (no.)			
Visits								
Total	5.621	5.770	0.149	0.362	27.341	15.841	-11.500	<0.001
ED	3.000	3.443	0.443	0.736	20.000	10.067	-9.933	<0.001
IP	0.000	0.231	0.231	<0.001	3.538	1.528	-2.010	<0.001
OP	0.000	0.588	0.588	<0.001	9.330	6.247	-3.083	<0.001
Total	5.764	7.180	1.416	0.462	27.678	17.411	-10.267	<0.001
ED/UC	3.112	4.051	0.939	0.217	20.122	11.800	-8.322	<0.001
OBS/IP	0.000	0.150	0.150	<0.001	3.642	1.545	-2.097	<0.001
CT scans								
Total	0.000	0.341	0.341	<0.001	3.212	0.826	-2.386	<0.001
LOS	Values (days)				Values (days)			
OBS/IP	0.000	0.571	0.571	<0.001	17.772	9.609	-8.163	<0.001

Pre (12-mo before); Post (12-mo after).
ED, emergency department; *IP,* inpatient; *LOS,* length of stay; *OP,* Outpatient, Observation Admissions and Urgent Care Visits and Outpatient Radiology.

trauma. Individuals in this population were typically younger than expected with 72% being less than 50 years old. Annual analysis of high-frequency patients (10 or greater ED visits OR four or greater inpatient admissions) at Mercy Health has shown that 70% of the population is less than 60 years old.[35] Surprisingly, we did not find a prevalence of medical disease driving high-frequency access in this population. We observed an important trend of a portion of this population using multiple healthcare systems; as health systems move further into risk-based contracts, it is important to consider the movement of patients between systems.

Next Steps

After development and successful implementation with high levels of engagement at our institution, a toolkit was developed to translate implementation knowledge, and standard evidence-based CCMs© were created for common subpopulations. CCMs© are currently being piloted at 26 Trinity Health hospitals across six different states in a web-based learning collaborative.[33]

LIMITATIONS

Our quality improvement analysis compares pre-intervention and post-intervention data whereby all patients were used as their own control. Observational design has potential for confounders and we do not report risk-adjusted data. Some of the effects could be attributed to a natural reduction in healthcare utilization and costs over time (i.e., regression to the mean). To address this limitation, we 1) performed a distributional analysis of the utilization outcomes, which provides evidence that regression to the mean in our sample is minimal; and 2)

included the number of years subjects were high-utilizers prior to intervention. Additionally, referral through a consultation process may introduce bias into the sample; however, we do not consider this a weakness but rather a strength of the intervention since it places value on a professional's assessment of a patient's level of complexity within the clinical moment, which we believe is a valuable way to identify patients whose complex needs are not being met. Our analysis is restricted to a single healthcare system, which reduces generalizability of the results to other settings, especially considering that frequent users could use more than one hospital network for access. Despite these limitations, we believe the main findings of our analysis provide important contributions for improving the efficiency of healthcare delivery to HNHC patients.

CONCLUSION

CCMs© for a select group of patients were associated with decreased healthcare system overutilization and cost of care.

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Risk of Skin and Soft Tissue Infections among Children Found to be *Staphylococcus aureus* MRSA USA300 Carriers

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Introduction: The purpose of this study was to examine community-associated methicillin resistant *Staphylococcus aureus* (CA-MRSA) carriage and infections and determine risk factors associated specifically with MRSA USA300.

Methods: We conducted a case control study in a pediatric emergency department. Nasal and axillary swabs were collected, and participants were interviewed for risk factors. The primary outcome was the proportion of *S. aureus* carriers among those presenting with and without a skin and soft tissue infection (SSTI). We further categorized *S. aureus* carriers into MRSA USA300 carriers or non-MRSA USA300 carriers.

Results: We found the MRSA USA300 carriage rate was higher in children less than two years of age, those with an SSTI, children with recent antibiotic use, and those with a family history of SSTI. MRSA USA300 carriers were also more likely to have lower income compared to non-MRSA USA300 carriers and no *S. aureus* carriers. Rates of Panton-Valentine leukocidin (PVL) genes were higher in MRSA carriage isolates with an SSTI, compared to MRSA carriage isolates of patients without an SSTI. There was an association between MRSA USA300 carriage and presence of PVL in those diagnosed with an abscess.

Conclusion: Children younger than two years were at highest risk for MRSA USA300 carriage. Lower income, recent antibiotic use, and previous or family history of SSTI were risk factors for MRSA USA300 carriage. There is a high association between MRSA USA300 nasal/axillary carriage and presence of PVL in those with abscesses. [West J Emerg Med. 2017;18(2)201-212.]

INTRODUCTION

Nationally, community-associated infections due to resistant *Staphylococcus aureus* (*S. aureus*) continue at high rates.[1-3] The predominant pediatric community-associated methicillin-resistant *S. aureus* (CA-MRSA) clinical presentation remains skin and soft tissue infections (SSTI) and is seen primarily in the ambulatory setting.[4-7] The prevalence of MRSA SSTI is likely under-reported in outpatient settings since many SSTIs are not submitted for culture testing. *S. aureus* infections originate from an endogenous source and, thus, carriage is a risk factor.[8,9] Most studies have evaluated MRSA carriage and its relationship to

infection in hospitalized populations.[10-15] Reports addressing pediatric carriage in community settings[16-18, 19,20] have primarily focused on carriage in the context of transmission to household contacts[21] or known risk factors, e.g., daycare attendance[22] or outbreak settings, e.g., newborn nurseries.[23] There are fewer studies addressing *S. aureus* carriage among healthy children[24,25] and its association with SSTIs in these otherwise-healthy children.[6,26] However, Fritz et al. demonstrated that 76% of children found to have MRSA SSTI were also colonized with MRSA.[27] Atopic conditions, e.g., eczema, asthma, have been associated with the development of SSTIs.[28] Atopic dermatitis is a chronic condition complicated by high rates of *S. aureus* infections, and children with this condition are known to frequently be carriers of *S. aureus*[29]

In Atlanta, Georgia the MRSA carriage rate among adults seen in the ED was 7.3%,[1,30] but the *S. aureus* carriage rate for children in Atlanta is unknown. In the U.S., the majority of CA-MRSA SSTIs have been attributed to pulsed-field type USA300,[31,32] but little is known regarding what all the risk factors for CA-MRSA USA300 carriage are[3,22] or what drives this carriage to then cause SSTIs in the pediatric population.[7,33] Therefore, to explore from an epidemiological perspective how *S. aureus* carriage, and specifically MRSA USA300 carriage, is associated with development of SSTI in children, we determined carriage rates and assessed for associated risk factors among a population of children with and without a *S. aureus* SSTI in a large urban emergency department (ED). We hypothesized that MRSAUSA300 carriage was more highly associated with those who presented with SSTIs compared to those who presented without a SSTI.

METHODS

Study Design

This was a case control study performed in the ED of a pediatric hospital in Atlanta, Georgia. During the study period (November 2006 through April,2008) the ED had 72,722 outpatient visits and 1,114 visits for SSTI.

Recruitment of Study Participants

Recruitment generally occurred on weekdays, 8 a.m. to midnight, and randomly selected weekend dates. (Using a random number generator, two weekend days per month were selected.) Patients younger than 21 years of age, who accessed the ED for any condition and were determined to be clinically stable by the attending physician, were eligible to participate. (Classification of "clinically stable" was based on two factors: 1) Emergency Severity Index assigned to patient (which had to be greater than or equal to three);[34] and 2) verbal acknowledgment by the treating physician that the patient was clinically stable.) Children with and without a diagnosis of SSTI were identified by the attending physicians and were approached by study personnel until 250 children with SSTI were recruited. In selecting the 750 who lacked an SSTI, every 10th patient triaged as not having SSTI and determined to be clinically stable was approached for enrollment until 750 were successfully recruited and consented. Selection of both cases and controls was concurrent (Figure 1).

Study Procedures

After informed consent and assent (when appropriate) were obtained, participants and legal guardians were administered a survey pertaining to their demographic, personal and household members' risk factors **(**Table 1). Two swabs were then collected, one each from the anterior nares and axillae. For the nares, a cotton-tipped swab (Copan Venturi Transystem® with Liquid Stuart Medium) was rotated three times in the anterior portion of each naris. For the axilla, three to five brush strokes under each axillary area were taken. Moistened swabs were then transported immediately to the clinical microbiology laboratory for plating on selective and non-selective media. The institutional review boards of participating institutions approved this study.

Assessment of Risk Factors for CA-MRSA Carriage and Infection

We reviewed medical records of study participants for demographic information, including health insurance information, details of the treatment rendered at the relevant ED visit, and evidence of any previous hospital visits for *S. aureus* infections. In the survey, we collected information on age, race/ethnicity, gender, household income and household size. Information on past medical history was also collected using an open-ended question, "Does your child have any significant past medical history?" For those who responded "yes," details were recorded into categories of medical conditions. Inquiry was also made about recent antibiotic use, hospitalizations, and surgeries. Participants were also asked about daycare or school attendance. We also surveyed information on household members' use of recent antibiotics, SSTIs, hospitalizations, surgeries, dialysis, indwelling catheters, daycare attendance, and living in a closely congregated setting (jail/prison, dormitory, or military barrack) or long-term care facility within the preceding 12 months.

Definition of *S. aureus* Carriage

We assigned *S. aureus* carriage to enrolled participants, based on evidence of *S. aureus* detection from swabs taken from nasal, or axillary areas, or specimens collected from cultured SSTIs. Because MRSA USA300 has been most tied with community-associated SSTIs, we then sub-categorized those identified as *S. aureus* carriers into "MRSA USA300 carriers" (cases) and "non-MRSA USA300 carriers" (control group 1)**.** MRSA USA300 carriers included any participant who had a MRSA isolate from nasal/axillary swabs that was typed USA300 and any participant without a positive MRSA nasal/axillary isolate who had an SSTI isolate, predictably MRSA USA300.[33,35-37] Non-MRSA USA300 (control group 1) included all participants who had *S. aureus* isolate, not MRSA USA300 isolate, from nasal/axillary swabs and participants not found to have *S. aureus* nasal/axillary

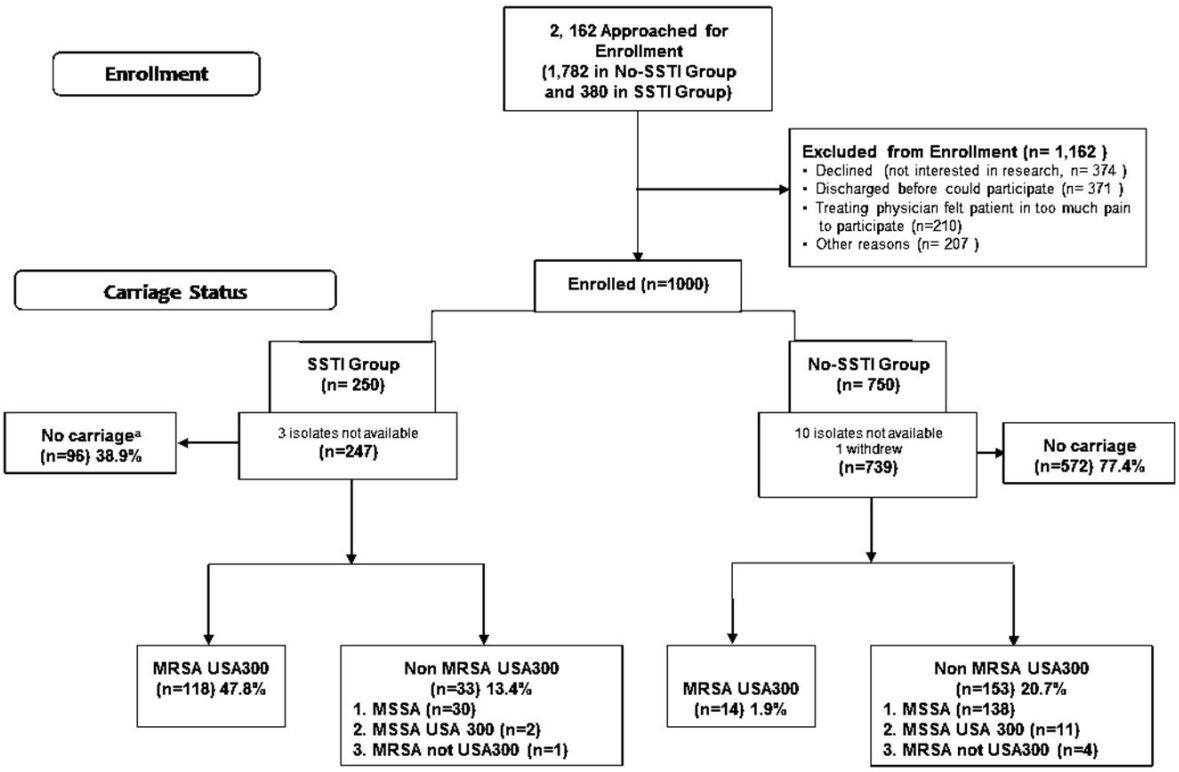

Figure 1. *Staphylococcus aureus* carriage enrollment flow diagram.
[a]Definition for 'No carriage': No detection of *S. aureus* from SSTI wound culture or no detection of *S. aureus* from cultures obtained from nasal or axillary swabs.
SSTI, skin and soft tissue infection; *MRSA,* methicillin resistant *Staphylococcus aureus.*

isolate but had an SSTI for methicillin-susceptible *S. aureus* (MSSA). If there was no evidence of *S. aureus* either from nasal/axillary swabs or SSTI culture, then we categorized the participant as not having *S. aureus* detected ("no *S. aureus"* carriage and assigned as control group 2).

Characterization of *S. aureus* SSTIs

We categorized SSTIs into the following conditions: abscess (any amount of fluctuance with or without surrounding erythema), cellulitis (erythema with or without evidence of purulence), infected wound (any break in the skin integrity with surrounding erythema and/or drainage), and other.

Laboratory Methods

Detection And Identification of S. aureus And MRSA

Swabs from enrollees were streaked within 24 hours of collection onto CHROMagar™ MRSA medium (BD Diagnostics, Sparks, MD) and Mannitol Salt Agar (MSP, Remel, Lenexa, KS). Plates were examined for typical colonies indicative of *S. aureus* and MRSA, 24 and 48 hours after inoculation and incubation at 35°C. Typical MRSA colonies on CHROMagar™ MRSA were mauve to light mauve as previously reported.[15] *S. aureus* appeared as yellow colonies on MSP. All typical colonies were sub-cultured onto 5% sheep blood agar plates (Remel, Lenexa, KS) and tested for the presence of clumping factor and protein A (*S*taphaurex®, Remel, Lenexa, KS). *S. aureus* isolates were frozen at -80°C until molecular characterization was performed.

Antibiotic Susceptibility Testing

Antimicrobial susceptibility testing was performed using MicroScan (Siemens Healthcare, Deerfield,IL). We made interpretations according to breakpoints established by the National Committee for Clinical Laboratory Standards Institute.[38] Antibiotics tested included penicillin, oxacillin, erythromycin, clindamycin, linezolid, trimethoprim-sulfamethoxazole, ciprofloxacin, quinupristin-dalfopristin, tetracycline, gentamicin and rifampin.

Pulsed-Field Gel Electrophoresis (PFGE) Typing

We performed strain typing by PFGE with the *Sma*I restriction enzyme as previously described,[39] using *Salmonella enterica* serovar Braenderup H9182 as the normalization standard. Gel images were compared using BioNumerics version 5.01 software (Applied Maths, Austin, TX) and assigned to previously defined pulsed-field types[39,40] at 95% relatedness by use of Dice coefficients and the unweighted-pair group method using average linkages.[41]

Table 1. Descriptive population characteristics of patients in study of risk of skin and soft tissue infections in children who are MRSA carriers.

Characteristic variable	Cases MRSA USA300 n=132(%)	Control 1 non-MRSA USA300** n=186(%)	P value	Control 2 No *S. aureus* n=572(%)	P value
Demographic information of participants					
Gender			0.0685		0.0747
Male	63 (47.7)	108 (58.1)		322 (56.3)	
Female	69 (52.3)	78 (41.9)		250 (43.7)	
Age distribution*			< 0.0001		0.0009
Birth through 2 years	60 (45.5)	29 (15.6)		162 (28.3)	
>2 through 5 years	28 (21.2)	21 (11.3)		139 (24.3)	
>5 through 8 years	9 (6.8)	42 (22.6)		99 (17.3)	
>8 through 12 years	15 (11.4)	51 (27.4)		81 (14.2)	
>12 years	20 (15.1)	43 (23.1)		91 (15.9)	
Family size			0.9164		0.584
0-4	78 (59.1)	111 (59.7)		323 (56.5)	
> 4	54 (40.9)	75 (40.3)		249 (43.5)	
Race/ethnicity			0.4775		0.0777
White	38 (28.9)	44 (23.7)		121 (21.2)	
Black	91 (68.9)	135 (72.5)		421 (73.6)	
Other	3 (2.3)	7 (3.8)		30 (5.2)	
Insurance type			0.1111		0.0158
Self pay	11 (8.3)	25 (13.8)		79 (13.8)	
Private	32 (24.3)	54 (29.8)		183 (32.0)	
Public	89 (67.4)	102 (56.4)		306 (53.5)	
Not reported				4 (0.7)	
Annual household income			0.0079		0.0027
Not reported	31 (23.5)	32 (17.2)		126 (22.0)	
<$20,000	80 (60.6)	98 (52.7)		264 (46.2)	
$20,00-$75,000	13 (9.9)	21 (11.3)		105 (18.3)	
>$75,000	8 (6.0)	35 (18.8)		77 (13.5)	
Participant risk factors					
Presence of SSTI			<0.0001		<0.0001
No	14 (10.6)	153 (82.3)		572 (100)	
Yes	118 (89.4)	33 (17.7)		0 (0.0)	
Prior atopic condition ***			0.0062		0.5466
No	114 (86.4)	137 (73.7)		482 (84.3)	
Yes	19 (13.6)	49 (26.3)		90 (15.7)	
Recent hospitalization or surgery			0.9416		0.1127
No	109 (82.6)	153 (82.3)		502 (87.8)	
Yes	23 (17.4)	33 (17.7)		70 (12.2)	

* For the multivariate analyses, the age groups were re categorized into 3 groups (birth through 2 years, >2 through 5 years, and >5 years) and Control Group 1, p=0.9129, and for Control Group 2, p=0.0359.

** This analyses was re-run excluding those which were determined to be MSSA USA300 (n=12) from the *S. aureus* non-MRSA USA300 cohort, and the significance levels (p<0.05) for the risk factors remained unchanged.

*** Prior atopic condition: eczema, allergies, and asthma.

SSTI, skin and soft tissue infection; *MRSA,* methicillin resistant *Staphylococcus aureus*.

Table 1. Continued.

Characteristic variable	Cases MRSA USA300 n=132(%)	Control 1 non-MRSA USA300** n=186(%)	P value	Control 2 No *S. aureus* n=572(%)	P value
Yes	7 (5.3)	13 (7.0)		24 (4.2)	
Employed in healthcare field			0.0131		0.3174
No	109 (82.6)	131 (70.4)		450 (78.7)	
Yes	23 (17.4)	55 (29.6)		122 (21.3)	
History of residing in congregate setting			0.111		0.0728
No	130 (98.5)	177 (95.2)		543 (94.9)	
Yes	2 (1.5)	9 (4.8)		29 (5.1)	

* For the multivariate analyses, the age groups were re categorized into 3 groups (birth through 2 years, >2 through 5 years, and >5 years) and Control Group 1, p=0.9129, and for Control Group 2, p=0.0359.
** This analyses was re-run excluding those which were determined to be MSSA USA300 (n=12) from the *S. aureus* non-MRSA USA300 cohort, and the significance levels (p<0.05) for the risk factors remained unchanged.
*** Prior atopic condition: eczema, allergies, and asthma.
SSTI, skin and soft tissue infection; *MRSA,* methicillin resistant *Staphylococcus aureus.*

Staphylococcal Chromosome Cassette mec (SCCmec) Typing

Among MRSA carriage isolates, identification of the SCC*mec* element was performed by polymerase chain reaction (PCR) analysis designed to identify SCC*mec* types II and IV only as previously reported.[37] *SCCmec* IV bearing strains were further sub-typed with primers for SCC*mec* IVa as described.[42]

Panton Valentine Leukocidin (PVL) Testing

We used PCR to identify the genes encoding *LukS-PV* and *LukF*-PV as reported by Lina et al.[43]

Statistical Analysis

We used descriptive statistics to provide mean value and relative frequency of each variable for all study participants and then for subgroups based on definitions of *S. aureus* carriage and the presence or absence of *S. aureus* SSTI at the time of enrollment. The relationships between MRSA USA300 and non-MRSA USA300 (MSSA USA300, MSSA not USA300, and MRSA not USA300) and presence or absence of SSTI, along with epidemiological risk factors were investigated by chi-square and t-test statistics as appropriate. We performed sensitivity analyses on risk factors to compare MRSA USA300 cases to two different control groups as described above. Certain variables were re-coded to fewer categories in order to conduct statistical analysis. For example, we grouped annual household incomes into three categories: low (< $20,000), moderate (≥$20,000 and ≤$75,000), or high (>$75,000). Household income and household size were also combined to factor in household income based on household size. We divided the midpoint of the household income reported by the household size. To look for associations between SSTI and atopic conditions, the past medical conditions were categorized into "atopic conditions" (eczema, allergies, asthma) or "not atopic conditions." We applied logistic regression to assess the bivariate association between carriage status and the presence of risk factors. Bivariate logistic regression analysis was also applied for those factors *a priori* thought to be associated with risk of MRSA USA300 and then multivariate logistic regression analysis was performed to assess the association between MRSA USA300 and non MRSA USA300 carriage status adjusted for those risk factors. Similarly, we performed multivariate logistic regression analysis to assess MRSA USA300 and no *S. aureus* carriage, adjusted for risk factors determined *a priori*. We used the log likelihood ratio test to assess the significance of variables on the odds of *S. aureus* carriage and, specifically, MRSA USA300 carriage. Likewise, we calculated odds ratios as estimates of relative risks, indicating the magnitude of associations, along with corresponding 95% confidence intervals (CI). All tests for significance were two-tailed, and a p-value of ≤ 0.05 was considered significant. We performed statistical analysis using SAS 9.1(SAS Institute, Cary, NC). Survey questionnaire responses were based on self-reports, which were administered as personal interviews conducted in the privacy of the ED examination room.

RESULTS

Study Population Characteristics

From November 2006 through April 2008, 2,162 children were approached in the pediatric ED for enrollment. Sixty-six percent (250/380) of children with an SSTI and 42% (750/1,782) of children who lacked an SSTI agreed to participate (Figure 1). Reasons for declining enrollment were similar in both groups.

Characteristics of *S. aureus* Carriers

Risk factors for S. aureus Carriage

Participants identified as MRSA USA300 carriers compared to non-MRSA USA300 (control group 1) were less than two years of age, presented with or had previous SSTI, had recent antibiotic use, and had a household member with past SSTI (Table 1).

In comparison, non-MRSA USA300 carriers, who were mostly MSSA carriers, were more likely to have a household member employed in healthcare field, have an atopic condition, and if they were less than or equal to two years of age, attended daycare. When we compared MRSA USA300 to those who had no evidence of any *S. aureus* carriage (control group 2), we determined that receiving public health insurance and having lower income also were significant risk factors.

Table 2 shows the adjusted odds ratio for the epidemiological risk factors associated with MRSA USA300 carriers compared to non-MRSA USA300 carriers and to those with no evidence of *S. aureus* carriage. In these multivariate analyses, we observed that those younger than two years of age who attended daycare were

Table 2. Multivariate logistic regression analysis of risk factors associated with MRSA USA300, Non-MRSA USA300 carriage, and no *S. aureus* carriage.

Risk factor	Odds ratio (non MRSA USA300)	95% CI (non MRSA USA 300)	Odds ratio (no *S. aureus*)	95% CI (no *S. aureus*)
Interaction between age and daycare				NS
>2 through 5 years	1.00			
Birth through 2 years	3.67	1.07-12.57		
>5 years	1.00		1.00	
Birth through 2 years	11.47	4.33-30.42	2.14	1.32-3.48
>2 years through 5 years	3.13	1.29-7.56	1.02	0.58-1.79
Interaction between age and no daycare				NS
>2 through 5 years	1.00			
Birth through 2 years	0.78	0.23-2.67		
>5 years	1.00			NS
Birth through 2 years	1.13	0.23-5.52		
>2years through 5 years	1.45	0.19-11.03		
Income				
>$75,000	1.00		1.00	
Not reported	3.21	1.09-9.49	2.13	0.87-5.21
<$20,000	4.18	1.57-11.12	3.13	1.37-7.16
$20,000-$75,000	3.54	1.06-11.82	1.37	0.51-3.68
Prior atopic condition *				NS
Yes	1.00			
No	2.47	1.19-5.12		
Recent antibiotic use				
No	1.00		1.00	
Yes	2.51	1.47-2.90	2.42	1.58-3.71
Past history of SSTI				
No	1.00		1.00	
Yes	4.88	2.08-11.43	4.45	2.46-8.05
Family history of SSTI				
No	1.00		1.00	
Yes	3.91	1.76-8.69	3.42	2.06-5.67

Multivariate risk analyses compared cases (MRSA USA300) to the two different controls, non MRSA USA300 (n=186), and no *S. aureus* (n=572).

* Prior atopic condition: eczema, allergies, and asthma.

SSTI, skin and soft tissue infection; *MRSA,* methicillin resistant *Staphylococcus aureus.*

almost four times more likely to be MRSA USA300 carriers (aOR 3.67, 95% CI 1.07-12.57) compared to non-MRSA USA300 carriers. Similarly, MRSA USA300 carriers had an adjusted odds ratio of 2.51(95% CI 1.47-29) compared to non-MRSA USA300 carriers for recent antibiotic use, 4.88 (95% CI 2.08-11.43) for past history before current episode of SSTI and 3.91 (95% CI 1.76-8.69) for family history of SSTI. These adjusted odds remained similarly higher for MRSA USA300 carriers compared to those who were not found to have any evidence of *S. aureus* carriage for all the risks except daycare attendance in those younger than two years of age. MRSA USA300 carriers were also 4.18 (aOR, 95% CI 1.57-11.12) and 3.13 (aOR 95% CI 1.37-7.16) more likely to have an income <$20,000 compared to non-MRSA USA300 carriers or those with "no *S. aureus"* carriage, respectively.

Among those with an SSTI, 48% (118/247) were MRSA USA300 carriers compared to 13% (33/247) non-MRSA USA300. In contrast, among those without SSTI at enrollment, only 2% (14/739) were MRSA USA300 carriers compared to 21% (153/739) non-MRSA USA300 (Table 3).

No MRSA carriers were found among those who had SSTI cultures that yielded no growth (14) or *S. pyogenes.*[4] MRSA USA300 carriers (71.2%, 84/118) were also more likely than non-MRSA USA300 carriers (39.4%, 13/33) to have an SSTI located below the waist than above the waist (p=0.0008) (Figure 2).

S. aureus Carriage Rates Based on Nasal and Axilla Cultures

The positivity rate was 25% (246/986) for *S. aureus* based only from nasal or axilla cultures. Of those with *S. aureus*, the carriage rates for MRSA USA300 and MSSA USA300 were 22.0% (54/246) and 5.3% (13/246), respectively; the remaining non-USA300 were mostly all MSSA (70.3%, 173/246) and very few MRSA (2.4%, 6/246) (Fig. 3). Significant risk factors for nasal/axillary MRSA USA300 carriage were the same as stated previously (data not shown).

Concordance between Nasal and Axillary *S. aureus* Carriage Isolates

Among 237 with positive *S. aureus* nasal isolates, 183 (77.25%) had positive *S. aureus* axillary isolates. Conversely, 183 of the 192 (95.3%) axillary carriers were also nasal carriers. Among the 57 *S. aureus* nasal and axillary pairs designated for typing, there was concordance of PFGE types in 53 pairs (93.3%). We found discordant pulsed-field types for three MSSA carriers who lacked an SSTI, of which two were associated with USA300. There was discordant pulsed-field typing of one MRSA carrier with an SSTI also associated with USA300.

Microbiological And Molecular Profiles of S. aureus Nasal and Axillary Carriage And SSTI Isolates

Susceptibility to ciprofloxacin, clindamycin,

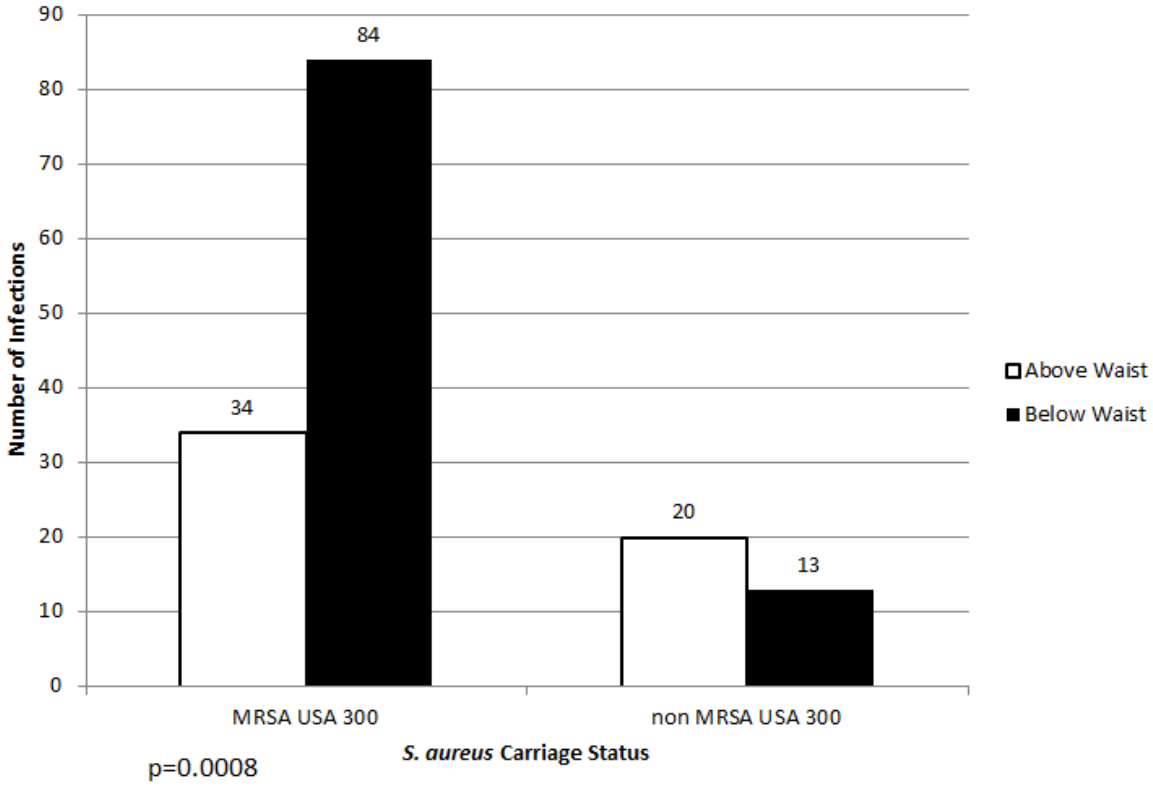

Figure 2. *S. aureus* carriage strains and body locations of skin and soft tissue infections. *SSTI,* skin and soft tissue infection; *MRSA,* methicillin resistant *Staphylococcus aureus*.

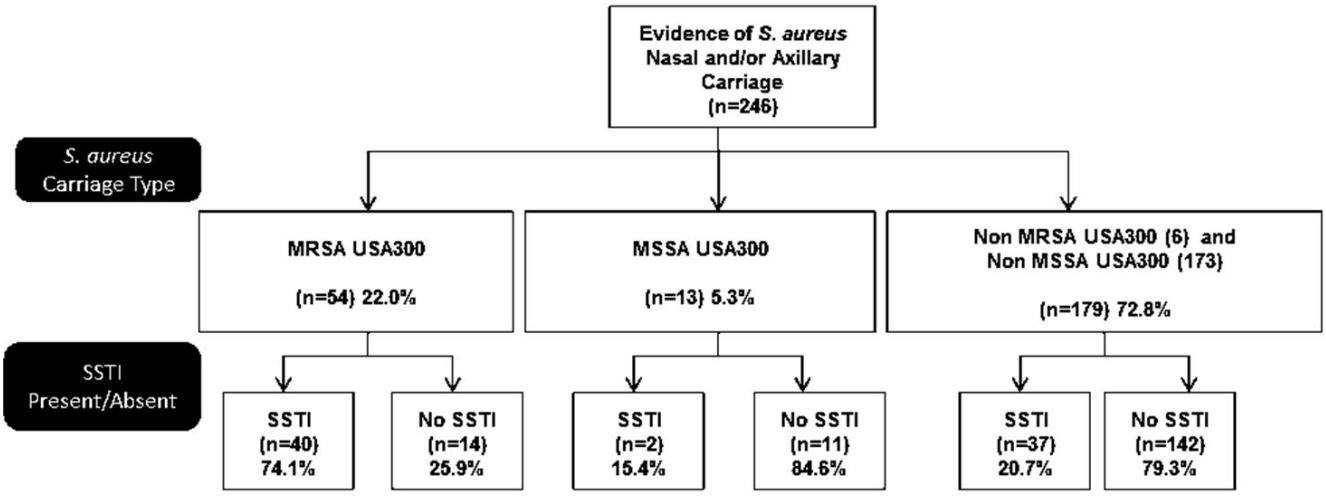

Figure 3. Distribution of nasal and axillary *S. aureus* carriage types between SSTI and no-SSTI groups.
Note: No *S. aureus* carriage was detected in 668 swabs taken from either nasal, axillary areas: 96/668 were from SSTI group and 572/668 were from No SSTI group.
SSTI, skin and soft tissue infection; *MRSA,* methicillin resistant *Staphylococcus aureus*.

erythromycin, gentamicin, linezolid, rifampin, trimethoprim-sulfamethoxazole, tetracycline, and vancomycin was shared between nasal/axillary carrier isolates and the associated SSTI isolates in 83.3% (10/12) MSSA isolates, and 93.3% (28/30) MRSA isolates.

There were 302 *S. aureus* nasal/axillary carriage isolates from 246 participants available for molecular testing. USA300 accounted for 88.3% (53/60) of all MRSA isolates. There was a significant difference between rates of MRSA USA300 nasal/axillary carriage among those with an SSTI (92.9%, 39/42) and those who lacked an SSTI (77.8%, 14/18, p=0.05). All nasal/axillary MRSA USA300 isolates had a SCC*mec* type IV element and 74.5% (41/55) were SCC*mec* type IVa. The PVL genes were found in 67% (12/18) of these MRSA carriage isolates from patients who lacked an SSTI and in 92.8% (39/42) of MRSA carriage isolates with an SSTI (p=0.009); all 39 PVL + MRSA carrier isolates were USA300.

DISCUSSION

In our study we hypothesized that children found to have SSTIs are more likely to be MRSA carriers and, in particular, MRSA USA300 carriers compared to children who presented without SSTI. We found that children younger than two years were 3.67 [95% CI, 1.07-12.57] times more likely to be MRSA USA300 carriers than all other *S. aureus* PFGE types; this observation persisted even after adjusting for factors such as daycare (Table 2). Most likely this is related to the naturally higher bacterial load and moist environment of the diapered area.[44] MRSA USA300 carriers were also more likely than all other *S. aureus* carriers to have SSTIs below the waist, even though the overall distribution of SSTI types was similar between MSSA and MRSA carriers (Figure 2). These two findings were consistent with what has been reported by Fritz et al.[27] Our risk factors for MRSA USA300 carriage in those children under two years, e.g., recent antibiotic use, history of SSTI, are similar to what others have reported for CA-MRSA infections where there was no pulsed-field typing done (Table 2). Our proxies for lower socioeconomic factors (low income, <$20,000, public health insurance) were more likely among those found to be MRSA USA300 carriers, which may be tied in with why household crowding is a risk for CA-MRSA infections (Table 2).

We did not find daycare or school attendance as a risk for SSTI among those who were MRSA USA300 carriers, and in fact among those who presented with SSTI, non-MRSA USA300 carriers had higher rates of daycare or school attendance than MRSA USA300 carriers (Table 2). Although daycare has been cited as a risk factor for CA-MRSA infections in some studies,[45] our finding is consistent with what others have also reported.[44] We postulate this may be attributed to the fact that daycare or school promotes close contact of children, and thus spread of infections among all types of *S. aureus* carriers, not just MRSA USA300. Others have suggested that daycare attendees may have more frequent changes of diaper and, consequently, less time where skin is directly exposed to stool or moisture.[44]

We found a history of atopic conditions to be associated with non-MRSA USA300 carriers with an SSTI, which was not found among MRSA USA300 carriers (Table 2). Interestingly, having a history of atopic conditions (including eczema or atopic dermatitis) did not occur more frequently among those who presented with an SSTI, even though this condition is clearly associated with compromised skin

Table 3. Relationship of *S. aureus* carriage and presence of skin and soft tissue infections.

Carriage status	SSTI, n= 247 (%)	No SSTI, n=739 (%)	Odds ratio (95%, CI)	P-value
No *S. aureus* (n=668)	96 (38.9)	572 (77.4)	1.0	
MRSA USA300 (n=132)	118 (47.7)	14 (1.9)	50.21 (27.71-91.01)	<0.0001
Non MRSA USA300 (n=186)	33 (13.4)	153 (20.7)	1.29 (0.83-1.98)	0.26

SSTI, skin and soft tissue infection; *MRSA,* methicillin resistant *Staphylococcus aureus*.

integrity and children with atopic dermatitis are known to have high carriage rates of *S. aureus*.[46,47] Little has been published on CA-MRSA carriage and its association to infections among those with atopic dermatitis,[48] despite the fact that these patients have a predisposition for being heavily colonized or infected with *S. aureus*.[49-51] In the study published by Matiz, et al., they also did not find higher rates of CA-MRSA among their atopic dermatitis population.[52] This observation may be due in part to a "protective effect" afforded by presence of other non- CA-MRSA organisms, and other factors, e.g., skin levels of fibronectin, fibrinogen.[53]

We found that even though the rate of household members with an SSTI was higher among MRSA USA300 carriers, almost 10% of non-MRSA USA300 carriers who presented without an SSTI had a household member with a previous SSTI (Table 2); this observation further demonstrates how widespread *S. aureus*-related SSTIs are in the community. In other studies, more than 50% of household contacts of patients with *S. aureus* infections have been shown to be *S. aureus* carriers.[27] The specific factors that lead a household member with *S. aureus* carriage to a household member with an infection may be multifactorial: the specific strain (e.g., specific virulence factors produced by USA300); host immunity (e.g., skin integrity); or environmental conditions (e.g., household crowding, extent of sharing of household items that contact the skin).

Not surprisingly, we also found that MRSA USA300 carriage was at least 10 fold higher in children with SSTI compared to those who lacked an SSTI (Table 3). In contrast, the no- MRSA USA300 carriage rates (which were mostly MSSA non-USA300 strains) were similar between SSTI and no SSTI, suggesting that MSSA carriage is not predictive of development of an SSTI. Our MRSA carriage rate was lower than the 61% observed among those with SSTIs reported by Fritz et al.[27] However, in our study, we also addressed the impact of specific strain types, namely the impact of MRSA USA300 carriage. There was also more heterogeneity in pulsed-field types among MRSA carriers who lacked an SSTI compared to those with an SSTI. This also suggests that MRSA USA300 carriage is predictive of development of a MRSA SSTI, particularly of abscesses large enough to warrant the clinician's decision to culture.

Our study supports the notion that PVL cytotoxin in MRSA USA300 carriage isolates may be a contributing factor to the development of an abscess type of SSTI as has been suggested by others.[1,33] The PVL genes were found in all of the MRSA USA300 nasal and axillary carriage isolates. Further study is needed to understand what additional virulent factors are tied to MRSA USA300 carriage and specifically which virulence factors contribute most to the development of recurrent SSTIs or more invasive infections.

The discordance between nasal and axillary isolates was higher for MSSA than MRSA and more often seen in MSSA carriers who did not present with an SSTI. We also found that MSSA carriers were more likely to have discordance with their SSTI isolates, which were found to be MRSA. These discordances taken together with the observation that there was no predictive association seen with MSSA carriage and development of an SSTI further support the notion that specific strains among MSSA, more so than MRSA, were likely to carry genetic backgrounds that were not disease producing.[26]

The MRSA nasal/axillary carriage rate among patients with an SSTI was far less than the MRSA SSTI rate among all cultured SSTIs. It is possible that many of those not found to be *S. aureus* carriers but had *S. aureus* SSTIs might be transient carriers, who simply were not detected at the time of enrollment in our point prevalence study. Intrinsic factors related to specific clonal types may be responsible and explain why some strains have the propensity for persistent carriage and subsequent development of an SSTI while others do not.

LIMITATIONS

This study was limited since it was a convenience sample, and thus, a point-prevalence determination of MRSA nasal and axillary carriage on the day patients were enrolled. We were not able to assess for differences between transient *S. aureus* carriers and persistent carriers. *S. aureus* isolates obtained from the SSTI cultures were also not available to perform pulsed-field typing or other molecular testing. Based on the fact that the nares have been considered to be the most frequent site for *S. aureus* carriage and a risk factor for subsequent staphylococcal infection,[19,54,55] our study collected from this area to determine carriage rates. It is possible that this site may not yield the highest possible number of *S. aureus* carriers[56] and therefore is an underestimation of the true *S. aureus* prevalence carriage rate in our population. Miller et al. found they would have missed 48% of *S. aureus* carriage by conducting a nares-only surveillance. (They screened for carriage from three sites: nares, oropharynx, and inguinal.)[26]

However, our *S. aureus* nasal carriage rates are similar to what others have reported in otherwise-healthy children.[6] Future studies may need to include broth-based cultures of specimens obtained from nasal, oral pharyngeal, and inguinal area so as to capture the highest number of *S. aureus* carriers.[57] Culturing additional body sites may also shed more information as to why some have reported USA300 strains predominantly colonizing groin areas compared to non-USA300 strains, which were found more frequently in the oropharynx.[58] We also recognize that the data were collected during the height of the CA-MRSA epidemic in this country; however, we believe that based on more recent studies (Immergluck L, personal communication on unpublished data of 85 children with SSTI enrolled from the same hospitals) SSTIs due to CA-MRSA remain a constant infection in our ambulatory and ED settings. Understanding the epidemiology, particularly as it relates to the specific circulating strains and the antibiotic profile (phenotype) of these strains that cause infections, is critical as we continue to revise the treatment guidelines for empiric treatment and for outlining when routine culture should be done in these settings. Moreover, the MRSA strains associated with carriage are also important to delineate, given the association between carriage and infection.

CONCLUSION

We found children younger than two years were at highest risk for MRSA USA300 carriage. We also found lower income, recent antibiotic use, previous or family history of SSTI (but not daycare) to be risk factors for MRSA USA300 carriage. There is clearly a high association between MRSA USA300 nasal/axillary carriage and presence of PVL in those found to have the specific SSTI diagnosis of abscesses. Our study pulsed-field typed the wide array of both MRSA and MSSA non-USA300 carriage isolates among children with no SSTI infections. The propensity for MRSA USA300 infections to occur in the groin and buttock areas is likely related to higher bacterial burden provided through the moist milieu in this area. Our finding of higher MRSA USA300 carriage in children younger than two years with SSTIs needs to be further explored. Additional studies are also needed to define what host and what specific pathogenic factors might distinguish those who become infected to continue to become persistent MRSA USA300 carriers from those who are merely transient MRSA carriers. Given the strain diversity for both MRSA and MSSA and the variability in which strains spread among household members, more studies are needed to help understand the virulence and host factors that allow certain strains to move from carriage to primary and recurrent infections if we are to wage a successful battle to decrease SSTI in this population.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias.

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Prevalence of Horizontal Violence Among Emergency Attending Physicians, Residents, and Physician Assistants

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Introduction: Horizontal violence (HV) is malicious behavior perpetrated by healthcare workers against each other. These include bullying, verbal or physical threats, purposeful disruptive behavior, and other malicious behaviors. This pilot study investigates the prevalence of HV among emergency department (ED) attending physicians, residents, and mid-level providers (MLPs).

Methods: We sent an electronic survey to emergency medicine attending physicians (n=67), residents (n=25), and MLPs (n=24) in three unique EDs within a single multi-hospital medical system. The survey consisted of 18 questions that asked participants to indicate with what frequency (never, once, a few times, monthly, weekly, or daily) they have witnessed or experienced a particular behavior in the previous 12 months. Seven additional questions aimed to elicit the impact of HV on the participant, the work environment, or the patient care.

Results: Of the 122 survey invitations 91 were completed, yielding a response rate of 74.6%. Of the respondents 64.8% were male and 35.2% were female. Attending physicians represented 41.8%, residents 37.4%, and MLPs 19.8% of respondents. Prevalence of reported behaviors ranged from 1.1% (Q18: physical assault) to 34.1% (Q4: been shouted at). Fourteen of these behaviors were most prevalent in the attending cohort, six were most prevalent in the MLP cohort, and three of the behaviors were most prevalent in the resident cohort.

Conclusion: The HV behaviors investigated in this pilot study were similar to data previously published in nursing cohorts. Furthermore, nearly a quarter of participants (22.2%) indicated that HV has affected care for their patients, suggesting further studies are warranted to assess prevalence and the impact HV has on staff and patients. [West J Emerg Med. 2017;18(2)213-218.]

INTRODUCTION

Disruptive behaviors, such as bullying, verbal or physical threats, emotional abuse, and other purposeful malicious acts initiated by one co-worker and aimed toward another, are often termed horizontal violence (HV) or lateral violence. Prevalence research in healthcare has thus far been studied almost exclusively in the context of nursing.[1-5] These behaviors negatively impact patient care and safety, increase hospital costs, decrease the morale of the healthcare team, and negatively impact the health and wellbeing of those involved.[1,6,7] Based on a study performed by the Institute for Safe Medication Practices (ISMP), which included 2,095 healthcare providers, almost half (49%) stated that they altered how they clarify medication orders based on previously encountered intimidating behaviors.[8] Another study found that 17% of 1,441 respondents were aware of a specific adverse event, defined as "an injury resulting from a medical intervention not due to the underlying condition of the patient," which occurred due to disruptive behavior.[9] Unlike violence originating from patients toward staff, as previously

studied, HV is more subtle, frequently non-physical, and ambiguous.[10] In 2004 Dr. Griffin described the 10 most common forms of lateral violence as "Nonverbal innuendo (raising eyebrows, face-making)," "Verbal affront (covert or overt, snide remarks, lack of openness, abrupt responses)," "Undermining activities (turning away, not available)," "Withholding information (practice or patient)," "Sabotage (deliberately setting up a negative situation)," "Infighting (bickering with peers,)" "Scapegoating (attributing all that goes wrong to one individual)," "Backstabbing (complaining to others about an individual and not speaking directly to that individual)," "Failure to respect privacy," and "Broken confidences." [11]

For consistency the questions chosen in this survey are similar to questions that have previously been used in HV research among nurses and aimed to address some of the 10 most common behaviors identified by Griffin. Prevalence data varies greatly among studies due to inconsistent measurement techniques and subjective reporting. In the United States estimates suggest that prevalence is between 5%-38%.[2] In response, the Joint Commission has produced a sentinel event alert (SEA) in an effort to improve patient and staff safety, wellbeing, and working conditions.[1] In this study we asked participants to respond whether they had witnessed or experienced HV behaviors originating from a co-worker toward themselves or toward another co-worker.

The goal of this pilot study was to assess whether HV extends beyond the nursing context and whether future studies are warranted to further identify disruptive behaviors and eventually aim to improve the work environment and patient care. To the best of our knowledge this is the first study looking at the prevalence of HV among emergency medicine (EM) attending physicians, residents, and MLPs.

Table 1. Demographic data of participants (n=91) in a horizontal violence survey regarding the prevalence of workplace bullying, including physical assault, between emergency physicians, residents and mid-level providers.

Participant demographics	Results (n=91)
Gender	
Male	64.8%
Female	35.2%
Age (years)	
Under 21	1.1%
21-30	35.2%
31-40	39.6%
41-50	11%
51-60	8.8%
Over 60	4.4%
Position	
Attending physicians	41.8%
Residents	37.4%
MLPs	19.8%
Other (fellow)	1.1%
Experience (years)	
2 or less	45.1%
3-5	17.6%
6-10	20.9%
11-15	5.5%
Over 15	11%

MLPs, mid-level providers.

METHODS

Study Design

This study implemented a descriptive cross-sectional design to ascertain the prevalence of HV in a population of attending physicians, residents, and physician assistants. All participants were current employees of a single practice plan who staffed three hospitals that are part of a large multicenter system in suburban Detroit, MI. We used an anonymous electronic survey using SurveyMonkey (www.surveymonkey.com), and distributed a link to the survey via e-mail. All data were collected electronically and anonymously between the dates of November 24, 2014, and January 1, 2015. We sent three follow-up e-mails via the electronic survey provider to participants who had not responded. To increase the response rate, participants who completed the survey were provided with a link to a second and separate survey to collect e-mail addresses that were then entered into a lottery system for a chance to win a $100 VISA gift card. Survey responses and e-mail addresses of participants were not linked, thus maintaining complete anonymity. One e-mail address was chosen at random by a randomizing algorithm provided by randomresult.com as the winner of the gift card. This study was reviewed and approved by the local health system internal review board committee.

Selection and Participant Demographics

Any participant who was a current employee (physician, resident or physician assistant) in the ED of one of the three hospitals surveyed in this study and had a valid e-mail address on file was included. We contacted 122 eligible participants, of whom 56 were attending physicians, 42 residents, and 24 physician assistants. Table 1 presents the demographic data of the 91 participants of this study.

Method of Measurement and Statistical Analysis

The survey consisted of 18 questions regarding HV (Table 2) and seven additional questions aimed to elicit its impact on the participant (Table 3). We addressed the

validity of this survey by designing questions based on previous peer-reviewed studies with the same or similar endpoint. Eight of the 18 questions were based on several previously published surveys measuring prevalence of HV in the nursing context.[2,8,12,13] We designed 10 of the questions used in this survey based on the Negative Acts Questionnaire - Revised (NAQ-R), a validated survey tool designed to measure the prevalence of workplace bullying.[14] The survey was adjusted based on feedback from the statistician of the local research institute but has not been validated by other experts in the field or by a sample population. The prompt stated, "Please answer how many times in the last 12 months, on average, you have personally experienced or witnessed any of the following behaviors displayed by a coworker (ex: by a physician, nurse, PA, resident, technician, etc.)." The answer choices for the 18 behavior questions were "never," "once," "a few times," "monthly," "weekly," or "daily."

We considered only behavior responses of at least "a few times" or more for the purpose of prevalence analysis and discussion in this study. The data were exported via Excel and SAV formats and sent to the local research institute for statistical analysis. The primary endpoint of interest was an estimation of the prevalence of horizontal violence (Figure). We calculated analysis of prevalence in each subgroup, attending physician, resident, and MLP, along with providing 95% confidence intervals.

RESULTS

We sent 122 survey invitations via e-mail, and 91 participants completed the electronic survey, yielding a response rate of 74.6%. Of those who responded 64.8% were male. Attending physicians represented 41.8%, residents 37.4%, mid-level providers 19.8%, and other (fellow) 1.1% of respondents.

Prevalence of Horizontal Violence Behaviors

The prevalence of HV behavior is measured as a participant having indicated that they experienced or witnessed a particular behavior at least "a few times" or more over the 12 months prior to taking this survey. If a behavior was experienced or observed more than just one time in the preceding 12 months, the participant was asked to indicate with what frequency this behavior was experienced or observed (a few times, monthly, weekly, or daily) to further characterize its prevalence. Data for this survey ranged between very low prevalence of 1.1% (n=1) to a prevalence of 34.1% (n=31) as indicated in the Figure. We did not include prevalence data for question 3 in the discussion as it was determined not to represent horizontal violence, based on feedback as mentioned in the limitations section of this paper.

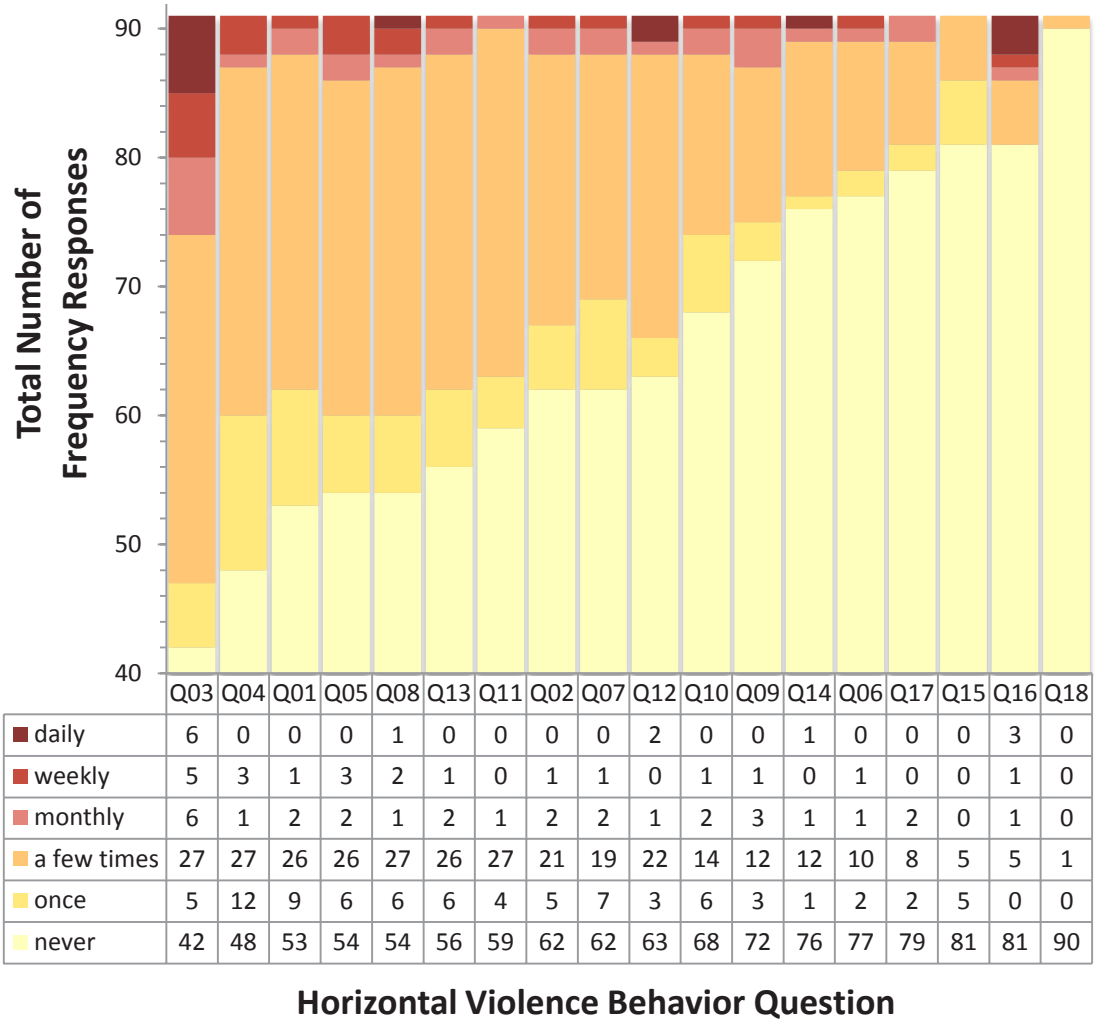
Subjective Impact of Horizontal Violence Behavior

Participants responded to seven additional questions aimed to gauge the impact of these behaviors on their work and personal wellbeing (Table 3). Less than 10% of

Table 2. Prevalence questions of survey used in this study of horizontal violence

Question (Q) #	Question content
Q1	Humiliated by a co-worker
Q2	Ridiculed by a co-worker for asking a question
Q3	Asked to do tasks below your competencies
Q4	Shouted at
Q5	Subject to demeaning remarks
Q6	Victim to threatening body language
Q7	Consistently criticized for your work
Q8	Deemed incompetent for a task within your skill level
Q9	Felt pressured to change your professional opinion or treatment plan due to feeling intimidated by another co-worker
Q10	Turned down or intentionally ignored when asking the opinion of a fellow co-worker
Q11	Victim of unflattering rumors
Q12	Turned down when asking a co-worker to do a task
Q13	Feel that your co-workers do not respect your professional decisions
Q14	Isolated or excluded by co-workers
Q15	Asked or hinted at to quit your job
Q16	Set up to fail a task asked of you (such as completing a task in a time frame that is not possible or realistic)
Q17	Threatened for voicing your opinion
Q18	Physically assaulted

Q, question.



	Q03	Q04	Q01	Q05	Q08	Q13	Q11	Q02	Q07	Q12	Q10	Q09	Q14	Q06	Q17	Q15	Q16	Q18
daily	6	0	0	0	1	0	0	0	0	2	0	0	1	0	0	0	3	0
weekly	5	3	1	3	2	1	0	1	1	0	1	1	0	1	0	0	1	0
monthly	6	1	2	2	1	2	1	2	2	1	2	3	1	1	2	0	1	0
a few times	27	27	26	26	27	26	27	21	19	22	14	12	12	10	8	5	5	1
once	5	12	9	6	6	6	4	5	7	3	6	3	1	2	2	5	0	0
never	42	48	53	54	54	56	59	62	62	63	68	72	76	77	79	81	81	90

Figure. Number of frequency responses correlating to questions of Table 2.
Q, question.

respondents reported that HV had affected their personal health (Q21), led them to think about quitting their job (Q22), or made them feel unsafe in their work environment (Q25). Nearly a quarter (22.2%) of respondents reported that they could remember a specific time in the preceding 12 months when it had negatively impacted care for their patients (Q19), and 11.1% reported dreading coming to work due to being subjected to bullying (Q20). Furthermore, 65.6% of respondents indicated that they felt safe to report acts of HV in their hospital (Q23) and 32.2% of participants indicated it had previously been addressed by their institution (Q24).

Horizontal Violence Prevalence in Subgroups: Gender, Position, and Experience

In the subgroup analysis, the behavior of being shouted at (Q4) was found to be more common among MLPs and females. However, as 77.8% of MLPs were female, making the variables of gender and position highly related, it cannot be determined whether this behavior is more prevalent among MLPs or females. Other behaviors that were more common in the female/MLP subgroups were being subjected to demeaning remarks (Q5), being a victim of unflattering rumors (Q11), feeling that coworkers did not respect their professional decisions (Q13), and being isolated or excluded by coworkers (Q14).

Several HV behaviors – such as being turned down or intentionally ignored when asking the opinion of a fellow coworker (Q10), being asked or hinted at to quit their job (Q15), set up to fail a task asked of them (Q16), and threatened for voicing their opinion (Q17) – were more common among attending physicians as well as those who were more experienced (number of years working). However, attending physicians also had the most experience working in the ED. Thus, it is not possible to determine whether these behaviors were more prevalent in the subgroup of position (attending physicians) or experience (number of years working).

Table 3. Responses to questions 19-25 eliciting impact of horizontal violence.

Question (Q)#	Question content
Q19	Can you remember a specific time at which acts of horizontal violence have affected care for your patients?
Q20	Did you or do you ever dread coming to work due to being subjected to bullying at the workplace?
Q21	Has Horizontal Violence (verbal or non-verbal) affected your own health?
Q22	Have you ever or are you currently thinking about quitting your job due to acts of Horizontal Violence towards you?
Q23	Do you feel safe to report acts of Horizontal Violence in your hospital?
Q24	Has your current institution addressed horizontal violence in the past year?
Q25	Do you feel unsafe in your current work environment for any reason?

Q, question.

DISCUSSION

To the best of our knowledge, this study is the first to look at the prevalence of HV in the context of attending physicians, residents, and physician assistants in the ED. Previous research has largely focused on HV among nurses, but it was not clear whether these types of behaviors also extend into other healthcare professions. Prevalence data in this study ranged from 1.1% to 34.1%, which is similar to data previously published in nursing studies of 5%-38%.[2,3,8,9,12] Nearly a quarter (22.2%) of participants felt that HV behaviors, either witnessed or experienced themselves, had negatively impacted patient care and 8.7% indicated that it had impacted their own health. Common behaviors (Q1, 2, 4, 5, 7, 11, and 12) identified in this survey fall into the previously described categories by Griffin of "Covert or overt verbal affront," "Failure to respect the privacy of others," and "Undermining clinical activities."[11] The prevalence of these behaviors having occurred "a few times, monthly, weekly, or daily" in the preceding 12 months ranged between 25 responses (27.4%) for Q12 (turned down when asking a co-worker to do a task) to 31 responses (34.1%) for Q4 (been shouted at). Only one respondent (1.1%) indicated having experienced or witnessed physical violence (Q18) between co-workers a few times in the preceding 12 months.

Previous studies have shown that HV behaviors impact patient care, medical errors, preventable adverse outcomes, negatively impact patient satisfaction, and increased malpractice risk.[1] These results suggest that there is a potential opportunity to enhance patient care by improving the working environment for healthcare providers. Furthermore, the prevalence of these behaviors may even be higher than detected in this survey as only 65.6% of participants felt safe to report acts of HV to their institution, suggesting that employees may have refrained from participating in this study.

In an effort to identify successful interventions, a recent study from 2013 compared previously published reports of policy implementations addressing lateral violence from 12 sources. The authors concluded that the most important interventions include 1) an engaged and strong managerial leadership encouraging a supportive culture for policy changes addressing lateral violence; 2) involving administration and personnel "frequently and consistently including matters of lateral violence;" 3) "intentionally changing policy and environment;" and 4) "implementing multiple interventions simultaneously that may not be effective when used alone."[15] While more research is required to identify best practices, as much of the evidence comes from expert opinion, we believe the proposed implementations are financially feasible, can be implemented in a timely fashion, and will address both job satisfaction and the quality of patient care. Many institutions may already be in the process of addressing HV or LV among their nurse employees and may want to consider expanding their efforts to include physicians and physician assistants.

LIMITATIONS

Our study has several limitations. The survey tool was not validated for a physician or MLP population. However, this tool was designed based on several survey tools that have been validated in studies examining the prevalence of HV in nurse and nursing student populations. We initially included Question 3 ("asked to do tasks below your competencies") in this study as it had been used in previous studies, but we decided not to include responses to this question in the results or discussion part of this study as feedback pointed out that it may not fit the definition of HV depending on its interpretation. For transparency it was not removed from the figures and tables of this study.

This is a pilot study, and as such there were relatively small numbers of participants in each category. The study participants were from a single practice plan and a single residency. The authors intend to expand this study to include multiple institutions and residencies. The data may be influenced by a recall bias such that participants may not have accurately remembered all events in the preceding 12

months and some may have avoided filling out the survey if they did not feel safe in reporting HV behaviors. We therefore encourage future studies to limit participant recall of events to six months or less and stress the anonymity of responses. There may also have been selection bias. Those who participated may have done so because they have been victims of HV and wanted to report it, or conversely, perpetrators. Lastly, approximately 25% of potential participants did not complete the survey, resulting in a small sample size that may have skewed results.

CONCLUSION

Horizontal violence and its impact on staff and patients is prevalent among emergency medicine attending physicians, residents, and MLPs. While direct comparisons to previously published data cannot be made due to the lack of a standardized survey tool, preliminary data suggest these behaviors extend beyond nursing to involve multiple healthcare professions. Everyday decisions made by physicians and physician assistants carry significant responsibility and may have a critical impact on the quality of care, medical errors, and outcomes of patients. Behaviors that negatively impact decision-making capacity should therefore be elicited and reduced or eliminated. Further research is warranted to understand and effectively intervene in behaviors that impact job satisfaction and patient care beyond the scope of nursing.

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Community Paramedicine: 911 Alternative Destinations Are a Patient Safety Issue

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The 2010 Patient Protection and Affordable Care Act (ACA) served as a conduit for many previously uninsured U.S. citizens to obtain health insurance; however, insurance does not necessarily equate to timely access to care. A 2015 study found that efforts by policymakers and health insurance plans to drive Medicaid patients out of emergency departments (ED) and into primary care clinics are not working. [1] More than half of all providers listed by Medicaid managed care plans could not offer timely appointments to enrollees, despite a provision in the ACA temporarily boosting pay to primary care physicians treating Medicaid patients. The median wait time was two weeks, but over one-quarter of providers had wait times greater than one month. Consequently, newly insured patients are increasingly seeking care in EDs and the reliance on emergency care remains stronger than ever. In a May 2015 poll, three-quarters of emergency physicians reported that emergency visits were going up. This represents a significant increase from just one year ago when less than half reported increases.[2] Lastly, a recent analysis of health plans under the ACA revealed that one in five plans did not even list any emergency services on the list of covered benefits.[3] This results in increased financial burden to patients when emergency care is provided by an "out-of-network" emergency physician, frequently leading to the patient receiving a "surprise" balance bill.

Increased demand for emergency services leads to longer wait times, crowding and increased patient boarding in the ED. All have been associated with several negative patient-oriented outcomes – from lower patient satisfaction scores to higher inpatient mortality rates.[4] Recognizing this, multiple stakeholders are currently working to mitigate the ballooning crowding dilemma.

One approach gaining popularity is community paramedicine (CP). CP is a "model of community based health care in which paramedics function outside their customary emergency response and transport roles in ways that facilitate more appropriate use of emergency care resources and/or enhance access to primary care for medically underserved populations."[5] Interest in CP has substantially grown in recent years based on the belief that it may improve access and quality of care while also reducing costs.[5]

In February 2014, California's Emergency Medical Services Authority (EMSA) submitted a proposal to the Office of Statewide Health and Planning (OSHPD) to train experienced paramedics and expand their scope of practice to include the ability to transport patients with specific conditions to alternative destinations (AD). Such destinations would include primary care, general medical clinics, urgent care centers, and other social or psychological services.

Proponents of CP maintain that such programs expand access to care in an era of primary care shortage, while improving quality and lowering healthcare costs. Further, they argue that utilizing paramedics in expanded roles is attractive because they are already trained to recognize and manage life-threatening conditions in out-of-hospital settings. This may facilitate more appropriate use of emergency care resources and/or enhance access to primary care. These claims require close scrutiny, however, as the effect of CP on ED utilization, cost savings and enhanced primary care access is still being assessed, and to date, limited data exist to support these claims.

CP is not a new idea. Programs have been piloted in several states including New Mexico, Nevada, Colorado, Texas, Maine and Pennsylvania. To quote Scot Phelps, a former paramedic and professor of disaster science, regarding a prior CP attempt in New Mexico, "We tried this in 1995 in Red River, New Mexico, and what we found, after spending hundreds of thousands of dollars, was that it didn't actually save any money or improve any care. So [that community] abandoned it, and

now coming eight years later it is the topic du jour."[6]

Several concerns have been raised regarding CP, most notably, the risk of paramedic under-triage and transport of patients requiring emergency care to AD. AD projects involve previously unknown patients who may have one or more unknown illnesses, injuries, or psychosocial problems. Complex patients are common in the prehospital and ED setting. Standard paramedic practice focuses on recognition of patients' unstable physiology and management with temporizing and lifesaving interventions until transport to an ED is complete. The ED is the controlled environment for complete stabilization, evaluation, diagnosis, and disposition with care coordination. The ED, contrary to most or all ADs, has extensive diagnostic and therapeutic resources to help ferret out the occult medical emergency.

Under-Triage is a Patient Safety Issue

As reported in the *Annals of Emergency Medicine* in 2014, studies have revealed under-triage by paramedics when not transporting patients to AD.[7] The potential for under-triage is real if there is a failure of a community paramedic to recognize a real emergency when it exists. Further, identifying non-emergent patients based on their initial presentation is hazardous. In a study by Raven et al, 11% of patients with "primary care treatable" visits required immediate intervention, 12.5% were admitted, and 3.4% went directly to the operating room emergently.[8]

According to Morganti et al., "Nearly all studies published to date have found significant rates of under-triage by EMS Personnel…" These investigators identified 13 research studies examining the ability of paramedics and EMTs to determine the need for transport to the ED. These studies reveal EMS AD under-triage rates from 3% to 32%. They commented that the ability of EMS professionals to safely determine nonemergency patient "has not been clearly established." Included in these studies was one study describing a cohort of under-triaged patients, who EMS professionals felt did not require transport to the ED for care, and who subsequently required admission to the hospital (18%), including a subset who required admission to the intensive care unit (6%). These problems were attributed to EMS professionals misusing study guidelines, undertraining in proper use of the guidelines, and improper or unclear instructions within the guidelines that could result in under-triage. These studies also revealed poor agreement between EMS professionals and emergency physicians about who required transport to the ED for care. Additional training is not likely to eliminate the problem of under-triage.

Alternative Destinations will Disproportionately Affect Critically Ill and Vulnerable Patient Populations

Patients who call 911 are more likely to be critically ill, elderly, and economically disadvantaged relying on public rather than private insurance.[9] The patient population that arrives by ambulance does not reflect the general ED population. Whereas a proposed estimate of 13.7% of ambulance calls could be diverted to an urgent care center based on a Health Affairs study by Weinick et al., this study reviewed all ED visits rather than the population of patients who call 911.[10] Rugar et al. analyzed ambulance transports and triage category and found less than 2% of patients arriving by ambulance had a triage category of less urgent or non urgent.[11] Patients with a triage category of emergent were nine times more likely to arrive by ambulance, and with a triage category requiring immediate interventions, 50 times more likely to arrive by ambulance. This suggests a vast majority of ambulance transports are appropriate. The policy of diverting 911 patients away from EDs will not target low acuity visits. Studies suggest that it may target sick, vulnerable patients who already have limited access to care, and may further limit their access to specialty care. Even though EDs certainly have problems referring patients for specialty care, or achieving consultation during the ED visit, such referrals and consultations from ADs would most likely be even more difficult, if not impossible.

In conclusion, lowering healthcare costs for payers should not come at the expense of patient safety. Limiting access to high quality emergency and specialty care may show immediate cost savings to payers, but concerns remain over the longer term expense to patients and payers in terms of overall health outcomes. To date, the literature does not support paramedic-guided diversion of ambulance patients away from the ED to AD in terms of cost savings or equivalent health outcomes. As interest grows in CP programs, rigorous research methods should be applied to validate claims that CP is safe, improves quality and lowers healthcare costs.

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Comments on "Emergency Medicine Resident Rotations Abroad: Current Status and Next Steps"

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To the Editor:

Morris and Schroeder have highlighted the need for a uniform and comprehensive national education program for emergency medicine residents doing international rotations. As faculty for a newly released course, *The Practitioner's Guide to Global Health*, we wanted to call your attention to this innovative resource for preparing resident physicians, medical students, and other trainees to participate in safe and sustainable global health rotations.

In response to the need Morris and Schroeder emphasized, global health faculty from many countries and specialties came together to create a series of open-access, online, timeline-based, interactive modules that 1) prepare medical students, resident physicians, and fellows to safely and effectively participate in global health rotations and projects, 2) permit flexible, asynchronous learning, and 3) provide an electronic evaluation tool for program leadership.

The Practitioner's Guide to Global Health is a three-part timeline-based, interactive, evaluative, open-access course that prepares students and trainees to safely and effectively participate in global health learning experiences. The course is free-of-charge and generates a certificate (upon successful completion) that can be shared with program directors to help facilitate a standardized preparation for trainees across the world. The course is available at tinyurl.com/globalhealthedx. The three parts of the course are as follows:

Part 1: The Big Picture (to be completed 6-12 months in advance) covers several important "big picture" questions: Why do you want to have a global health learning experience? What kind of experience is right for you and your current level of training? When would be a good time? Where should you do it? How will you fund it?

Part 2: Preparation & On The Ground (to be completed 1-3 months in advance) covers the logistics of planning, security, transportation, communication, personal, health, academic; health: vaccinations and prophylaxis; cultural awareness and sensitivity; packing; logistics and cultural awareness on the ground; and dealing with unexpected situations on the ground.

Part 3: Reflection (to be completed toward the end of your rotation or on your way home) helps you prepare to return, contains important information about dealing with unexpected feelings and health issues, and helps you plan for future work and sustainability.

Several academic institutions and residency programs now require this course for their trainees participating in global health rotations. We hope that this course will be adopted as the national standard for emergency medicine global health training.

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Twelve Years Since Importance of Cross-Cultural Competency Recognized: Where Are We Now?

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Introduction: The objective of this study was to analyze the content and volume of literature that has been written on cultural competency in emergency medicine (EM) since its educational imperative was first described by the Institute of Medicine in 2002.

Methods: We conducted a comprehensive literature search through the PubMed portal in January 2015 to identify all articles and reviews that addressed cultural competency in EM. Articles were included in the review if cultural competency was described or if its impact on healthcare disparities or curriculum development was described. Two reviewers independently investigated all relevant articles. These articles were then summarized.

Results: Of the 73 abstracts identified in the initial search, only 10 met criteria for inclusion. A common theme found among these 10 articles is that cultural competency in EM is essential to reducing healthcare disparities and improving patient care. These articles were consistent in their support for cross-cultural educational advancements in the EM curriculum.

Conclusion: Despite the documented importance of cultural competency education in medicine, there appears to be only 10 articles over the past 12 years regarding its development and implementation in EM. This comprehensive literature review underscores the relative dearth of publications related to cultural competency in EM. The limited number of articles found is striking when compared to the growth of EM research over the same time period and can serve as a stimulus for further research in this significant area of EM education. [West J Emerg Med. 2017;18(2)223-228.]

INTRODUCTION

Emergency departments (ED) are experiencing an increasingly diverse patient population, both racially and culturally.[1,2] In 2002, the now-famous Institute of Medicine (IOM) report entitled "Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care" addressed this issue and emphasized the need to improve healthcare disparities.[3] By 2003, the emergency medicine (EM) literature started to address the issue of disparities in EM care and the need for workforce diversity and training.[4] In the same year, cross-cultural competency recommendations were made in terms of EM educational curricula.[5] Although the initial response to disparities and cross-cultural competency training was noteworthy, it is unclear how much this issue has been advanced by EM educators and researchers since the first papers were published in this area.

The ED is frequently the first point of access to care for many minority groups.[6] Awareness of cultural sensitivities, or cultural competency, is necessary to overcome bias and clinical uncertainty that is often experienced by those treating

these patients.[1,2] An important point is that different cultures embody divergent help-seeking behaviors. This concept is well summarized from the textbook of *Emergency Psychiatry* in which Dr. Jayaram writes, "Notions of sickness are derived from systems of medical understanding that exist within a culture. Beyond that both the provider and the patient have epistemic systems that dictate how individuals express suffering."[7] It takes effort to bridge the differences in attitudes of illness between provider and patient, which are exacerbated when the two are from distinct and unfamiliar cultural backgrounds.

Effective communication between patient and physician is commonly regarded as a primary method to overcome cultural difference. Communication is dependent on mutually understood social constructs; however, these social constructs become ambiguous when the provider is unaware, or otherwise fails to recognize, that these cultural differences exist. Provider values, as well as patient values, can influence interpretation of symptoms and patient compliance with medical interventions.[8] These values are expressed both verbally and nonverbally. Miscommunication is exacerbated when there is language discordance as well underappreciated cultural manifestations of illness and health.[9]

Cultural differences can serve as a prelude to biases, which can be defined as "prejudiced or partial viewpoints that affects someone's interpretation of a problem."[10] A lack of appreciation for a specific culture can result in assumptions and subsequent management errors on the part of the culturally unacquainted provider. These cognitive biases serve as impediments to communication and as a result impair the achievement of an accurate diagnostic hypothesis. Cultural competency helps physicians to overcome these biases.[1] Thus, improving cultural competency in EM faculty and residents can help to ameliorate biases, which in turn may improve patient outcomes and the patient experience.

EM has exploded with available information and knowledge in many different domains since the inception of the specialty in 1961. With the growth in literature in EM topics, has the research regarding cultural competency education in EM, and its correlation with reducing bias and improving patient outcomes in the ED grown accordingly? This comprehensive literature review seeks to assess the literature and provide a brief summary of the findings associated with cross-cultural competency in EM since the IOM report first described this educational imperative.

METHODS

We conducted a comprehensive literature search to identify articles and reviews that address cultural competency in EM. This included articles that were focused on any cultural competency education measures for EM faculty and residents. We also included any article in which the impact on health disparities and/or establishing an EM curriculum was discussed. We performed an electronic search through PubMed in January 2015 and selected the terms "emergency medicine" or other common words used to describe an ED, coupled with "cultural competency" or "cross-cultural training" or "cross-cultural communication" or "cultural disparities," or other comparable variations to expand the search. We limited our search to English-language reviews and journal articles only. We evaluated all applicable papers for their relevance to EM cross-cultural training and associated curriculum development. In addition, the references from these papers were examined for other potential sources of information. The chosen articles were carefully scrutinized and their information was extracted to provide a brief comprehensive summary of cross-cultural competency in EM since its significance was first identified. The initial search revealed 73 articles. Two reviewers independently examined the search results to screen for applicable articles. Articles were targeted for inclusion only if they met the following criteria:

1) U.S. or Canadian-based studies;
2) Adult emergency medicine focused;
3) Some link to cultural competency, cultural awareness, diversity, cultural sensitivity, or multicultural education;
4) Medical journal (non-nursing or allied health).

RESULTS

There was agreement on 10 articles (Table), with three articles in question. After abstract review, we excluded the three articles because they documented a need for cultural sensitivity and training but not how it should be addressed in the EM curriculum. Of the excluded papers, Aratani and Addy concluded that **"**the disparities indicate a need for culturally sensitive and gender-specific services for this vulnerable population [at-risk youth]."[11] Royl et al. proposed that culturally sensitive healthcare might be enhanced through the use of interpreters, standardized surveys, and ease of access to appropriate cranial imaging in cases in which a benign etiology in headache cannot be confidently concluded.[12] The final article in question, Greenberg and Pierog, indicated that ACLS provider and instructor materials do not depict a fair representation of minority populations.[13]

The 10 articles that met criteria and selected by both reviewers are listed in the table.

DISCUSSION

Different cultures view illness and its effects in their own distinct manner. Although suffering can be considered as a universally recognizable situation, the type of suffering and the extent of suffering due to illness is variable in different cultures. Language discordance and a lack of

Table. Articles addressing cross-cultural competency in emergency medicine.

Date	Author	Title	Main points
November 2003	Cone DC, Richardson LD, Todd KH, Betancourt JR, Lowe RA.	Healthcare Disparities in Emergency Medicine	Addresses issues of disparities in healthcare and makes recommendations.
November 2003	Hamilton G, Marco C.	Emergency Medicine Education and Health Care Disparities	Provides rationale for cultural diversity in EM training and suggests educational approaches.
August 2006	Sheridan I.	Treating the World Without Leaving Your ED: Opportunities to Deliver Culturally Competent Care	Explains challenges faced by immigrant groups and their physicians in clinical encounters.
December 2006	Hobgood C, Sawning S, Bowen J, Savage K.	Teaching Culturally Appropriate Care: A Review of Educational Models and Methods	Presents overview of educational models for cultural training and EM applicability.
March 2007	Padela AI.	Can You Take Care of My Mother? Reflections on Cultural Competency and Clinical Accommodation	Portrays account of cross-cultural care.
August 2008	ACEP	Cultural Awareness and Emergency Care	Concludes that cultural sensitivity is necessary in EM training and in the practice of EM.
January 2009	Padela AI, Punekar IR.	Emergency Medical Practice: Advancing Cultural Competence and Reducing Health Care Disparities	Highlights importance of cultural awareness in the ED and addresses bias, cultural training, and workforce diversity.
October 2011	Bowman SH, Moreno-Walton L, Ezenkwele UA, Heron SL.	Diversity in Emergency Medicine Education: Expanding the Horizon	Discusses results of a survey testing unconscious bias and possibility of initiating an EM curriculum on cultural competency.
August 2013	Ezenkwele UA, Roodsari, GS.	Cultural Competencies in Emergency Medicine: Caring for Muslim-American Patients from the Middle East	Presents guideline to overcoming cultural barriers to effectively treat this population.
May 2014	Moll J, Kreiger P, Moreno-Walton L, Lee B, Slaven E, James T, Hills D, Podolsky S, Corbin T, Heron SL.	The Prevalence of Lesbian, Gay, Bisexual, and Transgender (LBGT) Health Education and Training in Emergency Medicine Residency Programs: What Do We Know?	Describes survey about LGBT education and found that many EM programs do not have a curriculum on this issue.

EM, emergency medicine; *ED,* emergency department

appreciation for the variation of cultural manifestation of illness can predispose one's thinking in favor of a certain viewpoint over more appropriate viewpoints. Helping providers to overcome cultural biases has been recognized as an important education goal in EM.[14]

It is well understood that preconceived notions about the behavior or health of minority populations and prejudice are contributing factors to the disparities observed in healthcare.[3] Intrinsic bias on the part of the provider, or cognitive dispositions to respond (CDR), may contribute to flawed clinical reasoning and diagnostic errors.[15] These are likely to be exacerbated when confronted with cultural differences unfamiliar to the provider. The tendency to adopt a predetermined viewpoint about a patient based on sociocultural factors, whether conscious or unconscious, interferes with a physician's ability to create an appropriate therapeutic plan. In addition, the time pressures and demanding nature of the ED atmosphere do not always allow for mindfulness, or presence in the moment. This presence in the moment is an important prerequisite in gaining a better understanding of a patient's background and the patient's behavior toward illness. A clear understanding of the patient's behavior helps to avoid stereotyping, which is often at its peak during multi-tasking, stressful events, and under time-sensitive situations.[4] As such, the importance of cross-cultural competency is amplified in specialties such as EM that are constrained by time sensitivities. The manner in which it is taught and when it is taught in the EM curriculum needs to be clarified.

Among the 10 articles that met criteria for inclusion, four were particularly pertinent in summarizing the imminent necessity of developing cultural competency measures and offered multiple concrete solutions to address this need in EM education. In 2003, Cone et al. and Hamilton and Marco first introduced the importance of cross-cultural training in EM as a mechanism of reducing disparity and its ties with educational initiatives.[4,5] These articles emphasized the extent of the issue of healthcare disparities as outlined in the IOM report. They

suggested an increase in workforce diversity and a cultural competency curriculum in EM as potential resolutions. In 2003, the Society of Academic Emergency Medicine (SAEM) and the Council of Emergency Medicine Residency Directors (CORD) established the Cultural Competency Curriculum Task Force (CCCTF) with the objective of developing a model curriculum for residency programs.[4] One of the papers referred to a web-based resource at the University of Virginia School of Medicine website. Within the website (med-ed.virgina.edu) is a page that is self-described as a monograph on cultural competency and is attributed to the CORD/SAEM Diversity Task force, also known as the CCCTF.[16] The website currently offers instructional materials, including 13 example clinical cases, and has chapters describing cultural competency as it pertains to EM. It also has links to numerous other relevant publications available in online format.

In 2006, Hobgood et al. provided a detailed review of the educational models in practice in all fields of medicine for teaching cultural competency as well as the barriers that impede the establishment of cross-cultural education.[17] Their paper described curricular methods for cross-cultural training employed in medical schools and residencies that include cultural immersion, community clinical experience, simulation, didactic models, literary models, portfolios, and continuing medical education adjuncts. They presented a cultural competency measure uniquely intended to educate faculty members in workshop format. The authors also remarked that this type of periodic and recurrent model would complement EM conference scheduling if it were to be extrapolated for EM education. In addition, the paper recognized a mixed-method instructional program that assesses students by measurable competencies. This paper also identified immersion models, whereby a group of students spends either a short-term or extensive period of time in a foreign location to foster cultural awareness and understanding.

Additionally, it stated that the Association of American Medical Colleges offers short strategies to assist in cultural information gathering during an initial physician-patient encounter. The paper also identified existing methods used for assessment including the Betancourt model and the Accreditation Council of Graduate Medical Education (ACGME) Toolbox. They described the Betancourt model as a system that evaluates attitude, knowledge, and skill using several ways to score each category, while the ACGME Toolbox provides a plethora of alternative methods. Supporting the Hobgood et al. paper was a statement in 2008 by the American College of Emergency Physicians (ACEP) affirming that "cultural awareness should be an essential element in the training of healthcare professionals and to the provision of safe quality care in the ED environment."[18]

Padela and Punekar in 2008 emphasized the significance of cultural sensitivity in the ED environment, and presented three ways to improve minority outcomes through teachings of cross-cultural communication:[1] 1) increasing cross-cultural training and decreasing physician bias; 2) maximizing provider diversity; and 3) accommodating diverse patients' needs. Bowman et al. in 2011 discussed the possibility of initiating an EM cultural competency curriculum and the obstacles associated with its implementation.[14] These results were obtained from a CORD workshop survey, and the authors used an implicit association test (IAT) to investigate bias in its survey participants. They chose to administer this tool due to the realization of the growing importance of addressing unconscious bias in cultural competency acquisition. Their primary notion was that bias is present and active in even the most well-intentioned physician and overcoming that bias can be challenging to effectively address in any cross-cultural training curriculum. In their paper, workshop participants came to a consensus that overcoming personal biases was a necessity in order to ameliorate cultural competency education. Participants also described obstacles that might be experienced in attempting to inaugurate such interventions. These barriers increased in complexity at institutions in which faculty, residents, and patients are less diverse and in which minority faculty do not wish to possess the burden of acting as the sole resource in cross-cultural education. In the paper, the participants reached agreement in that minority faculty should not solely be held accountable for amending the curriculum. Participants also expressed interest in developing cultural competency curricula by non-program director faculty members, and some intended to start discussions with program leadership. In contrast, some attendees felt troubled in asking for curricular modifications at institutions in which there was a scarcity of resources for this type of programming. Additionally, some noted that negative behaviors toward certain groups of patients were tolerated at some institutions.

Finally, in 2005 it was found that resident physicians in EM were more likely to disclose a deficiency in cultural competency education when compared with residents from other clinical areas.[19] This paper was not included in the 10-paper summary table as it was not EM focused and did not meet selection criteria.

Fortunately, the EM Milestones do address cultural competency in at least two domains. In EM Milestone 20, Professional Values (PROF1) Level 1, there is a statement indicating that behavior that "conveys caring, honesty, genuine interest and tolerance when interacting with a diverse population of patients and families" must be shown. Additionally, EM Milestone 22 – Patient-Centered Communication (ICS1) Level 3 – requires that residents be able to "effectively communicate with vulnerable populations, including both patients at risk and their families."

LIMITATIONS

There are several limitations in this study. First, due to the specifications employed in the title and abstract review process, it is possible that relevant journal articles that did not meet our defined criteria were excluded. By ensuring that the criteria were

broad enough to encompass all aspects of the topic discussed in this paper, we attempted to minimize the possible effects of this. Second, only two reviewers were responsible for screening articles, which may have resulted in selection bias or bias due to too few reviewers. In an attempt to diminish the selection bias, the two reviewers conducted independent screenings of the articles, then compared and discussed findings. Additionally, our search was PubMed-based and did not include articles from other databases. A preliminary review of EMBASE and PSYCINFO revealed no relevant articles but did reveal two brief published abstracts.

A critical limitation in this study was that advances in the area of cross-cultural competency may have been made by individual training programs or other forums in which we were not able to assess or include in this literature review. It may be that programs are adequately addressing the educational imperative of cross-cultural competency, but their methods and findings are not well published or were not discovered using the search strategy we employed.

CONCLUSION

Cultural competency has been recognized as an important educational goal for physicians and physician training since the IOM report in 2002. During the 12 years since that report, 10 papers have been published describing the significance and value of cultural competency in EM education. Given the importance of this topic, as evidenced by the IOM report and the subsequent papers on the topic, the volume of literature describing educational advances in this area appears to be relatively light. Our hope is that this comprehensive review will spur publications and additional attention to the area of cultural competency in EM. As has been stated in the literature, cross-cultural competency is an important means of improving patient safety and is a critical tool in creating a more effective and therapeutic patient experience in the emergency medicine setting.

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A Survey of Emergency Medicine Residents' Use of Educational Podcasts

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Introduction: Emergency medicine (EM) educational podcasts have become increasingly popular. Residents spend a greater percentage of their time listening to podcasts than they do using other educational materials. Despite this popularity, research into podcasting in the EM context is sparse. We aimed to determine EM residents' consumption habits, optimal podcast preferences, and motivation for listening to EM podcasts.

Methods: We created a survey and emailed it to EM residents at all levels of training at 12 residencies across the United States from September 2015 to June 2016. In addition to demographics, the 20-question voluntary survey asked questions exploring three domains: habits, attention, and motivation. We used descriptive statistics to analyze results.

Results: Of the 605 residents invited to participate, 356 (n= 60.3%) completed the survey. The vast majority listen to podcasts at least once a month (88.8%). Two podcasts were the most popular by a wide margin, with 77.8% and 62.1% regularly listening to *Emergency Medicine: Reviews and Perspectives* (*EM:RAP*) and the *EMCrit Podcast*, respectively; 84.6% reported the ideal length of a podcast was less than 30 minutes. Residents reported their motivation to listen to EM podcasts was to "Keep up with current literature" (88.5%) and "Learn EM core content" (70.2%). Of those responding, 72.2% said podcasts change their clinical practice either "somewhat" or "very much."

Conclusion: The results of this survey study suggest most residents listen to podcasts at least once a month, prefer podcasts less than 30 minutes in length, have several motivations for choosing podcasts, and report that podcasts change their clinical practice. [West J Emerg Med. 2017;18(2)229-234.]

INTRODUCTION

A podcast is a digitally recorded media product that can be downloaded or streamed, typically as an audio file.[1] Emergency medicine (EM) educational podcasts have become increasingly popular for learning and are one of the most widely consumed digital educational tools.[2] Their exponential growth is evidenced by over 15 million downloads of the *EMCrit* (Emergency Medicine Critical Care) *Podcast* and the more than 24,000 paid subscribers to *EM:RAP* (Emergency Medicine: Reviews and Perspectives).[3,4]

A recent survey on asynchronous learning among United States (U.S.) EM residents showed that residents spend a greater percentage of their time listening to podcasts than they do using other educational materials, including textbooks and journals. They also rated podcasts as the most beneficial use of their time.[5] A similar survey of Canadian physicians found that 90% of EM residents used podcasts every month. Despite their popularity, little is known about this phenomenon, which has

led EM educators to call for a deeper understanding of how and why learners use podcasts.[6]

While there has been a dramatic recent increase in the number of EM educational podcasts,[2,7] research into podcasting in the EM context is sparse. Though educators are now beginning to define quality indicators in EM podcasts,[8] little is known about motivation, adoption, usage patterns, or preferences in consumption among podcast listeners.[9] Outside of EM, small survey studies exist in undergraduate medical education,[10] anesthesia,[11] and nursing training,[12] yet the existing literature does not provide insight into the unique EM educational landscape.

As we adopt new technologies, we must also understand how and why they are being embraced by our learners in order to employ them more effectively. The important questions of why residents are using podcasts and how they are being used remain unanswered.[13] The personal, social, and technological factors that influence the use of EM podcasts – factors known to influence learning – merit further exploration.[14]

We aimed to better understand factors driving the asynchronous podcast phenomenon, including consumption habits, optimal podcast preferences, and motivation for listening.

METHODS

Study Design and population

This study was performed between September 2015 and June 2016. It was approved by the institutional review board at the University of Texas San Antonio.

We followed accepted guidelines for survey development in medical education research.[15] We created an electronic survey via Google Forms (Mountain View, CA) and sent a link to it in a solicitation email to EM residents in all levels of training at a sample of 12 EM training programs (n = 605). Based on an estimated population size of approximately 6,000 with a 5% margin of error, we estimated we needed approximately 360 respondents to reach a 95% confidence level. Due to historically low survey response rates in multi-institutional studies of health professions trainees[16] and the fact that recognition and trustworthiness of the survey sender may increase response rates,[17] we used a network strategy for program selection and survey implementation. We chose residencies to represent a geographical spread across the U.S. with a mix of public, private, military, three- and four-year programs, rural, and urban environments that had a local program director personally known to the authors. Either an author or faculty member at each residency sent the email with the survey, as well as reminder emails (up to six). All responses were anonymous. All programs were approved by the Accreditation Council for Graduate Medical Education.

Validity Evidence for Survey Items

After a thorough literature review, interviews with residents and faculty at two institutions (UW and UCSF-Fresno) and synthesis of background information, we developed questions. Several authors (AS, RR, SR) with expertise in EM education podcasting iteratively revised the items for clarity and relevance. The survey was then pilot tested with 10 residents at the Icahn School of Medicine Emergency Medicine Residency Program at Mt. Sinai to assess for clarity and understanding of the survey questions. No substantial changes were made after pilot testing.

We designed the survey to be completed in less than 10 minutes. Survey completion was voluntary and we provided no compensation for participation. Response rate calculation was based on all non-respondents being eligible, as the survey was sent to specifically named persons who met eligibility requirements. Partially completed surveys were included in response rate.

The final survey consisted of 20 items with questions designed to investigate hypothetical content domains related to listening habits, attention, and motivation (Appendix A). The domain "habits" investigated participants' setting and activities when listening to podcasts. We aimed to determine the educational environments in which podcasts are being used. The "attention" domain was designed to explore resident attention spans and listening length preferences. The domain "motivation" investigated the reasons why participants choose to listen to EM podcasts. We sought to identify what makes podcasts different than other available educational resources.

Data Analysis

All data were auto-populated into Google Sheets. We performed statistical analysis in Microsoft Excel (Microsoft Corporation, Redmond, WA). Descriptive statistics were used to evaluate survey data. We reported descriptive statistics in percentages of respondents.

RESULTS

Of the 605 residents invited to participate, 356 (n= 60.3%) completed the survey. Demographic data are presented in Tables 1 and 2.

Habits

The mean number of unique EM podcasts that residents subscribe to or regularly listen to was 2.69 (STD 1.89). Two podcasts were the most popular by a wide margin, with 77.8% (n = 277/356) and 62.1% (n = 221/356) regularly listening to *EM:RAP* and the *EMCrit Podcast*, respectively (Appendix B). Most respondents (91.4%, n = 309/356) listen on their smartphones, and about three-quarters (78%, n = 266/356) listen at normal speed (1x). When asked where they find them, 88.7% (n = 300/356) reported they find the podcasts they listen to from word of mouth from other residents, while almost two-thirds (65.7%, n = 222/356) reported finding podcasts based on recommendations from a lecturer or faculty member. The vast majority listen to podcasts at least once a month (88.8%, n = 316/356), and almost half listen at least once a week (48.0%, n = 171/356).

Table 1. Demographic data of survey respondents, eligible participants, programs involved in the study of educational podcast use, and all allopathic EM programs.

Participant demographics	Respondents (n = 356)	All eligible to participate (n=605)
Age (mean in years)	30.4	Unable to obtain
Gender		
Female	33.4% (n=119)	35.3% (n=164/464)*
Male	65.5% (n=233)	64.7% (n=300/464)*
Decline to state/other	1.1% (n=4)	
Level of training		
PGY-1	27.3% (n=97)	28.1% (n=170/605)
PGY-2	34.0% (n=121)	28.1% (n=170/605)
PGY-3	25.3% (n=90)	28.1% (n=170/605)
PGY-4	13.5% (n=48)	15.7% (n=95/605)

PGY, post-graduate year.
*Data obtained from EMRA Match website (https://webapps.acep.org/utils/spa/match#/search/map) on 9/8/2016 of self-reported data from U.S. allopathic EM programs. Twelve of the 182 allopathic programs are dual accredited. None of the programs in the study population are dual accredited. Missing data from study population programs were obtained by contacting faculty at the programs. Missing data from non-study population programs were considered missing and not counted in percentages. The two programs in Puerto Rico were excluded from region calculation.

Table 2. Demographic data of programs involved in the study of podcast use, and all allopathic EM programs.

Program demographics	Study programs	All allopathic EM programs
Primary training site		
Military	8% (n=1/12)	5% (8/152)*
Community	17% (n=2/12)	32% (48/152)
University	50% (n=6/12)	54% (82/152)
County	25% (n=3/12)	14% (22/152)
Years of training		
3	50% (n=6/12)	76% (n= 138/182)
4	50% (n=6/12)	24% (n=44/182)
Region		
West	17% (n=2/12)	14% (n=26/180)
Northeast	50% (n=6/12)	30% (n=54/180)
South	25% (n=3/12)	28% (n=51/180)
Midwest	8% (n=1/12)	26% (n=47/180)
ED volume (mean in patients/year)	105,000	89,716

*Data obtained from EMRA Match website (https://webapps.acep.org/utils/spa/match#/search/map) on 9/8/2016 of self-reported data from U.S. allopathic EM programs. Twelve of the 182 allopathic programs are dual accredited. None of the programs in the study population are dual accredited. Missing data from study population programs were obtained by contacting faculty at the programs. Missing data from non-study population programs were considered missing and not counted in percentages. The two programs in Puerto Rico were excluded from region calculation.
*Some military programs also listed as community, university, or county primary training site.

Attention

When asked what they thought was the ideal length of time for an EM podcast (Figure 1), 38.7% (n = 138/356) answered 11-20 minutes, followed by 21-30 minutes (34.6%, n = 123/356).

When asked if they had ever stopped listening or turned off an EM podcast when they had more time to listen, the top three reasons why they stopped listening were "It was too boring" (57.9%, n = 195/356); "It was not of high quality;" (57.9%, n = 195/356), and "It was too long" (55.2%, n = 186/356).

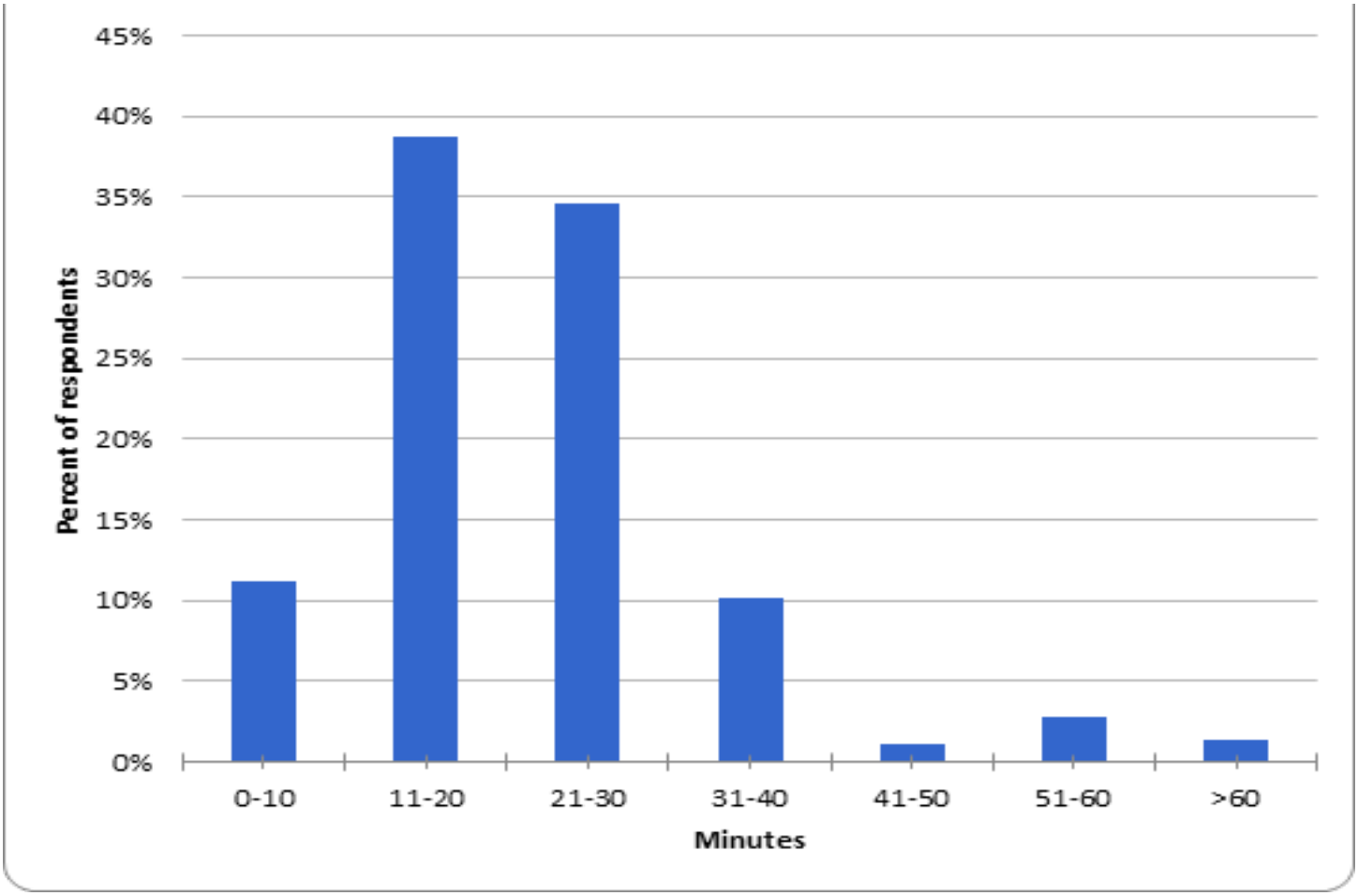

Figure 1. Resident perception of the ideal length of time for an emergency medicine podcast or podcast segment.

Motivation

Of those residents who prefer podcasts over other available educational resources (textbooks, blogs, online video, peer-reviewed journals, etc.), they prefer them for their portability (66.9%, n = 238/356), ease of use (66.0%, n = 235/356), and the ability to listen while doing something else (65.5%, n = 233/356). Only 13.8% (n=49/356) said they do not prefer podcasts over other educational resources, while 4.5% (n = 16/356) reported not listening to podcasts. A higher percentage of female respondents (20%, n=24/120) than male respondents (9.8%, n=25/256) said they do not prefer podcasts over other educational resources. Residents reported their motivation to listen to EM podcasts was to "Keep up with current literature" (88.5%, n = 315/356) and "Learn EM core content" (70.2%, n = 250/356), among other answers (Figure 2). Figure 2 details reasons why residents choose to listen to a particular EM podcast.

When asked how much EM podcasts changed their clinical practice, almost three quarters of residents (72.2%, n = 257/356) said podcasts changed their clinical practice either "somewhat" or "very much;" 27.8% (n = 99/356) reported podcasts changed their clinical practice "neutral," "not much," or "not at all."

DISCUSSION

Key points

Our data, derived from a diverse cohort of EM residents from across the U.S., suggest that most residents listen to podcasts at least once a month, prefer podcasts less than 30 minutes in length, have several motivations for choosing podcasts, and report that podcasts change their clinical practice.

This work builds on the two recent studies that demonstrated the popularity of asynchronous educational resources among residents by providing a deeper understanding of how and why EM learners are using podcasts.[5,6] The finding that more than 88% of residents listen to podcasts at least every month and the majority listen to two very popular podcasts (*EM:RAP* and *EMCrit*) is consistent with previous studies and highlights the significant influence these two podcasts may be having on resident education.

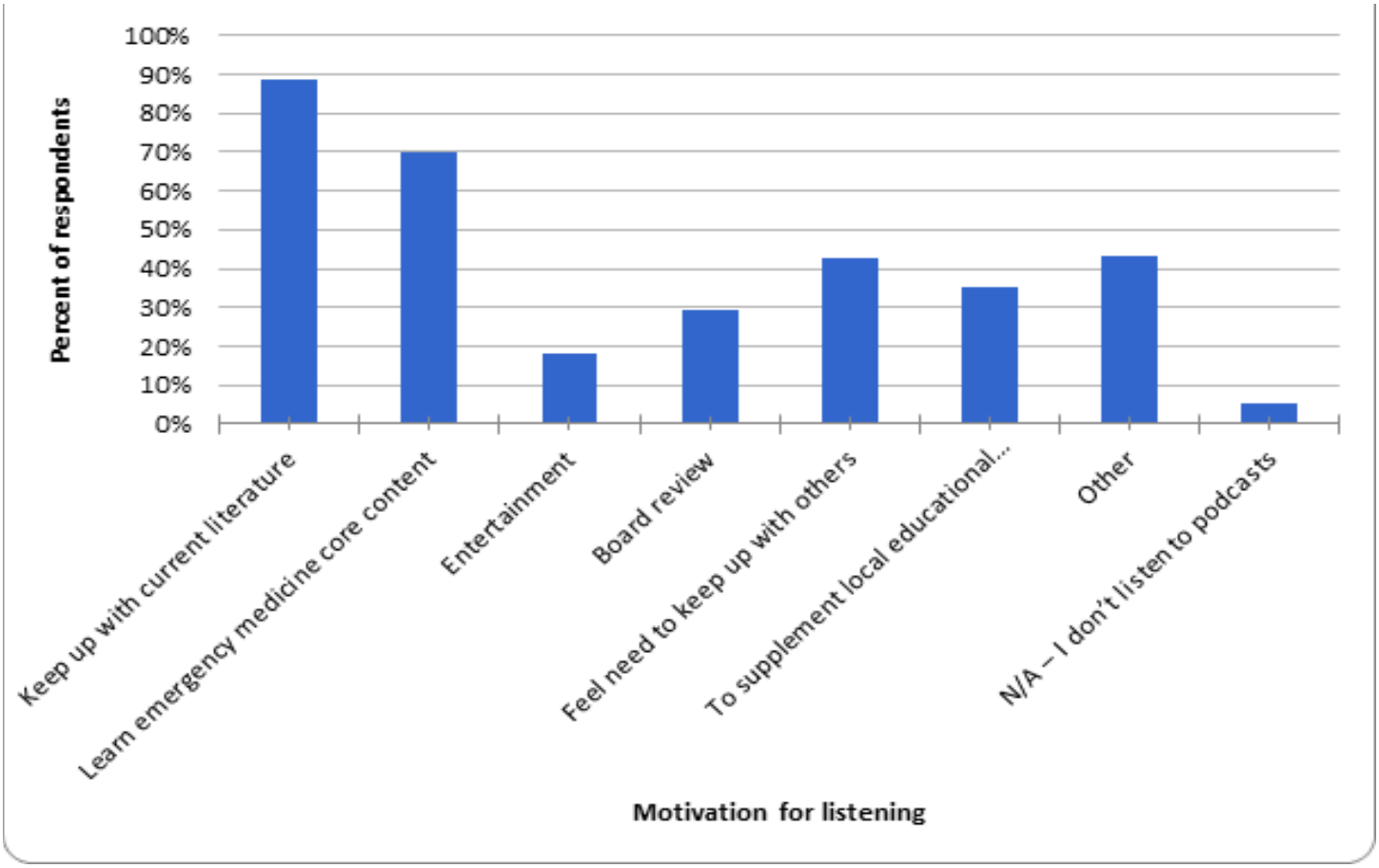

Figure 2. Residents' motivation for listening to emergency medicine podcasts.

Resident preference for podcasts less than 30 minutes in length is consistent with national trends in EM toward curriculum delivery in shorter segments.[7] Podcast creators and EM faculty making curricular decisions may bear this preference in mind. However, no direct evidence exists linking shorter podcasts to better resident retention of information.

Over two-thirds of residents indicated they are motivated to listen to podcasts to learn EM core content. However, the two most popular podcasts that residents listen to (*EM:RAP* and *EMCrit*) are known more for cutting-edge analysis and discussion of controversial new topics than core content. *EM:RAP* has recently re-introduced core content through the C3 Project; however, we did not ask residents to differentiate between main *EM:RAP* content and C3 Project content. The most popular podcasts known to the authors for specifically focusing on core content were regularly listened to by 29.2% (*EM Basic*), and 18.0% (*FOAMcast*) of residents. This may indicate a disconnect between resident expectations of what they're listening to and what they are actually hearing.

The extent to which podcasts cover the breadth of EM core content is unknown. A recent study of EM online educational resources (OERs) found an imbalanced and incomplete coverage of core content in EM OERs.[18] Comprehensive and balanced coverage of EM core content is needed if podcasts are going to serve the purposes for which residents are using them. Though several new podcasts have been developed specifically to cover core content topics that may be less represented in other OERs, the balance of core content in podcasts requires investigation.

Further research into the podcast phenomenon should also consider faculty perspectives and experiences. Research into the significance of the gender differences seen in the "motivation" domain will also be important. Qualitative inquiry can provide a deeper understanding of podcasting and may yield a richer theoretical understanding of how and why residents choose podcasts. Finally, a comparison among specific instructional design elements of podcasts may help educators to use podcasts most efficiently.

LIMITATIONS

Our study has several limitations associated with survey research, chief among them being the small sample size of only 12 residencies. Though we did not see significant

variability from those who did not complete the survey, it is possible given our response rate of 60% that our sample is not representative. The Midwest region is underrepresented in our sample and it is not known what impact demographic differences had on the outcomes reported in the study. Despite this, there was also substantial validity evidence inherent to our study design. Some of the survey content was based on published consensus, podcasting experts validated the items' clarity and relevance, the survey was piloted with a representative group of residents, the study population was well defined, reliable contact information was available for all potential participants, and the response rate was relatively high for a national survey.[5,6,19] The use of categorical response options to the survey items was done to increase the response rate. This limits our ability to use parametric statistics to compare groups. While our sampling limits generalizability outside of EM residencies, exclusively studying EM residents allowed specificity to our population of interest.

CONCLUSION

This survey study informs educators about podcast use among U.S. EM residents. Most residents listen to podcasts at least once a month, prefer podcasts less than 30 minutes in length, have several motivations for choosing podcasts, and report that podcasts change their clinical practice.

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American Association for Emergency Psychiatry Task Force on Medical Clearance of Adults
Part I: Introduction, Review and Evidence-Based Guidelines

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Introduction: In the United States, the number of patients presenting to the emergency department (ED) for a mental health concern is significant and expected to grow. The breadth of the medical evaluation of these patients is controversial. Attempts have been made to establish a standard evaluation for these patients, but to date no nationally accepted standards exist. A task force of the American Association of Emergency Psychiatry, consisting of physicians from emergency medicine and psychiatry, and a psychologist was convened to form consensus recommendations on the medical evaluation of psychiatric patients presenting to EDs.

Methods: The task force reviewed existing literature on the topic of medical evaluation of psychiatric patients in the ED (Part I) and then combined this with expert consensus (Part II).

Results: In Part I, we discuss terminological issues and existing evidence on medical exams and laboratory studies of psychiatric patients in the ED.

Conclusion: Emergency physicians should work cooperatively with psychiatric receiving facilities to decrease unnecessary testing while increasing the quality of medical screening exams for psychiatric patients who present to EDs. [West J Emerg Med. 2017;18(2)235-242.]

INTRODUCTION

Psychiatric disorders are second only to cardiovascular disease as the leading cause of lost productivity in the United States.[1] From 1992 to 2001, 53 million visits to the emergency department (ED) were for psychiatric complaints, a rate of 4.9%-6.3% of all ED visits,[2] with 3.6% receiving a mental disorder diagnosis at discharge.[3] When substance abuse is added to mental health disorders, one survey found the combined rate to be 12.5% over a year.[4]

EDs have become the primary and acute healthcare providers for many with mental health problems. Given recent legislation, the closure of state institutions, the national shortage of psychiatrists, reductions in funding for community mental healthcare including community-based crisis services,

and dwindling numbers of inpatient psychiatric beds, the number of psychiatric patients presenting to EDs is increasing and likely to continue.[1,5-6] As a result of these and other factors, psychiatric emergency visits are resource-intensive, longer and may contribute to crowding as well.[7-9]

There are four common reasons for patients who present with psychiatric concerns to receive a medical assessment. First, patients may have medical problems that are the primary cause of the presentation and require care exclusively in a medical setting. Second, medical problems may complicate or contribute significantly to a psychiatric problem such that medical care takes precedence and may obviate the need for psychiatric care. Third, medical problems may be completely coincidental but require attention during confinement for psychiatric care. Fourth, there may be medical problems that, under other circumstances, might be deferred indefinitely but cannot be neglected by the mental health facility to which the patient is transferred. The rationale for and execution of medical screening for each of these situations varies by location, yet they are all subsumed under the rubric of "medical clearance."

Few would argue about the necessity of careful screening in the first two situations above. However, the complexity of the screening is further modified by the capabilities of psychiatric receiving facilities, as they vary in their ability to assess and treat medical problems.[6] This often shifts the burden for the seemingly routine medical assessment and treatment planning in the last two situations above to emergency services. While the problems associated with the first two are more susceptible to scientific debate, the problems of the second two often have more to do with payment mechanisms and health policy.

In Part I of this series, an American Association for Emergency Psychiatry (AAEP) Task Force provides an overview of medical assessment of psychiatric patients in the ED, including review of the literature and evidence-based guidelines. In Part II of the series, the task force discusses controversies in medical clearance and presents an AAEP consensus statement on medical assessment. Selected articles were chosen individually by committee members on the basis of their relevance to the medical screening process. Existing medical screening policies, such as the one by the American College of Emergency Physicians (ACEP), were also carefully reviewed. Task force members consisted of Eric L. Anderson, Kimberly Nordstrom, Michael P. Wilson, Jennifer M. Peltzer-Jones, Leslie Zun, Anthony Ng, and Michael H. Allen chosen by the AAEP for their expertise on the topic, all with an extensive background in behavioral emergencies.

TERMINOLOGY PROBLEMS

Perhaps the first major hurdle in creating a consensus is agreement upon terminology. Depending upon how the term is used, "medical clearance" may imply patient readiness for psychiatric evaluation, stability for transfer to inpatient psychiatry, or stability for discharge to outpatient care. Additionally, depending upon the level of care to which the

Table 1. Terminology of historic/literature terms.

Term	Definition
Medical clearance	A general name for the process of ensuring the patient does not have a medical condition that requires further attention. It does not provide any guidance as to the purpose or depth of the evaluation, nor does it define the role of any medical conditions, if present. It implies a follow-on action, i.e., clearance to do something else, such as transfer or discharge the patient.
Medically clear	A term meaning that, in the opinion of the examining provider, the patient does not have any medical condition which merits further treatment or concern.
Medical assessment	A general name for the process of examining a patient for active or pertinent medical conditions. Unlike medical clearance, it does not imply any particular downstream goal.
Medical evaluation	A term that generally means the same thing as medical assessment.
Medical screening	Closely related to medical assessment and medical evaluation, screening usually implies that specific issues are being sought for presence or absence.
Organic clearance	A term that describes the process of eliminating somatic, non-psychological reasons for the patient's symptoms (although arguably most Axis I diagnoses have an organic etiology and/or pathogenesis, but these mechanisms have not been fully elucidated).
Focused evaluation/examination	A term that implies an evaluation of smaller scope than assessments, evaluation, or clearance.
Preferred/current terms causal, contributory, and/or incidental	These define the presence of medical condition(s), and whether those conditions have led to the current presentation, contributed to it, or were just found in the process of evaluating the patient
Stable vs. unstable	This more succinctly defines the status of the patient, regardless of the contribution of any medical conditions, and their appropriateness for discharge or transfer to another level of care

patient is referred, more or less stringent evaluation may be required. Some facilities have ready access to medical and surgical services and thus are better prepared to accept medically complex patients. Other facilities, especially freestanding psychiatric hospitals, often do not have easy access to medical and surgical services. Psychiatric patients with complex medical problems may not be within their capabilities, despite having originally presented with a psychiatric complaint.[10]

According to Weissberg (1979), "medical clearance" itself is an imprecise term that implies "everything has been done and no problems have been found."[11] There are at least three situations where the term is often used: 1) No medical condition is thought to be present; 2) a medical condition, e.g., hypertension, is known but is not thought to be the primary cause of psychiatric symptoms; and 3) a medical condition, e.g., intoxication, was present but no longer needs treatment. The term is often used to imply that causative medical problems have been excluded. Confusion may thus arise with the term "medical clearance," and some authors have suggested that the term be replaced with a more precise description, such as the narrative of the patient's clinical condition.[12]

Traditional or historic terms, as well as current and preferred terms, are presented in Table 1. In the following reviews of the literature, the original language was maintained for fidelity's sake.

MEDICAL ILLNESS IN PSYCHIATRIC PATIENTS

Medical problems are common in patients with psychiatric diagnoses.[13] Psychiatric presentations usually require some form of medical as well as psychiatric assessment.[14-17] Although the extent to which medical illness contributes to psychiatric symptoms has been the subject of much debate and research, medical illness is prevalent in mentally disordered patients.[18-26] In studies of psychiatric patients, Hall et al found that as many as 46% of patients had a medical etiology for their symptoms.[20-21] Similar results were found by Koranyi (1979), who found 43% of patients with at least one physical illness;[22] Summers et al (1981) who reported a medical illness frequency of 33.5%-63%;[23] Carlson et al (1981) who reported a frequency of 75%;[24] Olshaker et al (1997) who reported incidence of 24%-50%;[25] and Zun et al (1996) who reported an incidence of 19%-75%.[26] In 1994, Tintinalli et al reported that, in 80% of patients for whom a medical diagnosis should have been made, a "medically clear" label was given.[27] Taken together, the rate of comorbid medical illness that may contribute to, exacerbate, or cause any given patient's psychiatric symptoms ranges from 19 to 80%, but the true incidence is difficult to ascertain given the limitations of many of these studies, such as a lack of follow up, potential selection bias, and convenience sampling.

While the precise extent to which medical mimics of psychiatric disease are misdiagnosed as mental illness is unknown, it may be fairly common. For example, a study by Han et al (2009) found that delirium was common in the ED and that emergency physicians (EP) missed the diagnosis in 76% of cases.[18] Hustey et al (2003) found that impairment in mental status was 27% in their sample of ED patients, but that EPs altered their management in zero cases when informed.[28] The consequences of misdiagnosis may be grave. Hoffman for instance reported that 63% of patients originally admitted for dementia were found to have a treatable condition, and Reeves et al (2010) found that elderly patients with delirium who were admitted to psychiatric units were less likely to undergo complete diagnostic assessments than delirious elderly patients admitted to medical units.[29-30]

REVIEW OF THE LITERATURE

Hall et al (1981) examined 100 consecutive admissions to a research inpatient psychiatric unit and found that, with extensive testing, medical problems could be identified in 46% of patients.[21] They recommended, as routine screening, a complete psychiatric history, detailed neurological examination, 34-panel chemistry, electrocardiogram (EKG), complete blood count (CBC), urinalysis, and a sleep-deprived electroencephalogram (EEG) for new onset psychiatric symptoms. Dolan et al (1985), on the other hand, examined the clinical utility of routine laboratory testing in 785 patients in a psychiatric hospital. They found that clinically important abnormal findings were uncommon (4% of their study population),[31] consistent with Korvin et al (1975), who found only 223 clinically significant laboratory findings in a sample of 19,980 test results (a rate of 1.1%).[32] As with prior studies, these were limited by convenience sampling rather than random assignment of subjects. Detailed screening is associated with more consultations, more diagnostic investigations, and higher costs.[33]

Henneman et al (1994) evaluated a standardized ED medical evaluation conducted in 100 patients with new-onset psychiatric symptoms;[34] 63% had an "organic" etiology. They recommended routine, comprehensive laboratory screening as an integral part of the medical evaluation of alert patients with new psychiatric symptoms. In contrast, Olshaker et al (1997) evaluated the frequency of medical conditions in 345 patients in a retrospective study over a two-month period.[25] They found that 19% had medical conditions, most of which were identified via the history, physical exam (PE), and vital signs. They concluded that routine laboratory tests, including CBC, chemistry panels, and toxicology screening had a low yield.

Korn et al (2000) reported that comprehensive screening of all patients is prohibitive and an unnecessary use of resources.[35] In a retrospective chart review, they found that 38% of all patients had isolated psychiatric complaints and 62% had both medical and psychiatric complaints. They recommended routine laboratory examination for patients with

substance abuse, the elderly, homeless, and patients with new symptoms. They recommended against laboratory studies in patients with an established psychiatric history who had no medical complaints, no PE findings, and stable vital signs. This study was limited in that it was retrospective and only reviewed data over a five-month period.

A retrospective review of charts of those who were admitted to a psychiatric ED who had been expected to undergo a medical clearance process, found a wide variation in the PEs done in the ED by EPs, psychiatric residents/students and family practice (FP) physicians or FP nurse practitioners. In this study, FP physicians and nurses had the most complete exams, while EPs had the least complete exam.[36]

Although mental health patients in the emergency setting are sometimes assumed to have difficulty reporting medical symptoms or history accurately, Amin and Wang (2009) argued that no literature supports this view,[37] and at least some researchers have argued the complementary point that patients have a desire to be treated as credible reporters.[38] In the Amin and Wang study of 375 patients, only four had significant lab abnormalities that did not lead to any change in their disposition.[37] The authors concluded that the history and PE is sufficient in patients with psychiatric complaints for whom there is documentation of previous psychiatric history and a normal history and PE.

To clarify the importance of a history and physical, Reeves et al (2000) correlated physical findings with medical diagnoses in a group of psychiatric patients and found failure to obtain available history in 34.4%, an inadequate PE in 43.8%, and an inadequate mental status examination in 100% of those with missed medical diagnoses.[39] However, the population in their study was small (n=64). Further, in a sample of 1,340 patients admitted to a psychiatric unit between 2001 and 2007, Reeves et al (2010) found that a medical disorder had caused the symptoms of 55 patients (2.8%). Compared to patients admitted to medical units, patients admitted to psychiatric units had lower rates of completion of medical histories, PEs, cognitive assessments, indicated laboratory and/or radiologic studies, and treatment of abnormal vital signs. The authors concluded that assessment procedures are less likely to be performed in patients admitted to psychiatric units with mental status changes because the symptoms are more likely to be attributed to psychiatric illness than are those of patients without such a history.[40]

Given the conflicting literature on the utility of universal screening, it is perhaps not surprising that this is often an area of disagreement between EPs and psychiatrists. Broderick et al (2002) for instance reported that universal, as opposed to indicated, laboratory screening was one of the greatest barriers to consensus between the ED and psychiatry with respect to the medical examination.[41]

Substance abuse may be an indication for more extensive medical assessment but the screening method required is also controversial. In their 2000 study of 392 patients who presented to a psychiatric emergency service, Schiller et al found routine urine drug screening did not have an appreciable impact on either patient disposition or length of inpatient stay. The authors concluded that routine use of drug screening in such settings was not supported by their results.[42]

Agitation may also be an indication for further testing. Schillerstrom et al (2004) found several laboratory differences between agitated patients who required emergent medication and non-agitated patients. The authors concluded agitated psychiatric patients may be medically different from non-agitated patients and argued for testing. Limitations of their study included a short data collection period, retrospective design, and inconsistent measurements between subjects.[43]

In a review paper, Gregory et al noted that psychiatric patients in the ED should undergo screening if they are considered for a psychiatric admission.[10] The screening is intended to identify patients who cannot be safely or effectively treated on a psychiatric unit. Accordingly, medical clearance does not mean the patient is free of illness, but that there is no acute need to transfer the patient to a medicine service. The authors highlighted the need for greater standardization and provided a sample protocol for medical screening examinations.

Based upon a thorough review of the medical literature regarding medical assessment of psychiatric patients in 2005, Zun et al concluded that new-onset psychiatric symptoms require extensive ED evaluation but patients with chronic psychiatric illnesses do not need routine testing if the presentation was similar to past presentations. They also suggested that documentation of the medical assessment has more value than use of the ambiguous term "medically clear."[12]

Janiak et al (2010) noted that psychiatric treatment facilities have varying requirements for baseline testing and interventions before accepting patients. They argued that the history and PE performed by the ED is sufficient to identify medically compromised patients, and that tests done per psychiatric protocol are not cost-effective. However, the psychiatric service in their study had ready access to medical consultation and treatment services if needed, which is not the case in many free-standing psychiatric hospitals.[44]

Of note, requirements of the Emergency Medical Treatment and Labor Act (EMTALA) have at times been confused with what psychiatric facilities consider "medical clearance." There is a commonly held belief that if the ED does not complete a full medical clearance, there is risk of an EMTALA violation. However, under EMTALA 1) any individual who comes to an ED and requests care must receive a medical screening examination to determine whether an emergency medical condition exists; and 2) if an emergency

medical condition exists, treatment must be provided until the emergency medical condition is resolved or stabilized. This is not the same thing as "medical clearance" but rather stabilization of emergency conditions. There is no difference when it comes to a psychiatric condition; stabilization or transfer to a higher level of care must occur. There is no requirement for "universal" laboratory tests to be completed. This has led to disagreements between hospitals and disciplines. A free-standing psychiatric facility may feel compelled to reject the patient on grounds of medical stability, when in fact, the issue may be very different.

In summary, the best available evidence indicates that a thorough history and PE, including vital signs, are the minimum necessary elements in the evaluation of psychiatric patients. However, this has never been specifically studied in a randomized clinical trial.

AVAILABLE PROTOCOLS AND GUIDELINES

Several efforts have been made to standardize the evaluation of psychiatric patients. It is worth noting that efforts to create guidelines are often met with resistance from both mental health professionals and EPs.[45-46]

In 1996, Zun et al developed a tool to evaluate the appropriateness of patient transfer to state psychiatric beds.[47-48] This protocol reduced costs, but did not reduce throughput or ED rates of recidivism. In a 2010 report, Pinto et al noted that the "goal of medical clearance" is to determine if medical illnesses make admissions to psychiatry inappropriate or unsafe. They provided a template for the PE of psychiatric patients,[36] but clinical trials of the template are lacking.

Shah et al (2010) developed a two-part screening tool and retrospectively examined 500 charts of patients for whom psychiatric symptoms were the chief complaint. They concluded that their screening tool could be used to identify patients who can be referred for psychiatric evaluation without laboratory tests.[49]

Multiple states and hospitals have also developed tools and protocols for the evaluation of psychiatric patients in an effort to cut costs, enhance throughput, standardize evaluation, and improve patient care. Examples of these include the

Table 2. Medical clearance as currently practiced in select states.

	Clearance?	Labs	Should not admit	BAL/UDS	Special notes
University of Connecticut	Performed by ED	Per HPI/physical exam; some labs required for patients presenting for detox, overdose, or eating disorders	Patients on O2 therapy; who require IVs; who have high acuity; who require telemetry	BAL on all patients for detox; UDS on patients with overdose	Patients with BAL > 100 should stay in the ED
Massachusetts College of Emergency Physicians	Reflects short-term but not long-term medical stability. Does not indicate the absence of ongoing medical issues	Not required for low-risk patients (age 15-55, no acute complaints, no new psychiatric or physical symptoms, no substance use, normal physical exam, normal vitals)	Not specified	Neither the determination that the patient can be psychiatrically evaluated nor the determination that a patient can be transferred should be based on a specific level of alcohol	ED exam is focal and not a replacement for a general multisystem physical exam after transfer. Additional testing may be performed if receiving facility asks for it, but should not delay transfer.
Best practices report/Illinois Hospital Association	Focused medical assessment by ED preferred over term "medical clearance"	Not required if patient has no new psychiatric condition, no hx of active medical illness, normal vitals, normal physical exam, normal mental status	Not specified	Patient cannot be assessed psychiatrically if intoxicated, but cognitive abilities rather than absolute level should guide assessment.	If intoxicated, patient should remain in the ED. This is not a function of a specific alcohol level.

ED, emergency department; *HPI,* history of present illness; *BAL,* blood alcohol level; *UDS,* urine drug screen

Table 2. Continued.

North Carolina	Performed by ED	Not required for low-risk patients	NC psych facilities cannot safely manage serious medical conditions, such as (see report for full list): transfusions; recent head injury without workup; CVA; recent MI requiring telemetry; hypertensive crisis; acute drug intoxication; acute fracture; unexplained fever; DKA	BAL should be <300	Pay special attention to elderly patients, as medications may be causing their symptoms

ED, emergency department; *NC,* North Carolina; *CVA,* cerebrovascular accident; *MI,* myocardial infarction; *DKA,* diabetic ketoacidosis; *BAL,* blood alcohol level

Maine Health Medical Clearance Protocol,[50] Massachusetts College of Emergency Physicians: Joint Task Force Consensus Guidelines,[51] North Carolina Department of Mental Health guidelines (revised),[52] and University of Connecticut Health Center Medical Clearance protocol.[53] (See Table 2.) Unfortunately, few data are available concerning validation of these protocols.

In 2006, the Clinical Policy Committee of the American College of Emergency Physicians introduced a policy for evaluation of psychiatric patients presenting in the ED based on an extensive review of the literature.[54] Patients with abnormal vital signs, delirium, altered cognition, or abnormal physical examinations were excluded "because they often have medical illness that mandates a symptom-based evaluation." Several conclusions were offered by the task force with respect to the medical assessment process: 1) In alert, cooperative patients with normal vital signs, a noncontributory history and PE, and psychiatric symptoms, routine laboratory testing was felt to be of low yield and not necessary; 2) In alert, cooperative patients with normal vital signs, a noncontributory history and PE, and psychiatric symptoms, routine urine toxicology need not be performed, and screens obtained for the use of receiving psychiatric facilities should not delay the patient's evaluation or transfer; and 3) In alert, cooperative patients with normal vital signs, a noncontributory history and PE, and an elevated blood alcohol level, the patient's cognitive abilities rather than a specific blood alcohol level should be the basis upon which to begin a psychiatric assessment.

CONCLUSION

The review of the medical screening literature is varied, with multiple studies, multiple authors, and multiple methodologies used to investigate this question. Perhaps given the variability in study designs and populations, the literature is rife with controversy. The next article will present consensus recommendations in an effort to establish nationally accepted guidelines.

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Intentional Recreational Abuse of Quetiapine Compared to Other Second-generation Antipsychotics

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Introduction: Case reports and poison center data have demonstrated that the second-generation antipsychotic quetiapine is being obtained and used for recreational abuse. The purpose of this study was to describe the relative rates of single-substance abuse for different atypical antipsychotics and compare their demographic and clinical features.

Methods: We conducted a 10-year retrospective analysis of the National Poison Data System (NPDS) database (2003 – 2013). Trained nurses and pharmacists with specialty training in toxicology prospectively collect all NPDS data at poison control centers around the United States. We queried the NPDS for all cases of single-substance second-generation antipsychotic exposures coded as "intentional abuse." The data provided by the NPDS regarding rates and clinical features of quetiapine abuse and the abuse of all other second-generation antipsychotics were compared and described descriptively.

Results: During the study period, 2,118 cases of quetiapine abuse and 1,379 cases of other second-generation antipsychotic abuse were identified. Quetiapine abuse was more common than the abuse of other second-generation antipsychotics, compromising 60.6% of all abuse cases during the study period. After quetiapine, the next most frequently abused medications were risperidone (530 cases, 15.2%) and olanzapine (246 cases, 7.0%). For all second-generation antipsychotics including quetiapine, central nervous system clinical effects were most common, including drowsiness, confusion, and agitation. Other serious clinical effects observed with second-generation antipsychotic abuse included hypotension, respiratory depression, and seizures.

Conclusion: Quetiapine abuse is relatively common, and is abused far more often than any other second-generation antipsychotic. Emergency physicians should be aware of the clinical effects that may occur after second-generation antipsychotic abuse. [West J Emerg Med. 2017;18(2)243-250.]

INTRODUCTION

Quetiapine is a second-generation antipsychotic (SGA) approved for use in schizophrenia and bipolar disorder.[1] It is also commonly prescribed for generalized anxiety disorder, major depression, and mood disorders.[2,3] While the majority of quetiapine prescriptions are used for their intended purpose, some patients obtain quetiapine from both legitimate and illicit sources and use this medication as a drug of abuse.

Although SGAs are not classically considered to have significant abuse potential, over the last decade case reports and poison center data have demonstrated that quetiapine abuse is a common phenomenon.[4-15] The intentional abuse of quetiapine reportedly achieves a variety of desirable recreational alterations of sensorium, including anxiolysis,

hypnosis, and euphoria.[4,5,14,16,17] Quetiapine is also abused concomitantly with other illicit substances, such as cocaine or other sympathomimetics, to enhance their effects or to aid in self-treatment of withdrawal.[8,16]

Quetiapine abuse is particularly concerning given the morbidity and mortality associated with its "non-prescribed" use. This has been demonstrated most extensively in the literature discussing quetiapine overdoses. Many studies have shown that patients who overdose on quetiapine are at risk for coma, hypotension, respiratory depression, seizure, and death.[18-22] Additional literature demonstrates the need for advanced resuscitative measures after quetiapine overdose, including intravenous fat emulsion (Intralipid®) therapy and extracorporeal membrane oxygenation.[23,24] Based on these observations, some have remarked that quetiapine ingestions may be more dangerous than comparable ingestions of other antipsychotics.[18]

The purpose of this study was to identify the relative incidence of intentional recreational single-substance abuse of quetiapine compared to other SGAs, and to compare their demographic and clinical features. This study question is of great importance because if quetiapine abuse is in fact as common as prior literature suggests, quetiapine abuse presenting to the emergency department (ED) should be better characterized to prepare emergency physicians for management of these patients.

METHODS

Study Setting

This study is a retrospective review evaluating the intentional recreational abuse of quetiapine compared to other SGAs reported to the National Poison Data System (NPDS) from September 1, 2003, to September 1, 2013. Approval for this study was obtained from the institutional review board human subjects research committee.

The NPDS is owned and managed by the American Association of Poison Control Centers (AAPCC); it contains over 62 million exposure cases on over 420,000 different products since 1983. Nurses and pharmacists with specialty training in toxicology collect all NPDS data in real time. These trained experts use a systematic tool to assign clinical effects, clinical outcomes, and reasons for exposure to each case in a prospective manner. The NPDS also obtains close follow up by communicating directly with the caregivers for each case.

Definitions

The definition of "intentional abuse" used by AAPC-accredited poison centers is "an exposure resulting from the intentional improper or incorrect use of a substance where the patient was likely attempting to gain a high, euphoric effect or some other psychotropic effect, including recreational use of a substance for any effect."[25] In terms of NPDS coding, intentional abuse is a distinct entity from "intentional misuse" ("an exposure resulting from the intentional improper or incorrect use of a substance for reasons other than the pursuit of a psychotropic effect") and "intentional – suspected suicidal" ("an exposure resulting from the inappropriate use of a substance for self-harm or for self-destructive or manipulative reasons").[25]

The AAPCC also designates clinical outcomes for each individual case. Again, these outcomes are determined using standardized criteria.[26] Table 1 defines criteria for each clinical outcome from the NPDS guidelines, and examples may be found in the NPDS coding manual.[25]

Study Protocol

We queried the NPDS for all SGA exposures coded as "intentional abuse." Only single-substance exposures (those without co-ingestions of other substances) were included. We identified cases by the NPDS using all known product codes (generic and brand names for all formulations). The SGAs included in the query were quetiapine (Seroquel©), risperidone (Risperdal©), clozapine (Clozaril©), olanzapine (Zyprexa©), iloperidone (Fanapt©), arirpiprazole (Abilify©), paliperidone (Invega©), ziprasadone (Geodon©), asenapine (Saphris©), and lurasidone (Latuda©). We did not include combination formulations with drugs from other classes. Exclusion criteria were cases coded as "confirmed non-exposure," as well as cases where the patient age was less than 10 years old, as these were unlikely to be intentional abuse.

After acquisition of the electronic NPDS database, we divided cases into study cohorts. The primary study cohort included all cases of quetiapine abuse. Additional study cohorts for comparison included a group of all other SGA cases combined, in addition to cohorts of each individual SGA. If an individual SGA had fewer than 50 total cases reported to the NPDS over the 10-year period, it was excluded from comparative analysis as an individual cohort, but was still included in the cohort of all other antipsychotics combined.

For the first part of the investigation, we analyzed demographic data. The data points extracted included age, gender, route of exposure, chronicity of abuse, and patient disposition. This demographic analysis included cases with any medical outcome (no effect, minor effect, moderate effect, major effect, death, unable to follow, and not followed). The next part of the investigation sought to describe the clinical features of SGA abuse. This part of the analysis only included cases with known outcomes (no effect, minor effect, moderate effect, major effect, or death). This was done to improve the accuracy of the reported clinical data. The data collected regarding clinical features of SGA abuse included data on clinical effects (agitated/irritable, ataxia, coma, confusion, dizziness/vertigo, drowsy/lethargy, dystonia, hallucinations, seizure, slurred speech, conduction disturbance, dysrhythmia,

Table 1. Clinical outcome definitions in the National Poison Data System[26].

Medical outcome	Definition
Major effect	The patient exhibited signs or symptoms as a result of the exposure that were life-threatening or resulted in significant residual disability or disfigurement
Moderate effect	The patient exhibited signs or symptoms as a result of the exposure that were more pronounced, more prolonged, or more systemic in nature than minor symptoms. Usually, some form of treatment is indicated. Symptoms were not life-threatening, and the patient had no residual disability or disfigurement.
Minor effect	The patient developed some signs or symptoms as a result of the exposure, but they were minimally bothersome and generally resolved rapidly with no residual disability or disfigurement
Unable to follow	Insufficient follow up available
Not followed	Insufficient follow up available

electrocardiogram changes, hypotension, syncope, tachycardia, elevated creatine kinase/rhabdomyolysis, respiratory arrest, respiratory depression), therapies provided (alkalinization, benzodiazepines, cathartics, charcoal, CPR, intravenous fluids, intubation, lavage, naloxone, oxygen, physostigmine, sedation, vasopressors), and medical outcome (no effect, minor effect, moderate effect, major effect, or death).

Data Analysis

All data were obtained directly from the electronic NPDS database and analyzed with descriptive statistics. For all variables previously mentioned, we determined proportions for each cohort (quetiapine cohort, all other SGAs combined cohort, and each individual SGA cohort). All analyses were conducted using STATA (Version 12.1, StataCorp, College Station, TX).

RESULTS

During the study period there were 2,134 total cases of quetiapine exposures and 1,398 cases of SGA exposures coded as intentional abuse reported to the NPDS. In the quetiapine cohort, 16 cases were excluded (six due to age less than 10 years, 10 confirmed non-exposures), leaving 2,118 for analysis. In the other SGA cohort, we excluded 19 cases (17 due to age less than 10 years, two confirmed non-exposures), leaving 1,379 for analysis.

Quetiapine was the most commonly abused SGA (n = 2118) during the study period, accounting for 60.6% of all cases. The next most frequently abused SGA was risperidone (530), followed by olanzapine (246), aripiprazole (229), ziprasadone (229), clozapine (101), paliperidone (34), asenapine (6), iloperidone (2), and lurasidone (2). Table 2 depicts demographic data. Table 3 depicts patient disposition.

Of the 2,118 cases in the quetiapine cohort, there were 1,446 cases with known outcomes. Of the 1,379 cases in the cohort of all other SGAs, there were 919 with known outcomes. Table 4 demonstrates these medical outcomes for each cohort. Table 5 describes the clinical effects seen with SGA intentional abuse. Table 6 describes the therapies provided for each cohort.

DISCUSSION

Emergency physicians encounter substance abuse on a daily basis. Although quetiapine has not classically been considered a "drug of abuse," in this last decade there have been many reports in the medical literature as well as in the media describing this phenomenon.[4, 5, 7-9, 14, 15] Emergency medicine literature has previously been far more robust in describing the clinical features and adverse events associated with quetiapine overdoses;[18-23] however, recreational abuse of quetiapine appears to be another significant public health problem that emergency physicians must be aware of.

This study corroborates that quetiapine is the most commonly abused SGA. Although perspectives from case reports[4,14,] and survey data[16] suggested this was likely to be the case, this NPDS query confirmed that quetiapine abuse was identified and prospectively reported more frequently than any other SGA; in fact, quetiapine was abused more often than all other SGAs combined. In addition to our work, the most comprehensive publication thus far supporting this notion was a study using the Drug Abuse Warning Network (DAWN).[27] The DAWN is a public health surveillance system in the United States that uses medical record data from a representative group of hospitals in addition to population data to approximate prevalence. This differs from the NPDS dataset in that the data from the DAWN is estimated based on retrospective chart review, rather than prospectively identified cases called into national poison centers. Despite these different methods, the authors of this study found similar results; quetiapine-related ED visits increased by 90% from 2005 to 2011, including visits for misuse/abuse, suicide, and adverse events. Although they did combine visits for misuse and abuse, they identified 27,114 visits for these purposes during their study period, of which 6,780 were single-substance (quetiapine-only) visits. This number represented

Table 2. Patient demographics.

Demographics	Quetiapine (n = 2118)	All other SGAs (n = 1379)
Median age (years) (IQR)	17 (15 – 27)	18 (15 – 25)
Gender, male (%)	1313 (62.0%)	915 (66.4%)
Chronicity		
Acute	1685 (79.6%)	1044 (75.7%)
Acute on chronic	335 (15.8%)	260 (18.9%)
Chronic	32 (1.5%)	20 (1.5%)
Route of exposure		
Ingestion	1988 (93.8%)	1307 (94.5%)
Inhalation	120 (5.7%)	73 (5.3%)
Parenteral	16 (0.8%)	5 (0.4%)

All data provided as n (%) unless otherwise specified.
SGA, second-generation antipsychotics; *IQR,* inter-quartile range; if cases had multiple exposure routes coded, all were included.

Table 3. Disposition of patients coded as having intentionally abused second-generation antipsychotics (SGA).

Patient disposition	Quetiapine n = 2118	All other SGAs n = 1379	Aripiprazole n = 229	Clozapine n = 101	Olanzapine n = 246	Risperidone n =530	Ziprasidone n = 229
Treated and discharged	40.8%	39.4%	38.4%	23.4%	28.9%	44.3%	47.6%
Critical care admission	10.3%	9.3%	6.5%	22.8%	18.3%	5.8%	5.2%
Patient refused referral to hospital	7.8%	8.8%	10.4%	7.9%	9.3%	8.7%	6.1%
Psychiatric admission	7.2%	7.2%	9.6%	4.0%	8.5%	7.4%	5.2%
Non critical care admission	6.5%	6.6%	5.2%	14.8%	8.2%	6.2%	3.5%

All cases not included in table did not have available disposition data.

Table 4. Medical outcomes for each cohort.

Medical outcomes	Quetiapine n = 1446	All other SGAs n = 919	Aripiprazole n = 142	Clozapine n = 72	Olanzapine n = 167	Risperidone n = 361	Ziprasidone n = 149
Death	0.1%	0.1%	0	0	0	0.3%	0
Major outcome	2.0%	2.5%	0.7%	8.3%	5.4%	1.4%	1.3%
Moderate outcome	24.6%	37.6%	25.4%	50%	35.9%	44.0%	32.9%
Minor outcome + no effect	73.4%	76.8%	73.9%	41.3%	63.8%	54.1%	65.7%

SGA, second-generation antipsychotics

52% of all SGA misuse/abuse visits, with the next most common being risperidone misuse/abuse (5,804, 11%) and olanzapine misuse/abuse (4,528 cases, 9%), all figures similar to ours.[27]

Quetiapine prescribing is common in the U.S. A 2013 IMS Health report showed that quetiapine was the most frequently prescribed SGA, with over 14 million dispensed prescriptions that year.[28] Other studies support this, identifying a three-fold increase in prescribing over a decade,[29] an observation likely driven by the increasing popularity of quetiapine use for "off-label" indications.[2,3,16,29,30,31] These prescribing patterns may contribute to why quetiapine is the most commonly abused SGA in terms of absolute numbers of cases.

Aside from the public health concerns that emerge from

Table 5. Clinical effects seen with intentional abuse of second-generation antipsychotics.

Clinical effects	Quetiapine n = 1446	All other SGAs n = 919	Aripiprazole n = 142	Clozapine n = 72	Olanzapine n = 167	Risperidone n = 361	Ziprasidone n = 149
CNS effects							
Drowsy/lethargy	54.5%	39.4%	16.9%	62.5%	59.3%	31.6%	47.0%
Slurred speech	7.8%	6.4%	0.7%	16.7%	12.6%	4.2%	4.7%
Agitated/Irritable	5.5%	8.1%	3.5%	23.6%	16.2%	5.3%	3.4%
Dizziness/vertigo	5.0%	4.9%	4.9%	0	5.4%	3.9%	8.7%
Ataxia	4.4%	2.7%	0.7%	4.2%	7.2%	1.7%	2.0%
Confusion	4.2%	6.2%	3.5%	26.4%	11.4%	3.3%	0.7%
Hallucinations	1.6%	2.8%	0.7%	9.7%	4.8%	2.5%	0.7%
Coma	1.2%	1.6%	0	9.7%	3.0%	0.3%	1.3%
Seizures	0.8%	1.0%	1.4%	4.2%	1.8%	0.3%	0
Dystonia	0.6%	12.5%	12.0%	0	3.0%	19.1%	10.1%
Cardiovascular effects							
Tachycardia	22.9%	20.3%	14.1%	34.7%	19.2%	23.5%	12.1%
Hypotension	5.9%	3.0%	0	5.6%	1.8%	3.9%	4.7%
Syncope	1.8%	0.3%	0.7%	1.4%	0	0.3%	0
Conduction disturbance	1.2%	1.2%	1.4%	1.4%	0.6%	1.7%	0.7%
ECG changes	0.9%	0.5%	0	1.4%	0	0.3%	1.3%
Dysrhythmia	0.1%	0.1%	0	0	0	0.3%	0
Other effects							
Respiratory depression	1.0%	0.2%	0	0	1.2%	0	0
Elevated CK/rhabdomyolysis	0.4%	0.4%	0.7%	0	0.6%	0.6%	0
Respiratory arrest	0.1%	0.2%	0	0	0.6%	0.3%	0

SGA, second-generation antipsychotics; *CNS,* central nervous system; *ECG, electrocardiogram; CK,* creatine kinase

these results, other outcomes of interest in this study were the medical consequences of quetiapine abuse. Clinical outcomes due to non-prescribed ingestions of quetiapine were recently described by a group of researchers who similarly used the NPDS, but in a smaller sample. Although their study combined cases characterized as "misuse" and "abuse," the present study generally supports many of their findings regarding clinical outcomes. In this study, we confirmed that an ingestion of quetiapine for recreational purposes was likely to present symptomatic; 79.1% of cases with outcome data available described some degree of clinical effect, of which 26.6% were considered major or moderate effect. This finding is of particular importance to emergency physicians who will be caring for these patients.

According to our data, central nervous system (CNS) clinical effects will hallmark the quetiapine abuse patient presentation, as well as the presentation of any SGA abuse. SGAs treat both positive and negative symptoms of schizophrenia, and pharmacologically antagonize dopamine (D_2) and serotonin ($5HT_{2a}$) receptors.[32] Thus, as expected, sedation was often observed in this study. Interestingly, certain severe CNS effects were significantly more common in the clozapine and olanzapine cohorts. While quetiapine, clozapine, and olanzapine are unique among SGAs in that they all have antagonistic activity at muscarinic (M_1) receptors, olanzapine and clozapine are much more potent than quetiapine, which may be responsible for the increased incidence of agitation, confusion, coma, and hallucinations. In addition, clozapine is a known GABA-A receptor antagonist,[33] and in previous data has been known to cause seizures at higher rates than other antipsychotics.[34] Thus, the increased incidence of seizures seen for this particular medication in our study is not surprising.

Other than CNS effects, cardiovascular clinical effects were observed but were overall less common. Tachycardia was the most frequently observed cardiovascular clinical effect, followed by hypotension for most cohorts. While many SGAs cause adrenergic (α_1) antagonism, which would typically lead to hypotension and reflex tachycardia, cardiovascular effects are often multi-factorial and in our data did not align with the varying degrees of α_1-antagonism between drugs. The overall low rates of serious

Table 6. Therapies provided to patients who intentionally abused second-generation antipsychotics (SGA).

Therapies	Quetiapine n = 1446	All other SGAs n = 919	Aripiprazole n = 142	Clozapine n = 72	Olanzapine n = 167	Risperidone n = 361	Ziprasidone n = 149
Intravenous fluids	24.5%	24.3%	14.8%	41.7%	31.1%	24.1%	18.1%
Charcoal	15.1%	15.2%	16.2%	11.1%	25.1%	12.7%	14.1%
Cathartics	4.6%	5.1%	5.6%	4.2%	9.0%	3.9%	4.7%
Oxygen	3.9%	3.0%	0.7%	8.3%	6.0%	2.2%	2.0%
Benzodiazepines	3.3%	6.0%	5.6%	12.5%	9.0%	4.4%	2.0%
Naloxone	2.4%	2.5%	0	8.3%	6.6%	0.8%	2.0%
Sedation	1.7%	0.1%	0	4.2%	3.6%	0	0
Intubation	1.4%	1.5%	0.7%	5.6%	4.2%	0.6%	0
Lavage	1.0%	1.1%	1.4%	0	3.0%	0.8%	0
Alkalinization	0.5%	0.2%	0	0	0.6%	0.8%	0
CPR	0.1%	0	0	0	0	0.3%	0
Physostigmine	0	0	0	0	0	0	0
Vasopressors	0	0	0	0	0	0.3%	0

CPR, cardiopulmonary resuscitation

cardiovascular clinical effects suggest that hemodynamic instability is unlikely to be a key component of the presentation of SGA abuse, quetiapine or otherwise.

The intubation rate observed in this retrospective cohort of cases of quetiapine abuse was 1.4%, which represents a significant number of patients who may require airway management by emergency providers. The NPDS database does not specify reasons for intubation in each case but based on rates of clinical effects seen, CNS depression and/or severe agitation are the most likely indications. Studies characterizing quetiapine overdose identify much higher rates of intubation, suggesting a dose-dependent relationship regarding the need for intubation. One study found that 14 of 20 patients in their quetiapine overdose cohort of intensive care unit patients required mechanical ventilation.[20] A larger retrospective review of 945 quetiapine overdose cases found an intubation rate of 16%.[18] These findings should remind clinicians to have a high index of suspicion for acute respiratory failure in quetiapine abuse patients presenting after larger ingestions.

The rate of dystonia in the quetiapine abuse cohort was extremely low, with only 0.6% of cases manifesting this clinical effect. The pathophysiology of drug-induced dystonia is not wholly agreed upon. A commonly held theory is that a drug induces dystonia via dopamine (D_2) antagonism in the nigrostriatal pathways of the basal ganglia, leading to excessive cholinergic input.[35] This is supported by the presence of dystonic symptoms in patients with Parkinson's disease as well as the observation that drugs with increased D_2 antagonism cause dystonia that improves when antimuscarinic medications are administered. Considering the inherent antimuscarinic activity of quetiapine, olanzapine and clozapine, it is not surprising these three cohorts had the lowest rates of dystonia. This relative infrequency of dystonia in the quetiapine cohort could hypothetically contribute to quetiapine's higher incidence of abuse, as dystonia is generally viewed as an undesirable side effect.

LIMITATIONS

There are several limitations present in this study. The major limitation is its retrospective nature and the potential inaccuracy innate to the data available to the NPDS. Although highly trained poison center personnel collect NPDS data in real time, there was no means to verify data in this study, other than what was coded. NPDS data are at risk for certain misclassifications; however, this should be the same across all groups of SGAs and therefore mitigated. Cases can be incorrectly coded as single-substance ingestions when there were in fact co-ingestions, which could influence the reported clinical data. "Misuse" versus "abuse" could be interchangeably misclassified as well. Unfortunately, very limited data were collected regarding doses, which would have been helpful in understanding the clinical presentations of these cases. Prevalence of abuse is also likely underestimated in the present study due to the exclusion of co-ingestions and incomplete reporting to poison centers. (There is regional variability in poison center use as some poison centers charge hospitals for use and others preferentially use inpatient consulting toxicology services.) Again, these limitations however would hypothetically be similar for all medications included, so should not alter the conclusions regarding relative frequencies of SGA abuse.

CONCLUSION

This study is a large retrospective cohort evaluating demographic features, clinical features, and the relative frequency of quetiapine abuse as it compares to other SGAs. According to these data, quetiapine is the most commonly abused SGA by a substantial margin. The findings of this study also confirm that most patients who present to the ED will be symptomatic and may require therapeutic interventions. It is important for emergency physicians to be aware of these findings, as they are likely to encounter this scenario in their clinical practice.

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Management of Sickle Cell Disease Super Utilizers

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Much attention has been directed toward super utilizers of emergency department (ED) and hospital services. Often these patients have a chronic illness with significant potential for acute morbidity. In many settings, adults with sickle cell disease (SCD) are a significant proportion of super utilizers. This population has a significantly shortened life span compared to other adults as well as a high morbidity including acute life-threatening diseases such as acute chest syndrome and stroke. Compared to other chronic diseases, SCD patients have significantly higher[1] admission and readmission rates, and outpatient resources are often poorly available.[2]

Quality and uniformity of care across clinical locations is often questioned. Recent authors have highlighted that there are significant differences between specialists in the approach to pain management with vaso-occlusive crisis. This includes differences between hospitalists trained in internal medicine and hematologists.[3] Other authors have highlighted the difficulty of consistently providing high quality education to sickle-cell patients and their families. High utilizers of hospital services are often characterized by significant social and psychiatric challenges both in the SCD patient and in the supporting family.[4]

In this edition of *Western Journal of Emergency Medicine*[5] Simpson et. al. describe an intervention to enroll ED super utilizers with SCD in an ED management protocol and the formation of a medical home. The effort required for this intervention is significant and needs to be emphasized. This multidisciplinary clinic included a primary care doctor, social worker, addiction and pain specialist, pharmacist and psychologist. They demonstrated that ED utilization and length of stay, as well as admission rate and inpatient length of stay, can all be decreased using this method. Mortality and ICU readmission did not occur in the study group, but the small sample prevents an adequate statistical analysis. Such a targeted approach, which coordinates ED, inpatient and outpatient settings, is ideal for managing a chronic illness with significant potential for acute morbidity.

Other authors have highlighted the need for coordinated care and alternatives for ED management of exacerbations of SCD. Alternatives should be prompt and available a large number of hours to sufficiently replace the convenient 24/7 access of the ED.[6] The level of care must be appropriate for any reasonable acute exacerbation of SCD. Specialty infusion centers have been proposed by a large number of authors[7] and have demonstrated significant decrease in admission rates. Such centers require individual care plans, and support from social services and providers who are comfortable with SCD. Telemonitoring[8] has been advocated as a method of helping providers get access to expert opinion for their individual SCD patients. Continuing medical education on SCD and appropriate support for such providers may allow a larger number of providers to step into this critical gap of support of outpatient care.

EDs provide a life-saving environment for chronically ill patients with acute exacerbation of illness. EDs also provide an opportunity to treat the patient in accordance with a consistent care plan that is shown to decrease morbidity as well as resource utilization. The article by Simpson et. al.[5] describes a process that requires a significant investment of clinical resources but also a significant improvement in resource utilization. With larger numbers of participants, it may be possible to achieve cost savings through economies of scale. This approach can be replicated for patients with SCD as well as other resource-intensive chronic illnesses (for example, heart failure or advanced chronic obstructive pulmonary disease). As payers change from fee for service to population health models of reimbursement, EDs will have opportunities to participate in more multidisciplinary chronic care plans.

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Estimating the Cost of Care for Emergency Department Syncope Patients: Comparison of Three Models

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Introduction: We sought to compare three hospital cost-estimation models for patients undergoing evaluation for unexplained syncope using hospital cost data. Developing such a model would allow researchers to assess the value of novel clinical algorithms for syncope management.

Methods: We collected complete health services data, including disposition, testing, and length of stay (LOS), on 67 adult patients (age 60 years and older) who presented to the emergency department (ED) with syncope at a single hospital. Patients were excluded if a serious medical condition was identified. We created three hospital cost-estimation models to estimate facility costs: V1, unadjusted Medicare payments for observation and/or hospital admission; V2: modified Medicare payment, prorated by LOS in calendar days; and V3: modified Medicare payment, prorated by LOS in hours. Total hospital costs included unadjusted Medicare payments for diagnostic testing and estimated facility costs. We plotted these estimates against actual cost data from the hospital finance department, and performed correlation and regression analyses.

Results: Of the three models, V3 consistently outperformed the others with regard to correlation and goodness of fit. The Pearson correlation coefficient for V3 was 0.88 (95% confidence interval [CI] 0.81, 0.92) with an R-square value of 0.77 and a linear regression coefficient of 0.87 (95% CI 0.76, 0.99).

Conclusion: Using basic health services data, it is possible to accurately estimate hospital costs for older adults undergoing a hospital-based evaluation for unexplained syncope. This methodology could help assess the potential economic impact of implementing novel clinical algorithms for ED syncope. [West J Emerg Med. 2017;18(2)253-257.]

INTRODUCTION

There is increasing pressure to improve the value of healthcare, defined as health outcomes per dollar spent.[1] Hospital-based diagnostic evaluation has specifically received scrutiny and has been characterized as costly and overutilized.[2] Syncope is responsible for over one million emergency department (ED) visits annually in the U.S. and is associated with substantial healthcare costs.[3,4] Development of novel, evidence-based clinical algorithms, specifically for syncope, may improve the value of care.[5]

A major methodological challenge to evaluating the economic impact of clinical algorithms aimed at improving resource utilization is the absence of validated cost-estimation models.[6] While there have been prior attempts to estimate aggregate ED costs, estimating patient-level hospital costs is difficult since patient-level financial data are not readily available for privacy and proprietary reasons.[6]

The purpose of this brief research report was to compare three cost-estimation models with hospital cost data obtained from the hospital finance department. Our objective was to develop a model that could accurately predict the hospital costs of a diagnostic evaluation for older adults with unexplained syncope.

METHODS

Study Design

We used prospectively collected data on health services use among older adult patients who presented to the ED with syncope to compare three hospital cost-estimation models with actual hospital cost data. This study was approved by our institutional review board.

Study Setting and Population

Our study sample consisted of older adults who presented to the ED at an urban, tertiary care, academic medical center (45,000 annual visits) with syncope. The data collection was part of a multicenter, prospective, observational study on syncope risk stratification (NCT01802398). Only our primary institution was used for the current study since this was the only hospital from which we were able to access hospital finance department data. Inclusion criteria were 1) age≥60 years, and 2) a complaint of syncope or near-syncope. Exclusion criteria were seizure, loss of consciousness after head trauma, ongoing confusion, intoxication, and intervention to restore consciousness. We also excluded patients from analysis if they had incomplete data or if a serious medical condition was identified in the ED or during the index hospitalization. Serious conditions included myocardial infarction, pulmonary embolism, gastrointestinal bleeding, stroke, cardiac arrhythmia, aortic dissection, severe structural heart disease, and other serious illnesses. The purpose of excluding patients with serious medical conditions was to estimate the diagnostic costs associated with unexplained syncope and *not* costs associated with the treatment of serious conditions.

Key Outcome Measures

We obtained patient-level hospital cost data, i.e. resources spent to provide services, from the hospital finance department on the study sample. We did not analyze charges, which are often poorly related to costs, nor did we collect data on professional fees or patient co-pays since these were unavailable. Total hospital costs were obtained for the index hospital encounter. Hospital finance department cost estimates use a fully allocated operating expenses methodology, meaning that 100% of hospital operating expenses (both indirect and direct costs) are attributed to each patient charge item for a given time period. A cost per unit is the result of absorbing all direct and indirect expenses based on a combination of cost-weight methodologies. Cost per unit is multiplied by each charge-item quantity to calculate cost, which is then summarized at the patient, procedure, physician, and service line level.

Health service use was measured by chart review of medical records by trained, non-physician, research staff using a standardized data collection form. Assessment of inter-rater reliability on 10 charts demonstrated >95% concurrence on items that measured health service use. All charts with a potential serious outcome were reviewed by the senior author.

We used three different methods to estimate total costs. All three models were the sum of two components: 1) direct costs of tests, and 2) estimated facility costs. For all three models, the direct costs of tests was calculated by adding up the unadjusted payment rates for each individual test per Center for Medicare and Medicaid Ambulatory Payment Classifications (APC) payments (Appendix A).[7] The three models differed only in the way in which facility costs were estimated.

For the first model (V1), "Unadjusted Medicare Payment," published Medicare payments were used to estimate facility costs in the following manner: for patients discharged directly from the ED, we used evaluation and management (EM) Level 5 (APC code 616; $492.69) payment.[8] For patients placed under observation status, we applied the Extended Assessment & Management (Observation) (APC code 8009) payment ($1,234.70). For patients with an inpatient admission, we applied the facility's average Medicare payment for Diagnosis Related Group (DRG) "Syncope & Collapse" from 2013 ($5,575.16 at our institution). All admitted patients were assumed to have received a DRG classification for syncope (DRG code 312).

In the second model (V2), "Modified Medicare Payment, Prorated by LOS in Calendar Days," we estimated facility costs in the following manner: for patients discharged directly from the ED, we used evaluation and management (EM) Level 5 (APC code 616; $492.69) payment, as in model V1. For patients

placed under observation status, or admitted to the hospital, we applied the same Observation APC code 8009 for each calendar day included in the total LOS. This model was proposed to explore whether length of stay (LOS) in days is a better proxy for cost than DRG or observation figures, as identical services can be delivered to a patient in either setting (in-patient or observation) and yet be billed differently.

In the third model (V3), "Modified Medicare Payment, Prorated by LOS in Hours," we estimated facility costs in the following manner: for patients discharged directly from the ED, we used evaluation and management (EM) Level 5 (APC code 616; $492.69) payment, as in model V1 and V2. For patients placed under observation status or admitted to the hospital, we calculated an average hourly amount in this cohort based again on the Observation APC code 8009 payment and multiplied that average hourly amount by total LOS in hours. This model is potentially more accurate than V2 but does require more granular data (LOS in hours versus days).

Data Analysis

We performed descriptive analyses of modeled costs. To assess the agreement between hospital cost data and modeled costs for each method, we generated scatter plots, calculated Pearson's correlation coefficients and performed linear regression of direct costs on estimated costs. All analyses were performed in SAS 9.4 (Cary, NC, USA).

RESULTS

Characteristics of Study Subjects

We collected data on a convenience sample of 100 ED patients with syncope and age ≥60 years. Data collection occurred between April 29, 2013 – March 3, 2014. One patient was excluded due to incomplete data, and 32 were excluded due to a serious medical condition, leaving 67 patients for the final analysis. Included patients had a mean age of 73.4 years (range 60-98) and were 55% male (Appendix B).

Main Results

Scatterplots of estimated costs compared to actual costs are presented in the figure in U.S. dollars. The primary analysis using raw data for the direct and estimated costs revealed that all three models (V1, V2, and V3) demonstrated strong to very strong Pearson's correlation and linear regression coefficient with V3 performing the best (r =0.88 [95% CI 0.81, 0.92], regression coefficient 0.87 [95% CI 0.76-0.99]). The goodness of fit was also highest for V3 (0.77) (Table). The average estimated cost was $1,482, range [$347, $5,514]. The average actual cost was $1,486, range [$164, $4,893]. The intercorrelations between the

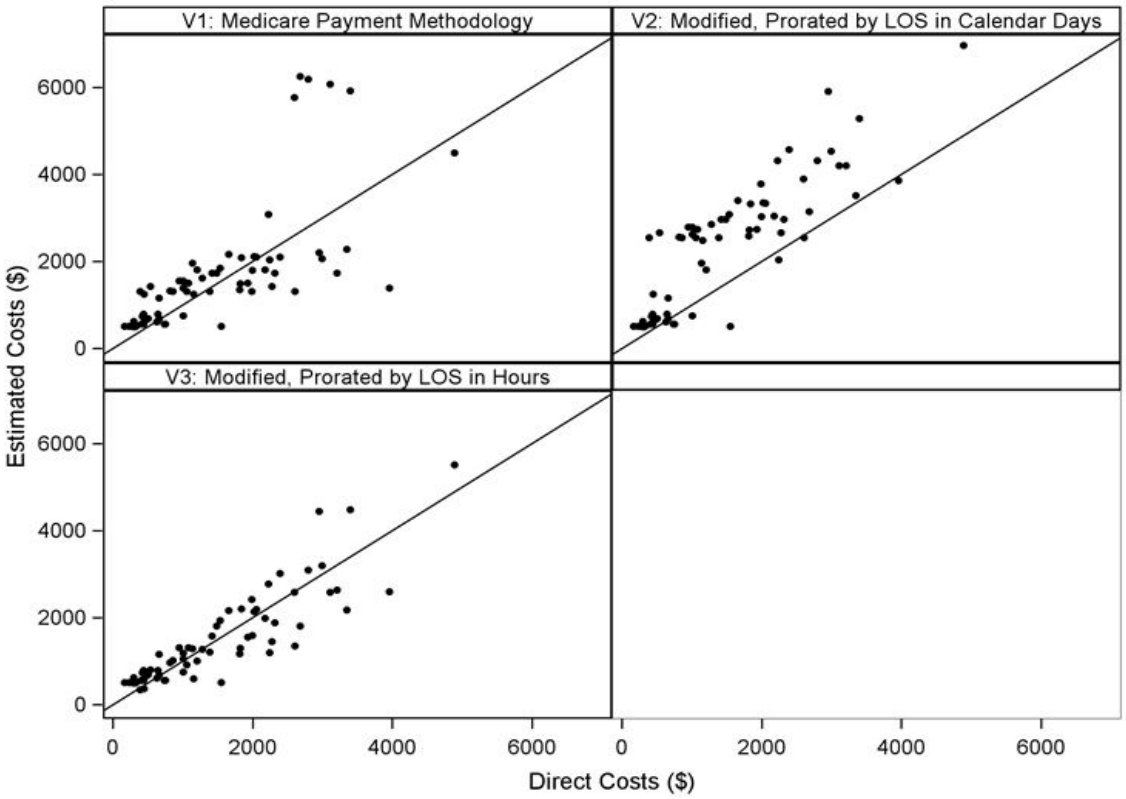

Figure. Scatter plots of estimated costs (V1, V2, V3) by direct costs for syncope care of older adults.

Table. Comparison of total cost estimation models (V1, V2, V3) versus actual hospital costs for syncope patients.

Method for estimating hospital costs	Pearson's correlation coefficient (95% CI)	Linear regression coefficient (95% CI)	R- squared
V1: unadjusted Medicare payment	0.69 (0.54, 0.80)	0.51 (0.38, 0.64)	0.48
V2: modified Medicare payment, prorated by LOS in calendar days	0.86 (0.78, 0.91)	0.60 (0.52, 0.69)	0.75
V3: modified Medicare payment, prorated by LOS in hours	0.88 (0.81, 0.92)	0.87 (0.76, 0.99)	0.77

CI, confidence interval; *LOS*, length of stay.

three models can be found in Appendix A.

DISCUSSION

We compared the performance of three cost-estimation models to predict the cost of care for unexplained syncope. One model, V3, consistently outperformed the other two models with respect to correlation with hospital finance data, which we used as the reference standard. By adding the individual costs of diagnostic tests (based on publicly available CMS data) and estimating facility costs using APC observation payments, prorated by LOS in hours, this model best predicted the total cost of care for patients with unexplained syncope. This model likely performed best because of two factors: 1) the inputs were more granular (hours versus days), thus leading to a more accurate estimation of the quantity of health services delivered; and 2) it removes the somewhat arbitrary payment differences between in-patient admission and observation stay, focusing instead on LOS as a proxy of the quantity of services delivered.

Developing a valid cost-estimation model would allow health services researchers to estimate costs associated with syncope without access to hospital proprietary information. Mounting pressures to contain healthcare costs have spurred researchers, administrators, and policymakers to devise and implement strategies to increase the value of care. Syncope was identified as one of the top conditions targeted by Medicare Recovery Audit contractors for repossession of medically unnecessary inpatient expenditures.[9] Estimating the costs of syncope-related healthcare services at the patient level is a crucial step in being able to predict the economic effects of implementing novel syncope clinical algorithms.

LIMITATIONS

Our study has certain limitations. First, our findings are from a small, single-site sample and should be validated in other settings. Second, our hospital finance department does not use strict activity-based costing, which is a highly resource intensive "gold standard" approach for cost estimation.[6] However, hospital financial data appear to be a more accurate method of assessing costs than other available methods.[10] We did not include professional fees or patient co-pays, both contributors to the overall costs of care, since these data were not available. However, hospital charges are generally the target of policies aimed at increasing healthcare value.

CONCLUSION

In summary, we derived and compared three models for cost estimation that correlated with actual hospital costs. The most accurate model (V3) uses Medicare payments for diagnostic tests and requires hospital LOS in hours to estimate hospital costs for the diagnostic evaluation of syncope. This simple cost model could be a useful tool for investigators to assess the economic impact of novel clinical algorithms for syncope.

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Serum Lactate Predicts Adverse Outcomes in Emergency Department Patients With and Without Infection

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Introduction: Lactate levels are increasingly used to risk stratify emergency department (ED) patients with and without infection. Whether a serum lactate provides similar prognostic value across diseases is not fully elucidated. This study assesses the prognostic value of serum lactate in ED patients with and without infection to both report and compare relative predictive value across etiologies.

Methods: We conducted a prospective, observational study of ED patients displaying abnormal vital signs (AVS) (heart rate ≥130 bpm, respiratory rate ≥24 bpm, shock index ≥1, and/or systolic blood pressure <90 mmHg). The primary outcome, deterioration, was a composite of acute renal failure, non-elective intubation, vasopressor administration or in-hospital mortality.

Results: Of the 1,152 patients with AVS who were screened, 488 patients met the current study criteria: 34% deteriorated and 12.5% died. The deterioration rate was 88/342 (26%, 95% CI: 21 – 30%) for lactate < 2.5 mmol/L, 47/90 (52%, 42 – 63%) for lactate 2.5 – 4.0 mmol/L, and 33/46 (72%, 59 – 85%) for lactate >4.0mmol/L. Trended stratified lactate levels were associated with deterioration for both infected (p<0.01) and non-infected (p<0.01) patients. In the logistic regression models, lactate > 4mmol/L was an independent predictor of deterioration for patients with infection (OR 4.8, 95% CI: 1.7 – 14.1) and without infection (OR 4.4, 1.7 – 11.5).

Conclusion: Lactate levels can risk stratify patients with AVS who have increased risk of adverse outcomes regardless of infection status. [West J Emerg Med. 2017;18(2)258-266.]

INTRODUCTION

The use of lactate to identify patients at risk for adverse outcomes and to guide treatment decisions for emergency department (ED) patients with infection has gained widespread adoption based upon a number of studies.[1-6] The Surviving Sepsis Campaign[7] has incorporated the measurement of serum lactate concentrations into its most current guidelines, emphasizing measurement within three hours of identification of sepsis. Despite there being many causes of elevated lactate levels, lactate functions well as a severity marker in ED patients with infection,[1,8] and it has been widely adopted as a method to risk stratify ED patients with infection.

In non-infectious diseases, such as cardiac arrest, ST-elevation myocardial infarction (STEMI),[9,10] trauma[11] and other causes of hospitalization,[1,12,13] lactate levels have also

demonstrated utility for risk stratification. For instance, current trauma guidelines[14] recommend using lactate to risk stratify patients and guide fluid administration, and a lactate is recommended for the diagnosis and staging of shock in the intensive care unit. [15] Furthermore, a recent study from Denmark demonstrated that stratified lactate concentrations predict 10-day mortality in an undifferentiated acute care population that had a lactate measured.[16] Although this study did not assess the potential effect of the underlying disease, it further supports the use of lactate to risk stratify patients regardless of diagnosis.

Animal model evidence suggests that sepsis alters regional perfusion, even after adjusting for decreased cardiac output, and that this sepsis-specific perfusion derangement is associated with elevated lactate levels compared with non-septic etiologies.[17] Furthermore, lactate metabolism is decreased during sepsis, compared to sterile inflammation, leading to prolonged elevation of lactate in septic animals.[18] Based on the altered physiology of lactate production and clearance during sepsis, it is plausible for lactate concentrations to have different strengths of association with adverse outcomes depending on the underlying disease. Therefore, for clinicians ordering a serum lactate to risk stratify potentially ill patients, there remains a need to understand if the strength of association is disease-dependent, or whether lactate concentrations add the same predictive value in non-infectious conditions. It is possible that the predictive value of serum lactate concentrations is modified by the underlying diagnosis, requiring clinicians to interpret lactate values differently depending on the disease process.

The objectives of this study were the following: 1) to describe the association between lactate concentrations and adverse outcomes in patients with and without infectious causes of abnormal vital signs (AVS); and 2) to assess whether lactate concentrations add significant prognostic value to clinical data when predicting adverse outcomes in a single ED population stratified by infectious or non-infectious cause of illness.

METHODS

This was a pre-planned secondary analysis of a prospective, observational cohort study of a consecutively enrolled population of ED patients with AVS who also had a lactate level obtained during the routine course of clinical care. We enrolled patients with AVS to target an "at risk" population.[19] Patients were enrolled from November 11, 2012, to January 31, 2013. The study was conducted at an urban, academic, tertiary care hospital with 55,000 annual ED visits. This study was granted waiver of informed consent after expedited review by the human subjects committee of our institutional review board.

We included patients above 18 years old with the presence of at least one of the following AVS at triage or during their ED stay: heart rate ≥ 130, respiratory rate ≥ 24, shock index ≥1, or systolic blood pressure < 90 mmHg, or a lactate level ≥ 4mmol/L. Vital sign thresholds were chosen based on our hospital system's previously published criteria to identify patients at higher risk of short-term adverse outcomes[20] and prior investigations of AVS and elevated shock index.[21,22] Exclusion criteria were the following: patients with tachycardia due to atrial fibrillation with rapid ventricular response or supraventricular tachycardia who were then discharged once rate control was achieved; vital sign abnormalities due to intoxication, withdrawal, psychiatric disorder, seizure, or simple trauma (i.e., fracture). We also excluded patients who were discharged from the ED. Excluding these patients focused our investigation on a population with AVS due to critical illness and needing further risk stratification in the original cohort. For the current study, we also excluded patients without a lactate measured in the ED. We continuously and prospectively screened patients in the ED for possible inclusions using our information technology system. If patients had qualifying vital signs in triage, in nursing notes, or through the bedside monitors, then they were identified for possible inclusion in the study. Identified patients then underwent a confirmatory chart review to affirm the presence of inclusion criteria and absence of exclusion criteria.

We reviewed hospital charts and abstracted the history of present illness, past medical history, pre-hospital and ED administered medications, and vital signs from the emergency physician notes. Past medical history and current medications were abstracted from the admission note from the inpatient team if the ED note was incomplete. Vital signs at the time of inclusion were used. We included the first peripheral venous or central venous lactate level sample, consistent with previous studies based on venous sampling[3,5,23]. Data abstraction was performed by two research assistants, trained and directly supervised by the principal investigator (PI). Chart abstraction was performed without knowledge of the final diagnosis, since adjudication of diagnosis was performed at a later date. Demographic information, hospital length of stay, and laboratory testing, including first lactate obtained in the ED, were matched to each patient from the hospital's electronic database after all abstractions were completed.

We defined the primary composite outcome "deterioration" as one or more of the following at any time during the present hospitalization: acute renal failure, non-elective intubation, vasopressors administration, and in-hospital mortality. Acute renal failure was defined as a creatinine value double the patient's most recent available value or new initiation of hemodialysis during admission. If a prior creatinine measurement was not available, an initially elevated creatinine was marked as acute renal failure if the value decreased greater than 50% during hospitalization. The secondary outcome was in-hospital mortality. We defined "shock in the ED" as 1) systolic blood pressure < 90 mmHg

after at least 1L fluid; 2) at least two systolic blood pressure readings < 90mmHg and with clear nursing or physician documentation of withholding fluids due to concern for fluid overload; or 3) use of vasopressors. The variable "triage acuity" (1, 2, or 3 inversely related to severity) was determined by the triage nurse at the time that patients arrived in the ED.

The presence of an infection and outcomes during admission were adjudicated by the PI through a review of both ED and hospital documentation after discharge from the hospital. The diagnosis of infection was guided by objective data (e.g. blood cultures, chest radiograph interpretations, urinalysis, etc.), and the final diagnosis was a clinical judgment based on integration of this data. A second reviewer adjudicated the first 500 subjects enrolled in the primary study to assess inter-rater reliability. This secondary analysis includes 343 patients (70%) that had a second review, and in this subset kappa = 0.85 (95% confidence intervals (CI): 0.78 – 0.90).

Data Analysis

We performed statistical analysis using SPSS version 18. The primary outcome was deterioration and secondary outcome was in-hospital mortality. The variable of interest was initial blood lactate level, which was stratified as low (< 2.5 mmol/L), intermediate (2.5 – 4.0 mmol/L) or high (> 4.0 mmol/L). To allow for easier clinical interpretation and application we used stratified lactate levels, as opposed to continuous lactate levels,.

Continuous variables were presented as mean ± SD and were compared using Student's t-test. Variables were compared using chi-square test, Mann-Whitney test, and chi-square test for trend, as appropriate. We tested the association between stratified lactate levels and both deterioration and mortality outcomes grouped by infection status.

We created multivariate logistic regression models to assess whether lactate was independently associated with deterioration and/or mortality. Variable selection for the models was based on clinical and statistical significance,

Table 1. Population characteristics of emergency department patients with abnormal vital signs in a study analyzing serum lactate levels as a measure of adverse outcomes.

Variable	Without infection (n=202)	With infection (n=286)	[a]P-value
Age (median ±SD)	62 ±18	66 ±18	0.95
Female (n, %)	100 (49.5%)	141 (49.3%)	0.97
Past medical history (n, %)			
Diabetes	69 (34.2%)	69 (24.1%)	0.02
Coronary artery disease	39 (19.3%)	51 (17.8%)	0.68
Myocardial infarction	14 (6.9%)	12 (4.2%)	0.19
Congestive heart failure	51 (25.2%)	49 (17.1%)	0.03
Hypertension	101 (50%)	129 (45.1%)	0.29
Dementia	12 (5.9%)	23 (8%)	0.38
Active cancer	47 (23.3%)	72 (25.2%)	0.63
Chronic obstructive pulmonary disease	37 (18.3%)	53 (18.5%)	0.95
Liver disease	17 (8.4%)	17 (5.9%)	0.29
Chronic renal insufficiency	13 (6.4%)	20 (7%)	0.81
Dialysis	19 (9.4%)	20 (7%)	0.33
History of stroke	11 (5.4%)	19 (6.6%)	0.59
Vital signs (median ±SD)			
Heart rate	104 ±24	110 ±24	0.02
Temperature	98.0 ±1.3	98.8 ±2.3	<0.001
Systolic blood pressure	105 ±30	102 ±28	0.5
Diastolic blood pressure	64 ±19	60 ±17	0.14
Respiration rate	20 ±6	20 ±5	0.89
SO2 (%)	97±4	98 ±4	0.07

[a]Statistical test used: Continuous variables: Student's t-test.
Categorical variables: Chi-squared test.

Table 2. Distribution of deterioration by stratified lactate value for both infected and non-infected patients.

	Without infection (n, %)	Infection (n, %)
Lactate < 2.5 (n=342)	142 (70.3)	200 (69.9)
2.5 ≤ Lactate ≤ 4 (n=100)	40 (19.8)	60 (21.0)
Lactate > 4 (n=46)	20 (9.9)	26 (9.1)

defined as $p < 0.05$. We used the n/10 rule to determine the maximum number of covariates to include in each model to prevent overfitting. We reported a final model and used the Hosmer-Lemeshow test for assessing model calibration and c-statistics for modeling discriminatory abilities.

Integrated discrimination improvement (IDI) was used to assess the added discriminate value of including stratified lactate to models predicting the outcomes of deterioration and mortality without lactate. IDI compares the predicted probability of an event for models before and after the addition of stratified lactate, and tests the improvement in reclassification of subjects with and without an event (i.e. deterioration). IDI was performed for patients with and without infection and for each outcome, using the best model created without lactate as a reference.[24]

Finally, we used locally weighted polynomial regression (LOESS) to analyze the association between lactate values expressed as a continuous variable and the adjusted probability of each outcome (deterioration or mortality) in both groups.

RESULTS

Patient Population

We identified 1,152 patients with AVS, of whom 366 met clinical exclusion criteria. Of the remaining 786 patients eligible for this analysis, 298 did not have ED lactate measurements, leaving 488 for the analysis. The mean age of our population was 63 (± 18) years. There were 168 patients (34.4%) who had a deterioration, and 61 (12.5%) died. Of the 488 patients analyzed, 286 (58.6%) had infectious etiologies; the non-infectious etiologies are shown in supplemental Table 1. The population without infection had a significantly higher prevalence of diabetes (34% vs. 24%, $p = 0.02$) and congestive heart failure (25% vs. 17%, $p = 0.03$). A comparison of vital sign variables between groups showed that patients with infection had a higher average heart rate and temperature (Table 1).

Overall, 342/488 (70.1%) had lactate < 2.5 mmol/L, 100/488 (20.5%) had lactate 2.5 – 4.0 mmol/L, and 46/488 (9.4%) had lactate > 4.0 mmol/L. Table 2 shows the distribution of deterioration stratified by lactate level for both infected and non-infected patients. We were unable to detect a difference ($p = 0.92$) when comparing the distribution of patients with and without infection between the stratified lactate groups.

Clinical Outcomes

Table 3 depicts the clinical outcomes of the cohort. Our data showed no difference between the two diagnostic groups in mortality rate ($p = 0.95$) or deterioration ($p = 0.76$). There was a significantly higher frequency of shock in the ED ($p = 0.002$) and administration of vasopressors ($p<0.001$) in patients with infection.

Overall, the deterioration rate was 88/342 (26%) for lactate < 2.5 mmol/L, 47/100 (47%) for lactate 2.5 – 4.0 mmol/L, and

Table 3. Outcome measures in the population of ED patients.

	Without infection (n=202)	With infection (n=286)	[a]P-value
Length of stay (days, median, IQR[b])	4 (2-7)	5 (3-8)	0.03
Deterioration[c] (n, %)	68 (33.7)	100 (35)	0.76
Acute renal failure (n, %)	32 (15.8)	46 (16.1)	0.94
Intubation (n, %)	27 (13.4)	38 (13.3)	0.98
Vasopressors during hospitalization (n, %)	23 (11.4)	69 (24.1)	<0.001
Death (n, %)	25 (12.4)	36 (12.6)	0.95
Shock in ED (n, %)	33 (16.3)	81 (28.3)	0.002

[a]Statistical test used for variable length of stay: Mann Witney, categorical variables: Chi-squared test
[b]IQR: Interquartile range
[c]Deterioration was considered to be one or more of the following outcomes during hospitalization: acute renal failure, non-elective intubation, vasopressors requirement, death.

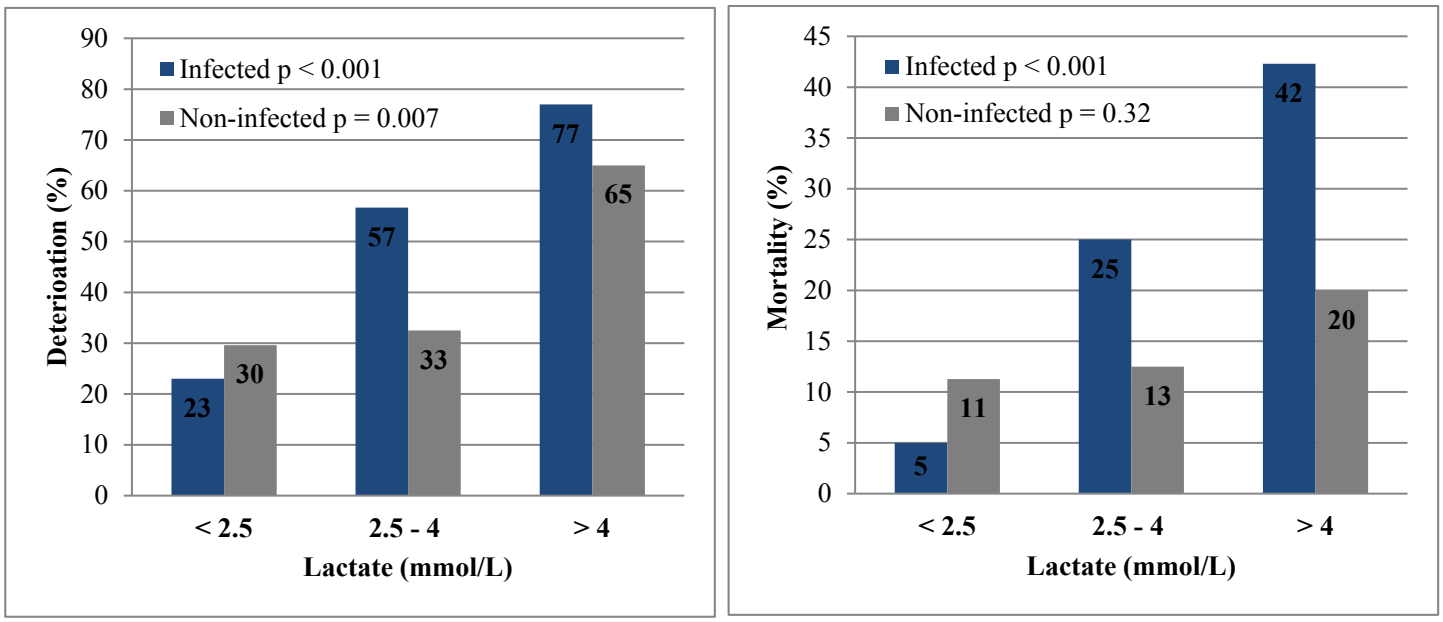

Figure 1. Incidence of deterioration and death in patients with and without infection stratified by lactate concentration; P-values by chi-square test for trend for positive association across stratified lactate levels.

Table 4. Multivariable logistic regression models.

Variable	AOR[a]	95% CI	P-value
a: For deterioration in patients with infection			
Lactate > 4	4.84	1.66-14.13	0.004
Systolic blood pressure < 90 mmHg	2.48	1.32-4.66	0.005
Triage acuity[b]	0.44	0.28-0.68	<0.001
Blood urea nitrogen	1.05	1.03-1.08	<0.001
b: For mortality in patients with infection			
Lactate > 4	4.41	1.7-11.45	0.002
History of stroke	4.52	1.42-14.33	0.01
Blood urea nitrogen	1.02	1.00-1.04	0.03
Triage acuity[b]	0.26	0.12-0.59	0.001
c: For deterioration in patients without infection			
Lactate > 4	3.6	1.25-10.32	0.02
Triage acuity[b]	0.49	0.29-0.82	0.007
History of stroke	0.11	0.01-1.11	0.06
Blood urea nitrogen	1.02	1.01-1.03	0.002
Altered mental status	5.9	1.89-18.4	0.002
d: For mortality in patients without infection			
Lactate > 4	1.19	0.27-5.21	0.81
Age	1.04	1.01-1.07	0.01
Active cancer	3.09	1.43-15.02	0.01
Altered mental status	4.63	1.43-8.13	0.02

[a], Adjusted odds ratio; [b], Triage acuity determined by emergency department nurse

33/46 (72%) for lactate >4.0mmol/L. Mortality was 26/342 (8%) for lactate < 2.5 mmol/L, 20/100 (20%) for lactate 2.5 – 4.0 mmol/L, and 15/46 (33%) for lactate > 4.0 mmol/L. Figure 1 shows the rates of deterioration and mortality by lactate levels for each group. Both groups demonstrated a significant positive association between stratified lactate level and deterioration rates ($p<0.001$ for infected and $p = 0.007$ for non-infected patients). Our data likewise showed lactate levels were associated with mortality in patients with infection ($p<0.001$), but not patients without infection ($p = 0.32$).

Discrimination Analysis

Patients with infection: The model for predicting deterioration in patients with infection is shown in Table 4a. Using non-lactate covariates resulted in an initial model with c-statistic of 0.81 (95% CI: 0.76-0.86) ($p <0.001$) when predicting deterioration. When lactate > 4.0 mmol/L is added to the reference model, area under the curve (AUC) = 0.83 (95% CI: 0.78-0.88) ($p <0.001$), with an absolute IDI of 0.03 (95% CI: 0.00-0.05) ($p<0.001$), showing a significant improvement in prediction. The model for predicting mortality in patients with infection is shown in Table 4b. The model using non-lactate covariates predicting mortality had a c-statistic of 0.80 (95%CI: 0.74-0.86) ($p <0.001$). This improves to 0.83 (95% CI: 0.78-0.88)($p <0.001$) when lactate > 4.0 mmol/L is added to the model, with an absolute IDI of 0.02 (95%CI: 0.00-0.05) ($p<0.001$) for this model.

Patients without infection: The analysis to predict deterioration among patients without infection is seen in Table 4c. The best model predicting deterioration without using lactate had a c-statistic 0.76 (95% CI: 0.69-0.83) ($p <0.001$). Adding lactate > 4mmol/L to this model yielded an AUC = 0.78 (95% CI: 0.71-0.85) ($p <0.001$). The new model had an absolute IDI of 0.03 (95% CI: 0.00-0.06) ($p<0.04$) suggesting that addition of lactate level improved the discriminatory value of the model for predicting deterioration.

Table 4d shows the model for predicting mortality among patients without infection. The multivariate regression model without lactate > 4.0 mmol/L achieved an AUC of 0.62 (95% CI: 0.54-0.70), and after adding lactate to the model, had an AUC = 0.62 (95% CI: 0.54-0.70). The absolute IDI was 0.00 (95% CI : 0.00-0.02) ($p = 0.07$). Of note, lactate > 4.0 mmol/L was not significant in this model ($p = 0.81$).

The LOESS graphs for adjusted outcomes and lactate levels provide a visual representation of the dose-response association for both deterioration and mortality between patient groups (Figure 2a+b).

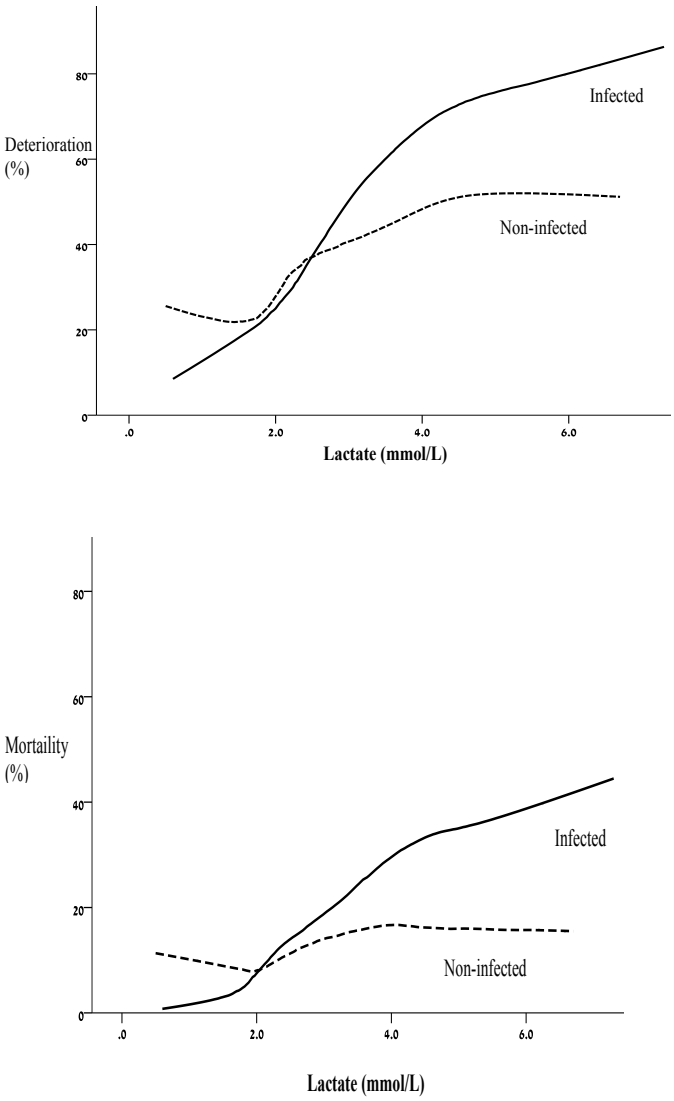

Figure 2a, b. Both groups exhibit increasing deterioration as lactate levels increase, although this figure suggests that the response may be larger in patients with infection.
LOESS, locally weighted polynomial regression.

DISCUSSION

This analysis evaluates the relationship between lactate concentrations and patient outcomes for patients with infectious and non-infectious causes of AVS. In patients with infection, a statistically significant association exists between both deterioration and mortality and an increasing lactate level. The regression models for predicting deterioration and mortality in infected patients further demonstrate that lactate concentrations add value to the prediction of both outcomes. Likewise, lactate concentrations can also assist in predicting deterioration in patients without infection. In this non-infected group, increasing lactate predicted increasing rates of deterioration. The model for non-infected patients likewise suggests that lactate levels can predict deterioration. While

neither the stratified analysis nor regression model for patients without infection demonstrated a significant relationship between lactate concentration and the outcome of mortality, this result is possibly due to type II error since the study was not powered to evaluate mortality primarily.

As mentioned before, the physiology of sepsis likely causes increased lactate production[17] and decreases lactate metabolism,[18] which could alter the relationship between lactate concentrations and adverse outcomes seen in patients with and without infection. The LOESS graph visually demonstrates the difference in the dose-response of deterioration for each lactate level between groups, generally being more strongly associated with the outcomes in patients with infection than in those without infection. Yet, despite the differences in lactate production and metabolism, the association between lactate concentrations and deterioration was strong and added prognostic value in both groups.

Prior studies have established the clinical utility of using lactate concentration in patients with a variety of critical illnesses [2,5,6,11-14,19]. For instance, Shapiro et al. showed that in ED patients with infection, the 28-day in hospital mortality rate was 28% if a single lactate was > 4 mmol/L, 9% if it was 2.5 to 4, and 4.9% if lactate levels were normal.[2] Our results are consistent with these prior studies, demonstrating the prognostic ability of lactate measurements when predicting adverse outcomes. Yet these studies are generally limited to a single disease and do not allow a comparison of a serum lactate's prognostic value between different disease categories.

Our study differs from most prior investigations by enrolling an undifferentiated patient population, allowing the association between lactate concentrations and adverse outcomes in patients with and without infection to be evaluated side by side. This analysis, stratified by the apparent presence of infection, supports the conclusion that the relationship between serum lactate measurements and adverse outcomes is not limited to a specific disease. This finding is consistent with a recently published report by Haidl et al.,[16] which demonstrated that serum lactate levels confer an increased risk of 10-day mortality among undifferentiated patients who present to the ED. Our study also furthers the Haidl et al. findings by assessing for differences in the predictive value of lactate levels based on the underlying disease category. Our stratified analysis suggests qualitatively that lactate levels have a similar degree of association with deterioration in patients with and without infection. Furthermore, while a difference in the association between lactate concentrations and adverse outcomes likely exists in between infectious and non-infectious diseases, best seen in the LOESS graph (Figure 2a+b), adding lactate > 4mmol/L to the best clinical models in both patient groups, added value to the prediction of adverse outcomes. These data support the clinical use and similar interpretation of lactate concentrations in ED patients with and without infection when predicting adverse outcomes.

When considering the secondary outcome of mortality, our study does contrast with the study by del Portal et al., which found that in an undifferentiated ED population of patients > 65 years old initial lactate levels were associated with increased mortality in both sepsis and non-sepsis patient populations. In part, the inability of our study to show that lactate added value to the prediction of mortality in patients without infection can be explained by differences between the studied populations. The population studied by del Portal et al. was older with a mean age of 77.2 (±7.8) years.

Also, this study used patients from 2004-2006, when lactate levels were less frequently ordered, especially for patients without infection. Our study includes a more recent patient population, which more closely reflects the current utilization of lactate levels in patients with AVS. However, similar to our analysis, the prediction model used by del Portal performed better in patients with infection than in the non-infected patient population.[8] Furthermore, our study was not powered to identify a difference in mortality, and it is possible that a difference may have been detected with a larger sample size.

Future Directions

This study creates a foundation for further investigation into the relationship between lactate levels and outcomes in patients with and without infection. Lactate clearance is also being studied across the spectrum of disease to predict outcomes. A study similar to this analysis comparing the prognostic value of lactate clearance in a cohort including both infected and non-infected patients is warranted.

LIMITATIONS

This study has a number of limitations. Identifying a broad group of patients who were critically ill required us to screen using vital sign criteria that can be caused from less urgent etiologies. Our vital sign thresholds allowed high sensitivity for critical illness, yet identified many patients who were not critically ill. The excluded diagnoses were decided a priori to represent a very low-risk group that would require minimal stabilizing interventions, and they account for the majority of excluded patients. While these patients were excluded prior to the current analysis, it is reasonable to expect that some of these patients would have a serum lactate measured during clinical care. Other comorbidities (i.e., liver disease) and medications (i.e., metformin) can affect the lactate level, yet may not be related to the acute illness treated in the ED. This study does not account for these alternative factors influencing lactate levels, as an ED clinician would do in a real clinical setting. Lactate concentrations should be interpreted with discretion when non-acute factors that may influence the level are present.

As an observational study, the physician's decision to obtain lactate measurements is likely to introduce selection

bias. However, in our institution it is common to obtain a lactate value in patients with signs of critical illness regardless of the underlying cause. Therefore, our vital sign thresholds likely reduce the degree of selection bias present based on physician ordering. Still, many patients were excluded because lactate measurements did not occur in the ED, and we do not know the rate of deterioration in this group.

The outcomes we chose for our composite outcome of deterioration are not all encompassing. Other investigators may have included more outcomes, the need for non-invasive ventilator support. While this approach likely decreased the number of composite outcomes in our study, we believe that using acute renal failure, vasopressor administration, intubation and mortality, created a composite outcome that clearly represents significant clinical events.

Misclassification of patients is another potential limitation, although using a second reviewer to assess agreement decreases this likelihood. Our kappa of 0.85 was fairly strong, yet some disagreements did occur, for instance, when considering whether bacterial translocation may have occurred in a small bowel obstruction or whether a COPD exacerbation was triggered by a respiratory infection. The PI determined the final diagnosis from the medical record, which may include only limited data to determine a diagnosis, thus contributing to misclassification bias. This fact would most likely not influence the study results, since it is unlikely to be systematically related to a patient's lactate level. Therefore, such misclassification would likely weaken the apparent relationships between lactate levels and outcomes. Lastly the treating clinicians were not blinded to results of lactate analysis and we do not know how this information may have affected clinical care, and thereby possibly the outcome parameters (i.e., use of vasopressors). This could have an impact on the ability to investigate lactate as a predictor of this outcome. However, within our ED the decision to use vasopressors is based on blood pressure parameters, not guided by lactate levels.

CONCLUSION

Lactate levels measured in ED patients exhibiting AVS correspond with adverse outcomes during their hospitalization in the presence and absence of infection. While differences in the predictive value may exist between patients with and without infection, lactate concentrations do add prognostic value in both groups at similar levels, justifying the utilization and similar interpretation of lactate levels regardless of underlying disease.

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Using the Electronic Medical Record to Reduce Unnecessary Ordering of Coagulation Studies for Patients with Chest Pain

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Introduction: Our goal was to reduce ordering of coagulation studies in the emergency department (ED) that have no added value for patients presenting with chest pain. We hypothesized this could be achieved via implementation of a stopgap measure in the electronic medical record (EMR).

Methods: We used a pre and post quasi-experimental study design to evaluate the impact of an EMR-based intervention on coagulation study ordering for patients with chest pain. A simple interactive prompt was incorporated into the EMR of our ED that required clinicians to indicate whether patients were on anticoagulation therapy prior to completion of orders for coagulation studies. Coagulation order frequency was measured via detailed review of randomly sampled encounters during two-month periods before and after intervention. We classified existing orders as clinically indicated or non-value added. Order frequencies were calculated as percentages, and we assessed differences between groups by chi-square analysis.

Results: Pre-intervention, 73.8% (76/103) of patients with chest pain had coagulation studies ordered, of which 67.1% (51/76) were non-value added. Post-intervention, 38.5% (40/104) of patients with chest pain had coagulation studies ordered, of which 60% (24/40) were non-value added. There was an absolute reduction of 35.3% (95% confidence interval [CI]: 22.7%, 48.0%) in the total ordering of coagulation studies and 26.4% (95% CI: 13.8%, 39.0%) in non-value added order placement.

Conclusion: Simple EMR-based interactive prompts can serve as effective deterrents to indiscriminate ordering of diagnostic studies. [West J Emerg Med. 2017;18(2)267-269.]

INTRODUCTION

Healthcare expenditures have risen sharply in the United States over the past decade and now account for one-fifth of the gross domestic product.[1] With annual healthcare costs above $2.8 trillion and still rising, they represent a threat to national economic security and are a leading cause of individual financial hardship and bankruptcy. In light of this, recent estimates that up to 30% of healthcare expenditures are unnecessary and do not improve care are especially sobering.[1,2] The need for increased value in U.S. healthcare is clear.

Physician decisions drive approximately 80% of healthcare expenditures, and many have suggested targeting clinician behaviors to reduce waste in U.S. healthcare.[1,2] Multiple medical specialty societies have committed to this goal and as part of the Choosing Wisely Campaign have

identified and targeted specific tests, treatments or services that are commonly used but are of little or no added value to the patient.[2]

More than five million patients undergo emergency department (ED) evaluation for chest pain in the U.S. annually.[3] Once considered routine in the evaluation for chest pain, coagulation studies have been shown to lack utility in the absence of specific indications that include ongoing warfarin therapy, ST-elevation myocardial infarction, active bleeding, history of cirrhosis, and known or suspected coagulopathy.[4,5] However, tests of prothrombin time (PT) and partial thromboplastin time (PTT) continue to be ordered frequently in the absence of these indications and account for more than $100 million in annual ED costs with no added value for the patient.[5] Our goal was to reduce ordering of coagulation studies that have no added value for patients presenting with chest pain. We hypothesized this could be achieved via implementation of a stopgap measure in the electronic medical record (EMR) that gives providers deliberate feedback and allows for real-time reflection on the utility of ordering a test that may not be clinically indicated.

METHODS

Study Design and Setting

We conducted a pre and post quasi-experimental study to evaluate the impact of an EMR-based intervention on coagulation study ordering for patients with chest pain. The study was performed in the ED of a 1,059-bed tertiary care hospital with a comprehensive cardiovascular care center. This work was performed as a quality improvement initiative and was granted exempt status by our institutional review board.

Description of Intervention

In August 2014, an electronic interactive prompt was incorporated into the EMR (EPIC) of our ED and set to appear each time a coagulation study (PT or PTT) was ordered. This prompt, which remained in place throughout the remainder of our study period, required ordering clinicians to indicate which anticoagulant therapy, if any, the patient was receiving prior to completion of the order using a series of two mouse clicks.

Data Source and Sample Selection

Electronic records were retrieved for all ED patients with a chief complaint of chest pain during a two-month period before (May-June 2014) and after (October-November 2014) the intervention. We excluded a two-month washout period post-intervention to allow for normalization of the effect of the intervention. A systematic random sample of charts was generated for detailed review from each time period by selecting every seventh encounter. Reviewers annotated whether coagulation studies were ordered at time of initial ED evaluation and, if ordered, whether any clinical indication for the order existed. Clinical indications for coagulation study were defined as home vitamin K antagonist therapy, ST-elevation myocardial infarction, history of or suspicion for liver disease, known coagulopathy, initiation of anticoagulant therapy during ED treatment, or strong suspicion for vascular hemorrhage or stroke. We classified orders for patients not meeting these criteria as non-value added.

Sample Size Determination and Statistical Analysis

We derived a sample size of at least 98 patients from each study period to detect an absolute 20% reduction in coagulation study order frequency from a baseline frequency of 75% with a confidence interval (CI) of 95% and power of 0.80. We calculated absolute difference and its corresponding 95% CI in the comparison of frequencies of total and non-value added coagulation study orders before and after intervention using chi-square test (SAS version 9.04, Cary, NC).

RESULTS

There were 727 patient visits with a chief complaint of chest pain during the two-month pre-intervention sampling period and 822 during the post-intervention sampling period. We performed detailed chart review for a randomized selection of 103 visits pre-intervention and 104 visits post-intervention. Demographics were similar between groups with a mean age of 48 years in the pre-intervention group and 44 years in the post-intervention, and 53% male pre-intervention and 58% male post-intervention. Pre-intervention, 73.8% (76/103) of patients with chest pain had coagulation studies ordered, of which 67.1% (51/76) were non-value added with an overall rate of 49.5% (51/103) of patients having coagulation studies that added no value to their care. Post-intervention, only 38.5% (40/104) of patients with chest pain had coagulation studies ordered, of which 60% (24/40) were non-value added. Overall, only 23.1% (24/104) of patients had coagulation study orders that added no value to their care post-intervention. There was an absolute reduction of 35.3% (95% CI: 22.7%, 48.0%) in the total ordering of coagulation studies and 26.4% (95% CI: 13.8%, 39.0%) in non-value added order placement. The intervention increased the overall proportion of ordered tests that were value-added.

DISCUSSION

Here, we show that a simple EMR-based intervention served as an effective deterrent to the ordering of non-value added diagnostic studies. While previous studies have shown that EMR-based interventions can lead to changes in clinician behavior, these interventions focused on more robust clinical decision support including display of evidence-based guidelines and individual diagnostic study costs.[6-8] This intervention generated a short pause in clinician workflow, and required clinicians to reflect on the reasoning behind order placement. As a result, indiscriminate ordering was curtailed significantly.

This intervention led to significant estimated cost savings. Using standard Medicare reimbursement rates[9] we estimated the average annual cost of coagulation studies on chest pain patients in our ED alone to be $47,959, of which $32,185 is non-value added. The intervention yielded a total annual cost savings of $22,964. Extrapolating these numbers to the national level demonstrates significant ongoing costs and potential for real savings. With over five million chest pain visits per year to EDs nationally,[3] using the standard Medicare reimbursement rate to value these tests and assuming similar ordering behavior at other EDs, nearly $50 million is spent annually of which over $33 million is non-value added. Implementing a similar intervention nationwide could produce a cost savings of about $18 million on an annual basis.

LIMITATIONS

While our findings strongly suggest that simple EMR-based interventions can alter clinician behavior and are potentially valuable tools for curtailing waste, there are important limitations to this work. We did not randomize patient encounters to EMR-based intervention, and comparisons were drawn between encounters that occurred before and after intervention. It is possible that other temporally related factors impacted clinician ordering patterns. Similarly, our ability to discern clinician motivation for decreased order frequency was limited to factors recorded in the EMR. For example, it is possible that the effect of our intervention was due to mouse-click fatigue, rather than improved decision-making. Indeed, we observed reductions in overall order frequency, and while our study was not designed to detect this, it is possible that this intervention resulted in decreased orders for coagulation studies that were clinically indicated. However, it is also possible that many of the tests we considered value-added did not provide any clinical contribution to care. For these reasons, EMR-based interventions such as this one are likely best paired with provider education initiatives. Finally, this work was performed at a single site and may not be directly applicable to all ED environments.

CONCLUSION

Simple EMR-based interactive prompts can serve as effective deterrents to indiscriminate ordering of diagnostic studies.

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Caudal Edge of the Liver in the Right Upper Quadrant (RUQ) View Is the Most Sensitive Area for Free Fluid on the FAST Exam

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Introduction: The focused assessment with sonography in trauma (FAST) exam is a critical diagnostic test for intraperitoneal free fluid (FF). Current teaching is that fluid accumulates first in Morison's pouch. The goal of this study was to evaluate the "sub-quadrants" of traditional FAST views to determine the most sensitive areas for FF accumulation.

Methods: We analyzed a retrospective cohort of all adult trauma patients who had a recorded FAST exam by emergency physicians at a Level I trauma center from January 2012 – June 2013. Ultrasound fellowship-trained faculty with three emergency medicine residents reviewed all FAST exams. We excluded studies if they were incomplete, of poor image quality, or with incorrect medical record information. Positive studies were assessed for FF localization, comparing the traditional abdominal views and on a sub-quadrant basis: right upper quadrant (RUQ)1 - hepato-diaphragmatic; RUQ2 - Morison's pouch; RUQ3 - caudal liver edge and superior paracolic gutter; left upper quadrant (LUQ)1 - splenic-diaphragmatic; LUQ2 - spleno-renal; LUQ3 – around inferior pole of kidney; suprapubic area (SP)1 - bilateral to bladder; SP2 - posterior to bladder; SP3 – posterior to uterus (females). FAST results were confirmed by chart review of computed tomography results or operative findings.

Results: Of the included 1,008 scans, 48 (4.8%) were positive. The RUQ was the most positive view with 32/48 (66.7%) positive. In the RUQ sub-quadrant analysis, the most positive view was the RUQ3 with 30/32 (93.8%) positive.

Conclusion: The RUQ is most sensitive for FF assessment, with the superior paracolic gutter area around the caudal liver edge (RUQ3) being the most positive sub-quadrant within the RUQ. [West J Emerg Med. 2017;18(2)270-280.]

INTRODUCTION

The focused assessment with sonography in trauma (FAST) exam is a critical screening tool for intraperitoneal free fluid (FF) assessment from traumatic injury by evaluating the subxiphoid, right upper quadrant (RUQ), left upper quadrant (LUQ), and suprapubic (SP) areas.[1–3] It is commonly

taught that FF will first accumulate in the most dependent parts of the abdomen and pelvis in a supine trauma patient, specifically the RUQ and pelvis.[1,4] The hepato-renal space (Morison's pouch) has been concluded to be the primary area where FF is initially seen.[4] Therefore, much of the current emphasis on the performance of the FAST exam has been placed on the RUQ Morison's pouch view.[1,5]

Interestingly, few studies have specifically looked at where FF preferentially accumulates within each standard view of the FAST exam. In 1998, Rozycki et al. assessed the sensitivity of Morison's pouch for the detection of FF, but did not analyze the sensitivity of other anatomic areas of the RUQ, nor the sensitivity of the other standard FAST views.[1] In 1996, Lentz et al. examined abdominal ultrasound (US) exams to assess where fluid typically is seen within each quadrant, but the study was performed by US technicians and before the standardization of the FAST exam.[6] Patient position is also important in adequate FF assessment. Several radiology studies using computed tomography (CT) and US scans have illustrated that FF layers to the most dependent areas in a supine patient (Figure 1), and best seen in the RUQ. [7,8]

We determined the test characteristics of the subquadrants of the FAST exam compared to criterion reference of CT done immediately after the FAST was performed. Our goal was to investigate the traditional FAST views of the abdomen and pelvis, as well as perform a sub-quadrant analysis of the RUQ, LUQ and SP areas to better define FF localization in order to determine where to better focus the FAST exam in the trauma patient.

METHODS

We analyzed a retrospective cohort of all adult trauma patients with recorded FAST exams by emergency medicine (EM) resident physicians of all levels of training at a Level 1 trauma center from January 2012 – June 2013. One US fellowship-trained faculty with three EM senior resident physicians reviewed all recorded FAST exams on supine adult trauma patients. Each FAST exam enrolled in the study had to include complete intraperitoneal views of sufficient quality to confidently assess all regions for FF by the reviewers. We excluded studies if all three intraperitoneal FAST views were not performed and/or recorded, image quality was extremely poor such that reviewers were unable to effectively assess the sub-quadrants, or accurate medical record information was not available for chart review of CT and operative findings. A study was positive if any amount of FF was noted in the peritoneum, including pelvis view of female patients. Positive studies were further evaluated to assess intraperitoneal FF location among the traditional abdominal and pelvic views of the FAST exam, and then further subdivided into the sub-quadrant areas. These areas included the originally described dependent areas of the abdomen: hepato-renal space, spleno-renal space and the

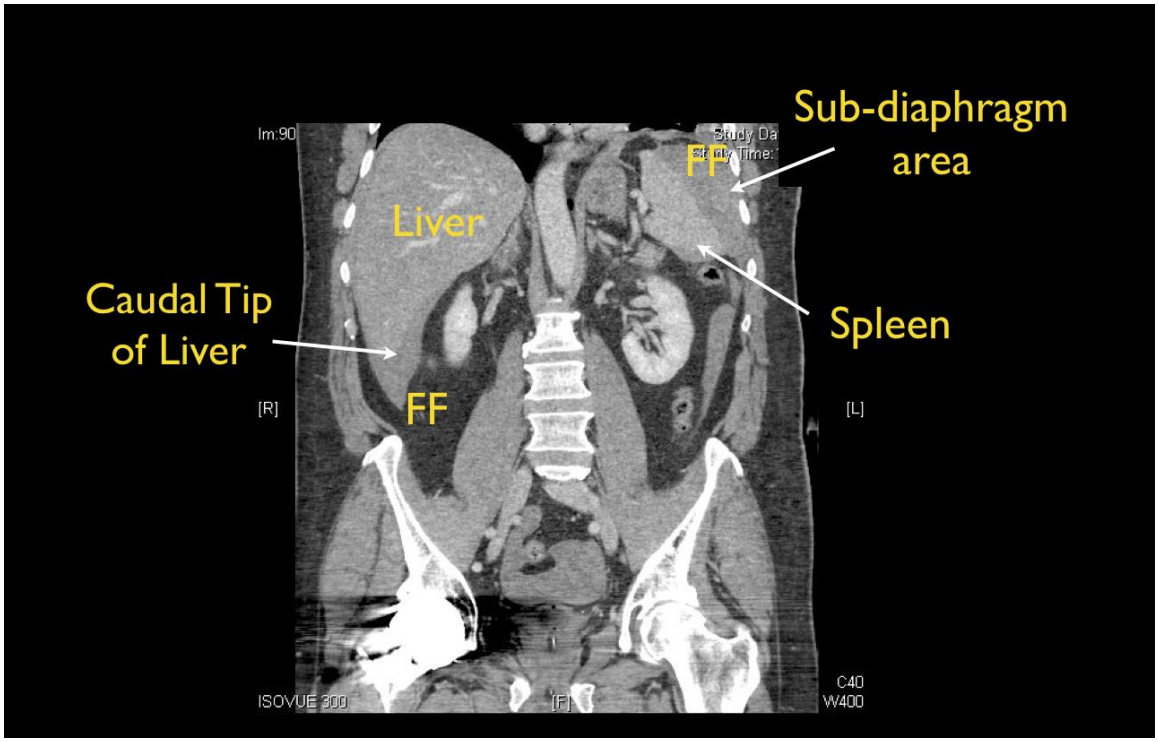

Figure 1. Computed tomography showing accumulation of free fluid (FF) in a traumatic supine patient.

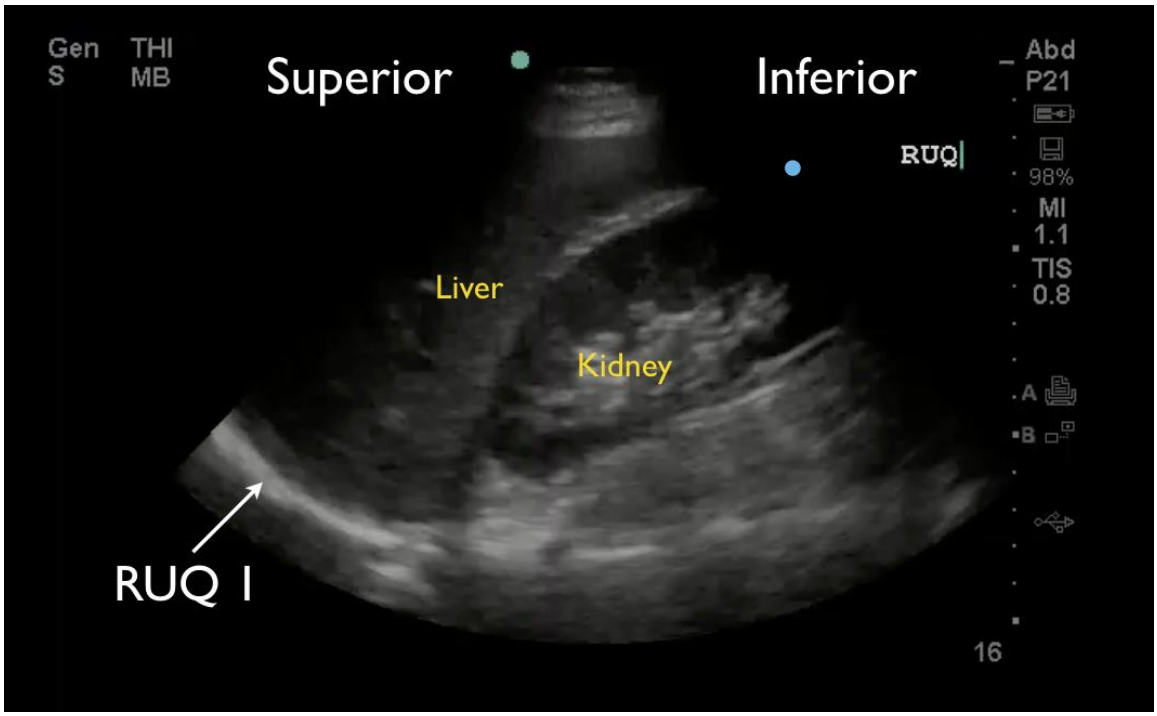

Figure 2. Right upper quadrant FAST view showing hepato-diaphragmatic space.

pelvis as described by the first authors of the FAST exam [2] but also adjacent areas where FF has been noticed in clinical practice.

Sub-quadrants:
RUQ1 - hepato-diaphragmatic space: area between diaphragm and liver (Figure 2)
RUQ2 - hepato-renal space, or Morison's pouch: area between liver and kidney (Figure 3)
RUQ3 – caudal edge of the liver, superior right paracolic gutter area (Figure 4)
LUQ1 - spleno-diaphragmatic space: area between spleen and diaphragm (Figure 5)
LUQ2 - spleno-renal space: area between spleen and kidney (Figure 5)
LUQ3 - inferior pole of the left kidney, or left paracolic gutter (Figure 6)
SP1 - lateral on either or both sides of bladder (Figure 7)
SP2 - posterior to bladder and anterior pelvic organs (Figure 8)
SP3 - posterior to uterus, or pelvic cul-de-sac, females only (Figure 7)

We reviewed medical records to confirm positive FAST results by noting the correlative findings on CT of the abdomen and pelvis. CTs were performed immediately after the trauma survey per ATLS guidelines, and read by board-certified radiologists. If a CT was not done, operative findings were compared. We plotted the percentage of positive sub-quadrants against the total number of positive studies evaluated with calculated percentages. All images reviewed were recorded using a SonoSite M-Turbo US machine using a phased array 5-1 MHz transducer.

We used Cohen kappa matrix and a pair-wise proportions test with Bonferroni correction for p values to evaluate for the correlation between quadrants and sub-quadrants. We assessed for statistically significant sensitivity of FF within sub-quadrants, and for predicting a positive quadrant.

The institutional review board approved the protocol, and appropriate protection of all medical health information was conducted.

RESULTS

We reviewed a total of 1,158 FAST exams of adult (over 18 years of age) trauma patients over the study period. Of the 1,158 completed FAST exams, we excluded 150 (12.9%) exams due to incomplete saved exams (40%), poor image quality (35%) and incorrect medical record information (25%). The remaining 1,008 FAST scans were included for analysis, of which 48 (4.8%) were positive for hemoperitoneum (Figure 9). Among the positive studies, 39 (81%) of patients had a follow-up CT that confirmed the FAST findings, while 9 (19%) were taken emergently to the OR where hemoperitoneum was confirmed. There were no false positive FAST scans. In the traditional FAST views, 32/48 (66.7%) were positive for FF in the RUQ, 17/48 (35.4%) were positive in the LUQ, and 23/48 (47.9%)

were positive in the SP region. Given that our study only focused on assessing for hemoperitoneum, the pericardial view of the FAST exam was not assessed. In sub-quadrant analysis of the RUQ, 30/32 (93.8%) were positive in RUQ3, 27/32 (84.4%) in RUQ2, and 5/32 (15.6%) in RUQ1. In the sub-quadrant analysis of the LUQ, 11/17 (64.7%) were positive in LUQ1, 10/17 (58.8%) in LUQ2, and 4/17 (23.5%) in LUQ3. In the sub-quadrant analysis of the SP view, there were 14 males and 9 females, of which 15/23 (64.7%) were positive in SP1, 9/23 (58.8%) in SP2 and 7/9 (77.7%) in SP3. The RUQ is the most sensitive region for FF assessment, followed by SP and LUQ. Within the RUQ, RUQ1 stands out as being the least sensitive with a substantial difference from the other RUQ sub-quadrants (Figure 10). Using Cohen kappa matrix (Figure 11), the correlation between quadrants and sub-quadrants can be shown. The RUQ is the most positive region of the FAST quadrants. The RUQ3 is the most sensitive indicator for a positive RUQ. LUQ1 is the most sensitive of the LUQ sub-quadrants and SP1 is the most sensitive of the SP sub-quadrants. Separate quadrants (i.e., RUQ, LUQ vs. SP) do not appear correlated in their positivity or negativity; for example, a positive RUQ does not necessarily mean a positive LUQ also.

Within each quadrant, the sub-quadrant accuracy is between 64% (SP3) and 94% (RUQ3). RUQ1 is an outlier with accuracy in its region of 43%. There were two cases where only the RUQ1 region was visualized as being the only positive view within the RUQ sub-quadrants. This is likely due to poor fanning and/or recording of images; the corresponding CT results confirmed FF through all sub-quadrants of the RUQ. RUQ1 and LUQ3 do not do better in their quadrants than random chance, while all other sub-quadrants predict their quadrant outcome with statistical significance (Figure 12).

DISCUSSION

The accuracy of the FAST exam depends on multiple factors. It is important that the physician performing the FAST scan be skilled to correctly identify the various anatomical landmarks to assess for FF in the intraperitoneal, pleural and pericardial spaces. This study illustrates that the caudal liver edge and the superior aspect of the right paracolic gutter is the most sensitive indicator for FF in the intraperitoneal space, and not in Morison's pouch as traditionally described. This is a critical finding and supports a change to the current teaching and performance of the FAST exam.

The trauma patient can arrive to an emergency department at any time period post-trauma, either ambulatory through the waiting room or supine by emergency medical services transport. Early scanning and patient positioning both provide potential obstacles to the ability to identify intraperitoneal FF. Fluid can accumulate over time in amounts needed to be visible on FAST scan, and in the region where FF is seen best: the RUQ in a supine patient.[9] In a study evaluating FF location on supine patients by using CT imaging, Wojtowicz et al. noted that FF ascends and settles in the RUQ and pelvis. The FAST exam is often performed in the emergent trauma setting

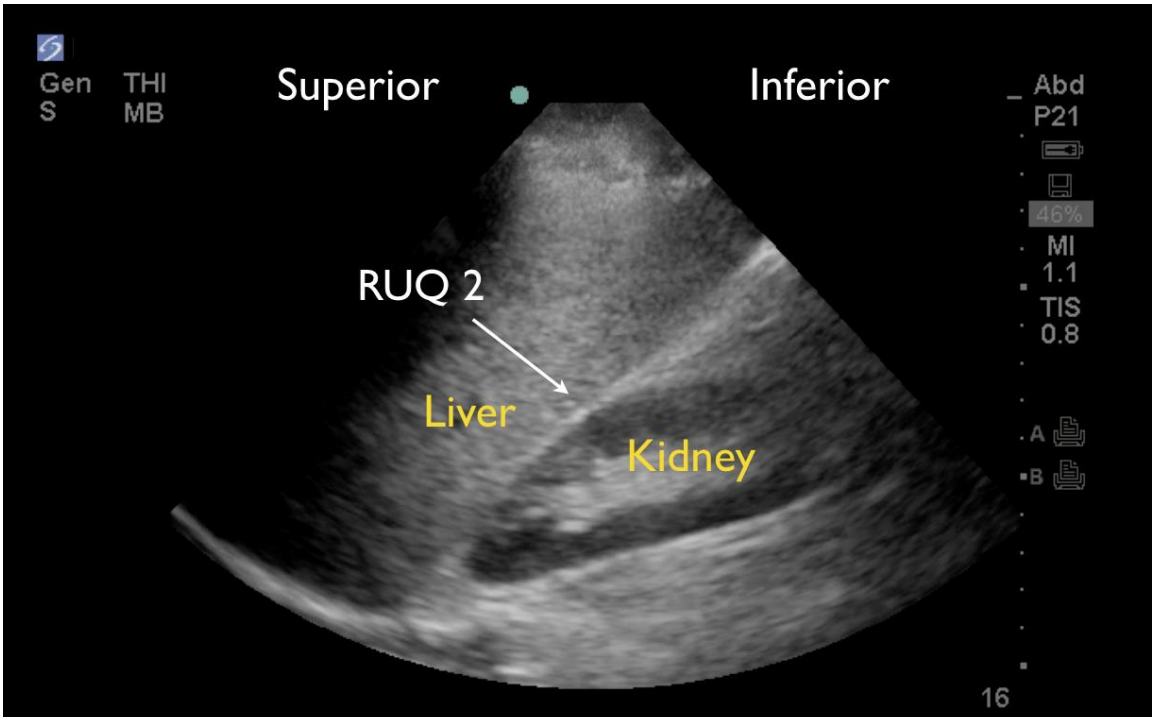

Figure 3. Normal right upper quadrant FAST view showing no free fluid in Morison's pouch (RUQ2).

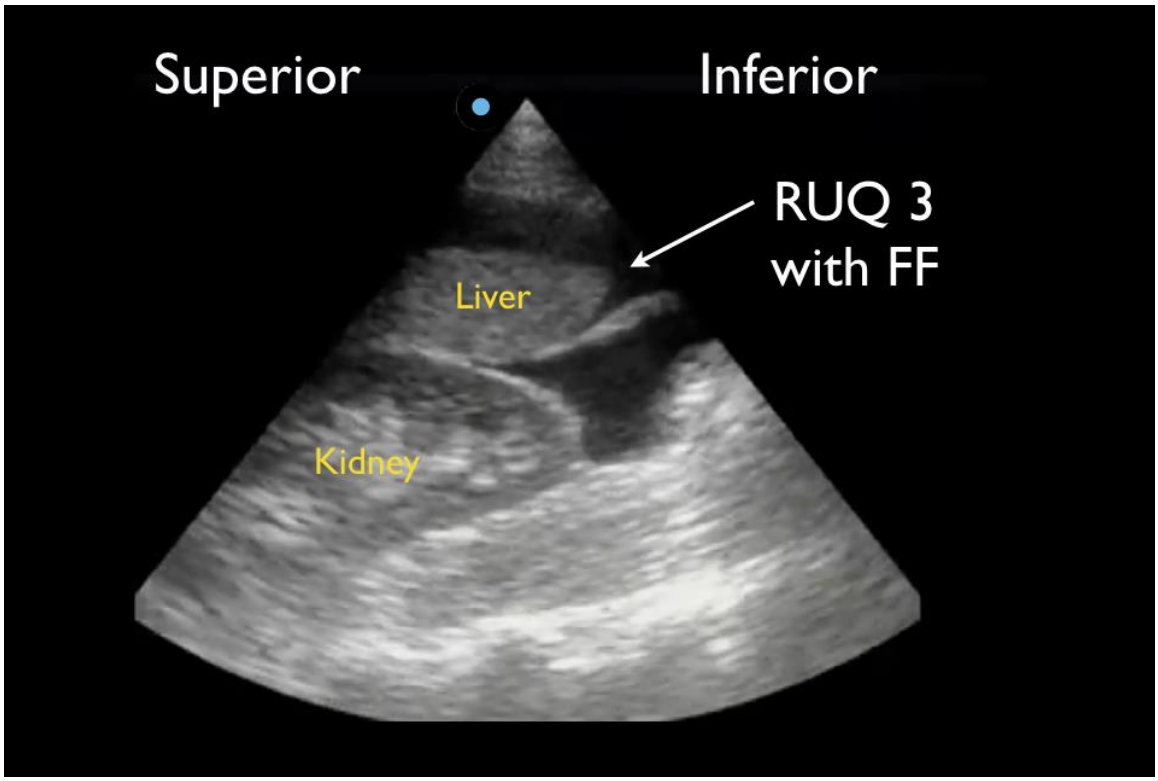

Figure 4. Positive right upper quadrant (RUQ) FAST view showing superior paracolic gutter around caudal liver edge (RUQ3), the most sensitive region for detecting free fluid (FF).

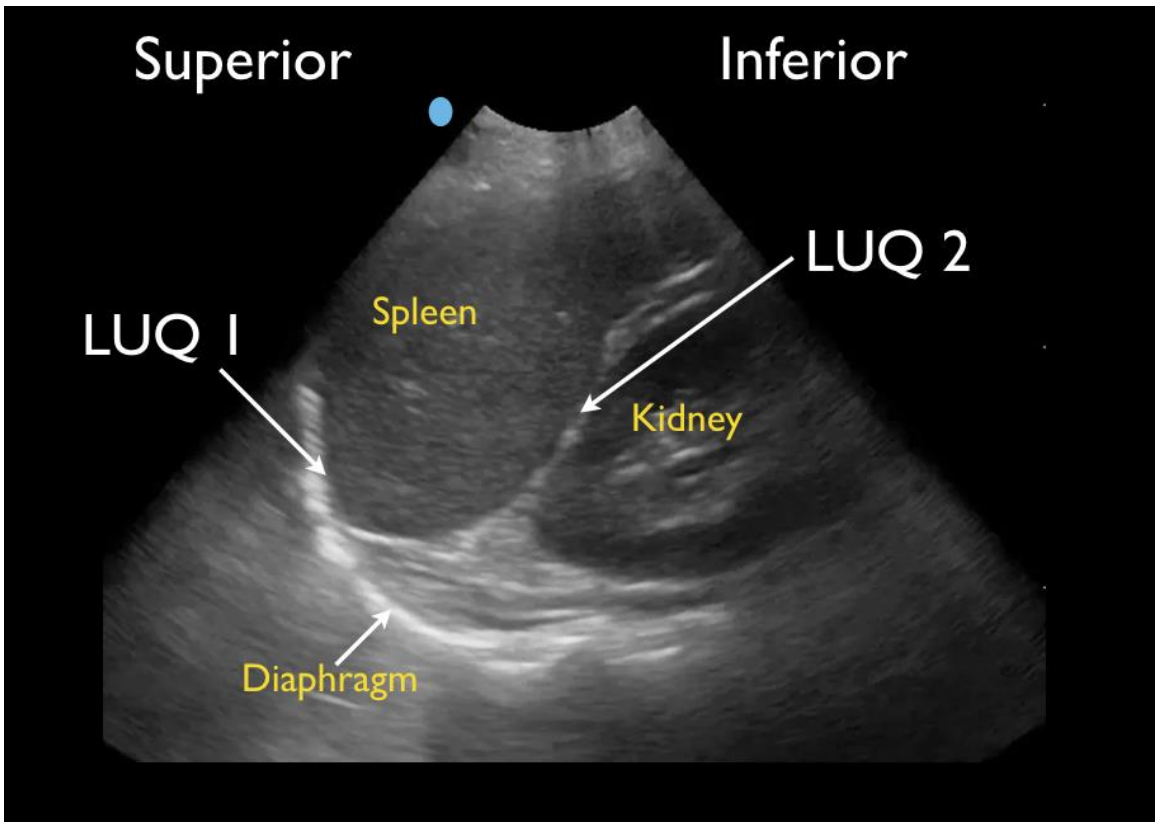

Figure 5. Normal left upper quadrant FAST view showing spleno-diaphragmatic space (LUQ1) and spleno-renal space (LUQ2).

during or after the primary survey per ATLS protocol,[10] where multiple evaluations and resuscitative measures are occurring simultaneously when a team-based approach is used. A higher-powered study assessing for the importance of serial FAST scans confirms that in supine patients, fluid accumulates over time, increasing one's ability to detect hemoperitonuem.[11]

A recent study of blunt abdominal trauma patients showed the FAST scan as the best bedside diagnostic modality to identify intra-abdominal pathology.[11] The FAST exam is ideal for detecting FF caused by intra-abdominal injury that results in shock and the need for emergent laparotomy.[3,12] This validates the importance of the exam to be performed both rapidly, to facilitate the flow of trauma resuscitation, and thoroughly, to avoid inaccurate interpretation.

An experienced sonographer can detect just 600ml of intraperitoneal FF, and possibly even less with optimal pelvic views.[12,1]. To optimize the ability of locating small amounts of FF, it is important to obtain images from multiple intraperitoneal sites.[13] As our study illustrates, FF may be seen in one quadrant but not others.

Patient positioning can affect the accuracy of the FAST scan. Various studies assessing supine vs. Trendelenburg positioning showed Trendelenburg positioning can allow detection of a lower amount of fluid (400 cc) as compared to the supine position (700cc).[15,16] When patient fluid assessment is performed by US, the Trendelenburg and right decubitus positions improved visualization in the RUQ. This suggests that fluid shifts in the direction of gravity.[17,18]

Importantly, when assessing the intraperitoneal space using the traditional RUQ, LUQ and SP views, the physician must understand the most sensitive regions for visualizing FF accumulation in order to increase the sensitivity of the study. In supine patients, fluid will accumulate in the most dependent areas of the peritoneal cavity, which have been shown to be the RUQ and SP regions, leading to conventional teaching describing the RUQ, specifically Morison's pouch, as the area where FF is first seen.[1,4,5,11] We specifically designed our retrospective study to test the hypothesis that a methodical sub-quadrant analysis of the traditional FAST views may allow for improved detection of intraperitoneal FF on the FAST examination. The RUQ view is noted to be the most sensitive for intraperitoneal fluid in our study, confirming previous studies. The liver and kidney allow sound-wave penetration and prevent scatter, allowing for optimal images. This study illustrates that the caudal liver edge and the superior aspect of the right paracolic gutter and not Morison's pouch is the most sensitive indicator for FF. While this difference between RUQ3 positivity and RUQ2 positivity was not statistically significant in our study,

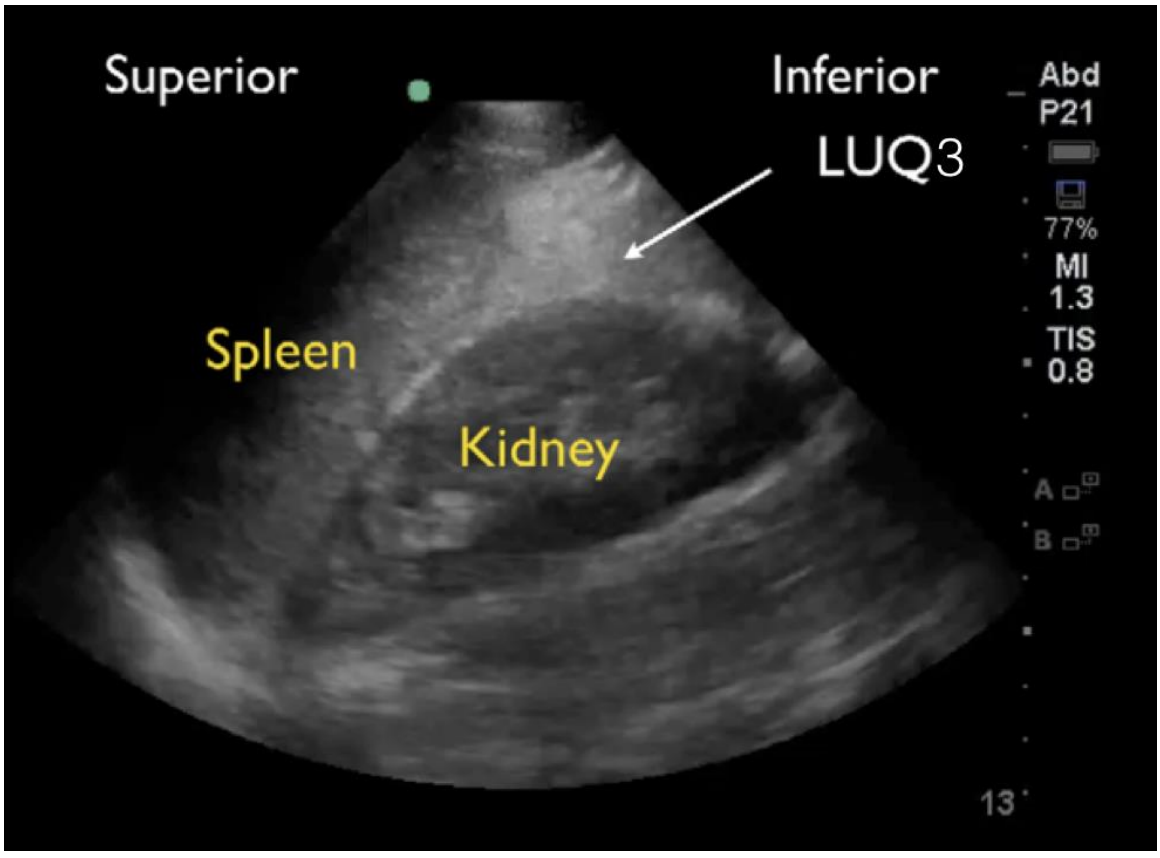

Figure 6. Normal left upper quadrant view of FAST showing left paracolic gutter (LUQ3).

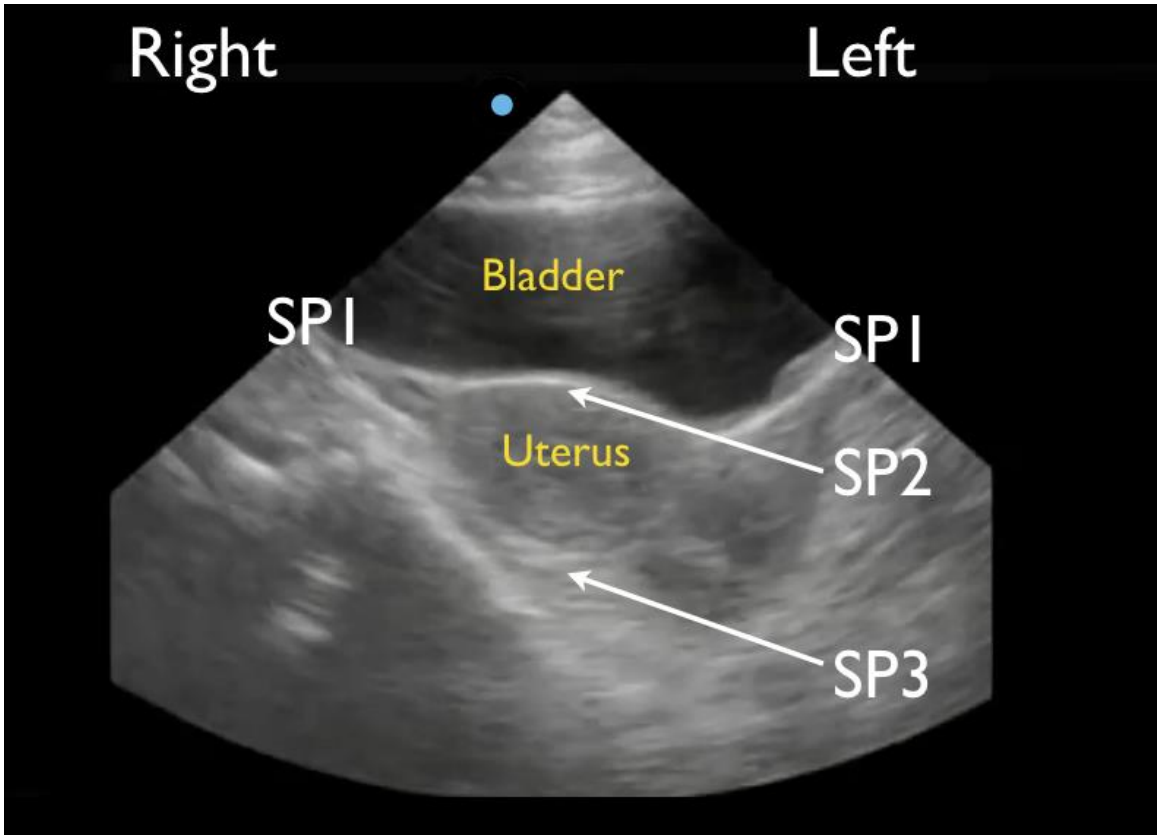

Figure 7. Normal short-axis suprapubic view of the FAST in a female showing lateral spaces to the bladder (SP1), space in between the bladder and uterus (SP2) and space posterior to the uterus (SP3).

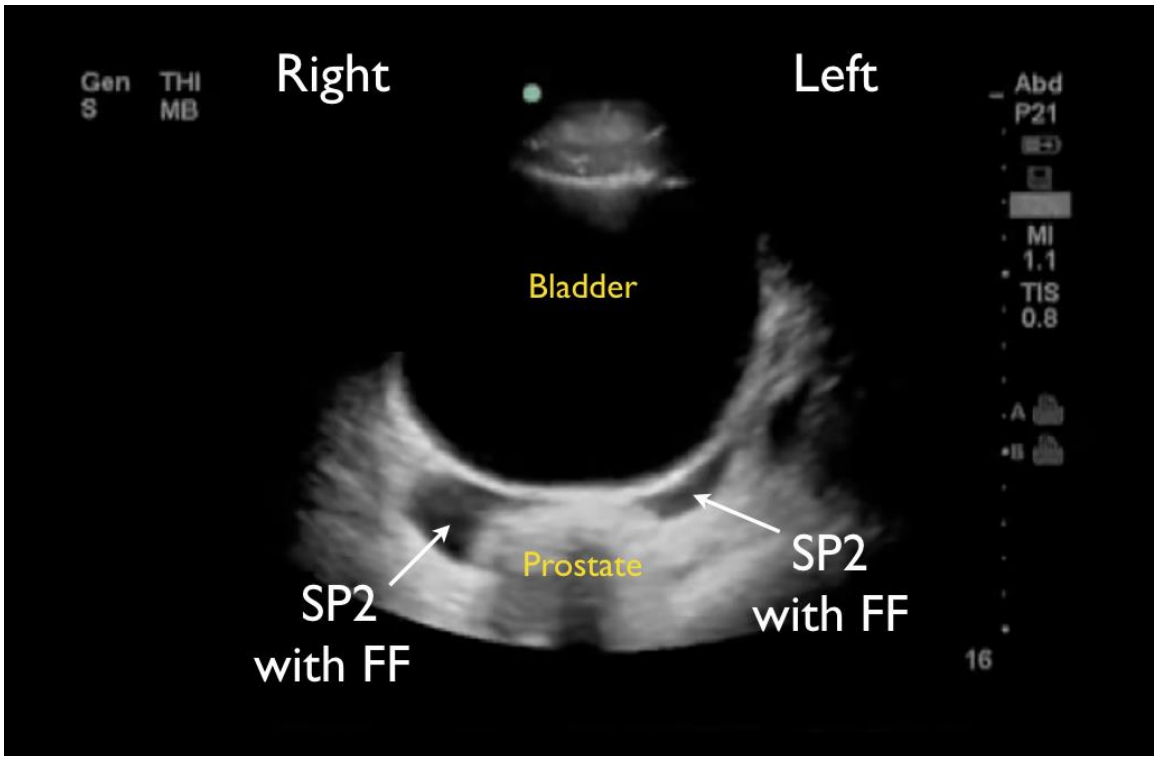

Figure 8. Suprapubic FAST view in a male patient showing free fluid (FF) posterior to bladder space but anterior to the prostate (SP2).

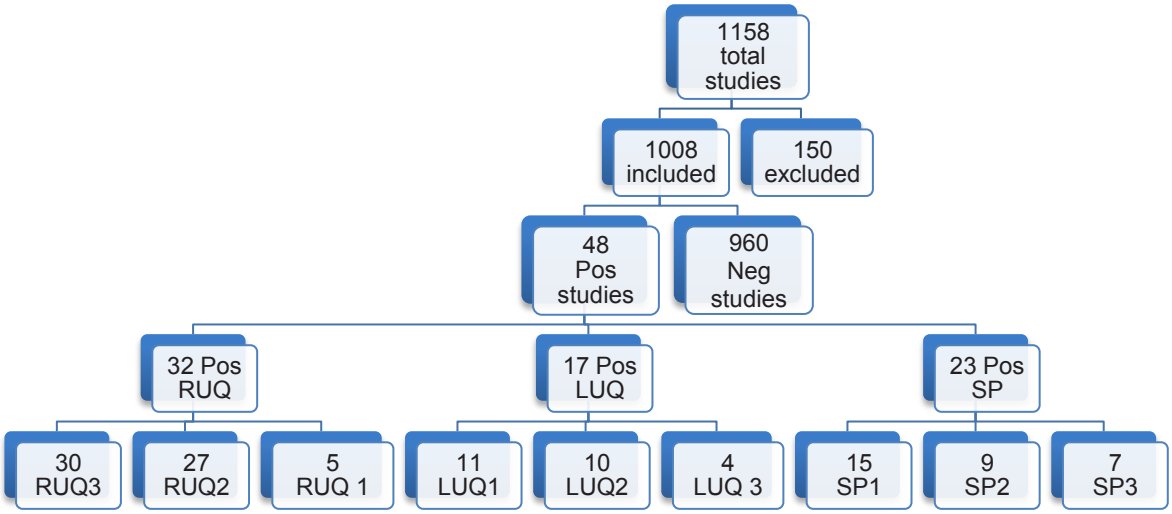

Figure 9. Flow chart of patient enrollment in retrospective study demonstrating caudal edge of the liver in the right upper quadrant view is the most sensitive area for free fluid on the FAST exam.
LUQ, left upper quadrant; *LUQ1,* spleno-diaphragmatic space; *LUQ2,* spleno-renal space; *LUQ3*, inferior pole of the left kidney; *RUQ*, right upper quadrant; *RUQ1*, hepato-diaphragmatic space; *RUQ2*, hepato-renal space; *RUQ3,* caudal edge of the liver; *SP*, Supra-pubic; *SP1,* lateral on either or both sides of bladder; *SP2*, posterior to bladder and anterior pelvic organs; *SP3,* posterior to uterus, or pelvic cul-de-sac.

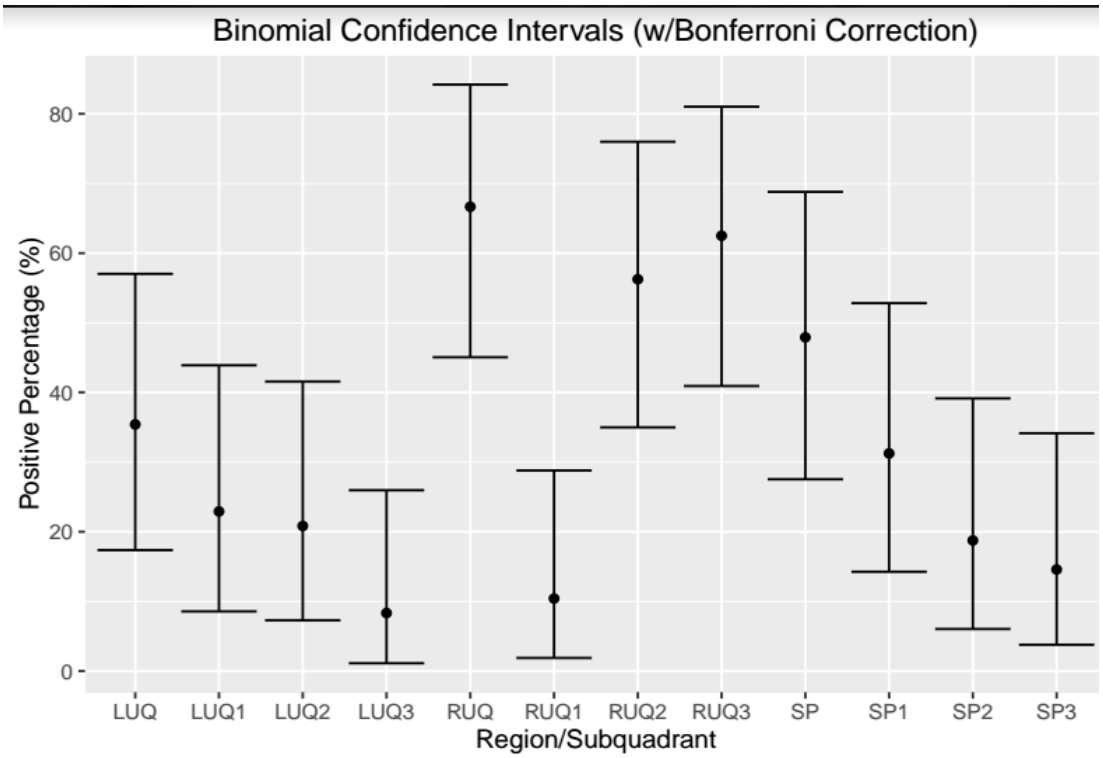

Figure 10. This plot gives the percentage of positive results from each sub-quadrant and quadrant with 95% confidence intervals around those estimates using the method of Clopper and Pearson with a Bonferroni correction to account for the multiple comparisons. As noted, the right upper quadrant (RUQ) is the most positive quadrant, and the caudal edge of the liver (RUQ3) is the most positive sub-quadrant among all reported FAST exams.
LUQ, left upper quadrant; *LUQ1,* spleno-diaphragmatic space; *LUQ2,* spleno-renal space; *LUQ3*, inferior pole of the left kidney; *RUQ*, right upper quadrant; *RUQ1*, hepato-diaphragmatic space; *RUQ2*, hepato-renal space; *RUQ3,* caudal edge of the liver; *SP*, Supra-pubic; *SP1,* lateral on either or both sides of bladder; *SP2*, posterior to bladder and anterior pelvic organs; *SP3,* posterior to uterus, or pelvic cul-de-sac; *FAST*, focused assessment with sonography in trauma exams.

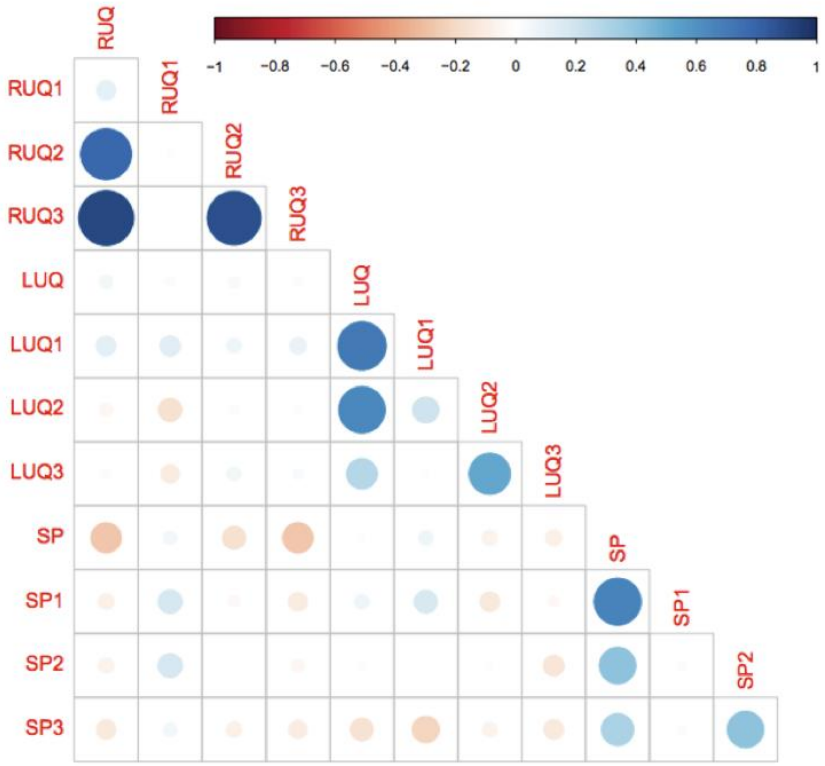

Figure 11. This matrix gives the correlation coefficient between pairs of quadrants and sub-quadrants using Cohen's kappa. The kappa coefficient measures inter-rater agreement between qualitative (categorical items). Values of kappa range from -1 (indicating total disagreement) to 1 (indicating total agreement). In this plot, the size and color (redness/blueness) of the dots corresponds to the degree of positive or negative correlation. Hence, the small light dots have a correlation nearer zero, i.e., no discernable correlation. The darker larger more saturated dots have a correlation nearer 1 (blue) or -1 (red) meaning a stronger correlation. LUQ1 appears to be the most consistent with other quadrants, while SP3 is the most in disagreement. RUQ1 is sub-quadrant with the least in agreement with its containing quadrant (RUQ).
LUQ, left upper quadrant; *LUQ1,* spleno-diaphragmatic space; *LUQ2,* spleno-renal space; *LUQ3*, inferior pole of the left kidney; *RUQ*, right upper quadrant; *RUQ1*, hepato-diaphragmatic space; *RUQ2*, hepato-renal space; *RUQ3,* caudal edge of the liver; *SP*, Supra-pubic; *SP1,* lateral on either or both sides of bladder; *SP2*, posterior to bladder and anterior pelvic organs; *SP3,* posterior to uterus, or pelvic cul-de-sac.

the RUQ3 was statistically the most sensitive indicator of a positive RUQ. These data support the premise that FF does in fact ascend and accumulate in the RUQ, as described by prior radiology CT studies,[7] by first moving around the caudal liver edge (RUQ 3) before ascending into Morison's pouch (RUQ2). This is important in the patient with early intraperitoneal bleeding who may only have FF in RUQ3. This study suggests placing less emphasis solely on imaging Morison's pouch and more emphasis on a more comprehensive exam that includes the caudal liver edge.

The LUQ, although thought to have adequate windows due to the spleen and kidney, is less sensitive for the detection of FF in our study. The spleen is smaller than the liver and offers less of an acoustic window. Furthermore, the stomach intrudes in the image causing scatter artifact. The area between the diaphragm and the spleen, or LUQ1, was found to be the most sensitive area for the detection of FF out of the three LUQ sub-quadrants. This observation would agree with other studies that the LUQ is not a mirror image of the RUQ and must be examined differently. There were, however, five cases in our series where the LUQ was positive, but the RUQ was negative. Therefore, it must still be included in the FAST scan to increase the overall FAST accuracy.

While the pelvic region is the most dependent region in supine patients and can be a sensitive view for detecting FF, it can miss FF due to the difficulty in obtaining adequate images, especially when there is an empty bladder, bowel gas artifact scattering the image, or posterior acoustic enhancement distal to a full bladder. Furthermore, gender differences have been shown to affect where FF will accumulate. In males, intraperitoneal FF accumulates around the posterior wall of the bladder. In females, FF is seen posterior to the uterus, in the pouch of Douglas. This region can be sensitive in detecting very small amounts of fluids.[14] However, small amounts of FF in young females of menstruating age can be

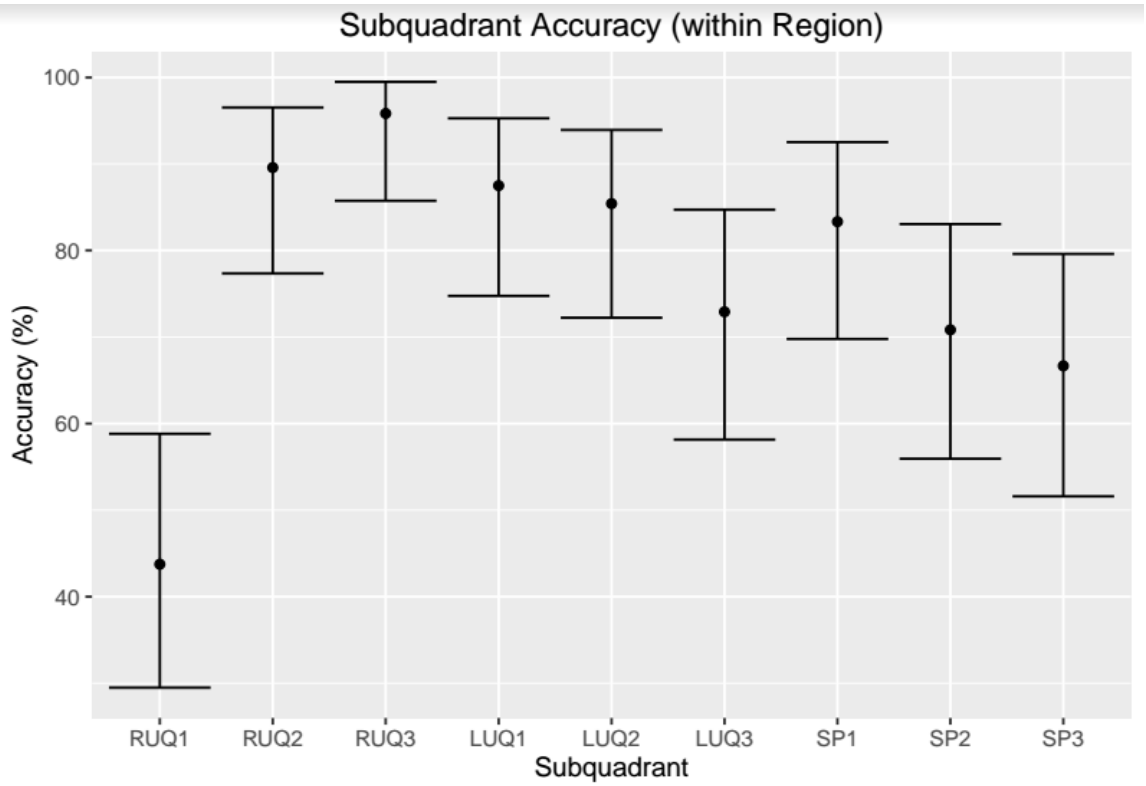

Figure 12. This plot gives the accuracy of each sub-quadrant in predicting the assessment from the corresponding full quadrant. Error bars describe the 95% confidence interval around the accuracy determined using the method of Clopper and Pearson. As depicted, the RUQ3 is the most accurate predictor of the RUQ.
LUQ, left upper quadrant; *LUQ1,* spleno-diaphragmatic space; *LUQ2,* spleno-renal space; *LUQ3*, inferior pole of the left kidney; *RUQ*, right upper quadrant; *RUQ1*, hepato-diaphragmatic space; *RUQ2*, hepato-renal space; *RUQ3,* caudal edge of the liver; *SP*, Supra-pubic; *SP1,* lateral on either or both sides of bladder; *SP2*, posterior to bladder and anterior pelvic organs; *SP3,* posterior to uterus, or pelvic cul-de-sac.

normal in the absence of trauma, which further complicates traumatic FF assessment in this region.[19] Our study found that lateral to the bladder (SP1) was the most sensitive SP region. However, our sample size by gender was small: 14 male and 9 female, limiting our analysis and conclusions.

LIMITATIONS

Our study was a retrospective study with a small positive FAST cohort. This does not reflect a true measurement of the percentage of positive traumatic FAST scans at our institution, as there are scans not recorded due to time constraints in data entry and lack of reliable operator recording. Secondly, while all enrolled patients were evaluated while they were supine, the amount of time between their traumatic event and the FAST scan was not recorded, nor was the time until CT or operating room (OR) confirmation reported. In addition, patients are always taken to CT scanners and/or the OR after the initial FAST exam; this allows time for continued bleeding and new areas of FF that may have not been present at the time of the FAST scan. This difference will likely lead to a decrease in sensitivity of each sub-quadrant. Next, the same investigators reviewed all studies, which included one US fellowship-trained EM attending and three EM senior resident physicians. We did not perform inter-rater reliability testing although we did review the chart to confirm their results. Next, while our study assessed all traumatic patients, we did not correlate the specific injury type to the FAST findings. The study did not include the pericardial view, which is a normal component of the FAST exam. Finally, our small sample size of positive findings in the pelvis limited our ability to confidently discriminate between men and women. This view would have to be investigated according to gender in a larger sample size, as traumatic fluid accumulation differs between men and women based on the difference in pelvic organs.

CONCLUSION

Compared to criterion references of CT and operative findings, we found that the sub-quadrants of the FAST scan most sensitive for FF visualization are RUQ3 (caudal tip of liver). RUQ3 is always positive when Morison's pouch

(RUQ 2) was positive for FF, but fluid may be seen here without being seen in Morison's pouch. This represents a change from the prior emphasis placed on Morison's pouch during performance and teaching of the FAST exam.

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Introduction: Twitter has recently gained popularity in emergency medicine (EM). Opinion leaders on Twitter have significant influence on the conversation and content, yet little is known about these opinion leaders. We aimed to describe a methodology to identify the most influential emergency physicians (EP) on Twitter and present a current list.

Methods: We analyzed 2,234 English-language EPs on Twitter from a previously published list of Twitter accounts generated by a snowball sampling technique. Using NodeXL software, we performed a network analysis of these EPs and ranked them on three measures of influence: in-degree centrality, eigenvector centrality, and betweenness centrality. We analyzed the top 100 users in each of these three measures of influence and compiled a list of users found in the top 100 in all three measures.

Results: Of the 300 total users identified by one of the measures of influence, there were 142 unique users. Of the 142 unique users, 61 users were in the top 100 on all three measures of influence. We identify these 61 users as the most influential EM Twitter users.

Conclusion: We both describe a method for identifying the most influential users and provide a list of the 61 most influential EPs on Twitter as of January 1, 2016. This application of network science to the EM Twitter community can guide future research to better understand the networked global community of EM. [West J Emerg Med. 2017;18(2)281-287.]

INTRODUCTION

Twitter is an online social media platform that allows individuals to communicate through tweets. A tweet is an electronic message of 140 characters or less that is accessible to the public. By following other users, you can view their tweets in your personal timeline. Twitter is used by 23% of online adults, making it one of the most popular social media platforms globally.[1] In 2009 there were 672 emergency physicians (EP) on Twitter, and in January 2016 there were 2,234.[2,3] According to one survey, more than a quarter of emergency medicine (EM) faculty use Twitter.[4] Despite its popularity, some have called Twitter "untested" and argued that one must "learn who to follow and who to trust."[5] Others have raised questions of relevance, threats to professionalism, and warned of rapid propagation of superficial and inaccurate information.[4,6–8]

Importance

Dissemination of information on Twitter can be rapid and viral, and is heavily influenced by important opinion leaders.[9] Ideas flow from mass media to opinion leaders and then to the rest of a community.[10] Opinion leaders have a wide and loyal audience, have the power to influence the decisions of others, and disproportionately impact the spread and credibility of information.[11,12] Opinion leaders on Twitter are the most followed and most connected. As such, they have the potential to influence the conversation and the content significantly more than their less influential counterparts.[9-11,12]

Despite its popularity and potential pitfalls, there is a paucity of data examining influence among Twitter users in EM. Furthermore, existing measures of influence in social media are not directly applicable to Twitter.[13] The only existing measure of social media impact in EM is the Social Media Index (SMi).

The SMi measures impact and quality of EM and critical care blogs and podcasts by measuring Google PageRanks, Alexa Ranks, Facebook Likes, Twitter Followers, and Google+ Followers. This measure was derived for a different purpose than ours. While useful for blogs and podcasts, it is a limited measure of influence specific to the Twitter platform, as it only includes total number of Twitter followers.

The influential group of opinion leaders in the EM Twitter community has not been defined. Defining this group is an important step toward understanding the spread of information among EPs on a social media platform.

Goals of this investigation

We aimed to both describe a method to identify the most influential EPs on Twitter and present a current list. To perform this task we used *network science,* a new type of applied graph theory that incorporates several disciplines.[14] This list of Twitter influencers will help us better understand the intricate relationships of EPs on Twitter and lay the groundwork for future scientific inquiry. Demonstrating how this contemporary methodology of defining influence can be applied to Twitter will enable future application to other networks of EPs and advance understanding of those with local, national, and global influence.

METHODS

This study was granted institutional review board exemption by the University of Washington Human Subjects Division.

Data Gathering

Twitter lists are a common tool to group users into categories by various criteria. The first curated list of English-language EPs on Twitter was published in 2009.[2] Lulic and Kovic first developed their list by examining Twitter users' biographies with web-based search tools from Twitter (www.Twitter.com), FollowerWonk (https://moz.com/followerwonk) and Twiangulate (http://twiangulate.com/search/). A snowball sampling technique was used to expand the list by exploring followers' biographies and the Twitter accounts of organizations and journals related to EM.[15] The list is titled "Emergency Physicians" and is published by the Twitter user @research_er. To the best of our knowledge, this is the most comprehensive list of EPs on Twitter.

From its January 2016 update, we gathered data about each member using NodeXL computer software (Microsoft Research, Redmond, WA). Variables including number of followers and tweets were recorded for each user.

Data Analysis

Network science helps identify influential people based on several different metrics of influence. This is conceptually important because an individual may have social influence within a community for many different reasons. For example, an EP on Twitter may be influential because he or she has a large number of followers, has followers who are influential themselves, or has a unique group of followers to help disperse information. As such, sociologists have developed contemporary methods to identify influential members in a network and rank them according to different definitions of importance. These measures of importance are called centralities.[16] We used NodeXL and Gephi software (Gephi Consortium, USA) to perform network analysis and visualization. We measured influence of each user in the network by calculating in-degree centrality, eigenvector centrality, and betweenness centrality.[16]

Measures of Influence

In-Degree Centrality

Degree is a measure of connections based on the number of followers a user has *within a network*. In the case of our study, it is *not* the total number of followers a certain user has on Twitter. Instead, it is a measure of how many EPs are following a given user. In this measurement, each follower has equal weight.

Users with high in-degree centrality are considered to have prominence, prestige, and importance.[17] Users with a higher number of EPs following them have a higher capacity to effect the discussion among those users. It represents voices in the EM Twitter conversation that are likely to be listened to.

Eigenvector Centrality

Messages can spread broadly if retweeted, or passed along, by a few influential users. As such, being followed by one popular Twitter user bestows more influence than being followed by many brand-new Twitter users with few followers. Eigenvector centrality accounts for this by going beyond the number of followers a user has. It measures the collective influence of each follower. Being recognized by someone seen as powerful contributes heavily to one's perceived influence. Eigenvector centrality elevates those users followed by a smaller, but more influential, number of followers.[18]

Betweenness Centrality

Betweenness is a measure of information gatekeeping. Users with a high betweenness centrality provide the shortest paths between other users within the network. Because of their position within the network, they have considerable control over information diffusion. They are important in passing along information through a network. Users with high betweenness are frequently viewed as leaders.[19]

Outcomes

There is no single measure of importance that is paramount in understanding a social network. Rather,

these centralities must be taken together to provide a robust measure of a user's influence.[16] As such, we defined influence as being at the top of the list in all three measures of network centrality. We ranked the previously identified 2,234 EPs on Twitter by each of the three measures of influence. Users that appeared in the top 100 of all three measures of influence qualified as the most influential EPs on Twitter. We queried these users' profiles for their name, gender, location, and year they joined Twitter.

RESULTS

Of the 300 users in the top 100 of each measure of centrality (see Appendix), there were 142 unique users. Of the 142 unique users, 62 users appeared on all three lists. One of the 62 users was removed because it was the corporate account for a publication that could not be linked to a human physician. We identify the remaining 61 users as EM Twitter influencers (TIs).

Fifty-three of the 61 (87%) provide their full name in their profile. Of those whose gender was easily discernable from their profile, 9 of 59 (15%) are women. Seventy-one percent of TIs are located in the United States, with others in Europe (13%), Australia (9%), Canada (5%), and Costa Rica (2%). The earliest users joined Twitter in 2007, while the most recent influencer joined in 2014.

DISCUSSION

The strengths of this study lie in a robust network analysis of over 2,200 EPs using three different measures of influence grounded in network science. We provide a network analysis method for determining the most influential EPs on Twitter. We also present a current list of those TIs, or Twitter influencers. This list helps quantify the qualitative concept of social influence and demonstrates a contemporary methodology for defining influence.

It is important to note that this analysis represents influence only *among emergency physicians,* and not broader influence among other healthcare networks or the lay public. For example, there are EPs with influence outside the EM community, like television star Travis Stork, MD, (@TravisStorkMD) who has 159,000 Twitter followers. He does not, however, influence the conversation or content among EPs because he is not followed by them and does not lie between them in the EP Twitter network.

Women make up a small percentage of the TIs. This gross disproportionality is consistent with other studies examining

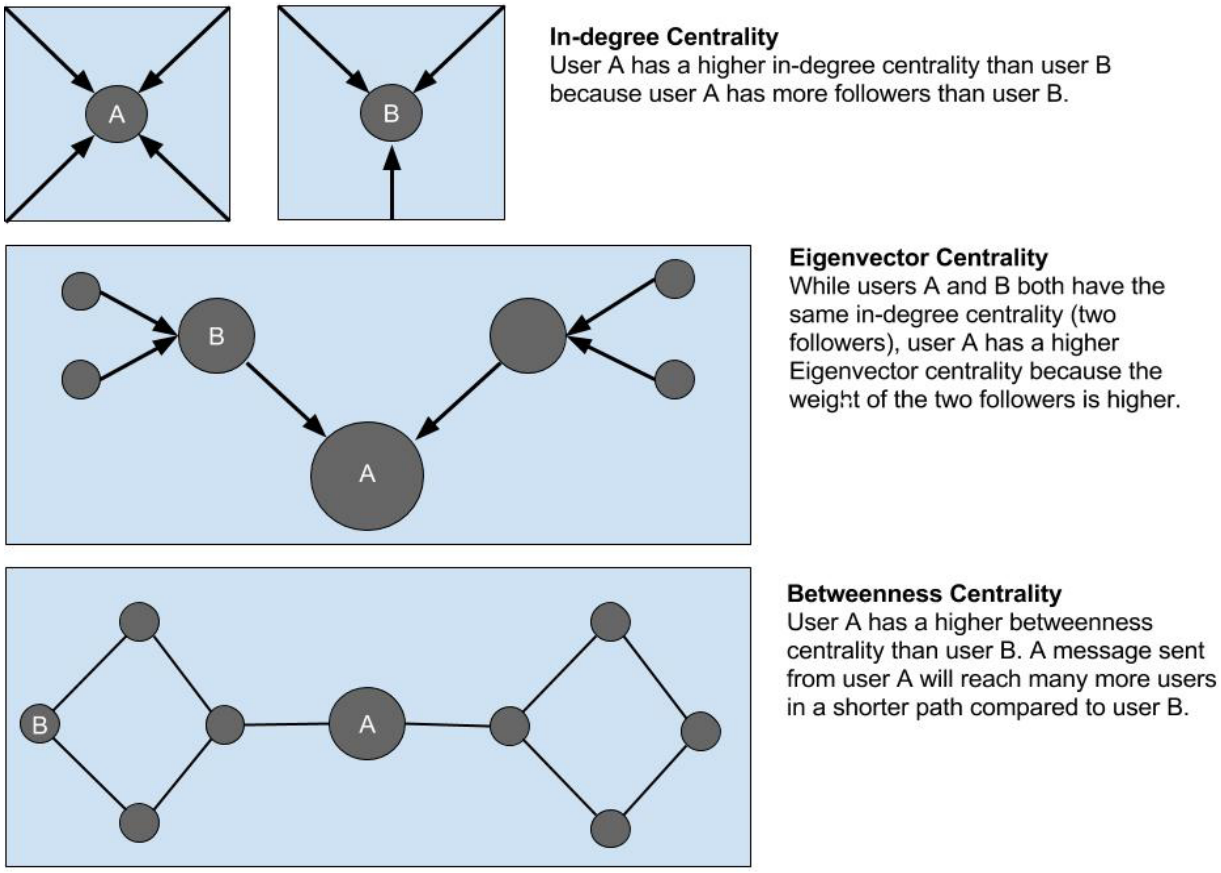

Figure 1. Pictorial description of In-degree, Eigenvector centrality and betweenness centrality.

Table. The most influential EM physicians on Twitter (as of 1-1-2016).

User	Twitter name	Gender	Location	Date joined
@_nmay	Natalie May	F	New South Wales, Australia	2012
@4hremergencydoc	4hremergencydoc	-	London, UK	2010
@airwaycam	Richard Levitan	M	New Hampshire, USA	2013
@amalmattu	Amal Mattu	M	Maryland, USA	2012
@andyneill	Andy Neill	M	Ireland	2011
@bobstuntz	EM Res Podcast	M	Pennsylvania, USA	2012
@brent_thoma	Brent Thoma	M	Saskatchewan, Canada	2012
@broomedocs	Casey Parker	M	Broome, NW Australia	2011
@cabreraerdr	Daniel Cabrera	M	Minnesota, USA	2014
@cliffreid	Cliff Reid	M	Sydney, Australia	2009
@criticalcarenow	Haney Mallemat	M	Baltimore, USA	2010
@drhowiemell	Dr. Howie Mell	M	North Carolina, USA	2012
@drjessepines	Jesse M. Pines, M.D.	M	Washington, DC	2011
@eleytherius	Michelle Johnston	F	Perth, Australia	2010
@em_educator	rob rogers	M	Kentucky, USA	2009
@embasic	Steve Carroll, DO	M	Texas, USA	2011
@emchatter	EMchatter	M	Missouri, USA	2012
@emcrit	Scott Weingart	M	New York, USA	2009
@emeducation	Rob Cooeny, MD, Med	M	Pennsylvania, USA	2008
@emergencypdx	Rob Orman	M	Colorado, USA	2010
@emergidoc	Kevin Kaluer DO, EJD	M	Tennessee, USA	2009
@emimdoc	David Marcus	M	New York, USA	2009
@emlitofnote	Ryan Radecki	M	Oregon, USA	2011
@emmanchester	Simon Carley	M	Manchester, UK	2009
@emswami	Anand Swaminathan	M	New York, USA	2013
@emupdates	reuben strayer	M	New York, USA	2011
@er_doc	ER doc	F	-	2008
@ercowboy	Pik Mukherji	M	New York, USA	2012
@grahamwalker	Graham Walker	M	California, USA	2007
@gruntdoc	GruntDoc	M	Texas, USA	2007
@jeremyfaust	jeremy faust	M	New York, USA	2009
@joelex5	Joe Lex	M	Pennsylvania, USA	2012
@ketaminh	Minh Le Cong	M	Queensland, Australia	2011
@klinelab	jeffrey kline	M	Indiana, USA	2014
@lwestafer	Lauren Westafer	F	New England, USA	2012
@m_lin	Michelle Lin	F	California, USA	2009
@mdaware	Seth Trueger	M	Illinois, USA	2011
@meganranney	Megan Ranney MD MPH	F	Rhode Island, USA	2011
@melherbert	EM:RAP's Mel Herbert	M	California, USA	2008
@movinmeat	Liam Yore, MD	M	Pacifc NW, USA	2008
@nickgenes	Borborygmi	M	New York, USA	2008
@painfreeed	Sergey Motov	M	New York, USA	2013
@pedemmorsels	Sean M. Fox	M	North Carolina, USA	2011

M, male; *F*, female.

Table. Continued.

User	Twitter name	Gender	Location	Date joined
@pemedpodcast	Andrew Sloas	M	Tennessee, USA	2011
@pharmertoxguy	Bryan D. Hayes	M	Maryland, USA	2012
@poisonreview	Leon Gussow	M	Illinois, USA	2009
@precordialthump	Chris Nickson	M	Melbourne, Australia	2008
@rainedoc	Todd Raine	M	British Columbia, Canada	2011
@rcempresident	Cliff Mann	M	London, UK	2010
@richardbody	Rick Body	M	Manchester, UK	2010
@rogerrdharris	Roger Harris	M	Sydney, Australia	2012
@sandnsurf	Mike Cadogan	M	Perth, Australia	2008
@smithecgblog	Stephen W. Smith	M	Minnesota, USA	2011
@socraticem	Victoria Brazil	F	Gold Coast, Australia	2011
@sonospot	Laleh Gharahbaghian	F	California, USA	2012
@srrezaie	Salim R. Rezaie	M	Texas, USA	2013
@takeokun	Jason T Nomura MD	M	East Coast, USA	2009
@tchanmd	Teresa Chan	F	Ontario, Canada	2009
@themattmak	Matt	M	London, UK	2011
@ultrasoundpod	Matt and Mike	M	Kentucky and Utah, USA	2011
@umanamd	Manrique Umana McD	M	San Jose, Costa Rica	2011

M, male; *F*, female.

influential EPs. A recent study found that only 11% of academic chairs in EM are women.[20] Despite recent progress in gender equality, there remains considerable work to be done to improve equality for women, including in the realm of social media.

This work builds on Lulic and Kovic's 2013 derivation of the EM users on Twitter list.[15] Without identifying users' names, Lulic and Kovic presented the graphical data highlighting a small inner network of connected and influential EPs on Twitter. In this study, we provide a list of that influential inner network.

Our derived cohort had some overlap with the only other existing measure of social influence, the SMi. Of the 61 Twitter users affiliated with the top SMi blogs and podcasts, 41 (67%) were in our list of TIs. By applying several different, robust measures of influence, this curated list adds to our knowledge of the influential EPs on Twitter.

We believe this list of 61 TIs can be used as a valid foundation for future research around Twitter in EM. Rigorous analyses of the 61 TIs will move forward our understanding of the way Twitter is used for content, conversation, and professional development. For example, in-depth content analysis of the tweets of the 61 TIs would give insight into the EM subjects with the most weight on Twitter. A recent analysis of free open-access educational resources found imbalanced and incomplete coverage of EM core content.[21] Understanding the balance of content on Twitter may help EM practitioners and educators make informed decisions. Finally, and most importantly from a research perspective, analyzing the veracity of the content disseminated by the TIs would help further shine the light of evidence-based medicine on EM social media. The concerns about superficial and inaccurate information spreading would best be answered by analyzing the group most likely to influence the spread of information. This list should be used as a scholarly launching point to dive deeper into the conversation, content, and quality of the EM Twitter network.

In response to the concern that social media was gaining too much influence and that we are losing sight of key metrics of scientific value, such as citation indices, the satirical Kardashian Index was described in 2014.[22] This index is a direct proportion of number of Twitter followers to number of citations. With tongue firmly in cheek it urges caution with placing value on metrics of social media influence at the expense of more traditional metrics. It is important to bear in mind that the purpose of our study was to create a list that would help inform the community about the nature of social media influence as a whole rather than to create or elevate a celebrity culture around a few EPs. Nor does it confer any EM expertise. On the contrary, it is intended to focus our analytical lens on the TIs to give the greater EM community an understanding of how opinion is influenced and ideas are spread in this popular social network. This list is not intended to be an endorsement of these users or a metric of the quality of their messages. It is simply a measure of influence.

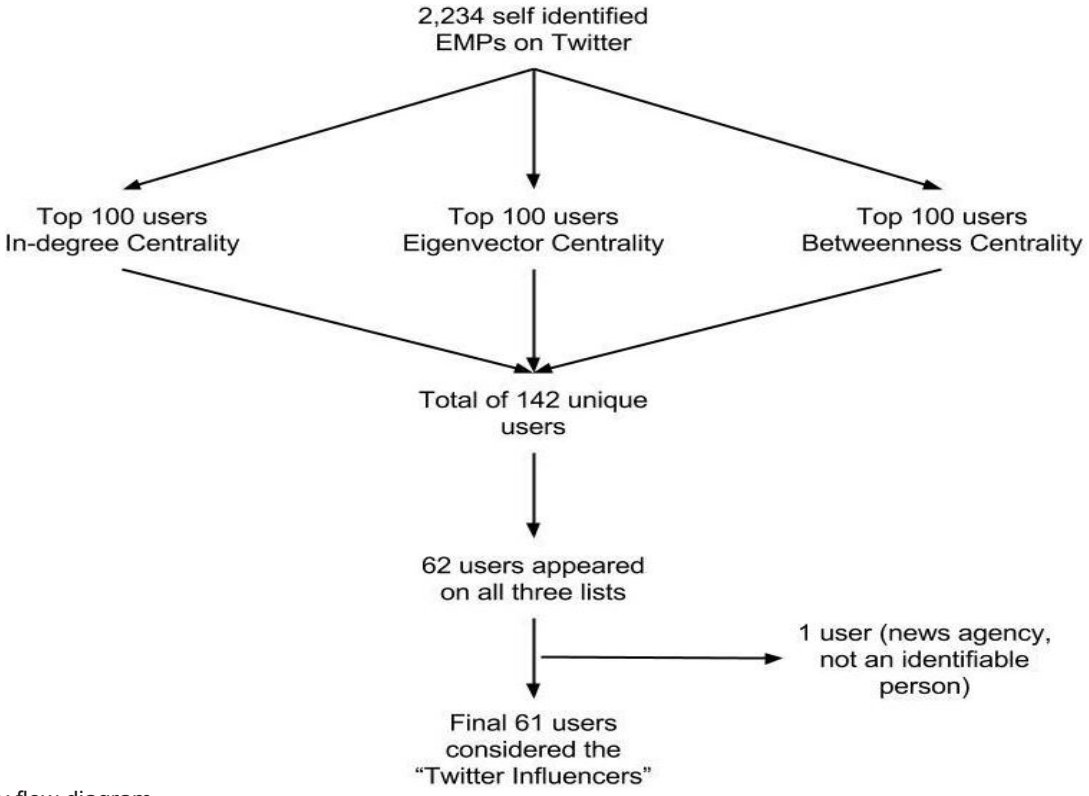

Figure 2. Study flow diagram.
EMP, emergency medicine physicians.

LIMITATIONS

This study is limited to English-language speaking EPs. We did not contact the users to verify that they were EPs, though most of the 61 TIs are known to the authors as EPs. While our network analysis examined the number of followers for each user within the network of EPs, it did not analyze recent account activity for these users. It is possible that there are other influential EP users with high eigenvector, in-degree centrality and betweenness centrality who were excluded from our analysis because they have not been identified as EPs on the existing EPs Twitter list. This list is also limited to physicians and does not include those emergency medical services personnel, social workers, nurses, and pharmacists who are influential in the EM Twitter community.

CONCLUSION

In summary, there is a growing network of EPs on Twitter, impacted by a small group of opinion leaders. To understand this network, we both describe a method for identifying the most influential users and provide a list of the 61 most influential EPs on Twitter as of January 1, 2016. This application of network science to the EM Twitter community can guide future research to better understand the networked global community of EM.

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Blog and Podcast Watch: Cutaneous Emergencies

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Introduction: The *WestJEM* Blog and Podcast Watch presents high quality open-access educational blogs and podcasts in emergency medicine (EM) based on the ongoing Academic Life in Emergency Medicine (ALiEM) Approved Instructional Resources (AIR) and AIR-Professional series. Both series critically appraise resources using an objective scoring rubric. This installment of the Blog and Podcast Watch highlights the topic of cutaneous emergencies from the AIR series.

Methods: The AIR series is a continuously building curriculum that follows the Council of Emergency Medicine Residency Directors (CORD) annual testing schedule. For each module, relevant content is collected from the top 50 most accessed sites per the Social Media Index published within the previous 12 months and scored by eight board members using five equally weighted measurement outcomes: Best Evidence in Emergency Medicine (BEEM) score, accuracy, educational utility, evidence based, and references. Resources scoring ≥30 out of 35 available points receive an AIR label. Resources scoring 27-29 receive an "honorable mention" label, if the editorial board agrees that the post is accurate and educationally valuable.

Results: A total of 35 blog posts and podcasts were evaluated. None scored ≥30 points necessary for the AIR label, although four honorable mention posts were identified. Key educational pearls from these honorable mention posts are summarized.

Conclusion: This Blog and Podcast Watch series is based on the AIR and AIR-Pro series, which attempts to identify high quality educational content on open-access blogs and podcasts. This series provides an expert-based, post-publication curation of educational social media content for EM clinicians with this installment focusing on cutaneous emergencies. [West J Emerg Med. 2017;18(2)288-292.]

BACKGROUND

Despite the rapid rise of social media educational content available through blogs and podcasts in emergency medicine (EM),[1] identification of quality resources for educators and learners has only minimally progressed.[2-4] In 2008, the Accreditation Council for Graduate Medical Education endorsed a decrease in synchronous conference experiences for EM residency programs by up to 20% in exchange for asynchronous learning termed Individualized Interactive Instruction (III).[5] Residency programs, however, are often unsure how to identify quality online resources specifically for asynchronous learning and III credit.

To address this need, the Academic Life in Emergency Medicine (ALiEM) Approved Instructional Resources (AIR) Series and AIR-Pro Series were created in 2014 and 2015, respectively, to help EM residency programs identify quality online content specifically on social media.[6,7] Using an expert-based, crowd-sourced approach, these two programs identify trustworthy, high quality, educational blog and podcast content. This Blog and Podcast Watch series presents annotated summaries written by the editorial board from the AIR and AIR-Pro Series.

This installment from the AIR Series summarizes the highest scoring social media educational resources on cutaneous emergencies.

METHODS

Topic Identification

The AIR series is a continuously building curriculum based on the CORD testing schedule (http://www.cordtests.org/).

Inclusion and Exclusion Criteria

A search of the top 50 most frequently visited sites per the Social Media Index[8] was conducted in March 2016 for resources relevant to cutaneous emergencies, published within the previous 12 months. Methodology details for inclusion, exclusion, scoring criteria, and data analyses are summarized in the original AIR publication.[6]

Scoring

Extracted posts were scored by eight reviewers from the AIR Editorial Board, which is comprised of EM core faculty from various U.S. medical institutions. The scoring instrument contains five measurement outcomes using seven-point Likert scales: Best Evidence in Emergency Medicine (BEEM) score, accuracy, educational utility, evidence based, and references (Table).[6,9]

Data Analysis

Resources with a mean score of ≥ 30 points (out of 35) are awarded the AIR label. Resources with a mean score of 27-29, deemed accurate and educationally valuable by the reviewers, receive the "honorable mention" label.

RESULTS

A total of 35 blog posts and podcasts were initially collected and reviewed. None scored ≥30 points necessary for the AIR label, although four honorable mention posts were identified. Key educational pearls from these honorable mention AIR posts are described.

AIR Honorable Mention Content

1. Hayes B, Awad N, Heil E. Sulfamethoxazole-Trimethoprim for Skin and Soft Tissue Infections: 1 or 2 Tablets BID? *Academic Life in Emergency Medicine*. (February 16, 2015) https://www.aliem.com/2015/sulfamethoxazole-trimethoprim-ssti-1-2-tablets-bid/

Sulfamethoxazole-trimethoprim (SMX-TMP) is recommended by the 2014 Infectious Diseases Society of America guidelines for purulent, suspected methicillin-resistant *S. aureus* (MRSA) skin and soft tissue infections (SSTIs). This post compares the evidence for one versus two double strength SMX-TMP tablets twice a day.

Take-home points**:** Two studies are discussed including a prospective evaluation of patients with confirmed MRSA SSTIs and a retrospective study of 106 patients hospitalized for cellulitis with and without abscess. The first study found no difference in clinical resolution of the infection between the two doses, while the second study showed increased clinical failure in morbidly obese patients taking one double-strength tablet SMX-TMP per dose. While not shown to be helpful in most patients, the increased dose of two tablets twice a day may be appropriate for patients with obesity, immunosuppression, and trauma-induced SSTIs. However, this increased dose may be associated with increased adverse effects including hyperkalemia.

2. Schneider E. SGEM#110: I saw the signs of angioedema. Skeptics Guide to Emergency Medicine. (March 7, 2015) http://thesgem.com/2015/03/sgem110-i-saw-the-signs-of-angioedema/

Non-allergic angioedema from angiotensin converting enzyme inhibitors (ACE-I) is thought to be bradykinin-mediated and is therefore resistant to standard anaphylaxis therapies of epinephrine, antihistamines, and corticosteroids. This post reviews a randomized control trial of icatibant, a bradykinin receptor antagonist, for the treatment of ACE-I associated angioedema.

Take-home points: The study enrolled 27 emergency department patients who presented with angioedema of the upper aerodigestive tract and were taking an ACE-I. The investigators compared icatibant 30 mg to the standard intravenous therapy of prednisolone 500 mg (corticosteroid) plus clemastine 2 mg (antihistamine and anticholinergic). The primary outcome showed that the icatibant group had a significantly shorter time to complete resolution of symptoms (8 vs. 27.1 hours). The icatibant

Table. Approved Instructional Resources (AIR) scoring instrument for blog and podcast content with the maximum score being 35 points.

Tier 1: BEEM rater scale	Score	Tier 2: content accuracy	Score	Tier 3: educational utility	Score	Tier 4: evidence based medicine	Score	Tier 5: referenced	Score
Assuming that the results of this article are valid, how much does this article impact on EM clinical practice?		Do you have any concerns about the accuracy of the data presented or conclusions of this article?		Are there useful educational pearls in this article for senior residents?		Does this article reflect evidence based medicine (EBM)?		Are the authors and literature clearly cited?	
Useless information	1	Yes, many concerns from many inaccuracies	1	Not required knowledge for a competent EP	1	Not EBM based, only expert opinion	1	No	1
Not really interesting, not really new, changes nothing	2		2		2		2		2
Interesting and new, but doesn't change practice	3	Yes, a major concern about few inaccuracies	3	Yes, but there are only a few (1-2) educational pearls that will make the EP a better practitioner to know or multiple (>=3) educational pearls that are interesting or potentially useful, but rarely required or helpful for the daily practice of an EP.	3	Minimally EBM based	3		3
Interesting and new, has the potential to change practice	4		4		4		4	Yes, authors and general references are listed (but no in-line references)	4
New and important: this would probably change practice for some EPs	5	Minimal concerns over minor inaccuracies	5	Yes, there are several (>=3) educational pearls that will make the EP a better practitioner to know, or a few (1-2) every competent EP must know in their practice	5	Mostly EBM based	5		5
New and important: this would change practice for most EPs	6		6		6		6		6

BEEM, best evidence in emergency medicine; *EP*, emergency physician.

Table. Continued.

Tier 1: BEEM rater scale	Score	Tier 2: content accuracy	Score	Tier 3: educational utility	Score	Tier 4: evidence based medicine	Score	Tier 5: referenced	Score
This is a "must know" for EPs	7	No concerns over inaccuracies	7	Yes, there are multiple educational pearls that every competent EP must know in their practice	7	Yes exclusively EBM based	7	Yes, authors and in-line references are provided	7

BEEM, best evidence in emergency medicine; *EP*, emergency physician; *EBM,* evidence-based medicine.

group also had a higher proportion of complete resolution of symptoms at four hours (38% vs. 0%) and a faster time to onset of symptom relief (2 vs. 11.7 hours).

There were several limitations noted including small sample size, no documentation of consecutive enrollment, lack of a blinded study design, and funding provided by the pharmaceutical company. Additionally, all patients enrolled were Caucasian even though ACE-I angioedema is five times more common in patients of African descent. The standard care group did not include therapies, such as epinephrine or fresh frozen plasma, which may have limited the results. Patient-oriented outcomes such as mortality, need for intubation, and cost were not studied. Overall, icatibant appears to be effective for the treatment of ACE-I angioedema; however, given its cost of $5,000 - $10,000 it should be reserved for the more severe cases involving airway compromise.

3. Long B. The emergency medicine approach to vasculitides. EM Docs. (June 12, 2015) http://www.emdocs.net/the-emergency-medicine-approach-to-vasculitides/

Systemic vasculitides are chronic, inflammatory, autoimmune disorders with multi-organ pathology secondary to inflammatory damage to blood vessels. This post provides an overview of emergent complications.

Take-home points: In the acute setting, beware of both infectious etiologies that require antibiotics as well as flares of rheumatic diseases that require high-dose steroids. Consultations with rheumatologists and intensivists are often indicated. Systemic lupus erythematosus (SLE) is specifically discussed and, of note, presents most commonly with rash, mucositis, and arthritis. The diagnosis of SLE is based on having ≥4 of the 11 diagnostic criteria: malar rash, discoid rash, photosensitivity, oral ulcers, non-erosive arthritis, serositis, renal disease, neurologic disorders, two or more hematologic cell lines decreased, positive anti-nuclear antibody, and another positive SLE antibody (anti-DNA, Anti-Sm, or antiphospholipid).

Vasculidites adversely affect numerous organ systems that emergency physicians should be aware of. Pulmonary complications can include interstitial fibrosis, pulmonary hypertension and diffuse alveolar hemorrhage. Thromboembolic complications can affect multiple systems resulting in such conditions as myocardial infarction, deep vein thrombosis, pulmonary embolism, renal vascular thrombosis, mesenteric ischemia, and cerebral vascular occlusion. Common cutaneous pathology includes erythema nodusum, palpable purpura from Henoch-Schonlein purpura, oral and genital ulcers of Behcet's disease, and the malar and discoid lesions of SLE.

4. Smith B. UOTW #66. Ultrasound of the Week. (January 7, 2016) http://www.ultrasoundoftheweek.com/uotw-66/

Often it is difficult to clinically distinguish cellulitis from a subcutaneous abscess. This post reviews the instructions for and utility of ultrasonography in differentiating between these two pathologies.

Take-home points: Ultrasound often changes gestalt management in differentiating between cellulitis with or without an underlying abscess. In cellulitis alone, ultrasonography often shows a cobblestone pattern. In subcutaneous abscesses, a hypo-echoic fluid collection is seen. Because ultrasonographic compression improves the sensitivity to detect subcutaneous fluid, by inducing fluid/pus movement or swirling, it should be performed every 1-2 cm throughout the area of cellulitis.

CONCLUSION

The Blog and Podcast Watch series serves to identify educational quality blogs and podcasts for EM clinicians through its expert panel using an objective scoring instrument. These social media resources are currently curated in the ALiEM AIR and AIR-Pro Series, originally created to address EM residency needs. These resources are herein shared and summarized to help clinicians filter the rapidly published multitude of blog posts and podcasts. One of the limitations is that the search only includes

content produced within the preceding12 months from the top 50 Social Media Index sites. While these lists are by no means a comprehensive analysis of the entire Internet for these topics, this series provides a post-publication curation and accreditation of recent high quality, educational social media content for the EM clinician.

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Academic Primer Series: Eight Key Papers about Education Theory

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Introduction: Many teachers adopt instructional methods based on assumptions of best practices without attention to or knowledge of supporting education theory. Familiarity with a variety of theories informs education that is efficient, strategic, and evidence-based. As part of the Academic Life in Emergency Medicine Faculty Incubator Program, a list of key education theories for junior faculty was developed.

Methods: A list of key papers on theories relevant to medical education was generated using an expert panel, a virtual community of practice synthetic discussion, and a social media call for resources. A three-round, Delphi-informed voting methodology including novice and expert educators produced a rank order of the top papers.

Results: These educators identified 34 unique papers. Eleven papers described the general use of education theory, while 23 papers focused on a specific theory. The top three papers on general education theories and top five papers on specific education theory were selected and summarized. The relevance of each paper for junior faculty and faculty developers is also presented.

Conclusion: This paper presents a reading list of key papers for junior faculty in medical education roles. Three papers about general education theories and five papers about specific educational theories are identified and annotated. These papers may help provide foundational knowledge in education theory to inform junior faculty teaching practice. [West J Emerg Med. 2017;18(2)293-302.]

INTRODUCTION

"But the teacher who has the insight which educational theory affords, inspired is [s]he for excellence in schooling."[1]

While educators often hypothesize about the optimal strategies for teaching, the assumed strategies may not always be valid or the most efficient manner for learning. Beliefs may arise from personal experiences or theoretical justifications. In the same manner as in clinical medicine, it is important to use evidence-based and previously tested theories. A firm knowledge of existing education theories provides an educator with the ability to optimize his or her efforts to achieve a desired goal,[2] thereby minimizing wasted resources on failed or inefficient approaches, improving learning efficiency, and preventing duplication of previously established approaches.

Many academic faculty members are educators, yet few are familiar with key education theories that inform their practice. The *Academic Life in Emergency Medicine* (ALiEM) Faculty Incubator was created in 2016 in an effort to provide advanced education training and mentorship, and

to establish a virtual community of practice for early-to-mid-career medical educators. The one-year program consists of a series of modules, each informed by key literature relevant to junior clinician educators. This paper is a narrative review that highlights some of the important literature on the topic of education theory, which was the third module covered in our discovery-based curriculum.

METHODS

In the third month of the ALiEM Faculty Incubator, the topic of education theory was discussed. We used a method similar to our previous Academic Primer series paper.[3] We allowed the discussion to unfold and gathered the titles of the papers that were cited, shared, suggested, or discussed within the online discussion forum by both experts and members of this virtual community of practice. This list was then augmented with a general call for suggestions via several social media outlets to optimize our literature list. On Twitter, we tweeted requests to have participants of the #FOAMed and #MedEd online communities provide suggestions for important papers on the topic of educational scholarship within emergency medicine (EM). The Figure shows an exemplar request tweet. All relevant papers discussing education theories were included in the initial analysis.

After the list of key education theory papers was created, a three-round modified Delphi-informed[4] voting procedure was followed to identify the eight key papers. Voting members included both novices (i.e. early clinician educators) and medical education experts (i.e. experienced clinician educators, all of whom have published greater than 10 peer-reviewed education publications). Novices consisted of Faculty Incubator members who demonstrated particular interest and were the top contributors on the topic of education scholarship, while the experts consisted of the monthly mentors and leaders. The composition of this mixed group was intentional to optimize the identification of articles that represent core content, meet a quality threshold, and are applicable to faculty early in their academic career. Articles were selected using a series of progressive surveys asking the group to rank and then select articles that were both relevant and valuable for early career educators. Once selected, papers were ranked by the percentage of voters who endorsed that this paper "must be included" in the final voting round.

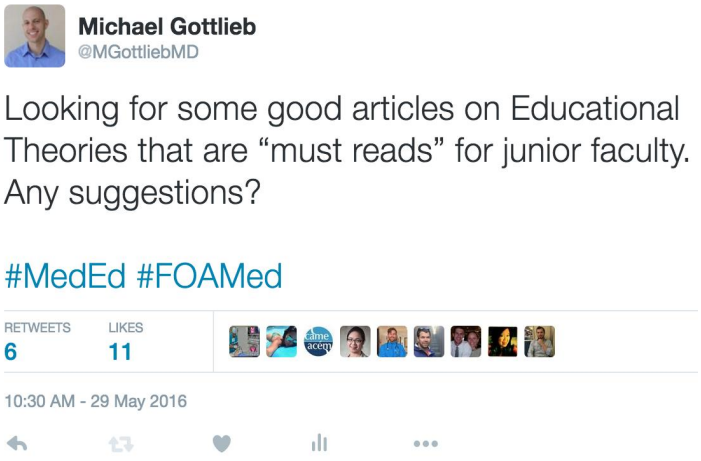

Figure. Example of an exemplar Tweet used in the process of helping to generate a list of key papers on theories relevant to medical education.

RESULTS

The initial ALiEM Faculty Incubator discussions identified 20 articles. The one-week social media campaign (May 29, 2016 - June 5, 2016) yielded 18 additional articles. Excluding four duplicates, a total of 34 articles were evaluated.

After initial review of the included articles, the articles were grouped into two broad categories. Eleven articles were categorized as "general theory overview" and 23 articles as "specific theory." The three-round voting procedure allowed our team to generate a rank-order listing of the papers in order of relevance from the most important to the least important. Five key articles were identified for the "specific theory" category and three for the "general theory overview" category (since there were twice as many articles in the "specific theory" section than the "general theory overview" section). The citations and our ratings of these 34 papers are listed in the Table. After the final eight papers were selected, it was noted that two papers were very similar.[5,6] Therefore, we included only the original paper from 1993 in our discussion and the next highest ranked paper was included as a fifth paper.[7]

DISCUSSION

The following is a summary of the top eight papers accompanied by commentaries on the relevance of the paper to junior faculty members and considerations for those creating programs for faculty development.

General Theory Overview

1. Torre DM, Daley BJ, Sebastian JL, Elnicki DM. Overview of current learning theories for medical educators. *Am J Med*. 2006 Oct;119(10):903-7.[8]

Summary

This article provides a summary of core learning theories in medical education. The authors briefly discuss behaviorism, cognitive learning theory, humanism, social learning theory, and constructivism. For each of the above approaches, they provide a discussion of the theory itself, followed by potential applications within medical education. In behaviorism, learning is defined by observable behaviors and based upon the relationship between stimulus and response. The teacher

plays an active role, while the learner is predominantly a respondent to the imposed environmental stimulus. Cognitive learning theory takes the stance that learning is an internal process. Learners receive, recall, and decode information and form mental representations of it. As they become experts, they create more complex representations (i.e., schemas or semantic networks). To deepen knowledge, defining concepts must be mastered. The teacher must ensure that information is given in an effective and digestible form to learners, so that they may build semantic and conceptual networks. Learners must be more active, as they need to create and reinforce these connections and schema. Two representative examples include the use of concept maps and reflective thinking. In the humanist approach, the goal is to develop a self-directed learner, which is particularly important given the increasing focus on technology in modern education. Social learning theory is based upon modeling and observation of others. Examples include mentorship, role-modeling, and collaborative learning. Finally, constructivism involves the influence of personal experiences to inform (i.e., construct) the interpretation and sense-making of information. Previous experience or knowledge is important when acquiring new information. Learning is goal-oriented. Students learn performing, interacting, and experimenting, while the teacher needs to design, facilitate, and present different tools to learners in learning encounters, for them to build their knowledge.

Relevance to Junior Faculty

Educators can improve their teaching efficiency by understanding and using existing education theories. While the core concepts of EM are taught during medical school and residency, the education theories behind successful teaching may not be readily apparent, nor are they typically taught to academic physicians. Without access to these core theories, a medical educator is missing a fundamental element. This can result in educators using inefficient, or even ineffective, teaching techniques. Moreover, given the large number of responsibilities placed on educators and learners, it is important to use proven techniques to maximize the effort and retention by the learner. Education theories can be used to help refine existing education tools, develop new curricula and assessments, and provide the background and rationale for novel teaching innovations. This paper provides an introduction with examples of five common education theories.

Considerations for Faculty Developers

This paper may be a useful first resource to provide to junior faculty. As an introductory resource, it compares and contrasts key theories and provides a helpful starting point to allow junior faculty to delve deeper into a theory.

2. Bordage G. Conceptual frameworks to illuminate and magnify. *Med Educ*. 2009 Apr;43(4):312-9.[9]

Summary

When encountering a question in education, it is wise to apply a conceptual framework (CF). Bordage compares CF to lighthouses or lenses. A CF illuminates like a lighthouse, and magnifies certain facets of a problem. CFs, therefore, help educators better understand how to approach a problem like a lense. A CF also acknowledges any assumptions made by the investigator in answering the scholarly question. CFs can be well-established theories, models derived from theories, or evidence-based best practices.[9] Scholars should consider multiple CFs to frame and answer a question, thereby building upon established theory from within or outside one's field. After selecting the appropriate CF(s), the scholar must rigorously apply the principles of the selected CF.[9] Thus, the educator is less likely to allow personal bias (i.e., an individual lens) to act as a barrier in identifying novel approaches to solving problems. Bordage presents three vignettes as examples for how to practically apply CFs in practice, thereby demonstrating a step-by-step, educationally sound approach to problems medical educators commonly face.

Relevance to Junior Faculty

Scholarship is the currency by which educators advance their career and the field. Junior educators must know how to approach educational problems, design studies in education, and, more broadly, generate scholarship in education. Adequate preparation, which involves conducting a comprehensive literature review and selecting the appropriate CF(s),[9,10] is a key step in designing scholarship. Cook describes CFs as one of six key items to report in educational experiments.[11] Bordage cites a lack of a CF as a top reason to reject manuscripts in health professions education.[12] CFs are present in only one-half of published studies in health professions education, but are identified more commonly in journals with higher impact factors.[13] It is essential that junior educators know how to use conceptual frameworks in designing scholarship.

Considerations for Faculty Developers

Bordage asserts that scholarship in health professions education lacks the ubiquitous use of CFs.[9,11] Given that this problem affects many health professions scholars, this should be a priority topic for faculty developers. Thus, faculty developers should have an in-depth understanding of conceptual frameworks. If one considers the issue from a lens of mentorship, knowledge[14,15] of CFs is an essential quality of the successful mentor.

3. Kay D, Kibble J. Learning theories 101: application to everyday teaching and scholarship. *Adv Physiol Educ.* 2016 Mar;40(1):17-25.[16]

Summary

This paper uses a problem-solving approach to

Table. The complete list of educational scholarship literature collected by the authorship team.

Citation	Round 1 initial mean scores (SD) max score 7	Round 2 % of raters that endorsed this paper	Round 3 % of raters that endorsed paper in last round	Top 3 overview papers	Top 5 papers describing a key education theory
Torre DM, Daley BJ, Sebastian JL, et al. Overview of current learning theories for medical educators. *Am J Med*. 2006 Oct;119(10):903-7.[8]	6.4 (0.8)	85.7%	100% endorsed as a good overview	1	
Bordage G. Conceptual frameworks to illuminate and magnify. *Med Educ*. 2009 Apr;43(4):312-9.[9]	6.1 (1.6)	85.7%	85.7% endorsed as a good overview	2	
Schumacher DJ, Englander R, Carraccio C. Developing the master learner: applying learning theory to the learner, the teacher, and the learning environment. *Acad Med*. 2013 Nov;88(11):1635-45.[17]	6.1 (1.1)	85.7%	85.7% endorsed as a key paper with important educational theories to know		1
Taylor DC, Hamdy H. Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. *Med Teach*. 2013 Nov;35(11):e1561-72.[18]	5.9 (1.5)	71.4%	85.7% endorsed as a key paper with important educational theories to know		2
Kay D, Kibble J. Learning theories 101: application to everyday teaching and scholarship. *Adv Physiol duc*. 2016 Mar;40(1):17-25.[16]	5.7 (1.5)	71.4%	57.1% endorsed as a good overview	3	
Young JQ, Van Merrienboer J, Durning S, et al. Cognitive Load Theory: implications for medical education: AMEE Guide No. 86. *Med Teach*. 2014 May;36(5):371-84.[7]	5.7 (1.4)	42.9%	28.6% endorsed as a key paper with important educational theories to know		5
Ericsson KA. Acquisition and Maintenance of Medical Expertise. *Acad Med*. 2015 Nov;90(11):1471-86.[6]	5.6 (1.6)	57.1%	57.1% endorsed as a key paper with important educational theories to know		4*
Ericsson KA, Krampe RT, Tesch-Romer C. The Role of Deliberate Practice in the Acquisition of Expert Performance. *Psychological Review*. 1993; 100(3): 363-406.[5]	5.6 (1.1)	42.9%	57.1% endorsed as a key paper with important educational theories to know		4
Regehr G, Norman GR. Issues in cognitive psychology: implications for professional education. *Acad Med*. 1996 Sep;71(9):988-1001.[19]	5.4 (1.1)	71.4%	7.14% endorsed as a key paper with important educational theories to know		3
Eva KW, Regehr G. "I'll never play professional football" and other fallacies of self-assessment. *J Contin Educ Health Prof*. 2008 Winter;28(1):14-9.[20]	5.3 (1.4)	57.1%			
Kaufman DM. Applying educational theory in practice. *BMJ*. 2003 Jan 25; 326(7382): 213–216.[21]	5.4 (1.4)	28.6%			
Miller GE. The assessment of clinical skills/ competence/ performance. *Acad Med*. 1990 Sep;65(9 Suppl):S63-7.[22]	5.4 (1.3)	28.6%			
Li LC, Grimshaw JM, Nielsen C, et al. Evolution of Wenger's concept of community of practice. *Implement Sci*. 2009 Mar 1;4:11.[23]	5.3 (1.4)	14.3%			

Table. The complete list of educational scholarship literature collected by the authorship team.

Citation	Round 1 initial mean scores (SD) max score 7	Round 2 % of raters that endorsed this paper	Round 3 % of raters that endorsed paper in last round	Top 3 overview papers	Top 5 papers describing a key education theory
Mann KV. Theoretical perspectives in medical education: past experience and future possibilities. *Med Educ*. 2011 Jan;45(1):60-8.[24]	5.3 (1.7)	57.1%			
Schuwirth LWT, Van der Vleuten CPM. General overview of the theories used in assessment: AMEE Guide No 57. *Med Teach*. 2011;33(10):783-97.[25]	5.3 (1.7)	57.1%			
Flynn L, Jalali A, Moreau KA. Learning theory and its application to the use of social media in medical education. *Postgrad Med J*. 2015 Oct;91(1080):556-60.[26]	5.1 (1.3)	42.9%			
Wolff M, Wagner MJ, Poznanski S, et al. Not another boring lecture: engaging learners with active learning techniques. *J Emerg Med*. 2015 Jan;48(1):85-93.[27]	5.0 (1.5)	28.6%			
Sandars J, Cleary TJ. Self-regulation theory: applications to medical education: AMEE Guide No. 58. *Med Teach*. 2011;33(11):875-86.[28]	5.0 (1.4)	28.6%			
Azer SA, Guerrero AP, Walsh A. Enhancing learning approaches: practical tips for students and teachers. *Med Teach*. 2013 Jun;35(6):433-43.[29]	4.7 (1.0)	42.9%			
Mughal F, Zafar A. Experiential Learning from a Constructivist Perspective- Reconceptualizing the Kolbian Cycle. *International Journal of Learning and Development.* 2011;1(2):27-37.[30]	4.6 (1.0)	42.9%			
Kuper A, Whitehead C. The practicality of theory. *Acad Med*. 2013 Nov;88(11):1594-5.[31]	4.6 (1.6)	14.3%			
Pangaro L. A new vocabulary and other innovations for improving descriptive in-training evaluations. *Acad Med*. 1999 Nov;74(11):1203-7.[32]	4.6 (1.3)	0%			
Yardley S, Teunissen PW, Dornan T. Experiential learning: AMEE Guide No. 63. *Med Teach*. 2012;34(2):e102-15.[33]	4.6 (1.1)	42.9%			
Watling CJ, Lingard L. Grounded theory in medical education research: AMEE Guide No. 70. *Med Teach*. 2012;34(10):850-61.[34]	4.4 (2.0)	14.3%			
Norman GR. The adult learner: a mythical species. *Acad Med*. 1999 Aug;74(8):886-9.[35]	4.3 (2.0)	42.9%			
Wong G. Literature reviews in the health professions: It's all about the theory. *Med Educ*. 2016 Apr;50(4):380-2.[36]	4.0 (1.0)	14.3%			
Norman GR. Problem solving skills, solving problems and problem-based learning. *Med Educ*. 1988 Jul;22(4):279-86.[37]	4.0 (1.2)	0%			
Santen SA, Deiorio NM, Gruppen LD. Medical education research in the context of translational science. *Acad Emerg Med*. 2012 Dec;19(12):1323-7.[38]	3.9 (1.5)	0%			
McGaghie WC. Medical education research as translational science. *Sci Transl Med*. 2010 Feb 17;2(19):19cm8.[39]	3.6 (2.1)	0%			

Table. The complete list of educational scholarship literature collected by the authorship team.

Citation	Round 1 initial mean scores (SD) *max score 7*	Round 2 % of raters that endorsed this paper	Round 3 % of raters that endorsed paper in last round	Top 3 overview papers	Top 5 papers describing a key education theory
Norman G. Data dredging, salami-slicing, and other successful strategies to ensure rejection- twelve tips on how to not get your paper published. *Adv Health Sci Educ Theory Pract*. 2014 Mar;19(1):1-5.[40]	3.4 (1.5)	14.3%			
Zerzan JT, Hess R, Schur E, et al. Making the most of mentors: a guide for mentees. *Acad Med*. 2009 Jan;84(1):140-4.[41]	3.1 (1.8)	28.6%			
Grow G. Teaching learners to be self-directed. *Journal of Adult Education Quarterly Spring*. 1991; 41:125-149.[42]	3.1 (2.1)	14.3%			
Azer SA. The top-cited articles in medical education: a bibliometric analysis. *Acad Med*. 2015 Aug;90(8):1147-61.[43]	2.7 (2.2)	42.9%			
Sherbino J, Kulasegaram K, Worster A, et al. The reliability of encounter cards to assess the CanMEDS roles. *Adv Health Sci Educ Theory Pract*. 2013 Dec;18(5):987-96.[44]	2.6 (1.3)	0%			

summarize five major learning theories by applying each to the development of a new curriculum. The paper addresses most of the relevant aspects of the following learning theories: behaviorism, cognitive learning theory, constructivism, social cognitive theory, and social constructivism. In addition to the theories defined above, social cognitive theory expands to include the role of observational learning. Learners will not solely react to stimulus; instead, they will imitate a behavior modeled by others. Social constructivism refers to learning through the internalization and adoption of external experience. Knowledge is acquired by interacting with tools, signs, symbols, and language in the learner's environment. Optimal learning occurs in a zone of proximal development, where the learner needs a more expert cohort in order to advance. Teachers need to design encounters so that learners face challenges within their zone of proximal development and work together to guide each other. An expert may not be ideal if the expertise is so sophisticated that it is out of the development zone of the learner.

Relevance to Junior Faculty

This paper provides a nice summary of major learning theories. It enhances the importance of consistency between the goals, objectives, instructional methods, and assessment strategies chosen for a specific learning activity or course. While there is not one specific theory that applies to every learner, it is valuable to have multiple teaching tools available to effectively reach a spectrum of learners.

Considerations for Faculty Developers

This is a great primer for all faculty developers to use when looking to provide an overview paper for new educators. Many of the early career educators in the Faculty Incubator found it difficult to link theory to practice. By providing real-life examples that link these theories to education practice, this paper is able to emphasize the importance of foundational literature.

Specific Theories

1. Schumacher DJ, Englander R, Carraccio C. Developing the master learner: applying learning theory to the learner, the teacher, and the learning environment. *Acad Med.* 2013 Nov;88(11):1635-45.[17]

Summary

As medical educators adopt and implement a competency-based framework in medicine, the authors of this article argue that it is incumbent upon learners to drive their own education and to thoughtfully engage with their teachers and their learning environments to achieve expertise. In essence, competency-based training requires the development of a "master learner." The authors highlight selected learning theories from the realms of cognitive psychology, experiential learning, and social constructivism, subsequently translating these theories to the clinical learning environment. In a stepwise fashion, this paper introduces the elements of "self-determination theory" (SDT) to describe the processes whereby a master

learner derives his or her motivation for learning. Once motivated, elements of "cognitive load theory" (CLT) are introduced, referencing the factors that impact the master learner's ability to learn in the clinical arena. Through the description of "situated cognition," we learn how the clinical environment and behaviors of the teachers impact the environment for learning.

Relevance to Junior Faculty

This article contains a number of examples to help junior faculty thoughtfully teach their burgeoning master learners. Through an understanding of CLT, junior educators can think through the elements of a task assigned to the learner: providing excessive or too complicated teaching for a learner to process (excessive *germane* load), providing a learning task too large or complicated for a learner to complete (excessive *intrinsic* load), or a task with too many associated elements for a learner to navigate (excessive *extraneous* load).

Considerations for Faculty Developers

A motivated learner is one who feels a sense of connection. Faculty developers can cultivate this at a programmatic level by creating a collegial environment where teachers treat learners as though they are on the same team. The authors argue for cohorting trainees on the same treatment team for extended periods, beyond the typical monthly training block, to promote cohesion. Faculty developers should be intimately aware of the state of situated cognition for their learners, exposing learners to teachers whom they admire and seek to emulate. This may include teachers who exemplify the best of evidence-based medical knowledge, superior interpersonal skills, or exceptional teamwork or leadership skills. The authors argue that program chairs should hire faculty who build individual relationships with the learners, and who effectively make tacit thought processes explicit. The work environment should include the physical space and the culture to promote teaching and feedback for learners.

2. Taylor DC, Hamdy H. Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. *Med Teach.* 2013 Nov;35(11):e1561-72.[18]

Summary

This paper provides an overview of a significant number of learning theories in adult education in various contexts. It is included here for its particular attention to Knowles' theory of andragogy, a widely cited theory in medical education. The components of Knowles' theory of andragogy include the following: (1) learners need a reason to learn the material; (2) they must have self-concept and be responsible for their own learning; (3) they must have their prior experiences valued; (4) they must have a readiness to learn, (5) they must be oriented to learn; and (6) they must be motivated to learn.

Relevance to Junior Faculty

The article provides an overview of theories in adult education, recognizing that adult education theory or andragogy may be foundationally flawed. Of note, Knowles' theory has been criticized as not being a theory at all, as his work is not informed by experimental or observational data. Moreover, cognitive learning theorists would debate the differences in learning patterns between a child and an adult. The theory also does not consider the importance of context and social factors in acquiring knowledge, skills, and attitudes. However, the principles espoused by Knowles' theory align with theories and evidence in educational psychology. The arrangement of these principles makes them readily accessible, connecting different concepts into a coherent framework.

Considerations for Faculty Developers

Faculty developers should help junior faculty distinguish between true learning theories and seemingly reasonable ad hoc frameworks. The paper ultimately presents a framework that unifies several relevant theories in adult education. The proposed framework may be useful for faculty developers because it attempts to explain the process of learning. Using this framework, faculty developers may be able to design learning environments that promote a better transfer of knowledge, skills, and attitudes to learners in the health professions.

3. Regehr G, Norman GR. Issues in cognitive psychology: implications for professional education. *Acad Med.* 1996 Sep;71(9):988-1001.[19]

Summary

Cognitive psychology can be described as the study of how humans think with an intimate linkage to the study of human memory. Although educational and cognitive psychology have historically been viewed as distinct fields, the authors focus on the significant overlap between these philosophies. This paper focuses on five key cognitive psychology concepts that influence our approach to teaching and learning: (1) organization of long-term memory; (2) influences on storage and retrieval from memory; (3) problem solving and transfer, (4) concept formation; and (5) decision making. Specifically, human memory is influenced by the degree to which we can impose meaning on the stimulus, context specificity (i.e., the similarity between the environment in which one learns and retrieves information), processing specificity (i.e., how the storage process will have effect on retrieval), and focused, goal-oriented practice.

Relevance to Junior Faculty

These cognitive psychology concepts have implications for the design of curricula and the teaching of learners. Information in isolation is of limited value. Educators should provide opportunities for clinical application of skills and knowledge to strengthen learners' semantic networks. A learner who has difficulty applying knowledge may not lack understanding, but rather may need to recode the information into a clinically useful form. Additionally, junior faculty should consider the influences on memory when teaching in the clinical environment. Teachers should emphasize clinical and bedside teaching, as well as in situ simulation. In providing variation of the learning and application environments, educators can reduce dependence on context.

Considerations for Faculty Developers

This is a valuable primer for faculty developers seeking to provide junior faculty members with an overview of the "basic science" behind teaching and learning (namely, psychology). At times some junior faculty members may be resistant to learning about these new concepts, so it is important for faculty developers to make clear the linkages between these key aspects of psychology and how they relate to a clinical teaching practice.

4. Ericsson KA, Krampe RT, Tesch-Romer C. The role of deliberate practice in the acquisition of expert performance. *Psychological Review.* 1993; 100(3): 363-406.[5]

Summary

In this landmark paper, Ericsson et al. provide a thorough description of talent and expertise, arguing that they do not arise from innate skill, but result from a consistent completion of well-planned, closely supervised practice over an extended period of time. The authors coin the term "deliberate practice," described as activities specially designed to improve the current level of performance, completed frequently over time (with 10 years described as an optimal duration). The authors examine a variety of contexts in which expertise has been described, including chess, art, athletics, and typing. They provide a multitude of references to support the idea that individuals are not born experts; rather, they often display a certain affinity for an activity at a young age, and begin to perform it earlier and more often than those with less "talent". The authors reference a number of studies that dispel the notion that hereditary factors confer an increased likelihood of expertise in any particular domain. Alongside the comprehensive examination of expertise as a result of practice, this paper includes two primary studies of musicians, comparing the study habits of "expert performers". They argue that the difference between an expert and a good musician is likely the result of more frequent practice (and less non-music focused leisure) over the many years of musical training.

For further reading on this theory, we highly recommend this article to both junior faculty members and faculty developers: Ericsson KA. acquisition and maintenance of medical expertise. *Acad Med.* 2015 Nov;90(11):1471-86.[6]

Relevance to Junior Faculty

The fundamental tenet of this paper is that expertise is acquired rather than inherited. It follows that any teacher can foster expertise in their learners via deliberate practice. It is important to note that not all practice is deliberate practice. For example, sending medical students home with a pig's foot and asking them to practice suturing 100 times by themselves does not satisfy the criteria of deliberate practice. It requires that the medical student "be given explicit instructions about the best method and be supervised by a teacher to allow individualized diagnosis of errors, informative feedback, and remedial part training."[5] The learner should be asked to repeatedly complete the task, with the instructor consistently available to correct and refine. Simulation facilitates the effective deployment of deliberate practice because it allows for frequent repetition not necessarily experienced in the unpredictable authentic clinical environment.

Considerations for Faculty Developers

Faculty developers must consider the great deal of time and effort required by deliberate practice. The individualized learning exercises must be unique to the learner and closely supervised. For the educator teaching a large number of learners or simultaneously tending to multiple levels of learners, deliberate practice would be challenging because of the individualized attention required. Finally, deliberate practice requires full attention and effort, which can only be sustained for a finite period of time for most learners and may require recovery time between sessions.

5. Young JQ, Van Merrienboer J, Durning S, Ten Cate O. Cognitive load theory: implications for medical education: AMEE Guide No. 86. *Med Teach.* 2014 May;36(5):371-84.[7]

Summary

This paper, from the classic AMEE Guide series, summarizes cognitive load theory. This theory is informed by models of human memory that suggest that sensory, working, and long-term memory are interlinked. Working memory has a very finite capacity, which is the rate-limiting step for learning. This paper defines key terms such as intrinsic load, extraneous load, and germane load and applies them to the learner.

Relevance to Junior Faculty

For junior faculty members, this paper is a key primer

to understanding the science and theory behind learning. Understanding the different components of human memory and capacity is invaluable when teaching the learner, emphasizing high-yield learning and avoiding extraneous cognitive load.

Considerations for Faculty Developers

This paper serves as a good overview of a very rich area of cognitive science. The paper is admittedly quite dense, so it would be prudent to guide new educators through this paper with clinical- or classroom-specific examples to bring these concepts to life.

LIMITATIONS

Similar to our previous ALiEM Academic Primer Series papers, the main limitation is that we did not use a systematic or comprehensive search strategy. However, we did attempt to triangulate recommendations for key literature from multiple sources (e.g. Faculty Incubator discussions, Twitter, etc.). Additionally, while we did attempt to provide a broad range of inputs, there is potential for bias, as most of the submissions were from a limited number of junior faculty and experts. We did augment this by using multiple social media calls, which resulted in a large number of additional suggestions.

CONCLUSION

This paper presents a reading list of key papers for junior faculty in medical education roles. Three papers about general education theories and five papers about specific educational theories are identified and annotated. These papers may help provide foundational knowledge in education theory to inform junior faculty teaching practice.

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Academic Primer Series: Five Key Papers about Team Collaboration Relevant to Emergency Medicine

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Introduction: Team collaboration is an essential for success both within academics and the clinical environment. Often, team collaboration is not explicitly taught during medical school or even residency, and must be learned during one's early career. In this article, we aim to summarize five key papers about team collaboration for early career clinician educators.

Methods: We conducted a consensus-building process among the writing team to generate a list of key papers that describe the importance or significance of team collaboration, seeking input from social media sources. The authors then used a three-round voting methodology akin to a Delphi study to determine the most important papers from the initially generated list.

Results: The five most important papers on the topic of team collaboration, as determined by this mixed group of junior faculty members and faculty developers, are presented in this paper. For each included publication, a summary was provided along with its relevance to junior faculty members and faculty developers.

Conclusion: Five key papers about team collaboration are presented in this publication. These papers provide a foundational background to help junior faculty members with collaborating in teams both clinically and academically. This list may also inform senior faculty and faculty developers about the needs of junior faculty members. [West J Emerg Med. 2017;18(2)303-310.]

INTRODUCTION

Team collaboration is essential to practicing emergency medicine (EM). It is necessary in the clinical environment when managing sick patients, as well as in the academic environment when running projects or creating scholarship.[1,2] Unfortunately, team collaboration is infrequently taught in medical school or residency, leaving the early clinical educator with few resources from which to develop and enhance these skills.[3] This is one of several needs identified by early clinical educators.[4]

The Academic Life in Emergency Medicine (ALiEM) Faculty Incubator was created in 2016 in an effort to address some of the issues that junior faculty members often face.

During our one-year experience, we created modules in which we described and discussed key literature relevant to junior clinician educators who are embarking in their careers within academic medicine. This particular paper is a synthetic, narrative review that highlights some of the most important literature on the topic of team collaboration, which was the second topic covered in our discovery-based curriculum. The objective of this paper was to summarize five key papers about team collaboration to both inform on key concepts and identify techniques for improving teamwork.

METHODS

In the second month of the ALiEM Faculty Incubator, the topic of team collaboration was discussed. The ALiEM Faculty Incubator consists of 30 junior faculty members and eight facilitators (faculty mentors and administrators) who exist via a closed, mixed-media, social media platform (Slack.com, San Francisco, CA). The platform allows for text-based communication, augmented by file-sharing and embedded website links. The discussion that occurred involved an international group of clinician educators spanning three countries (United States, Canada, and Chile) and multiple time zones.

For this publication, we used a method similar to our previous Academic Primer series paper.[5] We monitored the proceedings of the ALiEM Faculty Incubator from April 1-30, 2016, during which time all members participated asynchronously online in various discussions around the topic of team collaboration. During this month, 2,513 messages were posted. There were no in-person meetings.

We allowed the discussion to unfold and gathered the titles of the papers that were cited, shared, suggested, or discussed within the online discussion forum. This list was then augmented with a general call for suggestions via multiple authors using Twitter to optimize our literature list. We tweeted and retweeted multiple requests to have participants of the #FOAMed and #MedEd online communities provide suggestions for important papers on the topic of team collaboration with specific relevance to junior EM educators. Figure 1 shows an exemplar request tweet.

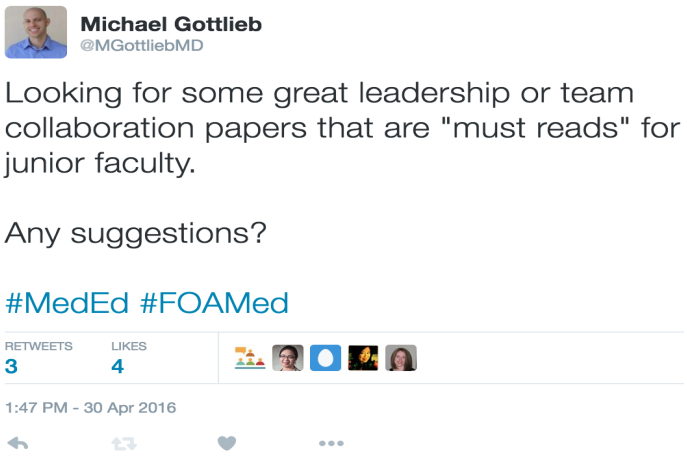

Figure 1. Example of an exemplar Tweet.

The authorship team was composed of seven members, consisting of four novices (i.e. junior faculty members) and three experts in the field (i.e., experienced clinician educators, all of whom have published >10 peer-reviewed publications). The expert group was pre-selected based upon significant expertise in the field, while the junior group was hand-selected by the topic experts for that month based upon significant contributions and interest related to the monthly topic. The authors had no major conflicts of interest to disclose. One of the authorship team members (FA) was a co-author of one of the selected papers, but exclusion of his votes did not significantly affect the ranking.

Once the list of the most important papers about teamwork was created, our authorship team conducted a three-round voting procedure inspired by the Delphi methodology. During the third round, there was a tie for the fifth paper, so a fourth round of voting was held with a clear majority favoring the fifth article listed below. The other article was included as an honorable mention. We have not described our method as a pure Delphi methodology since our authorship panel comprises both novices and experts in the field. We intentionally wished to have a mixed group of stakeholders select these articles (i.e., both novices and experts) in order to find articles that would both meet the approval of experienced clinician educators and resonate with junior faculty members entering the field of academic medicine.

RESULTS

Our initial review of the ALiEM Faculty Incubator discussions yielded a total of 12 articles mentioned by the mentors and the junior faculty participants. Social media calls over one week (April 30, 2016 - May 6, 2016) yielded five additional suggested articles, which led to a total of 17 articles for evaluation by our team. The four-round voting procedure allowed our team to generate a rank-order listing of all these papers in order of relevance from the most important to the least important. The citations and our ratings of these 17 papers are listed in Table.

DISCUSSION

The following are a summary of the top five papers accompanied with commentaries about their relevance to both junior faculty members and considerations for faculty developers when discussing these works.

1. Edmondson AC. Teamwork on the fly. *Harvard Business Review*. 2012 Apr;90(4):72-80.[6]

Summary

This paper is a distillation of Amy Edmondson's study of teamwork that describes the concept and skills required to

Table. The complete list of educational scholarship literature collected by the authorship team.

Citation	ROUND 1 initial mean scores (SD) *max score 7*	ROUND 2 % of raters that endorsed this paper	ROUND 3 % of raters that endorsed paper in last round	Top 5 papers
Edmondson AC. Teamwork on the fly. *Harvard Business Review*. 2012 Apr;90(4):72-80.[6]	6.00 (0.82)	100%	100%	1
Farley H, Casaletto J, Ankel F, et al. An assessment of the faculty development needs of junior clinical faculty in emergency medicine. *Acad Emerg Med*. 2008 Jul;15(7):664-8.[8]	5.14 (1.46)	85.70%	100%	2
Sargeant J, Loney E, Murphy G. Effective interprofessional teams: "contact is not enough" to build a team. *J Contin Educ Health Prof*. 2008 Fall;28(4):228-34.[9]	5.14 (0.90)	71.40%	100%	3
Kotter JP. Leading Change: Why Transformation Efforts Fail. *Harvard Business Review*. 2007 Jan;85(1):2-12.[10]	6.14 (0.69)	100%	85.70%	4
Fernandez R, Kozlowski SW, Shapiro MJ, et al. Toward a definition of teamwork in emergency medicine. *Acad Emerg Med*. 2008 Nov;15(11):1104-12.[11]	5.14 (0.69)	57.10%	42.90%	5*
Lerner S, Magrane D, Friedman E. Teaching teamwork in medical education. *Mt Sinai J Med*. 2009 Aug;76(4):318-29.[12]	5.00 (1.30)	57.10%	42.90%	Runner Up
Steinert Y, Naismith L, Mann K. Faculty development initiatives designed to promote leadership in medical education. A BEME systematic review: BEME Guide No. 19. *Med Teach*. 2012;34(6):483-503.[15]	4.86 (1.21)	28.60%	0%	
Fernandez R, Vozenilek JA, Hegarty CB, et al. Developing expert medical teams: toward an evidence-based approach. *Acad Emerg Med*. 2008 Nov;15(11):1025-36.[16]	4.71 (0.95)	42.90%	14.30%	
Bonebright DA. 40 years of storming: a historical review of Tuckman's model of small group development. *Human Resource Development International*. 2010 Feb;13(1):111-20.[17]	4.57 (0.98)	57.10%	14.30%	
Webb AM, Tsipis NE, McClellan TR, et al. A first step toward understanding best practices in leadership training in undergraduate medical education: a systematic review. *Acad Med*. 2014 Nov;89(11):1563-70.[18]	4.43 (1.27)	28.60%	0%	
Stoller JK. Developing physician-leaders: a call to action. *J Gen Intern Med*. 2009 Jul;24(7):876-8.[19]	4.29 (0.95)	14.30%	0%	
Wolter N, Tarnoff SL, Leckman L. Recruiting and retaining physician leaders. Healthc (Amst). Epub 2015 Oct 20.[20]	4.00 (1.41)	0%	0%	
Hall P, Weaver L. Interdisciplinary education and teamwork: a long and winding road. *Med Educ*. 2001 Sep;35(9):867-75.[21]	3.86 (1.35)	0%	0%	
Sacks L, Margolis R. Physician leadership in organizations undergoing major transformation. Healthc (Amst). Epub 2015 Oct 20.[22]	3.86 (1.35)	0%	0%	
Cochran J, Kaplan GS, Nesse RE. Physician leadership in changing times. Healthc (Amst). 2014 Mar;2(1):19-21.[23]	3.71 (1.11)	0%	0%	
Bisordi J, Abouljoud M. Physician leadership initiatives at small or mid-size organizations. Healthc (Amst). Epub 2015 Oct 20.[24]	3.43 (0.79)	0%	0%	
Bronson D, Ellison E. Crafting successful training programs for physician leaders. Healthc (Amst). Epub 2015 Oct 20.[25]	3.3 (0.95)	0%	0%	

*Due to a tie between two articles during the third round of voting, a fourth round was held between Fernandez et al.[11] and Lerner et al.[12] Fernandez et al. was selected as the fifth article for inclusion by a majority of votes.

master "teaming." Teaming addresses the challenges and skills needed of working in ad hoc teams, often dealing with multiple differences among team members: geographical hurdles, levels of expertise, varied disciplines, and possibly cultural norms. This paper then defines principles of teaming using a hardware and software analogy. The "hardware" (required overall project management) is broken down into leadership scoping out the challenge, implementation of light scaffolding to help the team

function effectively, and sorting of tasks by priority for execution. "Software" (the team leadership and team followership behaviors that allow teams to be successful) includes emphasizing purpose (shared goal), creating an environment of psychological safety for team members, embracing failure, and putting conflict to work. Furthermore, successful individual-based teaming behaviors include speaking up, listening intently, integrating information/ideas, experimenting, and reflecting. Undercurrents of Tuckman's stages of group development are woven throughout the article; for example, group "forming" and parts of "storming" would fall under hardware, and the software skills would cover group "storming," "norming" and "performing" (Figure 2).[7]

Relevance to Junior Faculty Members

Junior faculty are often pulled in many directions to both provide service to their institution and engage in academic endeavors towards promotion. Most of this work is done in ad hoc teams. Hospital-wide initiatives, working on projects within single departments, and networking with colleagues at different institutions would all qualify as needing teaming skills. This paper provides specific examples for behavior and structure that allows for work in ad hoc teams, and clear definitions of the elements of teaming. Although the longitudinal example played out in this article centers around an architectural and engineering problem, the concepts are generalizable to "teaming" within teams that physicians find themselves on - direct patient care and non-direct patient care based. Mastering the principles of teaming and reflecting on teaming function and dysfunction could help junior faculty use their time wisely to be more productive on ad hoc teams and possibly create more functional ad hoc teams.

Considerations for Faculty Developers

Healthcare is moving from a culture focused on individual exceptionalism to team-based care designed to deliver high-value care. Academic promotion and tenure committees are slowly following suit and are starting to recognize team-based scholarship. The faculty of tomorrow need to achieve competence in basic teaming behaviors to succeed in this environment. Faculty developers can help embed the basic teaming behaviors in departmental culture by valuing and celebrating teaming behavior, both clinically and academically, and creating faculty development programs focusing on teaming behavior. Faculty developers can also mentor junior faculty to navigate the tension between individual exceptionalism valued by traditional medical school promotion and tenure committees and teaming behaviors that are valued by health systems that ultimately hire many of the residency graduates of academic programs.

2. Farley H, Casaletto J, Ankel F, et al. An assessment of the faculty development needs of junior clinical faculty in emergency medicine. *Acad Emerg Med*. 2008 Jul;15(7):664-8.[8]

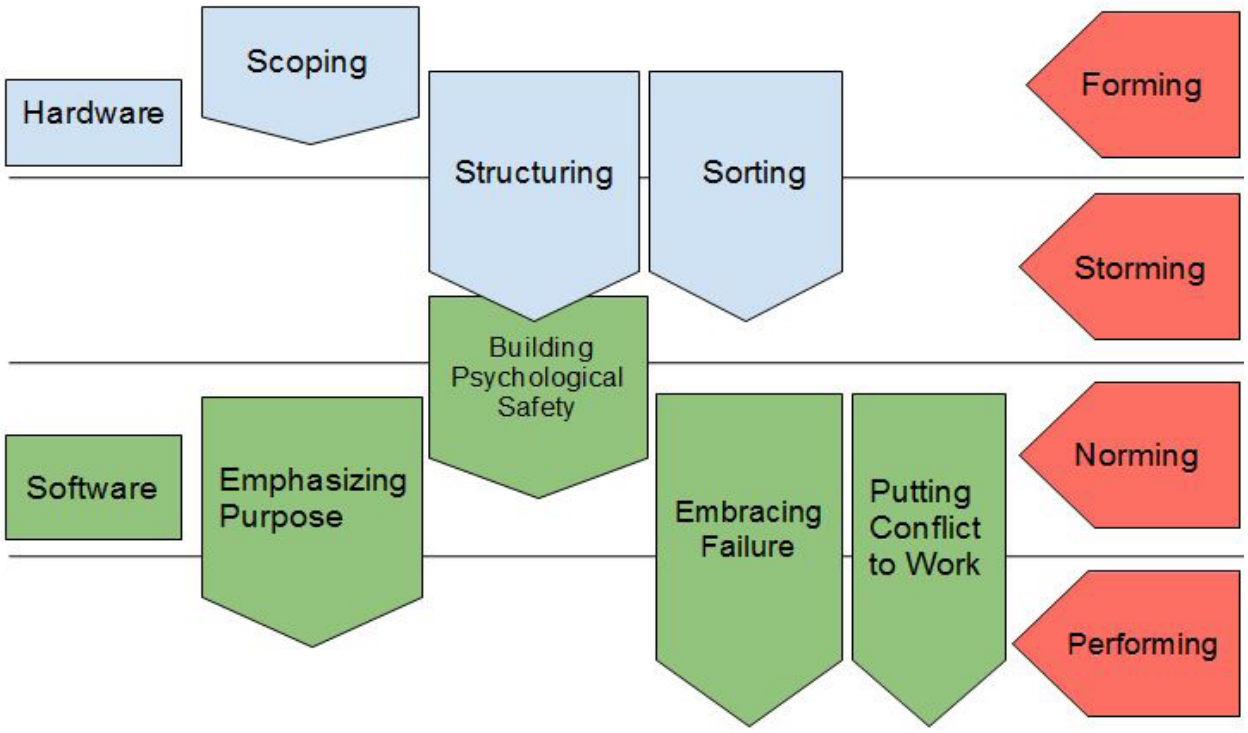

Figure 2. Diagram of the hardware and software model of teaming.

Summary

Junior clinical faculty in EM were surveyed to identify and rank importance of self-perceived career development needs. Identified needs included bedside teaching, lecture development, business skill, managerial skills, educational research, mentorship and career counseling, interpersonal skills, leadership skills, scholarly writing skills, physician wellness, and knowledge of the faculty development process. The authors also searched for available resources to address the identified career development needs. The majority of the needs identified had available educational opportunities through the American Academy of Emergency Medicine (AAEM), American College of Emergency Physicians (ACEP), Council for Emergency Medicine Residency Directors (CORD), and Society for Academic Emergency Medicine (SAEM) via national conferences and web-based educational resources. Physician wellness and mentoring were two career development areas identified as scarcely available resources during this review.

Relevance to Junior Faculty Members

The path to a productive academic career is often mysterious to a junior faculty member. Navigating the field and creating one's niche can be challenging, particularly in the early career when the novice may even be uncertain regarding his/her area of interest. Structure to the course of faculty development helps improve the efficiency of the development process. Junior faculty need assistance in development of both short-term and long-term goals. Academic advancement is facilitated by direction and monitored by goal-oriented progress. Specific faculty development resources aid in this process. Unfortunately, many faculty development resources are underutilized.

This article emphasizes that many resources are currently available to junior faculty. Many of them are unaware of several important resources currently in place to facilitate personal development. However, resources alone cannot substitute for mentorship and concrete faculty development goals. Invested mentors are an integral part to facilitate junior faculty development. Mentors offer direction, can help individualize a career roadmap and often provide opportunities to get one's "foot in the door."

Considerations for faculty developers

Faculty development and physician wellness are interrelated and integral to career satisfaction, vitality, and longevity. Academic physicians are often more productive if they are engaged, challenged and continually growing in knowledge and skills. As the authors state, "ongoing professional development is the mainstay of a successful and satisfying career in academic medicine."

This article emphasizes that there is either a lack of awareness of available faculty development resources and/or the resources do not meet the intended needs of junior faculty. Faculty developers should be inspired to innovate and invigorate current resources and also fill in the gap, particularly in the identified areas of mentorship and wellness.

3. Sargeant J, Loney E, Murphy G. Effective interprofessional teams: "contact is not enough" to build a team. *J Contin Educ Health Prof*. 2008 Fall;28(4):228-34.[9]

Summary

This is a qualitative analysis paper focused on identifying themes emerging from dedicated interprofessional focus groups. Assessments of interprofessional educational interventions and collaborations have demonstrated the value of optimizing team dynamics in improving learner knowledge and educational outcomes. To this end, this paper identifies five key characteristics that emerged among effective interprofessional healthcare teams. These include the following:

1. Understanding and respecting team members' roles
2. Appreciating that teams require more work than expected
3. Understanding the healthcare system or systems in which the team members work
4. Having the practical "know-how" to identify the correct team member for each task within the system
5. Having the ability to use appropriate communication skills to achieve the ends noted above; effective communication ties together and supports the foundation upon which the other characteristics can flourish.

Relevance to Junior Faculty Members

While this paper focuses primarily on the primary care physician, the junior faculty member within an emergency department is uniquely positioned to effect change at an institutional level; this necessarily involves multiple disciplines. Oftentimes, the traditional role of physician as leader and superior doesn't lend itself well to a sense of psychological safety within the group; perceptions of inequality within a team can present a challenge and serve as an impediment to teamwork in groups with non-physician members. An awareness of this is critical to the junior faculty member's effective integration into interprofessional teams.

Considerations for Faculty Developers

This paper discusses several themes that emerged from focus groups tasked with identifying key commonalities experienced when group members recalled examples of effective teaming. While the concepts discussed are not particularly novel, the paper does identify an underserved area within medical education and faculty development: development of teamwork skills in an interprofessional environment. Very little training is dedicated to this area of professional development in traditional medical education; for junior faculty members who lack these skills or who have not undergone formal training in this area, the faculty developer is presented with an opportunity for early intervention.

4. Kotter JP. Leading change: Why transformation efforts fail. *Harvard Business Review*. 2007 Jan;85(1):2-12.[10]

Summary

This was a narrative review paper from the business literature, which describes eight steps for leading transformative changes. The author discusses the following eight steps: 1) establishing a sense of urgency; 2) forming a powerful guiding coalition; 3) creating a vision; 4) communicating the vision; 5) empowering others to act on the vision; 6) planning for and creating short-term wins; 7) consolidating improvements and producing still more change; and 8) institutionalizing new approaches. The author also emphasizes the importance of sufficient time spent on planning and ensuring sufficient buy-in when enacting large changes.

Relevance to Junior Faculty Members

Junior faculty members are often in a great position to identify potential changes within an institution. As new faculty, they can provide an external view to existing curriculum or faculty development approaches, bring new knowledge and approaches from outside programs, and are closer to residents, allowing for an improved ability to identify with current resident and student needs. However, junior faculty also face the challenge of being new to the hospital without the experience or social capital of more senior faculty. This can make change difficult to instill.

This article discusses eight techniques, that have been successful for enacting change in similar scenarios in the business world. The author highlights the need for a cohort of project champions at various levels within the institution, as well as the importance of communicating and maintaining a consistent vision throughout the different academic ranks.

For example, if a few of the faculty consistently disparage a new change to the conference schedule, the negativity can rapidly spread to residents and other faculty, leading to conflicting messages and reduced overall buy-in. It is important to address these issues actively and quickly to ensure successful change. Additionally, one should build in small victories throughout any major change. Because significant changes require time to produce results, plan for and emphasize smaller wins throughout the process, such as resident or patient satisfaction surveys, pre- and post-test surveys, or congratulatory emails.

Considerations for Faculty Developers

This is a classic leadership and team management article that is a must-read for all aspiring leaders. The trick to teaching or coaching with this article is to use your local environment and local innovations to help bring these concepts to life for your junior faculty members. Using Kotter's eight steps as a conceptual framework for analyzing or prompting change with an upcoming innovation or educational program is a great way to help a junior faculty member think through their change process. Each step has actionable items that can be considered, and using a worksheet based on this model (see Appendix) can help your junior colleagues think through their own project and how they can anticipate their next steps for making changes based on their work.

5. Fernandez R, Kozlowski SW, Shapiro MJ, et al. Toward a definition of teamwork in emergency medicine. *Acad Emerg Med*. 2008 Nov;15(11):1104-12.[11]

Summary

This was a good overview article derived from the *Academic Emergency Medicine* Consensus Conference with a goal of describing and defining teamwork within EM. The authors discuss teamwork using the I-P-O model (input-process-output), wherein input refers to abilities and existing experience of team members, process represents the behaviors and actions, and outputs consist of performance and team satisfaction. Within this model they discuss a variety of necessary components, including assessment of available resources, clearly identifying and assigning roles, contingency planning, team adaptability, monitoring progress, keeping track of resources, workload distribution, and coordination of efforts. Additional supporting components include the importance of leadership, team awareness, and using closed-loop communication.

Relevance to Junior Faculty Members

Teamwork is an essential skill for junior faculty. While this article emphasized teamwork within the context of a medical resuscitation, it can be applied to multiple different types of teams. The importance of planning and strong communication both during resuscitations and when creating academic projects cannot be overemphasized. Performing sufficient needs assessments and discussing available resources (e.g. financial support, protected time, and support staff) can lead to much more successful and rewarding projects. Additionally, aspects such as team awareness and workload distribution can be valuable to ensure projects are continuously moving forward, especially in light of the busy and variable schedules of emergency physicians.

Considerations for Faculty Developers

This is a very good overview article that situates teamwork in EM. It focuses heavily on a single team-effectiveness model (the I-P-O model) but nicely guides the reader through the conceptual framework and explains it using a common experience that is likely shared among most junior EM faculty members (e.g., a critical care case that starts with pre-hospital team handover, includes an intubation, and the transition of the case to elsewhere in the hospital).

The challenge of using this article for faculty development will be to then show how this model might be useful in other teaming situations (e.g., How might we apply the I-P-O model to a good research team? What about a curriculum team?). It is

clinically oriented, and much thought and preparation on the part of the faculty developer is needed to transition the use of this article beyond the simulation room or resuscitation bay. There is some jargon in this article, although the authors explain each concept throughout the article.

Honorable Mention: Lerner S, Magrane D, Friedman E. Teaching teamwork in medical education. *Mt Sinai J Med*. 2009 Aug;76(4):318-29.[12]

This article is a fantastic review of teamwork training in medical education. It is a must read for those who want a solid foundation in the history and impetus for why we should be incorporating teamwork teaching in health professionals' education. It provides a more general overview of opportunities for team teaching across the classroom to clinical environments, covering topics including team-based learning (TBL),[12] team building exercises and team skills training, and the TeamSTEPPS training tool.[13] For junior faculty members, this paper provides a solid literature review to catch one up on literature around teamwork in medical education. For faculty developers, this paper may be a very good core article to provide as pre-reading before discussing topics around clinical team leadership and how to teach or coach learners on this.

LIMITATIONS

The main limitation of our proceedings is that our search strategy was not comprehensive. Although we attempted to gather recommendation from multiple sources (e.g., our expert recommendations, Faculty Incubator discussions, social media), we did not perform an exhaustive, structured literature review. The purpose of this paper, however, was to aggregate several high-yield papers that would serve as a starting point for junior faculty members embarking on their academic careers within EM. We believe that the inclusion of both experts and novices (i.e., end-users) in the selection and evaluation process also allowed for a more inclusive selection. The authors hope that this is a valuable starting point for the reader's exploration and initial development in this topic.

CONCLUSION

We have provided a reading list that may be beneficial to improve team collaboration among junior faculty. We hope this paper provides junior clinician educators a broad overview of this important topic, making it more approachable.

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Academic Primer Series: Five Key Papers for Consulting Clinician Educators

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Introduction: Clinician educators are often asked to perform consultations for colleagues. Invitations to consult and advise others on local problems can help foster great collaborations between centers, and allows for an exchange of ideas between programs. In this article, the authors identify and summarize several key papers to assist emerging clinician educators with the consultation process.

Methods: A consensus-building process was used to generate a list of key papers that describe the importance and significance of educational consulting, informed by social media sources. A three-round voting methodology, akin to a Delphi study, determined the most impactful papers from the larger list.

Results: Summaries of the five most highly rated papers on education consultation are presented in this paper. These papers were determined by a mixed group of junior and senior faculty members, who have summarized these papers with respect to their relevance for their peer groups.

Conclusion: Five key papers on the educational consultation process are presented in this paper. These papers offer background and perspective to help junior faculty gain a grasp of consultation processes. [West J Emerg Med. 2017;18(2)311-317.]

INTRODUCTION

Solving educational problems through educational consulting is recognized as a key skill for clinician educators.[1] Along with other skills such as teaching,[2,3] research and scholarship,[1,3-5] faculty development,[1,2] and leadership,[2,6] performing consultations for educational problems is an expected skill of a clinician educator.

The clinician educator's role in a consultation is to integrate education theory with practice.[2-5] The ability to apply education theory to practice is a key skill that differentiates a clinician educator from a clinician teacher (i.e., a clinician with only supervision or teaching roles).

Previously, we have discussed the role of education scholarship in the careers of clinician educators.[7] While engagement in scholarship is important, it is equally important for clinician educators to assist in translating the work of other education researchers and scholars into everyday practice.[5] Functioning as a problem-solver or

consultant is one way in which one can participate in this act of knowledge translation.

The *Academic Life in Emergency Medicine* (ALiEM) Faculty Incubator was created to train early career educators in developing the theoretical background needed to effectively complete educational consults. During our one-year experience, we created a one-month module focused on the art of performing the education consult. This paper is a synthetic, narrative review that highlights some important literature that may assist junior educators as they begin acting as consultants for local and external groups.

METHODS

In the fourth month of the 2016-2017 ALiEM Faculty Incubator (June 2016), the topic of education consultation was discussed. We monitored the proceedings of this group of educators from July 1-31, 2016. The discussion was allowed to unfold asynchronously; during this process, we gathered the titles of papers that were cited, shared, suggested, and discussed within the online discussion forum. Multiple participants in the Faculty Incubator (both junior and senior members) contributed papers to the discussion. This list was then augmented with a call for suggestions on Twitter. We "tweeted" requests to have participants of the #FOAMed and #MedEd online communities provide suggestions for important papers on the topic of education consultation and the role of the clinician educator.

The list of papers was compiled for the authors, who subsequently conducted a three-round voting process, inspired by the Delphi methodology. This was not a traditional Delphi methodology since our selection panel comprised of both novices (i.e. junior faculty members, participants in the Faculty Incubator) and experts in the field (i.e. experienced clinician educators, all of whom have published >10 peer reviewed publications, who serve as mentors and facilitators of the ALiEM Faculty Incubator). We intentionally sought to involve both junior and experienced clinician educators to ensure we selected papers that would be of use to a spectrum of educators at different career stages. The three phases for this multi-round consensus building process consisted of the following:

1. Round 1: A first round where each paper was voted along a seven-point scale, with a "1" being Unimportant for Junior Faculty (Unlikely to Significantly Impact Junior Faculty) and a "7" being Essential for Junior Faculty (Illuminating, Highly Useful).
2. Based on the authorship group's first-round scores, the participants were subsequently asked to vote on the papers that they thought should be included it the top five papers, but were allowed to endorse more than five papers in total.
3. In the third round, the same group was asked to review the percent endorsement for each paper and vote on ONLY five papers that should be recommended in the final paper.

After reviewing the papers in full, there were two papers excluded from this commentary, since the type of consultation discussed in those papers was not within the scope of this paper.

RESULTS

Our initial review of the ALiEM Faculty Incubator discussion thread yielded a total of 18 articles, which were mentioned by mentors and the junior faculty incubator participants. The social media call added one additional paper. The three-round voting procedure allowed our team to generate a rank-order listing of all papers in order of relevance, from the most important to the least important. Three papers were excluded as irrelevant after consultation with the entire authorship group, as they pertained to clinical consultations rather than educational consultations. The citations and our ratings of these papers are listed in the Table.

DISCUSSION

The following are a summary of the top papers accompanied with commentaries on their relevance to both junior faculty members, as well as potential considerations for faculty developers when discussing these works.

1. Sherbino J, Frank JR, Snell L. Defining the key roles and competencies of the clinician-educator of the 21st century: a national mixed-methods study. *Acad Med*. 2014 May;89(5):783-9.[5]

Summary

The current medical education environment requires increased accountability and revision of accreditation standards. As a result, formal medical education relies on a key group of clinician educators or medical consultants to serve as leaders in medical education. This study attempts to provide a formal definition for medical education consultants and describes the core competencies of a clinician educator. Clinician educators must be active in their practice, apply "education theory to teaching and learning," and engage in educational scholarship. Scholarship is not limited to formal research, but includes the scholarship of integration, application, and teaching.[21] In order to achieve these traits, medical consultants require additional training in medical education, such as advanced degree programs or continuous faculty development. Furthermore, clinician educators possess excellent communication skills and participate in curriculum development and assessment, with a firm basis in established educational theory. [5]

Relevance to Junior Faculty Members

Junior faculty may not have the confidence to provide medical education advice to their colleagues. However, this article confirms that the majority of medical education

Table. The complete list of educational scholarship literature collected by the authorship team.

Citation	ROUND 1 initial mean scores (SD) max score 7	ROUND 2 % of raters that endorsed this paper	ROUND 3 % of raters that endorsed paper in last round	Top 5 papers
Brown T. Design thinking. *Harv Bus Rev*. 2008 Jun 1;86(6):84·8	6.2 (1.6)	83.3%	100%	1
Sherbino J, Frank JR, Snell L. Defining the key roles and competencies of the clinician-educator of the 21st century: a national mixed-methods study. *Acad Med.* 2014 May;89(5):783-9.[5]	5.2 (2.0)	66.7%	100%	2
Turner AN. Consulting is More Than Giving Advice. *Harv Bus Rev*. 1982 Sep-Oct;60(5):120-9.[9]	4.8 (1.3)	83.3%	83.3%	3
Madsbjerg C, Rasmussen MB. An Anthropologist Walks into a Bar. *Harv Bus Rev*. 2014 Mar 1;92:80-8.[10]	5.3 (1.9)	83.3%	83.3%	4
Levinson W, Rubenstein A. Integrating clinician-educators into Academic Medical Centers: challenges and potential solutions. *Acad Med*. 2000 Sep;75(9):906-12.[4]	5.2 (1.2)	66.7%	66.7%	5
Kessler CS, Chan T, Loeb JM, et al. I'm clear, you're clear, we're all clear: improving consultation communication skills in undergraduate medical education. *Acad Med*. 2013 Jun;88(6):753-8.[11]	5.0 (1.9)	Excluded due to lack of relevance to present review.		
Roberts DH, Schwartzstein RM, Weinberger SE. Career development for the clinician-educator. Optimizing impact and maximizing success. *Ann Am Thorac Soc.* 2014 Feb;11(2):254-9.[3]	5.0 (1.1)	16.7%	0%	
Norman GR. Problem-solving skills, solving problems and problem-based learning. *Med Educ.* 1988 Jul;22(4):279-86.[12]	4.5 (1.8)	33.3%	0%	
Chan T, Orlich D, Kulasegaram K, et al. Understanding communication between emergency and consulting physicians: a qualitative study that describes and defines the essential elements of the emergency department consultation-referral process for the junior learner. *CJEM*. 2013 Jan;15(1):42-51.[13]	4.3 (2.1)	Excluded due to lack of relevance to present review.		
Branch, W. T., Kroenke, K., & Levinson, W. (1997). The Clinician-Educator—Present and Future Roles. *J Gen Intern Med*, 12(Suppl 2), S1–S4.[2]	4.3 (1.0)	50%	0%	
Sherbino J, Snell L, Dath D, et al. A national clinician-educator program: a model of an effective community of practice. *Med Educ Online*. 2010 Dec 6;15.[14]	4.2 (1.8)	16.7%	16.7%	
Steinert Y, Mann K, Centeno A, et al. A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education: BEME Guide No. 8. *Med Teach*. 2006 Sep;28(6):497-526.[15]	4.2 (1.6)	0%	0%	
Osterberg L, Swigris R, Weil A, et al. The highly influential teacher: recognising our unsung heroes. *Med Educ*. 2015 Nov;49(11):1117-23.[16]	4.2 (1.2)	16.7%	0%	
Leslie K, Baker L, Egan-Lee E, et al. Advancing faculty development in medical education: a systematic review. *Acad Med*. 2013 Jul;88(7):1038-45.[17]	3.3 (1.8)	0%	0%	
Mezrich R, Nagy PG. The academic RVU: a system for measuring academic productivity. *J Am Coll Radiol*. 2007 Jul;4(7):471-8.[18]	3.2 (1.9)	0%	0%	
House J, Santen SA, Carney M, et al. Implementation of an education value unit (EVU) system to recognize faculty contributions. *West J Emerg Med*. 2015 Nov;16(6):952-6.[19]	3.0 (1.4)	0%	0%	
Regan L, Jung J, Kelen GD. Educational value units: a mission-based approach to assigning and monitoring faculty teaching activities in an academic medical department. *Acad Med*. 2016 Feb 2.[20]	2.8 (1.5)	16.7%	0%	
Straus SE, Soobiah C, Levinson W. The impact of leadership training programs on physicians in academic medical centers: a systematic review. *Acad Med.* 2013 May;88(5):710-23.[6]	2.8 (1.3)	0%	0%	

leadership felt that junior faculty are qualified to be clinician educators. Clinician educators are in high demand, with 40% of respondents indicating training programs will require education consultation at least one half-day per week.[5] To be a respected consultant, the junior faculty member must receive some form of advanced medical education training, such as certificate programs or organized faculty development.[5] A firm understanding of education theory differentiates clinical educators from clinician teachers.

Considerations for Faculty Developers

Often a junior clinician educator may not initially imagine his- or herself as a person whom others might turn to for assistance or advice on medical education matters. This paper explains how education consultation fits into the job of a clinician educator.[5] Providing junior colleagues with this information early in a faculty development program may help them consider what skills and expertise they must gain so they can be prepared to be a better consultant later in their career.

2. Brown T. Design thinking. *Harv Bus Rev*. 2008 Jun 1;86(6):84-92.[8]

Summary

This paper is a modern classic from the *Harvard Business Review*. Tim Brown explains the basic concepts behind a major business consulting approach that has arisen in the past 20 years: Design thinking.[8] Design thinking is a human-centered business model that emphasizes the need for input from a wide range of users, fluency in ideas, and early, rapid prototyping so as to isolate the best solution to a problem. This paper also provides numerous examples of the use of design thinking both within and outside of the business world, describing its application in the design of a new approach to patient care transitions within a large healthcare system, the development of a new surgical tool, and expanding eye care to locations with poor healthcare access.[8]

Relevance to Junior Faculty Members

This article may be particularly valuable to junior faculty members as they are looking to improve upon existing or create new curricular models. Before initiating a new curricular change, it is important to perform a *Needs Assessment*.[22] Design thinking emphasizes the importance of involving a variety of end-users in the needs assessment and development stages to identify potential challenges and solutions. For example, when designing a new approach to patient care transitions, it would be valuable to involve residents and attending physicians from that department, nursing staff, consultants, and even patients to best understand the various components and challenges involved. It is also important to seek out *extreme users* (i.e. users who are at opposite extremes) and learn the different problems and workarounds they have developed. Finally, design thinking is a fluid and continuous process. While the process is often described in a series of stages, one must be cognizant that this should be a continuous and inter-linked process that thrives on broad ranges of ideas with frequent and rapid prototyping.

Considerations for Faculty Developers

Senior faculty members looking to use this paper for faculty development may find it useful to practice brainstorming and learner-centered interviewing with junior clinician educators via simulated exercises. Developing and affirming creativity is key for increasing fluency of ideas, and many junior faculty members may be initially uncomfortable or unfamiliar with these techniques. For more education-specific design thinking readings, senior faculty members may want to review resources from the webpage *Design Thinking for Educators* (http://www.designthinkingforeducators.com/), which contains free videos, examples, and a downloadable educator's toolkit in PDF format. Mr. Brown's paper is most useful as a starting point to open up a discussion around user-centered design, which has applications in medical education (i.e. learner-centered design) and health care (i.e. patient- or family-centered design).

3. Madsbjerg C, Rasmussen MB. An anthropologist walks into a bar. *Harv Bus Rev.* 2014 Mar 1;92:80-8.[10]

Summary

Finding a way to sift through complex social challenges is the primary focus of this article. The authors provide examples from the business world (e.g. a brewery, a toy maker, and a medical supply company) to show that everyday assumptions about human motivation can frequently be misguided if not directly anathema to the underlying truth. To solve these issues, one requires a systematic approach relying on empathy and the refusal to be guided by a priori thinking, known as *sense-making*. The first and most important step is to reframe the problem. Whereas most problems are seen as dichotomous issues of fact or fiction, sense-making requires a recalibration, looking at the subjective experience of the end-user. By attempting to ascertain the underlying motivations of the intended audience, one is better able to see the holes that prevented current practice from fulfilling expectations. After the underlying question has been found, one needs to gather diverse qualitative data about the issue, look for themes that emerge, and build upon that foundation.

Relevance to Junior Faculty Members

Frequently, novice educators are left without a framework of how to approach problems to which they are tasked with solving. Whereas their preclinical, clinical, and graduate medical education may have prepared them to decipher

complex biostatistical methodologies and critically appraise the merits of quantitative research, what is lost is the ability to troubleshoot social issues. To the novice educator, learning about empathy is rarely, if ever, broached in relation to patient interactions. Educators must be able to find holes in curriculum that they may not be aware or have experienced. Only through the eyes of their learners, can one gain the insight to make lasting and impactful changes. For example, a lecture-based curriculum for ultrasound may seem relevant to a teacher since she can connect the images to their reasoning, but if the learners desire training on image acquisition, the hands off style may be underappreciated and wasteful.

Considerations for Faculty Developers:

This paper expands upon the concepts described in the earlier paper by Tim Brown.[8] One of the key elements of great human- (or learner-) centered design is the ability to empathize and understand the needs of those for whom you are designing. Faculty developers who are seeking to teach junior faculty members about design thinking processes can use this paper to introduce some useful data collection techniques that assist in the evaluation of end-user needs. Those senior faculty familiar with qualitative methods will note that many of the techniques mentioned in this paper are consistent with those from social sciences, such as anthropology or sociology. This paper may serve as a good launching point for discussing what is truly needed in the local needs assessment phase of the curriculum design (as described by Kern[22]), or how one might diversify his or her techniques when gathering user-centered data during a robust program evaluation procedure.

4. Turner AN. Consulting is more than giving advice. *Harv Bus Rev*. 1982 Sep-Oct;60(5):120-9.[9]

Summary

Despite having been published 30 years ago, this classic business article still rings true for consultants. The article discusses the hierarchal pyramid for consulting, beginning with providing simple solutions and progressing through solving more complex problems, assisting with implementation, and eventually helping clients to self-diagnose problems and improve their own efficiency.[9] Some valuable points presented throughout the article include the importance of ensuring that the question is appropriate for the problem; understanding institutional limitations to ensure that solutions are feasible; and involving multiple levels of stakeholders to increase insights and buy-in.

Relevance to Junior Faculty Members

While this article was initially written for the business consultant, one could readily see the application to the education consultant, as well. Mirroring Bloom's Taxonomy,[23] this paper emphasizes the progressive levels of knowledge acquisition and self-direction that the consultant or educator wants the learner to achieve. As an educational consultant, it is important to remember that the goal is not merely to answer the question, but to assist the "consultee" in finding the answers and expanding their own knowledge and skill sets.

Considerations for Faculty Developers

This article offers an important hierarchical model of consultation sophistication that serves as a useful framework for faculty developers to guide junior educators. Faculty developers can use this framework to match the development plan and readiness of programs to engage in consultations of value. It also describes the importance of matching the readiness of the programs asking for consultations with the preferred method of consultation for the consultant. Ultimately, the article provides a stepwise approach to consultants wishing to turn programs into full-fledged learning organizations and permanently improving organizational effectiveness.

5. Levinson W, Rubenstein A. Integrating clinician-educators into academic medical centers: challenges and potential solutions. *Acad Med.* 2000 Sep;75(9):906-12.[4]

Summary

This commentary highlights challenges of integrating clinician educators into the standard promotional track at academic medical centers. The authors cite that an increasing proportion of faculty at academic medical centers (AMCs) are primarily spending their time working clinically, which is suggested to be a direct result of a changing economic structure for AMCs. These clinical educators are the foundation for education at AMCs. While colleagues, residents, and students appreciate their work, institutional credit is less common. Barriers to institutional recognition include the requirement for regional and national reputations among clinician educators, the lack of valid measurements for teaching activities, and the lack of training opportunities for junior faculty members. Potential solutions identified by the authors include hiring clinician educators as short-term employees with the intention of hiring new faculty every few years, as well as committing to develop a core group of clinician-educators that will focus on institution-specific educational programs. Analogous to this, the development of the education researcher will augment the growth of the core group of clinician educators.

Relevance to Junior Faculty Members

The majority of junior faculty members at AMCs will be clinician educators. It is important to understand requirements for promotion, as clinician educators often have difficulty

advancing within this track. The authors identify the possibility of hiring a new group of clinical educators every few years to address the difficulty in promotion as well as developing a core set of clinician educator researchers. Junior clinician educators should be aware of this as they develop novel educational programs and seek to publish the work they are doing. Longevity as a clinician educator will likely come to those who commit to developing scholarly skills within medical education, but also by mentoring new junior colleagues once established.

Considerations for Faculty Developers

This article presents a comprehensive review of the challenges for promotion for clinician educators and focuses on three themes: (1) regional and national reputation; (2) lack of metrics to measure educational impact;,and (3) challenges in researching educational innovations.[4] It gives examples of two institutions that have addressed these challenges. This articles can help faculty developers can focus on development plans for each of these areas when mentoring junior faculty and help inform junior faculty in the clinician educator track of the historical context of common for promotion challenges for clinician educators.

Excluded papers

During this month, our Faculty Incubator discussed the topic of consultations within the clinical context as well. During our online discussion, we discussed two papers[13,11] that discuss the nature and best practices for consulting colleagues in EM clinical cases. Although these papers are not relevant to our present discussion, the papers were rated initially quite favourably (>4/7 in terms of our initial Likert scale of relevance to junior faculty), and as such we have listed them in the Table.

LIMITATIONS

Of note this month, the faculty incubator participants and mentors had a wide-ranging discussion that included some papers that may seem irrelevant to readers expecting a paper on educational consultations. That being said, we have elected to be inclusive of all the papers we discussed this month, since some of these papers may be of use to those interested in other more peripherally related topics (i.e. emergency department referral and consultation processes).[13,11]

This was not an exhaustive, systematic search of the literature. We attempted to find relevant readings for the Faculty Incubator by performing a search online via Google Scholar looking for any key papers on completing educational consultations. We also attempted to seek assistance with finding more papers by using an open social media call via Twitter using hashtags #MedEd & #FOAMed, but only one additional paper was found. Since the purpose of this paper was to aggregate an introductory set of papers to assist junior faculty members in thinking about the consultation process, we feel that our method allowed us to aggregate papers that would accomplish this feat. Finally, we note that there may be an inherent selection bias of these topics by our junior faculty members who are involved in the Faculty Incubator. Of note, one of the in-person activities for the ALiEM Faculty Incubator 2016-2017 program included a design thinking introduction, which may have affected the selection of papers related to this topic for this paper.

CONCLUSION

The authors provided a reading list that may be beneficial as an introduction for junior faculty members to better acquaint themselves with consulting on medical education problems. We hope this paper provides junior clinician educators a broad overview of this important topic and makes it more approachable and less intimidating.

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Not All Young Journals Are Predatory

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I read the article by Hansoti et al. with great interest in which they list "predatory" open access emergency medicine journals.[1] Unfortunately, the authors neglected to mention a major limitation of their study methodology. The process required for a new journal to be included in various recognized medical library indexing services such as PubMed or the Scientific Citation Index is often complex and lengthy, sometimes requiring several years before being included. Thus, lack of inclusion of a journal title within these search engines is not evidence that the journal is illegitimate, since it may be too young to be included. Therefore, I was disappointed to see the journal *Clinical and Experimental Emergency Medicine* among the list of so-called "predator" journals. *Clinical and Experimental Emergency Medicine* (*CEEM*) is non-for-profit, peer reviewed and the official English language journal of the Korean Society of Emergency Medicine inaugurated about two year ago. The journal does not charge publication fees and is funded by the Korean Society. The journal has just been included into PubMed. The Korean Society of Emergency Medicine represents hundreds of Korean emergency physicians and is a highly reputable organization. Korean emergency physicians have made significant contributions to the body of emergency medicine and acute care knowledge, some of which have been published in *CEEM* as well as many other well-established journals. The editorial board of *CEEM* includes multiple internationally renowned emergency physicians who have joined forces to support the efforts of the Korean Society. *CEEM* was established as a platform for a large number of Asian emergency physicians to highlight many of the issues unique to this region. In today's era of emergency medicine globalization and rapid international growth it is important for all of us to come together and support the efforts of national emergency medicine organizations to grow their clinical and academic missions, such as the establishment of new journals like *CEEM*. Thus, extreme care should be taken before prematurely labeling young yet perfectly legitimate journals as "predators," especially in our relatively young field of emergency medicine.

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In reply to: "Not All Young Journals Are Predatory"

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Dear Dr. Singer,

We greatly appreciate your interest and comment on our study.[1] Your point about lack of inclusion of a young open access (OA) journal is well taken. We can't agree with you more that the process of getting a new journal recognized and included in various indexing services is both lengthy and complex. It took *WestJEM* five years and three attempts with major improvement prior to acceptance to MEDLINE.[2] We regret that we neglected to include this important issue as one of the limitations in our study methodology.

While the methodology we chose to use in our study was imperfect, we did address several limitations. Our intention was to present the likely predatory vs. legitimate OA journal titles and their website links as aids to authors to further scrutinize the journal before submission. As indicated, *Clinical and Experimental Emergency Medicine (CEEM)* was not found in any of the selected directories, indexes, databases, and publishers that we searched at the time the study was conducted. We are happy to discover that *CEEM* is now listed in the National Library of Medicine (NLM) Catalog. The detail record (https://www.ncbi.nlm.nih.gov/nlmcatalog/?term=clinical+experimental+emergency+medicine) shows *CEEM* content is now archived and accessible in PubMed Central (PMC) (https://www.ncbi.nlm.nih.gov/pmc/journals/3081/). As a result, its abstracts are automatically migrated to PubMed as well. This is an important milestone for *CEEM* to be recognized by NLM and we congratulate the Editorial Board for a major accomplishment.

We also did a thorough review of the current *CEEM* website (http://ceemjournal.org/). It is well designed, clear, and meets all the criteria for a legitimate, official journal website. Its information includes the 12 questions that our study posted for readers and researchers to be considered when reviewing a journal or publisher's website. Interestingly, *CEEM* is a unique OA journal that does not charge authors any processing fee. *"There is no author's submission fee or other publication-related fee since all costs of the publication process are underwritten by the Korean Society of Emergency Medicine* (http://ceemjournal.org/authors/authors.php)."

Your letter and another inquiry led us to check and update the information included in the original tables 4 and 5 in the manuscript. We found some changes, now reflected in the updates below (accessed November 25, 2016). Changed information in the tables are highlighted in yellow, and we have added explanatory footnotes. We also created a Table 6 (not in the original article) which lists journals that appear legitimate, but have not achieved indexing in any recognized service.

Again, thank you for bringing this oversight to our attention. In the spirit of open access, we encourage other legitimate scientists and publishers to expand the space for emergency medicine scholarship, so research and best practice can be freely available to the developed and developing world.

Sincerely,
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Table 4. Open access emergency medicine journals that have achieved indexing in recognized services and are therefore legitimate rather than predatory. NLM (National Library of Medicine) Catalog, SJR (Scimago Journal Rank), DOAJ (Director of Open Access Journals), EBSCOhost journal master list, and WS (Thomson Reuters Web of Science, including "expanded" and "emerging sources").

	Journal title and weblink	NLM catalog	PubMed central	SJR	DOAJ	EBSCOhost	WS
1.	Advances in Emergency Medicine from Hindawi http://www.hindawi.com/journals/aem/contents/				x		
2.	African Journal of Emergency Medicine[a] http://www.afjem.org/	x		x	x		x
3.	Australian Journal of Emergency Management[b] https://ajem.infoservices.com.au/items/AJEM-31-02			x			x
4.	BMC Emergency Medicine https://bmcemergmed.biomedcentral.com/	x	x	x	x	x	x
5.	Bulletin of Emergency & Trauma http://www.beat-journal.com/BEATJournal/index.php/BEAT	x	x		x		
6.	Case Reports in Emergency Medicine from Hindawi Publishing Corporation[c] http://www.hindawi.com/journals/	x	x		x	x	
7.	Clinical and Experimental Emergency Medicine[d] http://www.ceemjournal.org/	x	x				
8.	EAJEM: Eurasian Journal of Emergency Medicine http://www.akademikaciltip.com/eng/Anasayfa	x	x				x
19.	Emergency: An Academic Emergency Medicine Journal http://journals.sbmu.ac.ir/emergency	x	x		x		
10.	Emergency Care Journal http://www.pagepressjournals.org/index.php/ecj				x		x
11.	Emergency Medicine International from Hindawi Publishing Corporation http://www.hindawi.com/journals/emi/	x	x		x	x	x
12.	Hong Kong Journal of Emergency Medicine http://www.hkjem.com/			x			x
13.	International Journal of Emergency Medicine from Springer Open https://intjem.springeropen.com/	x	x	x	x	x	x
14.	Iranian Journal of Emergency Medicine http://www.journals.sbmu.ac.ir/en-iranjem				x		
15.	ISRN Emergency Medicine http://www.hindawi.com/journals/isrn/contents/emergency.medicine/				x	x	
16.	Journal of Cardiovascular Emergencies http://www.degruyter.com/view/j/jce				x		
17.	Journal of Emergencies, Trauma, and Shock http://www.onlinejets.org/	x	x	x	x	x	
18.	Journal of Emergency Medicine, Trauma and Acute Care from Qscience.com http://www.qscience.com/loi/jemtac			x	x		
19.	Journal of Emergency Practice and Trauma http://jept.ir/				x		
20.	Journal of Trauma Management and Outcome[e] https://traumamanagement.biomedcentral.com/	x	x	x	x	x	
21.	Open Access Emergency Medicine from Dovepress[f] https://www.dovepress.com/open-access-emergency-medicine-journal	x	x	x	x		x
22.	Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine[g] http://sjtrem.biomedcentral.com/	x	x	x	x		x

Table 4. Continued.

	Journal title and weblink	NLM catalog	PubMed central	SJR	DOAJ	EBSCOhost	WS
23.	Turkish Journal of Emergency Medicine http://www.trjemergmed.com/	x	x				x
24.	Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health http://escholarship.org/uc/uciem_westjem	x	x	x	x	x	x
25.	World Journal of Emergency Medicine[h] http://www.wjem.org/	x	x			x	x
26.	World Journal of Emergency Surgery[i] http://wjes.biomedcentral.com/	x	x	x	x	x	x

Journal numbers highlighted in yellow are changed from the original published version.
[a] African Journal of Emergency Medicine was recently added to NLM Catalog and only selected citations will soon be in PubMed. The full-text content currently is not in PMC.
[b] Australian Journal of Emergency Management was incorrectly placed in the potential predatory journal list. The journal is found and/or indexed in SJR and WS.
[c] Case Reports in Emergency Medicine from Hindawi Publishing Corporation is also found in the EBSCOhost journal master list.
[d] Clinical and Experimental Emergency Medicine has recently been added to the NLM Catalog. The full-text content is now archived in PMC and the citations are now searchable in PubMed.
[e] Journal of Trauma Management and Outcomes is found and or indexed in all the selected databases except WS.
[f] Open Access Emergency Medicine from Dovepress was incorrectly marked in EBSCOhost.
[g] Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine is indexed in WS, but the search for Thomson Reuters indexed journals needs to include "&" symbol rather than "and" in the title, in order to find the journal's title.
[h] Both the World Journal of Emergency Medicine and the World Journal of Emergency Surgery are found and/or indexed in the EBSCOhost and WS.

Table 5. Emergency medicine journals that have not achieved indexing in any recognized service, and are therefore potential or probable predatory open-access journals.

	Journal title and weblink
1.	Archives of Emergency Medicine and Critical Care from SciMed Central [i] http://www.jscimedcentral.com/EmergencyMedicine/
2.	Austin Emergency Medicine http://austinpublishinggroup.com/emergency-medicine/
3.	Edorium Journal of Emergency Medicine http://www.edoriumjournalofemergencymedicine.com/about-us/about-us.php
4.	Emergency Medicine: Open Access[j] http://www.omicsgroup.org/journals/emergency-medicine.php
5.	Emergency Medicine Open Journal from Openventio Publishers http://openventio.org/OpenJournal/EmergencyMedicine.html http://openventio.org/index.php
6.	Gavin Journal of Emergency Medicine[k] (journal has not published any issues) http://gavinpublishers.org/index.php/emergency-medicine
7.	Henry Journal of Emergency Medicine, Trauma & Surgical Care (journal has not published any issues) http://www.henrypublishinggroup.com/index.php/emergencymedicine/about
8.	HSOA Journal of Emergency Medicine, Trauma & Surgical Care http://www.heraldopenaccess.us/journals/Emergency-Medicine-Trauma-&-Surgical-Care/
9.	International Journal of Emergency Mental Health and Human Resilience[l] http://www.omicsonline.com/open-access/international-journal-of-emergency-mental-health-and-human-resilience.php
10.	Internet Journal of Emergency Medicine http://ispub.com/IJEM from Internet Scientific Publications.
11.	Journal of Emergency Medicine and Intensive Care http://elynsgroup.com/journal/journal-of-emergency-medicine-and-intensive-care

Table 5. Continued.

12.	Journal of General and Emergency Medicine http://scientonline.org/journals/general-emergency-medicine/31
13.	Journal of Intensive Care and Emergency Medicine http://www.signavitae.com/
14.	Mathews Journal of Emergency Medicine http://www.mathewsopenaccess.com/EMedicine.html
15.	OA Emergency Medicine http://www.oapublishinglondon.com/oa-emergency-medicine
16.	Open Emergency Medicine (latest content is 2013) http://benthamopen.com/toemj/home
17.	Pediatric Emergency Care and Medicine: Open Access http://pediatric-emergency-care.imedpub.com/
18.	SM Emergency Medicine and Critical Care (SMEM) http://smjournals.com/emergency-medicine/
19.	The Scientific Pages of Emergency Medicine http://thescientificpages.org/page/general-medicine/scientific-pages-of-emergency-medicine.php
20.	Trauma and Emergency Care (TEC) from OAT (Open Access Text) http://oatext.com/Trauma-and-Emergency-Care-TEC.php

Journal numbers highlighted in yellow are changed from the original published version.
[i] *Archives of Emergency Medicine and Critical Care* has been listed recently in the NLM Catalog, but "only citations for author manuscripts are included". It appears an author deposited the article to PubMed Central. Thus only this citation is found in PubMed under this journal. *JSciMed Central* published this journal and apparently is a well-known predatory publisher (https://scholarlyoa.com/2014/06/24/real-location-of-jscimed-central-revealed/).
[j] *Emergency Medicine: Open Access* – This journal has not achieved indexing in any recognized service. A record is found in the NLM Catalog where it said "Only citations for author manuscripts are included." It appears one author deposited an article to PubMed Central. This is the only citation found in PubMed under this journal. After reviewing the publisher's website, we determined this is most likely a predatory journal.
[k] *Gavin Journal of Emergency Medicine* (journal has not published any issues)
http://gavinpublishers.org/index.php/emergency-medicine - This journal is now published under a new title, Emergency Medicine Investigations, with an new URL under .com rather than .org.
[l] *International Journal of Emergency Mental Health and Human Resilience* was incorrectly marked indexed in WS. The journal was indexed in MEDLINE from Winter 1999 to Winter 2014. Only selected citations after Winter 2014 are in PubMed. In 2013 the journal was sold to OMICS Publishing Group, which was recently sued by the U.S. Federal Trade Commission for deceptive practices in August 2016.

Table 6. Emergency medicine journals that appear legitimate, but have not achieved indexing in any recognized service.

	Journal title and weblink
1.	Emergency Medicine and Health Care from HOAJ (Herbert Open Access Journal) http://www.hoajonline.com/emergmedhealthcare http://www.hoajonline.com/)
2.	Frontiers in Public Health | Disaster and Emergency Medicine[m] http://journal.frontiersin.org/journal/public-health/section/disaster-and-emergency-medicine
3.	International Journal of Critical Care and Emergency Medicine http://clinmedjournals.org/International-Journal-of-Critical-Care-and-Emergency-Medicine.php
4.	Journal of Japanese Society for Emergency Medicine https://www.jstage.jst.go.jp/browse/jsem
5.	Journal of Emergency Medicine & Critical Care from Avens Publishing Group Inviting Innovations http://www.avensonline.org/medical/emergency-medicine-and-critical-care/home-5/
6.	Open Journal of Emergency Medicine from Scientific Research An Academic Publisher http://www.scirp.org/journal/ojem/

Journal numbers highlighted in yellow are changed from the original published version.
[m] Frontiers in Public Health | Disaster and Emergency Medicine appears to be a new journal subsidiary to Frontiers in Public Health (http://journal.frontiersin.org/journal/public-health), which is found in DOAJ, but the new journal, "Frontiers in Public Health | Disaster and Emergency Medicine" is not. The core journal has 858 articles published, while the new journal only has 19 at press time. This new journal is not now found in any indexing services.

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Inappropriate Off-label Use of a Qualitative, Point-of-care hCG Device

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Dear Editor,

We read with interest the recent study by Gottlieb et al[1] describing the reduction in turnaround time achieved by substituting whole blood for urine on a qualitative point-of-care (POC) hCG device. The device used in this study is FDA-approved and CLIA-waived only when the manufacturer's instructions are followed: three drops of urine or serum are applied to the device and results are recorded within three minutes (urine) or five minutes (serum) after application of sample.[2] However, the practice described by the authors differs considerably from the manufacturer's instructions, as whole blood was used rather than urine or serum and results were interpreted after 10 minutes. Modification of an approved device constitutes off-label use, is considered a laboratory-developed test and requires extensive validation to establish the modified device's performance characteristics before it is used in a clinical setting.

We commend the authors for noting that qualitative POC hCG devices are not FDA-approved for use with whole blood and we acknowledge their concurrent testing of urine on the same POC hCG device as a reference method. However, in addition to a method comparison study, CMS requires that laboratory-developed tests undergo an evaluation of precision, analytical sensitivity, analytical specificity, reportable range, reference interval and any other pertinent performance characteristics prior to being released for clinical use.[3] Although a method comparison was performed, many additional device performance characteristics have not been defined. Furthermore, validation study results are limited to the specific clinical setting in which the study was performed and are not transferable to another institution, meaning that each institution that intends to offer a laboratory-developed test for clinical use must perform its own validation study. Use of an uncharacterized device to make clinical decisions puts patients at risk for adverse outcomes, particularly if inappropriate treatment is administered to a pregnant patient, an ectopic pregnancy goes undiagnosed due to a false negative result, or if necessary surgical intervention is delayed because of a false positive result. Use of modified devices without the required validation studies also jeopardizes the hospital laboratory's accreditation and may result in forced discontinuation of laboratory testing, which negatively impacts patient care throughout the hospital.

We support the authors' assertion that an FDA-approved device capable of rapid hCG detection in a whole blood specimen at the point of care would be valuable in healthcare delivery settings. We would like to point out that two FDA-approved test platforms are already available for exactly that: the Abbott i-STAT βhCG cartridge and the NowDiagnostics ADEXUSDx hCG test. In addition to receiving FDA approval, the performance characteristics of both of these devices have been independently evaluated in academic medical centers.[4,5] We strongly recommend that the authors engage with laboratory professionals at their institution to discuss available testing options and select appropriate test methods that meet the clinical need without jeopardizing patient care.

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In reply to: "Inappropriate Off-label Use of a Qualitative, Point-of-care hCG Device"

Michael Gottlieb, MD
Kristopher Wnek, MD
Jordan Moskoff, MD
Errick Christian, MD
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Dear Dr. Robert D. Nerenz, Dr. Ann M. Gronowski, and Dr David G. Grenache,

Thank you for your comments regarding our recently published article describing a reduction in turnaround time achieved by the substitution of whole blood for urine on a qualitative point-of-care hCG device.[1] We appreciate the insights and comments noted by Robert D. Nerenz, Ann M. Gronowski and David G. Grenache. The authors of this letter highlight the importance of multiple validation studies prior to routine implementation of non-FDA approved devices. We also agree with this and would like to highlight that the primary purpose of our study was to determine whether the substitution of whole blood for urine would decrease turnaround time, with the potential to reduce risks associated with delayed diagnoses of ectopic pregnancies, as well as expediting necessary imaging and treatment options that would be contingent upon pregnancy status.

While our study does support prior literature demonstrating similar accuracy between whole blood and urine for point-of-care hCG testing,[2] our study clearly emphasizes that further study is necessary prior to routine acceptance. One of the primary goals of our article was to justify and encourage further study into this application in order to appropriately validate it for routine clinical use.

At the time of our study, there were no FDA-approved point-of-care hCG devices that could utilize whole blood. We were excited to hear of the FDA approval of two alternate point-of-care hCG devices for use with whole blood. While our study was the first to provide evidence of an advantage in turnaround times when using whole blood in place of urine, we look forward to further studies to determine whether similar results will be seen with these newer devices.

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Coerced Contracting is Not a Reasonable Solution to Balance Billing

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Regarding the article on access to in-network emergency physicians, the authors conclude that a solution to the lack of access to in-network emergency physicians at many hospitals may be to require plans to contract with these physicians at hospitals that are in-network with the plan (if I understand their approach correctly). Though this mandate might be helpful in some cases, it is just as likely to increase the incidence of coercive contracting, where the plan puts pressure on a hospital in their network to force the emergency physician group at the hospital to accept deeply discounted rates from the plan, or be replaced by another group that will. A better solution would be for plans to be required to pay out-of-network emergency physicians (and on-call specialists) based on a benefit for out-of-network services that is a commercial market-based representation of the reasonable value of these services. Some percentile of usual and customary charges, using a database like the one established by FAIR Health, would provide such a reasonable value standard, while limiting outlier charges that are excessive and unreasonable. This approach is predicated on the idea that most physicians' charges are reasonable, are designed to address practice costs and overhead, allow these physicians to meet their EMTALA mission to provide care to all, regardless of insurance status or ability to pay, and are subject to the pressures of the market for these services. This in turn would encourage plans to negotiate fairly with emergency physician groups, and not just take advantage of the EMTALA obligation or coercive contracting. It would also eliminate the need for so-called surprise balance billing.

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In reply to: Coerced Contracting is Not a Reasonable Solution to Balance Billing

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We appreciate the letter to the editor and are pleased to respond to comments regarding our article on in-network access to emergency physicians. In our article, we highlighted that the present methods used by CMS to determine network adequacy for physicians in most medical specialties are not applied to emergency medicine. Rather, CMS enforces minimum payment thresholds for out-of-network emergency medical care. That threshold, known as the "greatest of three," is the greatest of the following: the plan's median payment amount for in-network providers, a payment based on the usual methods the plan uses to determine payments for other out-of-network services, or the amount that Medicare would pay for those services. Following this model (and the data that we presented regarding in-network physicians), we concluded that the present regulatory structure disincentivizes the formation of adequate emergency physician networks and therein incentivizes the practice of balance billing as physicians seek to compensate for the out-of-network care they provide.

We proposed that - in lieu of applying network adequacy standards to emergency physicians – and rather than defaulting to the present out-of-network payment thresholds, all emergency physicians should be paid an in-network rate negotiated with insurers. The letter to the editor suggests that it would be better to use a standard threshold of usual, customary, and reasonable (UCR) charges set by the market. However, we identify several issues with this proposal.

UCR charges are typically the highest of the "greatest of three," because they are the product of both (lower) in-network and (higher) out-of-network rates. As such, the adoption of a system defaulting to UCR charges would reasonably disincentivize emergency physicians from entering networks in favor of the higher out-of-network UCR charge. Furthermore, in defaulting to UCR charges, the practice of balance billing would become unnecessary, eliminating one of the incentives of coercive contracting.

However, defaulting to UCR charges would also change the incentives for emergency physicians to enter networks in the first place, as out-of-network emergency physicians would receive a higher rate by default. This may in turn result in a snowball effect wherein more physicians remain out of network, driving up UCR charges. It is foreseeable that such a scenario would incentivize carriers to actually increase the practice of coercive contracting so as to avoid paying higher UCR charges. That could, in turn, lead to an ultimate loss in physician reimbursements - even below present in-network rates.

Another issue with UCR charges is the present lack of transparency in their calculation. As recently as 2010, UnitedHealthcare subsidiary Ingenix was found guilty of manipulating data to underpay physicians, resulting in a fine of $300 million and the creation of a third-party, nonprofit database for charge data called FAIR health. In May 2016, after our article was published, ACEP filed a lawsuit against HHS for a similar claim, asserting that the "greatest of three" defaults lack transparency. It is unclear what will come of the suit, but the issues with UCR charges remain.

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Immigrants, the Emergency Physician and the Election Day

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The most recent Election Day — extraordinary in so many ways — seemed a typical Tuesday inside the emergency department (ED) at Elmhurst Hospital Center in Queens, NY. We weren't busy, but within hours I had treated patients from five continents. We used staff interpreters to speak to patients in Spanish and Mandarin, as well as the phone-based "language line" to converse in Russian, Bengali and Fujianese. Recent data show that 71% of residents of the Elmhurst neighborhood are foreign born, the highest proportion New York City.[1] Although our ED that day reflected this, each additional language seemed as commonplace and fitting as each new laceration, motor vehicle collision or appendicitis case.

By my next shift three days later, Donald Trump had become the president-elect and I realized how directly my patients and practice could be affected. During physical examinations, foreign-born patients nervously joked about the heightened possibility of deportation. Mindful of Trump's campaign promise to remove three million immigrants and to defund "Sanctuary Cities" such as ours, I didn't know how best to reassure them.[2] I would feebly suggest that mass deportation seemed absurd or even un-American. The patients tended to smile back, polite but unconvinced.

Beyond the obvious traumatic impact on immigrants' lives, these deportation threats would also harm the specialty of emergency medicine. The largest and most meaningful studies in emergency medicine typically include urban hospitals with significant foreign-born patient populations.[3] More individually, physicians encounter countless immigrants and refugees over their years of training. During my own residency at Bellevue Hospital Center in New York, these patients regularly exposed their personal stories and their ailing bodies to me — often on the worst day of their lives. I would not be the doctor I am today without these people.

For emergency physicians — a politically diverse group slightly more likely to favor the Republican Party — the ironies of this immigration debate can be nauseating.[4] Contrary to the common narrative of the presidential campaign, immigrants are significantly less likely than U.S.-born residents to come to the emergency department.[5] Meanwhile, a 2015 Association of American Medical Colleges (AAMC) report showed how the U.S. will face a shortfall of between 61,700 and 94,700 physicians by 2025.[6] Foreign medical graduates will be crucial to mitigating this deficit, particularly in many rural areas from which Trump drew his support.[7] Finally, as extreme as Trump's immigration threats may seem, his actions may only extend those of President Obama, who has deported more immigrants than any U.S. president in history.[8]

After initially submitting this article for publication, President Trump did indeed sign an executive order restricting entrance from seven predominantly Muslim nations and barring the admission of refugees from any country for 120 days. Notwithstanding the obvious danger this poses to refugees' lives, my two hospitals will also lose. The satisfaction of providing great care to those just starting out in our country is indescribable. Beyond our patients, we may sacrifice physicians as well. With trepidation, I read about the young Sudanese doctor attempting to return to her job at the Cleveland Clinic when she was instead placed in a holding cell at John F. Kennedy Airport in New York before being eventually sent to Saudi Arabia.[9] More broadly, Dr. Atul Grover, an executive of the AAMC, calculated that 260 individuals have applied to start their internships in the U.S. this July but may be barred as they hail from a prohibited nation.[10] Many of my brightest colleagues are foreign born; I hope that future generations of foreign physicians still consider practicing in American hospitals.

I am in no position to predict how immigration will ultimately change under the new president, but I can and do promise this to our foreign-born patients: in the emergency room, you are welcome. This welcome extends 24 hours a day, every day, no matter the political climate outside the hospital. We will speak to you in your preferred language, provide the same care that we give to all patients, and do this without regard to your ability to pay. As we have taken oaths to do, we will never divulge your personal information to any outside entity. When your medical problem is stabilized, our social worker colleagues can help you with other concerns such as obtaining prescription drugs, legal aid, or simply a safe

ride home. Speaking for my emergency nurse and physician colleagues, this is our avowed privilege — and it is the debt we owe to you.

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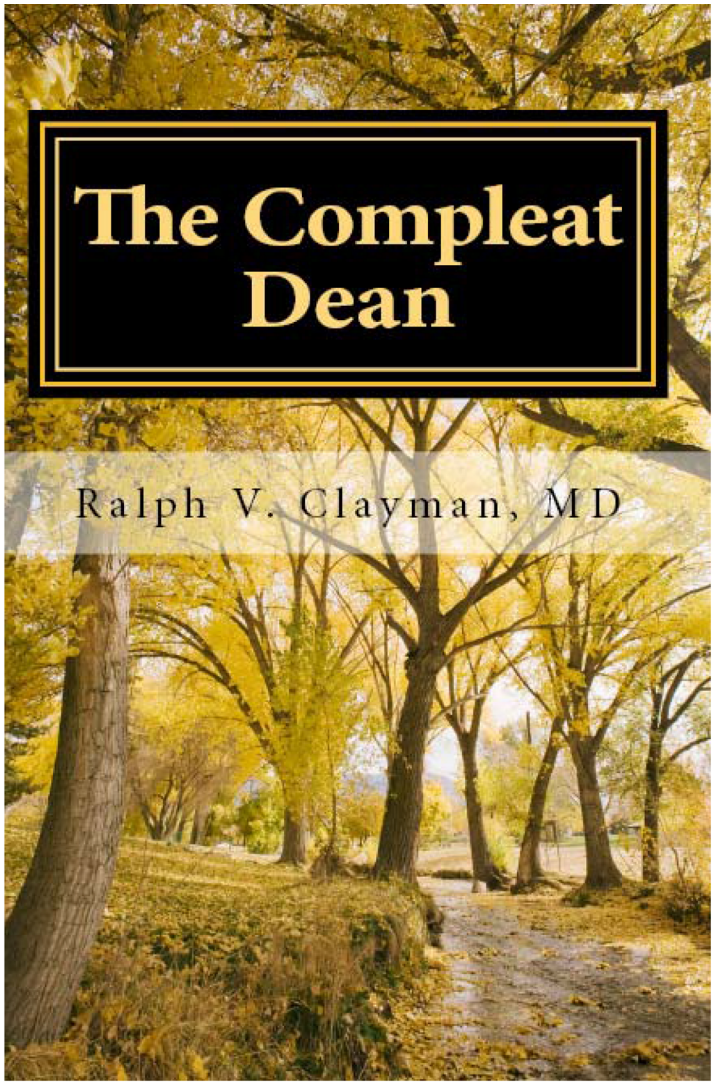

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