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Substance Use, Homelessness, Mental Illness and Medicaid Coverage: A Set-up for High Emergency Department Utilization

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Introduction: Frequent users of emergency departments (ED) account for 21–28% of all ED visits nationwide. The objective of our study was to identify characteristics unique to patients with psychiatric illness who are frequent ED users for mental health care. Understanding unique features of this population could lead to better care and lower healthcare costs.

Methods: This retrospective analysis of adult ED visits for mental healthcare from all acute care hospitals in California from 2009–2014 used patient-level data from California's Office of Statewide Health Planning and Development. We calculated patient demographic and visit characteristics for patients with a primary diagnosis of a mental health disorder as a percentage of total adult ED visits. Frequent ED users were defined as patients with more than four visits in a 12-month period. We calculated adjusted rate ratios (aRR) to assess the association between classification as an ED frequent user and patient age, sex, payer, homelessness, and substance use disorder.

Results: In the study period, 846,867 ED visits for mental healthcare occurred including 238,892 (28.2%) visits by frequent users. Patients with a primary mental health diagnosis and a co-occurring substance use diagnosis in the prior 12 months (77% vs. 37%, aRR [4.02], 95% confidence interval [CI] [3.92-4.12]), homelessness (2.9% vs 1.1%, odds ratio [1.35], 95% [CI] [1.27-1.43]) were more likely to be frequent users. Those covered by Medicare (aRR [3.37], 95% CI [3.20-3.55]) or the state's Medicaid program Medi-Cal (aRR [3.10], 95% CI [2.94-3.25]) were also more likely to be frequent users compared with those with private insurance coverage.

Conclusion: Patients with substance use disorders, homelessness and public healthcare coverage are more likely to be frequent users of EDs for mental illness. Substance use and housing needs are important factors to address in this population. [West J Emerg Med. 2018;19(6)902-906.]

INTRODUCTION

Mental illness is widespread and has high medical and socioeconomic costs.[1-5] Emergency department (ED) visits for mental healthcare are growing in the United States (U.S.).[6,7] Many patients continue to face significant barriers to consistent mental healthcare.[2,8-11] ED visits increase when mental health services are unavailable or uncoordinated.[12-14] Nationally, frequent ED users for all diagnoses account for 3–8% of all ED patients and 21–28% of all ED visits.[15-17] High ED utilization is often seen as a marker of unmet healthcare needs as well as an opportunity to decrease healthcare costs and improve resource utilization.[15,18,19] Yet prior research on frequent ED users found

that these patients have multiple chronic conditions and high rates of primary and specialty care outside the ED.[17,20] Studies of patients with high ED use for any diagnosis show that they have insurance coverage and are more likely to have private insurance or Medicare insurance.[17,20,21]

Patients with mental illness face barriers to consistent outpatient care. Mental health services tend to be difficult to access and poorly integrated with primary care.[22-24] Studies on ED utilization in patients with mental illness have focused on large urban populations and may not be generalizable to broader areas. Studies have evaluated ED utilization by patients with mental illness but are limited by the sample being either a single hospital or across a single urban area.[23,25-27] A study of ED visits in San Diego by patients with psychiatric diagnosis found that frequent users were more likely to have lower socioeconomic status, homelessness, and co-occurring substance use disorders.[26]

Our study examined ED utilization for patients with a primary mental health diagnosis over a six-year period across California, using data that included the geographic and socioeconomic diversity of the entire state. We hypothesized that patients with mental illness covered by Medicare or Medi-Cal (the state's Medicaid insurance program), those who were concurrent substance users, and homeless patients would be more likely to have high ED utilization. Understanding factors associated with high ED utilization across a large, diverse state has clinical and policy implications as systems attempt to address ED utilization and healthcare costs.

METHODS

We conducted a retrospective analysis of all adult ED visits to acute care hospitals with a primary mental illness in California from 2009–2014 using a cohort defined from patient-level data for all ED visits, reported to California's Office of Statewide Health Planning and Development (OSHPD). Each patient discharged from inpatient admission or ED treatment encounter in a licensed hospital in California is included in the OSHPD data. Our analysis included data on all ED visits from patients discharged or admitted through the ED from 2009–2014. These data do not represent a sample but rather surveillance with 100% coverage. The University of California Davis Institutional Review Board Administration as well as OSHPD's Committee for the Protections of Human Subjects approved this study.

Data used for the study included a unique patient identification number, patient demographic information to the level of Zip Code, date of service, expected source of payment, disposition, and up to 25 *International Statistical Classification of Diseases and Related Health Problems,* version 9 (ICD-9) diagnosis codes. We defined a surrogate marker for ED encounters of patients with a primary mental illness diagnosis as visits with mental health diagnosis in the first diagnosis position, using ICD-9 codes. Patients with a substance use disorder were defined as patients with a substance use diagnosis using ICD-9 codes in any one of the 24 secondary diagnosis positions. We defined patients with four or more ED encounters for a primary mental illness diagnosis in a 12-month period as frequent ED users. In the OSHPD database patients who were "homeless" were specifically assigned a zip code of "ZZZZZ." This designation is distinct from patients with an unknown Zip Code reported as "XXXX" and patients who do not reside in the U.S. reported as "YYYY."

We calculated descriptive analyses of patient demographic and visit characteristics (Table 1). Multivariate log-linear model with Poisson distribution was used to assess the association between patient factors such as age, sex, payer, homelessness, substance use disorder, and classification as an ED frequent user. We used adjusted rate ratios (aRR) to account for variations in person/time using the Poisson log-linear model. aRR and 95% confidence interval (CI) are reported in Table 2. Data analyses were performed using SAS (V9.4) software.

RESULTS

During the study period, a total of 846,867 visits were made to California EDs by adult patients with mental illness and a valid record linkage number. This total includes patients admitted, transferred, or discharged from the ED. Mean age was 54.0 (standard deviation 21.1) and 55.8% were male. Insurance status was 20.4% Medi-Cal, 31.5 Medicare, 12.4 private insurance, 10.2 % self-pay and 25.5% other (Table 1). Overall 238,892 (28.2%) of ED visits for mental illness were by frequent users.

Frequent users with mental illness had different characteristics than non-frequent users. Patients with a primary mental health diagnosis and a co-occurring, substance use diagnosis in the prior 12 months (77% vs. 37%, aRR [4.02], 95% CI [3.92-4.12]), homelessness (2.9% vs. 1.1%, odds ratio [1.35], 95% CI [1.27-1.43]) were more likely to be frequent users. Those covered by Medicare (aRR [3.37], 95% CI [3.20-3.55]) or Medi-Cal (aRR [3.10], 95% CI [2.94-3.25]) were also more likely to be frequent users compared with those with private insurance coverage.

DISCUSSION

Frequent ED users are a focus point for many health service agencies and policymakers because of the cost incurred from such patients on healthcare systems. Mental healthcare needs are often identified in the literature as a reason for high ED utilization.[23,25-27] However, in many other studies this conclusion is based on including all patients for whom a mental health diagnosis code appears in the case file, i.e., a code in any of the diagnosis lines in a patient file. When a mental health diagnosis from any position is included, mental illness may be a factor in the ED visit but not the primary reason for seeking care. We limited analysis to patients specifically seeking mental health treatment. Using this focused approach we noted several differences

Table 1. Descriptive statistics for mental health emergency department users.

	Less than 4 visits/year		4 or more visits/year	
Patient characteristics	N	%	N	%
Total	607975	71.8	238892	28.2
Gender				
Male	238463	50.1	22592	61.5
Female	237502	49.9	14129	38.5
Age				
21-25	55992	11.8	3916	10.7
26-30	52316	11.0	4922	13.4
31-35	47057	9.9	4700	12.8
36-40	42947	9.0	4123	11.2
41-45	47306	9.9	4493	12.2
46-50	51478	10.8	4815	13.1
51-55	47985	10.1	4277	11.6
56-60	36224	7.6	2752	7.5
61-65	24586	5.2	1512	40.1
66+	70074	14.7	1211	3.3
Payer				
Medi-Cal*	116373	24.4	14795	40.3
Medicare	119080	25.0	10971	29.9
Other	106354	22.3	5001	13.6
Private	54571	11.5	1737	4.7
Self pay	79587	16.7	4217	11.5
Homeless	5079	1.1	1074	2.9
Substance use in past 12 months	176147	37.0	28142	76.6

*Medi-Cal is the Medicaid healthcare program serving low-income people in California.

Table 2. Adjusted rate ratio for higher mental health emergency department use.

	Adjusted rate ratio	95% CI
Gender		
Male vs female	1.25	1.22-1.28
Payer		
Medi-Cal vs private	3.10	2.94-3.25
Medicare vs private	3.37	3.20-3.55
Self pay vs private	1.43	1.35-1.51
Other vs private	1.62	1.54-1.71
Age		
20-25 vs 51-55	0.97	0.93-1.01
26-30 vs 51-55	1.13	1.08-1.18
31-35 vs 51-55	1.15	1.10-1.19
36-40 vs 51-55	1.11	1.07-1.16
41-45 vs 51-55	1.08	1.03-1.12
46-50 vs 51-55	1.04	1.00-1.09
56-60 vs 51-55	0.91	0.87-0.96
61-65 vs 51-55	0.81	0.77-0.86
66+ vs 51-55	0.32	0.30-0.35
Homeless	1.35	1.27-1.43
Substance use in past year	4.02	3.92-4.12

CI, confidence interval.

between patients who are frequent users of the ED for mental illness and those who are not frequent users, including medical and social conditions that complicate treatment.

In our analysis concurrent, substance use diagnoses had a strong association with frequent ED visits for mental illness. This association between substance use disorders and mental illness highlights the importance of medical treatment that addresses both disorders. According to the Substance Abuse and Mental Health Services Administration's 2014 National Survey on Drug Use and Health, 7.9 million American adults have co-occurring, substance use disorders and mental illness.[28] Twenty percent of individuals with a serious mental illness develop a substance use disorder in their lifetime, yet only 7.4% receive treatment for both disorders and 55% receive no treatment at all.[28] Studies looking at single institutions have found high ED utilization in patients with co-occurring, substance use disorders.[23,26] Such dual-diagnosed patients have low rates of access to treatment for their substance use disorders.[29] Despite evidence that integrated treatment is considered best practice, there are barriers to widespread adoption.[11,30-33] Given the high demand for mental healthcare and substance use treatment identified in this study of California, future research should assess availability and impact of integrated mental health/substance use treatment programs.

Although less strong than the association between co-occurring, substance use disorders, we also found an association between homelessness and frequent ED visits for mental illness. Homeless patients had higher rates of ED visits and hospitalizations than non-homeless patients for all diagnoses, and they reported barriers accessing outpatient care.[34,35] Interventions designed to address homelessness such as supportive housing have shown to impact healthcare utilization and expenditures.[36-38]

National databases have shown that Medicaid recipients have a high prevalence of psychiatric disorders,[39] and psychiatric disorders are a driver of healthcare costs.[40] Indeed, we found a high proportion of patients entering the ED with mental illness were covered by the state's Medicaid program Medi-Cal. This finding is consistent with other studies that have noted that

patients covered by public insurance are more likely to use the ED when compared with those covered by private insurance.[41-43] Additionally, California extends its Medi-Cal eligibility to the largest extent feasible under federal law. Yet barriers to consistent primary care or lack of access to regular outpatient mental healthcare could explain the higher ED visit rates.[44,45]

LIMITATIONS

Studies that rely on retrospective data can be subject to a set of limitations such as selection, misclassification, and other forms of bias and confounding. Because our data cover the complete, documented population of ED visits in California, selection bias is mitigated. However, this study was dependent on diagnosis codes assigned by the ED provider and was subject to misclassification bias within and across the many hospitals from which patients were included. Further, choosing to identify those visiting the ED for mental health concerns by those with a mental health diagnosis in the first position served only as a proxy and risked missing patients. While individual chart review might have produced less concern, the volume of records made that infeasible. Prior work on ED populations and undiagnosed mental illness suggest that undercounting is more common.[46] We report on healthcare utilization, but the data cannot speak to health outcomes nor can we definitively identify the causes of high ED utilization. Despite its shortcomings, this study reports and identifies important characteristics of patients who visit EDs for mental illness frequently across a large, diverse population, information that suggests areas for further study.

CONCLUSION

Patients with substance use diagnoses, patients who are homeless and those who are covered by Medi-Cal, the state's Medicaid program, are more likely to be frequent users of the ED for mental illness. This suggests substance use and housing needs are important factors to address in patients with high ED use for mental health needs.

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Analysis of Patients with Ventricular Assist Devices Presenting to an Urban Emergency Department

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Introduction: Left ventricular assist device (LVAD) insertion is an increasingly common intervention for patients with advanced heart failure; however, published literature on the emergency department (ED) presentation of this population is limited. The objective of this study was to characterize ED presentations of patients with LVADs with a focus on device-specific complications to inform provider education and preparation initiatives.

Methods: This was a retrospective chart review of all patients with LVADs followed at an urban academic medical center presenting to the ED over a five-year period (July 1, 2009, to June 30, 2014). Two abstractors reviewed 45 randomly selected charts to standardize the abstraction process and establish a priori categories for reason for presentation to the ED. Remaining charts were then divided evenly for review by one of the two abstractors. Primary outcomes for this study were (1) frequency of and (2) reason for presentation to the ED by patients with LVADs.

Results: Of 349 patients with LVADs identified, 143 (41.0%) had ED encounters during the study period. There were 620 total ED encounters, (range 1 to 32 encounters per patient, median=3, standard deviation=5.3). Among the encounters, 431 (69.5%) resulted in admission. The most common reasons for presentation were bleeding (e.g., gastrointestinal, epistaxis) (182, 29.4%); infection (127, 20.5%); heart failure exacerbation (68, 11.0%); pain (56, 9.0%); other (45, 7.3%); and arrhythmias (40, 6.5%). Fifty-two encounters (8.4%) were device-specific; these patients frequently presented with abnormal device readings (37, 6.0%). Interventions for device-specific presentations included anticoagulation regimen adjustment (16/52, 30.8%), pump exchange (9, 17.3%), and hardware repair (6, 11.5%). Pump thrombosis occurred in 23 cases (3.7% of all encounters). No patients required cardiopulmonary resuscitation or died in the ED.

Conclusion: This is the largest study known to the investigators to report the rate of ED presentations of patients with LVADs and provide analysis of device-specific presentations. In patients who do have device-specific ED presentations, pump thrombosis is a common diagnosis and can present without device alarms. Specialized LVAD education and preparation initiatives for ED providers should emphasize the recognition and management of the most common and critical conditions for this patient population, which have been identified in this study as bleeding, infection, heart failure, and pump thrombosis. [West J Emerg Med. 2018;19(6)907–911.]

INTRODUCTION

With over 10,000 implantations to date, left ventricular assist device (LVAD) insertion as a bridge-to-transplant, bridge-to-recovery, or destination therapy, is an increasingly common intervention for patients with advanced heart failure,[1,2] yet most emergency physicians have limited training or experience in the care of such patients. Numerous clinical studies have illustrated the effectiveness and complications of LVADs,[3,4] but literature on the emergency department (ED) presentation of this population is limited, particularly with regard to device-specific complications.[5-7] In addition to the complications associated with heart failure, patients with LVADs are at risk for critical adverse events such as intracranial and gastrointestinal bleeding, driveline infection, and pump thrombosis. Early diagnosis of pump thrombosis is critical, as it can result in urgent transplantation, device replacement, or death. Incidence has been reported as 0.02 to 0.08 events per patient per year with continuous-flow devices.[8]

While investigators have proposed pathways for evaluating patients with LVADs and assessing device function in the ED,[9–11] the incidence and nature of ED encounters in this patient population remains unclear. Increased awareness regarding the common ED presentations of patients with LVADs could lead to more targeted education interventions, improved provider preparedness, and enhanced care for this complicated population. The purpose of this study was to characterize the presentation and clinical course of patients with LVADs presenting to an urban, academic medical center ED with a focus on device-specific complications.

METHODS

Study Design

This was a retrospective chart review of ED visits made by patients with LVADs during a five-year period (July 1, 2009 – June 30, 2014). The institutional review board approved the study protocol and waived informed consent requirements.

Study Setting and Population

The study site was an urban, academic medical center with approximately 60,000 annual adult ED visits. The institution's heart failure service maintains a database of all patients who have received LVADs at the institution. We queried a health record database for ED encounters by all 349 patients who had LVADs during the study period. Encounters that occurred prior to a patient's LVAD placement or after heart transplant were excluded.

Study Protocol and Measurements

Abstraction of the chart data used a combined deductive and inductive process. Data extracted for each encounter included patient demographics, chief complaint, evaluation, diagnostic testing, interventions, final ED ICD-9 diagnoses, and disposition. Two physician authors (ES, AG) reviewed 45 randomly selected encounters to develop presentation categories: device-specific; bleeding (e.g. gastrointestinal [GI], epistaxis); infection (e.g. bacteremia, driveline infection); heart failure exacerbation; arrhythmia; anemia; pain (chest, abdominal, or other); neurologic; dehydration; musculoskeletal; pulmonary; GI (non-bleeding); venous-access related; or other (including endocrine, renal, rheumatologic, oncologic, dermatologic, or psychiatric presentations).

We subcategorized device-specific presentations as abnormal device readings/alarms, grossly damaged equipment, or non-specific complaints. Bleeding and driveline infections, while related to having an LVAD due to requisite anticoagulation and percutaneous wiring, respectively, were not categorized as device-specific. Presentation categories were determined after review of the entire chart and were not mutually exclusive (e.g., a patient presenting with dyspnea who is diagnosed with a heart failure exacerbation from pump thrombosis would be categorized as both "heart failure exacerbation" and "device-specific: non-specific complaint").

The abstractors used the 14 a priori presentation categories and three subcategories to sort the remaining encounters. Conflicting or ambiguous chart elements were discussed between abstractors until consensus interpretation was reached. Interrater percent agreement on 10 random charts was calculated (satisfactory agreement >=90%). As a secondary analysis, we studied outcomes in bounce-back encounters (defined as a second ED visit within seven days of discharge).

Data Analysis

We analyzed data to calculate the frequency of, and reason for, presentation to the ED by patients with LVADs. A detailed review of device-specific encounters was performed to better understand the disposition and interventions in these patients. We compared categorical and continuous data using chi-squared and single-tailed unpaired t-testing, respectively.

RESULTS

Of the 349 patients with LVADs during the study period, there were 838 total encounters by 158 patients. Of these, 620 encounters made by 143 patients with LVADs (116 HeartMate II™, 27 HeartWare™) met inclusion criteria. The median number of encounters made by each patient was three (range 1-32, standard deviation [SD]=5.3). Patients were mostly male (109, 76.2%), with a median age of 60 (SD=13.2) at time of first encounter. Among the encounters, 431 (69.5%) resulted in admission, 187 (30.2%) resulted in discharge, one patient left against medical advice, and one left without being seen. Interrater agreement was 100% on primary categories and 90% when secondary categories were included. The most common category was bleeding, occurring 182 (29.4%) times. Of these, 104 (104/182, 57.1%) were GI bleeding, and 57 (57/182, 31.3%) were epistaxis. Average international normalized ratio (INR) for these patients was 2.3 (N=162, SD=1.5), compared to 2.1 (N=352, SD=1.0) in other encounters in which INR was measured

(P=0.08). Other common categories included 127 (20.5%) infections, 68 (11.0%) heart failure exacerbations, 56 (9.0%) pain, 45 (7.3%) other, and 40 (6.5%) arrhythmias (Figure).

No patients required cardiopulmonary resuscitation or died in the ED. Compared to other encounters, it was less common for bounce-back encounters to be device-specific (7/161 [4.3%] vs. 45/459[9.8%], P<0.01), and more common to be related to pain (25/161 [15.5%] vs. 31/459 [6.8%], P=0.02).

Device-Specific Encounters

Fifty-two encounters (8.4%) were device-specific (Table). In the majority of these encounters, patients presented with abnormal device readings/alarms (37, 6.0% of all encounters). Patients with device-specific presentations were admitted 44 times, with seven discharges. One patient left against medical advice. Pump thrombosis occurred in 23 cases and presented with an abnormal device reading/alarm (10) or a non-specific complaint such as hematuria (6), dyspnea (3), abnormal lab value (3), or chest pain (1). Average initial INR in patients with pump thrombosis was 1.9 (N=18, SD=0.6) compared to 2.2 (N=496, SD=1.2) when measured in other encounters (P=0.17). Average lactate dehydrogenase in patients with pump thrombosis was 2142 (N=14, SD=989) compared to 451 (N=188, SD=347) when measured in other encounters (P<0.001). Interventions for device-specific presentations included anticoagulation regimen adjustment (16, 30.8%), pump exchange (9, 17.3%), hardware repair (6, 11.5%), and device settings adjustment (4, 7.7%).

Table. Summary of device-specific encounters and interventions.

	N (%)
Number of device-specific encounters	52
Number of unique patients	32
Device type	
HeartMate II™	23 (71.9%)
HeartWare™	9 (28.1%)
Disposition	
Admit	44 (84.7%)
Discharge	7 (13.4%)
Against medical advice	1 (1.9%)
Presentation subcategory	
Abnormal device reading/alarm	37 (71.2%)
Grossly damaged equipment	2 (3.8%)
Non-specific complaint	13 (25.0%)
Interventions for device-specific encounters	
Anticoagulation adjustment	16 (30.8%)
Pump exchange	9 (17.3%)
Hardware repair, replacement, or adjustment	6 (11.5%)
Device settings adjustment	4 (7.7%)
Catheter-directed thrombolysis	4 (7.7%)
Heart transplant	2 (3.8%)
Diuresis	2 (3.8%)
Other	7 (13.5%)
No intervention	3 (5.8%)

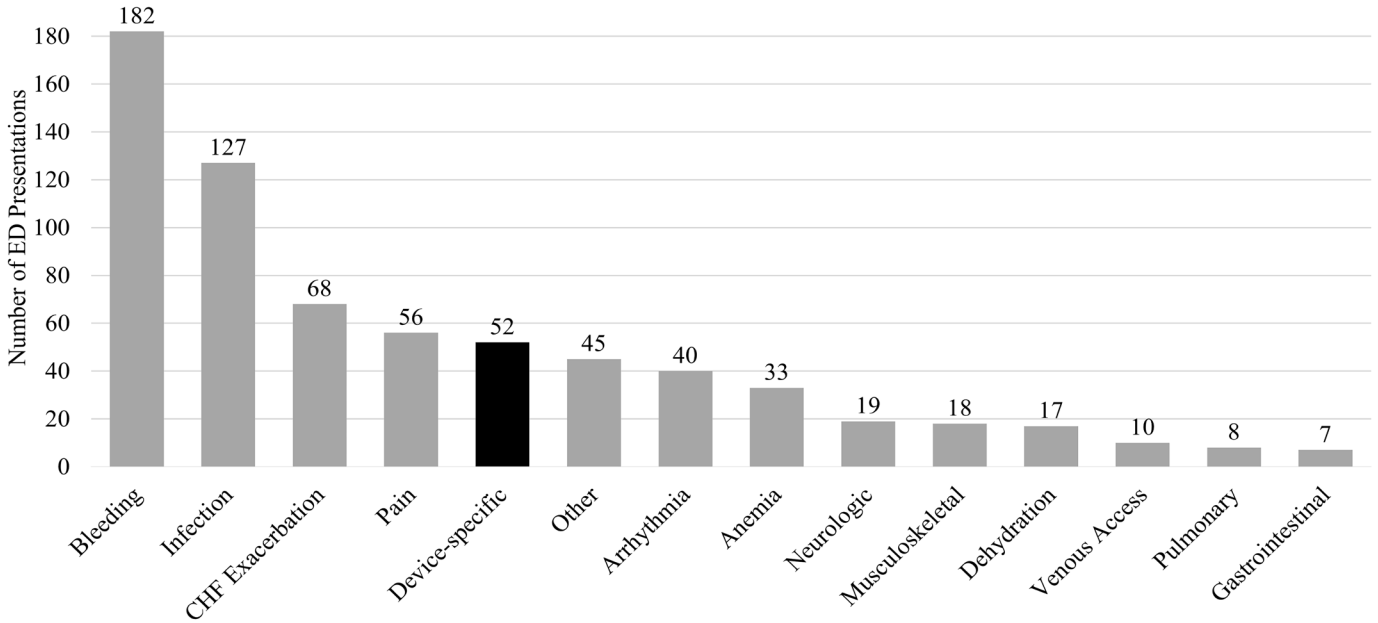

Figure. Number of emergency department (ED) presentations by category from patients with left ventricular assist devices in a five-year period. Device-specific presentations are highlighted in black.
CHF, congestive heart failure.

DISCUSSION

Specialized LVAD education and preparation initiatives for ED providers should focus on the most common and most critical presentations in this population. This study provides an evidentiary basis for such interventions by characterizing the frequency and nature of ED encounters for patients with LVADs. GI hemorrhage and epistaxis made bleeding the most common reason for presentation to the ED in our study, accounting for more than one in four visits. This is congruent with the results of previous studies.[6,7] Risk factors for bleeding in this population include anticoagulation, development of arteriovenous malformations, and acquired von Willebrand disease.[2] It is, therefore, extremely important that ED providers be familiar with the workup and management of bleeding complications in this population.

Infection was the second most common presentation category in our study, often presenting as bacteremia associated with a driveline infection. This is consistent with the known high risk of infection in this population, including the risk of sepsis developing in as many as 20% of patients within one year of device implantation.[1] Heart failure exacerbations ranked third in prevalence. The importance of familiarity with the management of these conditions in this population is underscored by the frequency of these presentations.

We identified device-specific presentations in 8.4% of ED visits. Although the majority of these encounters presented with an abnormal device reading/alarm, more than one in four had normal device readings. About half of the device-specific presentations were due to pump thrombosis. Thrombosis should be suspected in cases of abnormal device readings (e.g., increased power, increased calculated flow), worsening heart failure, and hemolysis, often in the setting of subtherapeutic anticoagulation.[8] Importantly, in our study, patients with pump thrombosis more often presented with a non-specific complaint than an abnormal device reading or alarm. Approximately one in 50 patients who presented with a non-specific complaint such as hematuria or dyspnea ultimately were diagnosed with pump thrombosis after admission for further testing. These data highlight the importance of vigilance in pursuing this diagnosis in patients with LVADs presenting to the ED.

LIMITATIONS

This was a retrospective chart review and used subjective interpretation of medical records to develop presentation categories. By using presentation categories, our intention was to provide more meaningful information than what is typically derived from the chief complaint, final diagnosis, or other objective outputs from health records. Our investigation of interventions was limited to device-specific encounters. Therefore, we did not report data on interventions for more common presentations such as bleeding and infection. Although we studied a large sample of patients across several years, we were limited to ED presentations at a single institution, and exclusively studied patients who had their LVAD placed at that same institution. Additionally, all patients received either the HeartMate II™ or HeartWare™ device, and thus our study does not include presentations of patients with other devices.

CONCLUSION

This is the largest study known to the investigators to report the rate of ED presentations of patients with LVADs and provide analysis of device-specific presentations. In patients that do have device-specific ED presentations, pump thrombosis is a common diagnosis and can present without device alarms. Specialized LVAD education and preparation initiatives for ED providers should emphasize the recognition and management of the most common and critical conditions for this patient population, which have been identified as bleeding, infection, heart failure, and pump thrombosis.

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Predictors of Admission in Adult Unscheduled Return Visits to the Emergency Department

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Introduction: The 72-hour unscheduled return visit (URV) of an emergency department (ED) patient is often used as a key performance indicator in emergency medicine. We sought to determine if URVs with admission to hospital (URVA) represent a distinct subgroup compared to unscheduled return visits with no admission (URVNA).

Methods: We performed a retrospective cohort study of all 72-hour URVs in adults across 10 EDs in the Edmonton Zone (EZ) over a one-year period (January 1, 2015 – December 31, 2015) using ED information-system data. URVA and URVNA populations were compared, and a multivariable analysis identified predictors of URVA.

Results: Analysis of 40,870 total URV records, including 3,363 URVAs, revealed predictors of URVA on the index visit including older age (>65 yrs, odds ratio [OR] 3.6), higher disease acuity (Canadian Emergency Department Triage and Acuity Scale [CTAS] 2, OR 2.6), gastrointestinal presenting complaint (OR 2.2), presenting to a referral hospital (OR 1.4), fewer annual ED visits (<4 visits, OR 2.0), and more hours spent in the ED (>12 hours, OR 2.0). A decrease in CTAS score (increase in disease acuity) upon return visit also increased the risk of admission (-1 CTAS level, OR 2.6). ED crowding at the index visit, as indicated by occupancy level, was not a predictor.

Conclusion: We demonstrate that URVA patients comprise a distinct subgroup of 72-hour URV patients. Risk factors for URVA are present at the index visit suggesting that patients at high risk for URVA may be identifiable prior to admission. [West J Emerg Med. 2018;19(6)912–918.]

INTRODUCTION

In strained healthcare systems globally, there is growing pressure to ensure efficient and high-quality care delivery. Therefore, it is important to develop performance metrics that can be used to monitor care quality and reflect important attributes of patient care. Several quality measures have been proposed and employed in emergency medicine including the number of patients who leave without being seen, ambulance diversion times, total length of stay, and the time delay from a patient's arrival until being seen by a provider.[1] This paper explores another performance metric – the unscheduled return visit (URV).

The URV refers to patients who are discharged from the emergency department (ED) and return unexpectedly within a specified time frame. Large, multi-hospital, quality improvement programs have used 72-hour URVs to monitor for adverse events and medical error.[2] Similarly, in the inpatient setting reimbursement and accreditation programs may penalize hospitals for high rates of readmission for

certain medical conditions.[3] The assumption underlying such surveillance is that the URV represents a potentially avoidable event and may be associated with unsafe or ineffective care. Chart reviews lend support to this idea, revealing links between URVs and missed diagnoses, premature discharge, and inadequate discharge instructions in the ED.[4-7]

Existing literature exploring the URV as an ED performance indicator is inconsistent. Published time frames for the URV range from 24 hours to 30 days, and the proportion of URVs that are considered avoidable may be as low as 3% to as high as 32%.[8,9] It is not surprising, then, that the degree of validity and utility of the metric remains unclear. For example, Pham et al. (2011) studied a large national database to find that 72-hour URV patients have similar disease severity, resource utilization, and rates of admission compared to other ED patients.[10]

The distinction between unscheduled return visits with admission (URVA) and unscheduled return visits with no admission (URVNA) may underpin some of the confusion surrounding the URV, as most investigations do not examine URV subgroups. In some guidelines, however, expert consensus recommends using the URVA over the URVNA to monitor ED performance.[1] This opinion is supported by Hu et al. (2012) who report a stronger link to medical error in URVAs than URVNAs.[11] In contrast, Sabbatini et al. (2016) found that URVAs were associated with lower mortality in the hospitalized population bringing the metric's validity into question.[12] Consequently, the utility of distinguishing between URVAs and URVNAs remains uncertain and many EDs continue to use the URV overall for performance measurement.

Here, we set out to compare URVA and URVNA populations in a large Canadian cohort. We hypothesized that these were distinct groups with different patient and disease factors at their initial, or index, ED visit. We described and compared each population and then evaluated for predictors of URVA.

Population Health Research Capsule

What do we already know about this issue?
Unscheduled return visits (URVs) are often used as a quality metric in emergency medicine. Some URVs result in admission to hospital (URVAs) whereas others do not (unscheduled return visits with no admission [URVNAs]).

What was the research question?
Are URVAs a distinct high-risk subgroup of URVs compared to URVNAs?

What was the major finding of the study?
URVA patients tend to be older, sicker, and have unique presenting symptoms.

How does this improve population health?
Identifying high-risk patients at emergency department (ED) discharge may help to prevent future hospital admissions. Healthcare administrators can better understand, measure, and improve ED quality of care.

METHODS

Data Source

The Edmonton Zone (EZ) of the Alberta Health Services (AHS) provincial healthcare delivery system contains 10 EDs that capture patient information using standardized data entry (Emergency Department Information System or "EDIS"). Clinical data is entered first by a triage nurse and then by the bedside nurse and attending emergency physician. Our source population was comprised of adult patients (greater than or equal to 17 years) who had a return visit within 72 hours of an index ED visit in the EZ between January 1, 2015, and December 31, 2015. The 72-hour threshold used by AHS for quality assurance is an accepted national standard.[2] This study was reviewed and approved by the University of Alberta Health Research Ethics Board.

Patient Selection

We excluded patients from the initial cohort who did not represent a URV. Firstly, patients whose return visit was scheduled or planned were excluded. These patients are flagged as 'Expected' in the EDIS system and, for example, might represent a patient who is asked to return to the ED for cast removal or a corneal abrasion recheck. Additionally, we excluded patients whose final disposition was not "Discharged With Approval." Examples of alternative dispositions include "Left Without Being Seen," "Left Against Medical Advice" and "Transferred With Approval." Lastly, frequent ED users were excluded. These patients represent a distinct group with frequent ED use who have an increased risk of URV often attributable to patient-related factors.[13] We defined frequent users as those patients whose number of ED visits during the study period was in the top 5% of the sample (95th percentile). While there is no universally accepted definition of frequent users, our definition is consistent with that used by other investigators.[14]

Variable Selection

Study variables were divided into two broad categories: 1) patient related and 2) system related. Patient-related variables included age (17-29, 30-49, 50-64, 65+ years), triage score (1 to 5), change in triage score (Visit 2 – Visit 1), and presenting

complaint (according to the Canadian Institute of Health Information Presenting Complaint List).[15] System-related variables included mode of transport (personal vehicle, air, ambulance, police), hospital type (academic teaching, referral community, and non-referral community), triage time (0700-1459, 1500-2259, 2300-0659), occupancy level (see description below), and total hours spent in the ED (0-4, 4-8, 8-12, >12 hrs).

Triage scoring used the Canadian Triage and Acuity Score (CTAS) measure.[16] The score is graded from 1 (most acute) to 5 (least acute). Standardized presenting complaints were recorded according to pre-defined CTAS categories, which are comprised of two elements: a broad, system-based descriptor (e.g., "gastrointestinal") and a more specific symptom (e.g., "abdominal pain").[17] We used the symptom for our descriptive analysis and the system-based descriptor for the multivariate analysis. Change in triage score was the only variable that used data from the return visit and was computed as the difference in score between the return and index visits. For example, a score of 4 at the index visit and 2 upon return would result in a change in triage score of -2. Thus, a negative value suggested a deterioration of health status.

Occupancy level was used as a measure of ED crowding. Occupancy level represents the number of patients registered at the time of triage divided by the number of care spaces in that ED; it is expressed as a proportion and was coded as a continuous variable. No single best metric for ED crowding exists; however, occupancy level has been previously used and validated.[18-20]

Statistical Analysis

We performed statistical analysis using statistical software (SAS v9.4, SAS Institute Inc., Cary, NC, USA). For categorical variables, URVA and URVNA populations were compared for similarity using the chi-squared test. For continuous variables, we performed a comparison of means using the t-test. Presenting complaints were ranked and the relative frequencies of the top 10 most frequent in the study cohort are reported; direct pairwise comparisons were not performed. To identify predictors of URVA, a logistic regression was carried out.

RESULTS

Population of Study

A total of 470,902 adult ED visits occurred during the study year with an overall admission rate of 12.4%. Of these visits, 40,870 were URVs (return rate of 8.7%). Excluded patients included 3,354 who were "Expected," 9,263 who were not "Discharged with Approval,", and 3,171 who were frequent ED users. Of the URVs there were 3,363 URVAs, giving a URV admission rate of 8.2%.

Descriptive Analysis

Comparison of group means are shown in Table 1. On average, URVA patients were older than URVNA patients (54.5 vs. 44.8 years, p <.0001) with lower CTAS scores (3.0 vs. 3.4, p <.0001). CTAS scores decreased between the index and return visit in the URVA group but not the URVNA group (-0.04 vs. +0.41, p <.0001). URVA patients had fewer ED visits during the study year (5.2 vs. 6.1, p <.0001) and presented slightly earlier in the day (13:54 vs. 14:18, p <.0001). Occupancy level at triage and total hours spent in the ED were higher in the URVA group (158% vs. 144%, p <.0001; 7.0 vs. 4.5 hrs, p <.0001).

Table 1. Mean comparisons in URVNA and URVA populations.

	URVNA (n = 37,507)	URVA (n = 3,363)	
	Mean	Mean	p-value
Age	44.8	54.5	<.0001
ED visits in year	6.1	5.2	<.0001
Hours in ED (hours)	4.5	7.0	<.0001
Time of triage (24-hr clock)	14:18	13:54	<.0001
Occupancy level (%)	144	158	<.0001
Change in triage score	+0.41	-0.04	<.0001
Initial triage score	3.4	3.0	<.0001

URVNA, unscheduled return visits with no admission; *URVA*, unscheduled return visits with admission; *ED*, emergency department.

Chi-squared tests revealed significant differences between URVA and URVNA patients for the ED type and mode of transport variables (Table 2). Trends suggest that URVA patients are more likely to arrive by ground emergency medical services rather than in private vehicle or ambulatory. Additionally, they are more likely to be seen initially at an academic teaching hospital or referral community center. The most frequent presenting complaints at the index visit are reported in Table 3. The most frequent complaint overall was "abdominal pain," which occupied a greater proportion in the URVA group. Notable trends included more instances of "shortness of breath" in the URVA group and a higher proportion of "wound checks" and "prescription requests" in the URVNA group.

Logistic Regression

Predictors of URVA are shown in Table 4. Older age was associated with URVA for all age strata with those over 65 years at particularly high risk of admission (odds ratio [OR] 3.6 [3.2 - 4.0]). Fewer ED annual visits also increased the risk of URVA (0-4 visits, OR 2.0 [1.7 – 2.4]). Patients spending more total hours in the ED were more likely to be admitted when they returned (OR 2.0 [1.7 – 2.4] for >12 hrs). Gastrointestinal symptoms at the index visit conferred 2.7 times the odds of admission, and URVA patients were more likely to initially present at an academic teaching hospital (OR 1.4 [1.2 – 1.5]) or a referral community center (OR 1.4

Table 2. Frequency distributions for URVNA and URVA populations.

	URVNA (n = 37,507)	URVA (n = 3,363)	
	Proportion (%)	Proportion (%)	p-value
ED Type			<.0001
Academic tertiary	19.9	31.0	
Referral community	34.9	41.2	
Non-referral community	45.2	27.8	
Mode of arrival			<.0001
Private vehicle/ambulatory	89.8	72.3	
Ground ambulance	9.3	26.5	
Police	0.41	0.65	
Other	0.05	0.13	

URVNA, unscheduled return visits with no admission; *URVA*, unscheduled return visits with admission; *ED*, emergency department.

Table 3. Frequent presenting complaints in URVA and URVNA populations.

URVNA (n = 37,507)		URVA (n = 3,363)	
Rank	%	Rank	%
1. Abdominal pain	14.8	1. Abdominal pain	21.2
2. Localized swelling	7.7	2. Shortness of breath	5.4
3. Wound check	6.7	3. Pregnancy issues <20 weeks	3.3
4. Pregnancy issues < 20 weeks	4.6	4. Flank pain	2.8
5. Prescription request	3.7	5. Lower extremity pain	2.5
6. Flank pain	3.4	6. Chest pain	2.5
7. Lower extremity pain	3.2	7. Headache	2.0
8. Chest pain	2.5	8. Local swelling	2.0
9. Headache	2.4	9. Wound check	1.0
10. Shortness of breath	2.1	10. Prescription request	0.5
11. Other	49.0	11. Other	57.0

URVNA, unscheduled return visits with no admission; *URVA*, unscheduled return visits with admission.

[1.3 – 1.6]). Higher index-visit triage scores predicted URVA. Compared to the most common CTAS score of 3, a score of 2 was associated with 2.6 times the risk of admission. Furthermore, an increase in disease acuity upon return visit, indicated by a more acute triage score by one level, increased risk of admission by 2.6 times (95% confidence interval [CI] [2.4 – 2.7]). Mode of arrival, time of triage, and occupancy level at the index visit did not emerge as predictors of URVA. Surprisingly, higher occupancy level reduced the odds of admission, albeit to a seemingly negligible degree.

A sensitivity analysis including frequent users of the ED did not significantly alter the results. Predictors of admission remained constant apart from the presenting complaint category – only abdominal pain and general/minor complaints remained predictors. No new risk factors emerged.

DISCUSSION

The overall URV rate in our study (8.7%) is consistent with estimates from multi-hospital, statewide U.S. data (7.5%).[21] Hospital-specific data captures only a subset of URVs and therefore often yields lower estimates (e.g. 1.3% – 5.5%).[4,22,23] Thus, it is important to use aggregate data to calculate the URV metric. We observed important differences between URVA and URVNA patients. In particular, advanced age was a strong predictor of admission on the repeat ED visit. This finding aligns with previously reported associations between older age and ED boarding time, resource utilization, and mortality.[24-26] Elderly patients have also demonstrated higher rates of 72-hour URV to the ED.[27-29] Our data confirm that older age remains a high-risk feature within the URV population.

Table 4. Factors associated with URVA in logistic regression analysis.

	OR (95% CI)	p-value
Age		
18-30	reference	
30-50	1.3 (1.1 – 1.4)	<0.0001
50-65	1.8 (1.6 – 2.0)	<0.0001
>65	3.6 (3.2 – 4.0)	<0.0001
Triage score		
1	6.6 (3.2 – 13.6)	<0.0001
2	2.6 (2.3 – 2.9)	<0.0001
3	reference	
4	0.3 (0.25 – 0.33)	<0.0001
5	0.1 (0.08 – 0.13)	<0.0001
Change in triage score (-1 point)	2.6 (2.4 – 2.7)	<0.0001
Presenting complaint		
Gastrointestinal	2.2 (1.4 – 3.5)	0.001
Respiratory	1.7 (1.1 – 2.8)	0.03
General and minor	1.7 (1.0 – 2.8)	0.04
Obstetric/gynecologic	1.6 (1.0 – 2.7)	0.05
Minor trauma	reference	
Hours in ED		
0-4	reference	
4-8	1.3 (1.2 – 1.4)	<0.0001
8-12	1.4 (1.3 – 1.7)	<0.0001
>12	2.0 (1.7 – 2.3)	<0.0001
Number of visits in year		
0-4	2.0 (1.7 – 2.4)	<0.0001
4-8	1.9 (1.6 – 2.2)	<0.0001
8-12	1.4 (1.2 – 1.7)	0.003
>12	reference	
Type of hospital		
Academic teaching	1.4 (1.2 – 1.5)	<0.0001
Referral community	1.4 (1.3 – 1.6)	<0.0001
Non-referral community	reference	
Occupancy level (+1%)	0.99 (0.99 – 1.00)	0.02

OR, odds ratio; *URVA*, unscheduled return visit with admission; *ED*, emergency department; *CI*, confidence interval.

We found a robust link between index triage scores and URVA. Existing evidence relating disease severity measures and URVs is conflicting. One study found similar disease acuity in patients admitted to hospital independent of prior ED visit.[12] Another large retrospective analysis showed that URV patients did not have a higher incidence of vital sign abnormalities compared to the average ED patient.[10] These studies analyzed disease severity at the return visit, whereas we analyzed the index visit and the change in health status upon return. Therefore, we cannot confirm or refute these findings; however, our results suggest that index triage scores may be an important consideration in risk stratification. Future studies should seek to further evaluate the utility of triage scores, both at index and return visits, in predicting adverse outcomes in URV patients.

The existing literature reporting typical symptom constellations associated with URVs is heterogeneous and inconsistent, varying with study population (e.g., URV vs. URVA) and diagnostic coding systems. Nevertheless, there are a few consistent effects. Gastrointestinal symptoms, and abdominal pain in particular, have been repeatedly linked to URVs.[30-36] Our findings confirm the importance of this presentation, demonstrating a nearly three-fold increase in odds of admission on the repeat visit in those with gastrointestinal symptoms. We also show that patients with respiratory and obstetric/gynecologic complaints are high risk; future subgroup analyses of these complaint categories could reveal specific high-risk disease processes. By focusing on URVA patients, it appears that the incidence of typically low-risk presentations such as wound check, localized swelling, and prescription request are minimized. In turn, the URVA may more accurately reflect a high-risk set of diseases that are clinically challenging on presentation to the ED.

After the exclusion of frequent ED users, fewer annual ED visits predicted URVA in our study. In turn, patients who visit the ED frequently have, on average, a lower risk for admission, perhaps because their presentations reflect patient-related factors such as social instability, or lack of primary care access. In contrast, those who present infrequently may be more likely to be experiencing an acute, rapidly progressive, or severe illness. Consistent with this interpretation is the observation that when URVA patients returned to the ED they demonstrated an average decrease in CTAS score (increased disease acuity) relative to their index visit. URVA patients also spent a longer time in the ED at their initial visit, perhaps indicating more extensive investigations or more complex presentations.

A longer ED length of stay, alternatively, might suggest a more crowded ED. Surprisingly, however, our proxy for ED crowding – occupancy level – was negatively correlated with URVA when other variables were controlled. The explanation for this result is unclear. One possibility is that reduced crowding is associated with high-risk features that were not measured in this study. For example, there is typically less crowding on overnight shifts but also less staffing coverage, increased fatigue, and decreased consulting service and radiology support. Alternatively, the occupancy level metric may not accurately capture ED crowding. For example, "unofficial care spaces" such as hallway stretchers are typically not reported to governing bodies but would alter an ED's true

capacity. Over 70 crowding indicators have been used in the existing literature, none of which are extensively validated.[37] Despite this limitation, our findings agree with previous authors who have found no association between ED crowding and URVs.[38-40] Future studies should attempt to further delineate the relationship between URVAs and ED crowding.

Future studies should also seek to establish links between URVs (URVAs in particular) and clinically important outcomes. Excess resource utilization associated with the URV should be quantified, including investigations, consultations, and therapies. To clarify the link between URVs and care quality, the relative associations between URVNAs, URVAs, and medical error is important. Ultimately, delineating the risk factors for URVA will drive predictive modelling and clinical decision support systems, which may reduce their occurrence. These findings may also serve to promote awareness of URVA risk factors, allowing clinicians to identify high-risk scenarios at an index visit and alter the chosen disposition.

LIMITATIONS

Our study's findings are bolstered by a large sample size taken from all EDs within a large, well-defined geographic region. Thus, we overcame the limitations of publications using hospital-specific data, which may be insensitive to patients who present initially to one ED and return to another. We do recognize, however, that a small proportion of patients may have sought care outside of the ED when they returned to hospital. Our choice of variables was limited by logistic, practical, and technologic constraints, leaving the possibility that confounding effects were unobserved. For example, we were unable to include medical comorbidities or vital signs, which are important patient-related variables. In addition, we have little information about the events that occurred during the ED visits themselves, such as consultations, investigations, and therapies. To effectively assess validity URVs should be linked to mortality and/or morbidity; we were not able to obtain this data using the available database.

Notably, using a 95th percentile cut-off to define frequent users implies a dichotomy where there is likely a continuum. A proportion of patients in the upper range of annual ED visits are likely similar to frequent users. Our sensitivity analysis including "frequent fliers" did not change our results, suggesting that the distinction itself may be artificial or not clinically important. Further studies might better define frequent ED users as a distinct subgroup.

CONCLUSION

Our work contributes a more detailed understanding of the 72-hour URV ED patient population of an entire health region. We show that measurable variables related to the patient, their disease, and the healthcare delivery apparatus are linked to the risk of admission when a patient returns to the ED. Overall, patients who are admitted upon return are older with fewer annual ED visits. At the index visit, they more often present to large referral hospitals with higher disease acuity, high-risk symptom profiles, and they spend a longer time in the ED. In turn, URVAs represent a high-risk group that is identifiable at initial presentation, and compared to URVNAs or URVs at large, they may be the superior quality metric in emergency medicine.

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Social Disconnection Among Older Adults Receiving Care in the Emergency Department

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Introduction: Social disconnection is a public health problem in older adults, as it can lead to decreased quality of life for this population. This study describes the prevalence of social disconnection and patient interest in social resources to address social disconnection among older adults receiving emergency department (ED) care.

Methods: We conducted a cross-sectional survey of community-dwelling older adults (≥65 years) receiving care at two U.S. EDs. We described participant characteristics (demographic, social, and health variables), social disconnection prevalence, and desire for social resources using percentages and 95% confidence intervals. Then, we performed Chi Square tests and logistic regression to determine factors associated with positive screens for social disconnection.

Results: Of 289 participants, 51% were female and the median age was 72 (interquartile range: 69-78). Most (76%) engaged with the community regularly, and 68% reported driving. Regarding social disconnection, a substantial minority of participants reported feeling as if they were burdensome to others (37%); as if they didn't belong (27%); or that people would be better off if they were gone (15%); 52% reported at least one of these. In separate regression analyses, the perceptions of being a burden or better off if gone were each significantly associated with needing help with routine tasks (odds ratio [OR] [5.87, 5.90]); perceived burden was associated with hospitalization in the prior month (OR [2.09]); and low belonging was associated with not engaging in the community regularly (OR [2.50]), not seeing family regularly (OR [3.82]), and difficulty affording food (OR [2.50]). Regarding potential ED referrals, most participants were interested in transportation options (68%), food assistance (58%), and mental health resources (55%). Participants experiencing difficulties affording food were interested in food and housing assistance (p=.03; p=.01).

Conclusion: Over half of this sample of older ED patients reported feeling socially disconnected. Social and functional health problems are often related and both must be addressed to optimize older ED patient quality of life. Future research should consider the impact of social disconnection on older adults discharged from the ED and work to develop ED services that could refer this population to programs that may decrease social disconnection. [West J Emerg Med. 2018;19(6)919–925.]

INTRODUCTION

In 2009, adults aged ≥65 years accounted for 18% of visits to emergency departments (ED) in the United States (U.S.).[1,2] Because hospitalization may negatively impact older patients, providers seek safe discharge plans.[3] Recent Geriatric ED Guidelines[4] address older ED patients' physical needs, but important social health determinants (e.g., social support, food, and housing access) receive less focus.[5,6]

Social connection refers to how individuals connect with others, comprising both objective (e.g., number of family members seen each week, amount of time spent with others) and subjective (e.g., loneliness, feelings of burdensomeness, feeling like one belongs in relationships) connections.[7] Social disconnection may increase health risks for older adults.[8,9] Affecting ~43% of this population,[10] it is associated with negative outcomes such as falls,[11] cognitive decline,[12] and mortality.[13] Two subjective forms of social disconnection are perceptions of burdensomeness, and not "belonging."[7] According to the Interpersonal Theory of Suicide (ITS), those feeling burdensome and as if they do not belong (to the point that they feel others would be better off if they were gone) may also experience increased suicidality.[14-16] Older adults with access to resources such as peer companionship, transportation, or food assistance may feel more connected.[17]

Socially disconnected older adults visit EDs more frequently than those feeling socially connected.[18,19] Thus, EDs have opportunities to identify and refer vulnerable older adults to programs to reduce social disconnection. Previous research suggests feasibility of referral interventions and older adult receptiveness to such programs.[20,21]

Among older ED patients, we sought to: estimate the prevalence of social disconnection; identify characteristics associated with this factor; and examine social resource needs and desires. Our findings may support ED interventions for connection with community services to enhance well-being.

METHODS

Design and Participants

This anonymous, cross-sectional survey took place at two academic EDs (targeting urban and rural populations (65,000 visits yearly) and exclusively urban populations (100,000 visits yearly). Research assistants (RAs) were trained in survey techniques by site principal investigators and they recruited patients 8:00 a.m. to 5:00 p.m., Monday-Friday, from July 2016 – April 2017. RAs identified patients ≥65 years on the ED's tracking board and asked treating providers to confirm eligibility (medically able to participate and not institutionalized [e.g., prisoners, nursing home residents]). RAs then approached eligible patients, described the survey, and assessed cognitive capacity to participate (could convey the study's purpose, potential benefits and risk, and voluntary nature). Paper-based surveys were completed independently, or were RA-administered for those with visual or other physical limitations. All approached patients received pamphlets of local resources.

RAs entered surveys into Research Electronic Data Capture (REDCap) for data management.[22] The Colorado Multiple and University of North Carolina-Chapel Hill institutional review boards approved this project.

Measures

Questions considered demographic, social, and health characteristics, including portions of the Geriatric Wellness Screening Tool that address social and financial needs.[23] Three validated Likert-scaled items[24-25] measured social disconnectedness as defined by the ITS. Participants screened positive for *perceived burden* when answering "somewhat" or "very" to "I feel like a burden on the people in my life" and/or to "I feel people would be better off if I was gone." And they screened positive for *low belonging* when answering "not at all" or "somewhat" to the statement "I feel like I belong."

Analysis

We described responses using percentages and 95% confidence intervals (CI), and compared subgroups using chi-square tests. With age and gender included a priori, separate logistic regression models were created considering factors associated with positive screens for (1) perceived burden, (2) low belonging, or (3) better off gone. Then, stepwise modeling identified models with best goodness-of-fit including variables significantly associated ($p<0.05$) with each outcome.

RESULTS

Of 305 participants, 289 were included in analysis for completing at least two social disconnection questions. The median age was 72 years (interquartile range [69-78] (Table 1); and 51% were female. Most reported regularly interacting with family and friends, engaging with the community, driving vehicles, and easily affording food and to pay bills. Regarding health characteristics and utilization, most had primary care providers and one fourth had experienced hospitalization(s) in the prior month. For Activities of Daily Living, more needed routine task assistance (33%) and assistive equipment (e.g. cane, walker; 41%) than personal care (14%).

Perceived Social Disconnection

On the social disconnection screen, 37% screened positive for perceived burden, 27% for low belonging, and 15% for feeling better off gone (Table 1). Half (52%) had ≥1 positive social disconnection screens; 7% had three positive screens. Perceived burden related to negative health factors; low belonging related to negative social factors; and feeling better off gone related to health and social factors (Table 1). More non-drivers vs. drivers reported perceived burden (52% vs. 31%, $p<.000$), low

Table 1. Population characteristics and perceived social disconnection (n=289).

Characteristic	Total		Social disconnection positive screen[a]								
			I feel like a burden			I feel like I don't belong			People would be better off if I was gone		
	n	%	n	%	CI%	n	%	CI%	n	%	CI%
Total	289	100	109	37.7	-	78	27	-	42	14.8	-
Demographics											
Age (years)											
65-74	98	33.9	44*	44.9	34.9-54.9	29	29.6	20.4-38.8	12	12.2	5.6-18.9
75-84	133	46	39	29.3	21.5-37.2	35	26.3	18.7-33.9	20	15	8.9-21.2
85-92	58	20.1	26	44.8	31.6-58.0	14	24.1	12.8-35.5	10	17.2	7.2-27.3
Gender (Male)	141	48.8	52	36.9	28.8-44.9	36	25.5	18.2-32.8	23	16.3	10.1-22.5
Live with someone	204	70.6	76	37.3	30.6-43.9	50	24.5	18.6-30.5	29	14.2	9.4-19.1
Live in a private home	260	90	95	36.5	30.6-42.4	65*	25	19.7-30.3	36	13.8	9.6-18.1
Employed	55	19	14*	25.5	13.6-37.3	11	20	9.1-30.9	2*	3.6	-1.5-8.7
Volunteer regularly	72	24.9	23	31.9	20.9-43.0	13*	18.1	9.0-27.2	8	11.1	3.7-18.6
Social connections											
Have pet	135	46.7	49	36.3	28.1-44.5	35	25.9	18.4-33.4	14	10.4	5.2-15.6
See family/friends regularly	251	86.9	95	37.8	31.8-43.9	56***	22.3	17.1-27.5	32	12.7	8.6-16.9
Talk to family/ friends regularly	263	91	95	36.1	30.3-42.0	64**	24.3	19.1-29.6	34*	12.9	8.9-17.0
Engage community regularly	220	76.1	78	35.5	29.1-41.8	46***	20.9	15.5-26.3	25	11.4	7.1-15.6
Drive a vehicle	196	67.8	60***	30.6	24.1-37.1	41**	20.9	15.2-26.7	17***	8.7	4.7-12.7
Eat alone regularly	101	34.9	38	37.6	28.0-47.2	28	27.7	18.8-36.6	12	11.9	5.5-18.3
Difficulty affording food	44	15.2	16	36.4	21.6-51.2	21**	47.7	32.4-63.1	10	22.7	9.8-35.6
Difficulty paying bills	66	22.8	29	43.9	31.6-56.2	25*	37.9	25.9-49.9	15*	22.7	12.4-33.1
Health characteristics and utilization											
Has primary care physician	265	91.7	94*	35.5	29.7-41.3	71	26.8	21.4-32.2	37	14	9.8-18.2
Hospitalizations in past month	71	24.6	40***	56.3	44.5-68.2	24	33.8	22.5-45.1	17*	23.9	13.8-34.1
Emergency department (ED) arrival method											
Ambulance	99	34.3	38	38.4	28.6-48.1	30	30.3	21.1-39.5	23*	23.2	14.8-31.7
Drove self	42	14.5	13	31	16.4-45.5	7	16.7	4.9-28.4	38	90.5	81.2-99.7
Family/friend	137	47.4	55	40.1	31.8-48.5	35	25.5	18.2-32.9	17	12.4	6.8-18.0
Other	11	3.8	3	27.3	0.0-58.7	6	54.5	19.5-89.6	1	9.1	-11.2-29.4
Participant disposition (definite/possible)											
Admission	116	40.1	53*	45.7	36.5-54.9	32	27.6	19.3-35.8	17	14.7	8.1-21.2
Discharge to facility	16	5.5	9	56.3	28.9-83.6	6	37.5	10.9-64.1	5	31.3	5.7-56.8
Discharge home	120	41.5	34	28.3	20.2-36.5	30	25	17.1-32.9	14	11.7	5.8-17.5
Uncertain	22	7.6	8	36.4	14.5-58.2	7	31.8	10.7-53.0	5	22.7	3.7-41.8
Activities of daily living											
Need help with routine tasks	96	33.2	63***	65.6	56.0-75.3	32	33.3	23.7-42.9	26***	27.1	18.0-36.1
Need help with personal care	41	14.2	30***	73.2	59.0-87.3	16	39	23.4-54.6	13**	31.7	16.8-46.6
Need special equipment	117	40.5	57**	48.7	39.5-57.9	39	33.3	24.7-42.0	21	17.9	10.9-25.0

CI, confidence interval.
*P < 0.05; **P < 0.01; ***P < 0.001 under unadjusted bivariate analysis using chi-square tests.

Table 1. Continued.

Characteristic	Total		Social disconnection positive screen[a]								
			I feel like a burden			I feel like I don't belong			People would be better off if I was gone		
	n	%	n	%	CI%	n	%	CI%	n	%	CI%
Total	289	100	109	37.7	-	78	27	-	42	14.8	-
How useful would it be for the ED to offer referrals for…											
Transportation options	196	67.8	66	33.7	27.0-40.4	51	26	19.8-32.2	28	14.3	9.3-19.2
Food assistance	167	57.8	52	31.1	24.0-38.2	41	24.6	18.0-31.2	26	15.6	10.0-21.1
Housing assistance	156	54	57	36.5	28.9-44.2	37	23.5	17.0-30.5	23	14.7	9.1-20.4
Mental health resources	160	55.4	57	35.6	28.1-43.1	44	27.5	20.5-34.5	24	15	9.4-20.6
Volunteer opportunities	138	47.8	52	37.7	29.5-45.9	37	26.8	19.3-34.3	23	16.7	10.4-23.0
Peer companionship programs	123	42.6	42	33.9	25.4-42.3	34	27.4	19.5-35.4	16	12.9	6.9-18.9

CI, confidence interval; *ED*, emergency department.
[a]Percent with positive screen (as defined in "Methods" section).
*P < 0.05; **P < 0.01; ***P < 0.001 under unadjusted bivariate analysis using chi-square tests.

belonging (40% vs. 21%, $p<.001$), and feeling better off gone (26% vs. 9%, $p<.000$) (Table 1).

Final regression models showed perceived burden relating to needing routine task assistance (OR [5.9], 95% CI [3.4-10.3] (Table 2), and hospitalization in the preceding month (OR [2.1], 95% CI [1.1-3.8]). Low belonging related to seeing family irregularly (OR [3.8], 95% CI [1.7-3.4]), irregular community engagement (OR [2.5], 95% CI [1.3-4.6]), and difficulty affording food (OR [2.5], 95% CI [1.2-5.1]). Finally, feeling better off gone related to needing routine task assistance (OR [5.9], 95% CI [3.3-10.7]).

Program Referrals

Many thought referrals for transportation (68%), food assistance (58%), or mental health resources (54%) would be useful (Table 1). Difficulty affording food related to food and housing assistance interest (79%, 95% CI [66-92], $p=.03$; 78%, 95% CI [65-91], $p=.001$). No other notable relationships existed between participant characteristics and social resource desires (not shown). Social disconnection questions and social resource interest were not significantly associated (Table 1).

DISCUSSION

Social disconnection – measured as perceived burden, low belonging, or feeling others would be better off if [I were] gone – was prevalent in this older ED population. Positive disconnection screens were most associated with hospitalizations in the prior month, needing routine task assistance, and irregular community engagement. Our findings highlight opportunities to improve ED geriatric care, especially for patients discharged home.

Half of participants reported experiencing disconnection, compared to 38% in a primary care sample.[25] Older adults without social support may have greater ED use because they cannot rely on others for healthcare needs.[18,19] Although social needs may be under-recognized, social and physical problems are often interconnected.[26] Here, feeling better off gone (which relates to suicidality[27]) was related to needing physical help with routine tasks. In this context, suicidality may increase when physical function and autonomy decrease.[28] Suicidality is often under-recognized in older adults, including in EDs;[29] assessing social needs may help with identification and intervention.

Burden factors (perceived burden and feeling better off gone) were related to hospitalization and needing routine task assistance, while low belonging related to irregular community and family contact.[3,10,30] Targeting these factors in the ED may improve older adult social outcomes. For example, health factors addressed through ED-based physical and occupational therapy programs may improve function and decrease future hospitalization and readmission;[31] providing connections to transportation programs[32] may improve community engagement.

Generally, participants expressed interest in resource referrals. ED teams with social workers and case managers could identify social disconnection and connect patients to social resources (e.g., transportation services, community centers, meal programs).[33] Because eating is a fundamental context for human social interactions,[34] addressing food insecurity might provide ways for improving social connectedness.[35,36] In one successful intervention that led to reduced readmissions, nurse practitioners used case-finding systems to identify older adults with unmet medical or social needs and referred them to services.[20] While such interventions appear feasible, few have

Table 2. Characteristics associated with Interpersonal Needs Questionnaire factors, based on stepwise regression, controlling for age and gender.

Characteristic	Multivariable odds ratio (95% CI)		
	Perceived burden	Low belonging	Better off gone
Age (years)	0.97 (0.96-1.04)	1.01 (0.97-1.06)	0.99 (0.95-1.03)
Gender (Male)	1.18 (0.67-2.02)	0.84 (0.47-1.48)	1.1 (0.69-2.05)
Hospitalization in past month	2.09 (1.13-3.85)*	-	-
Needs help with routine tasks	5.87 (3.36-10.27)***	-	5.90 (3.26-10.66)***
Does not drive	-	-	1.33 (0.73-2.44)
Does not talk to family regularly			1.50 (0.56-4.05)
Does not see family regularly	-	3.82 (1.74-8.38)**	-
Does not engage community regularly	-	2.50 (1.35-4.64)**	-
Has difficulty affording food	-	2.50 (1.22-5.12)*	-

CI, confidence interval.
*P < 0.05; **P < 0.01; ***P < 0.001 under multivariate regression.

been implemented.[21,37] More must be done to test effective health service systems that will increase older adult well-being.[38]

Interestingly, socially disconnected older adults did not desire social resources more than those with social connections. Older adults may not want to burden others with their desires, a reluctance that may extend to social resources. Normalizing discussion about older adult needs may increase access to needed services. In one study, while many older adults wanted services related to their assessed needs, some did not want services that would benefit them and others wanted services misaligned with assessed needs.[39] Thus, ED-based programs screening for social needs should educate older patients on actual vs. perceived needs and optimal resources and on ways to decrease social disconnection, while also considering the resources that the population feels they may need.[40]

LIMITATIONS

Results from this convenience sample of English speakers may not generalize to all older ED patients.[41] The survey did not assess certain factors (e.g., income, race/ethnicity, medical diagnoses); thus, we could not examine how these relate to issues such as social disconnection or social-resources desire.[42,43] Additionally, those with certain neuropathies or disabilities that kept them from participating in this survey may have been under-represented as we reported the prevalence of social disconnectedness.

CONCLUSION

In this sample of older ED patients, 52% experienced social disconnection and many were interested in ED-referred social resources. The ED may be a site from which such resources could be provided to populations needing social support. Research is needed to understand the impact of social disconnection on recovery after acute illness or injury and to develop and test individualized approaches for decreasing social disconnection in older ED patients.

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Characterizing Highly Frequent Users of a Large Canadian Urban Emergency Department

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Introduction: Highly frequent users (HFU) of the emergency department (ED) are a poorly defined population. This study describes patient and visit characteristics for Canadian ED HFU and patient subgroups with mental illness, substance misuse, or ≥ 30 yearly ED visits.

Methods: We reviewed health records from a random selection of adult patients whose visit frequency comprised the 99th percentile of yearly ED visits to The Ottawa Hospital. We excluded scheduled repeat ED assessments. We collected the following: 1) patient characteristics – age, sex, and comorbidities; and 2) ED visit characteristics – diagnosis category, length of stay, presentation time, consultation services, and final disposition. Two reviewers collected data, and we performed an inter-rater review to measure agreement.

Results: We analyzed 3,164 ED visits for 261 patients in all subgroups overall. Within the HFU random selection, mean age was 53.4 ± 1.3, and 55.6% were female. Most patients had a fixed address (88.9%), and family physician (87.2%). Top ED diagnoses included musculoskeletal pain (9.6%), alcohol intoxication (8.5%), and abdominal pain (8.4%). Allied health (social work, geriatric emergency medicine, or community care access centre) was consulted for 5.9% of visits. In 52.7% of these cases, allied health services were not available at the time of presentation.

Conclusion: HFU are a complex population who represent a marked proportion of annual ED visits. Our data indicate that there are opportunities to improve the current approaches to care. Future work examining ED-based screening and multi-disciplinary approaches for HFU may help reduce frequent ED presentations, and better serve this vulnerable population. [West J Emerg Med. 2018;19(6)926–933.]

INTRODUCTION

Highly frequent users (HFU) of the emergency department (ED) are a poorly defined population. A systematic review of frequent ED users in the United States suggested that this group comprised only 4.5-8% of ED patients, but accounted for up to 21-28% of all ED visits.[1] The Canadian literature is sparse, and to date there is a lack of a clear definition of HFU in urban academic centres.[2,3] Systematic reviews including international and Canadian studies have included definitions ranging from 3-20 ED visits per year.[1,2] The limited number of Canadian studies and lack of consistent HFU definition is an issue for healthcare providers and communities that aim to improve the quality of healthcare and reduce frequent ED use.[3,4]

HFU have been described as a heterogeneous population, with patient presentations for both significant medical and

social reasons.[5-9] As such, pre-existing attempts to address the needs of these patients to reduce ED presentation have had mixed success in the literature.[10,11] The HFU population has an increased prevalence of chronic disease, and mental health and substance misuse issues.[2] These attributes suggest a need for further focus on these subgroups. The objectives of this study were first to examine HFU within a Canadian urban academic ED based on a distribution cutoff of the 99th percentile of ED visits, and second to further characterize subgroups with substance misuse and mental illness issues within this population.

Population Health Research Capsule

What do we already know about this issue?
Highly frequent users (HFU) of the Emergency Department (ED) are a poorly defined population, with an increased prevalence of chronic disease, mental health, and substance misuse.

What was the research question?
We examined HFU using a 99th percentile cutoff, and characterized subgroups with history of substance misuse and mental illness.

What was the major finding of the study?
Top diagnoses included painful conditions and alcohol-related visits. Allied health consultants were often unavailable.

How does this improve population health?
Our data highlight discrepancies between the nature of HFU visits and the availability of acute care resources to serve medical and social needs of this complex population.

METHODS

We conducted a health records review of patients whose visit frequency comprised the 99th percentile of ED visits to the Ottawa Hospital between January 1 and December 31, 2014. The Ottawa Hospital is a large Canadian urban academic teaching centre, comprised of multiple campuses, which includes two EDs that received over 140,000 ED visits at the time of this study. The Ottawa Hospital is the regional trauma centre with high volumes of cardiac, dialysis, neurosurgical and cancer patients for the city and surrounding area. Ethics approval for this study was granted by the Ottawa Health Science Network Research Ethics Board.

Data Source and Patient Selection

We used The Ottawa Hospital Data Warehouse, a database with operational and patient information for research and quality assurance purposes, to identify eligible patients. Eligible patients were 18 years or older, whose ED visit frequency was greater than a distribution cutoff greater than the 99th percentile of ED visits, which was a minimum of seven times in 2014. Applying a standard definition using the 99th percentile captures the greatest outliers in patients who frequent the ED, while proportionally reflecting the volume and frequency of patients seen at our centre on an annual basis. We excluded visits for scheduled repeat assessments in the ED. We used a computerized random sample generator to select 250 patients evenly distributed by number of presentations (i.e., 7, 8, 9, 10, and 11 or more visits that year). We extracted patient and visit characteristic data from the ED record of treatment, nursing notes, and consultant notes from each visit. We collected the following patient characteristics: age at first ED visit that year, sex, medical comorbidities, listed family physician, and documentation of a fixed address. We characterized comorbidities by body systems and associated risk factors (i.e., cardiac disease) rather than specific comorbidity, due to the extensive range of comorbid conditions among ED patients. For example, cardiac comorbidities included a history of myocardial infarction, angina, hypertension and/or dyslipidemia.

We included the following visit characteristics: Canadian Triage Acuity Scale (CTAS) score,[12] ED time of arrival, ED length of stay (LOS), ED discharge diagnosis category, consultations made, and disposition from the ED. The CTAS is a validated triage system that prioritizes patient care by severity of illness and assigns a recommended time to patient initial assessment.[14] For example, CTAS 1 (resuscitation) patients should be seen immediately, CTAS 2 (emergency) within 15 minutes, CTAS 3 (urgent) within 30 minutes, CTAS 4 (less urgent) within 60 minutes, and CTAS 5 (non-urgent) within 120 minutes. We collected ED discharge diagnoses as documented on patient health records, and similar diagnoses were later grouped into appropriate categories for reporting purposes. For example, acute myocardial infarction and acute coronary syndromes were grouped into chest pain, whereas non-cardiac chest pain and chest wall pain were grouped into musculoskeletal chest pain. See Appendix 1 for full list of ED discharge diagnosis categories. Two reviewers (JK, OC) manually reviewed all ED records of treatment, which are hand-written but electronically scanned. We reviewed specialist consultant notes for ED visits on an as-needed basis for clarification of diagnosis, disposition, or patient comorbidities. We performed inter-rater review of randomly abstracted patient visits at two periods early within data collection.

Analysis

We conducted our analyses using *SAS version 9.3* software (SAS Institute, Cary, NC) and performed descriptive and univariate analyses. We compared frequencies using chi-squared and Student's t-tests for normally distributed data. ED LOS was not normally distributed, and thus was analyzed by Mann-Whitney U tests for non-parametric distributions. To ensure adequate inter-rater reliability and consistency of the health records review, we used Cohen's kappa to measure levels of agreement for categorical variables early in data collection. We performed subgroup analyses for patients with a documented history of mental illness or substance misuse. All patients who had ≥ 30 ED visits in 2014 were also included for additional subgroup analyses, if not already selected randomly. Patients who presented ≥ 30 times composed the most frequent 2% of all HFU who were eligible for inclusion.

RESULTS

Between January 1 to December 31 of 2014, 93,762 patients visited the Ottawa Hospital EDs on 140,503 separate occasions. The majority of these patients (95.2%) visited the ED on 1-3 occasions, which accounted for 81.5% of yearly ED visits. There was a smaller subset of frequent users who visited the ED 4-6 times, comprising 3.9% of the yearly ED patients and 11.8% of ED visits. The HFU who presented a minimum of seven times (> 99th percentile of ED visits) totaled 897 patients with 9,376 visits. As per our study definition, our HFU consisted of the most frequent 1.0% of ED patients, and comprised 6.7% of yearly ED visits. The maximum number of ED visits by a single patient that year was 84 separate visits.

The random selection of HFU resulted in 2,670 ED visits, and totaled 3,164 ED visits when including all subgroups (Figure 1). We excluded 24 patients for insufficient visits. These patients would have been included automatically by the Data Warehouse database for visiting the ED a minimum of seven times in the year. However, if a patient was seen directly by a consulting service and not the emergency physician, this would have excluded them from the minimum number of seven presentations to qualify as a HFU. The characteristics of patients and their comorbidity type listed by system category are identified in Table 1. The majority of patients had a family physician and fixed address at the time of their ED visit. The greatest percentage of patient comorbidity type included gastrointestinal problems, cardiac diagnoses or risk factors, and chronic pain. Alcohol was the most commonly misused substance, while anxiety and depression were the most commonly represented mental illnesses.

The characteristics of each ED visit by CTAS score, ED LOS, and disposition are listed in Table 2. The majority of patient visits (90.9%) had a CTAS score of 2 or 3, indicating acute presentations with a recommended physician assessment within 15 or 30 minutes respectively.[12] Median ED LOS was 5.2 hours, with an inter-interquartile range (IQR) of 3.1-9.0

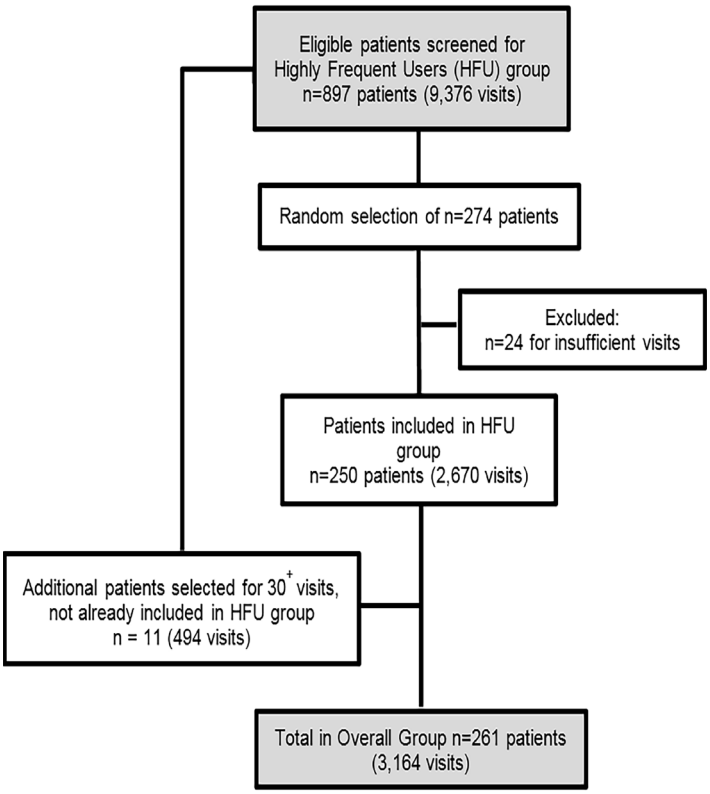

Figure 1. Patient selection process for highly frequent users of the emergency department.

hours. Most HFU were discharged home or to an outside residence from the ED, but 15.6% of HFU visits required hospital admission, and 5.1% of visits from the 30^{+} subgroup required admission. Comparatively, the baseline proportion of hospital admissions from the ED during 2014 was 17.1%. The ED diagnoses were grouped into appropriate categories and are listed in Table 3. Abdominal pain, alcohol intoxication and musculoskeletal pain were within the top five diagnostic categories overall, and for each subgroup analyzed. Overdose or substance misuse aside from alcohol intoxication was in the top five ED diagnoses only for patients with a history of mental illness, substance misuse, or patients with 30^{+} visits.

Specialist services that received the most consultations for HFU are shown in Figure 2. Internal medicine received the most consultations (18.3%), followed by psychiatry (10.2%), and social work (10.1%). Our allied health consultants who consist of social workers, geriatric emergency medicine (GEM) nurses, and community care access centre (CCAC) workers, received 15.6% of the HFU consultations altogether or 10.1%, 1.7% and 3.8% of consultations, respectively. CCAC is a community service that provides transitional home care for patients who may need additional assistance. This may include nursing support, physiotherapy, occupational

Table 1. Number and (percentage) of patients unless otherwise indicated.

	Number (%) of patients				
	Overall	Highly frequent users	Substance misuse history	Mental illness history	30+ Visits
Variable	n = 261	n = 250	n = 77	n = 107	n = 18
Age (in years)					
Mean ± SEM	52.7 ± 1.3	53.4 ± 1.3	45.5 ± 1.8	48.7 ± 1.8	38.5 ± 3.8
Range	18 - 96	18 - 96	18 - 82	18 - 88	18 - 62
Female sex	147 (56.3)	139 (55.6)	35 (45.5)	68 (63.6)	13 (72.2)
Family physician	225 (86.2)	218 (87.2)	56 (72.7)	93 (86.9)	12 (66.7)
Fixed address	231 (88.5)	222 (88.8)	52 (67.5)	88 (82.2)	13 (72.2)
Comorbidity system category					
Respiratory	109 (41.8)	103 (41.2)	24 (31.2)	41 (38.3)	7 (38.9)
Cardiac*	132 (50.6)	130 (52)	32 (41.6)	47 (43.9)	5 (27.8)
Gastrointestinal	163 (62.5)	154 (61.6)	48 (62.3)	61 (57.0)	12 (66.7)
Genitourinary	103 (39.5)	99 (39.6)	18 (23.4)	30 (28.0)	6 (33.3)
Musculoskeletal and soft tissue	116 (44.4)	111 (44.4)	30 (39)	44 (41.1)	8 (44.4)
Chronic pain	126 (48.3)	118 (47.2)	29 (37.7)	48 (44.9)	13 (72.2)
Endocrine	85 (32.6)	83 (33.2)	19 (24.7)	39 (36.4)	4 (22.2)
Neurological	112 (42.9)	106 (42.4)	30 (39)	55 (51.4)	7 (38.9)
Other medical comorbidity	129 (49.4)	122 (48.8)	28 (36.4)	44 (41.1)	10 (55.6)
Substance misuse history	80 (30.7)	77 (30.8)		48 (44.9)	6 (33.3)
Alcohol	53 (20.3)	52 (20.8)	53 (68.8)	30 (28.0)	3 (16.7)
Intravenous drug use	14 (5.4)	13 (5.2)	13 (16.9)	11 (10.3)	2 (11.1)
Opioids	14 (5.4)	12 (4.8)	12 (15.6)	9 (8.4)	3 (16.7)
Marijuana	23 (8.8)	21 (8.4)	21 (27.3)	15 (14.0)	3 (16.7)
Other substance misuse	12 (4.6)	11 (4.4)	11 (14.3)	9 (8.4)	1 (5.6)
Mental illness history	117 (44.8)	107 (42.8)	49 (63.6)		14 (77.8)
Anxiety	58 (22.2)	53 (21.2)	22 (28.6)	53 (49.5)	8 (44.4)
Depression	71 (27.2)	63 (25.2)	32 (41.6)	63 (58.9)	11 (61.1)
Psychosis/schizophrenia	24 (9.2)	20 (8.0)	10 (13.0)	20 (18.7)	5 (27.8)
Bipolar disorder/mania	18 (6.9)	18 (7.2)	12 (15.6)	18 (16.8)	0 (0)
Personality disorder	20 (7.7)	17 (6.8)	10 (13.0)	17 (15.9)	5 (27.8)
Other mental illness	25 (9.6)	21 (8.4)	12 (15.6)	21 (19.6)	4 (22.2)

SEM, standard error of means.
*Cardiac category includes cardiac conditions and risk factors.

therapy, social work support or medical supplies and equipment at home. For example, services may include daily dressing changes from a wound care nurse, administration of intravenous antibiotics at home, mobility support from a physiotherapist, or a home safety assessment by an occupational therapist. Overall, our allied health consultants provided support for 5.9% of ED visits for the HFU population. Within the "*Other"* consultant category, the most consulted specialists included infectious disease (1.9% of consults), psychiatric emergency services (psychiatric nurses and/or social workers but not psychiatrists) (1.8%), obstetrics and gynecology (1.8%), and medical oncology (1.8%).

Overall, roughly two thirds of ED presentations were between 4 pm – 7:59 am, outside of daytime hours. The subset of patients with 30+ visits had a slightly higher proportion of visits (67%) outside of daytime hours. Figure 3 illustrates ED LOS stratified by time of ED presentation. As shown by the box and whisker plots, median ED LOS was significantly

Table 2. Number and (percentage) of patients unless otherwise indicated.

Variable	Number (%) of visits	
	n = 2,670 visits	n = 3,164 visits
Canadian triage acuity scale		
1	14 (0.5)	17 (0.5)
2	1,049 (39.3)	1,243 (39.3)
3	1,377 (51.6)	1,633 (51.6)
4	208 (7.8)	240 (7.6)
5	22 (0.8)	31 (1.0)
Emergency department length of stay, median hours (IQR)	5.2 (3.1-9.0)	5.2 (3.1-8.7)
Disposition		
Home	1,764 (66.1)	2,051 (64.8)
Admission	417 (15.6)	451 (14.3)
Shelter	202 (7.6)	209 (6.6)
Retirement or nursing home	127 (4.8)	202 (6.4)
Group home	70 (2.6)	153 (4.8)
Home with supports	18 (0.7)	18 (0.6)
Left without being seen	19 (0.7)	21 (0.7)
Left against medical advice	18 (0.7)	20 (0.6)
Mobile crisis	7 (0.3)	7 (0.2)

IQR, interquartile range.

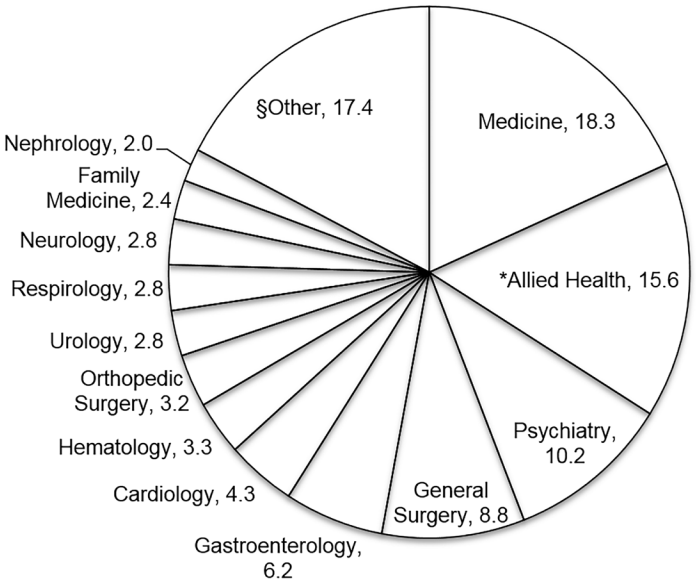

Figure 2. Proportion of consultations for highly frequent users. *Allied Health includes consultations for social work, community care access centre, and geriatric emergency medicine nurses combined. §Other indicates all other services consulted from the emergency department not listed above, and individually <2% of consultations. n=261 patients and 3,164 visits.

higher in the evening (12.7 hours, range 1.4-45.2 hours) compared to the daytime (5.4, 1.2-33.6; p=0.0002) as well as night (7.9, 1.0-38.3, p=0.02). Figure 4 depicts the proportion of allied health consultations and corresponding time of patient presentation to the ED. Bars show that 47.3% of consultations were made during the day, while 52.7% were made in the evening and night, 30.9% and 21.8% respectively.

To ensure adequate inter-rater reliability and consistency of the health records review, we examined 4.5% of abstracted health records (142 patient visits with 4,515 variables) early in data collection to reveal a Cohen's kappa score of 0.8 for agreement between our two reviewers (JK, OC).

DISCUSSION

This is the first study to analyze HFU of a large urban ED in Canada, using a well-defined distribution-based percentile cutoff as opposed to an absolute cutoff in number of visits. This method was first described in a smaller suburban setting,[13] and by using a statistical threshold rather than an absolute number of visits, it can be reproducibly applied to large or small EDs regardless of volume variations. Our results reflect that HFU are a heterogeneous and complex population.

Several patterns emerged from this analysis. The ED discharge diagnoses of HFU groups and subgroups analyzed in our study consistently highlighted an abundance of

Table 3. Emergency department discharge diagnoses were grouped into appropriate categories.

Patient group or subgroup	Number (%) of visits
Overall visits n = 3,164	
Abdominal pain	329 (10.4)
Alcohol intoxication	227 (7.2)
Musculoskeletal pain	204 (6.4)
Genitourinary infection	111 (3.5)
Chest pain	84 (2.7)
Highly frequent users n = 2,670	
Musculoskeletal pain	256 (9.6)
Alcohol intoxication	227 (8.5)
Abdominal pain	223 (8.4)
Genitourinary infection	90 (3.4)
Chest pain	81 (3.0)
Substance misuse history n = 889	
Alcohol intoxication	227 (25.5)
Overdose or substance misuse	52 (5.8)
Musculoskeletal pain	49 (5.5)
Abdominal pain	41 (4.6)
Chest pain	32 (3.6)
Mental illness history n = 1,202	
Alcohol intoxication	101 (8.4)
Musculoskeletal pain	96 (8.0)
Abdominal pain	85 (7.1)
Overdose or substance misuse	53 (4.4)
Chest pain	50 (4.2)
30+ Visits n = 801	
Abdominal pain	190 (23.7)
Flank pain	81 (10.1)
Alcohol intoxication	48 (6.0)
Musculoskeletal pain	35 (4.4)
Overdose or substance misuse	34 (4.2)

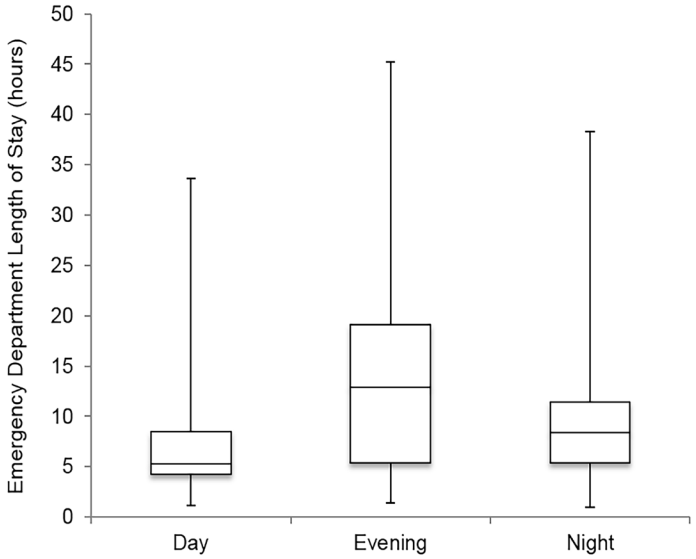

Figure 3. Emergency department length of stay by time of presentation.
Box and whisker plots representing median emergency department length of stay with inter-quartile ranges for n=3,164 visits.
Day: 0800-1559 hours (h); Evening: 1600-2359 h; Night: 0000-0759 h.

alcohol- and pain-related visits. There also appeared to be a discrepancy between the needs of HFU and the availability of allied healthcare support depending on time of presentation to the ED. While the majority of patients who received allied health consultations arrived in the evening or night, they were required to wait in the ED for a consultation in the morning when the service became available. This was reflected in a significantly prolonged ED LOS. It is important to note that social workers, GEM nursing and CCAC consultations are not available at our site for the majority of evening or night time hours, whereas most other consultant specialties are available 24 hours a day, 7 days a week.

While lack of access to a family physician was previously thought to be a strong predictor for frequent ED visits, studies have now suggested that many patients who frequent the ED do have family physicians.[14,15] We identified that 87.2% of HFU in our study had a family physician, suggesting that access to a family physician may not be sufficient to address the needs of this population or reduce frequent ED visits. In 2016, 84.2% of those aged 12 or older in Canada reported having a regular healthcare provider, and males who were 18-34 were more likely than any other group to be without a family physician.[16] Of the 15.2% without a regular healthcare provider, the most commonly reported reasons were that they "had not tried to find one" or "did not need one" (28.7%). In the province of Ontario in 2016, 94.3% of Canadians aged 16 or older reported having a primary physician.[17] Same-day response to phone calls to a primary care office in 2016 were 78.9%, but availability of same-day or next-day appointments was only 43.1%.[17] While primary group practices are beginning to offer patients after-hour clinics, ED-based screening and proactive interventions aimed at understanding and modifying other barriers to primary or outpatient healthcare access for HFU may better serve to address frequent ED presentation.

Research is now beginning to focus on quality improvement strategies for coordination of outpatient care for

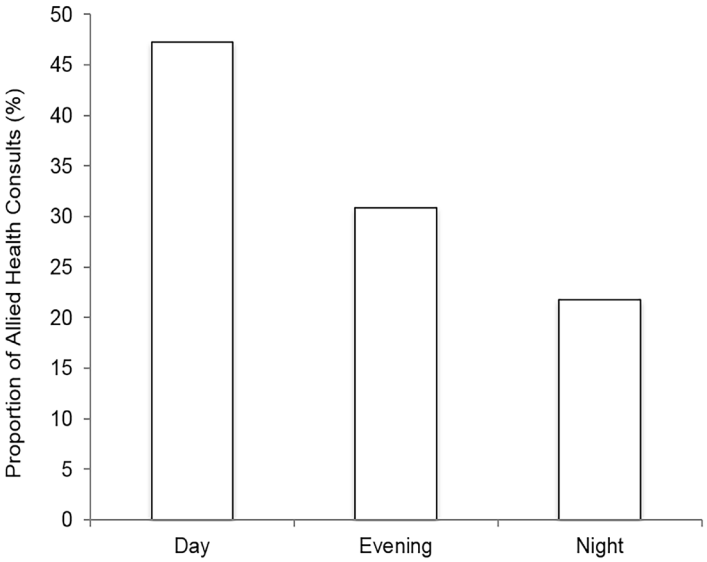

Figure 4. Proportion of Allied Health consults by time of presentation. n=203 allied health consultations during 188 of 3164 possible visits. Allied health consultants included social work, geriatric emergency medicine nurses, or community care access workers.
Day: 0800-1559 hours (h); Evening: 1600-2359 h; Night: 0000-0759 h.

ED patients with chronic conditions. Evidence is emerging that interventions such as dedicated case management can reduce ED use and associated healthcare costs for this population.[4,18-21] Case management was noted to significantly reduce identified issues such as homelessness, alcohol misuse, and financial need.[19,22] However, reviews of these strategies suggest the need for further research to determine the specific aspects of case management that are most successful and effective in reducing ED visits in frequent users.[10,23,24]

LIMITATIONS

While our study was able to capture patient and visit data in much more detail than is possible for typical administrative database studies, the following limitations should be considered. By reviewing individual charts, we were able to review many visits, but only a relatively small number of patients. We relied on the legibility of physician handwriting, which was highly variable. We used consultant notes to capture patient comorbidities and past medical history when hand-written emergency charts were illegible. This may have contributed to an underestimation of patient comorbidities if only the main or contributing comorbidities to the visit were listed on the record. We recognize that the chart abstracters were not blinded to the objectives of the study. In addition, there may be limitations in the generalizability of this study as a single urban site in Canada, noting that variability in patient comorbidities, social needs, and available services may exist based upon geographic location. Finally, we examined ED visits to our study sites without access to data from surrounding EDs in the city. Patients may have visited other EDs in the region, but our previous research suggests this is rare.[25,26]

CONCLUSION

HFU are a complex population who represent a marked proportion of annual ED visits, and our data indicate that there are opportunities to improve current approaches to their care. We have highlighted the discrepancy between the social needs of these patients and the availability of allied health resources when many HFU present to the ED. Our data suggest a need for more than emergency or primary management of chronically complex patients in an acute care setting such as the ED. Future work examining proactive screening for outpatient programs in chronic pain and substance misuse may help reduce frequent ED presentations, and better serve patients with complex medical and social needs.

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Obtaining History with a Language Barrier in the Emergency Department: Perhaps not a Barrier After All

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Introduction: Patients with limited English proficiency may be at risk for incomplete history collection, potentially a patient safety issue. While federal law requires qualified medical interpreters be provided for these patients, little is known about the quality of information obtained in these encounters. Our study compared the medical histories obtained by physicians in the emergency department (ED) based on whether the patients primarily spoke English or Spanish.

Methods: This was a prospective, observational study conducted at a single, urban, academic ED during a six-month time period. Resident and faculty physicians caring for adult patients with a chief complaint of chest or abdominal pain were eligible for participation. Patient encounters were directly observed by medical students who had been trained using simulated encounters. Observers documented which key historical data points were obtained by providers, including descriptions of pain (location, quality, severity, radiation, alleviating/aggravating factors), past medical/family/surgical history, and social history, in addition to the patient's language in providing history. Providers, interpreters, and observers were blinded to the nature of the study. We used chi-square analyses to examine differences in whether specific elements were collected based on the primary language of the patient.

Results: Encounters with 753 patients were observed: 105 Spanish speaking and 648 English speaking. Chi-square analyses found no statistically significant differences in any history questions between Spanish-speaking and English-speaking patients, with the exception that questions regarding alleviating factors were asked more often with Spanish-speaking patients (45%) than English-speaking patients (30%, p=.003). The average percentages of targeted history elements obtained in Spanish and English encounters were 60% and 57%, respectively.

Conclusion: In this study at a large, urban, academic ED, the medical histories obtained by physicians were similar between English-speaking and Spanish-speaking patients. This suggests that the physicians sought to obtain medical histories at the same level of detail despite the language barrier. One limitation to consider is the Hawthorne effect; however, providers and observers were blinded to the nature of the study in an attempt to minimize the effect. [West J Emerg Med. 2018;19(6)934-937.]

INTRODUCTION

Patients with limited English proficiency experience a disproportionate number of adverse events.[1] Under Title VI of the United States (U.S.) Civil Rights Law of 1964, healthcare institutions receiving federal funding are prohibited from discriminating against patients of limited English proficiency.[2] More recently, the Affordable Care Act Section 1557 requires that all healthcare institutions receiving federal funds provide qualified medical interpreters to patients of limited English proficiency.[3] While federal law requires qualified medical interpreters be provided for these patients, little is known about the quality of information that is obtained in these encounters. To our knowledge, there are no studies comparing the medical histories obtained in English- vs. Spanish-speaking patients in the emergency department (ED). It was against this background that our study was designed to compare the medical histories obtained by emergency physicians based on whether patients primarily spoke English or Spanish. We hypothesized that due to an increased time requirement required for interpretation, providers on average would ask fewer questions of Spanish-speaking patients.

METHODS

Design and Setting

This was a prospective observational study conducted at an urban ,teaching hospital ED with approximately 100,000 patient visits annually. Data was collected from February 2017 through July 2017. The study was approved by the institutional review board.

Study Procedure and Participants

Study investigators created a checklist to assess completeness of history that providers obtained. The checklist contained 12 historical items of interest: six items pertaining to the history of present illness (HPI), as well as past medical history, past surgical history, family history, social history, education, and allergies. The checklist also contained patient demographic information, a question about the language used for the patient encounter, and additional data points designed to keep all observers and participants blinded to the nature of the study. The question about encounter language had four answer options: English, Spanish without interpretation (provider spoke Spanish), Spanish with formal interpreter, and Spanish with family interpretation. The full checklist can be found in the Appendix.

Volunteer medical students served as observers. Observers were trained by study investigators to navigate the ED and to use the data collection checklist. Following initial training, observers viewed simulated patient encounters and recorded the interactions using the data collection checklist. Study investigators reviewed the training scores to ensure adequacy of training. Observers were kept blind to the nature of the study and outcomes of interest. Observers followed emergency medicine (EM) residents and faculty during their shifts. All EM residents and faculty working in the ED participated in the study. Observer shift times were scheduled according to observer availability but included a variety of morning, afternoon, evening, and overnight shifts as well as both weekday and weekend shifts.

During shifts, the volunteers observed provider-patient encounters with a chief complaint of chest pain or abdominal pain. They obtained verbal consent from the patient to witness the initial history and physical exam encounter. Subsequently, they continued to follow the provider throughout the rest of the provider's care of that patient, including diagnostic and treatment management, any performed procedures, and dispositioning the patient. This was done so that participants would remain blind to the nature of the study. The student observers also collected additional information including elements of the physical exam and orders that were placed for the patients including laboratory, radiology and medication orders to maintain blindness. Observers recorded all checklist items that were performed throughout the encounter in real time using tablets and the Research Electronic Data Capture (REDCap) database. REDCap is a secure, web-based application designed to support data capture for research studies.[4]

Outcome Measures

The primary outcome of interest was the percentage of HPI items obtained. With a sample size of 500 patients we calculated 99.4% power to detect an average of half a question difference at alpha = 0.05. Secondary outcomes included whether or not each of the 12 individual historical questions were obtained. While additional data points were primarily used for blinding purposes, we analyzed the data for any differences in performance of physical exam and the workup/treatment that was performed.

RESULTS

During the six-month data collection period, 753 patient encounters were observed. Of those encounters, 105 patients spoke Spanish and 648 spoke English. Chi-square analyses found no statistically significant difference in any of the history questions between the Spanish-speaking and English-speaking groups with the exception of alleviating factors. The question of alleviating factors was asked more often with Spanish-speaking patients (45%) than English-speaking patients (30%, p=.003) (Table 1). The average percentages of targeted history elements that were obtained in Spanish and English encounters were 60% and 57%, respectively. Table 2 displays result by translator type.

DISCUSSION

Patients with limited English proficiency represent a vulnerable patient population in our healthcare system.

Table 1. Elements of patient encounter obgtained: English compared to Spanish.

		Language				
		English		Spanish		
		N	%	N	%	Chi-Square
History of present illness (HPI) (choice=location)	No	24	3.7%	2	1.9%	0.877
	Yes	624	96.3%	103	98.1%	0.349
History of present illness (HPI) (choice=quality)	No	133	20.5%	25	23.8%	0.588
	Yes	515	79.5%	80	76.2%	0.443
History of present illness (HPI) (choice=severity)	No	436	67.3%	72	68.6%	0.068
	Yes	212	32.7%	33	31.4%	0.794
History of present illness (HPI) (choice=radiation)	No	280	43.2%	41	39.0%	0.640
	Yes	368	56.8%	64	61.0%	0.424
History of present illness (HPI) (choice=alleviating factors)	No	453	69.9%	58	55.2%	8.915
	Yes	195	30.1%	47	44.8%	0.003*
History of present illness (HPI) (choice=aggravating factors)	No	349	53.9%	53	50.5%	0.415
	Yes	299	46.1%	52	49.5%	0.519
Additional history (choice=past medical history)	No	36	5.6%	6	5.7%	0.004
	Yes	612	94.4%	99	94.3%	0.948
Additional history (choice=surgical history)	No	343	52.9%	61	58.1%	0.969
	Yes	305	47.1%	44	41.9%	0.325
Additional history (choice=family history)	No	546	84.3%	85	81.0%	0.728
	Yes	102	15.7%	20	19.0%	0.394
Additional history (choice=social history)	No	252	38.9%	48	45.7%	1.756
	Yes	396	61.1%	57	54.3%	0.185
Medications (choice=medications)	No	155	23.9%	28	26.7%	0.371
	Yes	493	76.1%	77	73.3%	0.543
Medications (choice=allergies)	No	418	64.5%	71	67.6%	0.385
	Yes	230	35.5%	34	32.4%	0.535

*Statistically significant result.

Table 2. History elements obtained by language spoken and type of translator used.

	Spanish					
	Family	Interpreter	Provider	English	Chi-square	Significance
Location	100.0%	97.5%	96.3%	100.0%	1.25	0.74
Quality	81.8%	78.5%	79.5%	60.0%	3.42	0.331
Severity	54.5%	29.1%	32.7%	26.7%	3.09	0.377
Radiation	72.7%	57.0%	56.8%	73.3%	2.72	0.437
Alleviating factors	63.6%	43.0%	30.1%	40.0%	10.98	0.012
Aggravating factors	54.5%	49.4%	46.1%	46.7%	0.58	0.902
Past medical history	100.0%	94.9%	94.4%	86.7%	2.4	0.493
Surgical history	63.6%	41.8%	47.1%	26.7%	4.46	0.216
Family history	9.1%	19.0%	15.7%	26.7%	2.17	0.537
Social history	45.5%	55.7%	61.1%	53.3%	2.19	0.535

Percentage of time questions were asked in history of present illness.

There are multiple variables in patient care that could lead to inequitable outcomes. In EDs, the initial patient encounter including the history and physical exam is crucial for downstream patient care. For this reason, we decided to examine the difference in the history obtained between our English- and Spanish-speaking patients.

Our initial hypothesis that providers are not as thorough or detail oriented in their history taking with Spanish-speaking patients was not supported in this study. In fact, the only historical component that attained statistical significance (alleviating factors) favored the Spanish-speaking patients. Although unexpected, this is a reassuring finding.

Since this was not expected, we considered possibilities that would lead to this finding. One is that providers wanted to take advantage of the time they had with the interpreter. They may have been asking all questions that could possibly be applicable during that initial encounter, as they knew that getting additional clarification later might have been difficult. Another possibility is that the institution used in this study has extremely proficient and available interpreters. These findings may not hold true at other institutions with a variety of available language services. Finally, perhaps our providers are aware of the vulnerability of this patient population and actively focus on thorough histories as a safety mechanism. Nonetheless, the evidence still points to healthcare disparities in this patient population. If the disparity doesn't lie in history taking, we need to examine other variables in patient care.

LIMITATIONS

This study was conducted at a single, academic, tertiary-care site in a Midwestern city in the U.S. The patient population primarily speaks English with the second most common language Spanish. As such, we only evaluated patient encounters using these two languages. An additional limitation of the study is the Hawthorne effect. We tried to control for this by blinding both the medical student observers and the residents and faculty who were being observed to the purpose of the study; however, the mere presence of the observer could have significantly altered the provider's history taking.

CONCLUSION

In this study at a large, urban, academic ED, the medical histories obtained by physicians were similar between English-speaking and Spanish-speaking patients. This suggests that the physicians sought to obtain medical histories at the same level of detail despite the language barrier. In some instances, the trend was toward more history obtained in the Spanish-speaking patients vs. the English-speaking patients. Areas for future study include noting the amount of time spent in the room with Spanish-speaking vs. English-speaking populations, evaluating the histories obtained by residents and by faculty, and evaluating different interpreter modalities including phones, video, and live interpretation.

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Emergency Department Patient Satisfaction with Treatment of Low-risk Pulmonary Embolism

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Introduction: Many emergency department (ED) patients with acute pulmonary embolism (PE) who meet low-risk criteria may be eligible for a short length of stay (LOS) (<24 hours), with expedited discharge home either directly from the ED or after a brief observation or hospitalization. We describe the association between expedited discharge and site of discharge on care satisfaction and quality of life (QOL) among patients with low-risk PE (PE Severity Index [PESI] Classes I-III).

Methods: This phone survey was conducted from September 2014 through April 2015 as part of a retrospective cohort study across 21 community EDs in Northern California. We surveyed low-risk patients with acute PE, treated predominantly with enoxaparin bridging and warfarin. All eligible patients were called 2-8 weeks after their index ED visit. PE-specific, patient-satisfaction questions addressed overall care, discharge instruction clarity, and LOS. We scored physical and mental QOL using a modified version of the validated Short Form Health Survey. Satisfaction and QOL were compared by LOS. For those with expedited discharge, we compared responses by site of discharge: ED vs. hospital, which included ED-based observation units. We used chi-square and Wilcoxon rank-sum tests as indicated.

Results: Survey response rate was 82.3% (424 of 515 eligible patients). Median age of respondents was 64 years; 47.4% were male. Of the 145 patients (34.2%) with a LOS<24 hours, 65 (44.8%) were discharged home from the ED. Of all patients, 89.6% were satisfied with their overall care and 94.1% found instructions clear. Sixty-six percent were satisfied with their LOS, whereas 17.5% would have preferred a shorter LOS and 16.5% a longer LOS. There were no significant differences in satisfaction between patients with LOS<24 hours vs. ≥24 hours ($p>0.13$ for all). Physical QOL scores were significantly higher for expedited-discharge patients ($p=0.01$). Patients with expedited discharge home from the ED vs. the hospital had no significant difference in satisfaction ($p>0.20$ for all) or QOL ($p>0.19$ for all).

Conclusion: ED patients with low-risk PE reported high satisfaction with their care in follow-up surveys. Expedited discharge (<24 hours) and site of discharge were not associated with differences in patient satisfaction. [West J Emerg Med. 2018;19(6)938–946.]

INTRODUCTION

There is increasing evidence that it is safe and effective to discharge home emergency department (ED) patients with acute pulmonary embolism (PE) at low risk of short-term adverse events, determined using a validated risk score or outpatient exclusion criteria.[1-4] The Pulmonary Embolism Severity Index (PESI) is a validated prognostic tool that can be used to stratify PE patients by risk of 30-day, all-cause mortality[1,5,6] and help identify eligible candidates for outpatient management. The PESI categorizes patients into five ascending risk classes, with many patients in Classes I-III eligible for outpatient management.[7,8]

While home treatment of PE has been shown to be safe and effective, rates of outpatient management vary widely,[9-12] and little is known about patient satisfaction with care and health-related quality of life (QOL) when managed at home. Health-related QOL refers to an individual's perception of their health and the effect it has on his or her daily life.[13] Recent research has found that patients treated for isolated deep vein thrombosis (DVT) at home with low-molecular-weight heparin report QOL scores similar to those treated as inpatients, but with better social functioning.[14,15] Limited research has been conducted focusing exclusively on patients with PE, although existing research indicates that outpatient management of PE has been satisfactory.[1,16,17] Patients with other conditions, such as community-acquired pneumonia and stroke, have also reported comparable or improved satisfaction and QOL scores following outpatient management, compared to inpatient treatment.[18-20] However, to our knowledge, little has been done to examine the effects of length of stay (LOS) within a population of low-risk PE patients.[1]

This telephone survey study of patients with objectively-confirmed PE within 21 community EDs examined patient satisfaction with care and QOL following their index ED visit. To understand the impact of different treatment pathways on patients with low-risk PE, we compared care satisfaction and QOL scores between patients with expedited home discharge (LOS<24 hours) and those without (LOS≥24 hours). Furthermore, we sought to determine any differences in satisfaction due to site of discharge, either from the ED or from the hospital, for those with a short LOS. We hypothesized that patients discharged within 24 hours would report similar, if not improved, satisfaction with care and QOL following their ED visit and that satisfaction ratings would not be greatly affected by discharge location.

Population Health Research Capsule

What do we already know about this issue?
Home management of pulmonary embolism (PE) is safe and effective for select low-risk patients. Little is known about patient care satisfaction or quality of life.

What was the research question?
Did length of stay (LOS) or discharge disposition impact patients' satisfaction with care or quality of life?

What was the major finding of the study?
Patient care satisfaction was high. Physical quality of life was higher for those with a length of stay <24 hours.

How does this improve population health?
Improved understanding of PE patients' care satisfaction and quality of life can help physicians in the development of care strategies.

METHODS

Study Design, Setting, and Population

This telephone-based survey of patients two weeks after an ED diagnosis of acute PE was undertaken in Kaiser Permanente (KP) Northern California, a large, integrated healthcare delivery system that provides comprehensive medical care for more than four million members. KP members represent approximately 33% of the population in areas served and are highly representative of the surrounding population.[21] KP Northern California is supported by a comprehensive integrated electronic health record (EHR) (Epic, Verona, Wisconsin) fully deployed in 2009.[8] The study was approved by the KP Northern California Institutional Review Board (IRB).

This patient survey was a component of a multicenter, retrospective cohort study of ED patients with acute, objectively-confirmed PE. The MAPLE study – Management of Acute Pulmonary Embolism – was undertaken at 21 non-rural community EDs from January 2013 through April 2015 and has been described elsewhere.[8,22] Management of patients with acute PE during the study period commonly included warfarin with 5-7 days of bridging with enoxaparin. Direct oral anticoagulants were not commonly used at the time.

We depict the cohort assembly for the MAPLE study in Figure 1. We undertook the patient survey during the final eight months of the MAPLE study to coincide with the intervention arm of a controlled, pragmatic study to evaluate the impact of electronic clinical decision support on site-of-care decision-making for ED patients with acute, objectively-confirmed PE (the eSPEED study – electronic Support for Pulmonary Embolism Emergency Disposition).[9] Patients who met criteria for the MAPLE study from September 2014

through April 2015 were eligible for the telephone-based survey if they were classified as PESI Classes I-III. For site-of-care analysis, we defined hospitalization to include admission to inpatient services as well as admission to ED-based, short-term (<24 hours) outpatient observation units.

We identified patients for the telephone survey in the following manner: Each week, the study programmer analyst obtained data for patients with a recent ED visit who appeared to be eligible for the survey based on ED/inpatient discharge diagnoses and evidence of radiological imaging for DVT or PE. A study investigator then reviewed these patients' charts to determine if the ED visit was eligible for the study and to assess for exclusion criteria as described previously.[8,22] A research assistant (RA) then reviewed the charts to evaluate for secondary exclusion criteria. Patients were excluded at this point if they were discharged from the ED to a skilled nursing facility, died in the ED, or were PESI Classes IV-V.

We chose to stratify by patient LOS, rather than site of treatment, because there is limited research about LOS effects on patient satisfaction. A 24-hour end-point was used for our definition of an expedited discharge as this would include patients discharged directly home from one of our EDs (median LOS approximately 5.4 hours)[8] as well as a majority of those discharged home from a short-term observation unit. Such a time frame is similar to that used in other prospective studies of outpatient PE management.[1,2,17,23] Two RAs contacted eligible patients for telephone interviews. To communicate directly with patients who were hard of hearing, the California Relay Service line was used. We excluded patients who could not complete the survey due to English proficiency level, cognitive impairment, or debility. Patients in PESI Classes I-III who consented to the survey within eight weeks of their index ED visit constituted our final cohort (Figure 1).

Phone Survey Development and Script

The follow-up phone survey was intended to evaluate patient site-of-care preferences, satisfaction with treatment, and QOL following discharge. The PE-specific, patient-satisfaction questions were adapted from Aujesky et al. and modified for relevance and clarity.[1] Questions asked about satisfaction with overall care, discharge instruction clarity, and LOS. To assess patient QOL, we adapted questions and protocol from the eight-item Short Form Health Survey to meet the needs of a phone-based, interviewer-assisted QOL survey. Our survey assessed eight aspects of health-related QOL, summarized as physical and mental scores.[13]

The phone survey instrument was pre-tested to assess length and clarity of wording and piloted with eligible participants prior to the study start date. Pilot testing identified minor wording changes that were needed for clarity and decreased the number of questions for redundant concepts, resulting in 11 multiple-choice questions. The final text of the survey was approved by the study team and was used for the

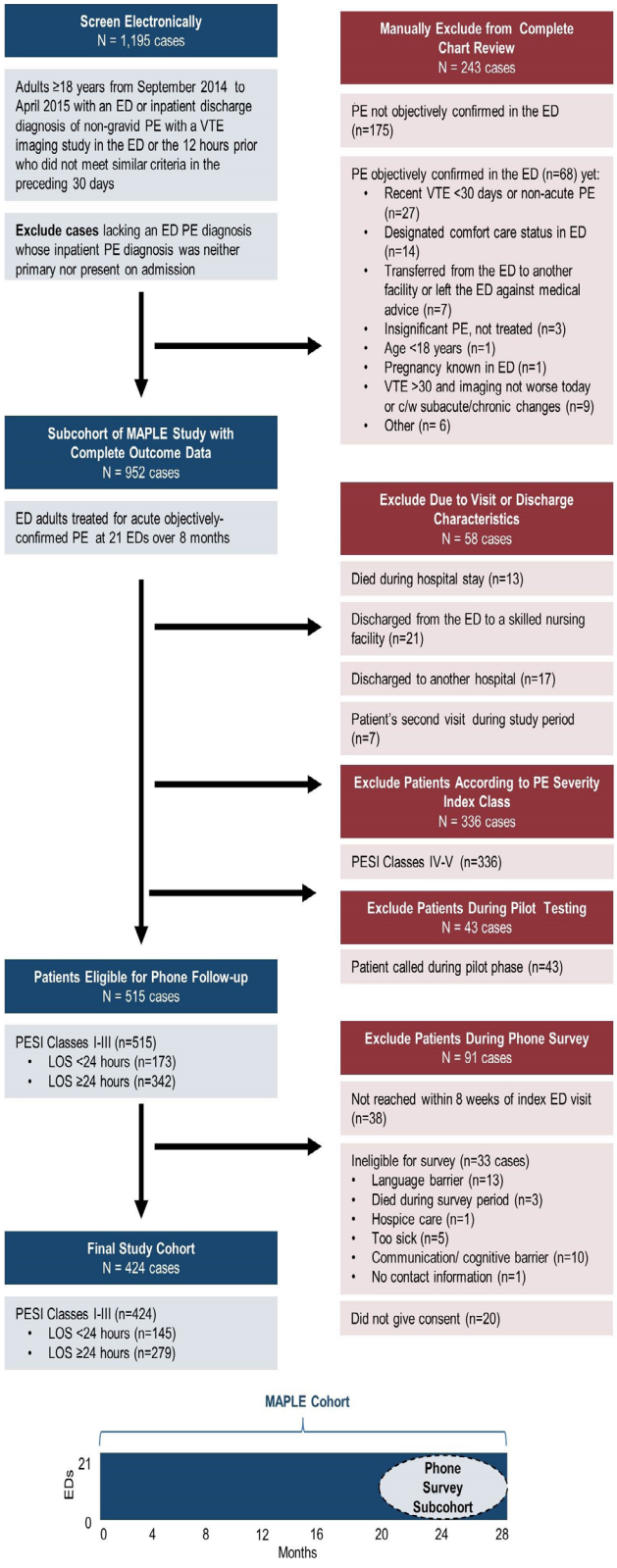

Figure 1. Cohort assembly of emergency department patients with acute pulmonary embolism for telephone follow-up survey. *ED*, emergency department; *PE*, pulmonary embolism; *VTE*, venous thromboembolism; *C/w*, consistent with; *MAPLE*, Management of Acute PuLmonary Embolism study; *PESI*, Pulmonary Embolism Severity Index; *LOS*, length of stay.

duration of the study (Appendix). The survey script included IRB-approved language requesting informed consent to participate in the phone survey.

Phone Survey Administration

Two RAs were trained and overseen by the study investigators and the study project manager; weekly meetings were held to address survey administration difficulties and to ensure compliance with survey protocol. The RAs conducted phone surveys with eligible patients starting 12-14 days after the index ED visit; potential participants were not contacted until they had been discharged home from any inpatient stay. Attempts to contact potential participants occurred between 8 a.m. and 9 p.m. seven days a week, with a maximum of 15 outreach attempts. Outreach ceased if a participant was determined to be ineligible, refused to participate, or eight weeks had passed since their index ED visit, whichever occurred first. Survey responses were recorded using paper data sheets or a customized, online survey form. A trained study RA later entered data from paper data sheets into the online form.

Statistical Analysis

Analysis included univariate and bivariate descriptive statistics, and examined differences between patients with expedited discharge and those admitted for ≥24 hours. Responses to the overall satisfaction and instruction clarity questions were condensed for statistical analysis. For overall care, we dichotomized responses into two categories: satisfactory/very satisfactory vs. neutral/unsatisfactory/ very unsatisfactory. For instruction clarity we analyzed two categories: mostly clear/completely clear vs. mostly unclear/ very unclear. LOS satisfaction was compared using three analyses: preferred shorter vs. satisfied/preferred longer, satisfied vs. preferred shorter/preferred longer, and preferred longer vs. satisfied/preferred shorter. We used chi-square test to examine the association between patient care satisfaction and LOS for all patients, and patient care satisfaction and site of discharge for those discharged within 24 hours. We also examined physical and mental QOL scores across patient stratifications using the Wilcoxon rank-sum test.

RESULTS

Of all 1,195 low-risk PE patients electronically identified from the MAPLE study, 515 patients were eligible for the phone survey and called by interviewers (Figure 1); 424 completed the follow-up survey (response rate 82.3%). The median age of respondents was 64 years, 201 (47.4%) were male, and 145 (34.2%) had a LOS<24 hours. The median LOS for all patients was 36.1 hours, with a median of 14.3 hours in the expedited discharge cohort and 53.1 hours in the longer LOS cohort. The median time from ED arrival to survey completion was 16 days (interquartile range [IQR] [14-21] days). Additional patient characteristics are described in the Table.

We outline respondent answers to care satisfaction questions in Figure 2. There were no significant differences in scores between patients with a LOS<24 hours and ≥24 hours ($p>0.13$ for all). Collectively, 89.6% were satisfied with their overall care and 94.1% found instructions clear. The majority of patients were satisfied with their LOS (65.6%), although 17.5% would have preferred a shorter LOS and 16.5% a longer LOS. Of those discharged within 24 hours, 65 (44.8%) were discharged home from the ED and 80 (55.2%) from the hospital (response rates described in Figure 3). Patients discharged home directly from the ED vs. the hospital had no statistically significant differences in scores for overall care satisfaction ($p=0.47$), instruction clarity ($p=0.33$), or LOS satisfaction ($p=0.67$).

Physical and mental QOL stratified by LOS and site of discharge are represented in Figure 4. Patient physical QOL was significantly higher for patients discharged within 24 hours compared to those with a LOS≥24 hours ($p=0.01$). Mental QOL was not significantly different between LOS cohorts ($p=0.69$). When considering site of discharge for patients with a LOS<24 hours, QOL scores were not found to be significantly statistically different for physical ($p=0.81$) or mental ($p=0.19$) QOL.

DISCUSSION

This telephone-based survey of low-risk PE patients discharged from 21 community medical centers describes patient satisfaction with care and QOL following their index ED visit. Patients reported high overall satisfaction (89.6%) and perception of instruction clarity (94.1%) for all treatment categories.

Patients of PESI Classes I-III were stratified by LOS and analyzed using a 24-hour cutoff. Satisfaction with overall care, clarity of instructions, and LOS did not significantly vary between patient groups. Aujesky et al. also described a similarity in the percentage of patients satisfied with their medical care between those with expedited discharge and a longer LOS,[1] reported in our study to be 90.3% and 89.2% ($p=0.73$), respectively. This analysis by Aujesky et al. was restricted to patients of PESI Classes I-II, whereas we expanded the eligible population to include patients in Class III. This decision was based on recent PE studies that found many Class III patients are eligible for outpatient care.[7,8]

Furthermore, our high level of patient satisfaction with overall care in the expedited discharge cohort is comparable to satisfaction ratings of outpatient management found in other studies on PE and venous thromboembolism, reported to be 91-92%.[1,24] The satisfaction ratings reported in our study may also be improved by the use of exclusive oral anticoagulant treatments instead of the bridging subcutaneous enoxaparin injections required at the time of the survey.[25] Ratings of instruction clarity were high in both the expedited discharge and longer LOS cohorts, 91.7% and 95.3%, respectively, and align with previously reported values.[24] Of note, our physicians

Table 1. Clinical characteristics of emergency department patients with acute pulmonary embolism, stratified by patient length of stay (n = 424).

	ED patient length of stay			
	LOS<24 hours N=145		LOS≥24 hours N=279	
Patient characteristics	No.	%	No.	%
Age median (IQR), years	64 (50-76)		64 (52-76)	
LOS median (IQR), hours	14.3 (5.8-20.5)		53.1 (37.2-94.5)	
Sex, male	67	46.2	134	48.0
Comorbidities				
Cancer (history of or active)	34	23.4	76	27.2
Chronic lung disease (includes asthma)	44	30.3	86	30.8
Heart failure (diastolic or systolic)	17	11.7	30	10.8
Vital signs*				
Systolic blood pressure, mm Hg				
<100 and ≥90	21	14.5	30	10.8
<90	6	4.1	12	4.3
Pulse, beats/min				
≥100 and <110	30	20.7	43	15.4
≥110	48	33.1	84	30.1
Respiratory rate, breaths/min				
≥24 and <30	42	29.0	75	26.9
≥30	18	12.4	25	9.0
Oxygen saturation, %				
<94 and ≥90	40	27.6	53	19.0
<90	17	11.7	40	14.3
Temperature <36°C (96.8°F)	1	0.7	2	0.7
Altered mental status[Ŧ]	1	0.7	2	0.7
Pulmonary Embolism Severity Index class				
I	53	36.6	77	27.6
II	56	38.6	110	39.4
III	36	24.8	92	33.0

ED, emergency department; *LOS*, length of stay; *IQR*, interquartile range.
*We report the most abnormal value in the direction in question. Vital signs include pre-arrival values from out-of-hospital and outpatient clinic settings if these were documented by the emergency physician. The numbers of missing vital signs were as follows: systolic blood pressure, n=2 (0.5%); pulse, n=2 (0.5%); respiratory rate, n=3 (0.7%); oxygen saturation, n=2 (0.5%); temperature, n=17 (4.0%).
[Ŧ]Altered mental status as defined by the Pulmonary Embolism Severity Index includes disorientation, lethargy, stupor, and coma.

used templated discharge instructions that typically included the following: general patient education on PE, anticoagulation medication information, follow-up arrangements with their primary care provider and with Anticoagulant Services, and indications to seek medical care. The satisfaction ratings reported by those with a LOS<24 hours, and their similarity to those with a longer LOS, demonstrate that expedited discharge may not negatively impact the patient experience.

Among patients in PESI Classes I-III with LOS<24 hours, we did not detect any variation between those discharged from the ED and those admitted for a short hospital stay in any of the primary outcomes: overall care satisfaction, instruction clarity, or LOS satisfaction. The similarity between cohorts indicates that admission to the hospital or an observation unit is not required for patients to be highly satisfied with their care. Discharge directly from the ED was not shown to adversely affect a patient's care experience.

Patient physical QOL 2-8 weeks after ED or hospital

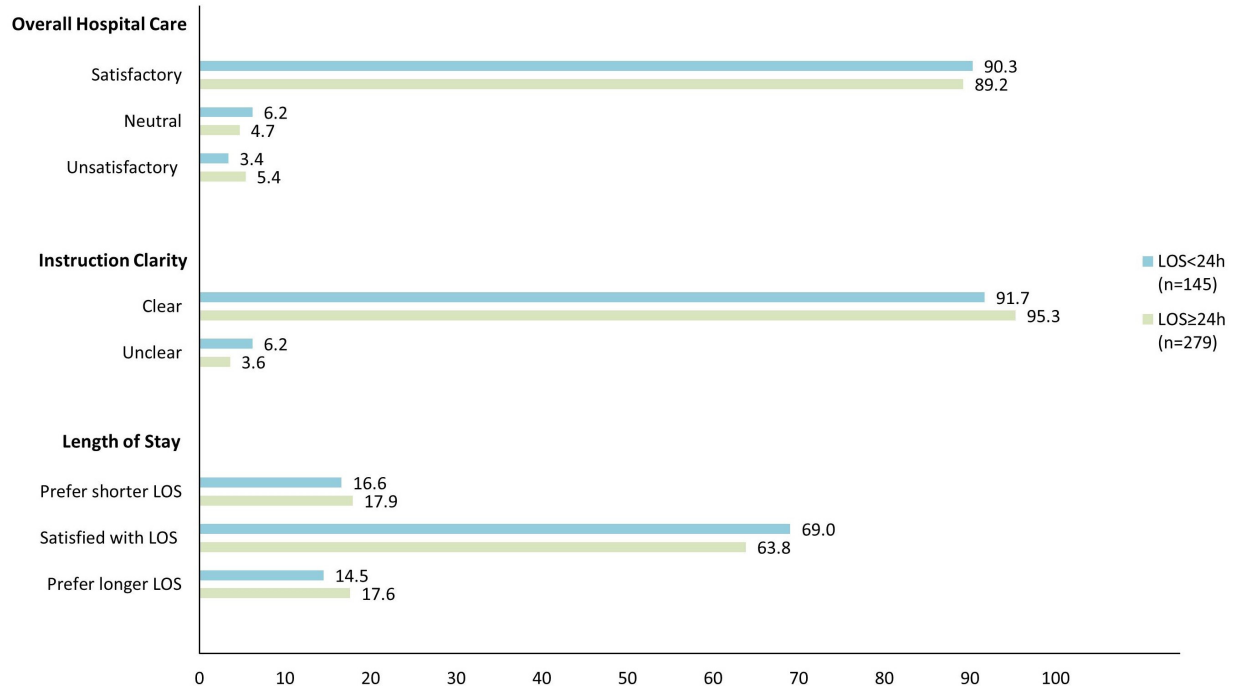

Figure 2. Responses to satisfaction questions by patients with low-risk pulmonary embolism, stratified by length of stay (LOS).
Note: There were no significant differences in satisfaction rates between patients with a LOS<24 hours and a LOS≥24 hours (p>0.13 for all).

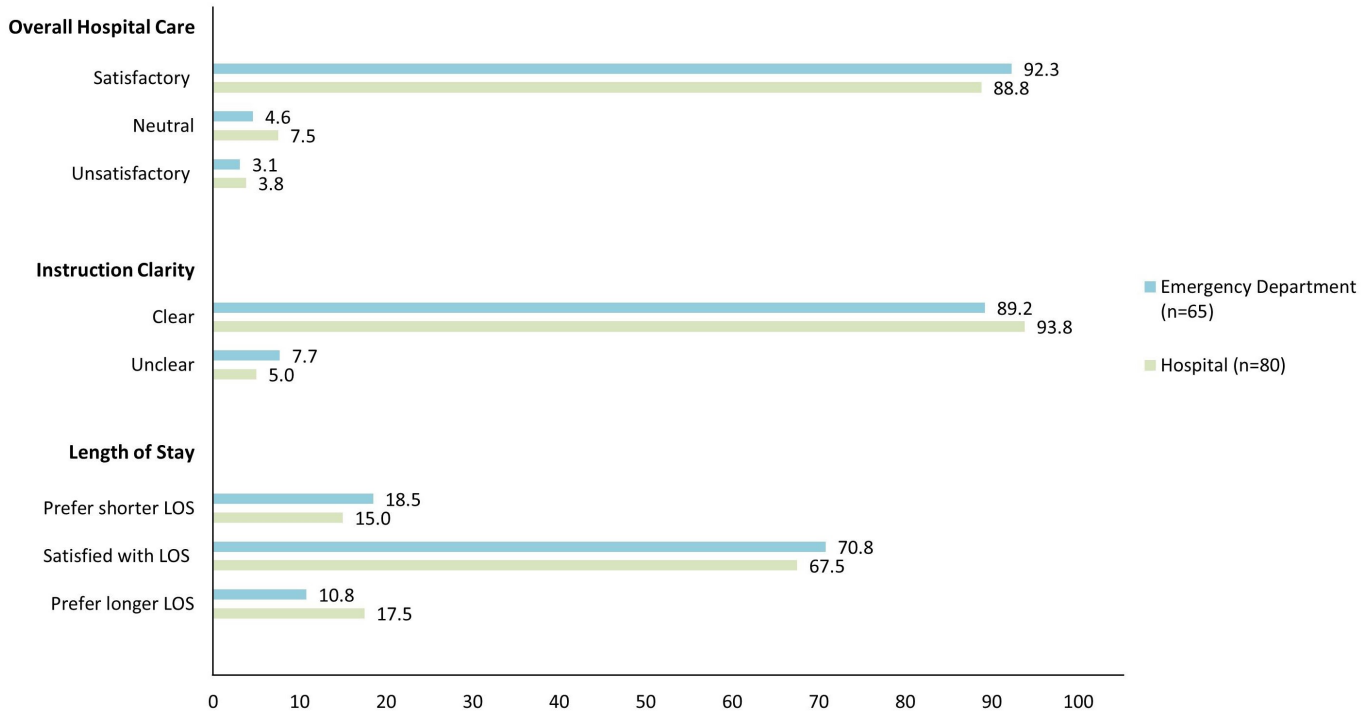

Figure 3. Responses to satisfaction questions by patients with low-risk pulmonary embolism, stratified by site of discharge.
LOS, length of stay.
Note: There were no significant differences in satisfaction rates between patients discharged from the emergency department and the hospital (p>0.20 for all).

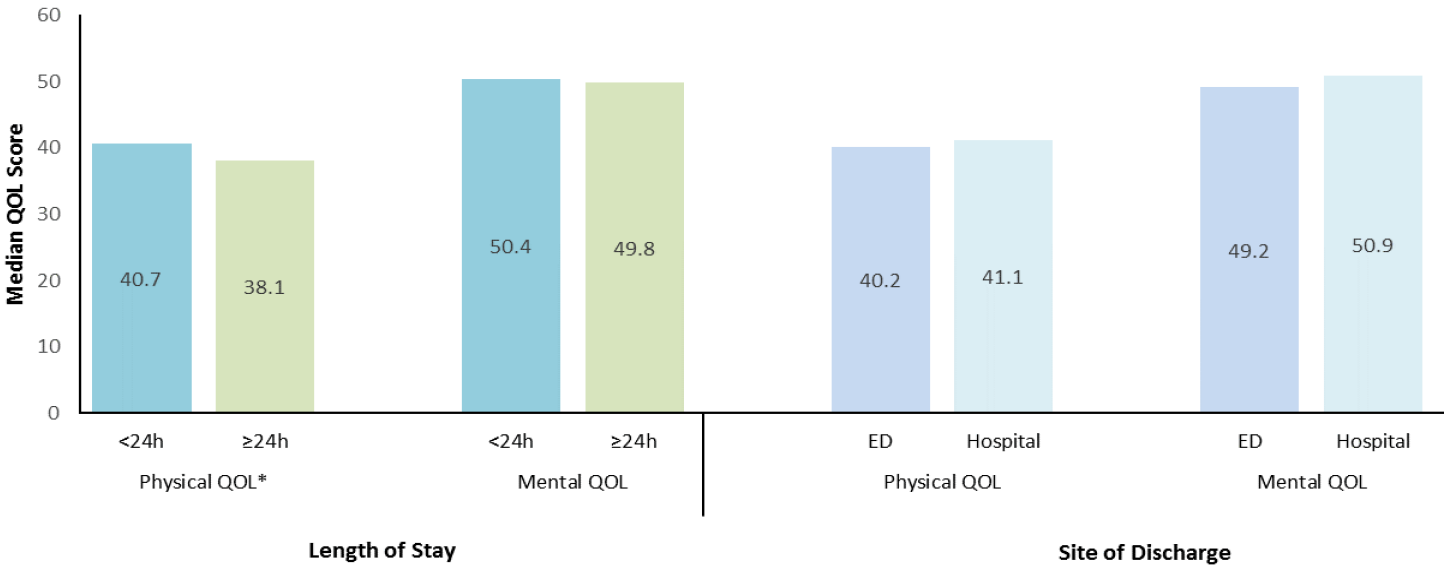

Figure 4. Physical and mental quality of life scores of patients with low-risk pulmonary embolism.
ED, emergency department; *QOL*, quality of life.
*No statistically significant differences found in patient QOL comparisons except for physical QOL when stratified by patient length of stay (p=0.01).

discharge was significantly higher in those with a LOS<24 hours compared to those with a LOS≥24 hours. There was no statistical difference in mental QOL between LOS cohorts. These findings are supported by other studies of outpatient management of DVT that have examined QOL in more detail. These studies have found no significant differences between treatment groups, except that patients treated at home score higher on physical and social functioning scales.[14,15] Additionally, expedited discharge has been shown to not compromise QOL for eligible patients with conditions such as pneumonia, respiratory infection, and stroke.[18-20] Furthermore, no statistically significant difference in QOL was found between patients discharged directly from the ED vs. those discharged from an observation unit or the hospital with a LOS<24 hours.

Our assessment of patient satisfaction with LOS demonstrates a potential area for improvement of patient care. Although the majority of patients were satisfied with their LOS, 17.5% would have preferred a shorter LOS (16.6% with LOS<24 hours and 17.9% with LOS≥24 hours, p=0.73) and 16.5% would have preferred a longer LOS (14.5% with LOS<24 hours and 17.6% with LOS≥24 hours, p=0.42). Other studies have also reported a similarly low incidence of patient dissatisfaction with LOS for PE treatments; Aujesky et al. found 14% of outpatients would have preferred a longer LOS and 29% of inpatients would have preferred to be treated at home.[1] In our study, the mean LOS for patients discharged within 24 hours was 13.1 hours and for patients discharged after 24 hours was 72.1 hours, compared to the mean LOS in the study by Aujesky et al.: 25.9 hours for outpatient management and 106.9 hours for inpatient management.

These reported differences in mean LOS may explain the discontinuities in the proportion of patients that would have preferred earlier discharge between the two studies. Because we did not ask patients to explain their rationale for their LOS preferences, we can only conjecture about their reasoning. Possible explanations for preferring a shorter LOS may include improvement of symptoms early in the ED or hospital stay or the presence of obligations the patient did not want to miss due to being in the ED or hospital. Possible explanations for preferring a longer LOS include persistent symptoms after discharge, anxiety about early discharge, or prior expectations of the need for a longer stay.

Provider communication to set care expectations could help to improve the satisfaction we observed with LOS. Effective provider communication has been shown to increase patient satisfaction with care and their treatment compliance.[26-28] Increased communication regarding the patient's treatment needs, including the most appropriate site of care, the probable LOS, and the treatment end-points, could help in setting more realistic patient expectations and may increase patient satisfaction with LOS.

Although patient satisfaction and QOL were high in our community setting, there are limitations to the feasibility of expedited discharge and home management of patients with PE. Specific system requirements are necessary for safe and satisfactory discharge of PE patients, such as the ability to adequately select patients for home discharge, patient access to a follow-up care team, and lack of other indications for

hospitalization.[8,9] Additionally, although the overall treatment cost is lower for outpatient management,[29,30] the cost burden of outpatient medication on the patient and their access to pharmacotherapy must be considered.[25] Assessment of these care aspects and patient preference should be incorporated into the site-of-care calculus.

LIMITATIONS

This study has several limitations. First, this satisfaction and QOL survey was conducted over the telephone. Potential selection bias is introduced in that not all eligible participants could be reached within the first eight weeks following their index ED visit and some refused to respond to the survey. However, it would be expected that this selection bias would affect all patient groups equally, thus minimizing the effect on the overall comparison. There is also potential variation in patient responses due to the length of time between their index ED visit and their telephone survey. However, 75% of surveys were completed within the first three weeks of the index ED visit. Notably, a common hospital inpatient satisfaction survey, the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), is administered between 48 hours and six weeks following discharge.[31] Some studies of expedited discharge of ED PE patients have conducted their patient-satisfaction surveys at 90 days.[17] There are also potential generalizability limitations due to the exclusion of non-English speakers. Additionally, the effects of differences in select patient characteristics between the cohorts could be further analyzed.

During the time of this study, warfarin was the oral anticoagulant predominantly used for treatment of acute PE. However, there has since been a migration to the use of direct oral anticoagulants for patients with PE. While the effects of this change in pharmacotherapy on patient satisfaction are unknown, studies suggest that patients receiving these newer agents will have maintained, or even improved, levels of patient satisfaction.[25]

Because this study was conducted following an ED visit for objectively-confirmed PE, patient QOL was not assessed prior to PE diagnosis; thus, we could not adjust for QOL preceding the index ED visit. Also, although modified for our patient population, our QOL survey was not PE-specific nor as extensive as other health-related QOL surveys. While the limited number of questions affects our ability to comment on specific health-related domains, this survey was chosen because it was less time consuming for respondents and we sought to limit the burden on the patient and increase the response rate. Finally, overall health prior to ED arrival could not be accounted for and those with worse overall health may have been more likely to be hospitalized for over 24 hours. It is unknown how this may have affected patient satisfaction with care, but analysis of select comorbidities revealed similar rates between cohorts.

CONCLUSION

In this telephone-based survey of ED patients with objectively-confirmed, low-risk acute PE, a high percentage reported satisfaction with their overall medical care and found discharge instructions clear. Additionally, the majority of patients were satisfied with their LOS. There were no statistically significant differences in patient-reported satisfaction between patients discharged within 24 hours vs. those with a LOS≥24 hours or between shorter LOS patients discharged directly from the ED vs. those admitted for a short hospital stay. The only significant difference in health-related QOL was a higher reported physical QOL for patients with a LOS<24 hours compared to patients with a LOS≥24 hours. These results may help inform future work to optimize site-of-care decision-making in patients with acute PE discharged from the ED or after a short observation or hospitalization.

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American Heart Association/American Stroke Association Deletes Sections from 2018 Stroke Guidelines

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The updated American Heart Association (AHA)/American Stroke Association (ASA) Guidelines for the Early Management of Patients with Acute Ischemic Stroke were published in January 2018.[1] The purpose of the guidelines is to provide an up-to-date, comprehensive set of recommendations for clinicians caring for adult patients with acute arterial ischemic stroke in a single document. The guidelines detail new and updated recommendations that reflect and incorporate the most recent literature in the evaluation and management of acute ischemic stroke. Some sections of the latest guidelines have sparked debate in the medical community.

Debate with regard to deciding the optimal diagnostic and treatment strategy for patients is healthy and anticipated with the release of new medical literature or recommendations. However, what is somewhat puzzling and unanticipated with the release of these new guidelines is that within two months of their release the AHA/ASA rescinded its recently released guidelines, publishing a "correction" in which several parts of the document have been deleted.[2] An action such as this at the guideline level is unprecedented in recent history and has left stakeholders in the medical community somewhat confused as to the rationale for its occurrence. This article will inform the emergency medicine (EM) healthcare professional of the recent correction of the updated stroke guidelines, identify which sections have been removed (deleted), and will provide a brief summary of the pertinent updates (that have not been deleted) to the 2018 stroke guidelines that have particular relevance to the EM community. [West J Emerg Med. 2018;19(6)947-951.]

INTRODUCTION

The American Heart Association (AHA)/American Stroke Association (ASA) has released a correction to its "2018 Guidelines for the Early Management of Patients with Acute Ischemic Stroke: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association."[1,2] In this correction notification, the AHA/ASA reports that based on recent feedback received from the clinical stroke community related to the "2018 Guidelines . . .," which published ahead of print January 24, 2018, and appeared in the March 2018 issue of the journal, the AHA/ASA has reviewed the guidelines and is preparing clarifications, modifications, and/or updates to several sections. Additionally, several sections were deleted from the guidelines[2] (Table 1).

Although the correction document reports continued support for the corrected version of the guidelines and its support for clinical decision-making, the rescinding of sections of the guidelines was done without the agreement of the Guideline Writing Committee.[3] Chair of the Guideline Writing Committee, William J Powers, MD, H. Houston Merritt Distinguished Professor and Chair, Department of Neurology, University of North Carolina at Chapel Hill, told Medscape Medical News: "This action by the AHA was carried out against the strongly voiced opposition and without the agreement of the majority of the 2018 Acute Ischemic Stroke Writing Group."[3] He also commented on contentious sections that had been deleted such as brain imaging recommendations and dysphagia recommendations. Powers reported, "in the case of MRI [magnetic resonance imaging] scans (referring to specific types), we simply stated they don't need to be routinely performed in all patients. There are certain patients in whom you have all the information you need to provide excellent, evidence-based patient care without an MRI scan. We didn't state that MRI scans should never be done in anyone, just each patient should be considered

Table 1. Sections that were deleted from the 2018 Stroke Guidelines.

Section	Content deleted from guideline
Section 1.3	EMS systems recommendation 4
Section 1.4	Hospital stroke capabilities recommendation 1
Section 1.6	Telemedicine recommendation 3
Section 2.2	Brain imaging recommendation 11
Section 3.2	Blood pressure recommendation 3
Section 4.3	Blood pressure recommendation 2
Section 4.6	Dysphagia recommendation 1
Section 6.0	All subsections (11)

EMS, emergency medical services.

individually in deciding whether MRI would be of benefit."[3] Regarding dysphagia screening, he reported that . . . "we didn't think there was enough evidence to recommend that every patient must have this. We said it was reasonable, but not mandatory."[3] Powers reports that the writing committee is working closely with the AHA to address the issues that have been raised. In a statement sent to Medscape Medical News, the AHA reported that they have reconvened the writing group to consider whether clarifications, modifications, or updates would address the concerns and anticipate an updated version of the guidelines to be ready for publication by summer 2018.[3]

Selected New Recommendations Pertinent to the Emergency Medicine Provider

Although with several new recommendations, there are a few new updates that bear particular relevance to emergency healthcare providers working in the prehospital and emergency department setting. One of the updates purported to have a significant impact on the initial evaluation and management of patients with suspected acute ischemic stroke is the window of time to perform endovascular thrombectomy, being increased to up to 24 hours in carefully selected patients. These recommendations are based on the results from the DAWN and DEFUSE 3 trials, which evaluated the effectiveness of endovascular therapy (thrombectomy) plus standard care vs. standard care alone in patients with large vessel occlusion acute ischemic stroke who had last been known to be well 6 to 24 hours (24 for DAWN and 16 hours for DEFUSE 3 studies) earlier with specific findings on advanced neuroimaging.[4,5] The primary outcomes that were measured focused on disability (e.g., utility-weighted modified Rankin scale) at 90 days. The authors concluded that among patients with acute stroke last known to be well 6 to 24 hours (24 for DAWN, 16 for DEFUSE 3) earlier who had a mismatch between clinical deficit and infarct, outcomes for disability at 90 days were better with thrombectomy plus standard care than with standard care alone. The authors observed no significant difference in symptomatic intracranial hemorrhage or death.[4,5]

The extension of the window of thrombectomy for ischemic stroke patients up to 24 hours is particularly significant as this new extended window can increase the proportion of patients who may benefit from this intervention. Noting that the inclusion criteria is selective and only a subset of the acute ischemic stroke population will benefit, this extended therapeutic window for this intervention has tremendous implications for the prehospital care environment where systems are designed to transport patients to healthcare facilities that can optimize the likelihood of positive patient outcomes. Regionalization of diagnosis-specific care through specialty centers and transporting patients to those centers equipped with the human and capital resources to achieve optimal patient outcomes takes a tremendous amount of time, energy, effort, planning, and resources at the organizational level of any emergency medical services (EMS) system. These changes also have implications for protocols and procedures at the hospital and provider level. This may be one of the reasons why so much consternation over the new recommendation commenting on bypassing intravenous (IV) alteplase-capable hospitals to transport to a higher level of stroke care may have been deleted. Specifically, Section 1.3 EMS Systems, recommendation 4 stated that when several IV alteplase-capable hospital options exist within a defined geographic region, the benefit of bypassing the closest to bring the patient to one that offers a higher level of stroke care, including mechanical thrombectomy, is uncertain.[1] From the removal of this recommendation, it is clear that different stakeholders have varying opinions with regard to optimal facility for acute ischemic stroke patients in the prehospital setting. Along with direct medical management, the guidelines also have implications for policies, protocols, procedures, financing, and operations at the systems level.

The use of telemedicine evaluation of acute ischemic stroke patients is also a new recommendation that supports a service to assist community physicians who do not have access to on-site neurological services. Telemedicine allows physicians and patients in resource-poor (specifically, neurology resources) communities to benefit from the expertise of a neurology consultation via live audio/video communication or simply by phone. The recommendations report that the administration of IV alteplase guided by telestroke consultation for patients with acute ischemic stroke may be as safe and beneficial as that of stroke centers.[1] Telemedicine provides the opportunity to extend the benefit of evidence-based decision-making to areas lacking the appropriate human resources. Other notable new updates include a secondary goal of door-to-needle time of 45 minutes in more than 50% of patients (primary goal stands at 60 minutes), performing brain imaging with 20 minutes of patient arrival in more than 50% of patients, and the use of brief, moderate hyperventilation (PCO_2 target 30-34 millimeters of mercury) for patients with acute severe neurological decline from brain swelling as a bridge to more definitive therapy.[1] For a selected list of new recommendations from the 2018 AHA/ASA Stroke Guidelines pertinent to the emergency practitioner in the acute initial setting, see table Table 2.

Table 2. Selected new recommendations from 2018 AHA/ASA Stroke Guidelines pertinent to the emergency practitioner.

Section	Pertinent content for the emergency provider in the acute initial setting
Section 1.5 Hospital stroke teams	1.5.3 It may be reasonable to establish a secondary DTN time goal of within 45 minutes in > 50% of patients with AIS treated with IV alteplase.
	1.5.5 Multicomponent quality improvement initiatives, which include ED education and multidisciplinary teams with access to neurological expertise, are recommended to safely increase IV thrombolytic treatment.
Section 1.6 Telemedicine	1.6.4 Telestroke/teleradiology evaluations of AIS patients can be effective for correct IV alteplase eligibility decision making.
	1.6.5 Administration of IV alteplase guided by telestroke consultation for patients with AIS may be as safe and as beneficial as that of stroke centers.
	1.6.6 Providing alteplase decision-making support via telephone to community physicians is feasible and safe and may be considered when a hospital has access to neither an in-person stroke team nor a telestroke system.
	1.6.7 Telestroke networks may be reasonable for triaging patients with AIS who may be eligible for interfacility transfer in order to be considered for acute mechanical thrombectomy.
Section 2.2 Brain imaging	2.2.2 Systems should be established so that brain imaging studies can be performed within 20 minutes of arrival in the ED in at least 50% of patients who may be candidates for IV alteplase and/or mechanical thrombectomy.
	2.2.4 The CT hyperdense MCA sign should not be used as a criterion to withhold IV alteplase from patients who otherwise qualify.
	2.2.5 Routine use of magnetic resonance imaging (MRI) to exclude cerebral microbleeds (CMBs) before administration of IV alteplase is not recommended.
	2.2.7 Multimodal CT and MRI, including perfusion imaging, should not delay administration of alteplase.
	2.2.9 For patients who otherwise meet criteria for EVT, it is reasonable to proceed with CTA if indicated in patients with suspected intracranial LVO before obtaining a serum creatinine concentration in patients without a history of renal impairment.
	2.2.10 In patients who are potential candidates for mechanical thrombectomy, imaging of the extracranial carotid and vertebral arteries, in addition to the intracranial circulation, is reasonable to provide useful information on patient eligibility and endovascular procedural planning.
	2.2.12 In selected patients with AIS within 6 to 24 hours of last known normal who have LVO in the anterior circulation, obtaining CTP, DW-MRI, or MRI perfusion is recommended to aid in the patient selection for mechanical thrombectomy, but only when imaging and other eligibility criteria from RCTs showing benefit are being strictly applied in selecting patients for mechanical thrombectomy.
Section 3.2 Blood pressure	3.2.1 Hypotension and hypovolemia should be corrected to maintain systemic perfusion levels necessary to support organ function.
Section 3.5 IV Alteplase	3.5.3 For otherwise eligible patients with mild stroke presenting in the 3- to 4.5-hour window, treatment with IV alteplase may be reasonable.
	3.5.4 In otherwise eligible patients who have had a previously demonstrated small number (1-10) of CMBs on MRI, administration if IV alteplase is reasonable.
	3.5.5 In otherwise eligible patients who have a previously demonstrated high burden of CMBs (>10) on MRI, treatment with IV alteplase may be associated with an increase risk of sICH, and the benefits of treatment are uncertain.
	3.5.6 IV alteplase for adults presenting with an AIS with known sickle cell disease can be beneficial.
	3.5.15 The risk of antithrombotic therapy within the first 24 hours after treatment with IV alteplase (with or without EVT) is uncertain.
3.6 Other IV Thrombolytics and sonothrombolytics	3.6.2 Tenecteplase administered as a 0.4 mg/kg single IV bolus has not been proven to be superior or noninferior to alteplase but might be considered as an alternative to alteplase in patients with minor neurological impairment and no major intracranial occlusion.

AHA, American Heart Association*; ASA,* American Stroke Association*; DTN,* door-to-needle; *AIS,* acute ischemic stroke; *BP,* blood pressure; *CMB,* cerebral microbleed; *CT,* computed tomography; *MCA,* middle cerebral artery; CTA, computed tomography angiography; *DW-MRI,* diffusion weighted magnetic resonance imaging; *ED,* emergency department; *IV,* intravenous; *LVO,* large vessel occlusion; *MRI,* magnetic resonance imaging; *sICH,* symptomatic intracerebral hemorrhage.
(Note: This list provides only a selected list of new recommendations introduced in the guidelines and is not exhaustive; for further details refer to the comprehensive guideline document.[1])

Table 2. Continued.

3.7 Mechanical thrombectomy	3.7.7 In selected patients with AIS within 6 to 16 hours of last known normal who have LVO in the anterior circulation and meet other DAWN or DEFUSE 3 eligibility criteria, mechanical thrombectomy is recommended.
	3.7.8 In selected patients with AIS within 6 to 24 hours of last known normal who have LVO in the anterior circulation and meet other DAWN eligibility criteria, mechanical thrombectomy is reasonable.
	3.7.17 In patients who undergo mechanical thrombectomy, it is reasonable to maintain BP < 180/105 mm Hg during and for 24 hours after the procedure.
	3.7.18 In patients who undergo mechanical thrombectomy with successful reperfusion, it might be reasonable to maintain BP at a level < 180/105 mmHg.
3.9 Antiplatelet treatment	3.9.5 In patients with minor stroke, treatment for 21 days with dual antiplatelet therapy (aspirin and clopidogrel) begun within 24 hours can be beneficial for early secondary stroke prevention for a period of up to 90 days from symptom onset.
3.10 Anticoagulants	3.10.3 The safety and usefulness of short-term anticoagulation for nonocclusive, extracranial intraluminal thrombus in the setting of AIS are not well established.
	3.10.5 The safety and usefulness of factor Xa inhibitors in the treatment of AIS are not well established.
4.3 Blood pressure	4.3.1 In patients with AIS, early treatment of hypertension is indicated when required by comorbid conditions. Lowering BP initially by 15% is probably safe.
	4.3.3 In patients with BP > 220/120 mmHg who do not receive IV alteplase or EVT and have no comorbid conditions requiring acute antihypertensive treatment, the benefit of initiating or reinitiating treatment of hypertension within the first 48 to 72 hours is uncertain. It might be reasonable to lower BP by 15% during the first 24 hours after onset of stroke.
	4.3.5 Starting or restarting antihypertensive therapy during hospitalization in patients with BP >140/90 mmHg who are neurologically stable is safe and is reasonable to improve long-term BP control unless contraindicated.
	4.3.6 Hypotension and hypovolemia should be corrected to maintain systemic perfusion levels necessary to support organ function.
4.8 Deep vein thrombosis Prophylaxis	4.8.2 The benefit of prophylactic-dose subcutaneous heparin (unfractionated heparin [UFH] or LMWH) in immobile patients with AIS is not well established.
	4.8.3 When prophylactic anticoagulation is used, the benefit of prophylactic-dose LMWH over prophylactic-dose UFH is uncertain.
5.1 Cerebellar and cerebral edema	5.1.4 Patients with large territorial supratentorial infarctions are at high risk for complicating brain edema and increased intracranial pressure. Discussion of care options and possible outcomes should take place quickly with patients (if possible) and caregivers. Medical professionals and caregivers should ascertain and include patient-centered preferences in shared decision making, especially during prognosis formation and considering interventions or limitations of care.
	5.1.10 Use of brief moderate hyperventilation (PCO2 target 30-34 mmHg) is a reasonable treatment for patients with acute severe neurological decline from brain swelling as a bridge to more definitive therapy.

DTN, door-to-needle; *AIS,* acute ischemic stroke; *BP,* blood pressure; *CMB,* cerebral microbleed; *CT,* computed tomography; *DW-MRI,* diffusion weighted magnetic resonance imaging; *ED,* emergency department; *IV,* intravenous; *LVO,* large vessel occlusion; *MRI,* magnetic resonance imaging; *sICH,* symptomatic intracerebral hemorrhage; PCO2; partial pressure of carbon dioxide.
(Note: This list provides only a selected list of new recommendations introduced in the guidelines and is not exhaustive; for further details refer to the comprehensive guideline document.[1])

SUMMARY

The AHA/ASA has released a correction to the 2018 Guidelines for the Early Management of Patients with Acute Ischemic Stroke: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association since its initial online publication in January 2018.[1,2] In this correction notification, the AHA/ASA reported that based on recent feedback received from the clinical stroke community related to the "2018 Guidelines" . . . the AHA/ASA has reviewed the guidelines and is preparing clarifications, modifications, and/or updates to several sections in it. Several sections of guideline were removed and the rescinding of the guidelines was done without the agreement of the Guideline Writing Committee.[3] Among those sections removed were ones that caused substantive debate within the medical community and relevant stakeholders. However, the updated 2018 Guidelines provide the latest treatment recommendations for patients with acute ischemic stroke and within the standing

sections of the corrected version, provide the emergency provider with the latest evidence-based updates.

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Low-dose Ketamine Does Not Improve Migraine in the Emergency Department: A Randomized Placebo-controlled Trial

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Introduction: Patients frequently present to the emergency department (ED) with migraine headaches. Although low-dose ketamine demonstrates analgesic efficacy for acute pain complaints in the ED, headaches have historically been excluded from these trials. This study evaluates the efficacy and safety of low-dose ketamine for treatment of acute migraine in the ED.

Methods: This randomized, double-blinded, placebo-controlled trial evaluated adults 18 to 65 years of age with acute migraine at a single academic ED. Subjects were randomized to receive 0.2 milligrams per kilogram of intravenous (IV) ketamine or an equivalent volume of normal saline. Numeric Rating Scale (NRS-11) pain scores, categorical pain scores, functional disability scores, side effects, and adverse events were assessed at baseline (T0) and 30 minutes post-treatment (T30). The primary outcome was between-group difference in NRS score reduction at 30 minutes.

Results: We enrolled 34 subjects (ketamine=16, placebo=18). Demographics were similar between treatment groups. There was no statistically significant difference in NRS score reductions between ketamine and placebo-treated groups after 30 minutes. Median NRS score reductions at 30 minutes were 1.0 (interquartile range [IQR] 0 to 2.25) for the ketamine group and 2.0 (IQR 0 to 3.75) for the placebo group. Between-group median difference at 30 minutes was -1.0 (IQR -2 to 1, p=0.5035). No significant differences between treatment groups occurred in categorical pain scores, functional disability scores, rescue medication request rate, and treatment satisfaction. Side Effect Rating Scale for Dissociative Anesthetics scores in the ketamine group were significantly greater for generalized discomfort at 30 minutes (p=0.008) and fatigue at 60 minutes (p=0.0216). No serious adverse events occurred in this study.

Conclusion: We found that 0.2mg/kg IV ketamine did not produce a greater reduction in NRS score compared to placebo for treatment of acute migraine in the ED. Generalized discomfort at 30 minutes was significantly greater in the ketamine group. Overall, ketamine was well tolerated by migraine-suffering subjects. To optimize low-dose ketamine as an acute migraine treatment, future studies should investigate more effective dosing and routes of administration. [West J Emerg Med. 2018;19(6)952–960.]

INTRODUCTION

Migraine is a debilitating primary headache disorder that affects one in seven adult Americans annually.[1] Many headache sufferers visit emergency departments (EDs) to alleviate migraine-associated pulsating head discomfort, nausea, vomiting, phonophobia and photophobia. American Headache Society guidelines recommend intravenous (IV) prochlorperazine and metoclopramide and subcutaneous sumatriptan for eligible adults presenting to the ED with migraine, but these medications are associated with adverse events and contraindications.[2] Prochlorperazine and metoclopramide can cause akathisia and are administered with diphenhydramine, which treats akathisia but sedates patients.[3-4] Dopamine antagonists like metoclopramide may cause dystonic reactions and Parkinsonism.[5] Triptans are contraindicated in patients with vascular disease, uncontrolled hypertension, and pregnancy; side effects include dizziness, chest pressure, and limb heaviness.[6]

Recently proposed migraine treatments include sedating and anesthetic drugs. For example, propofol was shown to be equally effective as sumatriptan for acute migraine in the ED.[7] Like propofol, ketamine is used for anesthesia induction but exhibits a different mechanism of action. Ketamine, a noncompetitive n-methyl-D-aspartate (NMDA) receptor antagonist, acts as a rapidly dissociative amnestic. It is frequently used for procedural sedation at dissociative doses of 1.0 milligrams per kilogram (mg/kg) or greater in the ED.[8] At doses less than 1.0 mg/kg ketamine exhibits hypoalgesic effects on nociceptive stimuli and alleviates chronic pain, cancer pain, neuropathic pain, and peri-operative pain.[9,10] In the ED, low-dose IV ketamine provides analgesia for acute abdominal, flank, and musculoskeletal pain that is comparable to morphine.[11,12] A review concluded that ketamine doses of 0.3 mg/kg or less are acceptable treatment for acute pain in the ED and result in fewer cardiopulmonary adverse events compared to opioid use.[13]

Our primary goal was to compare the efficacy of low-dose IV ketamine vs. saline placebo in the treatment of acute migraine using Numeric Rating Scale (NRS)-11 pain scores as our primary outcome.[14] We posited that low-dose IV ketamine would be superior to placebo in NRS score reduction after 30 minutes.

Population Health Research Capsule

What do we already know about this issue?
Low-dose ketamine has been shown to be effective for acute painful conditions in the emergency department and other settings.

What was the research question?
Is low-dose ketamine effective for migraine headache in an emergency department setting?

What was the major finding of the study?
Ketamine, at a dose of 0.2mg/kg, shows no benefit over placebo for migraine headache at 30 minutes.

How does this improve population health?
Migraine headache is a common presenting complaint in the United States. Multiple effective treatments are available, but ketamine does not seem to be effective at this dose.

METHODS

Study Design and Setting

This was a randomized, placebo-controlled, double-blinded trial conducted in the ED at a medical school-affiliated academic hospital with a Level I trauma center that accommodates over 90,000 visits annually. This study was approved by the facility's institutional review board and registered with clinicaltrials.gov.

Study Protocol

A convenience sample of patients was enrolled over 12 months by a team of trained researchers including research assistants, physicians, and medical students. Researchers received the International Headache Society (IHS) diagnostic criteria for migraine with aura, migraine without aura, and probable migraine with or without aura prior to beginning enrollment. These were reviewed with the primary authors of the paper (AE, LM, CH). Each researcher was assigned full-time patient recruitment shifts throughout the enrollment year during daytime and evening hours on weekdays and weekends. Because some periods of time could not be covered by researchers, continuous recruitment coverage during the enrollment year was not feasible. The assigned researcher performed real-time chart review of headache patients in the ED waiting room. After confirming with the attending emergency physician (EP) that patients had not received treatment in the ED, the researcher reviewed inclusion and exclusion criteria with patients. See Figure 1 for complete inclusion and exclusion criteria. Patients then provided written informed consent.

Patients were randomized into one of two treatment arms. Pharmacy completed block randomization using a random number generator to ensure roughly equal numbers in each group. Patients were assigned a subject number that corresponded with a numbered syringe containing an equivalent volume of normal saline or ketamine. Study drug preparation was managed by ED pharmacy staff and overseen by an ED pharmacist. Both ketamine and placebo were prepared in 30 mL aliquots, placed in identical

Inclusion Criteria:
(1) Patients 18-65 years old
(2) Meet ICHD (International Classification of Headache Disorders) criteria for one of the following:[16]
(a) Migraine without aura (ICHD 1.1)
(b) Migraine with aura (ICHD 1.2)
(c) Probable migraine with (ICHD 1.5.2) or without aura (ICHD 1.5.1)

Exclusion Criteria:
(1) First time headache over age 50
(2) Prior adverse reaction to ketamine
(3) Headache due to trauma
(4) New onset of focal abnormal neurological findings
(5) Altered mental status
(6) Pregnant and/or breastfeeding
(7) Fever greater than 100.3° F
(8) Physiologic instability (blood pressure > 170/120 or < 90/50; heart rate >120 bpm or < 50 bpm)
(9) Chronic renal, hepatic, or respiratory failure (defined as chronic ventilation, dialysis or cirrhosis or hepatitis by history)
(10) Suspected cardiac chest pain
(11) Provider intends to perform lumbar puncture
(12) Currently experiencing acute psychotic symptoms
(13) Previous enrollment in study

Figure 1. Inclusion and exclusion criteria in accordance with the International Headache Society (IHS) Clinical Trials.
bpm, beats per minute.
Subcommittee for guidelines for controlled trials in migraine.[15]

Side effect:	**Scoring:**
Fatigue	4=very bothersome
Dizziness	3=bothersome
Nausea	2=modest
Feelings of unreality	1=weak
Changes in hearing	0=no change
Changes in vision	
Mood change	
Generalized discomfort	
Hallucinations	

Figure 2. Side effects rating scale for dissociative anesthetics (SERSDA).

syringes, and sequentially labeled. Syringes were stocked in a refrigerator requiring a key for entry that was stored in a secured Pyxis MedStation in the ED. At no point did the primary investigator or researchers participate in study drug preparation and stocking. ED providers, nurses, researchers, and patients were blinded to syringe contents. Study numbers and group assignments were securely maintained in the hospital pharmacy and readily available in the event of an adverse reaction. Researchers were not aware of subject group assignments prior to study conclusion and analysis.

Demographic and baseline headache data were obtained from each patient including NRS-11 scores (0="no pain" and 10="worst pain imaginable"), categorical pain intensity score from 0 to 3 (0="no headache" and 3="severe headache"), and functional disability score from 0 to 3 (0="no disruption of daily activities" and 3="performance of daily activities is severely impaired"). Baseline side-effects scores were recorded using Side Effects Rating Scale for Dissociative Anesthetics (SERSDA) model often used in ketamine studies (Figure 2).[17,18]

The treating nurse then obtained the numbered syringe corresponding to each subject's study number. Study drug containing 0.2 mg/kg or an equivalent volume of saline was administered by slow IV push over one minute to each subject. Completion of IV push was considered time zero (T_0). Researchers returned to bedside at 30 (T_{30}) and 60 (T_{60}) minutes to record NRS scores, categorical pain scores, functional disability, side effects, and adverse events. Ramsay sedation scores were assigned to subjects at T_{30} and T_{60}. Subjects were asked at T_{30} if they desired rescue medication, which the supervising EP then administered at his discretion. At T_{60} research investigators asked patients about treatment satisfaction and whether they wanted the assigned study medication at a future ED encounter. Study participation was complete after T_{60}.

The assigned researcher recorded all data in real time on paper data collection sheets. Data was reviewed for completion and entered into a secured electronic database by the lead research investigator who also confirmed written consent from all study participants. Data was processed and analyzed by the statistician who was independent of data collection.

Outcomes

The primary outcome was the between-group difference in NRS score reduction from baseline to 30 minutes. Secondary outcomes included functional disability scores, categorical pain scores, pain response (>50% in NRS score and reduction of categorical score to 0 or 1), rescue medication request after 30 minutes, and patient satisfaction after 60 minutes.[15] SERSDA side effects, incidence of adverse events, and desire for study medication at a future ED encounter were also included in secondary outcomes.

Data Analysis

It was determined that a sample size of 32 subjects (16 subjects in each arm) was required to detect a 2.0-point difference in the primary outcome ($NRS_{baseline} - NRS_{T30}$) at 0.8 power. According to previous work we assumed a standard deviation of 2.0.[11] Although a difference of 1.3 points on the NRS scale is considered clinically significant, we chose 2.0 because this difference correlates with a clinically robust outcome and was employed in previous migraine studies.[11,14,19] This analysis was planned as part of a larger analysis of both headache recurrence and acute headache relief. The initial enrollment goal was 136 patients to achieve adequate power

for recurrence. The recurrence arm was abandoned early in enrollment due to extremely low follow-up rates.

We assessed the distribution of patient demographics and clinical measures using chi-square tests (or Fisher's exact test conditional on sample size) and two sample t-tests. Wilcoxon rank-sum tests were used if data was not normally distributed. To examine our primary and secondary outcomes, differences within and between study arms at baseline and T_{30} were assessed. NRS scores deviated from a normal distribution; therefore, medians, difference in medians, and corresponding interquartile ranges are provided. To better examine the direction of change for outcomes measured on an ordinal or Likert-like scale (i.e., functional disability and categorical pain scores), the differences from baseline to T_{30} were categorized as "no change" (no difference between scores), "worsened" (the score increased), and "improved" (the score decreased) and was assessed using chi-square tests. All analyses were performed in R (R Core Team, Vienna, Austria) at the alpha=0.05 level.

RESULTS

Subject enrollment occurred from March 2016 to March 2017. We assessed 173 patients for eligibility, and 34 subjects were randomized to one of two treatment groups (CONSORT diagram Figure 3). All 34 enrolled subjects and participating researchers were successfully blinded to treatment group allocation. Table 1 lists cohort demographics and baseline information. There were no significant differences between treatment groups. One patient had chronic daily hallucinations; at the time of enrollment this was discussed with the primary investigator (CH) and the decision was made that given her history of mild, chronic, daily hallucinations that were not disruptive to her function, risks would be discussed and she would be allowed to consent and enter the study.

Change in NRS pain scores between groups are listed in Table 2. The primary outcome – between-group difference in NRS scores from baseline to 30 minutes – favored saline placebo. This difference was neither statistically nor clinically significant. NRS score reductions within each treatment are also in Table 2. Within-group change for ketamine-treated subjects did not yield clinically significant pain score reduction at 30 minutes. Placebo-treated subjects experienced statistically and clinically significant NRS score reduction at 30 minutes. Categorical pain and functional disability scores are presented in Table 2. Placebo-treated subjects demonstrated a slightly greater improvement in categorical pain and functional outcomes scores at T_{30}, but these differences were not significant within or between treatment groups. Fatigue, nausea, and generalized discomfort were the most frequently experienced side effects at baseline and T_{30}.

SERSDA scores for generalized discomfort were greater in the ketamine arm at baseline and T_{30}, which reached statistical significance (Wilcoxon rank-sum test, p=0.0247, p=0.008, respectively) and fatigue was greater in the ketamine arm at T_{60} (Wilcoxon rank-sum test, p=0.0216). Otherwise, there were no statistically significant differences in side-effect severity at T_{30} between the ketamine and placebo arms. There were no adverse events in this study. Eighty-eight percent (14/16) of ketamine subjects received a Ramsay score of 2 (patient cooperative, oriented, and tranquil) at T_{30}. Two ketamine subjects received Ramsay scores of 3 (patient awake and only responds to verbal commands) at T_{30} but both resolved to scores of 2 at T_{60}.

Table 3 lists additional secondary outcomes. There were no statistically significant differences between arms

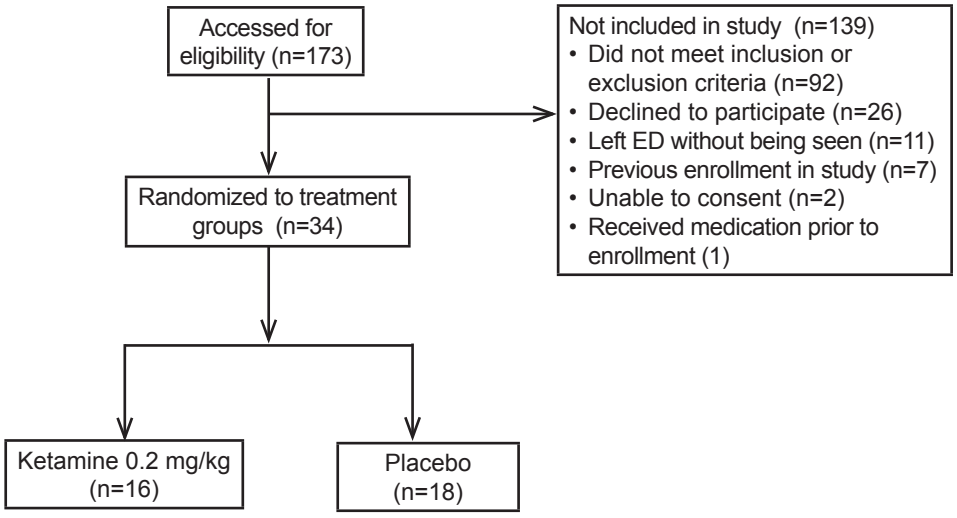

Figure 3. CONSORT flow diagram.
ED, emergency department; *mg/kg*, milligrams per kilogram.

Table 1. Baseline subject characteristics.

Characteristic	All patients N=34	Ketamine n=16	Placebo n=18
Gender, %			
Female	76	81	72
Male	24	19	28
Age, years, mean (SD)	34.3 (11.75)	38.5 (13.75)	30.5 (8.3)
Race, %			
White	68	62	72
Black	15	19	11
Other	18	19	17
Headache duration, %			
Days (≥ 24 hours)	32	31	33
Hours (< 24 hours)	62	62	61
Weeks (> 7 days)	6	6	6
Self-medicated before ED presentation, %	83	82	83
Visual aura present, %	36	34	33
ICHD, %			
1.1	48	47	50
1.2	24	33	17
1.5.1	15	13	17
1.5.2	12	7	17
Baseline categorical pain intensity, %			
Severe	77	88	67
Severe-moderate	3	0	6
Moderate	18	12	22
Mild	3	0	6
Baseline functional disability scores, %			
No disruption	0	0	0
Mildly impaired	26	25	28
Moderately impaired	35	38	33
Severely impaired	38	38	39
Baseline NRS score, median (IQR)	8 (7, 9.75)	8.25 (7.75, 10)	8 (7, 9)

ICHD, International Classification of Headache Disorders; *NRS*, Numeric Rating Scale; *IQR*, interquartile range; *ED*, emergency department; *SD*, standard deviation.

for these secondary outcomes. Rescue medications were not standardized and comprised a variety of treatments, which were not included in the data analysis.

DISCUSSION

The difference in NRS pain scores after 30 minutes was neither statistically nor clinically significant between ketamine and placebo groups. Therefore, 0.2mg/kg IV ketamine was not effective in treating acute migraine. Neither ketamine nor saline placebo induced pain reduction comparable to that of conventional and novel acute migraine therapies. Moshtaghion et al. compared IV propofol to sumatriptan for treatment of migraine in the ED, and NRS reductions at 30 minutes were greater than twice the reductions in our results.[7] Coppola et al. compared the efficacy of metoclopramide and prochlorperazine to saline placebo. Reductions in NRS scores at 30 minutes were 4.2, 7.6, and 1.5, respectively.[20] Although our placebo data is comparable to these results, conventional treatments produced twice the amount of pain reduction compared to our results.

Table 2. Changes in outcomes scores from baseline.

	Ketamine, n=16	Placebo, n=18	Difference
NRS score change from baseline*			Median (IQR)
Baseline – T_{30} (median (IQR))	1.0 (0, 2.25) p=0.0215	2.0 (0, 3.75) p=0.0034	-1.0 (-2, 1.0) p=0.5035
Categorical pain score change from baseline			Mean (95% CI)
Baseline - T_{30} (mean [95%CI])	0.56 (0.44, 0.68)	0.72 (0.61, 0.83)	0.16 (-0.85, 0.53)
Worsened, % (n)	0 (0)	6 (1)	
Unchanged, % (n)	69 (11)	44 (8)	
Improved% (n)	31 (5)	50 (9)	
Functional disability score change from baseline			
Baseline - T_{30} (mean [95%CI])	0.44 (0.32, 0.56)	0.39 (0.3, 0.48)	-0.05 (-0.59, 0.69)
Worsened, % (n)	6 (1)	11 (2)	
Unchanged, % (n)	62 (10)	50 (9)	
Improved% (n)	31 (5)	39 (7)	

IQR, interquartile range; *CI*, confidence interval; *NRS*, Numeric Rating Scale; T_{30}, 30 minutes post injection.
*Primary outcome.

Table 3. Additional secondary outcomes.

	Ketamine, % (n)	Placebo, % (n)	Difference, % (95% CI)
Patient satisfaction at T_{60}			
Yes	62 (10)	72 (13)	10 (-47, 28)
Patient desires same treatment in the future			
Yes	62 (10)	44 (8)	-18 (-21, 57)
Pain response at T_{30}*			
Pain response achieved	13 (2)	17 (3)	4 (-32, 24)
Rescue medication			
Requested at T_{30}	69 (11)	78 (14)	
Not requested at T_{30}	31 (5)	22 (4)	

CI, confidence interval; T_{30}, 30 minutes post injection; T_{60}, 60 minutes post injection.
*Defined as >50% reduction in the NRS score compared to baseline and a reduction on the 4-point categorical pain scale to a 0 or 1.

A placebo response is evident in our results, and similar responses have been reported in headache literature. Harden et al. investigated saline, ketorolac, and meperidine for acute headache treatment in the ED. After one hour saline-treated patients demonstrated a mean NRS score reduction of 2.82, and nearly 55% of saline-treated patients achieved clinical pain relief.[21]

Migraine pathophysiology remains complex, making this condition difficult to treat. A postulated component of migraine pathophysiology, the "wind-up" phenomenon, is an increase in nociceptive neuron excitability secondary to repetitive, frequency-dependent stimulation of nociceptive C-fibers. In humans, this equates to an increase in pain perception due to repetitive painful stimuli, also known as temporal summation. Coste et al. used a rat-model to demonstrate that "wind-up" enables and enhances the ability of trigeminal neurons to process painful stimuli.[22] This relationship is a possible underlying mechanism of chronic headache physiology. NMDA receptors are believed to play a role in the "wind-up" phenomenon and contribute to primary hyperalgesia, allodynia, and spontaneous pain when activated.[23] Therefore, ketamine's NMDA antagonism is theorized to induce antihyperalgesic effects in migraineurs.

At this time there is a lack of studies investigating low-dose IV ketamine as acute migraine treatment in the ED. Headache and head pain have been excluded from prospective trials investigating ketamine for acute pain treatment in the ED. Our literature search yielded two prospective,

randomized controlled trials investigating subcutaneous and intranasal ketamine for migraine treatment. Afridi et al. demonstrated that intranasal ketamine was effective at shortening the duration of aura in migraineurs, but pain relief was not measured.[24] Nicolodi et al. investigated 0.08mg/kg subcutaneous ketamine for acute migraine treatment. There was a greater reduction in pain intensity at 30 and 60 minutes in the ketamine group vs. the placebo group. There were no reports of dissociation from surroundings in the ketamine-treated group, but approximately 50% of treated subjects experienced feelings of weak insobriety.[25]

Only a few retrospective investigations and case studies have examined IV ketamine for treatment of migraine or other headache types. Pomeroy et al. conducted a retrospective study of patients with refractory chronic migraine, new daily persistent headache, chronic cluster headache, or visual snow. Patients were admitted to inpatient units and treated with continuous IV ketamine infusions for an average of 4.8 days. The mean reduction in NRS score from admission to discharge was 3.25, which was statistically and clinically significant. The most common adverse events included blurred vision (36.4%), confusion (24.7%), and hallucinations (20.8%). One patient developed suicidality and the infusion was halted prematurely.[26]

Lauritsen et al. drew similar conclusions with a retrospective case series. All six patients with refractory migraine achieved sustained pain relief for >8 hours with an average ketamine infusion dose of 0.34mg/kg/hour. Sustained pain relief occurred after an average of 44 hours.[27] While these results are promising for refractory migraine, these inpatient studies are not applicable to the ED as shorter treatments are desired for acute stabilization.

Analgesic efficacy of continuous albeit shorter IV ketamine infusions is established in the ED setting. Ahern et al. conducted a prospective, nonrandomized, nonblinded study in which IV ketamine infusions were administered for various acute pain complaints including abdominal, flank, and, joint pain. Patients were given 15mg IV push ketamine immediately followed by 20mg/hour IV ketamine infusion, which equates to ~0.3 mg/kg for a 70 kg individual. After infusion, 65% of patients had clinically significant NRS reductions, and 68% of patients had clinically significant reductions one hour after infusion.[28]

These analgesic benefits, however, are often associated with side effects including dizziness, fatigue, nausea, and, as in our study, feelings of unreality without hallucinations.[28] In accordance with prior literature, our study used an IV push of ketamine. Recently, Motov et al. demonstrated that subjects receiving 15-minute infusions experienced significantly lower rates of feelings of unreality while exhibiting no difference in analgesic efficacy compared to IV push.[29]

There is a paucity of knowledge concerning ketamine infusions for acute migraine treatment in the ED. A next step from our study is to investigate low-dose IV ketamine infusions for migraine treatment. Miller et al. compared 5-minute 0.3mg/kg IV ketamine infusions to IV morphine infusions for acute pain in the ED. Ketamine patients demonstrated a robust NRS score reduction (4.9 points) in the first five minutes after infusion with scores increasing from 5 - 20 minutes.[11] These results illuminate IV ketamine's complicated analgesic pattern for acute pain. This complex pharmacologic course could explain why patients in our study did not experience significant pain relief at 30 minutes. Perhaps if study participants had rated their pain at 5-minute intervals we might have seen significant pain reduction at earlier time points.

Our study demonstrates that a one-time bolus of 0.2mg/kg IV ketamine does not induce clinically significant NRS pain score reduction in subjects with acute migraine headache. Further investigation is needed to determine if increased dosage, different route of administration, or longer treatment duration increases analgesic efficacy.

LIMITATIONS

A limitation in our study was the chosen ketamine dose. At the inception of our work, a standardized analgesic dose of IV ketamine for acute pain was not established in the literature. The use of low-dose ketamine for acute migraine treatment was reported once in the literature, with a subcutaneous dose of 0.08mg/kg producing a significant pain reduction.[25] Lee et al. concluded that low-dose IV ketamine (defined as 0.3mg/kg or less) provides effective analgesia that is comparable to opioids, but this data was not published at our study's inception.[11] Doses between 0.5-1.0 mg/kg can produce neuropsychiatric side effects such as hallucinations and acute psychosis.[30] Beaudoin et al. compared two doses of low-dose ketamine (0.15 and 0.3mg/kg) as adjuvant treatment with morphine for acute pain in the ED. Both doses reduced pain, but 0.3mg/kg caused more side effects including nausea and tachycardia.[31] Recent studies using low-dose ketamine for acute pain used doses of either 0.2mg/kg or 0.3mg/kg with minimal side effects.[11,12,31,32] Due to the novel use of low-dose ketamine in migraine patients, a lower dose of 0.2mg/kg was chosen for our study.

The subjective quality of patient-reported data in pain studies is a limitation. It is nearly impossible in clinical emergency medicine research to obtain a cohort exhibiting equal pain tolerance. The placebo-controlled element of our study added an additional limitation. When subjects were informed they might experience neuropsychiatric side effects, some patients might have expected these side effects despite receiving placebo. For example, one patient at baseline and three patients at T_{30} reported hallucinations. However, all three patients received placebo. This demonstrates the reality of the placebo effect, as well as the subjectivity of patient-reported scores.

Another limitation in our study was maintaining strict control over additional medications given before or within 30 minutes of study drug administration. The aim

of the study was to investigate ketamine without adjuvant medications. During enrollment, the researcher's task was to communicate with the treating EP to ensure medications were not administered outside the study protocol. However, two subjects, one in the ketamine arm and one in the placebo arm, received 4mg ondansetron just prior to or during the 30-minute study period. One subject received 10 mg of metoclopramide with their study medication (ketamine). This patient was excluded from the analysis. We analyzed the data both with and without the two who received ondansetron, with no significant effects on any outcome except fatigue at 60 minutes (higher in the ketamine arm when the patients are included), and the final analysis was performed with the patients included.

An additional limitation was quantification of worsening side effects. While SERSDA is frequently used to monitor dissociative anesthetic side effects, many SERSDA side effects are also migraine symptoms. For example, it is difficult to extrapolate if increases from baseline nausea scores are secondary to ketamine administration or worsening migraine symptoms. Because ketamine side effects and migraine symptoms are similar, it was necessary to obtain baseline SERSDA scores. Therefore, SERSDA quantified baseline migraine symptom intensities as well as symptom progression throughout the study.

The final limitations include study location and sample size. This study was conducted at a single institution in a small city surrounded by a rural area. Subjects were recruited from one ED with a patient population representing demographics specific to the geographic region. Thus, the results of our study may have limited generalizability. Our sample size, though small, was the minimum number of subjects needed to determine a clinically significant difference in pain reduction between study arms. A two-point NRS reduction has been previously used as the primary outcome in other migraine and acute pain studies with similar sample sizes.[11,31] However, a larger sample size would have allowed us to power for clinically important outcomes such as changes in categorical pain and functional disability scores, achieving pain response, and rescue medication request.

CONCLUSION

A single bolus of 0.2mg/kg IV ketamine did not achieve greater NRS score reduction compared to placebo after 30 minutes. Despite similar pain reduction compared to placebo-treated subjects, ketamine-treated subjects exhibited minimal side effects that appeared endurable. Ketamine-treated subjects did not report serious neuropsychiatric adverse events, and both cohorts reported similar rates of treatment satisfaction. While the tolerability of ketamine in this neurologically sensitive cohort is promising to establish an efficacious dose and route of administration, we found that 0.2 mg/kg IV ketamine was not efficacious in treating migraine.

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Risk Factors in Pediatric Blunt Cervical Vascular Injury and Significance of Seatbelt Sign

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Introduction: Computed tomography angiography (CTA) is used to screen patients for cerebrovascular injury after blunt trauma, but risk factors are not clearly defined in children. This modality has inherent radiation exposure. We set out to better delineate the risk factors associated with blunt cervical vascular injury (BCVI) in children with attention to the predictive value of seatbelt sign of the neck.

Methods: We collected demographic, clinical and radiographic data from the electronic medical record and a trauma registry for patients less than age 18 years who underwent CTA of the neck in their evaluation at a Level I trauma center from November 2002 to December 2014 (12 years). The primary outcome was BCVI.

Results: We identified 11,446 pediatric blunt trauma patients of whom 375 (2.7%) underwent CTA imaging. Fifty-three patients (0.4%) were diagnosed with cerebrovascular injuries. The average age of patients was 12.6 years and included 66% males. Nearly half of the population was white (52%). Of those patients who received CTA, 53 (14%) were diagnosed with arterial injury of various grades (I-V). We created models to evaluate factors independently associated with BCVI. The independent predictors associated with BCVI were Injury Severity Score >/= 16 (odds ratio [OR] [2.35]; 95% confidence interval [CI] [1.11-4.99%]), infarct on head imaging (OR [3.85]; 95% CI [1.49-9.93%]), hanging mechanism (OR [8.71]; 95% CI [1.52-49.89%]), cervical spine fracture (OR [3.84]; 95% CI [1.94-7.61%]) and basilar skull fracture (OR [2.21]; 95% CI [1.13-4.36%]). The same independent predictors remained associated with BCVI when excluding hanging mechanism from the multivariate regression analysis. Seatbelt sign of the neck was not associated with BCVI (p=0.68).

Conclusion: We have found independent predictors of BCVI in pediatric patients. These may help in identifying children that may benefit from screening with CTA of the neck. [West J Emerg Med. 2018;19(6)961–969.]

INTRODUCTION

The incidence of head or neck vascular injury after blunt trauma ranges from 0.03-0.9% of pediatric injured patients.[1-4] Our focus is on blunt cervical vascular injury (BCVI). Without recognition and treatment, BCVI can result in neurologic morbidity or death.[4-6] A challenge in diagnosing BCVI is that symptoms may not initially present with focal, neurologic findings. Studies show there is often a delay in neurologic symptoms up to 10-72 hours after trauma in adults and children alike.[7,8] Screening criteria for adults are well established as described by the Denver and Memphis criteria.[9] There are no clearly delineated risk factors for pediatric BCVI nor standardized treatments.[10] The current recommendations of the Eastern Association for the Surgery of Trauma (EAST) recommends that pediatric patients should be screened using the same criteria as those in adult populations.[11]

Due to the often-occult presentation of these injuries and paucity of research until recently, the true incidence, risk factors and treatment regimens in pediatric BCVI are not certain. Yet a more generous screening regimen following the recommendations in adults may be problematic. Children are more susceptible to carcinogenic effects of ionizing radiation and they have a longer life expectancy during which cancer risk accumulates and can manifest.[12,13] The standard radiation dose of a brain and neck computed tomography angiogram (CTA) is about 16.400 millisieverts (mSv) while that of CT of the head is about 2.00 mSv.[14] A goal in pediatric radiology and trauma is to use dose-reduction strategies to reduce the number of radiation-induced cancers.[15] To comply with these goals and avoid radiation exposure when not warranted, a good screening algorithm is needed to determine those at high risk of BCVI. There is evidence that decision rules have helped decrease the number of imaging studies in pediatric head trauma.[16-18]

The purpose of our study was to determine the incidence of BCVI along with risk factors and treatment regimens observed in the pediatric trauma patients at our Level I trauma center. We also set out to determine the significance of the seatbelt sign in BCVI.

Population Health Research Capsule

What do we already know about this issue?
Computed tomography angiography (CTA) can screen patients for blunt cervical vascular injury (BCVI), but pediatric risk factors are not clear. Judicious CTA use is necessary in children.

What was the research question?
What are the risk factors for BCVI in children and is the seatbelt sign a reliable predictor?

What was the major finding of the study?
Some but not all of the risk factors of pediatric BCVI are similar to those in adults. Seatbelt sign is not a predictor.

How does this improve population health?
Findings contribute to evidence to clarify appropriate CTA screening with its inherent radiation exposure, for BCVI in children, limiting the exposure to those at highest risk.

METHODS

The study was a hospital-based cohort, retrospective review of patients less than 18 years of age in our trauma registry with blunt trauma who had a CTA of the neck performed from November 2002 to December 2014 in our Level I trauma center. We grouped the patients into age groups of less than 15 years and 15 years and older, as well as less than 2 years of age, 2-5 years, 6-14 years, and 15-17 years of age. Among the patients who underwent a CTA of the neck, individual and clinical markers were recorded including age, sex, race, Glasgow Coma Scale Score (GCS), mechanism of injury, Injury Severity Score (ISS), presence of cervical bruit, seatbelt sign of neck, hanging mechanism, focal neurologic exam and presence of laceration. We reviewed adjunct radiographic studies for injuries including cerebral hemorrhage, infarct on head imaging, facial fracture, cervical spine fracture or ligamentous injury, basilar skull fracture, clavicle fracture, thoracic spine fracture, rib fracture, and scapula fracture.

While ISS is not available in the trauma bay during an evaluation we are using it here as a surrogate for degree of severity of trauma, which may be used along with other factors to influence the decision to perform imaging on a patient (See Appendix A for data extraction form). These clinical and radiographic covariates were largely extrapolated from those included in the Memphis, Denver and EAST criteria to assess their significance in children. Data were extracted from the trauma registry and the electronic medical record (EMR) and recorded in a secure database (See Appendix B for trauma registry data abstraction methods). Seatbelt sign represented blunt injury to the neck including deeper abrasions, hematoma, "seatbelt sign" or deep bruising of the neck. We separated mechanisms of injury into three groups: motor vehicle collisions, other motorized vehicles, and other blunt injury. Two physicians each extracted data on all patients independently. Any inconsistencies were reviewed by both and reexamined in the EHR and a conclusion made.

Our outcome of interest was arterial injury of the neck.

The images and electronic medical record of the patients found to have BCVI in our cohort were queried for type of vessel damaged and mode of treatment in addition to the parameters mentioned prior. Vascular injuries were characterized as the following: internal carotid artery, common carotid artery, and vertebral artery. Mode of treatment included observation, aspirin, anticoagulation, and surgical intervention, including endovascular stenting and ligation. The observation group included those who had collaterals negating need for intervention, those for whom the positive radiological report was felt to be artifact by the treating physician, or patients for whom observation was the dominant management strategy. This group also included the patients who died within 48 hours of presentation for devastating head injury. Each patient was assigned to the highest grade of injury when more than one lesion was present and to the most aggressive treatment plan received. Observation was the least aggressive treatment plan followed by aspirin, anticoagulation, and finally surgical intervention.

All arterial injuries were graded by a neuroradiologist according to the injury scale proposed by Biffl and colleagues.[19] In this classification system, grade I injury involved intimal irregularity with < 25% narrowing, grade II injury involved vessel dissection or presence of hematoma with > 25% narrowing, grade III injury indicated pseudoaneurysm, grade IV represented vessel occlusion, and grade V represented transection of the vessel with extravasation.[19]

The pediatric trauma CTA scanner used during the study period was a Siemens Sensation 40 Helical CT (40 slice) and a Siemen's Definition AS+ Helical CT (128 slice). There is no difference in diagnostic utility of cervical vascular injury above the 16-slice scanners; thus, the ones used in our study were equivalent.

Statistical Analysis

We report on frequencies, proportions, and measures of central tendency. Factors associated with BCVI were analyzed using univariate analyses. Ordinal and nominal variables are reported using the chi square test or Fisher's exact test if the count in the contingency table was ≤6. Continuous variables were analyzed using Student's t-test. The logistic regression model includes all clinical variables and age. The covariates initially included the following: age, GCS, ISS, cerebral hemorrhage, seatbelt sign, infarct on head imaging, hanging mechanism, mechanism of injury, presence of facial fractures, cervical spinal fractures, basilar skull fractures, clavicle fractures, thoracic fractures, rib fractures, and scapula fractures. We used the backward stepwise elimination (Wald) approach to determine the covariates included in the final model. The functionality of the adjusted final model is verified, and the Hosmer and Lemeshow goodness-of-fit test is reported. Due to the increased standard error and the wide confidence interval (CI) of the covariate hanging mechanism, we created a second model excluding this particular covariate. A *p*-value <.05 (two-tailed) was considered statistically significant in all tests. We performed all analyses with IBM SPSS software (version 23).

RESULTS

During the study period, 13,735 pediatric trauma patients less than 18 years of age were evaluated in the emergency department and entered into the trauma registry. Of these, 11,446 suffered blunt injuries (83.3%). The 375 (3.3%) children who experienced blunt trauma and underwent screening with neck CTA were included in this study. Fifty-three patients were diagnosed with cervical vascular injuries (0.5% of all pediatric blunt trauma patients evaluated in the study period; 14% of all blunt trauma patients screened with CTA). Some of these patients had more than one vascular lesion. The mean age of patients was 12.6 years. Non-Whites (48%) and Whites (52%) were nearly equally distributed.

Univariable factors associated with cervical vascular injury (p< 0.05) were GCS </= 8, ISS >/= 16, presence of cerebral hemorrhage, infarct on head imaging, cervical spine fracture and basilar skull fracture. Seatbelt sign was not associated with cervical vascular injury (p=0.68) (Table 1). We created two models of multivariate logistic regression. Model 1, including the covariate hanging mechanism, showed the factors independently associated with cerebral vascular injury were ISS >/= 16 (odds ratio [OR] [2.35]; 95% CI [1.11-4.99%]), infarct on head imaging (OR [3.859]; 95% CI [1.49-9.93%]), hanging mechanism (OR [8.71]; 95% CI [1.52-49.89%]), cervical spine fracture (OR [3.84]; 95% CI [1.94-7.61%]) and basilar skull fracture (OR [2.21]; 95% CI [1.13-4.36%]) (Table 2). The goodness of fit test for this first model had a chi square= 8.37, degrees of freedom = 5, and p-value= 0.14. When we excluded hanging mechanism from the analysis, our model 2 had a better goodness-of-fit test (chi square = 5.57, degrees of freedom = 5, and p-value= 0.32) (Table 3). Importantly, the independent factors associated with BCVI in the first model remained the same.

There were similar proportions of patients in the less-than-15 years of age (182, 45.8%) group as compared to the 15 and older group (193, 51.5%). When we further separated the groups, there were 44/375 (12%) patients in the five years old and under group. See Figure 1A and 1B for a histogram with distribution of all ages in this cohort and a distribution of ages of children with vascular injuries, respectively. Ninety one percent of the vascular injuries were found in the six years and older group while only nine percent of vascular injuries were found in the preschool age group (five years and under). More than half of all lesions (32) were found in the 15 years and older group; 17% of this group were found to have BCVI.

There was a total of 63 cervical vascular lesions identified within the 53 patients, since some patients had more than one vessel injured (i.e., eight patients had two vessels involved, and one had three vessels injured). In our sample, the majority

Table 1. Univariate analyses of demographic and clinical factors associated with blunt cervical vascular lesions in children.

Characteristic	All N=375 (100%)	Cervical vascular lesion N=53 (14.1%)	No cervical vascular lesion N=322 (85.9%)	p-value
Demographic factors				
Age				
<15 years old	182 (45.8)	21 (39.6)	161 (50)	0.16
≥15 years old	193 (51.5)	32 (60.4)	161 (50)	0.16
Age				
<2 years old	7 (1.9)	1 (1.9)	6 (1.9)	0.57
2-5	37 (9.9)	4 (7.5)	33 (10.2)	0.57
6-14	138 (36.8)	16 (30.2)	122 (37.9)	0.57
15-17	193 (51.5)	32 (60.4)	161 (50)	0.57
Sex				
Male	246 (65.6)	29 (54.7)	217 (67.4)	0.07
Female	129 (34.4)	24 (45.3)	105 (32.6)	0.07
Race				
White	193 (51.6)	34 (64.2)	159 (49.5)	0.05
Non-White	181 (48.4)	19 (35.8)	162 (50.5)	0.05
Clinical factors				
GCS				
≤8	126 (33.6)	27 (50.9)	99 (30.7)	0.004
>8	249 (66.4)	26 (49.1)	223 (69.3)	0.004
ISS				
<16	173 (46.1)	13 (24.5)	160 (49.7)	0.001
≥16	202 (53.9)	40 (75.5)	162 (50.3)	0.001
Cerebral hemorrhage				
Yes	178 (47.5)	33 (62.3)	145 (45)	0.02
No	197 (52.5)	20 (37.7)	177 (55)	0.02
Seatbelt sign of neck				
Yes	86 (22.9)	11 (20.8)	75 (23.3)	0.68
No	289 (77.1)	42 (79.2)	247 (76.7)	0.68
Infarct on head CT				
Yes	25 (6.7)	10 (18.9)	15 (4.7)	≤0.001
No	350 (93.3)	43 (81.1)	307 (95.3)	≤0.001
Hanging mechanism				
Yes	8 (2.1)	3 (5.7)	5 (1.6)	0.09*
No	367 (97.9)	50 (94.3)	317 (98.4)	0.09*
Mechanism				
MVC	212 (56.5)	31 (58.5)	181 (56.2)	0.58
Other motorized	80 (21.3)	13 (24.5)	67 (20.8)	0.58
Other blunt	83 (22.1)	9 (17)	74 (23)	0.58
Facial fractures				
Yes	103 (27.5)	17 (32.1)	86 (26.7)	0.42
No	272 (72.5)	36 (67.9)	236 (73.3)	0.42
Cervical spinal fracture				
Yes	86 (22.9)	23 (43.4)	63 (19.6)	≤0.001
No	289 (77.1)	30 (56.6)	259 (80.4)	≤0.001

IQR, interquartile range; *GCS*, Glasgow Coma Scale Score; *ISS*, injury Severity Score; *CT*, computed tomography; MVC, motor vehicle collision.
*Fisher's exact test.

Table 1. Continued.

Characteristic	All N=375 (100%)	Cervical vascular lesion N=53 (14.1%)	No cervical vascular lesion N=322 (85.9%)	p-value
Basilar skull fracture				
Yes	127 (33.9)	26 (49.1)	101 (31.4)	0.01
No	248 (66.1)	27 (50.9)	221 (68.6)	0.01
Clavicle fracture				
Yes	35 (9.3)	4 (7.5)	31 (9.6)	0.80*
No	340 (90.7)	49 (92.5)	284 (90.4)	0.80*
Thoracic fracture				
Yes	50 (13.3)	10 (18.9)	40 (12.4)	0.20
No	325 (86.7)	43 (81.1)	282 (87.6)	0.20
Rib fracture				
Yes	65 (17.3)	8 (15.1)	57 (17.7)	0.64
No	310 (82.7)	45 (84.9)	258 (82.3)	0.64
Scapula fracture				
Yes	16 (4.3)	2 (3.8)	14 (4.3)	0.99*
No	359 (95.7)	51 (96.2)	308 (95.7)	0.99*

*Fisher's exact test.

Table 2. Model 1: Multivariate logistic regression analysis of clinical factors associated with cervical vascular lesions, including the covariate hanging mechanism.

	Variables in the equation							
							95% CI for OR	
	B	SE	Wald	df	p-value	OR	Lower	Upper
ISS ≥16	0.857	0.383	5.007	1	0.02	2.35	1.11	4.99
Infarct on head CT	1.348	0.484	7.761	1	0.005	3.85	1.49	9.93
Hanging mechanism	2.165	0.890	5.911	1	0.015	8.71	1.52	49.89
Cervical spinal fracture	1.346	0.349	14.907	1	0.000	3.84	1.94	7.61
Basilar skull fracture	0.796	0.345	5.318	1	0.02	2.21	1.13	4.36
Constant	-3.303	0.370	79.691	1	0.000	0.04		

ISS, injury severity score*; CI,* confidence interval; *OR*, odds ratio; *CT*, computed tomography; *B*, beta; *SE*, standard error; *df*, degrees of freedom.

Table 3. Model 2: Multivariate logistic regression analysis of clinical factors associated with cervical vascular lesions, excluding the covariate hanging mechanism.

	Variables in the equation							
							95% CI for OR	
	B	SE	Wald	df	p-value	OR	Lower	Upper
ISS ≥16	.775	.371	4.371	1	.04	2.17	1.05	4.49
Infarct on head CT	1.375	.471	8.531	1	.003	3.95	1.57	9.95
Cervical spinal fracture	1.289	.341	14.289	1	.000	3.63	1.86	7.08
Basilar skull fracture	.746	.339	4.841	1	.03	2.1	1.08	4.1
Constant	-3.148	.352	79.855	1	.000	.04		

ISS, injury severity score*; CI,* confidence interval; *OR*, odds ratio; *CT*, computed tomography; *B*, beta; *SE*, standard error; *df*, degrees of freedom.

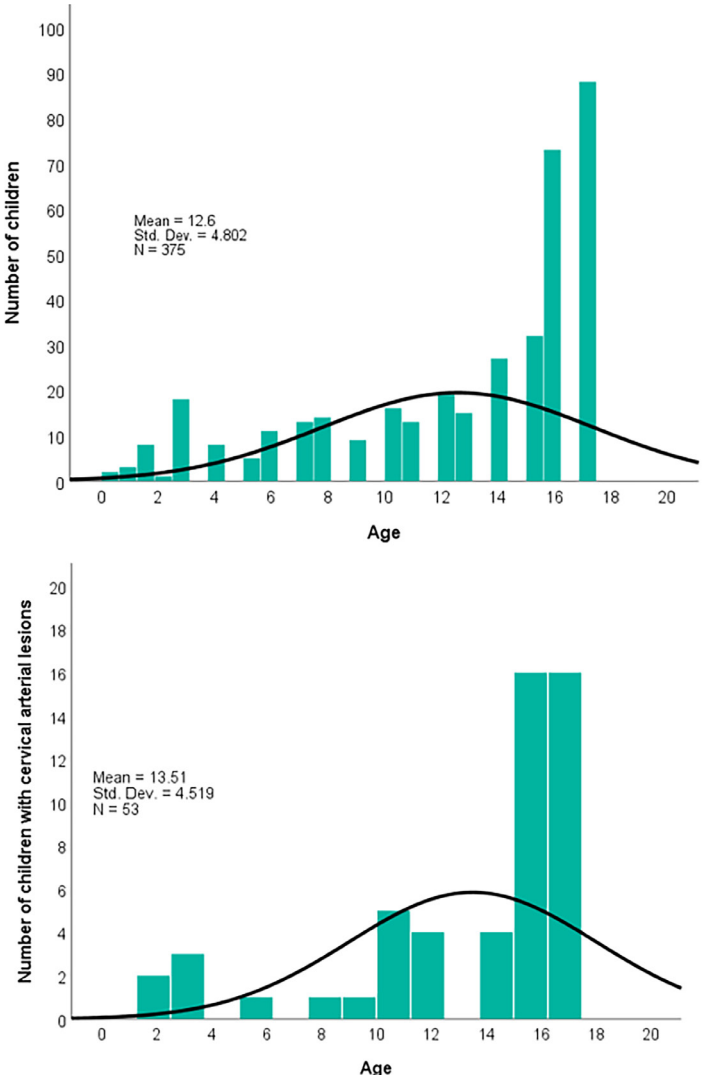

Figure 1ab. a) Histogram of ages of the total sample of children included in the study (top); b) Histogram of ages of children with cervical arterial lesions (bottom).

of the lesions were grade I (34%) followed by grade II and IV lesions (23% each). Grade III injuries composed 21% of the group. There were no grade V lesions in our sample.

Medication management was the most common treatment plan. Aspirin or anticoagulation was used for 66% of all patients and varied by the lesion grade. Grade I lesions tended to receive aspirin only, while grades II and higher included the use of anticoagulants. An interventional approach was used for only 1.8% of patients. In-hospital mortality occurred in 11% of the cases. Six patients expired within 48 hours of presentation to the ED with five of these dying within 24 hours. All of the deaths were attributed to brain injuries. Of these, one patient had cerebral edema and two others had ischemic changes on CT brain images. Figure 2 shows the number of children per graded lesion and the type of management received in each category.

DISCUSSION

Our large retrospective review identified similarities and differences in risk factors for BCVI in children when considering the risk factors identified in adults. Over the last decade there have been increased efforts to discover clinical risk factors for BCVI, specifically in children, but with little consensus. In 1999 Lew et al. reviewed the National Pediatric Trauma Registry with 57,659 pediatric blunt trauma patients and found that clavicular fracture demonstrated the strongest association with blunt carotid artery injury.[20] While we included clavicular fracture in our series as a potential risk factor, it did not bear an association with BCVI, with only four clavicular fractures found in the BCVI group and 34 in those without BCVI.

In another series, Jones et al. found that more than two thirds of pediatric patients presenting with stroke did not have screening indications similar to those observed in the adult protocols.[2] These researchers found a high percentage of blunt cerebrovascular injuries with cervical spine injuries in 19/45 (40%) of patients.[2] We also found cervical spine injuries to be significantly associated with BCVI in our cohort. This association makes sense from a mechanical and anatomical view as both cervical spine injuries and BCVI result from similar etiologies such as cervical hyperextension and rotations, hyperflexion, or a direct blow. Intimal disruption from the trauma causes emboli or occlusion of the vessel. As the cervical vasculature is adjacent to the cervical spine, if the latter is injured, the former is at risk for injury as well. In contrast, Kopelman and his group identified only 11 pediatric patients with documented BCVI, with 91% of these patients having a risk factor that had been associated with BCVI in adult populations. They concluded that the risk factors for pediatric BCVI mimic those of the adult population.[3] While some adult risk factors are confirmed in our series, others were not associated with BCVI in children such as facial fractures, Le Fort fractures, and chest injury such as rib, scapula, thoracic and clavicle fractures.

Ravindra and colleagues identified 234 patients who had screening for blunt cerebrovascular injuries with 37 injuries observed. They determined that fracture through the carotid canal, petrous temporal bone fracture, GCS < 8, focal neurological deficit, and stroke on initial CT were independent factors predicting vascular injuries, which do parallel some of our findings.[10] When validated in a multicenter trial, the sensitivity of the Utah score remained low at 59%, rendering a questionable utility of the score as an initial screening tool.[10] With the addition of mechanism of injury to this score, the McGovern-Utah score brings the sensitivity up to 81%.[21] While promising, this score still needs validation with other populations. Furthermore, cerebrovascular injuries of both head and neck were included in these cohorts.

We focused our study on CTAs of the neck and specifically analyzed the impact of seatbelt sign as a marker for vascular

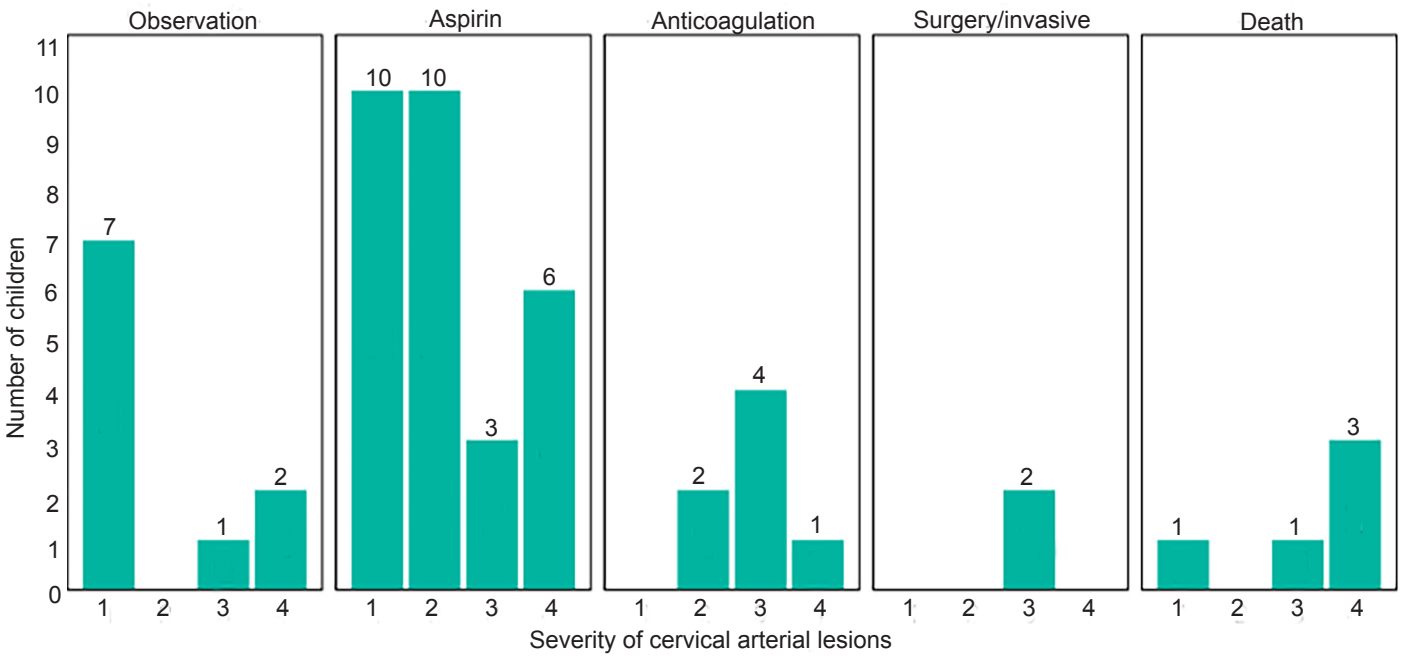

Figure 2. Types of treatments and mortality associated with graded severity of vascular lesions for study cohort, Grade I-IV. No Grade V was observed in this study.

injury. Our study did not find seatbelt sign to be an independent factor associated with BCVI, which supported previous studies' findings, albeit other reports included smaller sample sizes than our study. In 2014, Desai found that the cervical seatbelt sign was not associated with BCVI in children.[5] Dhillon and colleagues found a weak correlation between the cervical seatbelt sign and vascular injury in a mainly adult population.[22] These authors concluded that a protocol for CTA of the neck for patients with a cervical seatbelt sign can be reserved for those with associated injuries on physical exam and/or findings on standard trauma imaging.[22]

The EAST also recommends against the use of seatbelt sign to independently select patients for screening, although in practice it is sometimes still used.[11] A possible explanation for the lack of significance of the seatbelt sign in our current study is that we included records for only those patients who had a CTA neck performed, and it is possible that a child with seatbelt sign of the neck did not receive imaging. If imaging was not performed and the same patient followed up at a different institution with a vascular injury, a patient would have been missed in our cohort. Furthermore, due to its retrospective design, physical exam findings may not be documented accurately or simply not included. In addition, due to our interest in the exam findings of the neck, we focused only on CTA neck in this study. In a different study at our institution we included both CTA neck and brain to develop the McGovern score.[21]

LIMITATIONS

The retrospective design with inherent recall bias and the inclusion of a single institution are limitations. Our Level I trauma center is located in the inner city and our patient body is composed of a large percentage of uninsured and minority groups and may not be generalizable to all populations. Furthermore, with the collection of data covering a 12-year span, there may have been differences in practice patterns guiding the screening of BCVI.

It is also reasonable to hypothesize that our incidence of blunt CVI may have been higher if all blunt trauma patients (11,446) had been screened with a CTA of the neck as a large number were asymptomatic. It is quite possible that asymptomatic Grade I or II lesions did not go on to develop symptoms and were unreported without imaging. Yet it is not feasible to screen all trauma patients due to monetary costs and radiation risk to our pediatric patients. Moreover, we chose CTA as our screening vs. other modalities such as magnetic resonance angiogram (MRA) and angiogram because in the ED setting, CTA is the most logical choice for quick diagnoses. Research regarding the difference in diagnostic accuracy of CTA and MRA in blunt cerebrovascular injury has been mixed, but in recent years CTA has emerged as the study of choice, replacing the four-vessel digital subtraction angiography.[23-25] It is possible our facility may have had patients transferred from outside institutions or worked up during their hospital stay with other imaging modalities not included in our

analysis. We focused on patients with acute trauma presenting in the ED; thus, this constricted sample of only patients imaged for inclusion in the study is a limitation that may be accounted for in a prospective trial.

While most of our predictors of injury had narrow CIs, two in particular had wider ones. We postulate that the two factors with the widest CIs – infarct on head imaging and hanging mechanism – were affected by the small sample size of patients with these findings. There were 25 (6.7%) patients with infarct on head imaging and eight (2.1%) patients with hanging mechanism in the cohort of 375 patients. An even larger, prospective multicenter trial might validate our findings. Both these are risk factors in adult BCVI and our cohort.

There is no standard of care on selecting the optimal treatment when BCVI is discovered and no set pathway to mitigate risk of cerebrovascular accident. The majority of our cohort was treated conservatively or with aspirin alone, and only one out of 53 patients received surgical intervention. Our study did not have enough power to compare the effectiveness of different treatment plans, but we did not find adverse events related to either method in our series. The prevalence as well as the short- or long-term effects of adverse events is a topic that would benefit from research focused on the risks and benefits of treatments.

Further work should also delve into the true risk of stroke in the pediatric population. While we did not look at this specifically, it is information that deserves attention in future prospective studies. The pathophysiology of stroke may be different in children and adults. Children have greater elastic resilience of their vessels than adults and have more elastic bone and soft tissues around the vessels that can potentially absorb the kinetic energy of high-impact blunt trauma better than adults. Less diseased vessels in children may also allow for quicker recovery time in the setting of injury. There is evidence to suggest that BCVI in adults is more severe than in children.[26] It is true that the treatment of graded lesions vary by institution; thus, is not standardized. We believe a more standardized approach in diagnosing cervical vascular lesions may pave the way for more research into treatment and outcomes.

The need and interest to develop pediatric guidelines for CTA screening is demonstrated by the recent flurry in publications on this topic. Our study specifically extrapolated risk factors for BCVI in a pediatric population in one of the largest cohorts to date. It should be noted that clinical judgment may trump clinical guidelines, but we are in need of developing a robust rule. A prospective, multi-site, observational study is needed to devise a screening tool that is accurate enough to capture patients at risk for BCVI.

CONCLUSION

We identified independent predictors of cervical vascular injury in children in one of the largest samples to date – namely ISS >/= 16, presence of cerebral hemorrhage, infarct on head imaging, cervical spine fracture, and basilar skull fracture. These factors may help raise awareness and improve the quality of care of children undergoing a trauma evaluation for possible screening with CTA.

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Factors Affecting Family Presence During Fracture Reduction in the Pediatric Emergency Department

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Introduction: Asking family members to leave during invasive procedures has historically been common practice; however, evidence-based recommendations have altered the trend of family presence during pediatric procedures. The aim of this study was to determine factors related to family members' choice to be present or absent during fracture reductions in a pediatric emergency department (ED), and their satisfaction with that choice.

Methods: We administered role-specific, anonymous surveys to a convenience sample of patients' family members in the ED of a Level I pediatric trauma center. All family members were given a choice of where to be during the procedure.

Results: Twenty-five family members of 18 patients completed surveys. Seventeen family members chose to stay in the room. Family member satisfaction with their decision to be inside or outside the room during the procedure (median = very satisfied) was almost uniformly high and not associated with any of the following variables: previous presence during a medical procedure; provider-reported procedure difficulty, or anxiety levels. Family member perception of procedure success (median = extremely well) was also high and not associated with other variables. Location during the procedure was associated with a desire to be in the same location in the future (Fisher's exact test, p=0.001). Common themes found among family members' reasons for their location decisions and satisfaction levels were a desire to support the patient, high staff competence, and their right as parents to choose their location.

Conclusion: Family members self-select their location during their child's fracture reduction to high levels of satisfaction, and they considered the ability to choose their location as important. [West J Emerg Med. 2018;19(6)970–976.]

INTRODUCTION

Patient- and family-centered care (PFCC) refers to "health care that is compassionate, includes patients and families as partners and collaborators, is provided with respect, and treats patients and families with dignity."[1] The Institute of Medicine states that patient-centered care is geared toward "providing care that is respectful of and responsive to individual patient preferences, needs, and values, and ensuring that patient values

guide all clinical decisions."[2] Two important aspects of PFCC are family education and presence during patient care and treatment.

Although asking family members to leave during invasive procedures has historically been common practice, evidence-based recommendations have altered the trend of family presence during pediatric procedures. For instance, studies have refuted the misperceptions that family members may interfere during the procedure, that the procedure may cause great distress to them, or that they do not have a preference regarding their own presence.[3-7] Other studies have suggested that a provider's preference against family member presence is correlated with that provider's lack of experience having family present and that providers' views on family presence differ from patients' views.[8-14] In fact, family presence may have beneficial effects on the patient-doctor relationship and patients' medical outcomes.[15,16]

Despite these findings, few studies have investigated family member presence during fracture reductions and other orthopedic procedures, which are common in emergency departments (ED). Orthopedic procedures are unique among procedures as they are commonly performed in the ED, and frequently require procedural sedation and analgesia. However, the graphic nature of the procedure is often considered a reason to exclude family presence. PFCC, because it calls for collaboration with patients' families as partners, demands a challenge to the assumption that orthopedic procedures are difficult for family members to tolerate and may cause undue distress. Although there is literature assessing providers' views on family presence during fracture reduction, there is a gap in knowledge regarding factors affecting family members' preferences and decisions regarding whether to be present during fracture reduction.[17] To that end, this study aimed to identify factors that affect the decision to stay in a patient's room during a fracture reduction as well as to describe family members' self-reported experience during the procedure.

Population Health Research Capsule

What do we already know about this issue?
Providers overwhelmingly accept family presence during many emergency procedures, though this is less common during fracture reductions.

What was the research question?
To characterize location preference and experience of family members during pediatric fracture reductions.

What was the major finding of the study?
Family members self-selected their location with high satisfaction and stressed the importance of the choice.

How does this improve population health?
Delivering effective patient- and family-centered care, and building mutual trust and increased satisfaction require understanding of families' preferences and values.

METHODS

Study Design and Setting

This study was a prospective, observational survey study of a convenience sample of family members and providers of pediatric patients (i.e. less than 18 years old) undergoing fracture reductions in a tertiary-care pediatric ED with an average of 12,000 visits annually. After identification by ED providers, eligible family members were approached for enrollment based on the availability of the research assistant. The research assistant was a medical student on a summer research elective and was scheduled to be available 40 hours per week, during typical "daytime hours" (i.e., 9 a.m.-5 p.m.). Our institution has implemented many PFCC guidelines, a component of which recommends allowing pediatric patients' family members to choose whether to be inside or outside the procedure room before, during, and after fracture reductions.

Survey Design and Development

Survey instruments (one for pre-procedure, one for post-procedure) were created in consultation with the survey center affiliated with the study's parent university (Appendix). Family members were asked about factors that could contribute to their choice to be present or absent during fracture reductions in a pediatric ED and their satisfaction with that choice. These factors included relationship to patient, previous presence during a medical procedure, preference for being inside or outside the room during the procedure, and anticipated anxiety level during the procedure. Actual location (i.e., inside or outside the room) during the procedure was also recorded for comparison. The post-procedure survey assessed the actual level of anxiety felt during the procedure, impression of how well the procedure went, and location preference for future fracture reductions (i.e., inside or outside the procedure room).

Of note, after reviewing the results of the first 10 surveys, we modified the post-reduction survey to better assess family members' satisfaction with the procedure. We replaced, "Where would you recommend parents/family members of other children to be during the same procedure?" and "Do you want to be given the option to be in or outside the procedure room for all procedures performed on family members?" with the following:

"How satisfied are you with the way the staff prepared you for the procedure?"; "How satisfied are you with your choice to be inside/outside of the procedure room during the procedure?"; and "How important is the option to be in or outside the room for all procedures performed on family members?"

Survey Administration

The principal investigator administered paper surveys during the research work hours before (pre-reduction survey) and after (post-reduction survey) the procedure to eligible family members accompanying pediatric patients undergoing fracture reduction. Survey participants were informed of the purpose. No protected health information was gathered in this study.

Data Analysis

This is a descriptive study in which we display the association of pre-procedure factors compared with patients' family members' preferences for being inside or outside the procedure room during fracture reductions. We also observed the influence of actual location (inside or outside the procedure room) compared to post-procedure measures of satisfaction, such as overall impression of how well the procedure went, anxiety during the procedure, and location preference for future procedures. Furthermore, we examined family members' future location preferences when considering their perceived anxiety, actual location during the procedure, and initial location preferences. Finally, we asked family members the level of importance that they placed on having the choice to be present during the procedure. Quantitative data are reported as raw percentages and we used Fisher's exact test to determine the strength of association (though this should be viewed as exploratory only since we did not power this study to establish causation). As mentioned previously, due to the small number of patients and family members, all analyses should be considered descriptive.

For qualitative analysis, we performed conventional content analysis on responses to qualitative questions. This involved first reviewing answers to free-response questions and then creating de novo response categories based on common thematic elements among responses to the same question.

RESULTS

Characteristics of Participants

There were 25 family members accompanying 18 patients who completed surveys. Patient age ranged from 4-16 years old, with median age of nine (Table 1). A majority of the fractures were in either forearm (n=13, 72%), and a majority of patients were administered ketamine for sedation (n=16, 89%). Fourteen (78%) patients had at least one family member who stayed in the room during the procedure.

Twenty-one (84%) of the 25 family members completed pre-procedure surveys and all 25 (100%) completed post-procedure surveys. Of the 18 reductions performed, a child life specialist was present during the procedure for 14 (77.8%). As mentioned in the methods section, the post-reduction survey was modified part way through the study and 12 of 25 family members completed this revised post-survey.

Table 1. Patient characteristics (n=18) in survey of factors affecting family presence during procedure.

Patient characteristics	Number of patients (%)
Age	
4-5	4 (22.2%)
6-10	6 (33.3%)
11-15	7 (38.9%)
16	1 (5.6%)
Sex	
Female	7 (38.9%)
Male	11 (61.1%)
Fracture type	
Both forearm bones	13 (72.2%)
Distal radius	1 (5.6%)
Ankle	3 (16.7%)
Finger	1 (5.6%)
Anesthesia type	
Regional anesthesia	2 (11.1%)
Sedated with ketamine	16 (88.9%)
Number of family members in room during procedure	
0	4 (22.2%)
1	11 (61.1%)
2	3 (16.7%)

Main Results

There was no statistical difference between family member type (e.g., mother, father, other) and their actual location during the procedure: Mothers remained in the room in 86% of cases compared to 50% for fathers (p=0.08). There were four family members with missing values for location preference before the procedure; if we assume that their location preference was honored, almost everyone's preference was honored (80% of those who preferred to be inside ahead of the procedure stayed inside, and 100% of those who wished to remain outside the procedure room did [Table 2]). We observed no strong relationship of anticipated anxiety to choice of location, although those who anticipated lower anxiety were observed to be more likely to remain inside the procedure room (80% vs. 55.6%, p=0.35). Location during the procedure did not affect the family member's impression of how well it went; everyone who responded said it went "very well" to "extremely well" (Table 3). A majority of those who

Table 2. Status of patient's family member before procedure compared with location during procedure.

Family member characteristics	Inside	Outside	Fisher's p value
Relationship			
Mother	12 (85.7%)	2 (14.3%)	0.083
Father	4 (50%)	4 (50%)	0.083
Other	1 (33.3%)	2 (66.7%)	0.083
Location preference before procedure			
Inside	16 (80%)	4 (20%)	0.0055
Outside	0 (0%)	4 (100%)	0.0055
No preference	1 (100%)	0 (0%)	0.0055
Anticipated anxiety before procedure			
0-1 "None" to "a little"	8 (80%)	2 (20%)	0.35
2-4 "Somewhat" to "a great deal"	5 (55.6%)	4 (44.4%)	0.35

Table 3. Family member's location during procedure compared with impression of how well the procedure went.

Location	Very well	Extremely well
Inside	7 (41.2%)	10 (58.8%)
Outside	4 (50%)	4 (50%)

Fisher's exact test for count data, p=1.

Table 4. Family member's location during procedure compared with anxiety level reported.

Location	"None" to "a little" (0-1)	"Somewhat" to "a great deal" (2-4)
Inside	10 (58.8%)	7 (41.2%)
Outside	2 (25%)	6 (75%)

Fisher's exact test for count data, p=0.2016.

stayed inside during the procedure described having lower anxiety than those who were outside the room (Table 4).

When asked where they would like to be during a similar procedure in the future, everyone who stayed inside said they would choose to do so again; about half of those who stayed outside said they would do so again (Table 5) (p=0.001). Regarding the importance of the option to choose to be inside or outside of the procedure room, four of the 12 who responded (33%) thought the option was "extremely important," seven (58%) thought it was "very important," and one (8%) felt it was "somewhat important."

Table 5. Family member's location during procedure compared to reported future location preference.

Location	Inside	Outside	No preference
Inside	17 (100%)	0 (0%)	0 (0%)
Outside	3 (37.5%)	4 (50%)	1 (12.5%)

Fisher's exact test for count data, p=0.001.

Qualitative Outcome Measures

Regarding their satisfaction with their location during the procedure, 10 of the 12 family members responded that they were "very satisfied" (83%) while one was "somewhat satisfied" (8%) and another "neutral" (8%). The "somewhat satisfied" response came from a mother who remained inside the procedure room and stated, "It was hard to watch but still glad we were in the room." She also added that the "doctor and nurses made sure she [her daughter] was very comfortable. They also took their time making sure arm was perfectly back aligned." The mother wanted to be inside the procedure room in the future, writing that "being there was reassuring knowing she [her daughter] was ok."

The "neutral" response came from a mother who was outside the room during the procedure and had no preference as to her location in the future. She wrote: "He [her son] did fine without me. I was glad to not be exposed to the radiation." She marked "not at all" for her actual anxiety level and thought the procedure went "very well," noting "no pain, kind staff, accommodating my need to get food for patient."

Several themes emerged from family members' explanations of their experience. The most common reason for parents deciding to stay in the procedure room was to "be there" for their child. Of the 18 family members who reported wanting to be inside the procedure room on their pre-procedure survey, 15 (83.3%) cited a desire to be present as a support to their child. One respondent wrote that she wanted "to be there for my child so she feels comfortable and loved." Another wrote that it

was "easier to be with child than away worrying."

When asked to justify the importance of having the choice to be inside or outside of the procedure room for any procedure, 11 of 12 family members felt that it was very or extremely important and emphasized the benefits of having a choice. One respondent wrote, "Every parent has the right/responsibility to be there for support and protection." Another wrote, "Allowing family to be witness and in the room allows for a resemblance of control. Kicking the parents out only makes them worry more." Twenty-five percent of all family members also cited personal preference toward having the choice: "good to have a choice;" "I am glad I had the option;" and "some people would prefer to be with their child."

DISCUSSION

In this descriptive study of family member presence during pediatric fracture reductions in the ED, we found that family members largely 1) prefer to be inside the room during the procedure; 2) prefer to be in the same location for future procedures; and 3) believe it is important to be asked where they would prefer to be during the procedure. Studies on family presence during fracture reductions in the pediatric ED are limited. Most available literature focuses on family presence during pediatric resuscitation or other more invasive procedures.[14,18,19] Our study begins to address the need for procedure-specific studies focusing on the experience of family members, particularly as it relates to having a choice of location during procedures.

In our study, family members self-selected their location to a high level of satisfaction, regardless of what that choice was. Not only was satisfaction with location almost uniformly high among family members, but location during the procedure was also highly associated with the desire to be in the same location in the future. Understanding and accommodating this strong association may be an important factor in the development of PFCC guidelines in the ED.

Our results differ somewhat from Gamell et al., who conducted a survey study in an ED in Barcelona, Spain. Of their respondents, 86.5% expressed a desire to stay during fracture reduction, while only 37% actually stayed. Also, only 51.6% of parents believed that they should have the choice to be present.[20] This discrepancy in responses, particularly between the desire to stay and to have the choice to be present, may be attributable to many factors, including differences in culture, facility resources and institutional guidelines, but warrants further investigation into reasons behind each desire and how those desires might be reconciled.

Our results suggest that family members' positive impressions of procedure success were independent of family member location during the procedure; instead, positive impressions of success were associated with perceived staff competence. Responses from family members who stayed with the patient suggest that being inside the room enhanced family members' positive impressions. This likely informed their high levels of satisfaction. Regardless of the location, family members emphasized the importance of effective communication from staff regarding procedure progress and procedure success. This supports various studies that demonstrated effective provider communication shapes and improves family member and pediatric patient experience.[21-23]

There were four family members whose future location preference differed from the actual location. Of these four cases, it appeared that staying in the room was uncomfortable for them and they chose to leave, but indicated they still would like to be inside the room in the future. If family members find the procedure more distressing than expected, thorough pre-procedure education should inform them that they could ask for help or choose to step out at any time. This in turn will lead to self-monitoring of family members to inform staff if they need to leave the room.

In addition to a family presence guideline for fracture reduction, we routinely allow parents to remain with patients when radiography is performed, though parents are required to wear a lead apron if they remain in the room. Unfortunately, we did not ask about family members' concerns regarding exposure to ionizing radiation in this study. We also did not consider the presence of multiple family members since our guideline recommends only one family member to be in the room during procedures. Although not being present during the procedure may lead to lower satisfaction, knowing that at least one family member is present may be a source of reassurance for any others accompanying pediatric patients. We also did not consider socioeconomic and ethnic perspectives of patients and families in our study. All of these factors require additional consideration in future studies.

Based on the recommendations from the American College of Emergency Physicians and American Academy of Pediatrics, which support PFCC, and our own institutional experience, we feel that it is important to invite family member presence during pediatric fracture reductions. Guidelines regarding PFCC as it relates to procedures in the ED should consider family member preference and resource availability (e.g., child life specialists) in their recommendations. They should also strongly support communication between family members and care providers.

LIMITATIONS

This observational, descriptive study had several limitations. First, there was the potential for selection bias arising from convenience sampling. Second, our survey instruments were not previously validated, raising concern for possible information bias, although we constructed them with the help of methodological experts. Third, our study took place in a tertiary-care, pediatric ED with ample resources such as child life specialists, which may limit generalizability. Fourth, family members' answers to our survey may have

been subject to information bias if they did not want to admit they had made the "wrong choice" for themselves. Lastly, the change in the post-reduction survey mid-recruitment resulted in fewer responses to some of the questions, but we felt that the modified questions provided more insight into family members' satisfaction with the procedure.

CONCLUSION

In our study we did not find any factors associated with family preference to be present during fracture reduction in children. However, it was very important to family members to be given the option to be present with the child. Regardless of their pre-procedure location preference and actual location during the procedure, they uniformly experienced high levels of satisfaction.

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Tranexamic Acid in Civilian Trauma Care in the California Prehospital Antifibrinolytic Therapy Study

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Introduction: Hemorrhage is one of the leading causes of death in trauma victims. Historically, paramedics have not had access to medications that specifically target the reversal of trauma-induced coagulopathies. The California Prehospital Antifibrinolytic Therapy (Cal-PAT) study seeks to evaluate the safety and efficacy of tranexamic acid (TXA) use in the civilian prehospital setting in cases of traumatic hemorrhagic shock.

Methods: The Cal-PAT study is a multi-centered, prospective, observational cohort study with a retrospective comparison. From March 2015 to July 2017, patients ≥ 18 years-old who sustained blunt or penetrating trauma with signs of hemorrhagic shock identified by first responders in the prehospital setting were considered for TXA treatment. A control group was formed of patients seen in the five years prior to data collection cessation (June 2012 to July 2017) at each receiving center who were not administered TXA. Control group patients were selected through propensity score matching based on gender, age, Injury Severity Scores, and mechanism of injury. The primary outcome assessed was mortality recorded at 24 hours, 48 hours, and 28 days. Additional variables assessed included total blood products transfused, the hospital and intensive care unit length of stay, systolic blood pressure taken prior to TXA administration, Glasgow Coma Score observed prior to TXA administration, and the incidence of known adverse events associated with TXA administration.

Results: We included 724 patients in the final analysis, with 362 patients in the TXA group and 362 in the control group. Reduced mortality was noted at 28 days in the TXA group in comparison to the control group (3.6% vs. 8.3% for TXA and control, respectively, odds ratio [OR]=0.41 with 95% confidence interval [CI] [0.21 to 0.8]). This mortality difference was greatest in severely injured patients with ISS >15 (6% vs 14.5% for TXA and control, respectively, OR=0.37 with 95% CI [0.17 to 0.8]). Furthermore, a significant reduction in total blood product transfused was observed after TXA administration in the total cohort as well as in severely injured patients. No significant increase in known adverse events following TXA administration were observed.

Conclusion: Findings from the Cal-PAT study suggest that TXA use in the civilian prehospital setting may safely improve survival outcomes in patients who have sustained traumatic injury with signs of hemorrhagic shock. [West J Emerg Med 2018;19(6):977-986.]

INTRODUCTION

In the United States (U.S.), traumatic injury is the leading cause of death and disability among those aged 1 to 44 years old.[1] Among trauma victims, hemorrhage accounts for 30% to 40% of the mortality.[2-4] Within the prehospital setting, hemorrhage is one of the top causes of death and comprises the largest portion of preventable deaths.[2,3] Significant blood volume loss leads to the depletion of coagulation factors and dysregulation of the coagulation system. Combined, these factors threaten the body's ability to maintain hemodynamic stability and may result in cardiovascular collapse.

The burden of trauma-induced coagulopathies (TIC) has been demonstrated in more than half of trauma patients following arrival to trauma centers and has been associated with a significant increase in the risk of trauma-induced mortality.[5-9] Historically, paramedics have not had access to medications that specifically target the reversal of TIC.[3,4] As biotechnological advances enable better detection and understanding of TIC, a group of patients has been identified that may benefit from early reversal of traumatic coagulopathies, leading to a possible reduction in associated mortality.[8,10-12]

Tranexamic acid (TXA) is a synthetic derivative that inhibits fibrinolysis and has been shown to be effective in the hospital setting in the treatment of hemorrhagic shock. In 2010 the Clinical Randomization of an Antifibrinolytic in Significant Hemorrhage-2 (CRASH-2) trial suggested that TXA was associated with a 1.5% reduction (14.5% vs. 16%) in all-cause mortality at 28 days when administered within eight hours of injury without an increase in thromboembolic events.[13] In 2011 a post-hoc analysis showed that early TXA treatment within three hours from the time of injury in the hospital setting resulted in a 1.6% decrease in death due to bleeding; the reduction in mortality increased to 2.4% if administered within one hour from injury.[14]

Despite evidence surrounding hospital TXA use, a gap in knowledge exists surrounding the prehospital TXA use in the civilian setting. Multiple small studies have demonstrated the feasibility of prehospital TXA administration including the ability of paramedics to identify candidates with signs of hemorrhagic shock.[15-18] Two recent investigations focusing on civilian injuries in Germany and Japan further suggest that prehospital TXA use may reduce mortality in severely injured trauma victims.[19-20] However, their retrospective nature and the lack of standardized dosages and algorithms for TXA administration limited the generalizability of those studies. This paucity of out-of-hospital data has limited the widespread implementation of TXA into U.S. civilian prehospital-care protocols.

The California Prehospital Antifibrinolytic Therapy (Cal-PAT) study was designed to evaluate the safety and efficacy of TXA use in the civilian prehospital setting in traumatic hemorrhagic shock. A preliminary report during ongoing data collection from the Cal-PAT study was published in 2017.[21] This current study reports the final findings of the prehospital component of the Cal-PAT study. We hypothesized that the prehospital administration of TXA in cases of traumatic hemorrhagic shock would be associated with a decrease in mortality.

Population Health Research Capsule

What do we already know about this issue?
Prior studies assessing tranexamic acid (TXA) use in civilian and military trauma resuscitation demonstrate a promising effect on mortality reduction and a limited side-effect profile.

What was the research question?
What is the impact and feasibility of prehospital TXA use in trauma-induced hemorrhagic shock within North American emergency medical services standards?

What was the major finding of the study?
TXA use was associated with improved survival in traumatic hemorrhagic shock and a decrease in blood product utilization.

How does this improve population health?
Traumatic injury is a major cause of death in both developed and developing nations. TXA use represents a feasible measure toward reducing loss of life due to traumatic exsanguinating injury.

METHODS

Cal-PAT Study Overview

The Cal-PAT study was a multi-centered, prospective, observational cohort study with a retrospective comparison. The study was initiated in March 2015 in two Southern California counties–San Bernardino and Riverside. In early 2016 Alameda County joined the study. All eight receiving centers are designated Level I and Level II trauma centers. A total of 30 emergency medical services (EMS) agencies were involved across all counties. Current data collection for this study concluded in July 2017 in all counties. Within the prehospital setting, the California Emergency Medical Services Authority approved TXA to be included in EMS protocols as a standard treatment for all trauma patients showing signs of hemorrhagic shock. TXA administration was carried out uniformly among all participating EMS agencies. The institutional review board at each trauma center approved

CAL-PAT study protocols, including the incorporation of TXA into the massive transfusion protocol at each center as a standard of care for trauma patients and allowed for research data collection with a waiver of consent.

Data collection, Protocols, Outcomes

All patients ≥18 years old who sustained blunt or penetrating trauma with signs of hemorrhagic shock were considered for TXA treatment upon meeting enrollment criteria (Figure 1). Patient selection in the prehospital setting was determined by paramedics on ambulances or by registered nurses on helicopter transport units. Paramedics and registered nurses underwent a standardized training session including education on the guidelines for TXA candidate identification, the protocol for TXA administration, and the TXA known side-effect profile. Additionally, a system of access to real-time consultation with senior physicians familiar with study protocol at each participating trauma center was established prior to study initiation to address any first responder concerns regarding patient selection or TXA administration.

TXA was delivered in two doses following the protocol used in the CRASH-2 trial.[13,14] The first dose was 1 gram of TXA in 100 ml of 0.9% normal saline infused over 10 minutes via intravenous (IV) or intraosseous access. This first dose was administered by paramedics or registered nurses as soon as feasible after patient assessment. Identification of study patients receiving TXA was achieved through a wristband labeled "TXA", verbal communication at patient hand off by EMS, and/or by EMS run sheet. Following arrival to a participating trauma center, patients who received prehospital TXA were identified and re-assessed by trauma team members for signs of continued hemorrhagic shock. Patients who continued to meet the study criteria (Figure 1) received a second dose of 1 gram of TXA in 100 ml of 0.9% normal saline infused over eight hours via IV infusion. A patient may have received only one dose of TXA if they arrived to the trauma center and no longer met study criteria (Figure 1). We excluded from the study patients who were deceased upon arrival (declared dead on arrival with minimal resuscitation effort or failed to respond to resuscitation after 15 minutes in the ED), those who received TXA for non-trauma indications, and those who received TXA and were determined to be less than 18 years old upon arrival.

The control group was formed of patients seen at each receiving center within five years prior to the conclusion of data collection (June 2012 to July 2017). This group included patients who were not administered TXA because they were brought in by an EMS provider group not carrying TXA or because they were transported to the hospital by any means other than a designated EMS provider (e.g., friends, family, self). The control group patients met the same study criteria (Figure 1) as those in the TXA group. The control group patients were matched to TXA group patients through propensity scoring based upon gender, age, Injury Severity Score (ISS), and mechanism of injury. We further aimed to match TXA group patients with controls from the same trauma center.

The primary outcome was mortality measured at 24 hours, 48 hours, and 28 days. Additional variables included total blood products transfused during the hospital stay, the hospital and intensive care unit (ICU) length of stay (LOS), systolic blood pressure taken prior to TXA administration, Glasgow Coma Score observed prior to the first TXA dose in the field, and the incidence of known adverse events associated with TXA administration including thromboembolic events (e.g., deep vein thrombosis, pulmonary embolism), myocardial infarction, and neurological events (e.g., stroke, seizure).

Data for included subjects were abstracted from the electronic medical record and trauma registry for each patient. Follow up to determine mortality outcomes after hospital

Inclusion Criteria	Exclusion Criteria
The prehospital and hospital use of TXA should be considered for all trauma patients that meet any of the following criteria: •Blunt or penetrating trauma with signs and symptoms of hemorrhagic shock within three hours of injury. -Systolic blood pressure of less than 90 mmHg at scene of injury, during air and/or ground medical transport, or upon arrival to designated trauma centers. -Heart rate > 120. -Estimated blood loss of 500 milliliters in the field. -Bleeding not controlled by direct pressure or tourniquet. •Major amputation of any extremity above the wrists and above the ankles.	•Any patient <18 years of age. •Any patient more than three hours post-injury. •Any patient with an active thromboembolic event (within the last 24 hours) – i.e., active stroke, myocardial infarction or pulmonary embolism. •Any patient with a hypersensitivity or anaphylactic reaction to TXA. •Traumatic arrest with more than five minutes of cardiopulmonary resuscitation without return of vital signs. •Penetrating cranial injury. •Traumatic brain injury with brain matter exposed. •Isolated drowning or hanging victims. •Documented cervical cord injury with motor deficits.

Figure 1. Inclusion and exclusion criteria provided to first responders in the field and clinicians at receiving trauma centers.
TXA, tranexamic acid.

discharge was abstracted from the electronic medical record and trauma registry. In select cases, direct chart review was conducted, and in cases of missing data, study investigators contacted patients' and/or patients' families directly to determine survival outcomes. Estimated time to TXA administration by EMS was determined to be the estimated time of injury based on the time that the 911 call was received and documented time of TXA administration on the EMS run sheet.

Statistical Analysis

We conducted all statistical analyses using the SAS software for Windows version 9.3 (SAS Institute, Cary, North Carolina, USA). Descriptive statistics were presented as means and standard deviations for continuous variables, along with frequencies and proportions for categorical variables. Propensity score matching based on age, gender, ISS, and mechanism of injury were used to form the TXA and control groups. Matching of each patient for the TXA group and control group was performed within the trauma registry of each center involved. We conducted chi-square analyses to identify whether there was a difference in the mortality at 24 hours, 48 hours, and 28 days between the TXA and control groups. Independent T-tests were conducted to identify whether there were differences of continuous variables (e.g., age) between the TXA and control groups.

Wilcoxon rank-sum tests were conducted to identify whether the median of some continuous variables (e.g., hospital LOS) was different between the TXA and control groups. Based on the original study design, we conducted three subgroup analyses to assess patient outcomes including (1) those who received one dose of TXA in comparison to two doses of TXA; (2) those who sustained significant blood loss (≥10 units of total blood products transfused) and those who did not sustain significant blood loss (<10 units of total blood products transfused), similar to the subanalysis performed in the Military Application of Tranexamic Acid in Trauma Emergency Resuscitation (MATTERs) study;[22] (3) those who were severely injury (ISS ≥16) and those who were less severely injured (ISS <16).

The original sample-size calculation was based on the published results using 48-hour mortality as the primary outcome. Morrison and colleagues suggested that the TXA 48-hour mortality rates were 11.3% and 18.9% for TXA and control.[22] Controlling for the type I error rate of 0.05, a sample size of 369 patients in each group would achieve a statistical power of 0.80.

RESULTS

A total of 362 patients were included in the TXA group (Figure 2). To eliminate the confounding effect of age, gender, ISS, and mechanism of injury, we conducted a propensity matching based on these four factors to select 362 patients as the control group. As a result, 724 patients were included in the final analysis. The median time for paramedics to administer TXA from the estimated time of injury was 33 minutes (interquartile range: 26 min, 46 min). As expected per the propensity matching process, there was no statistically significant difference in age (37.96 vs. 37.64 years for the TXA and control groups, respectively, difference=0.32 with 95% confidence interval [CI] [-2.05 to 2.69]), percentage of males (80.9% vs. 80.9% for the TXA and control groups, respectively, odds ratio [OR]=1 with 95% CI [0.69 to 1.45]), ISS (16.08 vs, 17.15 for the TXA and control groups, respectively, difference=-1.07 with 95% CI [-2.86 to 0.72]), and mechanism of injury (percentage of blunt trauma was 37.0% for both the TXA and control groups, respectively, OR=1 with 95% CI [0.74 to 1.35] (Table 1).

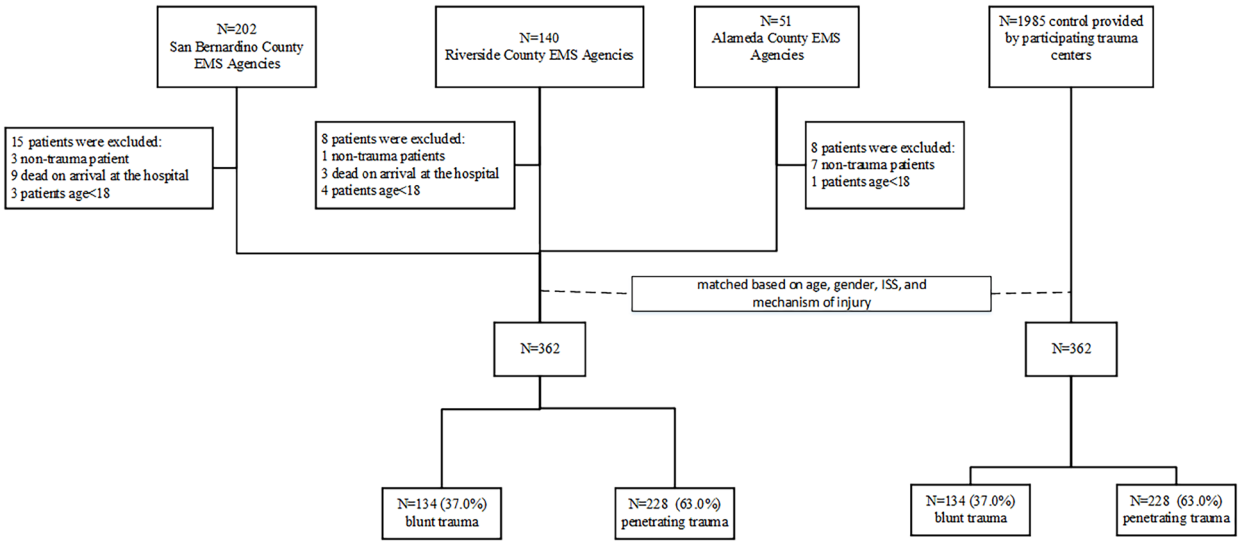

Figure 2. Patient flow chart.

Table 1. Patient outcomes for the control and TXA groups.

	TXA (n=362)	Control (n=362)	Statistic with 95% CI*
Mortality at 24 hours	7 (1.9%)	13 (3.6%)	0.53 (0.21, 1.34)
Mortality at 48 hours	10 (2.8%)	16 (4.4%)	0.61 (0.27, 1.37)
Mortality at 28 days	13 (3.6%)	30 (8.3%)	0.41 (0.21, 0.8)
Total blood products transfused (in units), median (Q1, Q3)	1 (0, 6)	3 (2, 8)	2 (1.14, 2.86)
Hospital LOS (in days), median (Q1, Q3)	4 (1, 12)	8 (5, 15)	4 (2.35,5.64)
ICU LOS (in days), median (Q1, Q3)	4 (2, 8)	5 (3, 8)	1(0.65, 2.25)
Adverse events			
Thromboembolic events	2	2	Not Applicable
Myocardial infarction events	0	0	Not Applicable
Neurologic events	0	0	Not Applicable
Penetrating trauma	228 (63%)	228 (63%)	1 (0.74,1.35)
Male	293 (80.9%)	293 (80.9%)	1 (0.69, 1.45)
Age, years, mean ± SD	37.96 ± 16.11	37.64 ± 16.33	0.32 (-2.05, 2.69)
ISS, mean ± SD	16.08 ± 10.69	17.15 ± 11.71	-1.07 (-2.86, 0.72)
SBP, mmHg, mean ± SD	78.42 ± 16.17	83.66 ± 14.13	-5.24 (-8.48, -2)
GCS, mean ± SD	12.78 ± 3.71	13 ± 3.4	-0.22 (-1.01, 0.57)

TXA, tranexamic acid; *LOS*, length of stay; *ICU*, intensive care unit; *ISS*, Injury Severity Score; *SD*, standard deviation; *SBP*, systolic blood pressure; *GCS*, Glasgow Coma Scale Score; *OR*, odds ratio; *CI*, confidence interval; *Q1*, 25th percentile; *Q3*, 75th percentile.
*Reported as odds ratio and the corresponding 95% confidence interval or difference in median or mean between TXA and control groups, depending on the variable type.

We compared clinical outcomes between the TXA and control groups. The results were also presented in Table 1. The TXA group had a statistically significant decrease in 28-day mortality (3.6% vs 8.3%, OR=0.41 with 95% CI [0.21 to 0.8]), fewer units of total blood products transfused (median of 1 vs. 3 units, difference=2 with 95% CI [1.14 to 2.86]), shorter hospital LOS (median of 4 vs. 8 days, difference=4 with 95% CI [2.35 to 5.64]), and shorter ICU length of stay (median of 4 vs. 5 days, difference=1 with 95% CI [0.65 to 2.25]).

Regarding the adverse events following TXA administration, no differences in the incidence of thromboembolic, myocardial infarction, or neurologic events were noted between the TXA and control groups. In the TXA group, two thromboembolic events, zero neurologic events, and zero myocardial infarction events were reported. In the control group, two thromboembolic events, zero neurologic events, and zero myocardial infarction events were reported. Additionally, two neurologic events were considered as possible adverse events in the TXA group, but after thorough review of each case, TXA as the primary etiology was deemed remote. In one case, a young male patient received TXA following a head-on, high-speed, motor vehicle accident where he sustained multiple, long bone fractures. He subsequently experienced a hemisphere ischemic stroke 40 hours after admission. Repeat computed tomography (CT) of his head revealed a new large ischemic infarct in the right middle cerebral artery distribution with moderate mass effect and midline shift. Suspecting traumatic vascular injury, a computed tomography angiography (CTA) study was ordered but not completed after his family decided to instate a do-not-resuscitate (DNR) order. A second case of ischemic stroke following TXA administration occurred in an elderly individual following a high-speed motor vehicle accident where the patient presented with altered mental status, scalp lacerations and a possible, small subdural hematoma as well as multiple, long bone fractures. Forty-eight hours after admission, the patient was diagnosed with an ischemic stroke, which neurosurgery attributed to fat emboli from long bone fractures.

We conducted a subgroup analysis to assess clinical outcomes between patients who received one dose vs. two doses of TXA (Table 2). Compared with patients who received one dose of TXA, those who received two doses of TXA required more blood transfusions (median of 0 vs. 3 units of blood product, difference=3 with 95% CI [1.34 to 4.67]).

A second subgroup analysis was conducted among patients who required transfusion (Table 3). Among patients who received <10 units of blood transfusion, the TXA group required fewer units of blood products transfused (median of 0 vs. 2 units, difference=2 with 95% CI [1.44 to 3.56]), had shorter hospital LOS (median of 4 vs. 8 days, difference=4 with 95% CI [2.28 to 5.73]), and shorter ICU LOS (median of 3 vs. 4 days, difference=1 with 95% CI [0.98 to 2.02]). Among patients who received ≥10 units of blood transfusion, the TXA group had a

Table 2. Subgroup analysis of the TXA group.

	Pre-hospital 1 dose of TXA (n=235)	1 Pre-hospital + 1 hospital dose of TXA (n=127)	Statistic with 95% CI*
Mortality at 24 hours	5 (2.1%)	2 (1.6%)	1.36 (0.26, 7.1)
Mortality at 48 hours	8 (3.4%)	2 (1.6%)	2.2 (0.46, 10.53)
Mortality at 28 days	9 (3.8%)	4 (3.2%)	1.22 (0.37, 4.06)
Total blood products transfused (in units), median (Q1, Q3)	0 (0, 3)	3 (0, 13)	3 (1.34, 4.67)
Hospital LOS (in days), median (Q1, Q3)	4 (1, 10)	6 (2, 15)	2 (-0.57, 4.58)
ICU LOS (in days), median (Q1, Q3)	3 (2, 5)	4 (2, 12)	1 (-1.07, 3.07)
Penetrating trauma	151 (64.3%)	77 (60.6%)	1.17 (0.75,1.82)
Male	188 (80%)	105 (82.7%)	0.84 (0.48, 1.47)
Age, years, mean ± SD	37.45 ± 16.62	38.76 ± 15.25	-1.31 (-4.81, 2.19)
ISS, mean ± SD	15.69 ± 10.77	16.81 ± 10.53	-1.14 (-3.45, 1.18)
SBP, mmHg, mean ± SD	80.53 ± 16	74.96 ± 15.94	5.57 (1.49, 9.65)
GCS, mean ± SD	12.73 ± 3.81	12.87 ± 3.53	-0.14 (-0.97, 0.69)

TXA, tranexamic acid; *LOS*, length of stay; *ICU*, intensive care unit; *ISS*, Injury Severity Score; *SD*, standard deviation; *SBP*, systolic blood pressure; *GCS*, Glasgow Coma Scale Score; *OR*, odds ratio; *CI*, confidence interval; *Q1*, 25th percentile; *Q3*, 75th percentile.
*Reported as odds ratio and the corresponding 95% confidence interval or difference in median or mean between TXA and control groups, depending on the variable type.

Table 3. Subgroup analysis of patients based on the number of units of blood product transfused.

	<10 units of blood transfused (n=584)			≥10 units of blood transfused (n=140)		
	TXA (n=291)	Control (n=293)	Statistic with 95% CI*	TXA (n=71)	Control (n=69)	Statistic with 95% CI*
Mortality at 24 hours	3 (1.0%)	7 (2.4%)	0.43 (0.11, 1.66)	4 (5.6%)	6 (8.7%)	0.63 (0.17, 2.33)
Mortality at 48 hours	5 (1.7%)	7 (2.4%)	0.72 (0.22, 2.28)	5 (7%)	9 (13%)	0.51 (0.16, 1.59)
Mortality at 28 days	7 (2.4%)	14 (4.8%)	0.49 (0.2, 1.24)	6 (8.5%)	16 (23.2%)	0.31 (0.11, 0.84)
Total blood products transfused (in units), median (Q1, Q3)	0 (0, 2)	2 (2, 4.3)	2 (1.44, 3.56)	18 (14, 32)	20 (14, 31)	2 (-2.76, 2.76)
Hospital LOS (in days), Median (Q1, Q3)	4 (1, 8)	8 (5, 15)	4 (2.28, 5.73)	13 (5, 22)	10 (6, 14)	3 (-2.76, 2.76)
ICU LOS (in days), median (Q1, Q3)	3 (2, 5.5)	4 (3, 8)	1 (0.98, 2.02)	5 (3, 14)	6 (4, 8)	1 (-1.87, 5.86)
Penetrating trauma	192 (66.0%)	175 (59.7%)	1.31 (0.93,1.83)	36 (50.7%)	53 (76.8%)	0.31 (0.15, 0.64)
Male	236 (81.1%)	230 (78.5%)	1.18 (0.78,1.76)	57 (80.3%)	63 (91.3%)	0.39 (0.14,1.08)
Age, years, mean ± SD	37.99 ± 16.3	38.26 ± 16.65	-0.27 (-3.01, 2.47)	37.87 ± 15.49	35 ± 14.68	2.87 (-1.85,7.59)
ISS, mean ± SD	14.77 ± 10.34	15.66 ± 10.28	-0.89 (-2.86, 1.08)	21.39 ± 10.51	24.81 ± 13.96	-3.42 (-7.4, 0.57)
SBP, mmHg, mean ± SD	79.61 ± 16.12	84.69 ± 14.17	-5.08 (-8.64, -1.51)	72.73 ± 15.36	78.88 ± 13.19	-6.15 (-13.57, 1.27)
GCS, mean ± SD	13.16 ± 3.42	13.25 ± 3.09	-0.09 (-0.91, 0.73)	11.21 ± 4.44	11.95 ± 4.39	-0.74 (-2.94, 1.46,)

TXA, tranexamic acid; *LOS*, length of stay; *ICU*, intensive care unit; *ISS*, Injury Severity Score; *SD*, standard deviation; *SBP*, systolic blood pressure; *GCS*, Glasgow Coma Scale Score; *OR*, odds ratio; *CI*, confidence interval; *Q1*, 25th percentile; *Q3*, 75th percentile.
*Reported as odds ratio and the corresponding 95% confidence interval or difference in median or mean between TXA and control groups, depending on the variable type.

statistically significant decrease in mortality at 28 days (8.5% vs 23.2%, OR=0.31 with 95% CI [0.11 to 0.84]).

We conducted a third subgroup analysis based on patients' ISS score (Table 4). Among patients with ISS <16, the TXA group had lower 24-hour mortality (0% vs. 2.6%, OR=0), fewer units of blood product transfused (median of 0 vs. 2.7 units, difference=2.7 with 95% CI [2.02 to 3.64]), shorter hospital LOS (median of 3 vs. 7 days, difference=4 with 95% CI [1.66

Table 4. Subgroup analysis of patients based on the Injury Severity Score.

	Patients with ISS <16 (n=384)			Patients with ISS ≥16 (n=340)		
	TXA (n=194)	Control (n=190)	Statistic with 95% CI*	TXA (n=168)	Control (n=172)	Statistic with 95% CI*
Mortality at 24 hours	0 (0%)	5 (2.6%)	0	7 (4.2%)	8 (4.7%)	0.89 (0.32, 2.52)
Mortality at 48 hours	1 (0.5%)	5 (2.6%)	0.19 (0.02, 1.66)	9 (5.4%)	11 (6.4%)	0.83 (0.37, 2.05)
Mortality at 28 days	3 (1.6%)	5 (2.6%)	0.58 (0.14, 2.47)	10 (6%)	25 (14.5%)	0.37 (0.17, 0.8)
Total blood products transfused (in units), median (Q1, Q3)	0 (0, 2)	2.7 (2, 6)	2.7 (2.02, 3.64)	4 (0, 15)	4 (2, 12)	0 (-1.89, 1.89)
Hospital LOS (in days), median (Q1, Q3)	3 (1, 6)	7 (4, 13)	4 (1.66, 6.34)	8 (2, 16)	10 (6, 17)	2 (-0.89, 4.89)
ICU LOS (in days), median (Q1, Q3)	3 (2, 5)	5 (3, 9.5)	2 (0.59, 3.41)	5 (2, 13)	5 (3, 8)	0 (-2.22, 2.22)
Penetrating trauma	140 (72.2%)	132 (70.0%)	1.14 (0.73,1.77)	88 (52.4%)	96 (55.8%)	0.87 (0.57, 1.33)
Male	157 (80.9%)	152 (80%)	1.06 (0.64,1.76)	136 (81%)	141 (82%)	0.93 (0.54, 1.62)
Age, years, mean ± SD	38.67 ± 16.68	38.95 ± 17.41	-0.28 (-4.06, 3.5)	36.72 ± 15.42	36.97 ± 15.07	-0.25 (-3.36, 2.86)
ISS, mean ± SD	8.61 ± 2.91	9.27 ± 2.89	-0.66 (-1.33, 0.01)	26.28 ± 9.97	26.65 ± 11.73	-0.37 (-2.72, 1.98)
SBP, mmHg, mean ± SD	78.7 ± 16.12	87.3 ± 19.09	-8.6 (-16.44, -0.76)	78.11 ± 16.29	83.77 ± 12.44	-5.66 (-9.41, -1.92)
GCS, mean ± SD	13.27 ± 3.21	14.72 ± 4.24	-1.45 (-2.96, 0.06)	12.22 ± 4.15	12.77 ± 3.53	-0.45 (-1.49, 0.58)

TXA, tranexamic acid; *LOS*, length of stay; *ICU*, intensive care unit; *ISS*, Injury Severity Score; *SD*, standard deviation; *SBP*, systolic blood pressure; *GCS*, Glasgow Coma Scale Score; *OR*, odds ratio; *CI*, confidence interval; *Q1*, 25th percentile; *Q3*, 75th percentile.
*Reported as odds ratio and the corresponding 95% confidence interval or difference in median or mean between TXA and control groups, depending on the variable type.

to 6.34]), and shorter ICU LOS (median of 3 vs. 5 days, difference=2 with 95% CI [0.59 to 3.41]). Among patients with ISS >16, the TXA group had statistically significant decrease in 28-day mortality (6% vs 14.5%, OR=0.37 with 95% CI [0.17 to 0.8]).

DISCUSSION

This prospective, observational cohort study with a retrospective comparison investigated the use of prehospital TXA in cases of traumatic hemorrhagic shock and suggested that prehospital TXA use was associated with improved survival outcomes. Reduced mortality was observed at 28 days. To our knowledge, this is the first large-scale, civilian study to systematically examine prehospital TXA administration in trauma patients in North America.

The mortality reduction noted in this study may be attributed to the antifibrinolytic properties of TXA. Evidence suggests that up to 15% of trauma patients may be in a state of hyperfibrinolysis at the scene of injury as noted on rotational thromboelastometry (ROTEM) and more than half of trauma patients may be in a state of moderate to severe fibrinolysis upon arrival to the hospital.[5,7-9,11,23] These coagulopathies often begin within minutes of injury and worsen during transportation from the scene to the hospital.[7,9,11] This process can threaten clot integrity and result in increased blood loss, morbidity, and mortality.[8,9] The antifibrinolytic properties of TXA may act to slow or stop progression of coagulopathies that contribute to excessive blood loss and disruption of hemodynamic stability.

The current study showed a reduction in the total blood products transfused in those administered TXA. However, TXA appears to exert an effect beyond 24 hours, after the risk of bleeding has decreased.[3] This may be a result of the anti-inflammatory effects of TXA that are mediated through a reduction in the magnitude of the plasmin level, thus reducing the pro-inflammatory effect of plasmin.[24,25] This may be responsible for the observed trend toward decreased mortality at 48 hours and longer. Though the exact mechanism is not clear, current evidence demonstrates that the therapeutic mechanism of TXA is likely multifactorial in nature.

In particular, severely injured trauma patients appear to benefit most from TXA. This may be attributed to an increased incidence of acute coagulopathies among patients who have sustained severe traumatic injury as detected on ROTEM.[7,9,26] Thesuinger et al. showed significant deterioration of relevant ROTEM clot parameters between the scene and hospital when TXA was not administered.[7] However, Kunze-Szikszay et al. conducted a follow up study by assessing for acute coagulopathies noted on ROTEM in severely injured trauma patients before and after prehospital TXA administration.[12] Despite no ROTEM changes following prehospital TXA,

Kunze-Szikszay et al. concluded that TXA might have reduced unnecessary fibrinogen consumption due to fibrinolysis after comparing their results to those of Theusinger et al. However, the study by Kunze-Szikszay et al. was limited by a small sample size.

Additionally, Moore et al. demonstrated that TXA use in severely injured patients might result in adverse outcomes in select patients in a state of fibrinolysis shutdown or hyperfibrinolysis.[8] Nonetheless, multiple other investigations of TXA use in the civilian prehospital and hospital settings found that TXA was most beneficial among severely injured trauma patients.[19,20,27] Though TXA use in severely injured trauma patients may be beneficial, it appears that both the exact candidate-selection criteria and mechanism of action conferring benefit remain unclear. In addition, mortality in this study may be biased due to differences in mechanism and complexity of injuries sustained by patients.

To date, CRASH-2 represents the only randomized controlled trial assessing TXA in civilian adult trauma.[13] The CRASH-2 findings suggested that TXA administered in the hospital within three hours of injury led to a decrease in all-cause mortality by 1.5% at 28 days. The current study demonstrated a decrease in mortality of 4.7% at 28 days. The corresponding number needed to treat was 22. One major difference between the two studies was the location that TXA was given and the timing of administration. By giving TXA in the prehospital setting, this significantly reduced the time to first dose from 2.8 hours in CRASH-2 to 33 minutes. Further, lack of standardized inclusion protocols between hospitals, many of which were part of underdeveloped trauma systems, along with unclear reporting of adverse events and injury severity, may have impacted the CRASH-2 findings.[19,20]

In regard to assessing the known side-effect profile associated with TXA use, the majority of studies note a limited incidence of adverse events. Though controversial, the CRASH-2 trial reported no increase in thromboembolic events in hospital patients given TXA.[13] Among other observational studies assessing prehospital TXA in the civilian setting, no increases in multiple organ failure, sepsis, or thromboembolic events were noted.[19,20] Notably, a slight increase in thromboembolic events following TXA was noted in a retrospective study in the combat setting; however, authors postulated that a higher injury burden in this setting may have resulted in this finding.[11] The current study showed no significant increase in adverse events following TXA administration.

Notably, two aforementioned neurologic events occurred in patients receiving TXA; however, direct causation between TXA use and each neurologic event was deemed remote, though it could not be definitely excluded. In the first case, a DNR order by the family prevented definitive imaging to assess for traumatic vascular injury vs. a thromboembolic complication secondary to TXA leading to an ischemic stroke. The latter was considered more likely with respect to timing at nearly 40 hours after TXA. Similar to the first case, the second case had a severe mechanism of injury as well as multiple, long bone fractures that likely led to an ischemic stroke that occurred 48 hours after hospital admission. With respect to the mechanism and timing of this neurologic event, direct association with TXA administration appeared to be a less likely etiology, although it cannot be completely excluded. Additionally, no increase in hospital or ICU LOS was noted in the current study, further supporting a relatively non-complicated course among patients administered TXA.

The exact dosing of TXA for traumatic injury remains unclear.[23] A fixed 1 gram dose administered in the field followed by a possible maintenance dose was deemed most practical in the emergency setting.[13] In the current study, 64.9% of patients were administered only the first dose of TXA. This may have occurred when a patient no longer satisfied the inclusion criteria for a second TXA dose upon arrival to a participating trauma center. No difference in mortality was observed between those receiving one dose vs. two doses of TXA. If sufficient antifibrinolytic and anti-inflammatory effects occur with only a single dose of TXA, this challenges the apparent need for a maintenance dose. With respect to drug half-life, the duration is unclear in present literature ranging from two to eight hours depending on the dosage.[28-30]

Lastly, our study did not employ coagulation testing before prehospital TXA administration to determine if patients were indeed in a state of hyperfibrinolysis. This significantly limited our ability to administer TXA in a selective fashion. Given the study design and current limitations of point-of-care thromboelastography (TEG) or ROTEM testing, it would have been infeasible to employ such testing in the prehospital setting. Further, previous studies noted the incidence of moderate to severe fibrinolysis at the scene and upon hospital arrival to be over 50%, with fibrinolysis steadily worsening from the scene to the hospital when measured on ROTEM.[7-9] Theusinger et al. concluded that monitoring coagulation via ROTEM at the scene of a trauma would not provide any clinically significant information in the majority of trauma patients.[7] However, upon arrival to the receiving center, growing (but weak) evidence exists suggesting that point-of-care TEG or ROTEM may guide in any additional TXA dosing and blood product administration in critically ill patients.[12,31] At present, administering TXA empirically to those with signs of hemorrhagic shock may be an effective practice until more prehospital point-of-care diagnostic techniques are available.

LIMITATIONS

First, this study was limited by design. The prospective, non-randomized, cohort design did not allow TXA to be administered in a blinded fashion. Prehospital providers and physicians were aware that TXA had been administered, which may have slightly affected the level of care provided. However, given that the primary outcome was mortality, this impact was likely minimal.

Additionally, while we did examine the adverse effects of TXA administration and report our findings, the original study was not powered based on the side effects of TXA administration.

Second, this study relied upon prehospital providers' ability to accurately recognize signs of trauma-related hemorrhagic shock in the field, even if active external bleeding was not present. Despite thorough didactic training and distribution of study protocols, high injury acuity and/or inexperience may have resulted in some providers improperly selecting TXA candidates. Incidences of improper exclusion during the initial months were estimated at <4%. Through active troubleshooting, real-time physician support, and additional education sessions, the estimated incidence was reduced to <2% at study conclusion.

Third, we acknowledge that we were not able to account for certain potential confounding factors. In the prehospital setting, we did not account for the impact of total EMS transport time, availability of IV access, first responder prehospital interventions, or differences in the transporting provider agency. With regard to transport times, shorter times may have impacted the ability of first responders to establish IV access and/or administer TXA prior to arriving to the trauma center. Differences in transporting provider agency may also have slightly impacted care due to differing of standard operating procedures; however, TXA protocols were uniform. We also acknowledge that multiple receiving trauma centers in different geographic area may have slightly impacted the patient care outcomes. We attempted to mitigate the influence of these factors by matching the majority of TXA group patients with control patients from the same center. Furthermore, there may have been minor differences in ICU LOS between the five-year, retrospective control group and current practice. However, there were no institutional changes in ICU policy that would have affected our outcomes. Without accounting for these factors, minimal inherent differences may exist between the TXA and control groups and limit the generalizability of these results.

CONCLUSION

The current study noted reduced mortality at 28 days following the administration of prehospital TXA in patients with signs of traumatic hemorrhagic shock. We further noted a decrease in blood product transfused and shorter hospital and ICU LOS, without an increase in thromboembolic events. Finally, this study demonstrated that TXA can be effectively and feasibly administered by civilian prehospital providers and in accordance with North American emergency medicine standards. Our findings support the use of prehospital TXA in adult civilian traumatic injury with signs of hemorrhagic shock.

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Burnout and Exposure to Critical Incidents in a Cohort of Emergency Medical Services Workers from Minnesota

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Introduction: Very little quantitative data on occupational burnout and exposure to critical incidents are available from contemporary United States emergency medical services (EMS) cohorts. Given that burnout has been associated positively with turnover intentions and absenteeism in EMS workers, studies that uncover correlates of burnout may be integral to combating growing concerns around retention in the profession.

Methods: We administered a 167-item electronic survey that included the Maslach Burnout Inventory (MBI) and a modified version of the Critical Incident History Questionnaire (n=29 incident types) to paramedics, emergency medical technicians (EMTs), and dispatchers of a single ambulance service. We defined the presence of burnout as a high score on either the emotional exhaustion or depersonalization subscales of the MBI.

Results: Survey respondents who provided regular 911 response at the time of the survey and completed the MBI portion of the survey were included in our analysis (190 paramedics/EMTs, 19 dispatchers; 54% response). The overall prevalence of burnout was 18%, with prevalence reaching 32% among dispatchers. The seven pediatric critical incident types presented in the survey accounted for seven of the top eight rated most difficult to cope with, and severity ratings for pediatric critical incidents did not differ by parental status (all $p>0.30$). A significant number of respondents reported that they had been threatened with a gun/weapon (43%) or assaulted by a patient (68%) at least once while on duty. Being over the age of 50, a parent, or in a committed relationship was associated with reduced odds of burnout in unadjusted models; however, these associations did not remain statistically significant in multivariate analysis. Increasing tertile of career exposure to critical incidents was not associated with burnout.

Conclusion: Medical dispatchers may be an EMS subgroup particularly susceptible to burnout. These data also demonstrate quantitatively that in this EMS agency, responders find pediatric critical incidents especially distressing and that violence against responders is commonplace. In this study, a simple measure of career exposure to potentially critical incidents was not associated with burnout; however, individual reactions to incidents are heterogeneous, and assessment tools that more accurately enumerate encounters that result in distress are needed. [West J Emerg Med. 2018;19(6)987–995.]

INTRODUCTION

The physical and emotional toll of emergency medical services (EMS) work has been acknowledged for several decades,[1-4] and likely contributes to turnover in the profession.[1,5] Occupational stress in EMS is attributed to a number of factors including performance in potentially hostile or hazardous environments, repeated exposure to traumatic situations, the physical demands of the occupation, the strains of shift work, and the organizational and leadership stressors spawned by the hierarchical cultures prevalent in EMS.[2,6]

Occupational burnout has been documented extensively in emergency physicians[7,8] and nurses[9] and has been linked to lower quality of care,[10] but less is known about the prevalence and determinants of burnout in EMS clinicians, particularly those currently practicing in the United States (U.S.). With the exception of two recent reports,[11,12] existing studies on burnout in U.S. EMS providers are more than two decades old.[3,4,13,14] More recent studies from other parts of the world have examined burnout in EMS workers[6, 15-18] using the Maslach Burnout Inventory (MBI),[19] the current gold standard for measurement of occupational burnout. Burnout has been associated positively with turnover intentions and absenteeism in cohorts of U.S. EMS workers;[11,12] thus, empirical studies to uncover correlates of burnout may be integral to combating growing concerns around retention in the profession[20] and optimizing quality and workforce engagement among EMS workers.

The potential for the development of post-traumatic stress symptoms in EMS personnel after exposure to critical incidents (CI) is well established,[6, 21-23] and such exposures therefore likely influence provider wellbeing. However, research on the effects of CI exposure on emergency responders has largely focused on post-traumatic stress disorder (PTSD) or other clinically manifest symptoms (e.g., sleep disturbance), and have been conducted in relation to singular sentinel events such as mass casualty incidents or large-scale disasters. The scope and impact of cumulative exposure over the span of an EMS career to smaller scale events that are experienced more frequently but are still potentially disturbing has not been well described.

As part of a provider wellbeing initiative, we conducted a survey among the paramedics, emergency medical technicians (EMTs) and dispatchers in our ambulance service for the purposes of evaluating aspects of general mental wellbeing, informing refinement of support resources, and contributing to generalizable knowledge about mental wellbeing among EMS professionals. In addition to demographics, the survey included the MBI and a comprehensive inventory of exposure to CIs, which provided data about the career frequency and severity rankings for 29 CI types. The objectives of this study were to (1) determine the prevalence of burnout, (2) describe the relative career frequency and perceived severity of specific critical incident types, and (3) examine the association between burnout and a variety of provider factors, including demographics and cumulative exposure to CIs. We hypothesized that increasing cumulative exposure to CIs would be associated with increased levels of burnout.

Population Health Research Capsule

What do we already know about this issue?
Occupational burnout is common in emergency physicians and nurses, but little is known about the prevalence in emergency medical services (EMS) workers.

What was the research question?
What is the prevalence of burnout in our agency, what clinician factors are associated with burnout, and what critical incident types are perceived as most difficult?

What was the major finding of the study?
The overall prevalence of burnout in our agency was 18%, and reached 32% among dispatchers. Calls involving pediatric patients were rated most difficult.

How does this improve population health?
Reducing burnout in EMS workers may improve quality of care for patients and improve retention in the profession.

METHODS

Setting and Study Design

This cross-sectional survey was conducted at Allina Health EMS, a large ambulance service that provides 911 dispatch, advanced life support, basic life support and scheduled medical transport in approximately 100 communities in and around Minneapolis-St. Paul, Minnesota. The agency employs paramedics, emergency medical technicians (EMT), dispatchers, and support staff, and responds to just over 110,000 calls annually across a service area that covers 1,800 square miles. Crew configuration for all 911 responses in this system is indiscriminately paramedic-paramedic or paramedic-EMT; therefore, exposures and work environment are considered identical for the two certification classes and they have been analyzed in aggregate (hereafter paramedics).

In 2012, we emailed a 167-item electronic survey to all agency employees (n=479) regardless of role. The survey included assessments of occupational burnout and a variety of potential risk factors including demographics, social support,

coping style and exposure to CIs. A penultimate draft was field-tested in a small number of paramedics employed by other ambulance agencies in the area who reported that the length and content was acceptable. Employees were told that the survey was voluntary and that there would be no individual follow-up. As an indirect incentive, each respondent was given the opportunity to designate one of three charities to receive a $10 donation on behalf of the ambulance service for their participation. The specific instruments used to assess burnout and exposure to CIs are described below. Additional details about the survey design and methods are available in "Supplemental Material." The study protocol was approved by the Allina Health Institutional Review Board with voluntary completion of the survey constituting informed consent.

Measures

We assessed occupational burnout using the 22-item MBI-Human Services Survey.[19] The MBI quantifies three dimensions of the burnout syndrome: emotional exhaustion (EE; 9 questions), depersonalization (DP; 5 questions) and reduced personal accomplishment (PA; 8 questions). Survey questions are stated as job-related feelings such as "*I feel emotionally drained from my work.*" Respondents indicate how often they feel this way with responses given on a scale from 0 (never) to 6 (every day), yielding the following ranges for the subscales: EE=0-54, DP=0-30, and PA=0-48. In addition to continuous subscale measures, we used previously described cutpoints based on normative U.S. data to define low, moderate, and high values on each scale (i.e., for EE, ≤16=low, 17-26=moderate, ≥27=high; for DP, ≤6=low, 7-12=moderate, ≥13=high; for PA, ≤31=low, 32-38=moderate, ≥39=high).[19,24] Finally, a dichotomous construct was created, with burnout deemed present in those with a high score on the EE or DP subscale. This definition has been used by others,[25-28] but approaches to using MBI subscales to determine the presence or absence of burnout are not consistent.[29]

We assessed exposure to CIs during EMS work using a modified version of the Critical Incident History Questionnaire (CIHQ).[30] The CIHQ was initially developed for use with law enforcement officers, but similar to a previously described approach[23,31] it was modified in this application by altering or removing items not relevant in EMS work. For example, "*Made a mistake in the line of duty that led to the serious injury or death of a fellow officer*" was replaced with "*Made a mistake that led to the injury/death of a patient.*" In addition, we added four pediatric incident types and items about mass casualty incidents, severe burn victims, and responding to incidents involving family/friends. The instrument also included two items related to violence against providers. The final instrument consisted of 29 CI types and indexed two dimensions of exposure – frequency and severity. For each incident type, the respondent was asked to estimate how many times during their career as a paramedic/dispatcher they had encountered that situation, using response categories of Never, 1, 2, 3,…9, 10-20, 21-50, or 50+. They were also asked to rate the severity of the incident type by answering the question "*In your opinion, how difficult would it be for paramedics/EMTs/dispatchers to cope with this type of incident?"* with ordinal responses ranging from 0 (*Not at all*) to 4 (*Extremely*).

The survey also contained basic demographic items including age, gender, current relationship status (single/not in a committed relationship, married/partnered), and parental status (yes, no). Respondents indicated their current position as Paramedic – Field staff, Paramedic – Supervisor/Manager, Dispatcher, Paramedic – Support staff (administration, education, clinical services etc.), interfacility transfer personnel, or other, with the first three categories used to identify the subset of respondents that provide regular 911 response. EMS tenure reflects the total number of years providing 911 response and/or direct patient care as a paramedic or dispatcher.

Data Analysis

We summarized characteristics of the study participants and burnout measures using proportions (categorical variables) or means and standard deviations (continuous variables). Mean frequency and severity ratings for each of the 29 CI event types were computed and rank ordered to examine which event types were encountered most frequently and which were perceived as most difficult for providers. We examined crude prevalence of burnout across categories of a variety of provider characteristics, including age, gender, and EMS tenure. To examine cumulative career exposure to CIs as a risk factor for burnout, we summed the reported number of experienced incidents across all 29 event types for each respondent, with the response categories "10-20," "21-50," and "50+" assigned midpoint values of 15, 35.5, and 51, respectively. Tertiles of this measure of cumulative career frequency of CIs representing low, moderate, and high levels of exposure were then used in analysis. We used logistic regression to generate crude odds ratios of burnout in categories of provider characteristics and tertiles of cumulative CI exposure. Adjusted odds ratios were computed using multivariate logistic regression models that included all variables that had statistically significant univariate associations with burnout, i.e., age category, parental status, relationship status, provider role, and response setting. We performed all statistical analyses using Stata version 14.1 (StataCorp LP, College Station TX, USA).

RESULTS

The overall survey response rate across all agency roles was 56% (266/479). We used human resources data to compare demographic characteristics of respondents with those of the target population where available, and the distributions of age, gender, years in current position and primary work setting among respondents closely reflected those of the agency as a whole.

At the time of the survey, 399 employees regularly provided 911 response, 217 of whom returned the survey (54% response). Among those 217, n=209 had complete data for the MBI and were used in this analysis. The average age in the analysis sample was 40, 60% were male, approximately two-thirds were parents, and 75% reported being married/partnered (Table 1). Slightly more than half reported they had been working in EMS for > 10 years, with nearly one third having an EMS tenure of 20+ years.

The overall prevalence of professional burnout in this cohort was 18% (Table 2). Using cutpoints derived from a normative U.S. sample, 6% and 15% of respondents scored high on the emotional exhaustion and depersonalization subscales, respectively, while 56% scored low on the dimension of personal accomplishment.

Survey respondents indicated that they perceived CIs involving children to be among the most difficult to experience and cope with. All seven of the pediatric incident types presented in the survey had very high average severity ratings, and accounted for seven of the top eight event types rated most difficult to cope with (Table 3). There was no difference in the mean severity ratings assigned by parents vs. non-parents for any of the seven pediatric incident types (all $p>0.30$). A strong inverse correlation of $r = -0.72$ ($p<0.001$) was observed between average severity rating and average reported career frequency across the 29 incident types. Using the median average severity rating (2.52) and the median average career frequency (3.92) to dichotomize incident types into high vs. low severity, and high vs. low frequency, four incident types emerged as being "high-frequency, high-severity" events: encountering a child that has been accidentally killed; encountering a child that has been severely injured; encountering a sudden infant death; and responding to a scene involving family/friends known to the crew. A significant number of respondents reported that they had been threatened with a gun/weapon (43%) or assaulted by a patient (68%) at least once while on duty during their EMS career.

The prevalence and odds ratios of burnout by provider characteristics and exposure to CIs are presented in Table 4. In univariate models, being over the age of 50, a parent, or in

Table 1. Characteristics of study population.

Variable	n = 209
Age, (years)	40 (12)
Age Category, (years)	
18-29	26% (55)
30-39	21% (43)
40-49	24 % (51)
50+	27% (56)
Not reported	2% (4)
Gender, % male	60% (125)
Parental status	
Parent	66% (137)
Not a parent	33% (69)
Not reported	1% (3)
Relationship status	
Married/Partnered	75% (157)
Single/Not committed	22% (46)
Not reported	3% (6)
EMS response role	
Paramedic	91% (190)
Dispatcher	9% (19)
EMS tenure (years)	
0-5	21% (43)
6-10	23% (49)
11-20	23% (49)
20+	33% (68)
Primary response setting	
Metro	70% (146)
Non-metro or rural	30% (62)
Not reported	< 1% (1)

EMS, emergency medical services.
Results are expressed as mean (SD) or percent (n).

Table 2. Burnout subscale measures and overall prevalence of burnout.

Variable	All Subjects (n=209)
MBI subscales	
Emotional exhaustion	
Mean (SD)	13.0 (8.6)
% Low	72%
% Moderate	22%
% High	6%
Depersonalization	
Mean (SD)	6.9 (5.9)
% Low	56%
% Moderate	29%
% High	15%
Personal accomplishment	
Mean (SD)	39.1 (6.2)
% Low	56%
% Moderate	33%
% High	11%
% with burnout	18% (37)

MBI, Maslach Burnout Inventory; *SD*, standard deviation.

Table 3. Rank-ordered mean severity ratings and mean reported career frequency of 29 critical incident types.

	Severity Rating Mean (SD)		Career Frequency Mean (SD)
Encountered a child that had been murdered	3.46 (1.0)	Encountered the body of someone recently dead	28.53 (19.6)
Encountered a child who had been badly beaten	3.25 (0.9)	Seen someone dying	26.48 (20.0)
Made a mistake that led to injury/death of a patient	3.20 (1.1)	Made a death notification	18.01 (19.3)
Encountered a child that had been accidentally killed	3.15 (0.9)	Encountered a suicide victim	14.80 (16.2)
Encountered a child that had been severely neglected	3.12 (1.0)	Encountered an adult who had been badly beaten	14.01 (16.4)
Encountered a child who had been sexually assaulted	2.99 (1.1)	Encountered a mutilated body or human remains	9.27 (14.4)
Encountered a SIDS death	2.93 (0.9)	Encountered a child that had been severely injured	8.86 (12.3)
Encountered a child that had been severely injured	2.75 (1.0)	Encountered an adult who had been sexually assaulted	7.11 (9.6)
Been present when coworker was seriously injured	2.74 (1.0)	Exposed to serious risk of AIDS/life-threatening diseases	6.64 (13.0)
Been threatened with a gun or other weapon	2.71 (1.0)	Encountered elderly person severely abused/neglected	5.87 (9.7)
Trapped in a potentially life-threatening situation	2.66 (1.1)	Encountered a SIDS death	4.81 (8.2)
Responded to a scene involving family/known to crew	2.63 (1.0)	Responded to a scene involving family/known to crew	4.75 (8.6)
Been seriously injured	2.62 (1.0)	Responded to a mass casualty incident	4.37 (8.0)
Been in a serious motor vehicle accident	2.58 (1.1)	Encountered a child that had been accidentally killed	4.24 (7.3)
Encountered elderly person severely abused/neglected	2.52 (0.9)	Exposed to life-threatening toxic substance	3.84 (10.7)
Had your life endangered in a large-scale disaster	2.50 (1.1)	Encountered a patient that was severely burned	3.92 (6.2)
Exposed to life-threatening toxic substance	2.33 (1.0)	Assaulted by a patient	3.56 (6.6)
Exposed to serious risk of AIDS/life-threatening diseases	2.30 (1.1)	Encountered a child that had been severely neglected	2.73 (6.0)
Encountered an adult who had been sexually assaulted	2.24 (1.0)	Encountered a child who had been sexually assaulted	2.49 (5.9)
Encountered a patient that was severely burned	2.23 (1.0)	Responded to a large-scale disaster	2.38 (5.3)
Responded to a large-scale disaster	2.17 (1.0)	Encountered a child who had been badly beaten	1.72 (3.0)
Encountered a mutilated body or human remains	2.16 (1.0)	Been threatened with a gun or other weapon	1.67 (3.8)
Encountered an adult who had been badly beaten	2.09 (1.0)	Trapped in a potentially life-threatening situation	1.40 (2.7)
Responded to a mass casualty incident	2.04 (1.1)	Been seriously injured	1.07 (3.3)
Made a death notification	1.99 (1.0)	Been present when coworker was seriously injured	0.81 (1.8)
Assaulted by a patient	1.99 (1.1)	Encountered a child that had been murdered	0.64 (1.8)
Encountered a suicide victim	1.96 (1.0)	Been in a serious motor vehicle accident	0.39 (0.9)
Seen someone dying	1.64 (1.0)	Had your life endangered in a large-scale disaster	0.34 (1.1)
Encountered the body of someone recently dead	1.45 (1.0)	Made a mistake that led to injury/death of a patient	0.23 (1.2)

SD, standard deviation; *SIDS*, sudden infant death syndrome; *AIDS*, acquired immune deficiency syndrome.

a committed relationship was associated with reduced odds of burnout. Dispatchers were at increased risk of burnout as compared to paramedics. This difference was not statistically significant, likely due to the small number of dispatchers in the analysis; however, the survey response rate among dispatchers was very high (76%; 19/25). There was no significant association between increasing tertile of cumulative career exposure to CIs, and burnout. Associations remained directionally consistent in a multivariate model, but none of the examined factors could be characterized as independently associated with burnout as all 95% confidence intervals included 1.0.

DISCUSSION

Burnout

Burnout has been linked to lower quality of care in other healthcare occupations;,[10] therefore, understanding burnout and its correlates in EMS professionals may have implications for optimizing experience and outcomes for persons treated in the prehospital setting. The overall prevalence of burnout in this cohort was 18%, with particularly high levels of burnout occurring in dispatchers (32%), and in clinicians who did not have children (26%), or were not in a committed relationship (28%). Only 5% of providers over the age of 50 in our sample

Table 4. Prevalence and odds ratios of burnout by provider characteristics and exposure to critical incidents.

Variable	Burnout %	Unadjusted odds ratio (95% CI)	Adjusted[a] odds ratio (95% CI)
Age category, (years)			
18-29	27%	1.00	1.00
30-39	21%	0.71 (0.27 - 1.82)	0.83 (0.27 - 2.53)
40-49	20%	0.65 (0.26 - 1.62)	0.98 (0.29 - 3.28)
50+	5%	0.15 (0.21 - 0.68)	0.27 (0.06 - 1.31)
Gender			
Male	18%	1.00	--
Female	18%	0.98 (0.48 - 2.03)	--
Parental status			
Parent	13%	1.00	1.00
Not a parent	26%	2.33 (1.12 - 4.85)	1.39 (0.49 - 3.95)
Relationship status			
Married/Partnered	15%	1.00	1.00
Single/Not committed	28%	2.30 (1.05 - 5.00)	1.46 (0.56 - 3.83)
EMS response role			
Paramedic	16%	1.00	1.00
Dispatcher	32%	2.37 (0.84 - 6.70)	2.15 (0.70 - 6.65)
EMS tenure (years)			
0-5	16%	1.00	--
6-10	27%	1.86 (0.66 - 5.19)	--
11-20	14%	0.86 (0.27 - 2.67)	--
20+	15%	0.89 (0.31 - 2.54)	--
Primary response setting			
Metro	21%	1.00	1.00
Non-metro or rural	10%	0.40 (0.16 - 1.01)	0.62 (0.23 - 1.68)
Tertile of critical incidents experienced during career			
Low (0 - 99)	13%	1.00	--
Moderate (100 - 226)	21%	1.82 (0.70 - 4.79)	--
High (> 226)	18%	1.49 (0.55 - 3.99)	--

EMS, emergency medical services; *CI*, confidence interval.
[a]Logistic regression model adjusted for age category, parental status, relationship status, response role and response setting.

appeared to be experiencing burnout.

Two early studies that used the Burnout Scale for Health Professionals found burnout among EMS providers was more prevalent than in other healthcare professionals in the U.S.[3,4] Two recent surveys conducted in U.S. paramedics and EMTs captured burnout measures using the Oldenburg Burnout Inventory and the Copenhagen Burnout Inventory.[11,12] One reported a work-related burnout prevalence of 30% in paramedics and 19% in EMTs,[11] and both found burnout was associated positively with turnover intentions and absenteeism.[11,12] In the only prior report of MBI data from a cohort of U.S. paramedics, mean scores for EE, DP, and PA were 19.2, 9.3, and 28.1, respectively.[13] MBI data from ambulance personnel outside the U.S. have been reported,[6,15-18,32] but variability in defining burnout as a dichotomous construct makes inter-study comparisons difficult. Among Scottish ambulance personnel, the prevalence of high DP and high EE were 26% and 20%, respectively.[15] Burnout among Dutch paramedics has been estimated at only 8.6%, but this prevalence is still higher than the 5.3% observed in a sample of the general working population in the Netherlands.[6]

Occupational burnout in large samples of employed physicians and the general working population of the U.S. has been estimated at 38% and 28%, respectively,[33] both considerably higher than our observed overall prevalence of 18%. Recent MBI data from primary care physicians in our own health system revealed a burnout prevalence of 38%.[34] While our paramedics appear to experience burnout at a comparatively low rate, the level of burnout among our dispatchers approaches the alarming level documented in physicians and exceeds that of the general working population of the U.S. Hypotheses about why burnout may be more prevalent among dispatchers in our agency include the high call volume and lack of "downtime" during shifts, stresses associated with operational accountability for a large number of crews and vehicles across an expansive coverage area, and the relatively sedentary environment. Dispatchers rarely have intervals void of incoming calls, whereas paramedics will often have some respite between patient encounters. To our knowledge, these are the first published data on dispatcher burnout, and studies in larger samples of this occupational subgroup are needed to elucidate whether this finding is unique to our agency.

Critical Incidents

Symptoms of PTSD (e.g., intrusive memories, nightmares) occur in 10% of rescue workers worldwide, and estimates in EMS responders are consistently higher than those in firefighters and police officers.[35] Logically, exposure to CIs has received a great deal of scrutiny as a primary contributor to the development of PTSD in rescue workers, with studies primarily focused on examining stress reactions after specific large-scale or widely-publicized events. But cumulative exposure to smaller-scale traumatic incidents outside the realm of extraordinary events may be equally deleterious, and examination of the full continuum of CI exposure in EMS workers is needed. The development of a comprehensive inventory to assess CI exposure in EMS professionals has been led by Donnelly and Bennett,[31] who administered a modified version of the CIHQ in a sample of U.S. paramedics and EMTs. Their findings and suggested modifications served as the basis for the instrument used in our study.

Not unexpectedly, our data indicate that the most difficult CIs to cope with involve children, persons known to the crew, or a clinical error that results in an adverse outcome for a patient. A number of studies from around the world have presented paramedics and dispatchers with ad hoc lists of event types for severity ranking and comment.[4,6,23,31,32,36,40] Consistent with our findings and irrespective of methods or geography, studies universally report that calls involving children or persons personally or professionally known to the crew are among the most disturbing. Unique to the current study, however, was an examination of incident severity rating by parental status. We hypothesized that emergency responders with children might find pediatric CIs more distressing because of mental and emotional transference of the situation to children in their own lives, but our findings did not support any difference in perceived severity by parental status.

Interpretation of frequency data from the modified CIHQ is less clear. We did not verify reported estimates of career frequencies as this was not feasible, so statements about absolute numbers of reported experiences would be speculative. However, similar to what has been observed in law enforcement officers,[30] the total number of CIs experienced by each respondent was positively correlated with years in EMS (r=0.52; p<0.001), which offers some support for validity. The inverse correlation we observed between career frequency and severity rating (r= -0.72) is also comparable to that observed by Weiss et. al.[30] in law enforcement officers (r= -0.61), and supports the hypothesis that frequent exposure to certain incident types may foster resilience.

Contrary to our hypothesis, we found no evidence that cumulative exposure to CIs in our responders is associated independently with professional burnout. This finding may be interpreted as being consistent with the viewpoint that an individual's reactions after distressing incidents are of greater importance than the absolute number of potential CIs to which they are exposed. As noted by others, there is heterogeneity across individual emergency responders as to what constitutes a "critical incident,"[31,37] and we readily acknowledge that the inventory used in this study only quantifies exposure to incident types with a high likelihood of heightened stress reactions and does not quantify the number of heightened reactions and resultant stress that is experienced. In the only other study that has attempted to quantify career exposure to CIs in EMS responders, the investigators observed that the correlation between lifetime CI exposure and a continuous measure of post-traumatic stress symptoms was relatively weak (r=0.25; p<0.01), and that more strongly correlated with post-traumatic stress symptoms was the level of stress that responders reported experiencing after such events (r=0.39; p<0.01).[31] These findings suggest that a more ideal instrument for assessing cumulative CI exposure in EMS professionals would more strictly capture incidents that resulted in distress for the responder personally.

LIMITATIONS

This study was conducted at a single, Midwestern EMS agency, and significant variation in EMS system models in terms of structure, volume, personnel attributes and geography likely compromise the generalizability of these results. Burnout may have been underestimated if employees who are disengaged were less likely to participate, or if those with extreme burnout have already exited the profession. However,

providers who have strong concerns about work stress may have been more likely to embrace the opportunity to contribute to a wellbeing survey. Our response rate, while seemingly modest, is comparable with previous studies on the topic (40%-72%).[6,15,16,32,41,42] We attempted to address the multifactorial nature of burnout by conducting multivariable analysis; however, our limited sample size resulted in wide confidence intervals and compromised our ability to make definitive statements about the predictive value of the factors examined.

Implications

As a result of these findings, our agency instituted a process that offers timely chaplaincy support to providers after all potentially traumatic CIs, with particular attention to pediatric calls. Using real-time data mining, calls with specific trigger characteristics (e.g., pediatric death, more than four units on scene) generate an alert text message to the EMS chaplain who contacts the crew to offer support. A full-time EMS chaplain[43] makes this protocol feasible, and the systematic approach acknowledges evidence that EMS providers are unlikely to seek assistance of their own volition after CIs.[44,45] However, individualized response makes it difficult to accurately identify which calls will be troublesome[32] and peer support models may be a more effective approach within existing EMS culture.[46,47] We have also recently conducted paramedic focus groups to improve understanding of difficulties with pediatric calls. These initiatives represent an important starting point for both normalizing expression around stressors and altering the common perception among EMS providers that management is not concerned about their mental wellbeing and that agency support is inadequate.[15-17,40,47]

CONCLUSION

Medical dispatchers in this sample exhibited a level of professional burnout commensurate with that of physicians and significantly higher than that experienced by the paramedics and EMTs who responded to the survey. These data also provide quantitative evidence that our EMS responders find pediatric CIs especially distressing, and that being threatened with a gun/weapon is commonplace in this population. In this study, a simple measure of career exposure to potentially critical incidents was not associated with burnout, but tools for more accurately capturing the number of incidents that resulted in distress are needed. EMS agencies should consider conducting assessments of burnout and other measures of wellbeing as a tool for mitigating systemic decline of wellbeing across the profession and averting personal tragedies in providers who are struggling.

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Scholarship in Emergency Medicine: A Primer for Junior Academics Part I: Writing and Publishing

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The landscape of scholarly writing, publishing, and university promotion can be complex and challenging. Mentorship may be limited. To be successful it is important to understand the key components of writing and publishing. In this article, we provide expert consensus recommendations on four key challenges faced by junior faculty: writing the paper; selecting contributors and the importance of authorship order; journal selection and indexing; and responding to critiques. After reviewing this paper, the reader should have an enhanced understanding of these challenges and strategies to successfully address them. [West J Emerg Med. 2018;19(6):996-1002.]

INTRODUCTION

Writing and publishing are an important component of academic medicine. However, it can be challenging for many junior academicians to navigate the process to a successful publication. In fact, studies have consistently demonstrated that less than half of all conference abstracts are ever published as full manuscripts.[1-3] Additionally, while many young researchers may benefit from local mentors guiding them through the authorship process, mentorship may be limited in many academic emergency medicine (EM) programs.[4-6] After many years of navigating this process at various research universities, the authors concluded that a practical primer would be useful for residents, fellows, and junior faculty in EM. In addition, the advent of open-access publishing as an alternative to traditional subscription-based publishing expands the possibilities and perils of scientific communication.[7] This is the first in a series of papers seeking to help faculty members and researchers maximize their scholarly efforts to develop their academic careers. In this article, we sought to incorporate expert consensus recommendations on improving scholarship in EM. This paper focuses on four common challenges faced by researchers when writing and publishing their academic work.

WRITING YOUR ARTICLE

One of the biggest challenges to publishing is often writing the manuscript. After a study has been completed, the next step is to create the manuscript and submit for publication. Often, this can be facilitated by writing the introduction and methods sections prior to completing the study and finishing the results and discussion sections after completion, so that the burden of writing is less to overcome. Additionally, reading and peer reviewing other articles can be incredibly valuable by providing experience and insights into the scientific literature, as well as learning what features make a high-quality submission. It may be particularly useful to review several articles from the intended journal prior to submission to ensure that your style and language are consistent with prior accepted submissions. All journals also have authorship instructions, which include guidelines on formatting, section categories, and article limits (e.g., maximum figures, tables, references, word count). Authors should review these carefully and diligently to ensure that they completely follow all of the rules.

When writing a manuscript, it is important to follow a structure. The most common format is: abstract, introduction,

methods, results, discussion, limitations, and conclusion. The introduction should be formatted such that it presents a summary of the literature and how the study fits into the current understanding of the topic. This has been referred to as the problem/gap/hook heuristic.[8] In this model, Lingard suggests that an introduction must do three things: identify a problem of significance to the reader; establish a gap in the current knowledge or understanding of the problem; and articulate a hook that convinces the reader of the importance of this.[8] The last sentence of the introduction commonly includes the research hypothesis and study aim. Authors should also keep the target audience in mind and ensure that the paper is specific and relevant to this group.

The methods section should clearly define the study protocol, such that it could be easily repeated by another investigator. Authors are advised to ensure that the population, intervention, control, outcome, and time interval are explicitly described.[9,10] Authors should also review the Enhancing the Quality and Transparency of Health Research (EQUATOR) guidelines (http://www.equator-network.org/) for their specific study design and ensure that their manuscript addresses all of the reporting criteria. For example, if the authors are publishing an observational study, they should adhere to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines,[11] while if they are performing a randomized controlled trial, they should use the Consolidated Standards of Reporting Trials (CONSORT) criteria.[12] These can also be valuable to help scaffold the paper and prevent writer's block.

The results section should describe the study population, adherence to the protocol, and all relevant outcomes. It may be advantageous to include data in tables and figures to avoid an overly lengthy results section. One common pitfall is to repeat the results in both the tables and figures, as well as the text. Often, only one is necessary and tables and figures are generally preferable. Another common error is to discuss the significance of the findings in the results section. Any discussion of importance and relevance should be deferred to the discussion section.

The discussion section should focus on applying the results in the context of the current literature, including how it supports or refutes prior studies and how this will impact future patient care and research. The limitations section should address all potential biases and confines of the current study. All studies have limitations and it is important to address them as thoroughly as possible, both with respect to the potential influence on results and directions for future study.[13] The last part of the discussion section (or formal conclusion section, if applicable) typically summarizes the authors' conclusions and provides directions for future research.

Prior to submission, it is valuable to have a local colleague pre-review the paper and provide comments and feedback. This can help identify some of the sentence structure and grammatical errors,[14-16] as well as provide an external opinion to ensure that the manuscript's argument is persuasive and coherent.[17,18] Bordage evaluated reasons why manuscripts were commonly rejected in a seminal paper in *Academic Medicine* (Table 1).[19] Authors can avoid many of these common pitfalls by involving a statistician early in the project (preferably in the study design stages before the project has launched) to ensure that the methodology is appropriate for the study.

Table 1. Top 10 reasons why manuscripts were rejected in Academic Medicine.[19]

1.	Inappropriate or incomplete statistics
2.	Overinterpretation of the results
3.	Inappropriate or suboptimal instrumentation
4.	Sample too small or biased
5.	Text difficult to follow
6.	Insufficient problem statement
7.	Inaccurate or inconsistent data reported
8.	Incomplete, inaccurate, or outdated review of the literature
9.	Insufficient data presented
10.	Defective tables or figures

Along with the manuscript, most journals also require a cover letter and title page. The cover letter should include a brief summary of the proposed study and why it is important to the journal's readership. The cover letter should also include how the study or results align with the journal's mission statement. Many journals require specific components within the cover letter, which can include a statement of conflicts of interest or funding, so one should ensure that this is also included if required. The title page requirements can vary between journals, but most commonly include a listing of the authors and their affiliations, the contact author, keywords, word count, funding, and prior presentations of the research. Those who are interested in learning more should review the following resource: https://www.aliem.com/2017/11/template-journal-manuscript.

SELECTING CONTRIBUTORS AND THE IMPORTANCE OF AUTHORSHIP ORDER

Authorship of publications is important for several reasons. Being designated as an author confers not only credit, but also responsibility for the findings and conclusions of the publication.[20,21] While there are often more people involved in a research project than listed on the author block, only those who contribute substantially to the paper should receive authorship credit.[21-23] The remainder may be included as an acknowledgment at the end of the paper, but should not be included as authors. Most experts recommend using the

International Committee of Medical Journal Editors guideline to define authorship criteria (Table 2).[20,24,25]

Table 2. ICMJE Authorship criteria.

The ICMJE recommends that authorship be based on the following four criteria:
1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
2. Drafting the work or revising it critically for important intellectual content; AND
3. Final approval of the version to be published; AND
4. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

ICMJE, International Committee of Medical Journal Editors.

Once you have decided on the author list, the next challenge is to determine the author order. The first author should be the person who contributed the most to the manuscript and receives the largest portion of the credit.[20,24,26] The last author is often the senior author and typically receives similar credit to the first author, as that person is assumed to be the intellectual and financial resource for the research project.[24,26]

The remaining author order can vary significantly depending upon the authorship team and the type of research project. Unfortunately, this can create challenges, as not all authors receive equal credit by promotion and tenure committees, with some committees ascribing greater credit to the second author than all other subsequent authors listed after the first author.[20] Some journals (more often with case report and review articles) will limit the number of authors for a manuscript, which can be important as you consider your author list. Additionally, many journals will limit the number of authors listed in the references to either three or six authors, followed by "et al.", which can leave the remaining authors feeling more hidden with respect to recognition for the paper.[20]

There are several well-described, authorship sequencing strategies in the literature. The "sequence-determines-credit" approach is based upon the principle that each successive person after the first author contributed a progressively smaller portion to the manuscript.[20,26] While this provides a simple mechanism for determining the author order, it is important to clearly explain to the other authors why each person is located in the specific location to avoid ill feelings between authors. Another strategy is referred to as the "equal contribution" approach. With this technique, all authors are given equal credit for the manuscript.[26,27] Typically, all authors will be listed alphabetically by last name. This strategy may be preferable when the authors have contributed similar degrees of effort to the paper. There are also some variations among these techniques, wherein the first or last author are maintained as primary authors, while the remainder are listed alphabetically. In the medical field it is more common to follow the "sequence-determines-credit" approach, while in other scientific fields the "equal contribution" approach is more common. At the time of application for academic promotion, many research-oriented universities ask the candidate to declare the percentage of contribution effort for each published manuscript claimed during the review period. This gives you the opportunity to self-describe your role and effort.

Whichever strategy is selected, it is advised to discuss the author order early in the development of the paper to ensure that all parties are aware of and agree with the decision.[20,24,28,29] However, you should allow room for flexibility, especially with respect to the middle authors, as the level of contributions may change over the course of the project. Typically, the first or last author will initiate the authorship conversation, but the other authors should also feel comfortable discussing this with the first author and study group.[28,29]

A separate role within the authorship block is the corresponding author, which is most commonly the first or last author. When the first author is a resident or a student, the corresponding author is often the senior author. The corresponding author is responsible for all publication correspondence regarding the article, both with respect to the journal itself and future readers. The corresponding author will be contacted by readers with questions regarding the research, requests for copyright release (with open-access journals), and could be challenged by other researchers to verify the methodology, statistics, or research results. While this is almost always the first or last author, it could be awarded to a different author to properly credit that person when she or he provided a substantial contribution to the project, but was not selected as the first or last author (e.g., originator of the project idea, the "second" senior author).[29,30] Another approach could be dual first authors who are listed as first and second but have an asterisk with their names explaining the designation as dual first authors. It is important to note that some journals do not allow dual first-author designations.

Finally, it is important to discuss the importance of unique author identification. While researchers and readers are often able to easily distinguish the work of authors with uncommon surnames from others, readers can struggle to differentiate the work of authors from others sharing a similar surname and first initial.[31] One technique to differentiate yourself is to add your middle initial to the author listing, decreasing the likelihood of ambiguity in article identification.[14] An additional and more effective way is to apply for an Open Researcher and Contributor Identification (ORCID) account (https://orcid.org/).[31] This is a non-profit organization that creates unique identifiers for researchers and is used by several publishers to help recognize authors for their work. Increasingly, journals

and publishers are now requiring authors to include ORCID numbers during manuscript submission. This may also be valuable if the author undergoes a name change, as PubMed will not change or link your current name with your prior publications. Obtaining an ORCID is free and takes only a few minutes to accomplish.

JOURNAL SELECTION AND JOURNAL INDEXING

There are a myriad of journals to which you could submit your research papers. To promote yourself and career, it is vital to understand the hierarchy of the quality and selectivity of journals. There are currently 78 journal titles that relate to EM in the Scimago Journal and Country Rank index (SJR). You can find an updated list at: http://www.scimagojr.com/journalrank.php?area=2700&category=2711. The supplemental table includes a list of the legitimate EM journals recognized by SJR and are indexed in Scopus as of this publication. An updated version of the list, maintained by the *Western Journal of Emergency Medicine* is available here: https://escholarship.org/uc/item/4pc1v507#supplemental.

A journal's scope of indexing determines how another physician can find your paper to read and possibly cite. The supplemental table includes whether a title is indexed in each of the following databases: PubMed, PubMed Central (PMC), MEDLINE, and Clarivate (formerly Thomson-Reuters) Web of Science Expanded or Emerging Sources. These are the key life-science databases in which journals attempt to index their contents. It also includes whether a journal is fully open access, and both the SJR and Clarivate two-year impact factors (if available). Articles are ranked in order from highest to lowest SJR impact factor to assist with determining journal submission decisions. In general, the higher the impact factor, the more selective the journal is for accepting your submission. If a journal is *not* listed, the quality of the journal may be questionable. For newer journals, it can be valuable to review the list of accepted publications to determine the quality of submissions. Discussing with more experienced researchers and medical librarians can also be valuable for assessing the potential quality of the journal.

Deciding where to submit may be overwhelming to more novice researchers. While it may seem tempting to submit to the journal with the top impact factor or a familiar journal title, it is important to select an appropriate journal to have the best chance of acceptance. You should begin by determining whether the journal accepts the category of article you are planning to submit. For example, while the *Western Journal of Emergency Medicine* no longer accepts case reports, its affiliated journal *Clinical Practice and Cases in Emergency Medicine* accepts exclusively case reports, images, and clinicopathologic cases; so the chance of successful acceptance is profoundly different between journals. Additionally, you should briefly review several recent issues to determine both the methodological rigor and topics typically accepted.

Read the scope and mission statements of the journals to see if your paper fits. Aligning with the journal's interests will foster a stronger cover letter when submitting and increase the likelihood of acceptance. There are many subspecialty journals related to EM that focus on specific arenas (e.g., administration, behavioral emergencies, cardiac care, critical care, medical education, prehospital medicine, injury prevention, neuroscience, pediatrics, public health, prehospital care, toxicology, trauma, and ultrasound). If your paper deals with one of these areas, consider expanding your potential submission list to include the relevant subspecialty journals.

Often, several journals will be a good fit for the article, and you must choose. One of the first determinants should be whether the journal is indexed in one of the United States National Library of Medicine's (NLM) databases. This information is located in the accompanying online table. Alternatively, you can type the name of the journal in the NLM catalog of journals referenced in the National Center for Biotechnology Information Database (PMC; https://www.ncbi.nlm.nih.gov/nlmcatalog/journals/) to determine if the journal is indexed in PubMed or MEDLINE. Currently, 89 titles appear for the search term "emergency medicine." However, many of these are listed as "not currently indexed in MEDLINE." This may indicate that the journal is either new, well established but not yet accepted for inclusion, or "predatory." Importantly, if a journal is not indexed in any of these databases listed in the supplemental table, it has not yet passed the rigorous vetting process of an established journal. You should, therefore, be cautious about submitting your paper there.

If the prospect journal is "open access," check to see if the journal content is included (i.e., archived) in PubMed Central (https://www.ncbi.nlm.nih.gov/pmc), the NLM's repository of full research papers. PMC currently contains 2,920 journal titles. Type the journal name into the "*Search for Journals*" box located under PMC Journals (https://www.ncbi.nlm.nih.gov/pmc/journals/) to see if the journal comes up, or you can browse the journal titles through the alphabetical list tabs. If the journal is found, this indicates it has gone through a moderate, multilevel vetting process that typically requires two years of publication and 25-50 submitted papers.

If a journal is in neither of these indices (PubMed or PMC), this may be a reflection of a lesser quality or newer publication. Quality subscription journals are commonly included in PubMed within 5-10 years of inception, and PMC within 2-3 years. Many newer journals are still developing the quality to achieve acceptance to these indices, so they may become PubMed indexed in the coming years. If so, it is customary for previous papers published in the journal before inclusion, to eventually be entered into these indices.

Additional factors to consider when submitting include the journal's impact factor, InCites Journal Citation Reports®, CiteScore™, and Eigenfactor® (discussed further in a subsequent paper in the series). Selecting journals with a higher rating suggests that the article will have more visibility and, therefore, be more likely to be cited. This is important

because journal ranking and the number of citations is highly valued by promotion and tenure committees. In general, there is an inverse correlation between a journal's impact factor and its acceptance rate.

Once you've made a list of potential journals, rank them using the above criteria and submit to the top-listed and most relevant journal first. Often, this will be the most rigorous and may result in an early rejection. However, if selected appropriately, the article will be sent out for reviews, which can provide valuable feedback and insights even if the article is rejected.[32] In some cases, the article may get rejected several times, requiring submission to multiple different journals. When this happens, it is essential to use the feedback from each review to strengthen the article for the next submission.

DISCRIMINATING BETWEEN LEGITIMATE AND PREDATORY OPEN ACCESS JOURNALS

"Open access" refers to a type of scholarly publication where the author retains the copyright to the work, and access to the entirety of the work is free of charge to readers and other researchers. Typically, the author pays the publisher for their services, with fees ranging from $400 to $4,000 per paper. Legitimate open-access publishers perform substantial scientific peer review with associated detailed revisions prior to publication, and have achieved wide indexing, so that your work can be easily read and cited.

Subscription-based publishers (e.g., Wiley, Blackwell, Taylor & Francis, Elsevier, Springer, Sage, Wolters-Kluwer) require the author to sign over the copyright of their work to the journal in exchange for publication. Authors must subsequently ask the publisher for permission to reproduce any parts of their paper (e.g., table or figure) and publishers often charge a fee for this. Because the publishing services are expensive, rather than charging a fee, the author pays for the services using their scholarly product as payment, and the publisher generates revenue through library subscriptions, copyright sales, and advertising.

Conversely, so-called "predatory" open-access publishing is an exploitative model that involves charging publication fees to authors without providing any significant editorial or publishing services. Predatory journals often identify authors from prior publications or large databases of physicians and routinely solicit submissions by email. They promise rapid review and publication in time frames that preclude substantive peer review.

While papers published by a predatory publisher are, in theory, accessible by other scholars, they do not return in the important indexing service searches that qualified scholars use to find and cite your work. These publishers (more than 900 worldwide in 2017) profit from inexperienced or desperate authors by charging exorbitant publication fees without providing the customary publishing services. Some of these publishers ask authors to provide substantial fees to withdraw their submission during the review period, once the authors realize they have been deceived. Tables 3 and 4 outline the criteria for spotting predatory, open access journals. For those interested in learning more, Hansoti and colleagues provide an excellent review on this topic.[7]

SURVIVING THE PEER REVIEW PROCESS

Peer review is the backbone of scientific publishing. At its

Table 3. Criteria for determining the legitimacy of an open access journal.

To determine if an open-access journal is legitimate, look for the following criteria:
1. Search the Directory of Open Access Journals (https://doaj.org/) to see if the journal is listed.
2. Ensure that the journal follows the Committee on Publication Ethics (COPE) standards (https://publicationethics.org/).
3. Ensure that the journal is a member of the International Association of Scientific, Technical, and Medical Publishers (http://www.stm-assoc.org/).
4. Ask colleagues if they are familiar with the journal and determine who else has published in it.
5. Ask your university librarian for guidance.
6. The article processing fee should be transparent and easily found on the journal's website.
7. The journal's website should have common policies posted (e.g., conflict of interest, human and animal subjects, plagiarism, informed consent, copyright and authorship, creative commons license type).
8. The Editor-in-Chief and editorial board should be clearly identified with appropriate academic credentials and affiliations. Beware that some predatory journals list editorial board members on their website without the members' knowledge.
9. Determine whether there is a discount or waiver policy for junior authors or those from low- to middle-income countries or institutional subscriptions.

Table 4. Features of a predatory journal.

1. Grammatical errors in the solicitation or website
2. Unclear or difficult to locate article processing fees
3. Excessively broad and unrelated journal title
4. Impact factor of greater than 2 in an unknown journal
5. Sends out frequent "spam" emails asking for submissions
6. Promise of rapid turnaround to publication (ie, 2 weeks or less)
7. Email addresses from public domain (e.g., Gmail, Yahoo)
8. Western street address with poor grammar or syntax
9. Overly flattering or flowery salutations including: "esteemed author," "with much greetings and respect," "kindly participate by submitting…"
10. No mention of indexing beyond Google Scholar
11. No sponsorship by a known medical society
12. Poor quality prior submissions

best, it will provide multiple, detailed, independent, and unbiased assessments of your work by clinicians and research peers. This is intended to improve your work prior to dissemination for future use by readers and scientists. Knowing that once published, your work will need to stand alone for years to come should change your perspective to one of welcoming the most thorough critiques in the hope of identifying all flaws prior to public dissemination.

Responding to reviewer critiques can be one of the most important aspects of the manuscript preparation, as it can determine whether your revised manuscript is accepted or rejected. Junior faculty submitting manuscripts for the first time can often feel quite overwhelmed by how to proceed with the critiques due to the number of requests, possible strong tones from reviewers, and the challenge of consolidating disagreements between critiques from different reviewers.

Here are some general principles to consider as you approach revisions and respond to critiques. First, disagreeing or not being able to comply with reviewers, although not preferable, is quite acceptable. However, this decision needs to be factually-based, polite without added emotion, professional, and appropriately referenced.[33] It might be necessary to mention that a particular revision request is beyond the scope of this research project and justify why this is true. It is particularly important to respond to all of the editor's comments, which are typically listed first in most journal response letters, though they may be hidden within the general resubmission requirements in some responses. It is in your best interest to acknowledge and appreciate the reviewer and the editor for the time and effort they have provided to improve your work.[34]

It can be valuable to wait 1-2 days prior to responding to let any strong emotions pass and allow you to focus on the scientific components of the paper. When responding to comments, you should make sure to respond to every critique, even if you disagree. This can be facilitated by separating reviewer paragraphs into separate points, listing them in order, and then sequentially responding to each comment.[34] This response is commonly referred to as a "point-by-point" response. When there is concern regarding how best to approach a comment, or if two reviewer comments contradict each other, it is best to discuss this directly with the editor prior to resubmission. Most journals will provide either the editor's email or submission query information to assist you.

When submitting the point-by-point response, it can be helpful to highlight your response in a different font style, indentation, or color. Make note of the response, corresponding line numbers, and the verbatim changes you have made in the paper for each comment. Make it as easy as possible for the reviewer and editor to know how you have addressed the request and the exact changes you have made in each specific instance.[33] Some journals may require you to copy-and-paste the response into their manuscript management system, which would negate the formatting changes noted above. If this is the case, you should also upload a copy of your formatted response appended to the revised cover letter.

If there are concerns regarding grammar or spelling in the manuscript (especially among authors who are less fluent in the submission language), you should consider having an experienced writer or professional copy editor review it to correct all language mistakes. Finally, make sure to review the journal's revision requirements, as some require submission of manuscripts with tracked changes in the document. Pay attention to the time frame required for revisions, which can be as short as a month. If you cannot meet the deadline, make sure to contact the editor early to ask for an extension. In general, it is best to resubmit as soon as feasible, ideally within one month.

CONCLUSION

This paper reviews four common challenges faced by all faculty and researchers when writing and publishing their academic work, and provides advice for effectively navigating this arena. We hope that this series will assist junior faculty, fellows, and residents as they pursue successful research and academic careers.

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Measuring Scholarly Productivity: A Primer for Junior Faculty. Part III: Understanding Publication Metrics

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There are approximately 78 indexed journals in the specialty of emergency medicine (EM), making it challenging to determine which is the best option for junior faculty. This paper is the final component of a three-part series focused on guiding junior faculty to enhance their scholarly productivity. As an EM junior faculty's research career advances, the bibliometric tools and resources detailed in this paper should be considered when developing a publication submission strategy. The tenure and promotion decision process in many universities relies at least in part on these types of bibliometrics. This paper provides an understanding of new, alternative metrics that can be used to promote scientific progress in a transparent and timely manner. [West J Emerg Med. 2018;19(6)1003-1011.]

INTRODUCTION

Understanding the strength and weaknesses of different publication metrics and deciding where to publish your research is crucial in today's competitive academic environment. Publishing papers in quality journals provides the best method to disseminate your work and increase your research exposure.

There are approximately 78 indexed journals in the specialty of emergency medicine (EM). While you can choose to submit your paper to any of these journals, it can be challenging to determine the best option for your research needs. This paper is the last of a three-part series focused on guiding junior faculty to enhance their scholarly productivity.[1,2] The first paper discussed strategies for effective writing and publication.[2] The second paper[1] highlighted promotion processes in one's career. This last paper provides an in-depth narrative review of different publication metrics that are used to measure the impact of published research.

Understanding the complexity of various bibliometric tools and their parameters can be a challenge. This paper will discuss the traditional metrics in the context of journal, article, and author level in addition to the rising importance of alternative metrics. Our goal is to provide junior researchers with a primer on how these metrics are calculated, as well as their benefits and pitfalls. We will then offer strategies for incorporating these to maximize your academic success: suggestions on journal selection, methods to track your research impact for academic achievement and potential collaborative work, and finally, tips on how to detect misleading metrics and impact factors that are not widely accepted in the scientific community.

Bibliometrics: Why it matters?

Bibliometrics is the quantitative analysis of scholarly publications. It quantifies both the quality and research impact of an author's productivity, and the prestige of a journal.[3] Citation analysis measures the impact of both a journal and an author's research impact. It generates the number of publications by an author, the total citations received from

these publications, and the prestige of the journals in which those articles were published.[4]

Journal-Level Metrics

There are several journal-level metric tools, but the data are mostly generated from two major indexing databases: Web of Science (WOS) and Scopus. Both databases allow users to search articles on a topic, track scholarly impact of a journal or individual author, and retrieve a list of journals in a specific field, e.g., journals in EM.

Journal Impact Factor and the Journal Citation Report

The WOS Core Collection is a multidisciplinary database provided by Clarivate Analytics (formerly ISI Thomson Reuters) that indexes over 20,300 journals in the Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI), and Arts & Humanities Citation Index (HCI). The Core Collection also provides the journal impact metrics found in Journal Citation Reports (JCR).[5] For decades, the Journal Impact Factor (JIF) has been the primary metric to evaluate the citation frequency of a scientific journal.[4,6] Published annually since 1975, JIF has long been the gold standard for librarians, researchers, and decision-makers to compare peer-review journals and research impact within a specific field.[7] Librarians use JIF as a criterion for journal selections, authors use it for deciding where to publish, academic officials use it for recruitment and promotion, and funding agencies use it for grant allocation.[8] JIF is a measure of the average frequency with which articles in a journal are cited. The data are gathered in WOS JCR that lists journals and their impact factors. The journals are categorized and ranked in the context of their specific field(s). The "two-year" JIF, though an arbitrary regarding time, is the most widely considered, as it provides a moderate period for other authors in the field to take note of, and reference the work. The method of calculation for an example two-year JIF 2017 is described below:

$$\text{Year 2017 JIF} = \frac{\text{Citations received to items published in 2015 + 2016}}{\text{Number of substantive articles (i.e., exclude editorials and letters) published in 2015 + 2016}}$$ [4,6]

The Limitations of JIF:

- In addition to the narrow two-year window metric calculation, the journal indexing coverage in SCIE is limited to 1,090 journals (http://mjl.clarivate.com/cgi-bin/jrnlst/jlresults.cgi?PC=D). Less than 30 EM journals were categorized, indexed, and reported in the 2017 JCR.
- The influence of self-citation boosts the impact factor and only citable articles are included.[9]
- It does not discriminate between higher and lower quality articles published in the journal.[10,11] It only counts the number of citations received and ignores information about those citation sources.
- JIF is biased toward certain fields of research; EM is a relatively new medical specialty. (The specialty's first journal, *Journal of the American College of Emergency Physicians*, was first published in 1972 and later renamed *Annals of Emergency Medicine*).[12] EM journals generally rank lower in impact factor among specialties.[13] For instance, the median impact factor found in the 2017 JCR report for the 26 EM journals was 1.391 as comparing to 3.186 for 222 journals in oncology.[14]
- JCR is a fee-based, expensive resource that is mostly subscribed to by major academic libraries.

Eigenfactor vs. Journal Impact Factor

The Eigenfactor algorithm uses citation data from JCR to assess and track the influence of a journal in relation to other journals.[15,16] The Eigenfactor measures the journal's overall importance by counting the total number of citations a journal receives over a five-year period. As a result, a journal that publishes a large number of articles is more likely to have a higher Eigenfactor Score (ES). Examples for this scenario are shown in Table 1. *Am J Emerg Med* was ranked #4 in Eigenfactor, but was weighted much less in JCR (#21), SJR (#20), and CiteScore (#28). As opposed to the journal *Emergencias*, which was ranked #4 by JCR, but was weighted outside the top 20 EM journals by Eigenfactor (ES = 0.00116), and was ranked within the 74-50th percentiles (second quartile) by Scopus and SJR (https://www.scimagojr.com/journalrank.php?area=2700&category=2711).

The impact factor measures citations per article, and can be a useful metric tool for authors when choosing a journal to submit their manuscripts. Eigenfactor, on the other hand, measures a journal's overall importance and the influence in its scientific community. The data are used by librarians in supporting their journal selection, decision-making process.[16] The Eigenfactor.org website provides a free searchable database of journal ranking (http://www.eigenfactor.org/projects/journalRank/journalsearch.php). By selecting "*Year, 2015*" and "*Emergency Medicine & Critical Care*" as the ISI Category, you will retrieve the Eigenfactor journal ranking of the 24 EM Journals from JCR (http://www.eigenfactor.org/projects/journalRank/rankings.php?search=FF&year=2015&searchby=isicat&orderby=Eigenfactor).

Scopus CiteScore and SCimago Journal Rank (SJR) Indicators

Similar to WOS, Scopus is a large, multidisciplinary database provided by Dutch publisher, Elsevier, that covers a wide range of subject areas. CiteScore is part of the Scopus collection of research metrics that provides citation impact metrics for over 25,000 journals indexed in Scopus. The calculation of CiteScore metrics includes SJR (SCImago

Journal Rank), SNIP (Source Normalized Impact per Paper), citation and document counts, and percentage cited. Both CiteScore and SJR use an algorithm similar to the Google Page Rank that orders the importance of websites by looking at the hyperlink structure of the World Wide Web.[17-19]

CiteScore does not rely on a two-year limit, but rather provides the average citation per document that a journal receives over a two-, three- and four-year period, with the additional analysis of SNIP that measures the impact of a paper within a subject field.[20] Unlike JIF, CiteScore counts all documents in the denominator of the calculation, including editorials, letters, corrections, and case reports, which are less likely to be cited, and, therefore, lower the average metric score.[17,18,21] The formula to calculate a three-year CiteScore for 2017 is illustrated below:

$$\text{Year 2017 CiteScore} = \frac{\text{Citations received to items published in 2014 +2015 +2016}}{\text{Total counts of all documents published in 2014 +2015 +2016}}$$ [17]

The metric data shown in Table 1 provides a brief analysis of the top 20 EM journals in 2017 JCR, Eigenfactor, SJR, and CiteScore. Four EM titles reported in JCR (*Adv Wound Care, Shock, Intern Emerg Med,* and *Crit Care Resusc*) were not grouped under the subject category of EM as in Scopus. Instead, the titles were categorized and ranked among other subject disciplines such as "Critical Care Medicine" and "Medicine, General." To make a fair comparison, we placed and ranked these titles with the 26 EM journals in JCR and compared them with SJR and CiteScore. Among the top 20 EM journals found in SJR and CiteScore, three titles (*Curr Heart Fail Rep, West J Emerg Med* (*West*JEM), and *J Trauma Manag Outcomes*) are currently not indexed in SCIE, and only *West*JEM is indexed in the Emerging Sources Citation Index (ESCI), a new WOS database launched in 2015. See Table 1 to learn more about other ranking variations and findings among these metric indicators in EM journals.

Google Scholar: Journal-Level Metrics

Google Scholar metrics publishes the top 100 publications of the world's journals every summer. The 2018 report (https://scholar.google.com/citations?view_op=top_venues) was released in August. The list is calculated using their five-year h-index and h-median metrics. The h-index has traditionally been used as an author-level metric, but in recent years it has been adapted to a journal-level metric by Google Scholar and SJR. The h-index of a journal is based on the set of most-cited articles published in that journal. It calculates the number (*h*) of most-cited papers published in that journal in the prior five years that were cited at least *h* times each. For example, *West*JEM received an h-5 index of 28 in the 2018 Scholar metric report. This means 28 papers published in the prior five years (from 2013 to 2017) in *West*JEM have been cited at least 28 times and was ranked #14 in the report. The h-5 index of the top 20 EM journals reported by Google Scholar in 2018 is at https://scholar.google.com/citations?view_op=top_venues&hl=en&vq=med_emergencymedicine.

Author-Level Metrics: h-index

The h-index, developed by Hirsch, measures the total citations generated from an individual author's publications based upon the most-cited articles.[22] It expresses an author's total number of papers (h) that have received at least 'h' citations. The h-index can easily be calculated manually by organizing an author's articles in descending order of number of citations. As shown in Table 2, Author A published 10 papers that have been cited 40, 35, 28, 20, 15, 11, 9, 6, 5, and 2 times. The h-index in this case is seven because the seventh most- cited papers by this author have been cited at least seven times. When paper #8 receives two or more citations, the h-index will then move up to eight.

Commonly, junior faculty are penalized by the h-index. It takes years to build a body of publications and generate citations. Even with a few highly cited papers, a junior faculty member, in general, has fewer publications and citations than their senior colleagues. As shown in Table 2, Author B**,** who published three papers that were cited at least 15 times only generates an h-index of three. The h-index therefore cannot be used to compare a junior faculty member with a few publications and a senior faculty member with more years of publications and high citations.

Among academic emergency physicians, the h-index has been suggested as a way to "evaluate performance and identify emergency physicians with future success in EM research."[23,24] Both the author search function in WOS and Scopus can be used to create a report of an individual author's overall citation counts, h-index, and publications. As with Google Scholar, individual authors can create a free scholar profile to track their publications and overall metric performance. Studies have found that Google Scholar yields a considerably larger number of "*Cited by*" items than either WOS or Scopus,[25] and nearly all academics had higher h-index in Google Scholar than in the two fee-based databases.[26-28] Google Scholar yields broader and more comprehensive coverage for most disciplines from publishers, professional societies, and university repositories that allow access. Unlike WOS and Scopus, Google Scholar is free and provides unbiased retrievals of citations across disciplines. The reason that Google Scholar citations, and the corresponding h-indices, are higher than WOS or Scopus is that Google Scholar counts citations from all journals found on the web, while WOS and Scopus only count citations in a more restricted subset of journals that these indices include.

Table 1. The comparison of top 20 emergency medicine journals in Journal Citation Report, Eigenfactor, SCImago Journal Rank (SJR), and CiteScore.

	JCR –top EM-related journals	JIF	Eigenfactor (ES) --Top EM-related journals	ES	SJR -- Top 20 EM journals	SJR	Scopus CiteScore – Top 20 EM journals	Citescore
1	Resuscitation	5.863	Resuscitation	0.02515	Resuscitation	2.643	Adv Wound Care[l]	6.21
2	Adv Wound Care[l]	5.2	Injury	0.01998	Ann Emerg Med	1.632	Resuscitation	3.81
3	Ann Emerg Med	4.680	Ann Emerg Med	0.01667	Acad Emerg Med	1.503	World J Emerg Surg	2.81
4	Emergencias[a]	3.608	Am J Emerg Med[b]	0.01478	Curr Heart Fail Rep[e]	1.468	Shock[j]	2.75
5	World J Emerg Surg	3.198	Acad Emerg Med	0.01354	Shock	1.331	Curr Heart Fail Rep[e]	2.73
6	Shock[j]	3.005	Shock[j]	0.01165	Prehosp Emerg Care	1.286	Injury	2.22
7	Acad Emerg Med	2.612	J of Emerg Med	0.01043	Adv Wound Care[l]	1.257	Prehosp Emerg Care	2.21
8	Intern Emerg Med[i]	2.453	Emerg Med J	0.00800	World J Emerg Surg	1.098	Acad Emerg Med	2.12
9	Scan J Trauma Resusc Emerg Med	2.312	Burns	0.00767	Burns	1.044	Burns	1.9
10	Prehosp Emerg Care	2.269	Ped Emerg Care	0.00655	Crit Care Resusc[f]	1.032	Scan J Trauma Resusc Emerg Med	1.7
11	Injury	2.199	Adv Wound Care[l]	0.00524	Injury	0.990	J Burn Care Res	1.57
12	Burns[j]	2.134	Scan J Trauma Resusc Emerg Med	0.00507	Emerg Med J	0.912	Ann Emerg Med	1.51
13	Emerg Med J	2.046	J Burn Care Res	0.00451	J Burn Care Res	0.768	Intern Emerg Med	1.48
14	Crit Care Resusc[f]	2.014	Intern Emerg Med	0.00433	Health Secur	0.739	Emerg Med Clin N Am	1.46
15	J Burn Care Res[k]	1.923	Prehosp Emerg Care	0.00375	Intern Emerg Med	0.735	Traumatology	1.43
16	Eur J Emerg Med[c]	1.729	Emerg Med Austr	0.00302	West J Emerg Med[g]	0.735	J Trauma Manag Outcomes[h]	1.42
17	Eur J Trauma Emerg Surg[d]	1.704	World J Emerg Surg	0.00276	Canad J Emerg Med	0.624	BMC Emerg Med	1.39
18	Canad J Emerg Med	1.481	Euro J Emerg Med[c]	0.00243	Emerg Med Austr	0.621	Emerg Med J	1.33
19	Emerg Med Clin N Am	1.429	Prehosp Disaster Med	0.00203	Scan J Trauma Resusc Emerg Med	0.618	Crit Care Resusc[f]	1.25
20	Emerg Med Austr	1.353	Euro J Trauma Emerg Surg[d]	0.00197	Am J Emerg Med[b]	0.604	West J Emerg Med[g]	1.24

[a]Emergencias was ranked #4 in 2017JCR, but was weighted much less by Eigenfactor (0.00116), SJR (0.603), and CiteScore (1.15).
[b]Am J Emerg Med was ranked #4 in Eigenfactor, but was weighted much lower in JCR (#21), SJR (#20), and CiteScore (#28).
[c,d]Both European journals are among the top 20 in JCR and Eignefactor, but that is not the case with SJR nor CiteScore..
[e,g,h]These journals were ranked among the top EM journals in SJR and CiteScore, but none are indexed in SCI Expanded Collection. Only WestJEM is indexed in WOS ESCI.
[h^]was ranked #34 in SJR, but ranked #16 in CiteScore.
[f, i, j, k, l]These journals were not categorized among the 26 emergency medicine journals found in JCR. Instead, they were grouped under other medical subject disciplines, e.g., "Critical Care Medicine."
JIF, journal impact factor; ES, Eigenfactor Score.

Article-Level Metrics: Alternative Metrics

The journal- and citation-based metrics described above have limitations, which have been the subject of much criticism and debate in research and peer evaluation.[29] They only measure a limited aspect of quality and no single metric can adequately reveal the full impact of research.[30] In addition to

Table 2. The calculation of h-index of an individual author's publications.

Publications	Paper #1	Paper #2	Paper #3	Paper #4	Paper #5	Paper #6	Paper #7	Paper #8	Paper #9	Paper #10	h-Index
Author A											
Cited by	40	35	28	20	15	11	9	6	5	2	**7**
Author B											
Cited by	40	30	15								**3**

the shortcomings of these traditional metric indicators, it takes years or decades to mature.[31] Article-level metrics (ALMs) are an alternative approach to quantifying the research and impact of published research.

iCite

iCite is a metric web tool developed by the National Institutes for Health (NIH) for calculating Relative Citation Ratio (RCR) for PubMed articles. The purpose is to show the scientific influence of one or more articles relative to the average NIH-funded paper,[32] and assess a researcher's quality and productivity. The algorithm is based on an interconnected network of citations and uses a co-citation network to measure the impact of a paper within a subject field.[33] The co-citation system enables comparison across scientific fields, e.g., comparing EM and critical care medicine. The article-level RCR is calculated by the total citations an article receives per year, divided by the average citations per year received by NIH-funded articles in the same field contemporaneously. Any article with RCR 1.0 has an RCR higher than 50% of NIH-funded papers, where 1.0 represents the field-normalized.[34]

The output data (e.g., total publications, publications per year, citations per year, RCR, and weighted RCR) produced by iCite can be used to understand the influence of articles within an analysis group. The NIH uses this application to determine the extent to which NIH awardees maintain high or low levels of influence in their respective fields of research.[32] The figure illustrates a 2013 *West*JEM article, "*Oral and Intravenous Acetylcysteine for Treatment of Acetaminophen Toxicity: A Systematic Review and Meta-analysis.*" This paper's mean RCR of 1.94 is higher than 73.8% of NIH-funded publications in EM.

As more scientists turn to social media and other "Web 2.0" platforms for communication and other scholarly activities, there is a need to measure the impact in non-traditional ways.[35,36] These have led to the development of alternative metrics.[37] "Altmetric" and other ALMs provide immediate measures and a more complete picture of the impact of scientific publications.[38]

Altmetric

Developed by Digital Science, Altmetric (https://www.altmetric.com/) is a web tracking system that measures impact by collecting relevant discussions and citations of each scholarly paper across the Internet and social media networks. These include peer reviews on Faculty of 1000 (http://f1000.com), citations on Wikipedia and in public policy documents, discussions on scientific blogs, mainstream news media coverage, bookmarks on reference managers (e.g., Mendeley), and mentions on social networks such as Facebook and Twitter.[39]

The Altmetric attention score is displayed with a colorful donut badge to help readers and researchers recognize the level and type of attention a paper receives in real time. At the time of completing this paper, an article published in *West*JEM in May 2016, "*Gender Differences in Emergency Department Visits and Detox Referrals for Illicit and Nonmedical Use of Opioids*" received an Altmetric score of 438. The article was mentioned by 54 news outlet, 11 tweeters, 1 Google+ user, and had eight Mendeley readers. In partnership with Altmetric, *West*JEM's readers and authors can trace the real-time attention of this article at: https://escholarship.altmetric.com/details/9119550. Additionally, authors can view and track the top 10 *West*JEM articles mentioned recently in social media https://westjem.com/top-10-articles. As mentioned on its website, this added feature provides *West*JEM's "authors with valuable feedback that gauges immediate impact of their work, long prior to article citation, the traditional metric of scholarly impact."

Even in the era of alternative metrics, most research data remain uncited and the actual impact of alternative metrics in evaluating article impact remains uncertain.[40] Conversely, a central criticism of alternative metrics is that they measure attention, and not necessarily quality.[40] The most frequently shared or "newsworthy" papers might not be the most scientifically rigorous.[41] A recent analysis of the top cited papers in EM suggested that there is a "mild correlation" between citation counts and Altmetric scores.[42] Other studies have also shown that top cited articles can be predicted by the number of tweets about the article, especially in the first several days following publication.[43]

PlumX Metrics

PlumX, an article-level metric, recently acquired by Elsevier, offers authors an alternative approach to understand how their work is used and communicated online in near real time. Similar to Altmetric, PlumX metrics capture online activities associated with both general and academic audiences. Research resources include but are not limited to articles, conference proceedings, book chapters, and multimedia use. Using five major categories

of metrics ("Usage," "Captures," "Mentions," "Social Media," and "Citations"), PlumX tracks citation activity that crosses traditional and alternative bibliometrics.[44] After citation counts, the article-level usage metric is the next most-preferred metric among researchers.[45] Authors can track their PlumX article-level metrics from a search result in Scopus[46] and in EBSCOhost (EBSCO: Elton B. Stevens Company, a privately held company that provides online research services) databases.[47]

Lastly, a group of information professionals recently launched the Metrics Toolkit to assist researchers and scholars in navigating the ever-changing bibliometrics landscape. The site (http://www.metrics-toolkit.org/) provides links to the 27 most popular research measurement indicators for books, book chapters, datasets, journal articles, software, etc. It also includes an app that can recommend discipline-specific metrics to meet your needs. Best of all, the Metrics Toolkit carries a CC-BY 4.0 (Creative Commons Attribution 4.0 International) license so the content can be used at will.

Strategies to Maximize Your Academic Success

Beware of Misleading Metrics and Fake Impact Factors

The bibliometrics described above are considered by the scientific community to be the measures of academic and scholarly productivity and scientific impact. Recently, the rise of so-called "predatory journals" has resulted in development of misleading, fake metrics that may fool novice researchers into believing that their works are being recognized and valued.[48,49] Furthermore, predatory journals charge high article processing fees, but fail to provide the value of reputable publishers with legitimate peer review and wide indexing.[50] They may advertise fabricated impact factors and other bibliometrics.[48] Although there has not been research on the availability or use of these metrics, efforts have been made to identify and publicize these false metrics. These include the "Stop Predatory Journals" website https://predatoryjournals.com/metrics/ and a library subject guide that help researchers understand the significance and value of publishing in open access https://guides.lib.uci.edu/understanding_research_publishing.

To identify specific predatory journals to which you should avoid submission, go to https://predatoryjournals.com/journals/ . In addition, you must also search in the predatory publishers list, as the predatory journals list only includes stand-alone journals, not those from multi-journal predatory publishers. Find these predatory publishers at https://predatoryjournals.com/publishers/ . If neither the journal title nor publisher appears in either of these lists, the journal is likely legitimate.

Find the Right Journal for Your Research Paper

For inexperienced researchers, getting a research paper accepted for publication can be a challenge. To avoid rejections and delay in submission, it is crucial to choose the right journal. Here are the steps that can help you find journals that could be best suited for publishing your paper.

1. Conduct a literature search in PubMed to determine where related articles in your research topic have been published. Select the journals from the search results that match your research interests.
2. Check the journal's indexing status in the NLM Catalog: Journals referenced in the NCBI Databases (https://www.ncbi.nlm.nih.gov/nlmcatalog/journals). Look for whether the journal is officially indexed in MEDLINE, PubMed, and PMC (PubMed Central). Avoid journals that are labeled as "*Only citations for author manuscripts are included," "PubMed: Selected citations only.*" This indicates the least potential for visibility.
3. Go to the SJR Journal Ranking website and review the journal's metrics, then query to further evaluate the specific ranking of the selected EM journals (http://www.scimagojr.com/journalrank.php?category=2711). Change the subject category at the top to assess rankings of journals in other fields.
4. After you identify the target journals that may match your paper and research, review the journal website to make sure that its scope and policies match your needs. In addition, check the journal's review process and the instructions for authors thoroughly.
5. If you are still not sure, the tools shown in Table 3 can help to select the correct journals, as well as find relevant articles to cite in your manuscript. For journal editors, these tools can also help to identify potential reviewers.

In addition to the steps described above, we offered recommendations and key components of writing and publishing a successful research paper in our first article[2] of this three-part series.

Consider non EM-specific Journals

With an exponential increase in the number of publications, particularly in widely-accessible open access journals, robust metrics that adequately describe the quality and impact of peer-reviewed publications is critical.[51,52] In EM alone, there was a 58% increase in the number of specialty-based journals in the first decade of this century.[53] The perceptions of EM as an academic specialty within the house of medicine are, in part, driven by how EM authors and reputable journals reach broader, non-EM audiences.[54] It is important, therefore, to attempt to publish your work also in non-EM-specific journals. Some common examples are public health, healthcare management, critical care, ultrasound and disaster medicine, as well as traditional specialty journals outside of EM, such as cardiology, pediatrics, neurology, and toxicology.

Create a Google Scholar Profile to Track Research

Google Scholar offers a free and simple way to create a scholar profile that showcases your papers, calculates your h-index, and tracks citations. In addition, it can help you connect

Table 3. Publishing tools to identify promising journals to which to submit your research paper.

Tool and weblink	Description
Jane (Journal/Author Name Estimator http://jane.biosemantics.org/	This website compares your abstract to millions of documents in PubMed. The results offer the best matching journals for your paper.
About Edanz https://www.edanzediting.com/about Edanz Journal Selection https://www.edanzediting.com/services/journal-selection	A fee-based editing service that is designed to help non-native English researchers to publish in international journals. Offers a list of three target journals that best match your research topic. Registration is required.
Elsevier Find a Journal https://www.elsevier.com/authors/journal-authors/submit-your-paper#find Match your Manuscript -- "Find the perfect journal for your article" https://journalfinder.elsevier.com	Search an Elsevier journal by name or enter your abstract in the "Match Your Manuscript" journal finder to locate potential Elsevier journals that are most suited for your research.
PubMed PubReMiner http://hgserver2.amc.nl/cgi-bin/miner/miner2.cgi	Allows you to run a search to determine journals that published the most articles relating to your topic.
Springer Journal Suggester https://journalsuggester.springer.com/	Enter your abstract, description of your research, or a sample text. The results will return with a list of relevant Springer and BioMed Central journals that are most suited for your research.

with scholars for potential future collaboration. Once you register and create a basic profile, Google Scholar provides you with a list of publications that may belong to you (with overlap of similar author surnames and initials). You validate your own publications and add them to your profile. After a profile is created, Google will automatically find and add your new publications. Other tracking features include the ability to see who is citing your publications, a graph of citations over time, and latest h- and i10-indices (articles cited at least 10 times).[55] In addition, you can create email alerts to help you stay informed of new research in your area and to receive updates on new citations to your articles.

To gain more insight on promoting and bringing visibility to yourself and your scholarship, the second paper of this three-part series offers constructive guidance to junior faculty on strategies and resource tools such as creating an ORCID and engaging in social networks.[1]

CONCLUSION

As an EM researcher's career advances, the bibliometric tools and resources above should be considered when developing publication submission strategies. Publications in indexed, higher-impact journals are more likely to capture the impact and influence of scientific work performed by the EM researcher. The tenure and promotion decision process in many universities relies at least in part on these types of bibliometrics.[1] Additionally, you now understand how newer, alternative metrics can be used to expand and promote scientific progress and your influence in new, more transparent, and timely ways.[38]

Finally, a word of wisdom from the authors: "The quality of your research and your contributions to the scientific community are of paramount importance. That brings the feeling of pride and honor, and is affected less by the prestige of the journal in which you publish."

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Student Experience with a Quality Improvement Project in the Emergency Department

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Dear Editor,

We read with great interest Manning et al.'s recent article on the use of medical student quality improvement projects (QIP) to promote evidence-based care in the accident and emergency (A&E) department (Manning et al., 2018). We believe that students are well positioned to effect change via QI initiatives and offer our experience to support their recommendations, alongside further suggestions to aid implementation and integration of medical student QIPs into clinical practice.

As part of our penultimate-year curriculum, we designed and managed a six-month QIP in a district general teaching hospital in southern England, whose trust receives approximately 138,000 visits per year (Western Sussex NHS Foundation Trust, 2017). While Manning et al. focused on implementing treatment pathways, our project focused on improving patient flow in a triage area on the acute medical ward, receiving referrals from community general practitioners, as well as less acutely unwell patients from the A&E department.

In their article, Manning et al. highlighted bidirectional alignment, "the idea that an institutional problem should be evaluated and addressed from the bottom-up as well as the top-down," as an important part of the QI process. Our experiences echo this; spending time immersed in the clinical area observing frontline staff drastically altered our perception of the patient flow process and informed our root-cause analysis of the barriers to efficient patient flow. Our first recommendation for any medical student QIP would be to pair students with clinical champions for change management who are instrumental in the day-to-day delivery of services. This will ensure projects are tailored and address the real issues impacting staff and patients alike.

Despite identifying and recruiting champions for change management, we faced significant challenges in implementing improvements. As students, we lacked autonomy to enact change in clinical areas. Although this proved to be a useful learning experience in independently raising concerns and proposing solutions, our second recommendation would be to pair students with a senior clinical practitioner in the department who is able to lend authority to students to undertake changes in the clinical setting. Involving both a senior leader and frontline staff will not only support students but, more importantly, encourage sustainable change which will outlast the duration of the student project.

Although we recommend a close working relationship with staff, we believe as external third-party observers that we were able to offer a unique perspective in the QI process. Manning et al. describe the "fresh perspective" of medical students as influential in creating "novel solutions." Indeed, we observed that frontline staff were aware of the main barriers to patient flow, yet appeared blinded to obvious solutions, remaining entrenched in current practice. For example, we identified a lack of clinical space as a barrier to flow and raised the possibility of using existing curtains to form temporary bays within the waiting room. This realization surprised staff, and one member of staff even suggested we should take them down completely to save space rather than utilizing them for clinical workspace. A fresh perspective is of particular importance in an acute medical setting where the clinical demands on staff hardly allow for lunch breaks, let alone detailed reflection and analysis of clinical practice. The two-day training we received in QIP methodology taught us how to use lean management tools to identify problem areas within the flow process: developing a root-cause analysis, plan-do-study-act cycles, A3 problem solving, engaging the key stakeholders, and establishing a plan for measuring the outcomes of our QI initiative. Furthermore, this training facilitated proactive inter-professional communication, more so than our conventional interprofessional education.

Our third recommendation would be for students to receive training, whether in the form of classroom-based teaching or online modules, before commencing clinical QIPs. This will ease their integration within the clinical team and reduce demands on staff, facilitating a more successful QIP.

Overall we strongly agree with the findings of Manning et al. and believe that QIPs have given us a unique insight into how we can effect evidence-based change in a clinical environment, which has real world implications on a day-to-day basis. We would encourage all A&Es to reinforce the role of medical student QIPs in improving patient care.

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Deaf and Hard-of-Hearing Learners in Emergency Medicine

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Approximately 23% of Americans over age 12 have some level of hearing loss.[1] Emergency departments can reduce healthcare barriers for deaf and hard-of-hearing (DHoH) patients through improved patient-physician communication. DHoH students, once they become physicians, may provide one mechanism for reducing existing healthcare disparities and communication barriers for DHoH patients, and may be more adept with patients facing other communication barriers. A renewed interest in disability access and a commitment to social justice has increased efforts toward the inclusion of individuals with disabilities in medical education and training. Despite this increased interest and a growing number of DHoH students entering medical education, DHoH students continue to be dissuaded from specialty careers such as emergency medicine (EM) over concerns regarding effective communication and ability. Given the academic medicine communities' commitment to diversity, a recounting of the successful inclusion of DHoH students in EM can benefit medical education and practice.

In this account, the authors reflect on the successful experiences of a visiting DHoH medical student in an academic EM rotation at a Level I trauma hospital that serves a diverse population, and they identify the potential challenges for DHoH students in an EM setting, offer solutions including reasonable accommodations, and provide commentary on the legal requirements for providing full and equal access for DHoH students. We secured permission from the student to share the contents of this article prior to publication. [West J Emerg Med. 2018;19(6)1014–1018.]

INTRODUCTION

Deaf and hard-of-hearing (DHoH) individuals* over the age of 12 comprise 23% of the U.S. population,[1] and over 500,000 patients use American Sign Language (ASL).[2] Disproportionate to the general population, allopathic medical students with disabilities account for only 2.7% (1,547) of the total medical student population and only a fraction of these (38) are DHoH students.[3] Medical schools may unintentionally discourage DHoH students from entering specialties such as surgery, obstetrics and gynecology (OB/GYN) or emergency medicine (EM) given the lack of knowledge regarding this population and the false belief that accommodations are not possible, too complicated, too costly, or that trainees are simply unable to perform the duties of a physician. A recent paper suggests that students with disabilities self-report being counseled out of subspecialties such as surgery, OB/GYN, and EM,[4] while a 2013 study shows that the majority of DHoH physicians (68%) practice in primary care specialties, supporting the idea that the majority of DHoH physicians do not enter subspecialities.[5] It may be that experiences in medical school and visiting rotations negatively inform students'

*Hearing loss throughout this article is defined as mild (>25 dB-40dB), moderate (>40dB-60dB), severe (>60dB-80dB), and profound (>80dB).

choices to forgo these specialties. Despite a growing interest in the experiences of DHoH students, there remains a dearth of information about the experiences of this population in subspecialty electives such as surgery, OB/GYN and EM. To our knowledge only one article exists that discusses a DHoH student's experiences in an anesthesia rotation.[6]

Researchers suggest that the inclusion of DHoH students, residents and physicians in the medical education continuum could offer multiple benefits to peers and patients alike including increasing disability awareness, improving interactions with DHoH patients and family members;[7,8] building empathy for persons with disabilities;[9] and promoting an accessible and supportive environment for patients and physicians, including aging physicians who experience hearing loss as part of natural aging.[8] DHoH patients may benefit from improvements in knowledge, attitudes, and communication that results from teaching medical students how to work with interpreters[9] specifically in emergency department (ED) settings where communication is central to patient outcomes. This is especially relevant for the DHoH population that uses ASL, as these patients are more likely to use the ED, when compared to the general hearing population.[10] Disparities in healthcare and poorer outcomes exist for DHoH patients.[11-13] Language-concordant patient-providers fluent in ASL may help reduce these disparities. For example, a 2011 study showed that ASL users who received primary care from ASL-using physicians were more likely to use preventive services.[14] It may be that physicians skilled at creatively navigating diverse and alternative forms of communication are able to provide more informed care to DHoH patients.[7,15]

While reduced healthcare disparities for patients and a commitment to social justice should drive the inclusion of DHoH students in medicine, recent court decisions have supported qualified DHoH individuals in the healthcare workforce noting that DHoH individuals are appropriate providers when properly accommodated.[16-19] Despite the courts' support of DHoH students and employees, and the greater focus on diversity and inclusion in medical education, there remains a great deal of stigma for DHoH individuals in medicine.[20,21] For example, concern has been expressed regarding effective communication with DHoH students. However, communication between non-DHoH physicians and teams is of equal concern in medicine. Techniques including establishing set protocols, using a check-back process to verify communication, and communicating the plan to the team members have proven effective in reducing communication errors in EM.[22] The same recommendations that guide hearing physicians also allow DHoH students to operate within a team and to provide excellent care to their patients. The addition of DHoH students in the ED may reduce common errors among *all* physicians through (1) a focus on accurate translation,[23] (2) patient care diversity awareness,[24] and (3) improved access to care through increased cultural competency in working with the DHoH population.[25]

Case Report on Deaf Student in Emergency Medicine

A deaf medical student completed a one-month visiting rotation in EM at a medical school in the Western U.S. The student had a history of using hearing aids, cochlear implants, communication access real-time transcription (CART), Cued Speech transliteration, and ASL interpreters (Table). With appropriate accommodations, the student performed well in undergraduate and graduate school. The student used designated healthcare interpreters (DI) – sign language interpreters linguistically specialized in working with healthcare professionals – throughout the clinical years in medical school and during the visiting EM rotation. The DIs were provided by the student's home institution who maintained financial responsibility for the interpreting services and full access for the student's educational experience.

Application and Disclosure of Disability

The student applied to the EM rotation through the Visiting Student Application Service. Once accepted, and two months prior to the start of the rotation, the student notified the school of the need for accommodations. The student's designated interpreter contacted the institution's Americans with Disabilities Act (ADA) designee to request accommodations and to provide guidelines and guidance for working with a deaf student. Two weeks prior to the start of the program, the program director and disability director provided a brief educational outreach to the ED staff, including techniques for working with deaf students in the clinical setting. The student and DI were invited to share their insights about working in the department at the conclusion of the rotation.

The ED setting presents challenges for all students, specifically a fast-paced and stressful working environment, interacting with patients speaking multiple languages, tight and noisy working spaces, witnessing trauma and overall loss of control in emergency situations. Yet the deaf student's feedback about the rotation was positive. The student and the DI noted the inclusiveness of the experience in this environment, including a respectful, responsive and communicative team. For example, hospital staff directly approached the student, not the DI, when they had questions about communication (e.g., inquiries about the amplified stethoscope). Educational materials and experiences for students in the program were equally accessible for the deaf student, and the program expressed genuine interest and excitement regarding the diversity the deaf student brought to their program.

Mechanisms for Inclusion

The program director welcomed the student and set clear expectations for the ED team. The DI was included in every interaction from orientation to patient care. Access to orientation items and to the virtual learning platform

were completely accessible as a result of being addressed proactively with the program director, student coordinator, disability services office, and designated interpreter. By requesting accommodations and accessible materials two months in advance, the student ensured 1) the addition of captioning to instructional videos contained in online learning platforms, 2) complete scheduling of the DI for didactic and clinical activities, and 3) the development of specialized medical sign language for the rotation (for terminology not currently designated in ASL) in advance of the student's arrival. This collaborative approach facilitated access to the program, normalized the presence of a deaf student, and contributed to an inclusive and non-marginalizing experience. Once the rotation began, the student identified potential barriers to the rotation including having to use a phone for consults, learning new clinical skills under traditional instructional models, responding to codes, and navigating field experiences, all of which could be removed using accessible practices. Each area is addressed below.

POTENTIAL CHALLENGES FOR DHoH STUDENTS

Phone Calls

While phone calls in the ED were a challenge for the student, these barriers were easily addressed. For this rotation, the phone was frequently used to access the language interpreting line, consult with the pharmacy, specialist physicians, and the laboratory. To facilitate phone calls, the student used assistive devices including adaptive headsets and video relay service. A speakerphone function or a two-way headset was the chosen method for facilitating phone calls, with the DI on each call interpreting for the student. This was a productive and effective method for removing barriers in this setting. A quick and professional disclosure that the student was using an interpreter or relay service reduced potential confusion when the student's gender did not match the voice of the DI, or if the receiving party was unfamiliar with communicating with a deaf person.

Learning Procedural Skills

The acquisition of procedural skills is an essential part of any rotation. Standard EM procedures range from laceration repairs and venipuncture to central line placement and endotracheal intubations. The traditional model of "see one, do one, teach one" whereby students watch a demonstration of a procedure, practice a mock simulation, and then demonstrate competency to a preceptor needed to be modified for the student. Typically, when demonstrating a procedure, the spoken instructions and demonstration often occurred concurrently. For a deaf student, it is difficult to simultaneously focus on both the procedure and the interpreter to capture the instructions. In these situations, the student felt empowered to request that faculty discuss the procedure first, followed by a demonstration of the procedure to allow the student to view the interpreting of instructions before shifting to the demonstration. Allowing time for verbal instruction in advance of demonstration was necessary for the deaf student to have full access to the material. While this approach to teaching the material is necessary for the deaf student it can also increase retention for all students by tapping into multiple learning styles.

Table. Mechanisms for communication with deaf or hard of hearing students.

American Sign Language interpreters (ASL)	A person trained in translating between a spoken and a signed language.
Designated healthcare interpreter (DI)	A designated interpreter is a linguistically specialized sign language interpreter who works extensively with a deaf healthcare professional, making cultural and professional adaptations to the professionals' career environment as appropriate.
Communication Access Real-time Translation (CART)	A captioner (CART provider) uses a court reporting stenography machine, a computer and software to display everything that is being said, word for word. The text is displayed on a computer, television or projection screen.
Cued Speech Transliterators (CST)	A visual mode of communication that uses hand shapes and placements in combination with mouth movements and speech to make the phonemes of spoken language visible.
Video Relay Service (VRS)	Video Relay Service is a form of Telecommunications Relay Service that enables persons with hearing disabilities to utilize ASL to communicate with voice telephone users through video equipment, rather than through typed text. Video equipment links the VRS user with a TRS operator – called a communications assistant, or CA – so that the VRS user and the CA can see and communicate with each other in signed conversation.
Adaptive hearing devices	A device that helps individuals with hearing loss or a voice, speech, or language disorder to communicate. (examples: Induction loops systems; FM systems, infrared systems; personal amplifiers, amplified stethoscopes, digital stethoscopes).

Codes

During a code, communication is essential to ensure role expectations and the team's approach to the case. When a deaf team member participates in the code they can easily follow their assigned role under the direction of the DI. Additionally, when deaf students become physicians and run a code they can develop strict communication protocols, ensuring that each team member understands designated hand signals. During this rotation, the student and the DI participated in several codes without incident. For each code, interpreter positioning was quickly identified and a line of sight was established to facilitate the student's involvement and interaction with the code.

Field Experiences

As part of the rotation, the student was expected to complete a ride-along with emergency medical services (EMS). Excusing the student from field experiences had been the approach during other rotations; however, this program felt strongly that the student should engage in all aspects of the rotation and that the rotation should be fully accessible. The student and the DI were included in required field experiences, including the ride-along in the ambulance. Observing the EMS crew was the main learning objective of the experience. However, the crew was called to an acute incident during the ride-along that necessitated an all-hands-on-deck approach. The student was included in the response by using non-verbal communication (hand signals) and by handing appropriate supplies and pointing or guiding the student's hands to the needed medical procedure. The DI facilitated verbal communication by establishing a position near the paramedic and emergency medical technician and interpreting essential instructions to the student.

MECHANISMS FOR ENSURING COMPLIANCE WITH THE ADA

The ADA was amended effective January 1, 2009, and new ADA regulations took effect March 15, 2011.[26] In the most general terms, the amendments and regulations broaden the definition of a disability, lowering the burden of proof to establish oneself as a person with a disability. The law requires medical education programs, including undergraduate medical education (UME) and graduate medical education (GME) to engage in an interactive process (see Figure) with qualified individuals that includes a discussion about their disability-related needs. This process calls upon disability specialists, program directors and other identified stakeholders to investigate potential and reasonable accommodations that would allow equal access to the program. Appropriately responding to ADA requests for accommodation requires that UME and GME designees maintain a full understanding of federal regulations, are able to articulate the essential functions of their programs and have a command of reasonable and effective accommodations. This case study highlights the effective, respectful, and proactive process among the parties.

CONCLUSION

A number of methods exist that allow for the full inclusion of DHoH students in medical education including ASL interpreters, DI, Cued Speech transliterators, and adaptive hearing devices. DHoH students with appropriate accommodations, including assistive technology, are able to effectively follow procedural instructions, respond to codes, and respond to other environmental cues effectively, even though these tasks are communication-dependent.

Given the large number of people with hearing loss that affects communication access, it is critical that the growing number of DHoH physicians in the pipeline be well trained and positioned to provide effective, culturally sensitive care. This is especially critical when navigating the communication challenges in EM environments. As evidenced in this case study, the logistical hurdles to access for a deaf student in an EM rotation, and for DHoH students broadly, can be remedied with creativity, advanced planning, and the institutionalization of team-oriented learning environments that prioritize clear communication.[26] This equips DHoH students to not only effectively handle a complex and diverse patient population, but also increases patient-provider concordance.

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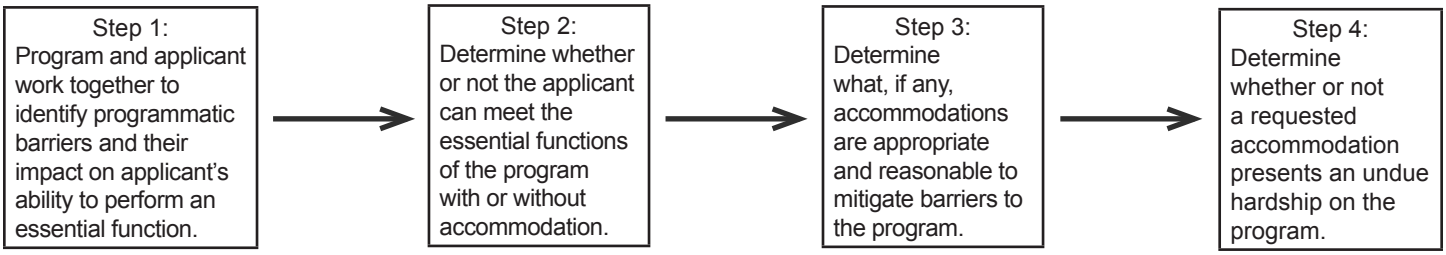

Figure. Steps for engaging in the interactive process.

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Standardized Patients to Assess Resident Interpersonal Communication Skills and Professional Values Milestones

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It has been a challenge to assess communication and professional values Milestones in emergency medicine (EM) residents using standardized methods, as mandated by the Accreditation Council for Graduate Medical Education (ACGME). This paper outlines an innovative method of assessing these Milestones using an established instructional method. EM faculty mapped the communication and professional values Milestones to an existing communication and interpersonal skills scale. We identified six communication-focused scenarios: death notification; informed consent; medical non-compliance; medical error; treatment refusal; and advanced directives. In a pilot, 18 EM residents completed these six standardized patient (SP) encounters. Our experience suggests SP encounters can support standardized direct observation of residents' achievement of ACGME Milestones. Further effort can be made to create a tailored, behaviorally-anchored tool that uses the Milestones as the conceptual framework. [West J Emerg Med. 2018;19(6)1019-1023.]

INTRODUCTION

Although effective communication with patients is an integral part of the role of all physicians and has gained the spotlight over the last decade, there is no established standard on how it should be taught and assessed during traditional medical training.[1-6] The urgency to address this gap is evident, as the literature indicates that deficiencies in communication skills can lead to higher malpractice rates, patient dissatisfaction, and adverse patient outcomes.[7-9] The Accreditation Council for Graduate Medical Education (ACGME) endorsed "Interpersonal and Communication Skills" and "Professionalism" as two of the six core competencies. These competencies, and newly mandated ACGME Milestones, are challenging to assess in the clinical setting due to varying faculty frames of reference and the influence of factors external to resident performance.[10] Faculty may use themselves, other doctors, or patient outcomes as frames of reference when assessing residents. In addition, faculty report that they often use "gut feeling" or "gestalt" to translate their observations to numerical assessment scores.[10]

Standardized patient (SP) encounters with validated tools are an established method of assessing learners[11] and may offer a more consistent way to assess residents. The literature supports a correlation between patient surveys and SP-based assessments of learners,[12] as well as the use of SP feedback for training and assessment of residents.[13-16] Using this established method can offer a more reliable assessment of these residency Milestones. This project aimed to pilot an innovative SP-based model to assess the interpersonal communication skills and professionalism Milestones of emergency medicine (EM) residents.

METHODS

In 2005, the University of Illinois-College of Medicine at Chicago (UIC-COM) Clinical Performance Center (CPC) developed an institution-based competency tool to provide resident performance data to program directors (PD). The Communication and Interpersonal Skills Objective Structured Clinical Exam (CIS-OSCE) was administered and analyzed across specialties including internal medicine, family medicine,

surgery, pediatrics, neurology, and obstetrics-gynecology.[17] Later, a many-faceted Rasch measurement model was used to further analyze each item on the scale and the results of this analysis were used to create an improved communication rating scale.[18] We used the new Revised Communication and Interpersonal Skills (RUCIS) scale, a four-category behaviorally anchored rating scale (Table).

Using a mapping method, four EM academic residency faculty integrated the Milestones into this existing RUCIS scale. Already being familiar with the Interpersonal and Communication Skills and Professionalism Milestones, the faculty members were given a chance to review the RUCIS Scale (with no modification to the anchors) and the details of the six communication tasks. They were then asked to individually map each of the behaviorally-anchored ratings on the RUCIS scale to a specific Milestone and level. Then the mapping was reviewed as a group and consensus was reached through iterative discussion until consensus was reached among all faculty (Table 1). Eleven of the 13 RUCIS items were successfully mapped to specific levels of the two EM Milestones (Milestone 20 PROF1 and Milestone 22 ICS1). In the 11 items, Levels 1 through 4 of both Milestones were represented, with Milestone 20 measured five times and Milestone 22 measured six times.

In parallel to the Milestone mapping, the communication challenges were identified and developed. The six communication tasks were identified based on the previously developed patient-centered communication competency assessment implemented in the CPC in 2003. The tasks were originally identified based on the communication literature and their salience to clinical practice. As noted by the authors, "they were designed to allow residents to demonstrate their skills across a range of patient ages, genders, and problems".[9] For our Milestone assessment initiative, the tasks used were the following: giving bad news; obtaining informed consent; patient education (addressing medication non-compliance); medical error; treatment refusal; and advanced directives. The cases for each of these tasks were either adapted to the EM setting from previous cases used by other specialties or were newly created and validated by EM faculty through iterative review. Each case was designed to present a communication task with an underlying communication challenge. For example,

Table 1. Snapshot of RUCIS, a behaviorally-anchored rating scale mapped to milestones.
(For quick reference to Milestone description and anchors, please use this link: https://www.acgme.org/Portals/0/PDFs/Milestones/EmergencyMedicineMilestones.pdf).

		Milestone: level
3. Listening to my story	( ) You rarely gave me any opportunity to tell my story and/or frequently interrupted me while I was talking, not allowing me to finish what I was saying. Sometimes I felt you were not paying attention (for example, you asked for information that I already provided).	22:0
	( ) You let me tell my story without interruption, or only interrupted appropriately and respectfully. You seemed to pay attention to my story and responded to what I said appropriately.	22:1
	( ) You allowed me to tell my story without inappropriate interruption, responded appropriately to what I said, and asked thoughtful questions to encourage me to tell more of my story.	22:2
	( ) You were an exceptional listener. You encouraged me to tell my story and checked your understanding by restating important points.	22:3
4. Honest communication	( ) You did not seem truthful and frank. I felt that there might be something that you were trying to hide from me.	20:0
	( ) You did not seem to hide any critical information from me.	20:0
	( ) You explained the facts of the situation without trivializing negative information or possibilities (e.g., side effects, complications, failure rates).	20:2
	( ) You were exceptionally frank and honest. You fully explained the positive and negative aspects of my condition. You openly acknowledged your own lack of knowledge or uncertainty, and things you would have to consult with others. When appropriate, you also suggested I seek a second opinion.	20:4
	( ) Not applicable. There was no information for the clinician to provide.	N/A
5. Interest in me as a person	( ) You never showed interest in me as a person. You only focused on the disease or medical issue.	20:0
	( ) In addition to talking about my medical issue, you spent some time getting to know me as a person.	20:2
	( ) You spent some time exploring how my medical issue affects my personal or social life.	20:3
	( ) You were exceptionally interested in me as a person. You not only explored how my medical problem affects my personal and social life, but also showed your willingness to help me address those challenges.	20:4

RUCIS, Revised Communication and Interpersonal Skills scale.

the communication task in the "giving bad news" case was for the resident to appropriately deliver a death notification and the communication challenge was for the resident to address the need for an autopsy of the deceased.

Each SP encounter was 10 minutes, with the SP completing the RUCIS scale immediately following the encounter. This was followed by 10 minutes for SP-to-resident debriefing. Professional actors were trained by an EM faculty member and an experienced SP trainer on each of the six cases. During the rigorous training, the actors reviewed and practiced the standardized scripting of each case and were tested on their accuracy and standardized portrayal of the patient. The SPs completed rater training for the RUCIS scale, which entailed discussing examples of each item and score with the trainers and watching video examples. The SPs were also trained in techniques of providing feedback to the residents according to the CPC protocol. A convenience subset of encounters were observed by an EM faculty member. At each session six residents rotated through the encounters and concluded the half day with an individual survey of their experience and a group debriefing.

Piloting consisted of 18 residents representing all levels of EM residents or combined EM/Internal Medicine residents in the University of Illinois at Chicago Program (seven postgraduate year [PGY]-1 residents, six PGY-2, and five PGY-3). The six cases were new to all resident participants. Residents were assigned a simulation time slot during which they were excused from clinical duties. At the end of the academic year, the data were forwarded to the EM PD for use during the annual evaluation process for individual residents overseen by the Clinical Competency Committee (CCC) meeting. The scores were averaged across the six cases using the mapped Milestone level, and the resident's level on Milestone 20 and Milestone 22 were reported separately.

This study was included under the Clinical Performance Center Institutional Review Board (or human subjects committee) approval.

RESULTS

As this was intended as a pilot of an innovative Milestone assessment method, the sample size was small and collected data was limited. An individualized score report was provided to the CCC for each resident that included the Milestone score for each of the two Milestones. See Table 2 as an example. The score report was included for faculty to review as part of the resident's file; but as this was a pilot, it was not incorporated in any specific numerical way into the resident's overall Milestone score.

Additionally, in the individual survey 94% of residents agreed that verbal feedback from the SP was helpful and 100% of residents felt the cases allowed them to demonstrate their communication and professionalism skills. In the faculty debriefing, residents uniformly agreed the SP encounter and feedback would improve the quality of care for future patients.

Table 2. Sample resident score report.

Resident X Score Report:
(Average score across 6 cases based on Milestone levels 1-5)
Milestone 20 (Professional Values) – 2.23
Milestone 22 (Patient-centered Communication) – 2.15
CIS score: 74%

DISCUSSION

In this program, essential communication skills were assessed and EM residents received feedback from the SP as well as an EM faculty member in a simulated setting. This paper demonstrates the utilization of an established OSCE method for Milestone assessment that could provide useful, quantitative performance data to a residency CCC. Although the CCC did not use this pilot data in a structured way, there is potential for standardized incorporation of these scores in the future. Using a larger sample size, it would be important to look at the correlation of individual resident OSCE scores with other assessments in their file.[19] Other possibilities would be to correlate resident scores to level of experience and comfort. Although in this pilot variability in resident scores across experience level was noted, the sample size was too small to report any statistically significant correlation data. Also, SPs were able to offer targeted feedback to individual learners and a difficult-to-obtain patient perspective. This method of assessment is reported in the literature,[13,14] but further study is needed to assess resident communication skills Milestone improvement after SP debriefing.

In this pilot, a previously created tool was mapped to the Milestones. Since patient-centered care was the conceptual framework for the RUCIS scale and not the ACGME EM Milestones, it is necessarily limited in directly assessing ACGME EM Milestones. Further work is needed to create a new, targeted assessment tool that can be used in conjunction with the established OSCE methodology to specifically assess interpersonal communication and professional values Milestones. Using the Milestones as a conceptual framework, a behaviorally anchored tool could be created, similar to the CIS-OSCE, to assess specific behaviors as outlined by the ACGME Milestones. This type of tool could provide consistent, reliable, quantitative data to residency PDs and enhance the instruction and assessment of residents throughout their training with the ultimate goal of improving these skills in patient interactions.

LIMITATIONS

As this was a pilot study, there was an anticipated limitation in sufficient data collection to perform definitive quantitative analyses. Residents knew they were scheduled for communication OSCE encounters and may have focused on demonstrating strong communication. Thus, like many standardized assessments these can be best thought of as "maximal performance" assessments, which may not reflect

learners' typical performance or "worst-case" performance.[20] Also, as with many OSCEs, it is possible that residents who were scheduled earlier discussed some case content with later-scheduled residents although the scores of later residents did not reflect this to be the case.

Of note, when the Milestones were mapped to the RUCIS scale, level 5 of both Milestones was not represented in the current tool, although it is notable that residents are not expected to reach level 5 during residency training. This may speak to the need to develop specific assessment methods to measure higher level Milestones with OSCE assessments used for early level Milestones. In addition, the scores provided to the CCC reported a number as a continuous variable as opposed to an ordinal variable as required by the Milestone scale, which may have limited their usefulness. In the future, qualitative feedback from the PD or the CCC on the value of the mapped OSCE score could inform score report structure. This program was piloted at one institution, which would limit its generalizability. Due to these limitations, it would be worthwhile to explore creating a new assessment tool with the EM Milestones as the underlying conceptual framework.

CONCLUSION

As competency-based medical education has come to the forefront, there is a need for reliable and valid methods of assessing communication and professionalism skills. This pilot supports the potential use of an established method to conduct a more rigorous assessment of interpersonal communication skills and professional values Milestones of EM residents. Future studies may also compare SP assessment to standard simulation assessment of these skills to further expand the Milestone assessment toolbox.

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Gun Violence: A Biopsychosocial Disease

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Gun violence is a complex biopsychosocial disease and as such, requires a multidisciplinary approach to understanding and treatment. Framing gun violence as a disease places it firmly within medical and public health practice. By applying the disease model to gun violence, it is possible to explore the host, agent, and environment in which gun violence occurs, and to identify risk factors to target for prevention. This approach also provides an opportunity to address scientifically inaccurate assumptions about gun violence. In addition, there are many opportunities for medical communities to treat gun violence as a disease by considering and treating the biologic, behavioral, and social aspects of this disease. The medical community must answer recent calls to engage in gun violence prevention, and employing this model of gun violence as a biopsychosocial disease provides a framework for engagement. [West J Emerg Med. 2018;19(6)1024–1027.]

Gun violence is a pervasive public health burden in the United States. Annually, over 36,000 Americans die from firearm-related events; tens of thousands are injured.[1] The medical community has periodically called for framing gun violence as a public health/medical issue.[2-9] Given the impact of gun violence on health and longevity,[10] others have suggested that physicians have a moral obligation to address gun violence.[11,12] More recently, others have called upon physicians to integrate firearm-related education about safety with their patients.[13]

Calls for engagement have increased with multiple physician organizations calling for action.[2,14] In much the same way that human immunodeficiency virus (HIV) rates grew unchecked until we began to acknowledge that it was a biopsychosocial disease that could be prevented and controlled, and scientifically we moved past the social stigmas of a disease first recognized as largely affecting homosexual men, gun violence will continue unchecked until we invest in research to discover effective means to reduce it. To fully engage physicians and other sectors of the healthcare community, we need to frame gun violence as a biopsychosocial disease.[12] We know that gun violence follows predictable patterns just like infectious diseases and other illnesses.[15] For example, young African-American males are at increased risk of firearm-related homicide, while older White males are at increased risk for firearm-related suicide. Through an understanding of the risk factors for a disease, we can identify means of control and prevention.

The disease model approach was first advanced in the 19th century and continues today. With a science driven understanding of disease etiology, physicians and other civic leaders were positioned to discover vaccines, thus changing the environments that breed the vectors of illnesses, while identifying high-risk groups for preventative interventions– all driven by the science of discovery. We are seeing this unfold today with the Zika virus,[16] and the prevention strategies of other communicable diseases such as tuberculosis and HIV that continue to benefit from the rigorous application of the disease model. By identifying and understanding the disease agent, its vector of transmission, and the high-risk hosts and environments, all sectors of civil

society – healthcare, public health, businesses, schools, fire and police agencies– can work in concert to institute interventions that reduce morbidity and mortality. These interventions may prevent exposure to the agent that causes disease, reduce the chance of becoming ill if exposed, or limit the damage after the disease is contracted.

Scientific investigations have advanced the disease model to include other causes of cellular/organ damage from a variety of etiologic agents.[17] For decades, clinicians and public health professionals have been trained to understand the definition of disease as having four components: etiology, pathogenesis, morphologic changes, and clinical significance.[17] We have learned that the etiologic agents of diseases are categorized into biologic and physical agents that interact with cells and organs, resulting in disruptions of cell walls and the release of substances that cause additional destruction.[18] For example, with the Ebola virus disease, the pathogenesis occurs over days and can manifest up to 21 days after exposure. The virus begins to replicate and results in morphologic changes in cells/organs that manifest as a constellation of symptoms, resulting in nausea, vomiting, and diarrhea, leading to dehydration, organ failure and death.

Analogously, the kinetic energy from a bullet is the physical agent of gun violence. The kinetic energy imparted by the speeding mass of the bullet results in the tearing of cellular membranes, leading to edema, fractures, and bleeding, resulting in organ failure, shock, and death. The energy ($KE=1/2MV^2$), is transmitted to the host/patient from the bullet – penetrating the skin, entering the body, and transmitting the energy, leading to temporary and permanent cavity formation, and a sterile injury to the patient.[18,19] The pathophysiology of this disease has received limited examination because the agent (kinetic energy) causes destruction so quickly (less than 0.1 sec).[20] The high-speed video camera is the "microscope" for this rapidly occurring disease. It is through this "lens" that we can document the temporary and permanent cavity formation that is the hallmark of the biology of this disease.[19-21] This dramatically brief pathophysiology limits acute interventions during the release of kinetic energy and is distinctive since diseases from other agents, such as viruses and bacteria, clinically develop over days or weeks.

By framing gun violence as a biopsychosocial disease,[22] it engages the healthcare community of physicians and nurses, complements the necessary multidisciplinary approach to advance our scientific understanding, and informs host, agent/vector, and environmentally-focused interventions beyond the immediate biology of fractures, bleeding, and edema. This is critically important since preventing and controlling gun violence will not occur to any significant degree until we begin to approach it in a manner similar to controlling other biopsychosocial diseases such as HIV. One immediate benefit of framing gun violence as a disease is the opportunity to address misleading/limiting statements as scientifically inaccurate, yet repeated over and over again. One of the most common of these is: "Guns don't kill people, people kill people."

The disease model provides us with accuracy: the bullet and its kinetic energy shreds, tears and destroys cells, and damages organs, leading to death and disability. While the behavioral health issues that result in a person pulling a trigger and releasing the energy need to be better understood, first and foremost we need scientifically accurate statements that advance the necessary, challenging discussions. By recognizing that bullets kill people, the gun, which carries the bullets, becomes a necessary focus of intervention. One such strategy would be to limit the rate of the release of bullets by, for example, banning bump stocks or automatic weapons, or by reducing the amount of potential energy the gun can carry (magazine capacity). Without this framing we will be limited to education of our patients[13] or continue to be stuck, mired in debates that do not advance scientific understanding, but only entrench positions. We limit progress related to gun violence by not addressing the environment and the social context and psychological antecedents and outcomes of this disease that affect patients, families and communities.[23,24]

In addition to the injury caused by a bullet, the body's own biologic stress response is activated and involves a cascade of bodily systems, including stress hormones. While this biological response is adaptive, sustained activation of the acute stress response degrades healthy adaptation following a life-threatening situation. This is even further exacerbated when an individual experiences psychological stress after trauma, particularly post-traumatic stress disorder (PTSD). The social context of gunshot-wound patients is paramount, including the community/neighborhood the survivor is coming from, the location of the wounding event, and the environment to which they have no choice but to return. Unfortunately, issues such as familial retaliation and the maintenance of perceived strength within communities with high levels of violence can perpetuate the cycle of gun violence, "spreading" the risk of the disease. Social, environmental, physical, and psychological pre-, peri-, and post-injury factors influence the course of gun violence as a disease and therefore should be treated from this biopsychosocial perspective.

There are many opportunities for medical communities to treat gun violence as a biopsychosocial disease. Increasingly, trauma centers[25] are recruiting clinical psychologists to provide behavioral health interventions that complement the surgical team's emphasis on the biology. While the integration of behavioral health specialists is occurring within centers where the disease is most likely to be treated, the majority of centers are not yet advancing care with this integrated approach. Behavioral/social interventions include hospital-based, violence-prevention programs, where the focus is to

address the social and behavioral issues of gun violence and to prevent recidivism. In some instances, primary care physicians are[26] trained in assessing exposure to trauma to understand the social context of the patient's health. They can provide recommendations for psychological care if distress is evident. While these examples exist within healthcare, unfortunately they are not the norm. To move disease prevention forward, significant development of integrated multidisciplinary programs is needed. Additionally, more research is needed in the inpatient setting of trauma centers to better understand the psychosocial elements of this disease to maximize outcomes and reduce recidivism.

The importance of this framing distinction can be more easily seen when we consider prior and ongoing work to reduce the burden of acute injury from car crashes. We have achieved considerable success in the application of the disease model, which has resulted in significant reductions in death and disability over the past 50 years.

Evidence-based policies such as seatbelt laws and significantly improved car and road designs that attenuate and control the energy exchange with passengers and drivers – all components of the disease model – have been systematically investigated and advanced.[29]

In the first 10 years of the 21st century there were substantial declines in morbidity and mortality from other public health burdens such as vaccine-preventable diseases, childhood lead poisoning, cardiovascular disease, workplace-associated injuries, and cancer, while improvements were made in areas such as maternal and fetal health.[27] However, similar improvements have not been made in firearm deaths during this time; in fact, deaths from firearms continue to rise. This may be attributed, at least in part, to the relative paucity of funding for firearm-violence research, due in part to the 1996 Dickey amendment, which states that, "None of the funds made available for injury prevention and control at the Centers for Disease Control and Prevention may be used to advocate or promote gun control."[28]

As a society, we have achieved success in controlling infectious diseases with a focused, disease-model approach, and we have successfully expanded the use of the disease model to prevent and control non-communicable diseases such as cancer and heart disease. We have used this approach for other challenging biopsychosocial disease burdens such as smoking and alcohol abuse.[30] Further, it was only once we blunted the political stigma stunting our progress in combating HIV that the most significant discoveries took place and lives were saved. Yet we have not taken the next step in using the disease model to prevent and control gun violence, in part due to the relative lack of funding, and therefore the relative lack of investigation. Framing gun violence as a disease places it firmly within medical and public health practice. Interventions across multiple sectors, informed by comprehensive, linked data and rigorous, adequately-funded research, can be used to prevent injuries, improve acute care and rehabilitation, and inform and evaluate program and policy interventions. These can ultimately reduce morbidity and mortality.

This framing opens up important areas of research and prevention strategies that can and must be organized to address all aspects of the disease: high-risk youth; adults and elderly; the gun and the bullets; and the environment.[30] Specific examination of the gun and its design/safety characteristics open up areas of potential interventions. Much like reducing a child's access to the energy contained in a medicine container resulted in decreases in unintentional chemical injury from aspirin and Tylenol,[31] banning bump stocks would reduce the rate of energy release that was so tragically seen in the Las Vegas shooting of October 2017. Designing a "smart" gun, which leverages new technologies to identify a gun's owner and prevent its use by others, could also have the potential to reduce the number of accidental (unintentional) deaths and suicides.[33, 34] In this environment, requiring background checks on all gun sales has the potential to further reduce unauthorized access.[35]

Recent calls to engage the physician and public health communities in addressing gun violence[6,11,36] must be answered by the medical community. Kaiser Permanente, one of largest health systems in the U.S., has recently approved a $2 million expenditure to study gun violence prevention.[37] By framing gun violence as a biopsychosocial disease we can move beyond acrimony and fear, use the tools that have been honed over centuries to advance science, and prevent and control this disease burden that adversely impacts our patients, families, and communities across the U.S. and the world.

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Analgesic Administration for Patients with Renal Colic in the Emergency Department Before and After Implementation of an Opioid Reduction Initiative

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Introduction: We aimed to evaluate the patterns of analgesic prescribing for emergency department (ED) patients suffering from pain of renal colic before, during, and after implementation of an opioid reduction initiative. We hypothesized that this initiative based on the concept of channels/enzymes/receptors-targeted analgesia would result in overall decrease in opioid utilization in the ED and at discharge.

Methods: We performed a retrospective analysis of ED electronic medical record of patients presenting with renal colic who received analgesics in the ED and at discharge over a five-year period. Patients were divided into three groups based on the following periods: 2012-2014 (pre-implementation phase); 2014-2015 (implementation phase); and 2015-2017 (post-implementation).

Results: A total of 4,490 patients presented to the ED with renal colic over a five-year study period. Analgesics were administered to 3,793 ED patients of whom 1,704 received opioids and 2,675 received non-opioid analgesics. A total of 3,533 ED patients received a prescription for analgesic(s) upon discharge from the ED: 2,692 patients received opioids, and 2,228 received non-opioids. We observed a 12.7% overall decrease from the pre-implementation to post-implementation time period in opioid prescribing in the ED and a 25.5% decrease in opioid prescribing at discharge, which translated into 432 and 768 fewer patients receiving opioids, respectively.

Conclusion: Implementation of an opioid-reduction initiative based on patient-specific, pain syndrome-targeted opioid alternative protocols resulted in a reduction in opioid administration in the ED by 12.7% and at prescriptions at discharge by 25.5%. Adoption of similar ED initiatives nationwide has the potential to foster effective non-opioid analgesic practices for ED patients presenting with renal colic and to reduce physicians' reliance on administering and prescribing opioids. [West J Emerg Med. 2018;19(6)1028–1035.]

INTRODUCTION

The United States (U.S.) is in the midst of an opioid epidemic related to prescription opioids that has affected the lives of hundreds of thousands of people and their families. The uncontrolled prescribing of opioid analgesics in the 1990s resulted in collateral damage in the form of abuse, diversion, misuse, and development of opioid use disorder.[1-5] Between 1999 and 2010, the rate of opioid prescribing increased by

700%.[1,2] In 2012 alone, healthcare providers wrote 259 million opioid prescriptions, an amount sufficient to supply every American adult with a bottle of opioid pills.[3-5] In 2014, 10.3 million persons reported using prescription opioids non-medically.[2-3] More importantly, this massive escalation of prescription opioid use led to a 200% increase in mortality related to unintentional opioid overdose between 2000 and 2014.[6-13] In fact, between 2013 and 2014 alone, opioid-related deaths in the U.S. increased 14%, from 7.9 to 9.0 per 100,000 population.[6, 7] More recently, about 66% of approximately 64,000 drug overdose deaths in 2016 involved an opioid, which translates to an average of 115 Americans dying every day from an opioid overdose.[8]

This alarming rise in the rates of opioid abuse and death also reflects parallel increases in the rates of addiction and death resulting from the substitution of heroin for prescription opioids.[5,14] Hospitalizations related to opioid misuse and dependence have also increased dramatically, with the rate of adult hospital-inpatient stays per 100,000 population nearly doubling between 2000 and 2012.[9,13,15] This public health crisis calls for immediate interventions on behalf of all healthcare providers to identify safe and effective ways to control pain. One such intervention is implementation of opioid-reduction protocols that emphasize use of non-opioid analgesic modalities.

Despite both increases in emergency department (ED) visits and rising rates of opioid prescribing[16-18] emergency physicians contributed less than 5% of total opioid prescriptions nationally (12.5 million prescriptions in 2012). In addition, emergency medicine (EM) as a specialty demonstrated the largest decrease in opioid prescribing rates (8.7% from 2007 to 2012) of all the medical specialties.[19,20] However, even a short course of an opioid analgesic after discharge from the ED can lead to long-term (after one year) opioid use in up to 13% of opioid-naive patients.[21,22] Similarly, prescriptions for opioid analgesics at discharge from the ED by "high-intensity prescribers" further augment this risk.[21-23] It is prudent for physicians to consider non-opioid analgesic modalities in the ED and at discharge and resort to opioids only when the benefits of short-term therapies outweigh the risks of opioid-related adverse effects and /or non-opioid therapies fail to provide acceptable analgesia.

We aimed to evaluate the patterns of analgesic prescribing for ED patients suffering from pain of renal colic before and after implementation of an opioid-reduction initiative. We hypothesized that implementation of such initiatives that promulgate a patient-specific, pain syndrome-targeted approach for non-opioid analgesic modalities would result in overall decrease in opioid utilization for these patients in the ED and at discharge.

Population Health Research Capsule

What do we already know about this issue?
Targeted emergency department (ED) clinician and patient education on minimizing opioid use in favor of non-opioid analgesics is associated with significant reduction in total opioid prescriptions.

What was the research question?
Would there be a change in the patterns of analgesic prescribing for ED patients with renal colic before and after an opioid reduction initiative?

What was the major finding of the study?
An opioid reduction initiative resulted in a reduction in opioid administration in the ED by 12.7% and at discharge by 25.5%.

How does this improve population health?
Similar initiatives in EDs across the United States might reduce opioid administration for ED patients with renal colic and decrease opioid prescribing at discharge.

METHODS

Study Design and Setting

We performed a five-year retrospective analysis of all ED patients presenting with renal colic and receiving analgesics in the ED and at discharge by using the ED electronic medical record (EMR) (Allscripts™). We based the design and implementation of an opioid reduction initiative in our ED on the concept of channels/enzymes/receptors-targeted analgesia (CERTA) that focuses on patient-specific, pain syndrome-targeted pain control for a variety of acute and chronic painful conditions in the ED (Appendix 1).[24,25] The CERTA approach promotes combinations of non-opioid analgesics as first-line treatment modalities when feasible and employs opioids judiciously and predominantly as a rescue. A pilot study of non-opioid analgesic administration conducted in our ED prior to implementation of the opioid reduction initiative demonstrated good pain relief and great patient satisfaction.[25] Subsequently to this pilot, the ED launched an educational initiative of roughly 12 sessions (30 hours) for physicians and nurses prior to full implementation of the opioid reduction protocols (Appendix 1 and 2).

Patients enrolled in the study were divided into three periods (phases) based on the inception and implementation of an opioid reduction initiative: 2012-2014 (pre-implementation phase); 2014-2015 (implementation phase); and 2015-2017 (post-implementation). The data obtained included

the following: age; gender; chief complaints of abdominal and flank pain; final diagnoses of renal colic, kidney stone, nephrolithiasis, urinary calculus, and calculus in the kidney; and analgesics administered in the ED (primary and rescue) and at discharge with name, dose, route and frequency of administration. Two non-blinded abstractors (AT and MB) independently reviewed patients' EMRs and retrieved data on pain scores, analgesics administered (primary and rescue) with their respected dosing, route, and frequency of administration in the ED and at discharge. We entered the data into a Microsoft Excel data abstraction spreadsheet.

The Excel data abstraction spreadsheet created by the principal investigator (PI) has been used for previously conducted, similar research projects. The PI (SM) holds an MD degree and is an expert in the field of EM and data abstraction via EMR. The PI trained all three abstractors on data gathering and entry specific for this study. One of the study investigators (JD) had over five years of experience in abstracting and recording data from ED EMR. JD and SM oversaw all the data abstraction. JD abstracted all the data independently of two primary abstractors (AT and MB) and, in case of discrepancy between two primary abstractors, JD re-reviewed the charts along with SM and reconciled all discrepancies. We conducted this study at a 711-bed urban, community teaching hospital with an annual ED patient census of greater than 120,000 visits. The study was approved by the hospital's institutional review board.

Selection of Participants

Patients considered for inclusion were adults aged 18 and older who presented to the ED with a chief complaint of abdominal and flank pain and final diagnoses of renal colic, kidney stone, nephrolithiasis, urinary calculus, and calculus in the kidney.

Statistical Methods, Data Analysis, Outcome Measures

We imported the Excel data set into the Statistical Analysis System (SAS). We divided time into three phases: pre-implementation phase (September 9, 2012—August 31, 2014), implementation phase (September 1, 2014—August 31, 2015) and post-implementation phase (September 1, 2015—December 30, 2017). We divided analgesics administered to the patients into opioids (morphine, hydromorphone, hydrocodone, hydrocodone/acetaminophen, fentanyl, methadone, oxycodone, oxycodone/acetaminophen, tramadol, meperidine) and non-opioids (acetaminophen, gabapentin, ibuprofen, ketamine, ketorolac, lidocaine, naproxen, ibuprofen). In addition, we distinguished three ordering contexts: 1) orders for discharge medication; 2) orders for medication to be administered within the ED; and 3) orders for rescue medication. In each context, we described each patient as a) taking both opioids and non-opioids, b) taking only opioids, c) taking only non-opioids, or d) taking neither.

We calculated descriptive statistics for the age and sex of ED patients. We did logistic regression analysis of the probability of prescription of the different type of drug based on patient age, sex and time periods, separately for each context. Additionally, we described which particular medications from the above list were never given in each context and tabularized time periods and class of medication used.

RESULTS

Sample Description

A total of 4,490 patients were enrolled in the study over the five–year period, of which 3,793 received analgesics in the ED (1,746 patients in pre-implementation phase, 823 patients during an implementation phase, and 1,224 patients in post-implementation phase). At discharge, 3,533 patients received prescriptions for pain medications (1,716 patients in pre-implementation phase, 804 during an implementation phase, and 1,013 patients in post-implementation phase). Patient demographic data are presented in Table 1.

We observed a meaningful decline in the percentage of patients receiving opioid medications in the ED between pre-implementation and implementation phases (2.71%) and pre-implementation and post-implementations phases (12.73%, 95% confidence interval [CI] [9.56-15.91]; p<0.0001). Similarly, we noted a reduction in opioid administration as primary analgesics between pre-implementation and implementation phases (2.3%) and pre-implementation and post-implementations phases (7.14% 95% CI [1.05-6.46]; p=0.16) (Figure 1).

Furthermore, we saw a significant decrease in opioid administration as rescue analgesics (12.5% 95% CI [9.45-15.05]) between pre- and post-implementation phases. At discharge, we observed a significant decrease in total prescriptions of opioid analgesics (25.49% difference, 95% CI [22.26-28.72]; p<0.0001) and only opioid prescriptions (23.2% difference) between pre-implementation and post-implementation phases (Figure 2).

In addition, we noted an increase in percentage of patients receiving non-opioid analgesics in the ED between pre- and post-implementation phases (4.9% difference) and at discharge (8.75% difference). Similarly, we found a significant increase in non-opioid analgesia at discharge as a sole pain medication from pre-implementation phase to post-implementation phase (11.03% difference) (Figure 3). Data on utilization of specific analgesics

Table 1. Demographics of patients enrolled in study of patients receiving opioid medications for renal colic.

Demographics	Pre-intervention	Intervention	Post-intervention
Mean patient age (SD)	45.8 (14.9)	45.7 (14.6)	49.4 (15.7) P<0.0001
Sex (female)	32.14%	32.41%	32.43% P=0.97

SD, standard deviation.

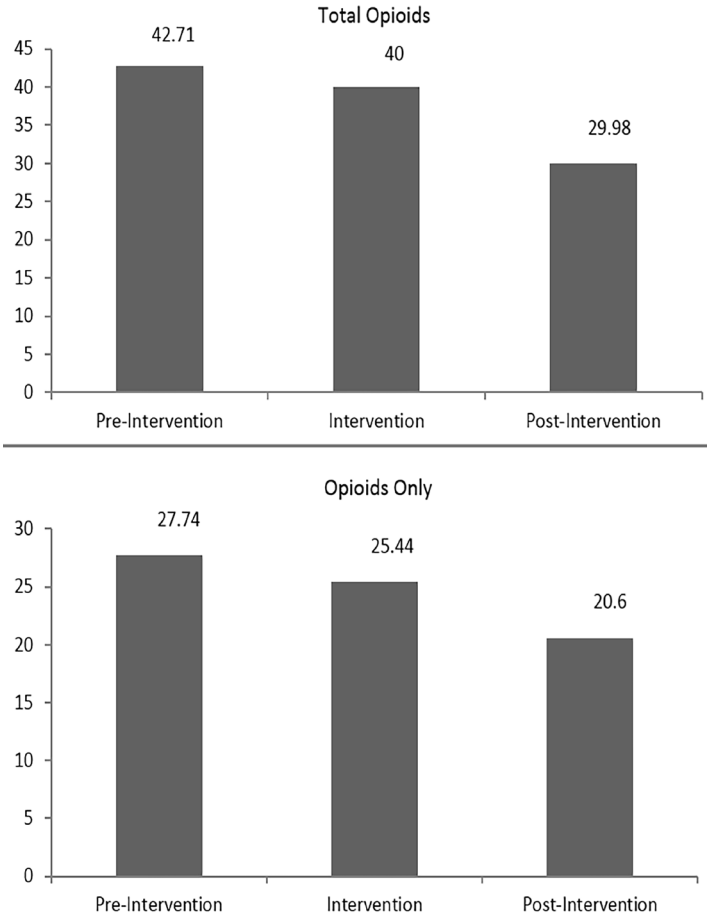

Figure 1. Percentages of opioid analgesic administration in the emergency department.

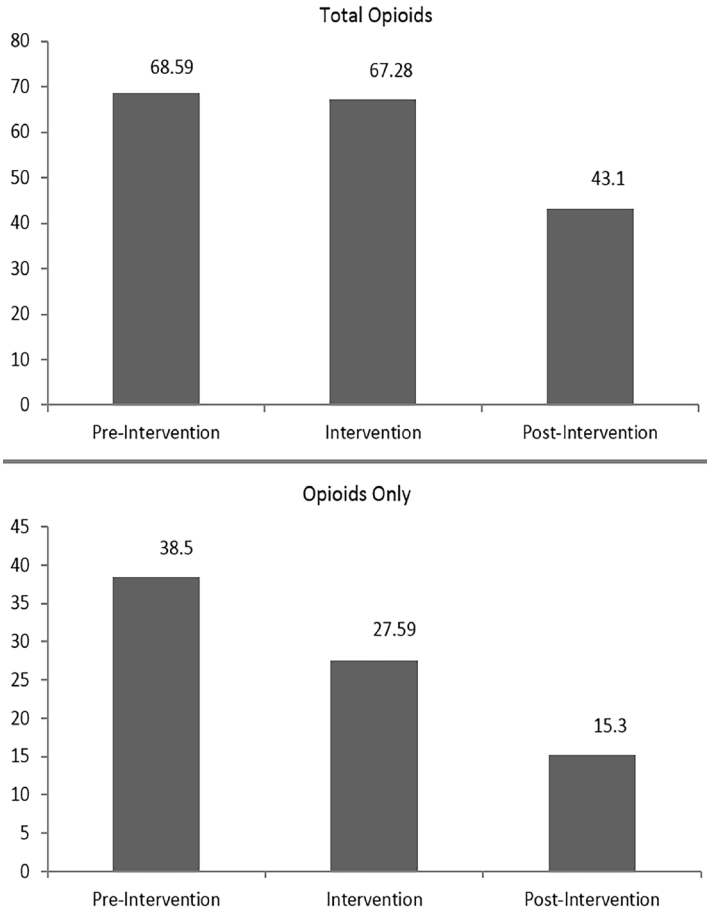

Figure 2. Percentages of opioid analgesic prescribed at discharge.

(opioids and non-opioids) are presented in Tables 2 and 3.

We observed the largest decrease in administration of parenteral morphine (11.23%) (95% CI [8.1-14.36]; p<0.0001), hydromorphone (0.76%) (95% CI [0.35-1.18]; p=0.0003), and oral oxycodone/acetaminophen (1.29%) (95% CI [0.05-1.7]; p=0.038) between pre- and post-implementation phases. At discharge, we observed the largest decrease in oxycodone/acetaminophen administration (24.69%) (95% CI [21.45-27.94]; p<0.0001) and hydrocodone/acetaminophen between pre and post-implementation phases (5.95% 95% CI [4.69-7.21]; p<0.0001). At the same time we noted an increase in prescribing of morphine sulfate immediate- release tablets at discharge (5.25%) (95% CI [4.1-6.4]; p<0.0001) between pre- and post-implementation phases. We saw an increase in parenteral lidocaine use (0.75%) (95% CI [0.31-1.19]; p=0.0009) as well as an increase in oral acetaminophen (3.23%) (95% CI [2.09-4.36]; p<0.0001) and ibuprofen (1.55%) (95% CI [0.59-2.5]; p=0.0015) in the ED; and acetaminophen (3.21%) (95% CI [2.3-4.13]; p<0.0001) and naproxen (1.1%) (95% CI [0.04-2.17]; p=0.043) at discharge. Lastly, we noted a significant decrease in parenteral morphine (7.84%) (95% CI [5.23-10.44]; p<0.0001) and hydromorphone (0.98%) (95% CI [0.4-1.56]); p=0.0009) rescue administration but an increase in fentanyl rescue (0.51%) (95% CI [0.09-0.93]; p=0.0167) between pre-and post-implementation phases.

DISCUSSION

We implemented a longitudinal educational program in our ED beginning in 2014 that focused on non-opioid analgesic modalities based on the CERTA approach. This program included a complaint-based, non-opioid medication selection tool (Appendix 1) made available to physicians at the point of patient's care. We posited that implementing guidelines that promote non-opioid analgesics as a first-line, pain management strategy whenever practicable and appropriate would result in a reduction of opioid prescription in and from the ED.

The results of our study demonstrated that implementation of an opioid reduction protocol in our ED for patients presenting with renal colic decreased the rates of both parenteral and enteral (oral) opioid administration in the ED and at discharge by 12.8%

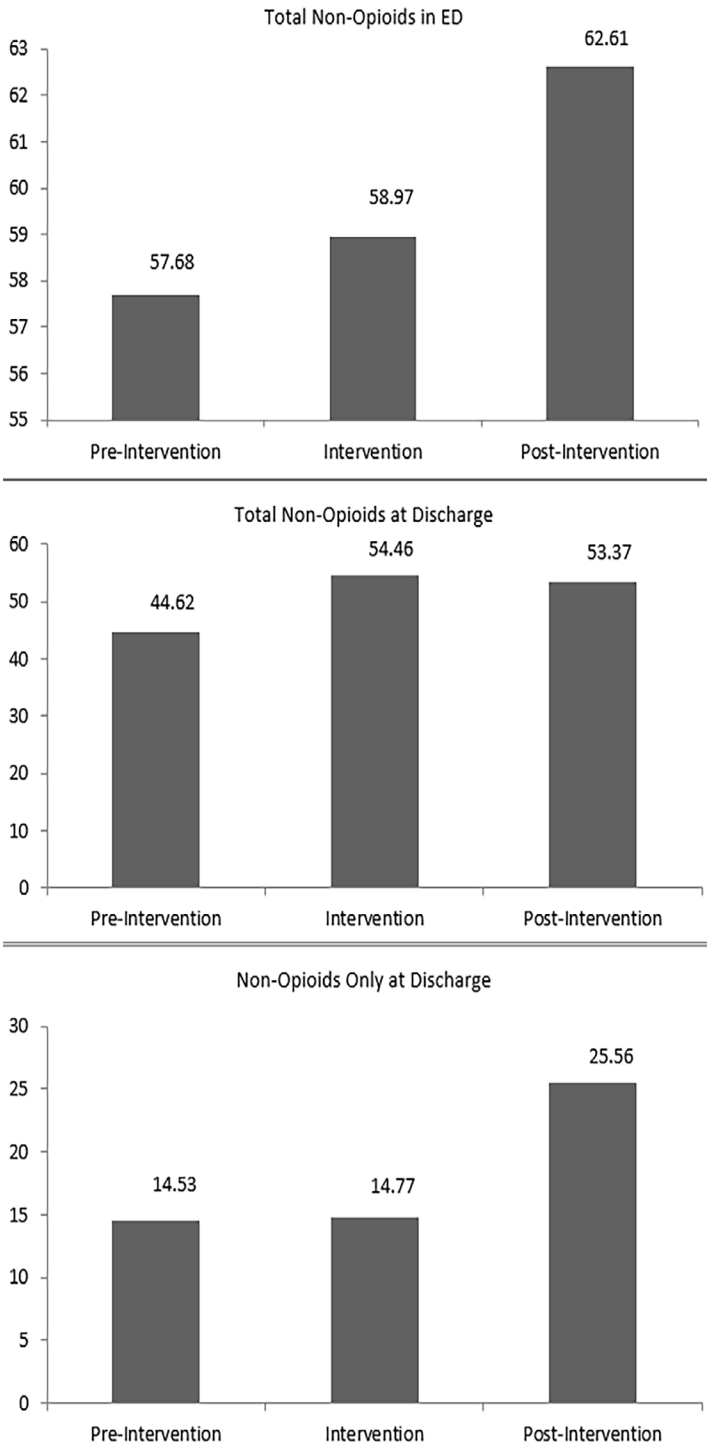

Figure 3. Percentages of non-opioid analgesic administered in the ED and at discharge.
ED, emergency department.

and 25.5% respectively. Consequently to opioid decrease, we observed an increase in non-opioid analgesic utilization by 4.9% in the ED and by 8.75 % at discharge. Perhaps more importantly, two highly addictive opioid analgesics, hydromorphone and oxycodone/acetaminophen combinations (Percocet), had the largest decline in prescribing in the ED and at discharge: 76% decrease in the ED for hydromorphone, and 91% decrease in the ED and 25% at discharge for oxycodone/acetaminophen. Similarly, we observed a decrease in prescribing of opioids as rescue analgesics between pre- and post-implementation phases: 7.8% decrease for morphine, and 98% for hydromorphone.

Of note, we saw a 525% increase in prescribing of morphine sulfate immediate release (MSIR) between pre- and post-implementation phases with a 595% simultaneous decrease in prescribing of hydrocodone/ acetaminophen combination. The increase in utilization of MSIR and simultaneous decrease in oxycodone/acetaminophen and hydrocodone/acetaminophen prescribing were largely attributed to departmental safe and judicious opioid prescribing practices geared towards administration of less euphoric opioids in the ED and at discharge.[26,27]

In parallel to reduction in opioid prescribing in the ED and at discharge, we observed a significant increase in administration of parenteral lidocaine by 100% during an implementation phase and by 75% in post-implementation phase. We attribute this increase to the departmental implementation of CERTA concept with specific emphasis on intravenous (IV) lidocaine as a viable alternative to opioids in patients with renal colic.[28,29] Additionally, we saw an increase by 384% of oral acetaminophen administration in the ED and by 321% at discharge, as well as 110% increase in naproxen administration at discharge. It is important to emphasize that the results of our study with overall decrease in ED opioid prescribing were not related to opioid shortages during the study periods.

The two biggest challenges faced by authors during the implementation phase of the opioid reduction initiative included lack of familiarity with some of the non-opioid analgesics in the ED (IV lidocaine, sub-dissociative dose ketamine) among physicians and nurses, as well as reluctance to change established practices of pain management among several faculty physicians. Thus, to get a full departmental buy-in of physicians and nurses, a significant amount of time was devoted to the educational piece (opioid and non-opioid analgesics, regulatory and administrative concerns) and to development of non-opioid analgesic protocols focusing primarily on analgesic safety. We believe that addressing these challenges and subsequently getting the full support of the physicians and nurses were the keys to our success in establishing the opioid reduction initiative in our ED and, taken further, might serve as a model for other EDs across the country.

We believe that the concept of patient-specific, pain syndrome-targeted (e.g., renal colic) analgesic therapy can be applied by clinicians to reduce opioid use in EDs across the country. This concept enhances the analgesic armamentarium of emergency physicians and allows broader utilization of non-opioid analgesics. We developed and implemented an opioid reduction initiative that focused on this concept and

Table 2. Percentages of patients receiving individual opioid analgesics.

Analgesics	Pre-intervention	Intervention	Post-intervention
In emergency department			
Morphine sulfate	39.58	36.62	28.35
Hydromorphone	0.83	0.72	0.07
Meperidine	0.05	0	0
Fentanyl	0.05	0	0.27
Oxycodone/acetaminophen	2.2	2.67	1.29
Codeine/acetaminophen	0.15	0	0
At discharge			
Morphine sulfate immediate release	0.05	0.2	5.3
Hydromorphone	0.1	0.1	0
Meperidine	0.05	0	0
Hydrocodone/acetaminophen	7.24	1.44	1.29
Oxycodone	0.2	0.1	0.2
Oxycodone/acetaminophen	61.2	65.74	36.51
Codeine/acetaminophen	1.17	1.23	1.29
Rescue			
Morphine sulfate	23.34	19.79	15.5
Hydromorphone	1.32	2.46	0.34
Meperidine	0.05	0	0
Fentanyl	0.1	0.41	0.61
Oxycodone/acetaminophen	5.77	3.79	1.63
Codeine/acetaminophen	0.1	0	0.07

Table 3. Percentages of patients receiving individual non-opioid analgesics.

Analgesics	Pre-intervention	Intervention	Post-intervention
In emergency department			
Ketorolac	55.28	56.51	56.15
Ketamine	0.05	0	0.07
Acetaminophen	1.13	1.33	4.35
Ibuprofen	1.17	0.72	2.72
Lidocaine	0	1.13	0.75
At discharge			
Gabapentin	0	0	0.07
Ketorolac	7	1.33	5.91
Acetaminophen	0.05	0.1	3.26
Ibuprofen	34.74	51.69	42.49
Lidocaine patch	0	0	0.27
Naproxen	1.96	0.51	3.06
Rescue			
Ketorolac	14.33	12.82	10.4
Ketamine	0	0	0.14
Acetaminophen	0.24	0.21	8.33
Ibuprofen	0.59	0.62	0.54

employed continuous, longitudinal education on strategies to reduce opioid prescribing, promote safe opioid prescribing practices, and encouraged the involvement of patients in shared decision-making about analgesic choices in the ED. Our future research projects are geared toward expanding the role of non-opioid analgesics beyond the ED by creating interdepartmental collaborations and educational initiatives.

LIMITATIONS

Our study was limited by its retrospective design. Data regarding prescribing information when extracted from EMRs may not always be accurate. In addition, we could not assess or display any data with respect to analgesic efficacy of monotherapy or combinations of analgesics that were used to treat renal colic in the ED. Similarly, we could not evaluate the safety of single agents and their combinations with respect to side effects. Lack of a control group severely limited our ability to conclude that the results of this retrospective project were solely attributable to the opioid reduction initiative and not to other factors operating during the same time period. Lastly, lack of blinding among the abstractors (who were in fact authors) to the study hypothesis may have introduced potential, unintentional bias. Additionally, our study was a single-site study, which may not be generalizable to other EDs.

CONCLUSION

The opioid reduction initiative resulted in a 12.8% reduction in opioid administration in the ED and 25.5% reduction in opioid prescriptions at discharge over the five-year period. Adoption of similar initiatives in EDs throughout the country has the potential to reduce opioid administration to ED patients who present with renal colic and to impact the opioid epidemic by reducing opioid prescriptions, which are known to lead to recurrent opioid use and abuse.

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The Emergency Department as an Opportunity for Naloxone Distribution

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Introduction: Substance use disorders, including opioid use disorders, are a major public health concern in the United States. Between 2005 and 2014, the rate of opioid-related emergency department (ED) visits nearly doubled, from 89.1 per 100,000 persons in 2005 to 177.7 per 100,000 persons in 2014. Thus, the ED presents a distinctive opportunity for harm-reduction strategies such as distribution of naloxone to patients who are at risk for an opioid overdose.

Methods: We conducted a systematic review of all existing literature related to naloxone distribution from the ED. We included only those articles published in peer-reviewed journals that described results relating to naloxone distribution from the ED.

Results: Of the 2,286 articles we identified from the search, five met the inclusion criteria and had direct relevance to naloxone distribution from the ED setting. Across the studies, we found variation in the methods of implementation and evaluation of take-home naloxone programs in the ED. In the three studies that attempted patient follow-up, success was low, limiting the evidence for the programs' effectiveness. Overall, in the included studies there is evidence that distributing take-home naloxone from the ED has the potential for harm reduction; however, the uptake of the practice remained low. Barriers to implementation included time allocated for training hospital staff and the burden on workflow.

Conclusion: This systematic review of the best evidence available supports the ED as a potential setting for naloxone distribution for overdose reversal in the community. The variability of the implementation methods across the studies highlights the need for future research to determine the most effective practices. [West J Emerg Med. 2018;19(6)1036–1042.]

INTRODUCTION

In April 2018, the United States (U.S.) Office of the Surgeon General released a public health advisory urging communities to improve access to naloxone for those who are at risk for opioid overdose.[1] This recommendation is shared in the 2017 President's Commission on Combating Drug Addiction and the Opioid Crisis, and the World Health Organization's guidelines that recommend increased access to naloxone.[2,3]

These recommendations are supported by previous research, which demonstrated that community-based, take-home naloxone distribution is associated with reduced opioid-overdose death rates and is cost effective.[4–6] A national survey of community-based naloxone distribution programs found that from 1996 to 2014 152,284 individuals received naloxone from a community-based program, which resulted in the successful reversal of 26,463 overdoses.[4] Despite the high number of reversals, take-home naloxone programs are only present in 8% of U.S. counties overall and 12% of counties with the highest opioid-overdose rate.[7] To improve access to take-home naloxone, community distribution programs have expanded to include substance use treatment facilities, primary care clinics, and pharmacies.[4] The emergency department (ED) presents another opportunity to further expand access to take-home naloxone.

Over the last decade, the number of opioid-related ED visits has dramatically increased. From 2005 to 2014, these visits nearly doubled from 89.1 to 177.7 per 100,000 people, and more recent Centers for Disease Control and Prevention (CDC) estimates indicate an even sharper increase has occurred since 2015.[8,9] This rise in ED visits positions the ED as a powerful venue for identification of patients with substance use disorder (SUD) needs that,if unmet will result in higher hospital and ED admissions and healthcare costs.[10] This large pool of patients also provides an opportunity for healthcare workers to engage patients with opioid use disorder (OUD) and provide evidence-based interventions such as take-home naloxone.

Naloxone, a U.S. Food and Drug Administration-approved opioid overdose antidote, is a proven viable, safe, and effective intervention that can reduce opioid-overdose deaths in the community setting and be effectively administered by lay people. It has decreased ED visits when co-prescribed with opioid medications.[1,5,11,12] Pulmonary edema has been reported following the administration of naloxone; however, the best evidence has indicated these cases are multi-factorial and that naloxone is recommended in the case of opioid overdose.[13,14]

Previous research has demonstrated that an OUD intervention in the ED can reduce overdose risk and that ED providers are willing to prescribe take-home naloxone; however, they have low confidence in doing so.[15,16] Further, the majority of patients at risk for opioid overdose in the ED are willing to accept a take-home naloxone kit and believe that the ED is an appropriate venue.[17] Healthcare workers in the ED who want to implement a take-home naloxone program must be able to refer to the literature to understand the available evidence. The purpose of this systematic review was to identify, evaluate, and summarize available evidence regarding the distribution of take-home naloxone in the ED and identify the areas that require future research.

METHODS

This review adheres to the Preferred Reporting Items for Systemic Reviews and Meta-analyses (PRISMA) guidelines.[18] We did not conduct a meta-analysis due to the heterogeneity of study interventions, assessments, and analysis of collected data. Extracting and grading the evidence was not possible due to the variation in outcome measures and design across included studies.

Literature Search

One author (MM) performed comprehensive searches in Ovid MEDLINE, Ovid MEDLINE In-Process & Other Non-Indexed Citations, Ovid MEDLINE Epub Ahead of Print, Embase.com, Cochrane Central Register of Controlled Trials, and CINAHL via the EBSCOhost research platform. The searches were initially run in June 2017 and rerun for the final time in April 2018. Each search consisted of a combination of ED and naloxone terminology, with appropriate, controlled vocabulary and title and abstract keyword variations. The searches yielded 2,286 citations after duplicates were removed in Endnote X6 (Clarivate Analytics). We excluded conference abstracts and conference papers from the Embase search. The searches were otherwise free of restrictions. The Ovid MEDLINE search is included in Table 1 and all complete, reproducible searches are available in a data repository at doi:10.7302/Z2WD3XSM.

Eligibility Screening

Two authors (AG and ZS) independently reviewed the titles and abstracts of all retrieved and included articles that described naloxone distribution from the ED. A third author (AM) resolved any disagreements to remove selection and scoring bias. All included papers were reviewed for any additional articles not identified in the literature database search.

The inclusion criteria required that articles do the following: (1) Be or include original research with outcomes; (2) describe a naloxone distribution from the ED; and (3) create an intervention targeted to individuals with OUD, SUD, or current opioid use. We excluded conference proceedings, thesis papers, white papers, policy recommendations, and abstracts. Although the literature search was not limited to English-only articles, all records identified through database searches were published in

Table 1. Literature search strategies regarding naloxone access for the three Ovid MEDLINE databases.

Search #	Search statement
1	exp naloxone/ or (antioplaz or curamed or maloxone or mapin or nalone* or naloxon* or narcan or narcanti or narcon or ratiopharm or zynox).tw. or (opioid* or opiate*).ti.
2	exp emergency medical services/ or exp emergency treatment/ or emergenc*.ti. or (emergenc* adj2 (depart* or room* or service* or unit* or ward or wards)).tw.
3	and/1-2

English. Of the records screened, the most common reasons for exclusion were not describing naloxone distribution initiatives, not describing distribution from the ED specifically, and inappropriate publication types such as dissertations or poster abstracts. Five articles met all of the inclusion criteria as shown in the PRISMA flow diagram in Figure.

RESULTS

Five articles out of the 2,286 we identified met the inclusion criteria and had direct relevance to the naloxone distribution from the ED setting. The included articles varied in study design from randomized clinical trial (1) to prospective cohort studies (2), retrospective qualitative analysis (1), and descriptive study (1).

Across the studies, there is variation in the methods of implementation and evaluation of ED take-home naloxone programs. These methods of implementation included grant-funded counselors available to perform the intervention, medical student volunteers to screen patients in the ED, electronic health record (EHR) alerts that notified providers of eligible patients, and a physician's assistant (PA) with training in addiction medicine. The methods of evaluation included two studies that examined the rate of prescribing take-home naloxone, two that followed up with patients to determine effectiveness of the intervention, and one that examined the amount of time between the intervention and the next EHR-recorded opioid overdose.

In the three studies that attempted patient follow-up, the rate of successful follow-up was low, which limits the evidence for effectiveness. Authors attributed the poor follow-up to social and economic factors of the patient population, including that a majority of enrolled patients were homeless or living in impermanent housing. In the included studies, there is evidence that distributing take-home naloxone from the ED has the potential of harm reduction; however, the uptake of the practice remained low. Barriers to implementation included time allocated for training hospital staff and the burden that distribution and counseling place on ED workflow.

Banta-Green et al.[19]

This randomized clinical trial identified 241 adults at risk for opioid overdose in two hospital EDs and placed participants to either overdose education with a brief behavioral intervention and take-home naloxone, or usual care. Participants were identified through EHR review or staff

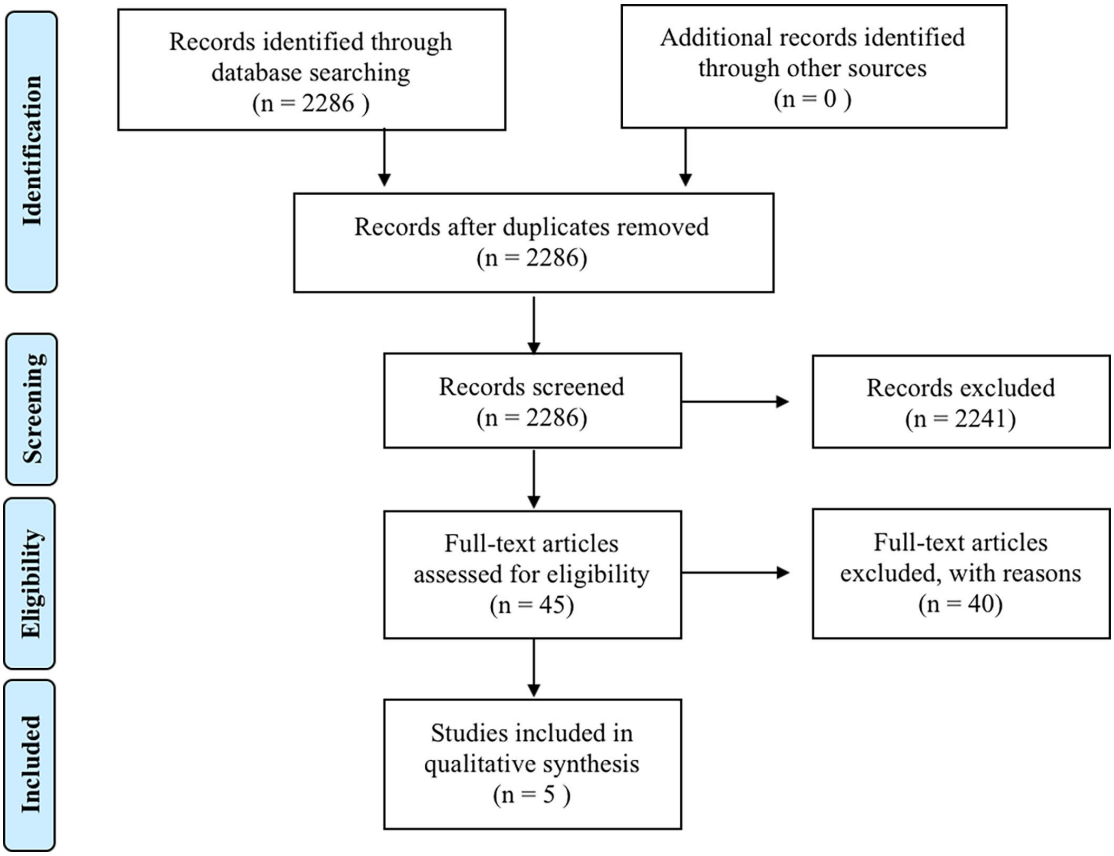

Figure. Literature search and article selection.

referral and the majority of participants were male, white, non-Hispanic, homeless, unemployed, and more than half had used opioids every day of the previous month. The 30-minute intervention was conducted by interventionists with a master's degree who had basic training in motivational interviewing.

The primary outcome was the number of opioid-related events recorded in the EHR following the intervention for the intervention and control group. The authors found no significant difference in the number of opioid events between the control and intervention group as well as no significant difference in the time to the first overdose between the groups. The authors concluded that the null findings may have been the result of the low housing security in their study population and that more intensive interventions may have been necessary to have substantial impact on opioid overdoses. The study did not report self-reported overdoses or the use of naloxone administration due to low follow-up rates. Finally, the authors suggested that due to the constraints of timing and space in the ED, a more concise overdose and naloxone training may be sufficient and congruent with the population-level benefit in mortality rates in communities with greater rates of naloxone distribution.

Barbour et al. [20]

This prospective cohort study included 24 patients at risk of opioid overdose. In the ED, two medical students trained in harm reduction identified patients with an opioid- or overdose-related chief complaint. Participants completed a brief survey, and the medical students then delivered education in overdose reversal and naloxone usage, which took approximately 15 minutes per participant. The treating physician prescribed naloxone to eligible patients, which could be filled after discharge.

While 71 patients at risk of opioid overdose presented to the ED during this study and 43 were interested in the study, only 24 were included. For 16 eligible participants, the treating physician refused to prescribe naloxone and as a result they were excluded. Seven of the 24 patients enrolled in the study were successfully contacted for the three-month follow-up. Of these seven patients, only two had filled their prescription despite none of the other participants reporting obstacles to obtaining naloxone. The authors concluded that the greatest barrier to take-home naloxone in the ED was physician resistance. The authors believed that the high number of patients whose physician would not prescribe naloxone emphasizes the need to improve physician education about harm reduction. Another identified barrier was the pharmacy policy that prevented the ED from providing take-home naloxone directly at discharge.

Devries et al. [21]

This descriptive study of a healthcare systemwide quality improvement project describes a multisite, interdepartmental effort to increase take-home naloxone access for patients at risk for opioid overdose. This widespread initiative included the development of prescribing guidelines, educational materials for providers, EHR alerts and order sets, and the inclusion of all types of naloxone in standard pharmacy stock. In the ED, a medical student screened patients for opioid-overdose risk and eligibility for take-home naloxone. Once identified, providers would prescribe take-home naloxone and had the option of billing private insurance when available or the use of internal funds to cover the cost of naloxone for patients that were un- or under-insured.

Across the health system, the education program conducted 13 training sessions in eight departments. In the ED, specifically, 40 of the 98 physicians and 40 of the 184 nurses completed the training. In 2015, the ED had zero prescriptions for take-home naloxone and from May 2016 to September 2016, they prescribed 46 take-home naloxone kits. Of all the naloxone prescriptions, 43% were intramuscular, 53% were intranasal, and 4% were naloxone auto-injectors. The EHR alert led to a prescription for take-home naloxone 14% of the time. The authors emphasized the need for more-targeted EHR alerts to increase the rate of prescriptions and avoid alert fatigue. The study results showed that take-home naloxone programs can be initiated at large, multisite health systems and, specifically, within the ED.

Drainoni et al.[22]

This study retrospectively examined the uptake of nasal naloxone distribution in the ED following the implementation of a new policy encouraging the intervention. The study team supplemented this data with qualitative interviews of the ED staff. In the eight months prior to policy implementation, 8% of ED patients at risk for opioid overdose received take-home naloxone kits. The low distribution rate was attributed to a variety of factors, including lack of knowledge of the intervention. In addition to broader distribution of naloxone, the new policy meant that take-home naloxone kits were available 24 hours a day. Despite this, in the eight months following the policy initiation, only 7% of ED patients with the same overdose risks received take-home naloxone in the ED. Despite the low uptake, the qualitative interviews with ED staff revealed strong philosophical acceptance of the intervention. The barriers to implementation identified from interviews included logistical workflows, ambiguous staff roles, and lack of education.

The authors concluded that the successful implementation of a naloxone distribution in the ED setting is largely driven by factors other than acceptance by providers. The specific recommendations for establishing implementation included the following: creating a focused target population with a high degree of risk to initiate the innovation; developing training to engage providers in overdose prevention and harm reduction; and identifying at least one clinical champion from each role in the ED.

Dwyer et al.[23]

This prospective cohort study included 415 patients who were at risk for opioid overdose. A PA approached those patients to provide education about overdose risks as well as how to recognize and respond to an overdose. Of this group, 359 received opioid education only and 56 received opioid education and naloxone. The delivered opioid education and naloxone distribution took five minutes. Each kit cost 55 dollars for two atomized 2 mg naloxone vials; these were funded by the Massachusetts Department of Public Health. One year following the ED visit, these patients were contacted for a telephone survey.

Fifty-one of the original group of patients completed the survey: 37 patients who had received opioid education and naloxone, and 14 who received opioid education only. Of those who completed the survey, over half (53%) had witnessed an overdose since their ED visit. Moreover, within the group that witnessed an overdose, the majority (65%) called 911 and nearly all (93%) stayed with the victim. Of those who received a naloxone kit within the surveyed group, 16% reported using their kit to successfully reverse a witnessed overdose, which is consistent with previous reports of take-home naloxone programs distributed in the community.[4]

The study authors concluded that the ED is a promising opportunity for opioid overdose harm reduction and naloxone distribution to laypersons. While the results of the study demonstrated the potential for the ED setting, this study was limited by its low follow-up interview enrollment. Only 12% of the patients who received either intervention completed the survey; however, over 50% of the group that received naloxone participated in the survey.

Implementation Considerations

The variability of the implementation methods across the studies highlights the need for future research to determine the most effective practices. The following categories are general themes for implementation considerations: (1) Identification of personnel; (2) education for providers and staff, (3) EHR integration; (4) patient identification methods; (5) funding for take-home naloxone; and (6) method of dispensing take-home naloxone. Table 2 contains detailed explanations for these implementation considerations.

DISCUSSION

On the basis of the evidence available, the ED represents a potential opportunity to engage patients at risk for overdose and distribute take-home naloxone for overdose reversal in the community. The reviewed work demonstrates that patients at risk of opioid overdose presenting to the ED are willing to accept take-home naloxone, which is consistent with previous related research.[17,19,20,23] While the evidence regarding the effectiveness of the intervention is poor, one study reported that16% of patients who received naloxone kits went on to use it in the rescue of an opioid overdose.[23] Even with this potential for harm reduction and the acceptance among patients and providers, the practice of prescribing take-home naloxone was overall low.[20-23]

In addition to identifying the ED as an opportune setting to distribute naloxone, the included studies provide insight on the potential barriers and enabling factors for implementation as shown in Table 2. These considerations are continuing to change as the environment around naloxone distribution is developing. Many states have expanded naloxone-access

Table 2. Implementation considerations for take-home naloxone programs in the emergency department.

Identification of personnel	Included studies used health counselors, medical student volunteers, PAs, pharmacists, physicians, and nurses.[19–23]
Education and training	Lack of time available for workforce training was identified as a key barrier to successful implementation.[22]
EHR integration	Only 14% of EHR notifications resulted in a prescription for take-home naloxone. Authors identified that more targeted alerts could be more effective.[21]
Patient identification and workflow	The identification of patients in the included studies was done through provider referral, listed chief complaint, listed diagnosis, and screening questionnaires.[19–23] One study recommended starting with a specific high-risk population in the ED to implement the practice and scale to other at-risk patient populations.[22]
Source of funding for take-home naloxone kits	Take-home naloxone kits were funded in a variety of methods, including grant funding, billing private insurance, billing Medicaid or Medicare, and relying on a cross-sector partnerships with local and state health departments.[19–23]
Pharmacy considerations	In two studies, even when naloxone was prescribed, very few were filled. To this end, a common factor identified as an enabling factor was ED patients being able to leave the ED with the take-home naloxone kits at any time of day.[20,22] Further, the type of naloxone distributed across the studies varied. The most common was a mucosal atomizer kit with a vial of naloxone.[19–23]

EHR, electronic health records; *ED*, emergency department.

laws, allowing a provider to write a standing order for an entire group of people, such as medical students, for example, to distribute naloxone kits. Additionally, private insurance companies are publicly making intranasal naloxone available with very little or no co-pay. The majority of the included studies as well as previous research has shown that providers are accepting of take-home naloxone programs and willing to prescribe.[15,19,21–23] In one study, however, physician resistance to prescribing naloxone was identified as the key barrier.[20] The reasons for the experienced resistance are unclear and emphasize the importance of developing training to engage providers before initiating the intervention and identifying a program champion.

The included studies have low rates of patient follow-up, which limits our understanding of the effectiveness of take-home naloxone from the ED. The absence of this evidence may deter other EDs from attempting to implement such a program. This course of action would not be consistent with the recommendations of the authors in each of the included articles and the previous research that has shown community-based naloxone distributions are cost effective and decrease mortality.[5,6,19-23] While more research is needed to determine the best methods and to measure effectiveness of ED programs, the low rate of follow-up is likely the result of this difficult-to-track population, which is largely homeless and unemployed.[19] The ED can reach patients at risk for overdose who do not present to other healthcare venues. Thus, the potential for harm reduction signals the power of further engagement of patients at risk for overdose in the ED.

This review is the first to analyze previous research related to take-home naloxone distribution from the ED. While there are few studies published, the results show that such programs are feasible and could be an effective venue for harm-reduction strategies in the face of the rising number of opioid-related ED visits. Clinicians and hospital leadership should consider strategies to promote the distribution of naloxone to at-risk patients from the ED. Future work that examines the relative effectiveness of distributing take-home naloxone, motivational counseling, and connecting patients with evidence-based treatment could be vital in creating effective methods. Additionally, more research is needed to improve the real-time identification of at-risk patients and to understand which formulation of naloxone is most effective for take-home use.

LIMITATIONS

Only five articles met the inclusion criteria. This small sample size highlights the need for future research but also provides little evidence to support claims. The inclusion criteria only allowed for peer-reviewed, published literature to be reviewed. The authors recognize that ED-based, take-home naloxone programs may exist around the country but have not been reported on. Further, literature that described naloxone distribution from settings other than the ED was excluded, which limited the possibility of expanding findings to outside the ED. Finally, we could not conduct a meta-analysis due to the low number of included studies and heterogeneity of outcomes, which limits the conclusions that can be drawn from this review.

CONCLUSION

The systematic review of the best evidence available supports that the ED is a potential setting to distribute naloxone for overdose reversal in the community. The variability of the implementation methods across the studies highlights the need for future research to determine the most effective practices.

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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. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Use of Fine-scale Geospatial Units and Population Data to Evaluate Access to Emergency Care

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Introduction: Time to facility is a crucial element in emergency medicine (EM). Fine-scale geospatial units such as census block groups (CBG) and publicly available population datasets offer a low-cost and accurate approach to modeling geographic access to and utilization of emergency departments (ED). These methods are relevant to the emergency physician in evaluating patient utilization patterns, emergency medical services protocols, and opportunities for improved patient outcomes and cost utilization. We describe the practical application of geographic information system (GIS) and fine-scale analysis for EM using Ohio ED access as a case study.

Methods: Ohio ED locations (n=198), CBGs (n=9,238) and 2015 United States Census five-year American Community Survey (ACS) socioeconomic data were collected July—August 2016. We estimated drive time and distance between population-weighted CBGs and nearest ED using ArcGIS and 2010 CBG shapefiles. We examined drive times vs. ACS characteristics using multinomial regression and mapping.

Results: We categorized CBGs by centroid-ED travel time in minutes: <10 (73.4%; n=6,774), 10-30 (25.1%; n=2,315), and >30 (1.5%; n=141). CBGs with increased median age, Hispanic and non-Hispanic Black population, and college graduation rates had significantly decreased travel time. CBGs with increased low-income populations (adjusted odds ratio [AOR] [1.03], 95% confidence interval [CI] [1.01-1.04]) and vacant housing (AOR [1.06], 95% CI [1.05-1.08]) had increased odds of >30 minute travel time.

Conclusion: Use of fine-scale geographic analysis and population data can be used to evaluate geographic accessibility and utilization of EDs. Methods described offer guidance to approaching questions of geographic accessibility and have numerous ED and pre-hospital applications.[West J Emerg Med. 2018;19(6)1043–1048.]

INTRODUCTION

Geographic analysis is a highly relevant methodology for assessing spatial accessibility, i.e., access to and utilization of emergency departments (ED). This methodology requires careful selection of both geospatial units and data sources. Individual-level residential addresses and socioeconomic or health data provide the finest scale of analysis, although access to such data is often not possible. Using the state of Ohio, this study evaluated the benefits and limitations of using freely accessible, fine-scale geographic entities, socioeconomic data from the United States (U.S.) Census (five-year American Community Survey [ACS] estimates), multinomial regression and geographic information

system (GIS) analysis to evaluate travel time from EDs in relation to demographic and socioeconomic population characteristics. Modification of these methods have numerous applications in emergency medicine (EM), including access of individual patients to any or a specific ED, market oversaturation, or establishing pre-hospital transport protocols.

Geospatial Units

"Coarse" geospatial units include census tracts (CT), county, and ZIP codes. Use of coarse-scale geospatial units potentiates the risk for "ecological fallacy," in which aggregate characteristics of a population within a given area incorrectly suggest characteristics of its subdivisions or individuals.[1,2] "Fine" geospatial units include census block groups (CBG) and small area estimation. Many CBGs make up one CT. CBGs contain 600-3,000 people, while CTs contain 1,200-8,000 people. These units "do not cross state, county or CT boundaries but may cross the boundaries of any other geographic entity."[21] Fine-scale, freely accessible units such as CBGs have been used to analyze large population health datasets in a variety of contexts including childhood obesity, cancer patient outcomes, immunization patterns and numerous projects conducted by the Public Health Disparities Geocoding Project.[6-9] Datasets that pair with such units are free and publicly available. ACS data at the CBG level, used in this analysis, is particularly useful for investigating questions relating to spatial accessibility.

Practical Application of Fine-scale Geospatial Units

Reliance on coarse-scale rather than fine-scale geographic areas has shown negative implications on health, seen in the delayed discovery of elevated blood lead levels in children of Flint, Michigan, during 2015.[11,12] Kaplowitz et al. showed that when compared to ZIP codes, use of CBG characteristics offered better specificity and sensitivity both in the identification of high-risk children as well as opportunities for better cost savings.[13] Similar approaches could be undertaken in EM to identify high-risk groups and opportunities for saving not only costs but improving health as well.

Ohio census and ED data explain the difference between coarse and fine-scale units. Chillicothe, Ohio, and a branch of Ohio University sit within Ohio ZIP Code tabulation area (ZCTA) 45601 (3,458.18 square miles/894 square km). This is the largest Ohio ZCTA by area with a total population of 56,783 – approximately 40,000 of whom are age 25 and over (Figure 1, Map A). According to ZCTA units, 6,299 people (15.7%) of those 25 and over hold at least a bachelor's degree. However, evaluating this characteristic using the CBG unit shows that this 15.7% is not uniformly distributed. Over half (25 CBGs) have only 0-15.7% of residents with a bachelor's degree or higher. The remaining 22 CBGs (near a college campus) have a greater proportion of residents with a bachelor's degree or higher. Similarly, estimates of distance of one CBG centroid to the nearest ED range from <10min to >30min between CBGs, giving a more nuanced picture of access to EDs (Figure 1, Map C). A similar phenomenon emerges in research regarding "hot spots" of violent crime, in which the majority of violent trauma incidents originate in a small geographic space.

Population Health Research Capsule

What do we already know about this issue?
Population health questions are often analyzed using "coarse scale" geographic units like zip code or census tract level data with Euclidean (as the crow flies) distances. Using coarse scale units can inaccurately represent a given population, particularly when studying access to emergency care.

What was the research question?
How does the use of fine scale geographic units and Manhattan distance impact analysis of access to emergency facilities?

What was the major finding of the study?
Use of fine scale geographic units and Manhattan distance in analysis of American Community Survey data yielded a more nuanced view of access to emergency departments in Ohio than would be possible with more coarse analytical units.

How does this improve population health?
Employing finer geographic units with a road network analysis, researchers can more accurately measure population characteristics and their overall level of access to healthcare services by modeling the actual paths one would use to access a facility.

Access to and Utilization of Emergency Departments

Various studies have shown that increased time and distance to general or emergency clinical care increases mortality rates, making geographic accessibility to EDs important.[17,18] Current guidelines recommend, for example, that if fibrinolytic therapy is to be used in reperfusion therapy of ST-elevation myocardial infarction patients, it be initiated within 30 minutes of hospital arrival.[16]

The state of Ohio has approximately 11.5 million residents and contains 1,197 ZCTAs, 2,952 CTs and 9,238 CBGs[22], with 22.1% of Ohioans living in rural areas (89.2% of total area)

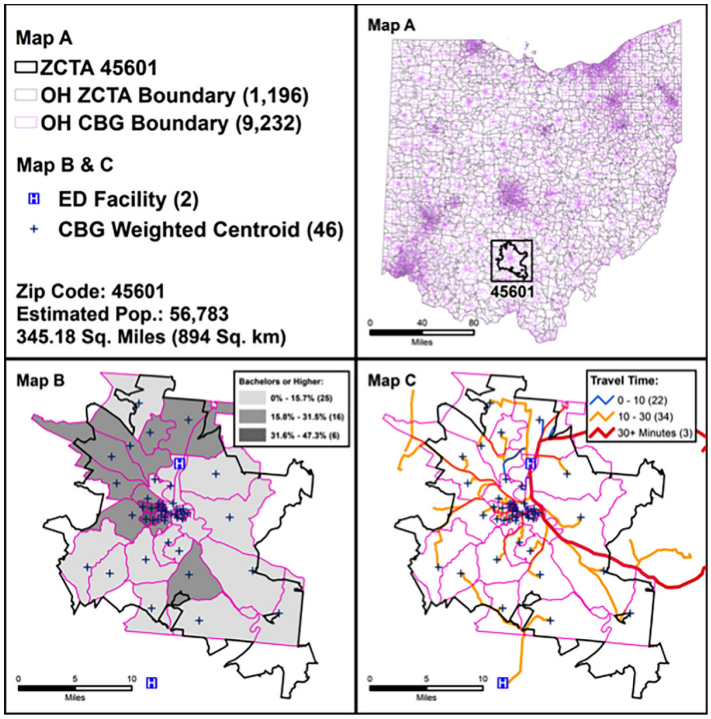

Figure 1. Maps A, B, C – Measuring emergency department access using census block groups vs. Zip Code tabulation area units.

compared to 77.9% living in urban areas (10.8% of total area).[23] As of 2015, 198 EDs served Ohioans. This study evaluated distribution of and geographical access to those facilities by socioeconomic and demographic population characteristics. We used CBG population-level data from the 2010-2014 five-year ACS and geospatial analysis to help identify potential gaps in ED access. While the focus of this analysis was on demographic characteristics in a single state, similar methodology could be employed to analyze particular ED use patterns or pathologies.

METHODS

We used free, publicly accessible resources to geocode addresses of individual EDs, incorporate a fine-scale geographic spatial unit (CBGs) within the state of Ohio, and use the most reliable socioeconomic data offered by the U.S. Census (five-year ACS estimates).

Choosing Appropriate Geospatial Units in ED Access and Utilization Analysis

Apparicio et al. described four parameters required to properly measure geographic accessibility. Descriptions and the parameter chosen by this research group are described in Table 1.[5] Road-network distances were particularly important, as most patients are transported to EDs by emergency medical services or personal vehicles. Time was considered more clinically appropriate than distance in determining access to services.

Table 1. The four parameters required to measure geographic accessibility parameters.

Description	Parameter selected
Spatial unit of reference for the population	Census Block Group
Aggregation method to account for distribution of population in residential area	Population-weighted centroids based on population within Census Blocks
Measure of accessibility	Travel time to closest emergency department
Type of distance for computing the accessibility measures selected	Road-network Cartesian (Manhattan)

Choosing Appropriate Population Data

This study used five-year data estimates extracted from the freely available U.S. Census Bureau's ACS five-year estimate (2011-2015). ACS questions include general demographic questions, income, education and a variety of other socioeconomic factors. These data can be freely downloaded from American Fact Finder (https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml) or the National Historical Geographic Information System (https://www.nhgis.org). Other reasonable population datasets include electronic medical record or billing data. For purposes of a state-level analysis, ACS data seemed most appropriate to explain the methodology.

Mapping

Individual street addresses of Ohio trauma centers and non-trauma center EDs (n=198) operating in 2015 were obtained and verified from publicly accessible state and federal databases and direct communications with administrators. We excluded psychiatric, veterans' affairs and pediatric-exclusive EDs. Addresses were geocoded using Google Fusion Tables and Google Maps. CBG-level ACS population data and associated 2010 CBG shapefiles were acquired using the National Historic Geographic Information System (https://www.nhgis.org). We excluded CBG codes beginning with a zero (containing only water), located on an island and not connected to the main Ohio road network, or those with a null population (n=8). Maps used population-weighted centroids for CBGs (Figure 1, Map B) based on the population within each census block, as opposed to simple geographic centroids, which are less accurate in identifying where people live within a CBG. These population centroids acted as a proxy for patient address. Final analysis included n=9,230 population-weighted centroids, representing 2010 boundaries.

We modeled network drive times using Esri's North American Detailed Streets network dataset (https://www.arcgis.com/home/item.html?id=f38b87cc295541fb88513d1ed7cec9fd). Once the network was established, centroid-ED distance and travel time were estimated using the closest facility function in Network Analyst and road-network (Manhattan) distance.[5,26]

We then stratified the centroid-ED pairs by travel time into three groups: <10minutes, >10-30 minutes and >30 minutes. These categories were established based on literature linking increased mortality to these cut-points.[16,27] We used CBG-level ACS data to assess statistically significant differences in relation to centroid-to-ED travel time. Multinomial regression was used to examine the association between travel time and CBG characteristics. We included variables significant at the univariate level in the multivariate model. All analyses were performed in IBM SPSS v21.

RESULTS

Of the 9,230 CBGs included in the analysis, 73.4% (n=6,774) had a <10 minute travel time. Of CBGs with increased travel time, 25.1% (n=2,315) had a 10-30 minute travel time, and 1.5% (n=141) had a >30 minute travel time (Figure 1, Map C). CBG population descriptions are presented in Table 2 and cartographic representation of travel times from CBG centroids to EDs is visualized in Figure 2.

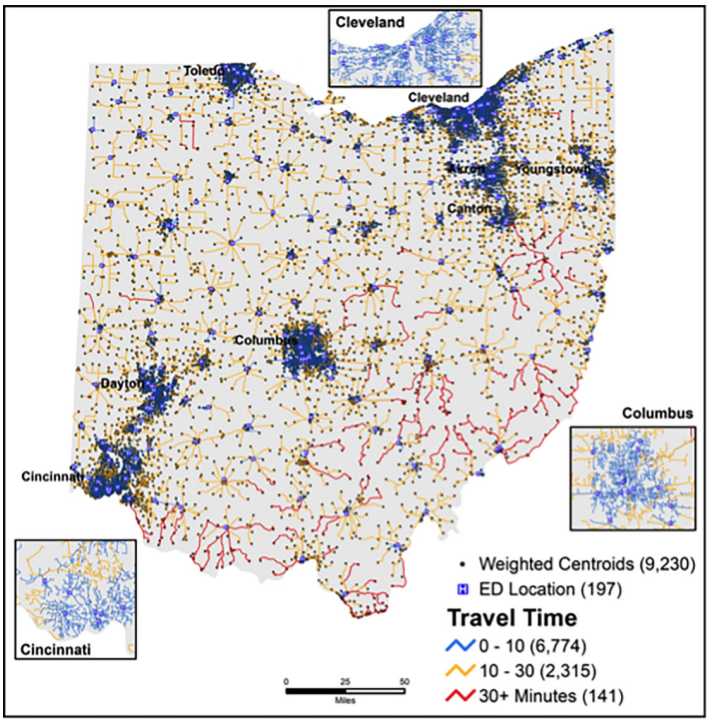

Figure 2. Population-weighted census block groups centroid to nearest emergency department (ED) travel time.

Of the 15 CBG characteristics examined at the univariate level, only 10 remained significant in the multivariate model (Table 3). Travel time to the nearest ED significantly decreased with increased median age, increased Hispanic and non-Hispanic Black population, and increased college graduation rates.

Table 2. Ohio census block group characteristics, 2010-2014 United States. Census American Community Survey.

Characteristic	Mean (SD)	Median
Driving time to nearest ED (minutes)	8.3 (6.7)	6.2
Distance to nearest ED (miles)	4.8 (4.1)	3.4
Population density (per square mile)	3,119 (3,456)	2,167
Median age	40.2 (8.8)	40.2
Percent male	48.7 (6.2)	48.8
Race/Ethnicity (%)		
Hispanic	3.5 (6.7)	1
Non-Hispanic, White	78.4 (26.9)	90.3
Non-Hispanic, Black	14.2 (24.9)	2.1
Non-Hispanic, other	3.9 (5.3)	2.1
Education (%)		
No HS diploma/GED	12.5 (10.1)	10.1
HS diploma/GED/AA degree	64.4 (15.3)	67.6
At least a college degree	23.1 (18.7)	17.6
Income: Poverty Ratio <1.0 (%)	18.3 (16.9)	12.9
Unemployment rate (%)	6.4 (5.4)	5
Vacant houses (%)	11.4 (10.9)	8.9
Owner-occupied homes (%)	66.8 (24.5)	72.1
Household vehicle access (%)	90.6 (11.7)	94.9
Individuals without insurance (%)	11.6 (8.4)	10

SD, standard deviation; *ED*, emergency department, *GED*, General Education Development; *AA*, Associate of Arts.

DISCUSSION

This study showed that the use of GIS, fine-scale geographic units, population data and network travel time to facility is an effective methodology to evaluate access to emergency care. The majority of Ohio CBG centroids had <10-minute travel time to an ED, and there appear to be minimal gaps in access among the population characteristics. Increase in a CBG's median age, population density, percent Hispanic, non-Hispanic Black, educational attainment of at least a college degree, and owner-occupied houses had a decreased odds of having an increased drive time to an ED. As percent of a CBG's population fitting these characteristics increased, odds of being farther away decreased.

While Ohio's ED access appears to be generally robust, states with fewer medical facilities can use the methodology described to evaluate areas with a significant population requiring excessive transportation time to the detriment of the patient. It is also important to note characteristics of areas that have increased travel time. For instance, the odds of Ohio CBGs with increased low-income populations and vacant housing had an increased

Table 3. Results of a multinomial regression for travel time to the nearest emergency department.

	10-30 vs. < 10 minutes		>30 vs. < 10 minutes	
Characteristic	AOR	95% CI	AOR	95% CI
Median age	0.946	.937 - .954	0.967	.941 - .994
Population density	0.999	.999 - .999	0.998	.998 - .999
Percent Hispanic	0.974	.960 - .987	0.782	.693 - .884
Percent Non-Hispanic, Black	0.968	.961 - .975	0.911	.850 - .975
At least a college degree	0.975	.965 - .984	0.925	.897 - .955
Percent owner-occupied homes	1.02	1.015 - 1.025	1.027	1.011 - 1.044
Income: poverty ratio <1.0	0.993	.985 - 1.001	1.026	1.005 - 1.047
Unemployment rate (%)	0.987	.970 - 1.004	0.945	.899 - .994
Vacant houses (%)	1.007	1.000 - 1.015	1.064	1.047 - 1.080
Household vehicle access (%)	1.019	1.008 - 1.031	0.985	.958 - 1.012

AOR, adjusted odds ratio; *CI*, confidence interval.

odds of being >30 minutes from the closest ED. Because a drive time over 30 minutes correlates with adverse patient outcomes, consideration of these CBGs when evaluating ED access is warranted.

This methodology may be used for densely populated areas to assess where "super-users" originate and establish targeted interventions to address these populations, thus reducing ED visits and costs while improving patient outcomes. Use of large datasets may also be useful in pairing patient-level data for clinical research or establishing disaster response protocols for emergency responders. For physicians and researchers with access to individual patient addresses in a given healthcare system or government, the described methodology can also be employed to create an even more nuanced picture of access and utilization of emergency care.

LIMITATIONS

This study had several limitations. ED-specific characteristics, including available resources, proximity to higher level of care, patient volume, and average wait time, were not incorporated into analysis. While we calculated distance and time using accepted practice, the time travel models were made assuming no stops and at a fixed speed from origin to destination. This approximates but is not identical to real-world conditions, in which volume of traffic, stops at traffic lights, intersections, and weather conditions will add time between locations. Centroid-ED time was also based on residential address, rather than on where a patient was most likely to be at the time of an injury or illness. This is often a limitation regardless of dataset used, as patient address is often pulled from registration or billing data, which is tied to a patient's home address.

CONCLUSION

This study provides a guide for professionals interested in identifying the most appropriate population level data and geospatial units to identify gaps and opportunities in access to emergency care. Use of proper geographic and population characteristic tools is necessary to support individual patients and emergency medical staff as well as the systems they support.

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Bundled HIV and Hepatitis C Testing in the Emergency Department: A Randomized Controlled Trial

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Introduction: An estimated 25% of the 1.2 million individuals living with human immunodeficiency virus (HIV) in the U.S. are co-infected with hepatitis C (HCV). The Centers for Disease Control and Prevention recommends HCV testing for high-risk groups. Our goal was to measure the impact of bundled HIV and HCV testing vs. HIV testing alone on test acceptance and identification of HCV and HIV.

Methods: We conducted a two-armed, randomized controlled trial on a convenience sample of 478 adult patients in the Jacobi Medical Center emergency department from December 2012 to May 2013. Participants were randomized to receive either an offer of bundled HIV/HCV testing or HIV testing alone. We compared the primary outcome, HIV test acceptance, between the two groups. Secondary outcomes included HIV and HCV prevalence, and HCV test acceptance, refusal, risk, and knowledge.

Results: We found no significant difference in HIV test acceptance between the bundled HCV/HIV (91.8%) and HIV-only (90.6%) groups (p=0.642). There were also no significant differences in test acceptance based on gender, race, or ethnicity. A majority of participants (76.6%) reported at least one HCV risk factor. No participants tested positive for HIV, and one (0.5%) tested positive for HCV.

Conclusion: Integrating bundled, rapid HCV/HIV testing into an established HIV testing program did not significantly impact HIV test acceptance. Future screening efforts for HCV could be integrated into current HIV testing models to target high-risk cohorts. [West J Emerg Med. 2018;19(6)1049-1056.]

INTRODUCTION

The Centers for Disease Control and Prevention (CDC) estimates that 1.2 million individuals in the United States (U.S.) are living with human immunodeficiency (HIV) and 3.5 million individuals are living with hepatitis C virus (HCV).[1-4] Due to similarity in risk factors and transmission, the prevalence of HIV/HCV co-infection is high. An estimated 25% of individuals living with HIV in the U.S. are co-infected with HCV, and approximately 80% of people with HIV who inject drugs also have HCV.[5] Co-infection increases non-AIDS related morbidity and mortality in HIV-positive patients, more than tripling the risk for liver disease, liver failure, and liver-related death.[5]

The CDC recommends HCV testing for high-risk groups, including people who inject drugs (PWID), recipients of organ transplants or blood products prior to 1992, healthcare or public health workers exposed to HCV-infected blood, and one-time testing of all persons born between 1945 and 1965, a cohort accounting for 75% of all chronic HCV infections in the U.S.[6-8] To augment screening, as of 2013 a New York State law mandates inpatient hospital and primary care settings

to offer HCV tests to every individual in this birth cohort.[9] However, reliance on risk-based testing may miss undiagnosed HCV-positive patients. Approximately 80% of infected individuals are asymptomatic, rendering diagnosis challenging without routine screening.[10] Of those already infected, an estimated 50% are tested for HCV, about 43% enter into care, and only 9% achieve sustained viral response.[10] In settings of high HCV prevalence, routine screening and counseling with prevention messages may facilitate earlier diagnosis, linkage to care, and transmission reduction.[11]

The emergency department (ED) is an ideal setting to increase access to routine screening and counseling services, particularly for high-risk populations that are less likely to have access to ongoing primary care.[12-14] Immigrants, substance users, uninsured, and individuals with unstable housing situations often rely on EDs for incident and routine health care. These populations are also at higher risk of HCV and HIV infection, rendering the ED an important location to improve widespread healthcare delivery.

The high prevalence of HIV and HCV co-infection, similarity in testing strategies, and interrelated risk factors suggest a practical overlap in integrating screening services. A previous survey of patients during an ED or pharmacy visit found that more than half of the participants prefer hepatitis B/C testing to be in conjunction with HIV testing, rather than hepatitis alone.[15] This integration could effectively use existing resources and infrastructure to address both epidemics and facilitate the linkage of HCV-infected individuals to care. Integrating HCV testing into existing HIV testing and counseling programs may also reinforce prevention education messages to reduce risky behavior among high-risk populations, particularly PWID.[16]

The objective of this study was to integrate rapid HCV testing into an established HIV testing and counseling program to evaluate the effect of rapid, bundled screening on HIV-test acceptance rate. Secondary outcomes include HCV test acceptance, identification of newly diagnosed HCV and HIV positive patients, HCV knowledge, risk assessment, and refusal reasons.

Population Health Research Capsule

What do we already know about this issue?
HIV testing in emergency departments (EDs) has significantly influenced the number of undiagnosed HIV infections. Similar ED screening efforts are now being applied to hepatitis C (HCV).

What was the research question?
We sought to determine the effect of integrating rapid HCV testing into an established HIV testing program.

What was the major finding of the study?
We found that offering rapid HCV tests in conjunction with rapid HIV tests did not adversely affect HIV test acceptance.

How does this improve population health?
Bundling HIV and HCV testing into a single screening program could improve population health by identifying and linking infected individuals to care.

METHODS

Study Design

We obtained institutional review board (IRB) approval through the Albert Einstein College of Medicine IRB (IRB #2012-491, approved August 13, 2012). A two-armed, randomized controlled trial (RCT) was conducted at Jacobi Medical Center, a Level 1 trauma and tertiary-care center located in the Bronx, New York. The ED HIV screening program ran 24 hours a day seven days a week; however, screening was limited to the times when a trained research associate (RA) was available. In the six-month study period, an RA was available 75 days to screen and enroll patients. The hours of the RCT were limited to weekdays from 9am-5pm on these days. Upon recruitment, all participants completed questionnaires that included demographic information, HCV risk assessment, and HCV knowledge questions. Participants were randomized either to the control arm or the intervention arm. The control arm was offered HIV testing only, and the intervention arm was offered HIV testing concurrently with HCV testing (bundled HIV/HCV screening). The research protocol received approval from Albert Einstein College of Medicine IRB.

Sample Recruitment

Patients were recruited from the adult ED at Jacobi Medical Center. Recruitment took place during a six-month period from December 2012 to May 2013. Inclusion criteria required patients to be 18 years of age or older and to speak English or Spanish. Patients were excluded from the study if they were medically unstable as determined by their ED provider, unable to consent, did not speak Spanish or English, were known to be HIV and/or HCV positive, or had been tested for HIV/HCV in the prior six months. Patients who refused to participate in the study completed a short, anonymous refusal form, which captured demographic information and reason for refusal. There was no racial or gender bias in selection of participants. As noted above, we excluded non-English or Spanish-speaking

patients based on our IRB policy that requires informed consent documents be available in the patient's native language. These translated documents were not available for this study.

Study Procedure

RAs were trained as public health advocates to perform HIV and HCV testing and counseling. They approached eligible patients in the ED and followed a script in asking patients if they were interested in participating in a study through which they would be offered free screenings recommended for their general health. Patients who refused the offer of the HIV and/or HCV tests completed a test-refusal questionnaire. All enrolled participants completed a questionnaire including demographic information, HCV risk assessment, and HCV knowledge. After providing verbal consent, participants were randomized to either an HIV test only group (control) or a bundled HIV/HCV test group (intervention). An independent statistician used a computer-generated allocation sequence to determine randomization. Randomization assignments were placed in sealed, opaque envelopes that were opened sequentially after verbal consent was obtained for the study.

Those randomized to the control group were offered only an HIV test, and those randomized to the intervention group were offered both HCV and HIV tests. The OraQuick® HCV rapid antibody test was employed as a rapid blood fingerstick test for HCV antibodies. The OraQuick *Advance*® rapid HIV-1/2 antibody test was used to test for HIV-1 and HIV-2 antibodies in oral fluid. Both point-of-care tests provide results in 20 minutes. Study subjects were not billed for either HIV or HCV testing.

A public health advocate delivered the test(s) results to the patient and conducted post-test counseling. In the case of a preliminary positive result on either test, the public health advocate informed the patient and the patient's provider and scheduled a follow-up appointment for the patient. Patients who tested positive for HIV were linked to care according to the protocol already established by the existing HIV testing program.[14] Patients who tested positive for HCV were similarly linked to care with a provider at the Adult Comprehensive Services clinic within Jacobi Medical Center, where blood was drawn for viral-load confirmatory testing. A public health advocate confirmed contact information for any positive patients to schedule follow-up appointments if necessary. After participants completed the study, educational materials from the CDC were provided on HIV and HCV.

Outcome Measures

We compared the primary outcome, HIV test acceptance, between the control (HIV only) and intervention group (HIV and HCV). HIV test acceptance was used as an outcome proxy to evaluate the feasibility of integrating HCV testing into the established HIV testing program without adversely impacting HIV testing. Secondary outcomes included HIV and HCV incidence, HCV test acceptance, refusal reasons, risk level, and knowledge. We adapted the seven-question knowledge form from patient information sheets distributed by the CDC and a previously-validated hepatitis knowledge measure published in 2009.[5] We identified characteristics associated with HCV test acceptance and HCV knowledge.

Sample Size

We determined sample size using the following parameters: 1) 80% power; 2) significance level of 0.05; 3) two-sided significant test; and 4) 10% difference between groups on the acceptance of HIV testing. Using these parameters, a sample of 227 in each group was needed to test the primary outcome: acceptance of an integrated screening program for HIV and HCV infection. Groups of at least 333 were used to allow for drop-out and protocol violations.

Statistical Analysis

Data was recorded in Microsoft Excel (Microsoft Corp., Redmond, Washington) throughout patient recruitment, from December 2012 to May 2013. Data obtained from subjects entered using unique subject numbers, without specific identifiers. This method of data management was used to ensure patient confidentiality.

We analyzed data using descriptive statistics to compare the baseline characteristics of study participants in the intervention and control groups. Categorical variables were compared with proportions and Fisher's exact test-derived confidence intervals [CI]. Continuous variables were compared with means and 95% CIs for parametric data and medians for nonparametric data. We compared acceptance rates for HIV testing in experimental and intervention arms using chi-square test with Fisher's exact test-derived CIs. Stata ®(StataCorp LLC, College Station, Texas) statistical software was used to tabulate participant demographics and testing frequencies for HIV, HCV, or both.

RESULTS

Of the 733 patients assessed for study eligibility, 478 were eligible and agreed to participate (Figure). There were 244 participants in the control (HIV-only) arm and 234 participants in the experimental (bundled HCV/HIV) arm; 91.8% of the control arm accepted an HIV test and in the experimental arm, and 90.6% accepted an HIV test. We found no significant difference in HIV test acceptance between the HIV-only (90.6%, 212/244), and bundled HCV/HIV (91.8%, 224/234) groups (p=0.642). There were no significant differences in gender, race, ethnicity, or other participant demographics between the control and intervention groups (Table 1). Overall participant demographics were representative of the Bronx community; approximately 50% of participants were Hispanic, and approximately 40% were Black.

A total of 8.2% (20/244) of the control arm and 9.4% (22/234) of the experimental arm refused HIV testing (p-value 0.794) (Figure). More than half the participants refused HIV testing in each group because they did not feel they were at risk of contracting HIV (11/20 in the control arm and 15/22 in the experimental arm). Other reasons for refusals included the following: "I am afraid to find out my results;" "I don't care whether I have HIV or not;" I don't have time to test;" "I am worried that the test will slow my care;" "I am with family or friends;" or no reason given. None of the participants in either the control or experimental arm tested positive for HIV.

Acceptance of HCV testing was high in the bundled arm (79.9%, 187/234). The two main HCV test refusal reasons were "I do not want to have my finger stuck," (29/47) and "I don't feel that I am at risk of having hepatitis C" (23/47). Other refusal reasons included "I don't have time to test," "I don't care whether I have hepatitis C or not," "I am worried that the test will slow my care," and no reason given. One (0.5%) participant in the experimental arm tested positive for HCV. A majority of participants (76.6%,) reported at least one HCV risk factor (Table 2). The most common risk factor reported was a tattoo (67.5%), followed by a piercing other than the

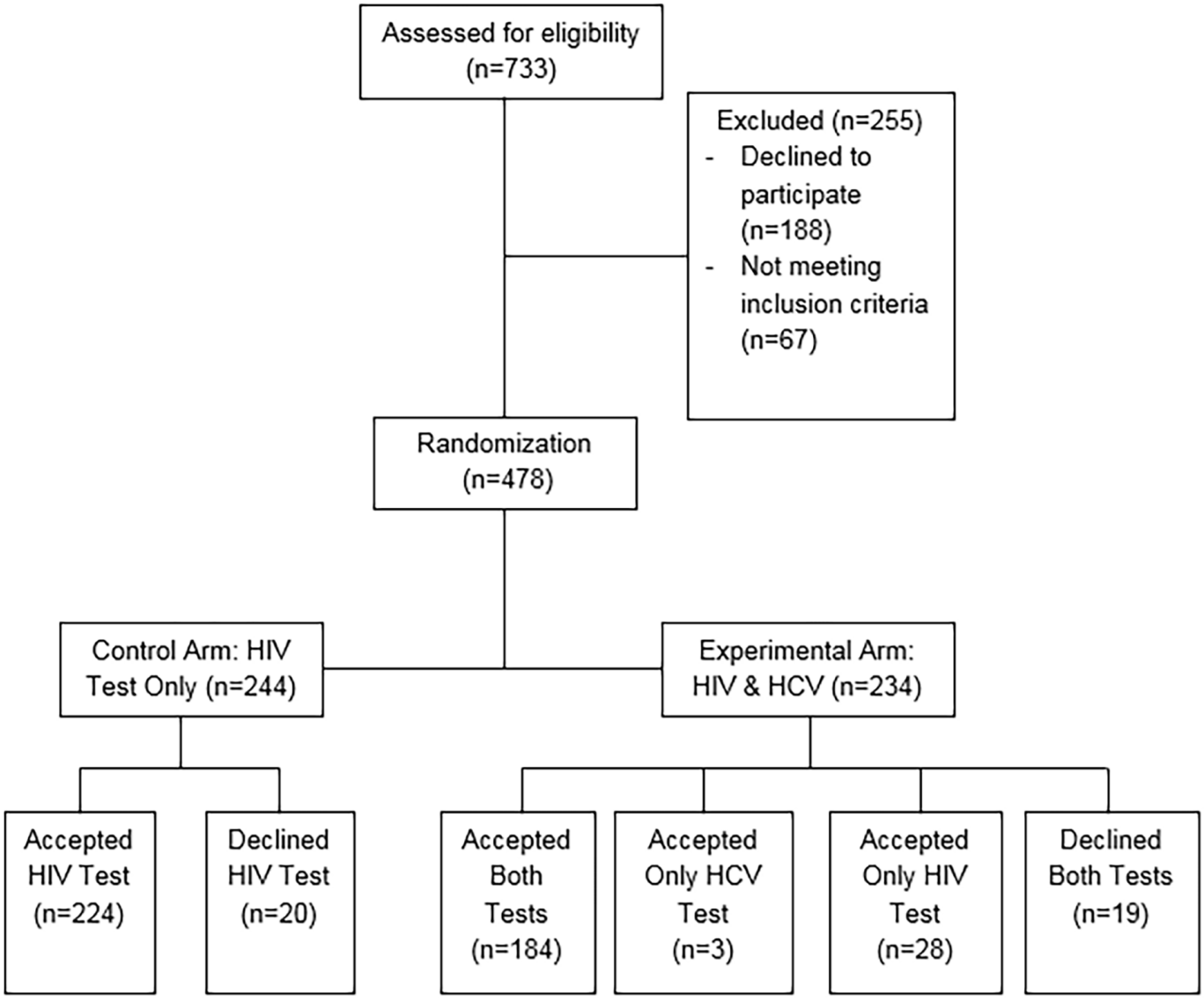

Figure. CONSORT Diagram: Participants enrolled in a randomized controlled trial to evaluate integration of HCV testing into a rapid HIV testing program.
HIV, human immunodeficiency virus; *HCV,* hepatitis C virus.

Table 1. Participant demographics of a randomized controlled trial to evaluate feasibility and efficacy of bundled HIV/HCV rapid testing.

Demographics	Control arm: HIV Only (n=244)	Experimental arm: HIV & HCV (n=234)
Age	35.8±13.5	35.5 ±13.0
Gender		
Male	43.4%	45.3%
Female	55.7%	53.8%
Transgender	0.8%	0.4%
Ethnicity		
Hispanic	52.9%	53.8%
Non-Hispanic	45.9%	44.9%
Race		
Black	39.3%	36.3%
White	12.7%	13.7%
Other	34.5%	36.7%
Education		
0-8th grade	7.0%	8.1%
Some high school	20.5%	20.1%
High school degree	58.7%	58.6%
College degree	7.8%	7.3%
Graduate degree	0.8%	1.7%
Insurance		
Medicaid	32.0%	37.6%
Medicare	4.5%	2.6%
Private	23.4%	20.1%
Not insured	35.7%	35.0%
Previously tested for HIV	89.0%	89.7%
Previously tested for HCV	37.7%	38.0%

HIV, human immunodeficiency virus; *HCV,* hepatitis C virus.

Table 2. Reported hepatitis C virus risk factor prevalence in urban emergency department patient cohort.

Risk factors	Percentage
Tattoo	67.5%
Piercing other than the ear	44.5%
Birth cohort (1945-1965)	26.5%
Sex with someone who exchanged sex for money or drugs	12.3%
Accidental needle stick at work	9.6%
Lived with someone who is HCV positive	5.2%
Sex with a PWID	4.6%
Blood transfusion or organ transplant before 1992	3.3%
Sex with MSM	3.3%
Sex with someone who is HCV positive	3.0%
Ever used injection drugs	2.2%
Currently using injection drugs	1.6%
Long term dialysis	1.4%
Ever used methamphetamine (crystal meth)	1.4%
Received blood clotting factor before 1987	3.3%

HCV, hepatitis C virus; *PWID,* person who injects drugs; *MSM,* men who have sex with men.

ear (44.5%) and being a member of the birth cohort (1945-1965) (26.5%). Few participants reported ever (2.2%) or currently (1.6%) using injection drugs.

All study participants answered a hepatitis C knowledge questionnaire. A majority of study participants (74.3%) acknowledged that HCV-infected people can live for years with unrecognized infection. A total of 70.7% of participants responded that they knew that alcohol could damage the livers of people living with HCV, 66.9% knew that HCV can be transmitted sexually, 55.9% knew that HCV can be treated, 45.8% knew that HCV can be cured, and 43.9% knew that there was no vaccine available for HCV (Table 3). A total of 47.3% of patients knew that HCV infections are more common in people born between 1945 and 1965.

DISCUSSION

This study is one of the first to implement an on-site, bundled, rapid HIV/HCV testing and counseling program in a high-volume urban ED. Integration of rapid HCV testing into a pre-existing HIV testing program did not adversely impact patients' HIV test acceptance. These results indicate the feasibility of integrating HCV testing and counseling into established HIV testing programs as effective screening interventions to target high-risk populations.

For a mobile patient population – many with current or history of IDU, homelessness, or incarceration – a public health approach is indicated to counter structural barriers inhibiting the HCV care continuum.[17,18] Impediments to timely diagnosis and care often include patients' limited access to care, prohibitive costs, and insufficient provider training or incentive to screen and treat HCV infection. Incorporating point-of-care HCV testing and counseling into existing HIV screening infrastructure can counter these barriers by relying on public health advocates already trained to navigate patients to care in both clinical and non-clinical settings.

Findings are consistent with other studies that found that health counselors and patients are receptive to the incorporation of HCV counseling and testing into existing HIV screening programs.[19] A previous study comparing the acceptance of HCV tests in different settings (i.e., correctional facilities, drug treatment facilities, field/visit outreach sites, HIV counseling/

Table 3. Hepatitis C virus knowledge questions and percentage correct responses from a patient cohort of an urban emergency department.

7-Question true/false knowledge measure (n=478)	% Correct
Hepatitis C can be given to someone during sexual intercourse. (T)	66.9%
There are no treatments for hepatitis C. (F)	55.9%
People can live with hepatitis C for many years without knowing that they have been infected with the virus. (T)	74.3%
People living with hepatitis C can damage their liver if they drink alcohol. (T)	70.7%
There exists a hepatitis C vaccine that can be used to prevent people from getting infected with the hepatitis C virus. (F)	43.9%
There is no cure for hepatitis C. (F)	45.8%
Hepatitis C infections are more common in people born between 1945 and 1965. (T)	47.3%

testing sites, sexually transmitted disease clinics, family planning clinics, and primary healthcare facilities) found the largest number of HCV tests were administered at HIV testing/counseling sites.[19]

However, the HCV diagnosis rate in this sample was lower than anticipated; only one participant tested positive for HCV (0.5%). This finding is inconsistent with previous studies evaluating bundled HCV/HIV screening. In the aforementioned study comparing HCV test acceptance and diagnosis rate across sites, almost 20% of participants who tested for HCV at HIV testing/counseling sites were HCV positive, suggesting that targeting HIV testing sites captures a population at high risk for HCV.[19] In our study sample, the low prevalence of HCV is likely attributable to two factors specific to this study population – age and prior IDU. Very few of the individuals enrolled in the study fell within the birth cohort and only 2% had ever used injection drugs. Given that these two characteristics are significant predictors of HCV infection, it could explain why the HCV prevalence rate in this study was low. Furthermore, this was a convenience sample of a much larger ED population and the HCV prevalence rate in this study cannot be generalized to the larger ED population. The purpose of the study was to show that non-targeted HCV screening can be easily incorporated into existing HIV screening programs without any negative impact. This study was not meant or powered to characterize the overall HCV prevalence rate in the more general ED population.

Studies assessing HIV and HCV testing strategies for PWIDs have postulated that bundled HIV and HCV screening can lead to increased health testing rates and improved access to prevention and care.[16] While previous studies evaluated HIV/HCV testing specifically in PWIDs, this study is one of the first to assess the impact of rapid, bundled, routine screening on an undifferentiated population in an urban ED.[16,20] The ED has become an important setting to implement public health interventions for other infectious diseases, particularly HIV infection, to capture those lacking consistent access to primary care. Urban EDs have become a primary point of care for high-risk populations such as PWID, the unstably housed, undocumented immigrants, and the formerly incarcerated, contributing to the high prevalence of HCV in an ED setting.[12,13,21]

This study also demonstrated the feasibility of rapid HCV testing. Although conventional HCV testing is most commonly employed, this testing method requires extensive follow-up that is often challenging for high-risk populations, including homeless individuals, undocumented immigrants, and formerly incarcerated individuals.[22] The enzyme immunoassay requires phlebotomy, which limits testing to clinical settings; it also poses additional challenges of finding a usable vein for PWID.

For high-volume settings such as the ED, rapid testing offers an effective intervention to diagnose and link high-risk patients for whom follow-up is not always feasible. Rapid HIV screening has been widely accepted as an efficient approach to identify and link to care HIV-positive individuals within an urban ED.[14] Rapid HCV screening similarly addresses barriers previously inhibiting stages of the HCV care continuum by facilitating on-site delivery of results, counseling, and linkage to care.[22] The OraQuick® HCV assay can detect HCV antibodies in oral fluid or blood and allows result delivery after 20 minutes, preventing the rampant loss of follow-up that occurs with conventional testing, while also allowing for screening in nonclinical settings.[23] The accessibility of rapid testing for both HCV and HIV allows ease of integration of these point-of-care screening programs to maximize diagnosis and linkage to care.

LIMITATIONS

The feasibility of integrating HIV and HCV screening services in this study relied heavily on the already well-established HIV-testing program at Jacobi Medical Center where the HIV test acceptance has been higher than reported in other studies.[14] Outside the context of this RCT, approximately 85% of patients approached accept HIV testing.[14] This unique model was designed specifically to address the testing and counseling needs of a high-risk population relying on the ED for healthcare needs and has been proven effective at providing quality education and screening services in this setting.[14] Because of this unique pre-existing model, it is uncertain whether bundled, rapid HIV/HCV screening can be replicated with similar ease and efficiency in other settings. As a single-center study, the generalizability of these results to other hospitals or healthcare settings is uncertain. Additionally, the study was limited to individuals who spoke English or Spanish, limiting generalizability to other populations.

This sample also consisted of a negligible percentage of Asian participants, which is generally representative of

the community this hospital serves in the Bronx, New York. However, recent surveillance data suggests that Asian and Pacific Islander populations are disproportionately affected by HCV, correlating with presence of tattoos, use of acupuncture needles, and IDU.[4] While this study was intended to target the particular demographics of the inner-city borough, this limitation restricts generalizability to broader populations.

With the high rate of refusals to participate in the study (233 refusals), it is also possible that sampling bias impacts the generalizability of the study. The percentage of participants within the high-risk birth cohort was lower than anticipated in this sample (26.5%), and it is uncertain whether more patients within the birth cohort would be as receptive. Self-perceived low risk was the most common reason for refusing screening, both within the HIV-only arm and the bundled HIV/HCV arm. However, the HCV knowledge survey indicated suboptimal understanding of the increased risk among the birth cohort (47.3% correct). Future public health interventions should include educational components to increase awareness of risk factors. Those who refused HCV testing also commonly reported, "I do not want to have my finger stuck." It is likely that rapid testing with the more recently developed OraQuick® oral swab would reduce refusals in future screening interventions.

CONCLUSION

This study demonstrated that integrating rapid HCV and HIV testing is an effective and efficient approach to screen at-risk populations in an urban ED setting. Offering rapid HCV tests in conjunction with rapid HIV tests did not adversely affect HIV test acceptance; both HIV and HCV test acceptance rates were high. Both the high prevalence of patient risk factors and suboptimal HCV knowledge underscore the need to implement and sustain rapid HCV testing. Further studies should evaluate the feasibility of establishing new bundled HIV/HCV screening programs where rapid testing infrastructure does not yet exist.

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Implementation of a Collaborative HIV and Hepatitis C Screening Program in Appalachian Urgent Care Settings

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Introduction: With the current hepatitis C (HCV) epidemic in the Appalachian region and the risk of human immunodeficiency virus (HIV) co-infection, there is a need for increased secondary prevention efforts. The purpose of this study was to implement routine HIV and HCV screenings in the urgent care setting through the use of an electronic medical record (EMR) to increase a provider's likelihood of testing eligible patients.

Methods: From June 2017 through May 2018, EMR-based HIV and HCV screenings were implemented in three emergency department-affiliated urgent care settings: a local urgent care walk-in clinic; a university-based student health services center; and an urgent care setting located within a multi-specialty clinic. EMR best practice alerts (BPA) were developed based on Centers for Disease Control and Prevention (CDC) guidelines and populated on registered patients who qualified to receive HIV and/or HCV testing. Patients were excluded from the study if they chose to opt out from testing or the provider deemed it clinically inappropriate. Upon notification of a positive HIV and/or HCV test result through the EMR, patient navigators (PNs) were responsible for linking patients to their first medical appointment.

Results: From June 2017 through May 2018, 48,531 patients presented to the three urgent care clinics. Out of 27,230 eligible patients, 1,972 patients (7.2%) agreed to be screened for HIV; for HCV, out of 6,509 eligible patients, 1,895 (29.1%) agreed to be screened. Thirty-one patients (1.6%) screened antibody-positive for HCV, with three being ribonucleic acid confirmed positives. No patients in either setting were confirmed positive for HIV; however, two initially screened HIV-positive. PNs were able to link 17 HCV antibody-positive patients (55%) to their first appointment, with the remainder having a scheduled future appointment.

Conclusion: Introducing an EMR-based screening program is an effective method to identify and screen eligible patients for HIV and HCV in Appalachian urgent care settings where universal screenings are not routinely implemented. [West J Emerg Med. 2018;19(6)1057–1064.]

INTRODUCTION

Hepatitis C virus (HCV) significantly increases the risk of developing hepatocellular carcinoma and liver cirrhosis.[1] Treatment of HCV-related illnesses is estimated to cost approximately $6.5 billion per year in the United States (U.S.).[2] Individuals born between 1945 and 1965 currently account for three-fourths of all HCV infections and are recommended to have at least one HCV test in their lifetime, according to Centers

for Disease Control and Prevention (CDC) recommendations.[3] Recently, an HCV epidemic related to injection of opioids has led to a sharp increase in incident cases in the U.S.

Central Appalachia (Kentucky, Tennessee, Virginia, West Virginia) has been particularly hard hit by this epidemic, with observed cases of HCV increasing 364% between 2006 and 2012.[4,5] A recent study has demonstrated a need for further HCV testing and intervention in the Appalachian region.[6] Among Central Appalachia states, West Virginia currently has the second-highest incident rate of HCV in the nation.[4] Of particular concern is the fact that HCV co-infection has been observed in rates as high as 90% among human immunodeficiency virus (HIV) positive injection drug users.[7] Although West Virginia has historically had a low HIV prevalence, there has recently been an alarming increase of HIV cases in the state.[8] This increase, coupled with the HCV epidemic, demonstrates the need for established screening efforts to help halt the cycle of transmission of HIV and HCV.[7]

One plausible location to increase our HIV and HCV screenings are local, acute care, walk-in clinics where research has been limited. A recent review of the National Hospital Ambulatory Medical Care Survey revealed that HIV testing was significantly greater in outpatient ambulatory medical care settings than in emergency departments (ED) and physicians' offices, suggesting that urgent cares may be an important setting in which to expand testing.[9-10] HCV has been identified in individuals outside of current CDC recommendations for testing, indicating a need to implement universal screening during patient visits.[11] Multiple studies have demonstrated success in using a best practice alert (BPA) model, prompting and streamlining the linkage-to-care process.[11,12] Additionally, urgent care clinics may be an ideal setting for both HIV and HCV screenings, as physicians may be less constrained by time or patient acuity compared to the ED setting. To our knowledge, there are no prior scholarly works discussing the implementation of a dual HIV-HCV screening program within an urgent care location, especially within rural Appalachian settings.

The purpose of our study was to implement an electronic medical record (EMR)-based HIV and HCV screening program at three of our local urgent care clinics with the primary objective of using BPAs to enhance a provider's likelihood of ordering a test in patients eligible for HIV and HCV screenings. A secondary objective was to increase the overall number of tests ordered, adapting from very minimal to routine testing practices.

Population Health Research Capsule

What do we already know about this issue?
There is a need for increased Hepatitis C (HCV) testing in conjunction with CDC guidelines in the Appalachian region, due to the high co-infection rates among HIV-positive injection drug users.

What was the research question?
Is an electronic medical record-based screening program an effective method to identify and screen eligible patients for HIV and HCV in urgent care centers?

What was the major finding of the study?
HIV and HCV screenings are feasible during routine urgent care patient visits, with subsequent successful linkage to care efforts for positive patients.

How does this improve population health?
Early identification and intervention of HCV infections may decrease the spread of the virus while in early stages, reduce HIV co-infection rates, and prevent future epidemics.

MATERIALS and METHODS

Study Population and Clinical Sites

The three locations used for the implementation of HIV and HCV screenings were two local urgent care clinics (one stand alone and one multi-specialty based) and a student health services clinic affiliated with a large, mid-Atlantic university. The urgent care clinic typically sees approximately 24,000 patients per year of all ages, with an average throughput time of 49.7 minutes. The student health services clinic evaluates approximately 70% of the total student population (~30,000 per year), with an average throughput time of 36.8 minutes. Student health services also has approximately 2,000 visits from the general public per year, including university faculty and staff. Approximately 2-7% of patients seen in these clinics will have blood drawn as a part of their care, although a larger proportion receives point-of-care testing. None of the three walk-in clinics had previously conducted preventive screenings during routine patient visits.

The three sites represent different demographics. Although the majority of patients at all three locations have private-payer insurance (roughly 50%), the percentage of Medicare/Medicaid vs. self-pay varies between the three locations and may have affected screening rates. However, all screenings were free of charge to patients at all three locations, regardless of their insurance status. HIV and/or HCV screenings were only performed during a patient visit if concerns were identified related to current symptoms or when a patient presented for a sexually transmitted infection screening. Therefore, the introduction and implementation of

HIV and HCV screenings into the urgent care settings would allow for these tests to become a routine part of patient visits, no longer relying on the clinician-driven method previously used. This study was given a non-human subjects research designation by our university's institutional review board.

The Electronic Medical Record

To introduce routine HIV and HCV screenings into the urgent care settings, the EMR (Epic® 2015, Epic Systems Corporation) was used. BPAs, a clinical decision tool, were used to populate within the charts of registered patients who qualified to receive the following: 1) only an HIV screening; 2) only an HCV screening; or 3) both an HIV and HCV screening. The BPAs were developed based on CDC screening guidelines, which include a variety of risk factors.[13,14] HIV testing is recommended for patients aged 13-64 years at least once a year as part of routine healthcare.[14] A list of recommended guidelines with risk factors warranting HCV screening is shown in the Table.

The EMR would identify eligible patients by searching charts of registered patients to see if they met screening guidelines and/or had a history of risk factors in the "Problem List" tab. BPAs appeared on the computer screen within the EMR upon opening of eligible patients' charts during their visit. Upon presentation of a BPA, providers and staff (i.e., physicians, nurses, and technicians) could order the suggested screening tests; if they decided to not order the test(s) for eligible patients, providers and staff were prompted to choose one of the following options: "will assess," "not clinically appropriate," or "patient refused" (Figure 1). To prepare for the implementation providers and staff received education on both the BPAs and the screening eligibility criteria at staff meetings .

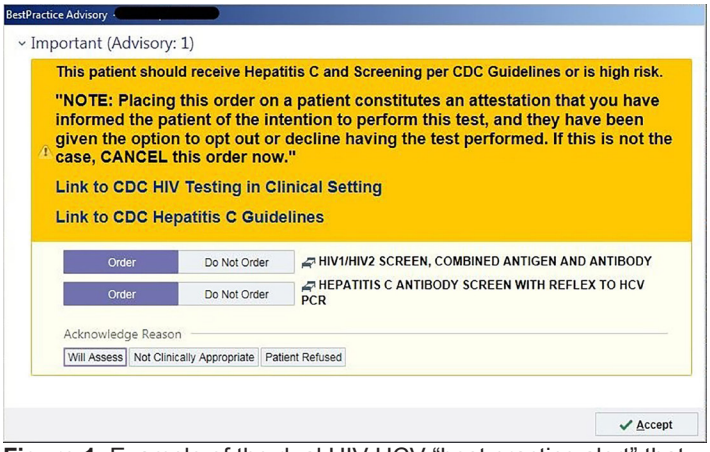

Figure 1. Example of the dual HIV-HCV "best practice alert" that populates upon patient eligibility, which are seen by providers and staff at the urgent care locations.
HIV, human immunodeficiency virus; *HCV*, hepatitis C virus; *CDC*, Centers for Disease Control and Prevention

Implementation of Screenings

Routine EMR-based HIV and HCV screenings began in June 2017 and were free of charge to all eligible patients. Placards were hung in care rooms, triage areas, and restrooms to inform patients of the current screenings, providing them the opportunity to opt out from testing. If eligible, providers and nursing staff discussed the options of screenings privately with patients in their respective treatment rooms. In addition to having the option to opt out from HIV and/or HCV testing, other exclusions included providers' decisions on the

Table. Hepatits C screening recommendations and risk factors, per CDC guidelines.[13]

Guidelines	Risk factors
HCV testing is recommended for those who:	Are adults born from 1945 through 1965 (without prior ascertainment of HCV risk factors)
	Are currently injecting drugs
	Ever injected drugs, including those who injected once or a few times many years ago
	Have certain medical conditions, including persons: 1. who received clotting factor concentrates produced before 1987 2. who were ever on long-term hemodialysis 3. with persistently abnormal alanine aminotransferase levels (ALT) 4. who have HIV infection
	Were prior recipients of transfusions or organ transplants, including persons who: 1. were notified that they received blood from a donor who later tested positive for HCV infection 2. received a transfusion of blood, blood components, or an organ transplant before July 1992
HCV testing based on a *recognized exposure* is recommended for:	Healthcare, emergency medical, and public safety workers after needle sticks, sharps, or mucosal exposures to HCV-positive blood
	Children born to HCV-positive women

HCV, Hepatitis C virus; *CDC*, Centers for Disease Control and Prevention.

populated BPAs, and patients refusing a venipuncture during their visit. If patients refused a blood draw, an option for a third-generation oral fluid HIV antibody test at the student health services clinic was offered, with results available within 20 minutes. Patients also had the option to opt out from the oral fluid antibody test, if desired.

Upon patient verbal consent, blood samples or oral swabs were obtained from eligible patients for HIV and/or HCV testing. The HIV screening test used is a fourth-generation combined antigen and antibody chemiluminescent immunoassay test that reflexes automatically to an antibody differentiation immunoassay. All positives obtained from the rapid testing are confirmed with the combined antigen and antibody testing by the laboratory. The HCV screening test used is a chemiluminescent microparticle immunoassay performed on ARCHITECTi®. The test reflexes automatically to quantitative HCV ribonucleic acid (RNA) testing if the initial test result is positive. Results were available within 12 hours.

Patient Navigators and Linkage to Care

Patients were initially contacted by the urgent care provider with results and follow-up instructions. Upon receiving notification of a positive HIV and/or HCV screening result in the EMR "in-basket" pool, PNs then were responsible for linking patients to their appropriate care needs. PNs would call patients via phone to discuss 1) that patients had spoken to a provider and were aware of their results; 2) the availability of follow-up appointment options; and 3) scheduling their follow-up appointment with the appropriate clinic.

HCV Linkage-to-care Process

Patients were referred for follow-up appointments with a university-based, infectious diseases clinic upon an initial HCV antibody-positive screening result. Regardless of confirmatory testing status, it can be helpful to counsel patients about risk-factor modification in the event they are currently "negative" for HCV infection. Therefore, PNs would make initial contact with HCV antibody-positive patients regardless of confirmatory-test outcomes. Patients could also be referred to a university-based, behavioral medicine and psychiatry clinic or a digestive diseases clinic, depending on patient preferences or the specified care plan of referring providers.

HIV Linkag- to-care Process

Patients who initially screened positive for HIV with a negative or indeterminate confirmatory test were contacted and encouraged to have repeat testing in six weeks due to the risk of early infection. When possible, these patients were scheduled to return to one of our primary locations. PNs were responsible for linking confirmed HIV-positive patients to a university-based, infectious diseases "Positive Health Clinic" for follow-up appointments.[15] The Positive Health Clinic provides comprehensive, primary HIV care services to a largely rural, impoverished, medically underserved area, where access to care is limited.

Transportation Assistance

In order to support patient linkage to care, PNs offered transportation assistance and coordination with follow-up clinic schedulers. PNs would coordinate taxis with patients who did not have their own means of transportation or provide information on local bus transit routes close to their residence. In addition, PNs would offer gasoline gift cards to those who had a reliable source of transportation but needed transportation assistance. In terms of scheduling, PNs worked closely with clinic schedulers in university-based departments of infectious diseases, and behavioral medicine and psychiatry, and in the urgent cares to quickly get patients into follow-up appointments.

Data Analysis

We analyzed collected data descriptively to assess the progress of the implementation with the goal to provide feedback to provider and nursing staff. Reports on BPA firings were also conducted via the EMR to provide feedback to staff. We tracked counts of the number of patients tested at each site, as well as counts of the number of positive test results for HIV and HCV. Rates of positivity for HIV and HCV screenings were calculated, as well as the linkage-to-care rates for all positive patients identified at all locations.

RESULTS

Prior to implementation, approximately 1,639 HIV screenings and 150 HCV screenings were conducted at the clinics between June 2016—May 2017. The majority of HIV screenings were rapid tests (86%) and occurred at the student health services clinic (89%). From June 5, 2017—May 31, 2018, a total of 48,531 patients presented to the three urgent care clinics, with the majority (51%) presenting to the local, stand-alone urgent care clinic. The multi-specialty urgent care clinic began conducting screenings in February 2018, once it opened in September 2017. The BPAs populated on 36,389 patients eligible for HIV screening (75%). Overall, 3,388 patients (9.3%) refused HIV screenings, with 5,771 patients (15.9%) deemed "not clinically appropriate" through the BPAs by providers. Additionally, the BPAs populated on 7,465 patients eligible for HCV screening (24%), with 489 patients (4.2%) deemed "not clinically appropriate'"by providers. Furthermore, a total of 467 patients (4.0%) refused HCV screenings.

Of the remaining 27,230 patients eligible, 1,972 agreed to be screened for HIV (7.2%). Similarly, of the remaining 6,509 patients eligible, 1,895 (29.1%) agreed to be screened for HCV (Figure 2). The student health services clinic had higher screening rates for both HIV and HCV compared to the local

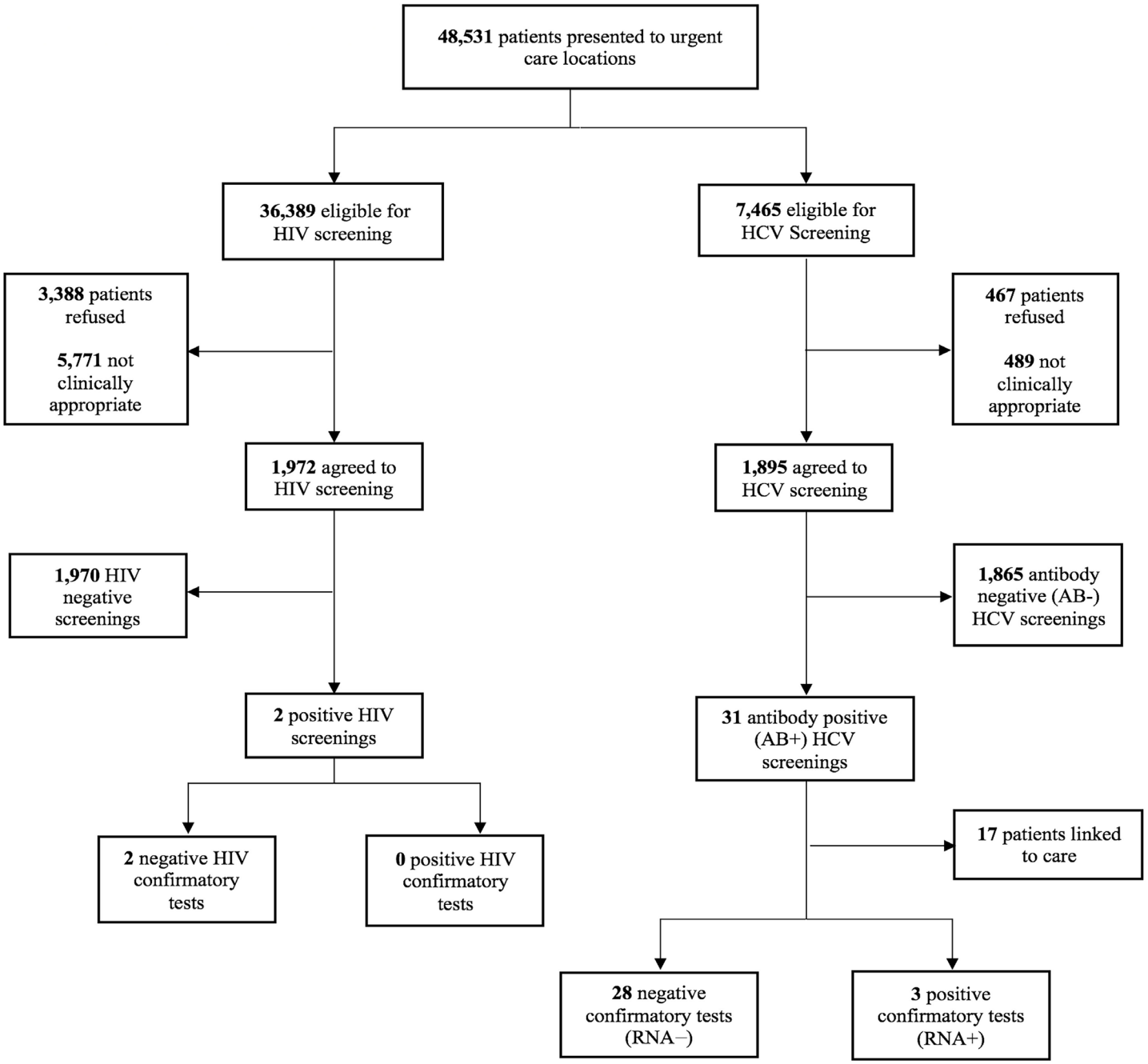

Figure 2. Flowchart of HIV and HCV screenings at all urgent care clinics.
HIV, human immunodeficiency virus; *HCV*, Hepatitis C virus; *RNA*; ribonucleic acid.

urgent care clinics, with 70% of all screenings occurring at student health. Since screenings were not included as part of the acute sick visit, no initial baseline numbers are available for preventative health screenings in comparison.

Thirty-one patients (1.6%) screened antibody-positive for HCV, with three (9.7%) subsequently having a positive RNA result. The average age of HCV antibody-positive patients was 25 years, ranging from 18-65 years. All patients with antibody-positive HCV results were referred to infectious diseases for follow-up through our PNs. No patients in any of the three clinics were confirmed positive for HIV during this time period. However, two patients had an initial positive screen with a negative confirmatory result. Our PNs were able to link 17 patients (55%) to their first appointments during this time, with the remaining 14 (45%) patients having a scheduled future appointment.

DISCUSSION

Our study demonstrated that an EMR-based HIV and HCV screening program is effective in the Appalachian urgent care settings. The "opt-out" model of testing allowed these varying locations to successfully increase screenings in conjunction with CDC guidelines and increase linkage to care through the use of PNs. The EMR is effective at identifying eligible patients to be screened for HIV and HCV, as demonstrated in the number of BPA firings during the initial four months.

During the initial implementation, there were relatively low acceptance rates for both HIV and HCV testing by our patient population. There are a number of factors as to why initial patient testing was low. If providers and staff were choosing "will assess" upon firing of the BPAs, instead of immediately addressing it, the BPAs would continue to populate on the same patients until one of the following occurred: the test was ordered; it was considered not clinically necessary by the provider; or the patient refused to be tested. In cases where only "will assess" was chosen, it is possible that a final decision for the screenings may not have been addressed, as it was not required for chart closure. In these cases, documentation for reasoning was frequently unrecorded. For those patients who were documented as "not clinically appropriate" or "patient refusal," some indicated that they would defer testing, since no additional blood work was indicated at the time of visit.

With a low percentage of patients typically having blood drawn during a visit and short throughput times, patients do not want to spend the "extra" time giving blood. A practical alternative would be to reinforce the availability of the oral swab test to those patients, which could help increase the HIV testing rates. Other patients indicated a desire to discuss testing with their primary care provider or felt they were low risk and testing was unnecessary. Finally, due to the strong, negative stigma still surrounding HIV and HCV, patients may not want to know if they are positive for either. In some cases, the tests were ordered but not directly from the BPA if later decided. Although there was a comment option on the BPA, it was rarely used by the providers to capture the additional reasons noted above. It may be beneficial to require reasoning on the BPA in order to close the patient chart, as well as enforce consistent responses from all providers and nursing staff, to generate the most accurate reports of the BPA results.

BPA fatigue is often a problem in clinical locations due to multiple documentation requirements. In the urgent care settings, these BPAs are somewhat limited when compared to inpatient services and outpatient primary care. Our current EMR administration has addressed some of these needs in the background that are not readily apparent to the practitioner. In these cases, certain documentation is required prior to chart closure without prompting a BPA alert. Due to this, our location was likely more successful than others by implementing this method. Although we did not survey staff perceptions about the implementation of routine HIV and HCV testing, physicians, advanced practice providers, and nursing staff seemed willing to participate when education of the department was performed during departmental meetings. Testing was performed under all providers and orders seemed to increase with ongoing education.

There were a number of challenges with the EMR. First, the accuracy and completeness of searchable, historical data in the EMR affected the accuracy of BPA firings. If the patient's past medical history or current problem list was not up to date, BPAs would populate unnecessarily or repeatedly in the case of those patients who had been previously tested. Risk factors that were not captured by the EMR, such as multiple sexual partners and injection drug use, represented missed opportunities for screening. These behaviors were often not addressed in the patient visits unless indicated by initial patient complaints. If addressed at a previous visit, the information may have been documented within the body of the provider note as free-text and not in a location that could be easily accessed via the EMR logic for the BPA requirements. Also, BPAs were initially set to only detect prior blood screenings. During this study period, past oral HIV antibody testing was not captured by the BPAs. However, upon review of the BPA data, patients who had refused initial blood work but consented for an oral HIV antibody swab were not counted in the totals; therefore, in future we would like to adjust the BPA to capture these tests.

Challenges with EMR data have been previously reported in the literature.[16,17] Despite the commonly held belief that EMRs decrease medical errors by providing complete patient information and history, inaccuracies and incompleteness are a frequently occurring problem. One study found that 25% of patient charts were incomplete, with the most commonly inaccurate fields being current medications, medical history, and medical allergies.[16] In a study by Tse and You, inaccuracies in medications were reported in 51% of records.[17] While over 91% of participants had a history summary with eight or less items present, omissions were reported for one in every five participants.[17] Further work is needed to improve EMR accuracy, especially when implementing widespread, EMR-based routine screening for infectious diseases.

Since the BPAs were designed around CDC guidelines for screenings, there is the possibility that some patient populations could be missed. Of particular interest are those who are younger than the HCV birth cohort of 52-72 years of age. Although baby boomers account for the majority of existing infections, newly diagnosed HCV infections are increasing most rapidly among 20-29 year

olds.[14,18] The urgent care providers were recognizing risk factors not previously noted in the EMR, and thus began using wider screening efforts than the original BPA design. For example, if the BPA was triggered by patient eligibility for an HIV screening, providers would also recommend an HCV screening to the patient, since they would already be having blood drawn upon verbal consent. Interestingly, all of the HCV antibody-positive patients were younger than the birth cohort, with an average age of 24 years, ranging from 18-38 years. This may be related to the HCV epidemic that the Appalachian region is currently enduring. The initial findings support the need for universal HCV screenings among this population, since birth cohort screening does not identify a significant portion of people infected with HCV.[18]

PNs played a crucial role in the screening program. All 10 patients (100%) who tested HCV-antibody positive were successfully scheduled with referrals to infectious diseases for follow-up. Although 90% of those patients did not have HCV RNA-positive results, it is important for the patients to attend their follow-up appointments due to possibly having a previous infection. These follow-up appointments also present an opportunity to counsel "negative" patients on risk-factor modification. Our linkage-to-care rate was significantly higher than what is currently seen in the literature.[19,20] In a recent EMR review from a large healthcare system, no action was taken in 30% of patients who tested positive for HCV.[16] Other studies have demonstrated that only about 15% of patients diagnosed with chronic HCV have received treatment.[20] A possible explanation for our successful linkage-to-care rate could be the PN transportation assistance. Transportation is a significant issue with patients in the Appalachian population; therefore, providing financial assistance has benefitted our population tremendously.

Their successes notwithstanding, the PNs have faced a number of challenges. PNs discovered that patients were more likely to attend their infectious diseases follow-up appointments if scheduled close to their original urgent care visit. Initially, PNs and schedulers could get patients in within four weeks of initial visit. However, both PNs and schedulers have become more efficient in scheduling these appointments closer to within two weeks of initial visit. This has been a common issue for patient care coordinators in other settings; the longer the delay to getting a follow-up appointment, the less likely a patient is to attend.[18] Patients who are motivated to seek treatment will sustain this wait; however, those patients who lack motivation or education are less likely to wait and will eventually fail to access care.[18] Additionally, PNs could only interface with patients when contact information was available to them in the EMR. Therefore, if patients did not provide sufficient or correct contact information upon initial presentation to the clinic, the PNs could not follow up with them in a timely manner, if at all. To improve follow-up we suggest that clinic staff encourage patients to provide multiple modes of contact upon registration with front-desk staff at these clinics.

Future Directions and Improvements

Although initial implementation has been successful, there are many areas to improve and expand upon. First, patient-reported reasons for not having HIV and/or HCV screenings conducted during their visit should be documented in provider and staff notes within the patients' EMR. This would allow tracking of patient perceptions. Similarly, surveying all patients on their opinions of HIV and HCV screenings during their visits, regardless of whether or not they were tested, would increase insight into patient perceptions. This could provide feedback on the opt-out process for testing, as well as on the placards hanging in all treatment rooms and triage locations. Surveying providers and staff on their opinions and perceptions of the screening program would be valuable for improving the screening process. It is crucial to continuously gain feedback from those on the front lines of implementation in order to best tweak the program to what will be most efficient for both the patients, and the providers and nursing staff. It is also important to have multiple risk factors recorded in easily accessible areas of the EMR so the BPA will populate accurately.

CONCLUSION

This study has demonstrated the feasibility of introducing an EMR-based method to identify and screen eligible patients for HIV and HCV in Appalachian urgent care settings, successfully transitioning from conducting essentially no screenings to making this a part of routine patient visits within a 12-month period. Other urgent or acute care clinics in the Appalachian region should consider adopting a similar practice to manage the side effects of the current opioid epidemic.

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This Article Corrects: "Coronary Disease in Emergency Department Chest Pain with Recent Negative Stress Testing"

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Coronary Disease in Emergency Department Chest Pain with Recent Negative Stress Testing.
Walker J, Galuska M, Vega D

Erratum in
West J Emerg Med. 2018 November;19(6):1065. Missing Table 1 and Table 2.

PMCID: PMC2967694 [PubMed - indexed for MEDLINE]

Table 1. Characteristics of patient encounters (n = 337).

Characteristics of patients	Number of patients
Excluded patients	173
Most recent stress test was positive	111
Alternative exclusion criteria*	62
Included patients	164
Age (mean)	55 (Range 27-93)
Gender	
Male	82 (50%)
Female	82 (50%)
Stress test results	
Negative	122 (74.4%)
Inconclusive	42 (25.6%)

*Three alternative exclusion criteria were defined as a history of another previous positive cardiac stress test within 3 years of admission or an interval cardiac catheterization or coronary artery bypass graft between the most recent stress test and the hospital admission.

Table 2. 30-day adverse cardiac events (n = 34).

Type of event	Number of events
AMI	3
Positive stress test	5
Positive catheterization	11
Positive stress test and catheterization	3
AMI and positive stress test	1
AMI and positive catheterization	9
Positive catheterization and CABG	1
Death	1

AMI, acute myocardial infarction; *CABG*, coronary artery bypass graft.

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