



**SAEVA**  
New England Regional Meeting



# A Data-driven Approach to Defining Phenotypes of Infection

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### Background

Phenotypes of infection (sepsis, severe sepsis, etc.) have traditionally been defined by expert consensus in terms of specific dichotomous/categorical combinations of symptoms, vital signs, and laboratory findings. Recent evidence has challenged the sensitivity, specificity, and validity of these categories. A data-driven approach to categorizing patients with infection using unsupervised learning may better elucidate whether distinct clusters of severity exist and their number. We therefore aimed to determine whether data-driven phenotypes exist and their number by assessing cluster analysis fit and clustering validity (i.e. evaluation of a clustering structure by comparing it with other clustering schemes).

### Method(s)

Retrospective study of patient visits from 3 EDs within a single healthcare system from 3/2013-5/2016. Patients were included if they had an admission diagnosis ICD-10 code matching a list of infectious type codes as determined by expert review. The clinical elements were chosen for their role as parameters in the Sepsis 2 and Sepsis 3 definitions. Missing values were imputed with a Random Forest algorithm, and values were scaled by z-score. A search for clusters was conducted by clustering the data with K-means and DBSCAN algorithms across a hyperparameter space. Cluster validity was evaluated numerically with the silhouette score, gap statistic, and Calinski and Harabasz score, and visually by projection into two dimensions with principal component analysis and t-SNE.

### Result

A total of 44,294 ED encounters were included in the final analysis. By both visual and numerical evaluation, the data were best represented by a single cluster and followed a continuous distribution along the three principal components. The silhouette score was highest at 0.88 with a single cluster by DBSCAN and 0.14 with the minimum of two clusters by K-means. The gap statistic did not show any number of clusters to have increased explanatory power. The CH score decreased with each additional cluster indicating no discernible clusters.

### Conclusion

The lack of distinct clusters suggests that patients in the ED with infection do not fall into distinct, non-continuous phenotypes as defined by international sepsis definitions, but rather exist along a continuum in contrast to traditional conceptions of sepsis classification.

### Keywords

sepsis, infection, machine learning, clustering



# A Novel Curriculum to Teach Bad News Delivery in the Emergency Department

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### Background

Effective patient care relies on sound communication. Delivery of bad news can be particularly challenging given time constraints as well as lack of prior relationships with patients and their families. The objective of this study was to determine whether a dedicated ED curriculum on breaking bad news would increase resident comfort level regarding this task.

### Method(s)

This was a prospective study assessing a novel curriculum of delivery of bad news in the ED at a tertiary urban teaching hospital. We developed the IDEALS (Introduction, Discover, Educate, Acknowledge Emotion, Listen to Questions, Summarize) method for bad news delivery in the ED setting. This was introduced to our PGY 1-3 EM residents as a curriculum comprised of a didactic teaching session and a simulation case in 2017. Residents were randomized to control and intervention groups. Pre and post didactic surveys evaluating self-assessed comfort level and skill using a 0-10 Likert scale were administered to both groups. Means and confidence intervals were calculated and compared pre and post curriculum.

### Result

Eighteen residents completed both the pre-intervention and post-intervention surveys out of 39 residents in our program (46%) and were included in the analysis. Seven (39%) of these residents did not have the curriculum and 11 (61%) participated in the activity. Seventeen (94%) had received prior breaking bad news training, with all but 3 of them receiving training in medical school. In the pre-intervention survey, residents rated their comfort at delivering bad news at

5.9 out of 10 (95%CI 4.7-7.2) and their skill at 5.6 out of 10 (95%CI 4.4-6.8). The residents who received the curriculum rated their comfort at 8.1 (95% CI 7.6-8.6,  $p=0.008$ ) and their skill at 7.6 (95% CI 6.9-8.2  $p=0.02$ ). Those who did not participate rated their comfort at delivering bad news at 7.1 out of 10 (95% CI 6.3-8.0,  $p=0.21$ ) and their skill at 6.7 (95% CI 5.8-7.6,  $p=0.11$ ).

### Conclusion

Most EM residents receive some form of breaking bad news to patients. However, the majority did not learn the skill in the ED setting. Residents who participated in the IDEALS curriculum had increased self-assessed comfort and skill compared to their colleagues who did not take part in the session.

### Keywords

Education, breaking bad news



# A Quality Improvement Project to Decrease Vancomycin Usage for Non-Purulent Cellulitis

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## **Background**

The Infectious Disease Society of America (IDSA) has set evidence-based guidelines for soft tissue skin infections (SSTIs). For non-purulent cellulitis, vancomycin is only recommended in severe cases. There have been efforts nationally to decrease vancomycin usage in order to address the increasing problem of vancomycin resistant organisms. At both our academic and community sites, vancomycin usage was high which mirrored national trends. This quality improvement project aimed to reduce vancomycin use in non-purulent SSTIs by educating emergency medicine providers on current IDSA guidelines.

## **Method(s)**

In June 2017, we presented our revised non-purulent cellulitis treatment guideline at faculty meetings and conferences. Providers were given their own personalized vancomycin prescribing rates compared to peers and guideline recommendations. Trained abstractors retrospectively reviewed the medical record for all patients treated in both the academic and community sites with a diagnosis of non-purulent cellulitis for disposition type and administration of vancomycin six months before and after the implementation of the guideline. We used chi-squared testing to compare the data from pre and post intervention by patient disposition.

## **Result**

There were a total of 1,127 charts reviewed. There were 616 patients before the intervention and 511 post intervention. In the discharged patient group at the academic site, before intervention, 16.0% of patients received vancomycin compared to 1.8% in the post intervention phase ( $p < 0.001$ ). At the community site there was a decrease from 18.9% to 1.2% pre and post intervention ( $p < 0.001$ ). Admitted patients at the academic site pre-intervention received vancomycin at a rate of 63.9% and post-intervention 31.1% ( $p < 0.001$ ). At the community site, there was a drop from 55% to 33% ( $p = 0.013$ ). For observation patients at the academic site only, 37.2% received vancomycin before and 13.0% received it after intervention ( $p = 0.006$ ).

## **Conclusion**

Through an easy to implement guideline-based intervention we were able to decrease use of vancomycin in ED patients with non-purulent skin infections. By educating providers on current guidelines and by giving individualized feedback and follow-up, we saw a dramatic drop in vancomycin use across all disposition types.

## **Keywords**

Infectious disease, quality improvement, vancomycin



# A Retrospective Study of Time to Benzodiazepine's Effect on Hospital Admission Rates For Alcohol Withdrawal

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A retrospective study of time to benzodiazepine effect on hospital admission rates for alcohol withdrawal  
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### Background

Alcohol withdrawal is a massive public health problem in western countries with over 2 million visits to the Emergency Department annually resulting in hospital admission in the United States in 2010[1]. In many cases it is easily prophylaxed with medications if a patient is recognized as being at risk. Despite multiple studies of alcohol withdrawal and symptom based dosing versus fixed schedule dosing, no study has yet looked at time to benzodiazepine in the Emergency Department and its effect on admission rates, which we feel can be used as a surrogate for severity of illness.

### Method(s)

This was a retrospective cross sectional study to evaluate whether or not early benzodiazepine administration was associated with a decreased risk of admission to the hospital for all causes.

### Result

324 randomly identified visits for alcohol related complaints were reviewed. Of these, 246 cases were identified as being of interest and included. Of these, 112 received benzos and of those receiving benzos 48 received benzos within the first hour of triage vitals. Those who received benzodiazepines within one hour were admitted for all causes to the hospital at a rate of 20.8% while those who received benzos after an hour were admitted to the hospital for all causes at a rate of 49%.

### Conclusion

Simply put, time to benzodiazepines in patients either presenting in ETOH withdrawal or identified as at risk for ETOH withdrawal matters. Patients in whom benzodiazepines were delayed had a significantly higher rate of admission to the hospital for all causes. When using a logistic regression, we can show with these data that once benzos are delayed longer than 3 hours, the chance of admission goes up to above 50%. A randomized prospective trial of early benzodiazepine administration in patients at risk for alcohol withdrawal is needed.[1] ALCOHOL-RELATED EMERGENCY DEPARTMENT VISITS AND HOSPITALIZATIONS AND THEIR CO-OCCURRING DRUG-RELATED, MENTAL HEALTH, AND INJURY CONDITIONS IN THE UNITED STATES: FINDINGS FROM THE 2006 - 2010 NATIONWIDE EMERGENCY DEPARTMENT SAMPLE (NEDS)

### Keywords

Alcohol withdrawal



# A Survey of Massachusetts Primary Care Physicians: Older Adult Fall-Risk Assessment, Intervention & Referral

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### Background

In 2015, 2.5 million older adults were treated in emergency departments (EDs) for non-fatal fall-related injuries, more than 734,000 were hospitalized<sup>1</sup>, and estimates of the direct medical costs for older adult exceeded \$30 billion<sup>2</sup>. Falls are the leading cause of fatal and non-fatal injuries among older adults<sup>1</sup>. Even when falls are not injurious, they can result in fear of falling, which can be psychologically disabling<sup>3</sup> and lead to future falls through physical deconditioning<sup>4,5</sup>. Some falls treated at EDs might be prevented if evidence-based fall assessment and interventions were better integrated into primary care practice.

### Method(s):

We surveyed all primary care providers (N=136) at two multispecialty practice groups in Massachusetts to assess their knowledge, attitudes, beliefs, and practices regarding fall-risk assessment, intervention, and referral for their older adult patients.

### Result

The response rate was 71% overall. The two provider groups were similar on almost all measures, suggesting that our results may be generalizable to other Massachusetts primary care providers. Most respondents believed that all older adults should be assessed for fall risk and that assessment would identify risk factors that could be modified. Only about half, however, believed that they had the expertise to conduct fall risk assessment and only about two thirds believed that assessing older adult patients for fall risk was the prevailing standard of practice among their peer providers. Only 14% of respondents were aware of

the CDC STEADI Toolkit<sup>6</sup>, a fall risk assessment algorithm, and only 39% were familiar with evidence-based community fall risk prevention programs.

### Conclusion

Falling is a predictor of subsequent falls<sup>7,8</sup>, and an injurious fall predicts a future fall requiring medical attention<sup>9,10,11</sup>. An older adult seeking medical care for a fall-related injury should signal healthcare providers that risk-mitigation intervention is required. ED staff can encourage their older adult fall patients to talk to their primary care physicians and families about the presenting fall event and in general about falls risk assessment and prevention<sup>12</sup>.

### Keywords

older adult falls, emergency department, evidence-based fall assessment, primary care physicians



# Addressing Homeless Population Needs in the Emergency Department Using Community-Based Participatory Research

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## Background

Annually 1.5 million Americans face housing insecurity, and compared to their domiciled counterparts are 3 times more likely to utilize the Emergency Department (ED). The ED is uniquely able to address homeless health issues due to frequent contact and existing community resources. Community Based Participatory Research (CBPR) methods have been used in underserved populations, but utilization in the ED has been limited. We employed CBPR with a primary outcome of reduced ED recidivism and secondary outcome of improved linkage to care.

## Method(s)

According to CBPR methodology we identified stakeholders through literature search as well as input from community leaders and established experts in the field. This was supplemented by snowball sampling for additional leads. A needs analysis was performed using semi-structured individual interviews with stakeholders and analyzed using grounded theory. Stakeholders were also invited to join the “CBPR team”. In team meetings we utilized Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis to develop a theory of change, interventions targeting our outcomes, and measures of success.

## Result

Through CBPR modeling we identified 18 stakeholders: 3 ED administrators and clinicians, 4 housing programs, 1 mental health treatment center, 3 outpatient clinics, 4 social workers, and 3 clients experiencing housing insecurity. SWOT analysis of our structured meetings resulted in 3 primary opportunities for intervention: 1) Recognition of homeless patients in the ED, 2) Discharge process, and 3) Communication between ED and

community facilities. Patients with insecure housing could be identified by implementing standardized screening questions at intake. A medical record flag to identify homelessness would further aid recognition. Clear discharge instructions are especially vital for patients returning to shelters and respite programs. Access to outpatient services including social work, substance abuse, and mental health are key.

## Conclusion

CBPR is a promising approach to addressing gaps in homeless health care as it provides a comprehensive view incorporating various critical perspectives. ED-based interventions can be developed to improve identification of housing insecurity, reinforce relationships between the ED and community resources, and improve discharge planning.

## Keywords

Homeless housing CBPR Community Based Participatory Research



# Am I growing into a Capable EM Physician? A National Survey of Resident Attitudes Toward Receiving Feedback

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### Background

Resident evaluation can be vague or are scales that provide little meaning to residents. This study aimed to understand emergency medicine resident attitudes toward receiving both written and verbal feedback from attendings.

### Method(s)

This study aimed to survey all current emergency medicine residents in CORD affiliated residency programs. Questions characterized the facilitating platform and identify obstacles to receiving both written and verbal feedback. Qualitative themes were taken from individual free-text responses on strengths and weaknesses.

### Result

52 residents (PGY-1 to 4) from 7 programs responded. Residency programs used various web based applications, handwritten notes, and verbal feedback. 9.62% are extremely satisfied with their current platform, 46.15% somewhat satisfied, 30.77% neutral, 11.54% somewhat dissatisfied, and 1.92% extremely dissatisfied. Positive written feedback was given 59.64% on average, while constructive feedback was 33.98%. The main strength in written feedback identified was easy of access (14 of 33). The majority of weaknesses (21 of 38) discussed the low frequency of feedback. The biggest obstacle was being delayed (37.93%), followed by inadequate amount (26.44%), inadequate contact with different attendings (18.93%), outliers (9.2%), and other (4.6%), while 3.45% had no obstacles. Positive verbal feedback was given 48.84% on average, while constructive feedback was 39.8%. Residents found

more value in unsolicited feedback (37.5%), specific situational feedback (30.36%), pre-shift goals (17.86%), and actively requesting feedback (14.29%). The biggest obstacles are lack of time for the attending (38.89%) and resident (20.37%), positive feedback lacking details (23.15%), insufficient contact with attendings (4.63%), avoiding confrontation (4.63%) and negative feedback (4.63%), and other (2.78%), while 0.93% had no obstacles.

### Conclusion

While the platform is perceived to be easy to use, low frequency is a barrier to receiving effective written feedback. For both written and verbal feedback, positive comments were more common than constructive ones. This may be of importance given that 23% believe positive feedback lack details. With further study, evaluation platforms can be further improved to not only be easy to use but to increase the frequency of responses to become more useful to residents.

### Keywords

Evaluation, feedback, residency, education





# An Analysis of Mental Health Among Collegiate Emergency Medical Services Providers

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## Background

Incidents of mental illness and suicide are increasing on college campuses. Collegiate emergency medical technicians (EMTs) are both students and frontline emergency medical services (EMS) providers, potentially exacerbating the already high rates of stress, depression, and burnout previously demonstrated in EMS providers. However, how the dual role of student and EMT affects collegiate EMTs is largely unknown. Our objective was to evaluate the prevalence of mental illness in collegiate EMTs and to assess contributing factors.

## Method(s)

Collegiate EMTs were surveyed during the 2017 National Collegiate Emergency Medical Services Foundation Conference. The survey inquired about mental health history, EMS experiences, and demographics. Statistical tests including Pearson chi-square test and Fisher exact test were performed.

## Result

Four hundred seventy-four responses were collected (58% response rate). Freshmen composed 6% of respondents, sophomores 23%, juniors 34%, and seniors 27%. Overall, 32% (95%CI 28%-36%) of respondents self-reported depression and 20% (95%CI 15%-25%) reported thoughts of self-harm. Of those who reported depression or self-harm, 68% had never been

treated, 58% had never sought help, and 33% did not feel comfortable seeking help. Respondents at smaller institutions were more likely to report depression and self-harm and were less likely to feel comfortable seeking help. Most (90%) felt that their symptoms are not related to their work as medical providers. However, those who had transported a self-injurious patient were more likely to report that their symptoms are related to their work (16% vs. 2%).

## Conclusion

Our study, to our knowledge the first to evaluate the mental health of collegiate EMTs, suggests that collegiate EMTs are vulnerable to high rates of depression and self-harm, and may not be comfortable seeking help. While rates of self-reported depression are on par with national averages, specific factors contributing to depression in this unique population warrant further evaluation. Potential contributors suggested by this study include student population size, job exposure, and concerns related to confidentiality and trust. Further research is needed to better understand not only these factors, but also the impact of EMS work on mental health and barriers to care.

## Keywords

EMS, mental health, depression, suicide, collegiate EMS



# Analysis of Patient Dispositions by Hour of Shift for Emergency Physicians

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Emergency departments (EDs) across the country continue to see increasing volumes with higher acuity, which can have consequences on ED throughput. One major metric of throughput is the time to decision or disposition time. Once a patient is seen and evaluated with a completed work up, a decision to find the appropriate disposition becomes necessary to generate throughput and open up the bed for the next patient. This study was performed to analyze how decision times are distributed throughout the length of an ED shift. The study was conducted at an academic hospital with an EM residency where resident shifts are matched with attending shifts. Shift lengths are 8 or 9 hours. We performed a retrospective analysis from 07/01/2015 to 06/30/2016 for a total of 2190 shifts. The number of patient dispositions (PDs) by hour elapsed since shift onset was recorded. Dispositions included were: discharge, against medical advice, inpatient or observation bed requested. Eloped patients and left without being seen were excluded. The expected number of PDs by shift hour was calculated by taking the median time to disposition (stratified by ESI) and added to the time when the patient was seen by the attending. A chi-squared test was performed on the data. The first two hours had a similar number of observed PDs (0.3 and 0.8) when compared to expected (0.3 and 0.5). The third through seventh hour had a smaller number of observed PDs (1.4, 1.8, 2.1, 2.4 and 2.8, respectively) compared to expected (3.7, 3.2, 3.0, 2.9 and 3.0, respectively). From the eighth hour onward, there is a larger number of observed PDs (3.1, 2.9, 1.8, 1.2, 0.8 and 0.6, respectively) compared to expected (2.8, 2.4, 1.3, 0.2 and 0.0, respectively). The p-

value of the chi-squared test was 0.001, representing a statistically significant difference. The observed number of PDs by hour of shift differs significantly from the expected number. Whereas the observed data showed PDs towards the later part of the shift, the expected data anticipated more PDs towards the early and middle portions of the shifts. Many factors could contribute to this difference including the desire to have dispositioned patients prior to signout to decrease the burden for the oncoming physician. Other factors might include a non-linear degradation in provider efficiency as the number of hours elapsed during a shift as well as the number of tasks that must be performed.

## Keywords

Disposition, Operations



# And the Winner Is... Teaching Awards in Emergency Medicine: Characteristics of Awardees

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### Background

Despite increasing numbers in medicine, women remain underrepresented in academic medicine. Some hypothesize that unconscious bias may be an important contributor to the small numbers of female physicians choosing academics while others suggest that career interruptions may play a role. While the reasons for gender-based differences in achievement of academic milestones such as promotion and tenure remain unclear, it is important to note that such accomplishments are often tied to outcomes like salary, where gender-based differences exist even when controlling for factors such as experience, rank, and academic productivity. One component of the advancement process is demonstration of teaching excellence, often evidenced by receipt of teaching awards such as those presented by residencies. With research from diverse disciplines demonstrating gender-based differences in learners evaluations of teachers, we wondered if such differences exist in within Emergency Medicine (EM).

### Objective

To describe the relationship between demographic characteristics and receipt of an EM residency-based teaching award during the 2016-2017 academic year. We hypothesized that gender would be significantly associated with award receipt.

### Method(s)

We conducted a correlational study using a web-based survey distributed to US ACGME-approved EM residency training program coordinators (N=218). Dillman tailored design method was employed. Data included program, award, and recipient characteristics and were analyzed using descriptive and correlational analyses.

### Result

Representatives from 129 programs reported on 117 awards, including 74 focused on teaching. Awards were received by a significantly greater proportion academic (v. clinical) track physicians, those 6-15 years post-residency (v. 0-5 or >16 years), assistant professors (v. instructors, associates, professors), and men (0.001 for each). Controlling for career track, length, and academic rank, the gender effect persisted (0.0001).

### Conclusion

In this sample of EM programs, gender was significantly associated with receipt of teaching awards. Additional study is warranted to determine the extent to which teaching awards enhance or impair EM physicians ability to achieve academic advancements.

### Keywords

gender, bias, emergency medicine, education, teaching, awards



# Assessing Pre-hospital providers' Proficiency and Comfort with Performing the Patient Capacity Assessment: A Qualitative Descriptive Study

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**Purpose**

To describe pre-hospital providers self-reported confidence and technical approach to performing patient capacity assessments. Background: When patients refuse medical care in the pre-hospital setting, it is important to determine whether they possess the cognitive capacity to make an informed decision. Medical harms can occur when patients are incorrectly assessed to have capacity. Little literature exists describing pre-hospital providers comfort and approach to performing capacity assessments.

**Method(s)**

Two focus groups were conducted with paramedics. Open-ended probes were used to elicit participants views on conducting capacity assessments, including challenges, facilitators, and comfort level. The focus groups were recorded and transcribed. Transcripts were coded using thematic analysis.

**Result**

Six paramedics were interviewed, representing four services. Providers agreed that determining patient capacity is based on patients ability to understand information, manipulate/reason with that information, and communicate a decision. Participants described the process they use to perform the capacity assessment and persuade patients to accept transportation to the hospital. The skills required to achieve this persuasion

fit into three domains: internal tools, external tools, and environmental tools. Internal tools included proficiency in theory of capacity, promoting beneficence, and communicating reasoning. External tools included utilization of bystanders, law enforcement, and medical control. Environmental tools included organic symptoms, scene context, and local policy. Subjects agreed that the quality of their existing capacity assessment training was inadequate. They preferred a case-based, interactive approach to continuing education.

**Conclusion**

In this pilot study, pre-hospital providers describe a complex process by which they assess capacity, requiring skills in three domains. Participants indicated that current training is inadequate. Further description of the gaps in pre-hospital providers training in capacity assessment as well as analysis of the tools they possess and utilize to perform assessments is needed to update and revise this training. We intend to interview a nationwide sample of pre-hospital providers in order to build a generalizable model.

**Keywords**

Capacity, Pre-hospital Management, Ethics, Emergency Medical Services



# Association Between Hospital Star Ratings and Emergency Department Characteristics

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### Background

The Centers for Medicare & Medicaid Services (CMS) publicly reports Overall Hospital Quality Star Ratings as a single score ranging from one (lowest) to five (highest) stars derived as a composite of nearly sixty individual hospital quality metrics. No prior work has examined a relationship between ED characteristics and overall hospital based ratings.

### Method(s)

We linked data obtained from CMS Hospital Compare to data from the Emergency Department Benchmarking Alliance (EDBA). CMS Hospital Compare publicly reports Hospital Star Ratings. The EDBA dataset includes self-reported survey on ED characteristics and performance metrics. ED characteristics include annual visit volume, teaching status, urban/suburban/rural geography, and acuity based on professional services code. EDBA ED performance metrics included median values of Length of Stay (LOS), discharge and admitted LOS, and boarding time; door to provider time; and Left Before Treatment Completed (LBTC) percentage. We utilized linear regression to assess the correlation between each ED characteristic, ED performance metric, and overall star rating. Student T test and ANOVA were used to assess significant differences in average star rating based on ED characteristics. Logistic regression was used to explore the potential to predict hospital star ratings based on ED characteristics.

### Result

1000 EDs had data available for linkage in both datasets. A significant difference was found amongst all descriptive ED characteristics and average Overall Star Ratings. The average star rating among teaching ED was 2.6 versus nonteaching ED 2.95 ( $p=7.8E-06$ ). The average star rating for urban ED was 2.63, suburban was 2.98, and rural was 3.03 ( $p=5.4E-09$ ). Correlation coefficients between ED performance metrics and higher overall star ratings all performed similarly ( $r=0.88-0.91$ ). No combination of ED characteristics and performance metrics was predictive of overall star rating.

### Conclusion

ED throughput measure performance metrics have a significant relationship with publicly reported overall hospital quality ratings. Dedicating resources to improved ED flow may improve hospital rating. Given significant differences based on ED characteristics, hospital administrators should consider benchmarking star ratings among similar hospitals when comparing results.

### Keywords

Benchmarking, Hospital Ratings



# Association Between Opioid Prescribing and Opioid Use Disorder and Overdose Among Opioid-Naïve Individuals

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## Background

There is little data regarding the incidence of addiction and overdose among opioid-naïve patients initiating opioid treatment and whether the risk of these outcomes is changing over time.

## Method(s)

We performed a longitudinal analysis of opioid-naïve Massachusetts residents age 11 and older receiving an opioid prescription in 2011-2014 using the Massachusetts Chapter 55 dataset. This dataset is comprised of linked data from the Prescription Monitoring Program, the Massachusetts All Payer Claims Database, The Acute Hospital Case Mix database containing all emergency department visits, observation stays and inpatient hospitalizations in the state, the Massachusetts Cancer Registry, and the Office of the Chief Medical Examiner circumstances of death and toxicology reports. We determined the cumulative incidence of subsequent opioid use disorder (OUD), nonfatal or fatal opioid overdose from 2011-2015 using Kaplan-Meier estimates. We specified Cox proportional hazard models incorporating year of initial prescription and treatment characteristics (strength of prescription, concurrent benzodiazepines and therapy duration) as predictors and patient characteristics as covariates. We determined the substances present at autopsy among those who died of opioid overdose in 2014-2015.

## Result

There were 2,074,184 opioid-naïve patients in Massachusetts receiving opioid prescriptions in 2011-

2014. Among those with an initial prescription in 2011, the incidence of OUD was 11.7% at 4 years. The four-year incidence of nonfatal and fatal opioid overdose were 0.55% and 0.075%, respectively. Rates of each outcome decreased over time, with lower rates at each time point for patients receiving initial prescriptions in later years. Longer therapy duration and concurrent benzodiazepines were associated with higher rates of OUD and opioid overdose; strength of initial prescription had a modest association. Of those with an overdose death in 2014-2015, 47.3% had fentanyl present at autopsy.

## Conclusion

Among opioid-naïve individuals starting opioid therapy, there was a substantial incidence of subsequent OUD, while overdose was rare. Shorter treatment duration and avoidance of benzodiazepines were associated with lower risk of OUD, nonfatal and fatal overdose. Rates of each outcome have declined over time in recent years.

## Keywords

Opioid Health Services Research



# Atropine Titrated to Respiratory Mechanics Improves Survival in a Rat Model of Organophosphate Poisoning

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## Background

Atropine is the main anticholinergic agent for acute organophosphate poisoning (OP) but treatment regimens differ depending on the location of treatment with fixed doses used by military in the field and titrated intravenous atropine used in hospital settings. Objectives: Our objective was to compare the survival rates of rats given atropine at either a fixed or titrated dose in an animal model of acute OP poisoning.

## Method(s)

Rats were intubated, anesthetized with isoflurane, and ventilated (Scireq Flexivent FX4). Oxygenation saturation, heart rate, end-tidal CO<sub>2</sub>, peak inspiratory pressure (PIP), lung capacity (LC), and lung elastance (LE) were continuously monitored. Parathion (40mg/kg) was given IV, followed by 2-PAM (90 mg/kg every 6 hours) and atropine (bolus and infusion) once heart rate fell 25% or after 40 minutes. Atropine was initially given as a bolus of 0.6mg/kg followed by infusion at 0.25mg/kg/hr. A second group of rats had the atropine dose titrated. Atropine was increased 0.1mg/kg each hour (or an additional bolus of 0.6mg/kg), or decreased 0.15mg/kg based on the volume and consistency of secretions, change in LC, PIP, and LE. All rats received equivalent suctioning practices and the volume of pulmonary secretions were recorded. Comparison between groups was performed using Fischer Exact or Student T-test.

## Result

Overall survival was higher when atropine was titrated. Animals treated in the fixed atropine group (n=14) had a survival rate of 57.1% at 16 hours (n=8/14) compared to 100% in animals treated with titrated atropine (n=18), p=0.0033. Atropine dosing was increased in 66.7%, unchanged in 22.2% and decreased in 11.1% of animals. Prominent respiratory secretions were seen in 4 of the 6 animals that died in group 1 (fixed dose of atropine). The other 2 animals that died demonstrated a small amount of thickened pulmonary secretions that resulted in airway obstruction. Baseline cardiopulmonary variables did not differ between treatment groups. Animals in both treatment groups demonstrated increasing pulmonary elastance and decreasing lung capacity.

## Conclusion

In this rat model of severe OP poisoning, titrating atropine to pulmonary effects resulted in increased survival. Too little atropine resulted in profuse pulmonary secretions but too much atropine resulted in airway obstruction from thickened secretions.

## Keywords

Organophosphate, Atropine, Poison



# Augmented Triage for Emergency Department Patients Using Gradient-boosting and Deep-learning

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## Background

The Emergency Severity Index (ESI) is a commonly utilized 5-level emergency department triage system. ESI-3, the triage level for stable, but resource-intensive patients, comprises the greatest fraction of the patient census. Creating an additional level of triage within ESI-3 by using the likelihood of admission as a measure of expected resource-use may reduce ED wait-times. In this study, we predict admission in ESI-3 patients at triage using XGBoost, a scalable implementation of gradient-boosting, and deep-learning.

## Method(s)

This retrospective study included 655,677 adult ED visits between March 2013 and July 2017 from one academic and two community emergency departments, filtered by an ESI level of 2, 3, or 4 and a recorded disposition of either admission or discharge. We build on previous work on the topic by including a vast amount of historical data available from the EHR in addition to variables collected at triage, yielding 972 variables per visit. The dataset was split into a training set and a train-validation set comprised of ESI-2, 3 and 4s, and a test-validation and a test set comprised solely of ESI-3, containing approximately 97/1/1/1% of the data, respectively. Three models were built using XGBoost and deep-learning: one from the full set of variables, one from variables of importance extracted from XGBoost, and one from only the variables collected at triage.

## Result

XGBoost and deep-learning performed at an equivalent level on the full set of variables, yielding a train AUC of 0.93, train-validation AUC of 0.92, test-validation AUC of 0.86, and a test AUC of 0.86. The reduced model built from variables of importance yielded a test AUC of 0.83. Both the full and reduced models significantly outperformed the model built using only the variables collected at triage, which yielded a test AUC of 0.78 (95%CI 0.01 for all values).

## Conclusion

Our results provide rationale for including historical data from the EHR as features in a predictive model and illustrate a method of augmenting triage that can be incorporated into the current ESI system.

## Keywords

Machine-learning, prediction, triage, ESI, admission





# Automated Import of External Laboratory Results into an Emergency Department Information System Reduces Repeat Lab Utilization

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## Background

Patients transferred to a tertiary care center from a community ED often have laboratory results sent in paper format or made available through cumbersome electronic medical record linkages. Due to the challenges in reviewing and sharing those records with consulting services, labs are often repeated at the receiving hospital to facilitate viewing the results in a familiar presentation. Often this repeat testing does not serve a clinical purpose, and is purely for communication and visualization reasons. We developed a system to automatically retrieve the ED visit lab results for patients transferred from one of our community sites, and display those results within our homegrown ED information system (EDIS) in a manner similar to how local results are shown. We hypothesized that the automated import of these results would decrease the frequency of repeat labs being performed.

## Method(s)

We performed a before and after study of patients transferred from a community referring hospital to the ED of a single tertiary care teaching hospital over two 6 month periods. Six months of data post-implementation was collected and compared with the corresponding six months the previous year. The primary outcome measure was whether repeat labs were performed within the first four hours of a patient tertiary ED visit. Serum creatinine was chosen as a representative lab test as it is commonly included in standard chemistry panels and rarely changes over short intervals.

Frequency of repeated labs were compared before and after intervention. Significance testing was performed using the Fisher exact test.

## Result

A total of 601 patients transferred between 7/1/2016-12/31/2016 and 7/1/2017-12/31/2017 were included in the study. Automatic display of external lab results decreased the percentage of repeat lab testing from 74% (n=261/352) to 56% (n=139/249), 0.01.

## Conclusion

Automatic import of labs decreased repeat testing and lab utilization in transferred patients. While the results were available electronically at the receiving facility during both study phases, importing those results and displaying them in a more familiar location reduced unnecessary testing. Future studies will be need to study a broader set of labs to better understand the cost savings as well as measure possible impact on clinical care, length of stay and throughput.

## Keywords

Labs; Transfer; FHIR; EDIS, EMR



# Bedside Pelvic Ultrasound Decreases Length of Stay in the Emergency Department

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## **Background**

Emergency physicians (EP) can accurately rule out ectopic pregnancy by visualization of intrauterine pregnancy (IUP) with pelvic point of care ultrasound (PPOCUS). While training in PPOCUS has become standard in modern emergency medicine residency training, EPs frequently have the option of ordering a comprehensive ultrasound (CUS) through the radiology or gynecology departments. Emergency department (ED) length of stay (LOS) is an important metric affecting ED crowding and quality of care. This systematic review and meta-analysis examines the effect of PPOCUS vs CUS on ED LOS.

## **Method(s)**

A systematic review of the literature was performed. Databases searched included Pubmed, Embase, Web of Science, Cochrane, and the Countway Discovery EBSCO Databases in all languages. The study group included patients receiving EP-performed PPOCUS for pelvic pain or vaginal bleeding, and the control group included patients receiving CUS without PPOCUS. Keywords and search terms were generated for PPOCUS, ED LOS and CUS. Two independent reviewers screened abstracts for inclusion. A third reviewer was used when conflicts arose to gain consensus. Articles included for full review were assessed with the Quality Assessment of Diagnostic Accuracy Studies Statement (QUADAS) tool. Meta-analysis was carried out using Review Manager 5 software. Since our outcome of interest was continuous, we pooled the mean differences between studies in which mean and standard deviation were

provided or able to be estimated between groups using a random-effects model.

## **Result**

Database screening resulted in 2901 initial articles. All titles and/or abstracts were screened, 31 articles underwent detailed review, 7 underwent QUADAS review, and 5 were included in the final meta-analysis. There were 675 patients in the study group and 1484 in the control group. All studies showed a decreased LOS with a mean decrease of 93.6 minutes (95% CI 58.1, 129.1). Two studies not included in the meta-analysis (no distribution data given) also showed significantly decreased LOS with PPOCUS.

## **Conclusion**

Use of PPOCUS in the evaluation of pelvic pain or vaginal bleeding decreases LOS. This review suggests that this finding is generalizable to a variety of practice settings.

## **Keywords**

Point of care ultrasound; Bedside ultrasound; Pelvic ultrasound; Emergency medicine; Ectopic pregnancy; Length of stay



# Brain Death and the ToxIC Registry

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**Background**

Comatose patients who present to care after overdose are at risk for premature brain death declaration due to ongoing drug effect. The purpose of this study is to describe the features of patients assessed by medical toxicologists who ultimately have a brain death declaration. Hypothesis: To evaluate cases of toxicologic exposure resulting in brain death declaration.

**Method(s)**

A retrospective search of the Toxicology Investigators Consortium (ToxIC) Registry was performed to collect data on all patients seen by a medical toxicologist who were diagnosed brain dead. Data including age, sex, intent of ingestion, agent involved, and brain death diagnosis were abstracted.

**Result**

From 01/01/2014 to 12/31/2016, we identified 197 deaths. Of these, brain death was confirmed in 82 cases (41.6%). Among those declared brain dead, 41 were male (50%), with a median age of 40.5 years. Self injury was documented in 19 cases, and unknown in 24 cases; in the majority of cases (n=49, 59.8%), toxicologists noted that there was no suicidal

intent. Primary agents listed included opioids (17%), acetaminophen (13.4%), carbon monoxide (n=3), and bupropion (n=2). Reported sedative hypnotic exposures included phenobarbital (n=2, ); two of the opioid cases involved methadone. Discussion: This review provides initial descriptive data regarding patients with confirmed brain death after overdose. We suspect that the outsized population with no self-injury reported is due to opioids. We also recognize that transplant considerations may account for the number of acetaminophen-related cases in this subset. Moreover, long-acting opioid agents and barbiturates can mimic brain death. Limitations: Data on timing and methodology for brain death declaration were not included in these data, and will form the basis for a future ToxIC subregistry.

**Conclusion**

Ongoing drug toxicity may place patients at risk of inappropriate diagnosis of brain death after overdose. Of the limited proportion of patients confirmed brain dead after overdose, details regarding specific methodology and timing of brain death declaration remain unknown. Further studies are needed to ensure optimal management of this specific patient population.

**Keywords**

Brain death, overdose



# Carotid Doppler Ultrasound for the Measurement of Intravascular Volume Status During Lower Body Negative Pressure Simulation

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### Background

Corrected flow time (FTc) is calculated from noninvasive Doppler measurements of the carotid artery. It has been previously validated as a tool for the detection of volume responsiveness in septic patients and blood donors undergoing passive leg raise. Our study aimed to evaluate changes in carotid FTc in a controlled setting using lower body negative pressure (LBNP) to simulate intravascular volume loss.

### Method(s)

This is a prospective laboratory study using healthy human volunteers placed supine with their lower body enclosed in a vacuum-sealed chamber which temporarily pulls blood into the lower extremities reducing central volume under adjustable levels of negative pressure. Spectral Doppler tracings of the carotid artery were recorded at baseline, after simulated blood loss (-60 mmHg LBNP), and after simulated blood transfusion (return to baseline). Flow time and cycle time were measured using electronic calipers. FTc calculations were corrected for pulse rate. Pre- and post-LBNP data were analyzed using two-tailed parametric t-tests.

### Result

15 volunteers were enrolled. 10 completed data collection. 5 were eliminated after becoming symptomatic or due to laboratory equipment failures. Mean carotid FTc at baseline was 344 ms (Standard deviation [SD] 18). Mean FTc after central volume loss, at -60 mmHg LBNP, was 316 ms (SD 22). Mean decrease in FTc from baseline to -60 mmHg was 27 ms (95%

confidence interval [CI] 15 to 40;  $P=0.0009$ ). The corresponding increase in mean HR was 7 BPM (95% CI 2 to 15;  $P=0.1226$ ). Mean FTc after returning to baseline LBNP, was 349 ms (SD 22). This equated to an increase in mean FTc of 33 ms (95% CI 53 to 13;  $P=0.0032$ ) from central volume replacement.

### Conclusion

Our results show that carotid FTc was able to detect intravascular volume loss at levels that preceded detectable changes in heart rate. A decrease in intravascular volume simulated by application of -60 mmHg LBNP was associated with a significant decrease in mean carotid FTc pre- and post-LBNP. Similarly, restoring subjects to their baseline intravascular volume status to simulate volume infusion, was associated with a significant increase in corrected flow time. This demonstrates the potential utility of a noninvasive Doppler measurement of the carotid artery for detecting volume-depletion. Carotid FTc may be a useful bedside tool for the guidance of fluid resuscitation.

### Keywords

point of care ultrasound, fluid responsiveness, intravascular volume status, carotid Doppler, Corrected Flow Time, FTc, Lower body negative pressure



# Caveat Emptor: A National Secret Shopper Survey of Emergency Care Billing in the Era of the Affordable Care Act

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### Background

Access to health insurance with narrow coverage networks and high out-of-pocket spending exposure has risen dramatically through implementation of the Affordable Care Act. Despite this shift to “consumer-focused healthcare coverage, little price transparency exists for healthcare services—particularly hospital-based emergency care. Recent evidence suggests an epidemic of “surprise out of network billing in emergency care; however, empiric evaluation of emergency care billing from the perspective of the patient is limited. Our objective was to utilize a secret shopper methodology to assess the adequacy of emergency care coverage and availability of billing information to patients in advance of an acute, unscheduled emergency department visit.

### Method(s)

We utilized a simulated patient audit, or “secret shopper approach. Trained research assistants posing as a potential patient called all hospital based emergency departments (n=2845) in 30 states. The surveyor asked a series of questions including: 1) Do you take my insurance? 2) Will I get a separate bill from your emergency department? 3) Do your emergency room doctors work for the hospital? In each scenario, the surveyor reported coverage by the most subscribed health insurance within state One attempt was made per hospital. We report descriptive statistics.

### Result

Callers were able to make contact with a person on 2474/2845 (86.9%) calls. Of these 2259/2474 (91.3%) hospitals responded that the emergency department did accept the caller insurance, 8/2474(0.3%) indicated that they did not accept caller insurance and the remaining did not provide a clear response. A total of 1645/2474 (66.5%) hospitals responded that the caller would get a separate bill from the emergency department. Furthermore, 264/2474 (10.7%) responded that ED doctors worked for the hospital, and 1020/2474 (41.2%) indicated that emergency physicians do not work for hospital.

### Conclusion

Despite coverage of emergency services as an essential health benefit by the ACA, nearly 10% of simulated callers were unable to confirm that their ED visit would be covered. With nearly half of calls the source of billing remains nebulous. Future research and policy efforts should explore patient-centered transparency for acute, unscheduled care in the hospital-based ED.

### Keywords

Insurance, Transparency, Affordable Care Act, Secret Shopper



# Comparison of Peri-procedural Amnesia Associated with Moderate Versus Deep Procedural Sedation with Propofol in the Emergency Department

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## Objectives

To determine if there is a difference in procedural amnesia and retrograde amnesia (RGA) between moderate (MS) and deep (DS) sedation with propofol for procedures in the ED.

## Method(s)

This was a randomized clinical trial of patients undergoing procedural sedation with propofol between March 2015 and May 2017. Patients were randomized to a target sedation level of either MS or DS. Drug doses, vital signs, interventions, and observer assessment of alertness/sedation (OAAS) score were recorded. A standardized image was shown every 30 seconds starting 5 minutes before sedation, during sedation, and until the patient returned to their baseline mental status. Recall and recognition of images were assessed 10 minutes after the return to baseline. RD was defined as any occurrence of a SaO<sub>2</sub> < 92%, change in ETCO<sub>2</sub> > 10 mm Hg, or an absent ETCO<sub>2</sub> waveform. Patient perceived recall of the procedure were collected using visual analog scales (VAS). Data were analyzed with descriptive statistics and Wilcoxon rank sum tests.

## Result

107 patients were enrolled; 54 randomized to target MS and 53 to DS. There was no difference in procedural recall or retrograde amnesia between the randomization groups. Among those that achieved MS, patients recognized images during the procedure 27% more frequently than those that achieved DS (22/40 vs

19/68, P=0.02) and recognized images 3.6 minutes sooner than the DS group (P=0.001). Of those who had procedural recall, they had higher VAS recall scores (p=0.04), higher OAAS during the procedure (3 vs 2.3, p=0.001), and had longer procedures (p=0.004). There was no difference in initial or total propofol dosage or incidence of respiratory depression. Patients had over one minute of image recall RGA 32% of the time. Of these patients, there was no difference in initial, second, or total propofol dose, procedural recall, or depth of sedation. Patients had less RGA with image recognition than recall (18% vs 51% at 30 seconds, 12% vs 32% at 1 minute, and 6% vs 17% at 1.5 minutes).

## Conclusion

Targeting MS rather than DS did not change the rate of procedural amnesia or retrograde amnesia. Of those that achieved MS, patients had higher rates of procedural recall and recall occurred more quickly after propofol dose. Of the patients with procedural recall, they were more alert during procedures and tended to have longer procedures. The factors leading to retrograde amnesia are unclear.

## Keywords

Sedation, procedural sedation, propofol, amnesia



# Description of Drug-Assisted Intubation in Statewide Treatment Protocols

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## Background

Endotracheal intubation in prehospital airway management has been a focus of research and debate for decades. Endotracheal intubation is performed using drug-assisted intubation (DAI) or without medication. DAI is divided into rapid sequence intubation (RSI) where a sedative as well as neuromuscular blockade is used or sedative-only intubation. The extent to which DAI is incorporated in statewide treatment protocols (STP) has not been described. The majority of states have STPs that are either mandatory or serve as a guide for medical directors. The purpose of this investigation is to describe the extent to which STPs include DAI and the variability in pharmacopeia utilized.

## Method(s)

Cross sectional study of STP utilizing a standardized review of DAI protocols and medications. Protocol revision date was also captured.

## Result

Thirty one out of fifty states (62%) issue STPs, seven (23%) of which serve as guidelines. RSI is included in the STP of 16 states (52%). Sedative-only intubation is included in the STP of 4 states (13%). The most commonly included induction agent is etomidate (17 STPs, 55%); other induction agents include midazolam (15 STPs, 48%), ketamine (11 STPs, 35%), fentanyl (2 STPs, 6%), and propofol (1 STP, 3%). Succinylcholine is the most commonly included paralytic (16 STPs, 52%); rocuronium (11 STPs, 35%) and vecuronium (7 STPs, 23%) are other approved paralytic agents. 14 states (45%) permit intubation of both adult and pediatric

patients while 6 states (19%) only allow DAI of adult patients. All protocols have been revised within the past 5 years and 75% of protocols were revised since 2015.

## Conclusion

The NAEMSP position statement on drug-assisted intubation recommends the use of a paralytic during DAI, as it increases the likelihood of first pass success. Just over half of all STPs allow for DAI, and 13% allow for sedative-only intubation despite the NAEMSP position statement on DAI. There is significant variation in both the induction agent as well as the paralytic utilized for intubation across STPs. There is also variation in the number of states that allow for both adult and pediatric intubation. Additional research is needed to determine optimal agents and protocols for prehospital intubation.

## Keywords

EMS Operations



# Design and Implementation of a Faculty Development Procedure Education Curriculum

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### Introduction

Emergency medicine physicians (EP) must be able to perform a wide variety of procedures. In academic medical centers with active training programs, the vast majority of procedures are performed by trainees with varying levels of supervision by the attending EP. While this practice allows trainees to learn and hone their procedure skills, it can contribute to attending physician skill decay. Our goal was to design and implement a simulation-based, longitudinal faculty development procedure education curriculum for our emergency medicine faculty.

### Method(s)

We designed a needs assessment survey that was distributed to the EP faculty at our university-affiliated, level 1 trauma center. The results were used to select topics for the curriculum. All faculty were invited to attend the sessions that took place every 8 weeks after faculty meetings. Each session focused on a single procedure and included a didactic component and opportunity for hands-on practice. Attendance was recorded and faculty were asked to complete a survey where they rated their confidence in performing and supervising the procedure before and after the session using 5-point Likert scales (1=Not at all confident, 5=Very confident).

### Result

The curriculum was successfully implemented. On average, 15 faculty EP attended each session (range 10-24). For the emergency childbirth session, confidence in performing/supervising a delivery increased (2.4 to 3.8/2.6 to 3.8). Confidence in performing/supervising a fiberoptic intubation rose (3.2 to 4.1/3.3 to 4.3). Confidence performing/supervising a surgical airway rose (2.8 to 4.3/2.9 to 4.4). Confidence in performing/supervising a Blakemore tube insertion rose (1.7 to 3.8/2.1 to 3.8), as did confidence performing/supervising placement of a trans-venous pacemaker (2.5 to 4.3/2.8 to 4.5). Confidence performing/supervising a thoracotomy rose (2.4 to 3.5/3.0 to 3.6).

### Conclusion

Our data show that we successfully designed and implemented a longitudinal faculty development procedure education curriculum. In addition to being well-attended and well-liked, each session increased confidence in both performing and supervising the selected procedures. Given the dangers of attending physician skill decay, our group plans to continue this curriculum to support ongoing training and learning.

### Keywords

Education, Faculty Development, Simulation





# Diabetic Ketoacidosis Management in the Emergency Department

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## Background

Improved understanding of diabetic ketoacidosis (DKA) has resulted in reduction of morbidity and mortality. Although treatment of DKA has been outlined in literature, management remains difficult as electrolytes, glucose, and fluids require close monitoring. The purpose of this study was to evaluate the quality of DKA management in the emergency department (ED) relative to guideline recommendations.

## Method(s)

This was a single-centered, retrospective chart review at a large academic teaching facility. Data on 44 cases of DKA in the ED was collected and analyzed. Patients were identified using admission International Statistical Classification of Diseases and Related Health Problems (ICD) Codes for DKA. Patients were included if they met diagnostic criteria outlined in the American Diabetes Association (ADA) guidelines and if an insulin drip was initiated in the ED. The primary outcome was compliance to the ADA guidelines recommendations for management of DKA. Secondary outcomes were total volume of fluids administered, potassium replacement prior to initiation of insulin, choice and rate of maintenance fluids, frequency and dose of insulin boluses, initial rate of insulin drips, and rate of glucose correction in the ED. Safety parameters evaluated were incidences of hypoglycemia and hypokalemia. All data was stored in a standardized electronic data collection form using Microsoft Excel, 2015. Continuous data was summarized as medians with standard deviations and discrete data as frequencies.

## Result

A total of 44 patients were included in the final analysis. Sixty did not meet all DKA diagnostic criteria and 2 were not initiated on insulin drips in the ED. Overall, 77% of cases in the ED did not comply with current ADA standards. Insufficiencies identified include not initiating maintenance fluids and insufficient potassium repletion in 73% and 4% of cases, respectively. Patients were not switched to a dextrose containing fluid in 16% of cases. Adverse event rates for both hypoglycemia and hypokalemia were 4.5%.

## Conclusion

DKA remains a challenging presentation to manage in the ED with a large proportion of patients not receiving all components of multifactorial management. Optimization of DKA order sets to include maintenance fluids may help guide providers and avoid potential complications.

## Keywords

Ketoacidosis Endocrine



# Diagnoses from an Emergency Care Center in Rural Kenya

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## Background

Emergency care is a neglected area of focus in low-resource settings. A modern emergency care center with a systematized triage system and the capacity to simultaneously manage multiple patients of varying acuities has not previously been described in rural Africa. The authors previously reported on the first six months of operations of an emergency care center in rural Kenya. The objective this study was to report on the demographics and accompanying diagnoses of patients that presented to this same rural community hospital emergency care center in western Kenya after integration into the local health system and implementation of an electronic medical record.

## Method(s)

Demographics, mode of arrival, triage priority, chief complaints, discharge diagnoses, and dispositions were prospectively extracted from the electronic medical records of all patients that presented to the Sagam Community Hospital Emergency Care Center between October 1, 2016 and September 30, 2017.

## Result

There were 14,518 unique patient encounters at the Sagam Community Hospital Emergency Care Center over this one year interval. 8,931 (61.5%) were female, 5,571 (38.4%) male and median age was 32 years (interquartile range 17-55). Of the total visits, 12,668 (87.3%) were triaged as low acuity and hospital admission rate was 15.4%. The ten most common disposition diagnoses were malaria (n=3,704, 18.9%), acute upper respiratory tract infection (n = 1,242, 6.3%), injury (n = 828, 4.2%), urinary tract infection (n=764, 3.98%), viral syndrome (n=622, 3.17%), pneumonia (n=614, 3.13%), gastroesophageal reflux (n=612, 3.12%), gastritis (n=608, 3.1%), labor (n=495, 2.52%), and arthritis (n=461, 2.35%).

## Conclusion

Malaria, respiratory infections and acute injuries were the three most common diagnoses among patients that presented to the Emergency Care Center at Sagam Community Hospital. This distribution of diagnoses may assist in the design of emergency care centers elsewhere in rural East Africa.

## Keywords

Electronic medical services, Kenya, low-resource setting, electronic medical record



# Disparities in Treatment of Non-Purulent Cellulitis in Intravenous Drug Users

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## Background

Although it is well known that general compliance with the Infectious Disease Society of America (IDSA) guidelines for cellulitis treatment is poor, the level of compliance when treating intravenous drug users (IVDUs) specifically is unknown. Skin infections in IVDUs are categorized as moderate or severe by the IDSA due to the associated high rates of failing treatment and are recommended inpatient treatment for the infections. Often IVDUs are admitted to ED observation (EDOBS), a unit for patients who require further assessment, to determine if ED treatment was adequate or if inpatient admission is necessary.

## Objective

Compare treatment compliance to IDSA guidelines between IVDUs and non-IVDUs and determine treatment failure rates in the EDOBS unit.

## Method(s)

We conducted a retrospective chart review of 444 patients, ages 18 years or older, treated for a cellulitis infection at one community or one academic ED from December through May 2017. The IVDU group consisted of any patient with documented current or past intravenous drug use. Treatment regimens were compared to the IDSA guidelines for non-purulent skin infections. Discrete variables were analyzed using Pearson chi square test, and we used multivariate logistic regression to assess predictors of being undertreated adjusted for the contributions of other variables.

## Result

Of the 444 patients treated during the study period, 46.4% were female, the mean age was 51.2 18.4 years, and there were 60 (13.5%) individuals in the IVDU group. Treatment for IVDUs matched IDSA guidelines less frequently (31.7% vs 46.1%,  $p=0.001$ ) and IVDUs were more frequently undertreated (45% vs 12%,  $0.001$ ). After adjusting for age, gender, and illness severity, IVDUs were more than two times more likely to be undertreated when compared to non-IVDUs (OR 2.38; 95% CI 1.15, 4.95). The IVDU group was also 3.9 times more likely to fail EDOBS treatment, requiring inpatient admission (OR 3.85; 95% C.I. 95% 1.01-13.6).

## Conclusion

Patients classified as IVDUs are twice as likely to be undertreated and four times more likely to fail EDOBS treatment than non-IVDU patients. Although in general adherence to IDSA guidelines is poor, this problem is particularly pronounced in IVDUs. In addition, high rates of EDOBS failure indicate the recommended inpatient treatment of IVDUs should be followed more closely.

## Keywords

Intravenous drug use, Infectious Disease Society of America guidelines, cellulitis



# Do Gender Differences Exist in Emergency Medicine Faculty Shift Evaluations of Emergency Medicine Residents?

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## Background

Recent literature demonstrates a gender bias in faculty milestone assessment of EM residents. This topic and its implications are receiving more attention among medical educators. Despite attempts to eliminate bias, resident assessment inevitably has significant subjectivity. It is unknown whether faculty gender plays a role in the amount of resident feedback in shift evaluations. The purpose of the study was to determine whether differences in free text feedback of EM residents in faculty shift evaluations correlate with resident and faculty gender.

## Method(s)

This was a retrospective study of EM resident shift evaluations by EM faculty at a single academic, urban medical center with a three-year residency program. Electronic resident shift evaluations by academic faculty were prospectively collected from 2013 to 2016. Number of words in the "strengths and suggestions for improvement" comment boxes, attending gender, and faculty gender were recorded. Nonacademic faculty and faculty who completed less than five evaluations during the study period were excluded. We compared number of words for both "strengths and suggestions for improvement" comments by resident and faculty gender using multivariate general estimating equations models. Models were adjusted for resident post-graduate year.

## Result

During the study period a total of 4965 evaluations were completed by 52 faculty members. Compared to male attendings evaluating male residents, female faculty provided a greater number of "strength" words for both female and male residents (B coefficient 0.306,  $p=0.031$  and B coefficient 0.308,  $p=0.011$ , respectively). Similarly, female faculty provided a greater number of "suggestions" words for male residents (B coefficient 0.228,  $p=0.048$ , but not to female residents (B coefficient 0.179,  $p=0.27$ ), while male attendings provided less "suggestions" words to female residents (B coefficient 0.179,  $p=0.27$ ).

## Conclusion

Female faculty provided significantly more "strength" words compared to male attendings. Multicenter studies are needed to further validate these findings. Faculty should be aware of these biases when evaluating trainees as this can have an impact on resident assessment.

## Keywords

resident evaluation, milestone, residency education



# Do Likes Attract? Patient Experience Through the Lens of Gender Concordance

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### Background

Gender concordance (GC) is thought to lead to increased medical compliance, better outcomes, and improved patient satisfaction. Past primary care studies suggest an overall preference for male doctors by patients of both genders except for “sensitive complaints and “bad news visits where concordance seems to improve levels of satisfaction. Little is known about the effect of GC on patient satisfaction in emergency medicine. Prior studies have focused on post-visit survey. Little work to date has focused on large databases. This study seeks to determine if there is an association between patient physician GC and improved levels of satisfaction as reflected in the Press Ganey (PG) scores.

### Method(s)

We performed a retrospective analysis of EHR and PG data for 36 months from 2015-2017 involving one large academic site and two community sites within a single healthcare system. We used a proprietary dashboard that overlays our EPIC database with PG data for returned surveys for treat and release patients. We summarized categorical data using frequencies and proportions with 95% confidence intervals (CIs). Continuous data were summarized using means with standard deviations (SDs) or medians with interquartile ranges (IQRs), where appropriate. To determine the effect of concordance on PG results, an analysis of covariance was performed with physician gender and

patient gender serving as independent variables, and patient age serving as a covariate. P value of 0.05 was considered statistically significant.

### Result

The number of visits with returned PG surveys was 9518, of these, 7029 (73.8%) with completed gender data were included in the analysis. The overall PG response rate was 9.2% for the three-year period. Analysis revealed the following mean PG scores for all patients with male MD 86.7 (n=4094), all patients with female MD 85.9 (n=2935 Male patients with male MD 88.4 (n=1608), Male patients with female MD 87.6 (n=1150), Female patients with male MD 85.8 (n=2486), Female patients with female MD 84.9 (n=1785). Analysis of covariance, shows no statistical difference in mean overall PG scores between models with and without gender interaction terms, p-value =0.5906

### Conclusion

In this multi-site retrospective analysis containing large sample of PG data, there was no statistical difference in overall PG scores with gender concordance.

### Keywords

Sex and Gender, Gender Concordance, Patient Experience, Patient Satisfaction, Operations, Emergency Medicine



# Do Morbidity and Mortality Presentations Alter Subsequent Error Rates in Emergency Medicine?

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## Background

Morbidity and Mortality (M&M) rounds are traditional, recurring, peer review conferences presenting cases with adverse outcomes and difficult management decisions. These rounds are commonly held in large healthcare institutions by medical services. Their primary objective is to learn from complications and errors, modify behavior and judgment based on previous experiences, and prevent repetition of errors leading to complications. It is unclear if there is a direct effect in altering types of case presentations in future M&Ms or if there is an effect on attending-specific presentations. We hypothesized that there would be a difference among chief complaint (CC) of M&Ms from year-to-year as M&Ms should modify behavior and systems to prevent repetitive errors arising from specific types of complaints. We also hypothesized that there would be an effect in the rate of M&M case presentations based on years of clinical experience secondary to an educational effect.

## Method(s)

We reviewed all M&M cases from 2012-16 in our ED. M&Ms were grouped in 12 different CC categories. Poisson regression was used to compare CC category frequency across years. Poisson regression was used to adjust for covariates including experience (categorical: 1-4, 5-9, 10+ years), attending fixed effects, linear time effects, and time-by-experience interactions.

## Result

There were 427 M&M cases presented from 2012-16. Across all CCs, there were 12.5 more cases presented per year ( $p=0.01$ ) with no difference between CC categories from year-to-year ( $p>0.7$  for all categories). Attendings with 1-4 years of experience had an increasing year-to-year trend in number of M&M cases over the 5 years, consistent across all CCs. Attendings with 5-9 or 10+ years of experience had significantly fewer M&Ms when compared to 1-4 years of experience (0.001).

## Conclusion

There was a consistent increase in the number of M&M cases over the 5 years studied with no change across CC category from year-to-year. Newer attendings show increased rates of M&M cases relative to more experienced attendings. This may be a function of increasing prominence and systematic use of the M&M system, but there does appear to be an "experience effect". Further studies are needed to fully investigate the educational effect of M&M presentations.

## Keywords

Morbidity and Mortality; Clinical Education; Quality Assurance



# Does Completeness of Nursing Home Transfer Documentation Impact Emergency Department Admission?

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## Background

Nursing home (NH) residents account for over 2.2 million US emergency department (ED) visits annually. EDs rely upon the accuracy of NH transfer documents to assess patient needs, although this topic has not been well studied. We aimed to assess the extent to which completeness of these documents impacts likelihood of hospital admission of NH residents.

## Method(s)

This retrospective study examined NH transfer documents of visits to three EDs of a large urban healthcare system from Sept. 2015 to Sept. 2016. Residents of assisted and independent living were excluded. Two abstractors blinded to the study aims reviewed the completeness of NH transfer documents according to the expected core components of transfer communication, as defined by the INTERACT 4.0 quality improvement tool. Multivariable logistic regression with random effects was used to assess the association between the completeness of documentation per the INTERACT 4.0 and hospital admission, adjusting for patient characteristics (age, gender, race/ethnicity), ED, clinical severity (Emergency Severity Index) and comorbidities (Charlson Comorbidity Index).

## Result

496 visits were included in the study; the median patient age was 78 years; 43% were male, and 33% had dementia. NH transfer documents were present for 95% (95% CI: 94-96%) of patients sent to the ED, the state Department of Health-required continuity of care form present for 69% (95% CI: 67-71%), and 77% (95% CI: 75-79%) of transfer document core components per the INTERACT 4.0 tool were complete. After accounting for patient characteristics, ED, clinical severity, and comorbidities, hospital admission was more likely when more of the core components of NH transfer documentation were complete (aOR 1.09, 95% CI: 1.01-1.18).

## Conclusion

More complete NH transfer documents was associated with greater hospital admission likelihood, even when accounting for clinical severity and comorbidities. The results suggest that better NH documentation can assist ED clinicians determine appropriate dispositions for these medically complex patients.

## Keywords

transfer documentation



# Does Use of a Novel Hospital Gown Improve the ED Patient Experience? A Pilot Randomized Controlled Trial

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### Background

Optimization of the patient experience plays an increasingly important role in health care. Patients view the traditional hospital gown as uncomfortable, immodest, and dehumanizing. Modification of the hospital gown represents a low risk opportunity for improving the patient experience. We hypothesized that a novel hospital gown addressing patient priorities would improve the patient experience.

### Method(s)

We designed and constructed a novel hospital gown that addressed patient priorities, including comfort, modesty, and humanization. The gown was studied in a suburban community ED. 20 patients were randomly assigned to change into either a novel gown or a traditional gown upon their arrival in the ED. Prior to departing the ED, study participants completed a paper survey consisting of Likert scale and open ended questions that inquired about their perceived ED experience vis-à-vis the gown, including its ease of use as well as how it contributed to their comfort, modesty, and respect. Survey responses were compared via two-sample t-tests.

### Result

English speaking patients over age 18 were included in the study; patients with BMI over 41, height greater than 65", altered mental status, and for whom the novel gown presented a safety risk were excluded. There were no significant differences in age, BMI, or gender between the two groups. Patients in the novel gown group were significantly less likely to feel physically exposed than those in the traditional gown

group (Likert Score 1 v. 2.9,  $p \leq 0.01$ ). They were also significantly more likely to feel that the gown was warm (2.5 v. 1.5,  $p=0.05$ ) and that they would use the gown again (3.1 v. 1.9,  $p \leq 0.05$ ). There were trends towards an increase in comfort (2.9 v. 2,  $p=0.07$ ), respect (2.3 v. 1.5,  $p=0.08$ ), and improvement in hospital stay (2 v. 1.4,  $p=0.07$ ) among patients in the novel gown group as compared to those in the traditional gown group. There were no significant differences in ease of use between the two groups.

### Conclusion

Patients perceived the novel gown to be more comfortable and modest than the traditional gown and were more likely to report that they would use it again, suggesting that modification of the traditional gown to better align with patient values holds promise as a low risk means of optimizing the patient experience.

### Keywords

Patient satisfaction





# Drip and Ship vs. Ship and Drip: tPA Use in the Northeast

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## Background

Transfer of acute ischemic stroke (AIS) patients is common. Characteristics of transferred vs non-transferred patients likely differ, but differences in the quality of stroke care by transfer status are not well-described.

## Method(s)

We used prospectively collected data from the Get with the Guidelines-Stroke registry from 234 of the 394 Northeast hospitals to identify AIS patients from 2007-2011. Medical history, presentation, transfer status, and treatment variables were analyzed. Descriptive statistics characterized patients stratified by transfer status. Differences were compared using Pearson chi-square for categorical and Kruskal-Wallis tests for continuous variables.

## Result

Of the 85,992 AIS patients in our sample, 5768 (6.7%) were transferred. Transferred relative to non-transferred patients were younger, more often male and white (78 vs 81 years; 48% vs 42% male; 90% vs 83% white; all 0.001), with similar onset-to-first hospital arrival time (144 vs 165 minutes,  $p=0.07$ ). Transferred patients had more severe strokes than non-transferred (median initial NIHSS 6.5 vs 5, 0.001), and median NIHSS generally increased from sending to receiving hospitals (6.5 to 8, IQR 3-15 to 3-16). Transferred patients were as likely to receive tPA as non-transferred patients (5.5% vs 5.2%,  $p=0.29$ ), however tPA was more often given after transfer (67.3%). Among tPA-treated transfer patients, institutional door-to-needle time was faster for those treated at the receiving hospital than for those at the sending hospital (59 vs 79 minutes), as was door-to-needle  $\leq 60$  minutes (53% vs 30%). Time from onset to tPA was similar among transferred and

non-transferred patients, regardless of whether treatment occurred at the sending or receiving hospital (median times: 142 minutes for non-transferred, 149 when treated at sending hospital, and 154 when treated at receiving hospital,  $p=0.13$ ).

## Conclusion

Transferred AIS patients in the Northeast were as likely to receive tPA as non-transferred patients, with treatment more often after transfer to another hospital. Despite potential delay with transfer, time from symptom onset to treatment was similar for transferred vs non-transferred patients. Research in more contemporary cohorts is needed to determine if there are regional patterns of care and if quality improvement efforts have altered these findings.

## Keywords

Stroke; thrombolytics; systems of care



# Effect of a Controlled Substances Law on Prescribing Patterns of Emergency Providers

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## Background

Nearly 2 million Americans abuse or are dependent on prescription opioids, the leading cause of overdose deaths in the US. New state policies are part of a multifaceted approach to reduce avoidable opioid prescribing. In April 2016, Maine passed Chapter 488, legislation mandating: (1) use of electronic prescribing and the PMP for benzodiazepine and opioids, (2) new prescriptions to be 100 morphine milligram equivalents (MME) or tapering to 100 MME for existing prescriptions and (3) continued education for prescribers. We sought to evaluate whether this law influenced prescribing patterns in the highest volume emergency department (ED) in Maine.

## Method(s)

We conducted an interrupted time-series analysis of health record data collected in our tertiary referral center ED before-and-after implementation of the expanded law. The primary outcomes were monthly opioid and benzodiazepine prescriptions for discharged ED patients from 1/2015 to 10/2017. We inferred the law effect on prescribing patterns by comparing month-by-month MME and benzodiazepine equivalents (BZE). In addition, we assessed for changes in tramadol prescribing.

## Result

We observed a significant decline in the number of opiate prescriptions overall (monthly mean (M) 508,  $\pm$ 51 vs. 353,  $\pm$ 66), the total MME prescribed each month (M 63225,  $\pm$ 8052 vs. 39852,  $\pm$ 9208), the number of opioid orders per

ED patient (M 0.14,  $\pm$ 0.01 vs. 0.10,  $\pm$ 0.02), and the number of MME prescribed per ED patient (M 17.6,  $\pm$ 1.96 vs. 11.1,  $\pm$ 2.5) (0.001 for each) following implementation of Chapter 448. Similarly, significant reductions in the number of benzodiazepine prescriptions (M 86,  $\pm$ 13.0 vs. 69,  $\pm$ 13.2) and the number of benzodiazepine prescriptions per patient (M 0.023,  $\pm$ 0.003 vs. 0.019,  $\pm$ 0.003) were noted (0.001 for each). An increase in the number of tramadol prescriptions was not noted; tramadol MMEs did decrease significantly in the post-legislative period (M 2494,  $\pm$ 874 vs. 1742,  $\pm$ 544,  $p=0.004$ ).

## Conclusion

Enactment of a state controlled substance law led to a significant reduction in the amount of opioid and benzodiazepine prescribing by ED providers at our institution. These findings are consistent with similar studies, suggesting that policy change can influence clinical practice.

## Keywords

opioid prescribing, benzodiazepine prescribing, legislation, health policy, prescription monitoring program



# Effectiveness of an Acute Sexual Assault Curriculum for Emergency Medicine Residents

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### Background

Caring for acute sexual assault (ASA) patients is a task all emergency providers (EPs) face. Although the American Board of Emergency Medicine views competence in this area as essential, training in it varies among EM residencies. An ASA curriculum has been adopted in the Department of EM at Alpert Medical School of Brown University as part of weekly required EM residency didactics. The objective of this study was to determine the curriculum effectiveness in terms of affective objectives.

### Method(s)

After participation in the curriculum, learners were asked to fill out a written retrospective pre-/post-survey that included Likert scale questions regarding their perceived ability to provide components of ASA care and their attitudes towards such care. These questions addressed ability in the identification of patients who are eligible for forensic evidence collection, drug facilitated sexual assault testing, sexually transmitted infection (STI) testing and prophylaxis, and emergency contraception; accurate completion of a sexual assault evidence collection kit; identification of genital injuries; ordering of Centers for Disease Control and Prevention-recommended STI and pregnancy testing and prophylaxis; and treatment of patients in a trauma-informed manner. One question inquired about the extent to which learners agreed that providing ASA care is part of the EP role. Pre- and post-survey responses were compared via paired t-tests.

### Result

21 learners participated in the curriculum. Compared to pre-survey responses, post-survey responses demonstrated significantly increased perceived ability in the aforementioned areas (all  $p \leq 0.001$ ). Additionally, compared to pre-survey responses, post-survey responses revealed stronger agreement that providing ASA care is part of the EP role ( $p=0.002$ ).

### Conclusion

Learners who participated in the ASA curriculum gained self-efficacy with regard to their ability to care for ASA patients and viewed caring for this population as more critical to their role as an EP after participation as compared to before participation.

### Keywords

sexual assault, graduate medical education



# Efficacy of Resident-Run Procedure Sessions for Medical Students

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### Background

With many medical schools decreasing the length of pre-clinical education, less time remains for teaching procedures prior to clerkships. Studies have shown that residents and attendings perform similarly when lecturing students, and that resident teaching competency mirrors clinical competency; however, there is limited data on hands-on teaching of medical students by residents. We sought to assess the efficacy of a resident-run procedure session created for pre-clinical medical education, hypothesizing that this would be an effective teaching modality.

### Method(s)

This study is a retrospective, cross-sectional study of medical students and emergency medicine residents from a single academic medical center. Residents created a curriculum for teaching five core emergency medicine procedures (intravenous lines, intra-arterial lines, laceration repairs, orotracheal intubation, bag-mask ventilation) during 2.5-hour sessions. Students who participated were given anonymous questionnaires to assess their comfort performing each procedure both before and after the session. Answers were given on a 5-point Likert scale. Data were analyzed using T-tests to compare pre- and post-session scores.

### Result

A total of 70 first-year medical students who participated in a full session were included in the study. The average comfort levels for intravenous lines before and after the session were 1.35 (95% CI -0.25 to 3.15)

and 3.80 (95% CI 2.22 to 5.38); for arterial lines, 1.12 (95% CI 0.30 to 1.94) and 3.54 (95% CI 1.66 to 5.20); for laceration repairs, 1.55 (95% CI -0.03 to 3.13) and 3.62 (95% CI 2.10 to 5.14); for bag-mask ventilation, 2.26 (95% CI -0.18 to 4.70); and for orotracheal intubation, 1.18 (95% CI 0.12 to 2.24) and 3.45 (95% CI 1.55 to 5.35). The difference between pre- and post-session scores for each procedure reached statistical significance, with all p values < 0.0001.

### Conclusion

Medical students view resident-run procedure sessions as an effective tool to increase their comfort in performing emergency medicine procedures. Further sessions with different student/resident populations and different procedures would make these findings more generalizable. Establishing a protocol for observing and scoring medical students performing these procedures before and after the session would decrease bias in determining the utility of similar curricula.

### Keywords

education, simulation, procedure, resident, medical student



# Emergency Department Texting Lifespan with Care: The Feasibility and Acceptability of a Bi-Directional, Text Message-Based Intervention in the Emergency Department

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## Background

Text messaging improves adherence to medication and follow-up appointments in outpatient populations. Disease-specific text message programs are acceptable and feasible in the ED. The feasibility, acceptability, and efficacy of bi-directional, post-discharge text messaging for undifferentiated chief complaints have not been determined.

## Method(s)

A convenience sample of English-speaking, discharged adult patients with any non-psychiatric complaint was recruited from 2 EDs over 7 months. Consenting participants completed a validated baseline survey and were randomized to receive either usual care (UC) or post-discharge text messages plus usual care (SMS). SMS participants received 3 days of automated messages asking if they made follow-up appointments and filled prescriptions. The primary outcome was feasibility and acceptability of SMS (defined as message response rate  $\geq 60\%$ ; System Usability Scale (SUS) score  $\geq 68$ ; and rate of users needing nurse contact), assessed with descriptive statistics. Secondary outcomes were satisfaction (willingness to return to same ED per validated, post-intervention questionnaire), discharge instruction adherence (self-report of filling prescriptions and making appointments), and return visits to in-network EDs within 14 days, comparing UC and SMS groups with

multivariable logistic regression. Theory-based covariates included age, gender, race/ethnicity, income, chief complaint, and ED utilization.

## Result

220 participants (76.1% of eligible) consented; 109 (49.6%) randomized to SMS; 160 (73.0%) completed 7-day follow-up. Mean age was 35.9 (SD 13.6); 51.8% were female; 49.5% were non-Hispanic white. Overall SMS response rate was 70.0%. Mean SUS score was 75.5 (SD 22.4). Only 5 (2.3%) participants required nurse contact based on message responses. Compared to UC, SMS participants had adjusted odds ratio (aOR) 0.79 (95%CI 0.27-3.20) of satisfaction; aOR 1.88 (95%CI 0.89-3.97) of making a follow-up appointment; aOR 1.32 (95%CI 0.40-4.39) of filling prescriptions; and aOR 1.62 (95%CI 0.53-4.91) of a 14-day return visit.

## Conclusion

Automated, bi-directional text messaging is feasible and acceptable to discharged adult ED patients. Studies with larger sample sizes are needed to define the association between this intervention and satisfaction, discharge instruction adherence, and ED recidivism.

## Keywords

Text messaging; digital health; mHealth; medication adherence; follow-up appointment; patient satisfaction; emergency department recidivism.



# Emergency Department Triage Pain Score is not Associated With Admission to Hospital

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## Background

Vital signs have long been recorded in the initial screening as part of the process to triaging patients. Patients with abnormal vital signs are associated with increased mortality and need for admission which assists in the triage process. The Joint Commission Pain Management Standards advanced the idea of the pain score as the “fifth vital sign”. The objective of this study is to determine if the Pain Score is associated with admission to the hospital and helpful in the triaging of ED patients.

## Method(s)

This is a retrospective cohort study performed at an academic hospital with an annual ED volume of ~55,000 patients. The study period was from 01/01/2016-12/31/2016. Triage vital signs including temperature, heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, pulse oximetry, as well as triage pain score, Emergency Severity Index (ESI), age, gender, ED length of stay (LOS) and disposition were extract from the electronic health record. Patients who had missing pain scores were excluded. A multivariate logistic regression model was used to test for significance of all covariates with the primary outcome being a binary outcome of admission to hospital. A Hosmer-Lemeshow goodness of fit test was performed to ensure no evidence of poor fit.

## Result

A total of 52,746 patients were included in the study. Temperature, heart rate, systolic blood pressure, respiratory rate were all found to be significant predictors of admission to the hospital ( $p < 0.001$ ). ESI, age and LOS were also significant covariates ( $p < 0.001$ ). The pain score was not significant ( $p = 0.75$ ), nor was diastolic blood pressure ( $p = 0.51$ ) or gender ( $p = 0.63$ ). The Hosmer Lemeshow test did not have evidence of poor fit ( $p = 0.47$ ).

## Conclusion

The pain score unlike other vital signs are not associated with admission to the hospital. While symptomatic relief of pain in the ED is important, treating the pain score as a vital sign is not beneficial for the triaging of patients unlike temperature, heart rate, blood pressure, respiratory rate and pulse oximetry.

## Keywords

pain, triage, admission



# Emergency Physicians Accurately Identify Wall Motion Abnormalities

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## Emergency Physicians Accurately Identify Wall Motion Abnormalities

### Background

The ability to identify wall motion abnormalities may be useful for emergency clinicians, but is not typically evaluated in point-of-care echocardiograms. We sought to determine if emergency physicians with basic training in emergency echocardiography could identify regional wall motion abnormalities (RWMA) in patients admitted with ST-elevation myocardial infarction (STEMI).

### Method(s)

We prospectively enrolled a convenience sample of patients with admitted with STEMI to a regional referral center for cardiovascular care. Emergency medicine resident physicians with basic training in emergency ultrasound, blinded to other patient data, performed a point-of-care echocardiogram to evaluate for RWMA. If present, they also recorded the suspected territory of the RWMA. We calculated test performance characteristics and compared the agreement between point-of-care and comprehensive echocardiogram for RWMA and territory.

### Result

75 patients with STEMI were enrolled; 6 were excluded (2 withdrew consent, 1 left against medical advice, 2 had no interpretable echocardiogram images, and 1 had incomplete data), leaving 69 with data for analysis. 62% had a RWMA. RWMA were identified with excellent test performance characteristics (sensitivity 88% (95% CI 75-96); specificity 92% (95% CI 75-99). The area under the

receiver operating curve was 0.74 (95% CI 0.61-0.87).

The RWMA territory was identified accurately with strong performance (sensitivity 87% (95% CI 73-96); specificity 83% (95% CI 65-94). There was substantial agreement between the point-of-care echocardiogram and reference standard (Cohen kappa = 0.79; 95% CI: 0.64-0.94) for detection of RWMA.

### Conclusion

Emergency physicians with basic training in point-of-care echocardiography accurately identified RWMA in patients with STEMI. These results support providing focused training in RWMA detection and expansion of the clinical uses of emergency echocardiography.

### Keywords

regional, wall, motion, point-of-care, echocardiogram



# Emergency Physicians' Experience with the Safe Handling of Firearms Encountered in the Workplace

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## Background

Emergency physicians (EPs) experience high rates of workplace violence, the risks of which increase with the presence of weapons. Up to 25% of trauma patients brought to the ED have been found to carry deadly weapons, including guns. Given that EPs are vulnerable to workplace violence and knowing that they are at risk for encountering firearms, we conducted an educational needs assessment to characterize EPs experience with handling these weapons. We aimed to assess EPs knowledge of firearms, frequency of encountering firearms in the ED and level of comfort with safely removing firearms from patient care settings.

## Method(s)

This was a survey study of resident and attending EPs at 2 academic and 4 community hospitals in the midwest and northeast. A 26-item questionnaire was emailed to all EPs at the 6 institutions. The questionnaire included multiple choice and free response questions pertaining to EPs knowledge of firearms, experience with handling firearms and exposure to firearms while at work. Proportions and p values were calculated.

## Result

One hundred fifty of 243 recipients (61.7%) completed the survey. Thirty three respondents (22.0%) reported encountering firearms in the ED workplace. Ninety one

respondents (60.7%) report never handling a firearm, and 25 (16.7%) handle firearms at least once per year. Thirty six respondents (24.0%) report formal firearms training, and 64 (42.7%) have had no firearms training of any kind. There were no significant regional differences regarding firearms training or exposure. Twenty three respondents (15.3%) felt extremely confident that they could safely handle a firearm until it could be turned over to law enforcement, while 41 (27.3%) reported no confidence that they could do so. Respondents from the northeast were more likely to be extremely, moderately or somewhat confident in this regard than those from the midwest ( $p=0.031$ ).

## Conclusion

The majority of EPs at the surveyed institutions report little experience with safely handling firearms. There is a regional difference in confidence in handling firearms prior to law enforcement involvement. Given the realities of workplace violence and the frequency with which firearms are encountered in the ED, further investigation is needed to evaluate provider competence in safely handling them. EPs may benefit from dedicated training on this topic.

## Keywords

Medical education, Workplace safety, Firearms





# Epidemiology of Trauma Patients with Head Injury at a Tertiary Hospital in Rwanda

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**Background**

Little is known about the epidemiology of head injury in Rwanda. In this study we use a linked prehospital to hospital database to investigate the use of alcohol, demographics, mechanism, and degree of acute medical interventions amongst patients with head injury.

**Method(s)**

This was a retrospective cohort study. Data was collected on patients with head injury who were transported by prehospital care providers to the University Teaching Hospital of Kigali (UTH-K) from December 2012 to February 2015.

**Result**

Amongst 945 patients with traumatic injuries, 534 (56.5%) patients had head injury of which 429 (80.3%) were males and 105 (19.7%) females. The median age was 30 (IQR: 25, 36). Road traffic accidents (RTA) caused 78% (n=417) of head injuries. Approximately 17% (n=89) of head injury patients involved in road traffic injuries were pedestrians. Glasgow Coma Score (GCS) was recorded for 416 (79.9%) patients of which 32 patients had a GCS less than eight. Of these, 14 were successfully intubated in the emergency department. There were 17% (n=93) confirmed cases of alcohol use

and 81.3% (n=434) cases where alcohol use was not evaluated. 184 patients were admitted of which 24 (13%) underwent craniotomies and 17 (9.2%) patients died after admission. The overall mortality rate was 7.3% with 4.1% of deaths occurring in the ED.

**Conclusion**

A significant proportion of prehospital patients with trauma have head injury and most head injuries occur due to road traffic accidents. Notably, 1 in 6 head injuries involved a pedestrian struck by a vehicle and more than half of deaths amongst patients with head injury occurred in the ED. It is important to note that though most cases of alcohol use are not documented, the number of patients with confirmed alcohol use still remains high. Documentation of alcohol use and the epidemiologic description of patients with traumatic head injury can provide critical information to help guide strategies in the public health prevention, treatment and management of traumatic head injuries in Rwanda.

**Keywords**

Keywords: alcohol, head injury, pedestrian, trauma, Africa



# Evaluating The Viability of an Urgent Care Center in Nigeria

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## Background

Nigerians lack access to affordable, high quality primary and urgent health care services. Current estimates are that between 25 and 50% of all sick children and adults do not receive needed care. There are currently no urgent care centers in Nigeria and healthcare is mostly delivered through hospitals which is expensive. We hypothesized that a survey of Nigerian adults would show that a majority of visits to hospitals are for conditions that can be managed in an ambulatory setting. We also sought to gather information on the average spend at different healthcare facilities, and estimate the likelihood that Nigerians would be willing to use an urgent care facility.

## Method(s)

We performed a cross-sectional survey of adult Nigerians in October 2015. The survey was conducted via telephone interviews of a random nationwide sample of 1,004 people 18 years and older from the six geo-political zones in the country.

## Result

88% of respondents indicated that a member of their household (themselves included) had visited a medical facility within the past year. Most Nigerians had visited public hospitals (53%), Pharmacies (43%), and private hospitals (34%) over the last year. There was overlap because a significant proportion of respondents had visited different facilities over the course of the year. There were no significant differences in preference for medical facility by gender or age group. Malaria, cough or cold, fever and headache accounted for 63% of all encounters. Most Nigerians (74%) traveled less than 30 minutes to the medical facilities they visited. Although respondents visited medical facilities for similar conditions, there were major differences in the average amount spent at the different facilities Chemist (₦1,365

/ \$6.83), Pharmacy (₦1,879 / \$9.40), Public Hospital (₦3,204 / \$16.00), and Private Hospital (₦5,744 / \$28.72). 79% of respondents were very likely or likely to seek care from an urgent care center.

## Conclusion

Nigerians access care mostly for disease conditions that can be managed in an ambulatory setting. Most people use healthcare services that are in close proximity to them (less than 30 minutes away). Many Nigerians would be willing to use an urgent care facility for their healthcare needs. Considering that pharmacies are visited very often, a model of care delivery to explore would be to provide physician consultation at existing pharmacies.

## Keywords

international, urgent care, global health



# Evaluation of a Near Real-time Statewide Emergency Department Surveillance System for Suspected Opioid Overdoses: Experiences from Rhode Island

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## Background

In April 2014, following an outbreak of fatal fentanyl-involved overdoses and recognizing a gap in timely nonfatal data, the Rhode Island (RI) Department of Health (DOH) passed emergency regulations requiring hospitals and health care providers to immediately begin reporting all suspected opioid overdoses treated in RI emergency departments (EDs) to the DOH within 48 hours. We describe the implementation of this policy, examine select attributes, and share lessons learned.

## Method(s)

Interviews with key stakeholders, data submitted to a central repository, known as the Opioid Overdose Reporting System, and data dissemination products were used to assess the barriers and facilitators to implementation and the usefulness, completeness and timeliness of the data.

## Result

All 13 nonfederal hospitals in RI were submitting data to the system within the first year, with 183 cases reported in three months. Processes for reporting, personnel responsible, and perceived barriers varied widely among those interviewed. Key facilitators were automatic submission through the hospitals IT platforms, and a change from a fax to a web-based reporting system. Nineteen variables are currently collected through a simple and flexible on-line form which can quickly adapt to meet the state changing

data needs. Thirty-one percent of the 1,568 cases in 2016 were submitted within 48 hours with four hospitals reporting at least 75% of cases within 48 hours. Median time to submission overall was 9 days. Completeness of reporting of most variables is 100%. The data have been used to provide timely case counts by hospital, overdose location, information on pre-hospital naloxone use, naloxone kits dispensed by EDs, and provision of recovery coach or other support services, much of which is not available in traditional claims databases. These data are disseminated through a state-funded website, shared with hospitals and heavily used for evaluation of overdose prevention programming.

## Conclusion

This regulation has resulted in an ED reporting system which provides useful statewide data on nonfatal opioid overdoses and associated preventive measures. These data have informed real-time responses, program planning and evaluation of programs and policies. The system may serve as a useful model for localities seeking to improve the timeliness and value of ED overdose data.

## Keywords

opioid overdose; surveillance; policy



# Evaluation of Emergency Department Clinical Pathway for Management of Alcohol Withdrawal Syndrome

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### Background

In western societies, 20% of men and 10% of women will develop an alcohol use disorder, while 50% will develop symptoms of alcohol withdrawal syndrome (AWS) with discontinuation of alcohol consumption. Alcohol intoxication and AWS are common ED presenting complaints. AWS treatment often involves CIWA-guided benzodiazepines; however management is often not standardized and clinicians have a variable threshold for admission. As a multidisciplinary group of ED physicians, nurses, psychiatrists, and pharmacists, we developed a pathway for care of ED patients with AWS or with alcohol intoxication who develop AWS during their ED course. The pathway incorporated a diazepam dose escalation protocol and encouraged admission after a threshold of 120mg was reached.

### Method(s)

Primary outcome was rate of hospital and ICU admissions. Historical controls were identified over the year prior to pathway implementation based on ICD-9/10 codes and discharge diagnosis of withdrawal. After pathway implementation, clinicians were prompted by the ED electronic tracker for enrollment if certain historical elements were met, or subjects could be manually enrolled. 95% confidence intervals, using Exact method for proportions, were calculated.

### Result

There were 84 historical controls. Average age was 47 and 81% were male. 56% (95%CI 44-67%) were admitted to a medical floor service, while 19% (95%CI 11-29%) were admitted to an ICU. Average hospital length of stay was 3.4 days (95%CI 2.5-4.2). For 2 months after pathway implementation, 104 subjects were enrolled (20 patients were declined). Average age was 47 and 71% were male. 29% (95%CI 20-39%) were admitted to a medical floor service, while 11% (95%CI 5-18%) were admitted to an ICU. The average hospital length of stay was 7.7 days (95%CI 3.3-12.1).

### Conclusion

Implementation of an ED pathway standardizing management of AWS significantly decreased hospital admissions. Patients characterized as appropriate for admission had a longer length of stay suggesting the pathway successfully identified sicker patients.

### Keywords

Clinical pathway, Alcohol withdrawal



# Evaluation of Pilot Peer Support Program

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### Background

Burnout among residents has become increasingly recognized in recent years. Despite the high prevalence, physicians rarely seek help, due to concerns about public perception, and negative career implications. The aim of this pilot study is to explore the feasibility, and report on the resident perceptions of a Peer Support Program initiated in an urban, academic, PG1-4 EM residency program.

### Method(s)

Five volunteer resident peer supporters were trained, with 6 hours of standardized training. After 1 year of program implementation, all peer supporters and program utilizers completed anonymous, online surveys assessing the perceived helpfulness of the program, and if they would recommend it to others. Program utilizers were asked to provide basic demographic information and reason(s) for using the program.

### Result

All five peer supporters reported that the training and supervision they received was adequate. In one year, only 6/47 (13%) residents in the residency reported taking advantage of the program; 4 (66.7%) male, and 2(33.3%) female, PGY distribution over all years. All utilizers were either referred in by the occurrence of a major event, or by a concerned peer. There were no self-referrals. All participants found the program &ldquo;very useful or &ldquo;useful&rdquo;, all reported that they would &ldquo;definitely use it again or &ldquo;probably use it again&rdquo;, and all reported that they would recommend the program to others.

### Conclusion

Implementation of an ED based peer support program is feasible, although utilization was low. It was expected that very few providers would access the program themselves in the first year. Those that did participate, however, reported that they found it useful, would use it again, and would recommend it to others. This pilot study may serve as a template for residency programs that seek to offer similar support to residents. Future studies should address ways of increasing utilization, and evaluating the effectiveness of such programs.

### Keywords

Wellness



# Examining Trends in Marijuana use of Patient's Seen at a Major Trauma Center in Massachusetts

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## Abstract

Examining trends in marijuana use of patient's seen at a Major Trauma center in Massachusetts  
Study objectives: Legalization of marijuana for both medical and recreational purposes is increasing throughout the United States.

The objective of the study was to observe if the incidence of positive marijuana tests in trauma patients is increasing in patients seen in a major trauma center in Massachusetts.

## Method(s)

This was a single center retrospective cohort analysis of a major academic emergency department and Level I trauma center with approximately 44,000 annual visits. The trauma registry was reviewed on all trauma patients seen from 2008-2016. Factors such as type of injury, trauma severity score, and admissions versus discharge were examined. All registry entries were reviewed for results of marijuana and other intoxicants. These results were trended over time to examine rate of use in trauma patients. IRB approval was obtained prior to study commencement.

## Result

The Trauma registry from 2008-2016 contained 7661 records. Of these records, 4327 patients had toxicology studies. The records were divided into 2 groups, before medical marijuana was legalized in November 2013, and after legalization. The use of marijuana and ethanol increased with time. In the 2008-2013 group, tested patients were positive for marijuana 3.51% of the time, and the 2013-2016 group tested patients were positive 5.14% of the time. The two groups were respectively positive for ethanol 20.6% and 32.0%. Both show increases with time, marijuana increasing 68.3%, ethanol 64.4%

## Conclusion

In a large pool of trauma patients seen at a Level 1 Trauma Center, there were clear upward trends observed in rates of use of marijuana and alcohol with time. The rate of increase in the use of marijuana was greater than the increase of ethanol. Further observation seems warranted given the recent changes in legislation legalizing the use of marijuana in the commonwealth of Massachusetts.

## Keywords

Trauma Marijuana Ethanol



## Exploring the Association Between Clinician Burnout and Adherence to Back Pain Evaluation and Treatment Guidelines in the Emergency Department of an urban safety-net hospital

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### Background

Guidelines for best practices in routine acute back pain care do not recommend imaging or opioids. Physician burnout has been associated with self-reported lower quality of care. Objective: We sought to examine the association between self-reported provider burnout and quality of care in treatment for acute back pain.

### Method(s)

We surveyed attending physicians and nurse-practitioners in a large, urban safety-net ED from May to June 2017. Burnout was dichotomized using a validated single burnout item question on the Mini-Z survey; a score of  $\geq 3/5$  indicating burnout. Data was abstracted from the medical records of patients with chief complaint and/or discharge diagnosis of non-traumatic back pain, cared for by study providers, 3 months pre- and post-survey. The two main outcomes were the percentage of patient ordered/prescribed opioid medication and those that were imaged. We examined the association between burnout and outcomes of opioid prescriptions/ imaging in unadjusted and adjusted analyses using logistic regression, with standard errors clustered by provider, controlling for patient age, sex, race/ethnicity, language, history of comorbid depression, anxiety, or substance use.

### Result

Thirty one out of thirty two (97%) providers completed the survey; burnout was present in 20%. Of 1,337 unique back pain visits, 4% of patients received opioids and 9% imaging. In adjusted regressions, burnout was not associated with opioid prescribing or imaging. Providers reporting burnout were no less likely to order opioids in the ED (AOR:0.86, 95%CI 0.33-2.21), nor upon discharge (AOR 0.51, 95%CI 0.07-4.02), and no less likely to order imaging (AOR: 0.94, 95% CI 0.32-2.73). There were no statistically significant differences in outcomes between providers who reported burnout and those who did not.

### Conclusion

We found no association between provider burnout and adherence to guidelines for back pain care with respect to opioid prescribing or imaging, both of which were relatively uncommon in this ED.

### Keywords

burnout, quality of care



# Front End Provider Wait Room Safety Study

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Front End Provider Waiting Room Safety Study  
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## Background

We developed a process to enhance front end patient flow for certain ESI level 2 and 3 patients, where patients are assessed shortly after triage in one of five Front End Provider (FEP) rooms that are adjacent to triage. There, an advanced practitioner conducts a physical examination, makes a preliminary diagnosis, orders tests, and decides if the patient can return to a Waiting Room (FEP WR) chair to await the next available main ED bed. Patients not deemed safe to return to the waiting room stay in the FEP area or are moved immediately to Red Pod, our acute resuscitation bay.

## Objectives

To study the ED course and outcomes of FEP WR patients, including safety, wait times, among others.

## Method(s)

This was a retrospective chart review of 11,203 patients over a 12 month period in an urban Level 1 Trauma Center with an ED census of 105,000 adults and an admission rate of 29%. Using Epic Reports (Epic System Corporation) identified FEP WR patients and their disposition were tracked. All ICU and OR patients, as well as every tenth admitted and eloped patient chart were evaluated for any worrisome aspects of the patient presentation or testing to determine whether it was safe for these patients to sit in a chair in the waiting room.

## Result

11,203 patients with FEP WR status were identified. The charts of 325 admitted patients were reviewed. Length of stay per patient location also tracked, including waiting room, FEP, FEP WR, main ED, among others. Most importantly, there were no patients whose ED or inpatient courses seemed unsafe as a result FEP WR process, specifically no STEMIs, intracranial hemorrhages or other life threatening processes were left to dwell in the waiting room before recognition. (Exact numbers/results are preliminary at this point and subject to change.)

## Conclusion

Emergency departments must be innovative in regards pt flow to deal with increasing crowding. The FEP WR process is a starting point for a new avenue to address this issue, possibly decreasing overall stay/usage of crucial main ED resources. In fact, not only does FEP WR seem safe, but is may safer than having patient dwell in the waiting room post triage for the next available bed.

## Keywords

Front End Provider, operations, Safety





# Gender Differences in the Decision to Seek Care Among Ischemic Stroke Patients

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### Background

Delay between symptom onset and hospital arrival is a frequent contributor to ineligibility for acute interventions and poor outcomes among patients with stroke, but little is known about social and cognitive factors that impact delays to care. We investigated the role of gender and the influence of others on patients' decisions to seek or delay medical care after onset of stroke symptoms.

### Method(s)

Trained research assistants conducted semi-structured qualitative interviews with adults with acute ischemic stroke presenting to a comprehensive stroke center from 7/2015 - 3/2016. Only those with time to hospital arrival > 3.5 hours after onset of symptoms were included. Sample size was determined using thematic saturation. Patients were interviewed about the decision process leading to their arrival at the hospital. Each interview was coded by multiple team members using a pre-defined coding scheme. The coding scheme was then refined in an iterative process based on interview content. Themes were developed and compared between women and men for two main topic areas, the role of patient gender and the influence of others on the decision to seek care.

### Result

Our sample included 23 participants: 48% women and 17% non-white and/or Hispanic. Women were 4 years older than men (mean 66 vs. 62 years old). For women, many did not believe their gender affected their decision to seek or delay care. Women, however, tended to make a connection between being a woman

and being a caregiver, and reported seeking medical attention so they could 'stay healthy' and maintain their roles as caregivers. Men often reported that being a man with its associated characteristics ('stubborn,' 'thick-headed,' 'tough guy') caused them to delay seeking care, and men described strategies to self-treat the symptoms of stroke prior to seeking help. Some men also identified as caregivers and noted that this was a motivating factor in seeking care. Women often described seeking help from children and friends, though sometimes hesitated in order to 'not bother' others; men often described the influence of spouses on their decision to seek care.

### Conclusion

Among stroke patients, social and cognitive factors affecting delays to medical care differ by gender. Future research should explore the potential effectiveness of gender-specific interventions for reducing delays to care among stroke patients.

### Keywords

stroke, gender differences



# Global Health Electives and Procedural Experience: Increasing Competency

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## Background

Many EM residents choose to augment residency training with global health elective rotations in resource-limited settings. However, there is little data on what types of skills are gained during such rotations. As competency-based assessments have become standard in measuring trainee progress through a residency program, we aimed to assess how such experiences might affect milestone achievement. We assessed number of procedures performed on global health electives and resident self assessment of its effects on milestone achievement

## Method(s)

A cross-sectional survey was sent in June 2017 to 601 residents in 14 EM residencies across the United States. It was open to all residents even if they had not completed a global health elective.

## Result

118 EM residents responded to the survey (response rate 19.6%), 24 had completed a clinical elective in a global health setting and provided data on procedures they had performed. 91.7% of residents felt that their experience had helped them in achieving residency milestones. Residents reported completing rare procedures. For example, 16.7% (4) performed a pericardiocentesis, 12.5% (3) of the residents reported performing a thoracotomy, one performed a

cricothyrotomy and a second additionally reported a needle cricothyrotomy. Chest tubes were often completed on such rotations, with 50% (12) of the residents placing at least one, and 16.7% placing between 6 and 15 chest tubes. Procedures not tracked by the Residency Review Committee (RRC) included thoracentesis, suprapubic catheter and venous cutdown. Despite residents reporting a high procedural volume and different/more severe spectrum of diseases encountered, two residents (8.3%) reported no formal pre-departure preparation, and 7 reported a lack of direct supervision. Only 20% of the residents reported having direct, on site supervision 100% of the time.

## Conclusion

EM residents on global health electives have an opportunity to encounter complex, severe medical pathology outside their typically encountered spectrum of illness, and to complete uncommon procedures required for their training. However, pre-rotation preparation and supervision seem to be lacking. Care should be taken to orient residents to the skills and knowledge they may need, and to ensure resident placement in sites where appropriate preceptorship is available.

## Keywords

global health, international emergency medicine, medical education, milestones, procedure skills



# Hawks vs Dove Phenomenon in Faculty Attending Evaluations of Emergency Medicine Residents

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## Background

The “hawk vs dove phenomenon refers to the stringency of evaluators (i.e. hawks evaluate learners more stringently whereas doves evaluate more leniently) compared to their peers. While this concept has been discussed in the literature, its presence in EM resident evaluations is unclear. The objectives of this study were to determine if hawks and doves differ in the amount of written feedback provided on EM resident evaluations and if gender or seniority correlates with an evaluator being a hawk or a dove.

## Method(s)

This is a retrospective study of EM resident shift evaluations at a single academic medical center with a three-year residency. EM faculty attending evaluations of EM residents from 2013-2016 were included. Ratings of residents medical knowledge, number of words in the “strengths and “suggestions for improvement comment boxes, attending gender, and senior versus junior faculty (greater or less than 5 years post training) were extracted from the database. Evaluators whose medical knowledge rating was outside of the interquartile range (25th-75th percentile) were deemed hawks or doves. A multivariate generalized estimating equations analysis was performed to comparing the above variables. Models were adjusted for resident post-graduate year.

## Result

4965 evaluations by 52 faculty attendings were included. 13 (25%) were hawks and 13 (25%) were doves. Hawks provided fewer “strengths word comments (B-coefficient -0.310,  $p=0.001$ ) and more “suggestions for improvement words (B-coefficient 0.533,  $p=0.000$ ) compared to their peers. Doves provided more “strengths words (B coefficient 0.278,  $p=0.080$ ) and fewer “suggestions for improvement words (B-coefficient 0.504,  $p=0.020$ ). 73% of all faculty evaluators were male, with 92% of hawks being male and 69% of doves being male ( $p=0.190$ ). There was no significant difference in faculty seniority between the hawks and doves ( $p=0.962$ ).

## Conclusion

Hawks provided more “suggestions for improvement comments. Male faculty were more likely to be hawks, however, this was not statistically significant. Further faculty development on written evaluation feedback may reduce variability by gender and provide learners with a more accurate assessment of their progress.

## Keywords

resident evaluations, gender, attending evaluations



# How Did You Get Here? Interim Analysis of the Mode of Arrival of Pediatric Asthma Patients to a Busy Urban Children's Hospital Emergency Department

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## Background

Asthma is a common cause of emergency department (ED) and emergency medical services (EMS) utilization among children, yet the intersection of these healthcare sectors remains poorly studied in the pediatric asthma population. Research describing the pediatric asthma ED population with respect to arrival mode is needed to inform future studies of factors associated with EMS utilization for childhood asthma as well as the effectiveness of prehospital pediatric asthma care protocols.

## Method(s)

A retrospective chart review was conducted to identify all patients under 18 years of age who presented to a large pediatric ED during 2016 and received a primary asthma-related admitting or discharge diagnosis (ICD-10-CM code J45.xx). We queried a total of 52,855 patient encounters, yielding 1685 encounters meeting our search criteria. A random sample of 140 charts (8.3%) were analyzed for eligibility, of which 126 met inclusion criteria for the study. EMS versus non-EMS arrivals were compared on the basis of demographic, clinical, and disposition characteristics, as well as arrival time and healthcare utilization history.

## Result

Ambulance arrivals comprised a minority of pediatric asthma ED patients, with prehospital EMS transports representing 10.3% of the sample. EMS patients were similar in age (median 5 years, IQR 3) and sex (69.2% male) to non-EMS arrivals (median 5 years, IQR 7; 66.1% male), but EMS patients were more frequently discharged from the ED (76.9% versus 67.9%). EMS patients had less history of prior pediatric ICU asthma admissions (0.0%) than non-EMS patients (18.3%), yet a

greater proportion had more than one asthma-related ED visit in 2016 (53.8% versus 46.8%). EMS patients also presented to the ED more often during typical pediatrician office hours (31%) than non-EMS arrivals (19%). Conclusion: Pediatric asthma patients transported to the ED via EMS may be less acutely ill than non-EMS arrivals. Patterns of greater repeat ED utilization and more frequent presentation during pediatrician office hours by the EMS cohort may be reflective of disparities related to transportation and healthcare access among these patients. The interim results of this ongoing study provide necessary background for future investigations of the pediatric asthma ED population with respect to EMS utilization and prehospital treatment efficacy.

## Keywords

Asthma, Pediatrics, Emergency Medical Services



# Hurry Up and Wait: Internal Waiting Room Prevalence, Usage and Impact in a Sample of United States Emergency Departments

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## **Eric Goralnick, Author**

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### Background

Emergency department (ED) overcrowding is a growing problem. To mitigate the issue and improve flow many EDs have instituted the concept of an internal waiting room (IWR) or a dedicated space within the clinical care area where patients can wait for their results, receive treatment, and wait for their disposition to be determined. Existing literature on this topic is limited and the impact of the intervention remains unknown. Our aim was to survey a convenience sample of emergency departments to understand variability of terminology and the utilization, implementation and impact of IWRs on ED throughput metrics.

### Method(s)

We conducted a cross-sectional survey using a convenience sample of U.S. EDs from the Emergency Department Benchmarking Alliance (EDBA) listserv. The survey included 10 questions focused on: prevalence, naming conventions, logistics, patient satisfaction, staff satisfaction and operational metrics including length of stay, door to doctor time, patients left without being seen, and time on diversion. It was distributed to the EDBA listserv using RedCap.

### Result

We received 139 responses of which 115 were valid. Of those surveyed with valid entries 55 used the concept of an IWR. The treatment area was most consistently called the pending results area and designed using chairs only with no cardiac monitoring capability. Most of the 55 EDs noted an increase in patient satisfaction scores when the area was utilized during peak flow periods. Additionally, most of those EDs also saw a drop in their institution door to doctor time, ED length of stay of discharged patients and in the number of patients that left without being seen.

### Conclusion

U.S. EDs share common challenges of crowding and IWRs have been suggested as a possible solution yet this survey of a convenience sample of EDs reveals high variation in terminology, design, utilization and impact of this concept. Future efforts should be dedicated to a more comprehensive survey to seek a better understanding of the IWR.

### Keywords

internal waiting room, emergency department flow, ED benchmarks, operations, LEAN



# Identification of patients with atraumatic intracranial hemorrhage: Novel Applications for Machine Learning

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## Background

Many clinical and health services research studies rely on procedure and diagnosis codes to identify disease; however, such billing data often lacks clinical accuracy. A traumatic intracranial hemorrhage (ICH), a phenotype inclusive of both intracerebral hemorrhage and subarachnoid hemorrhage is a neurological emergency of research interest; however, unlike ischemic stroke, has no established administrative claims based definition. Our objective was to apply machine learning classification methods to create administrative claims based definition for ICH.

## Method(s)

Our initial dataset was generated using a structured query of the Electronic Health Record (EHR) to include any patient admitted to a tertiary medical center with either an International Classification of Disease version 10 (ICD-10) codes for ICH during the ED visit or as a principal hospital discharge diagnosis. As a gold standard, we defined the ICH phenotype based on manual chart review as atraumatic intracranial hemorrhages in adults excluding cases of microhemorrhage secondary to brain neoplasms. Using the total dataset, we then performed feature selection based on chi-square scores to filter ICD-10 codes for use in machine learning algorithms. We tested 5 approaches including support vector machine (SVM), linear discriminant analysis (LDA), random forest (RF), decision tree (DT), and k-nearest neighbor (KNN). Two-thirds of the dataset was used for training the classification model and one-third for testing. We report five standard measures of model performance.

## Result

A total of 1834 patients with 2174 unique ICD-10 codes existed in the dataset, of which 24% were true positive based on chart review. Feature selection identified 220 features among available diagnostic code combination. SVM performed best (Accuracy=85%, Sensitivity=85%, Specificity=86%, AUC=80%, F-score=74%), while RF, DT, and KNN were modest and LDA was worst in terms of accuracy.

## Conclusion

Our application of SVM effectively identifies ED patients with an atraumatic ICH phenotype with 85% accuracy. This algorithm could be utilized for EHR based applications such as public health surveillance or clinical trial enrollments or for observational research using large datasets. Future research should explore such methods to define other acute condition phenotypes poorly characterized by ICD-10 codes.

## Keywords

Atraumatic, intracranial, hemorrhage, classification, machine, learning



# Identifying Barriers to Emergency Care for Immigrants, Refugees, and Limited English Proficiency Speaking Patients

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## Background

In the United States, foreign-born individuals often lack a reliable source of primary healthcare due to multiple barriers to accessing and utilizing our healthcare system. These individuals often use emergency departments (EDs) for non-emergent issues or delay utilizing other sources of care until their health issues become life threatening. Since the ED serves as an entry point to healthcare for this population, understanding the barriers to healthcare unique to this setting is imperative. This pilot study aims to determine the barriers to emergency care for non-English speaking patients, and to thereby improve the quality of their ED care.

## Method(s)

Researchers developed a survey using a literature search and by holding a focus group with interpreters from a large urban academic safety net hospital. Study participants who met the eligibility criteria were provided with a self-administered survey in their chosen language from the top five languages spoken at our hospital. Although data is still being collected, the following are the preliminary results (n=35).

## Result

The majority of participants completed the survey in Spanish (74.3%). The highest proportion of age was between the ages of 35 to 44 years (25.7%). The majority of participants have been living in the United States for 5-10 years (28.6%) or more than 10 years (28.6%). Most participants have visited our ED between

1 and 3 times (65.8%). There was a clear preference for in-person professional interpretation (54.3%) over telephone or family member/friend. On a Likert scale from 0-3 (0=not at all to 3=a lot), participants main barrier was concern about paying a bill (22.9%). Other barriers included concern about being studied, uncertain availability of ED providers who speak their language, and uncertain availability of interpreter services.

## Conclusion

Preliminary results from this pilot study suggest that financial concerns are the primary barrier to emergency care for foreign-born patients, followed closely by language barriers. These barriers are associated with, and may contribute to, poorer health status. Addressing these key barriers through methods such as improving availability of in-person interpreter services in the ED or educating patients and providers about social service financial options can greatly improve patient access to emergency care.

## Keywords

Social determinants of health



# Impact of an Emergency Department Split-Flow Model on Satisfaction and Throughput

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## Background

Emergency department (ED) overcrowding is a well-known barrier to receiving timely, quality care in the United States. Prolonged wait and visit times decrease care quality and patient satisfaction while increasing adverse events and numbers of patients that leave without being seen. To address this, we implemented a Rapid Decision Unit (RDU) staffed in triage by a nurse (RN), physician/advanced practice professional, and phlebotomist during peak volume hours. We sought to determine whether RDU implementation would improve throughput metrics and patient perceptions of care as assessed by a point-of-care survey.

## Method(s)

The study was conducted over a six-week period at one tertiary care referral center ED. Upon disposition, a convenience sample of patients were selected from three cohorts: (1) evaluated and treated only in the RDU, (2) initially evaluated in the RDU and dispositioned from the main ED, (3) treated only in the main ED. A 13-item questionnaire similar to the Emergency Department Patient Experiences with Care (EDPEC) Survey was electronically completed by patients. Demographics, ED diagnoses, and throughput metrics were matched to survey participants using the electronic health record.

## Result

150 patients participated. Those treated in the RDU had lower ESI acuities than their main ED counterparts ( $p < 0.05$ ). When comparing patient perceptions of RN and

physician courtesy/respect, careful listening, and explanation clarity, significant differences were not noted based upon treatment location ( $p > 0.05$  for each). Perceptions regarding privacy, needs being met during the visit, and timeliness of care also did not differ ( $p > 0.05$  for each). A significantly greater proportion of patients treated primarily in RDU (19% v. 4%,  $p = 0.007$ ) felt their pain was not adequately addressed as compared to those treated in the main ED. Patients treated in the RDU had statistically significant reductions in throughput metrics, including door-to-provider, door-to-analgesia, door-to-disposition decision, and ED length of stay ( $p < 0.05$  for each).

## Conclusion

Establishment of a front-end RDU intervention led to a meaningful improvement in patient flow without adversely impacting overall patient satisfaction. This study supports a growing body of quality improvement literature endorsing front-end ED process models in improving timeliness and quality of patient care.

## Keywords

Split-flow, emergency department flow, emergency department quality, quality improvement, rapid decision unit





# Impact of Peer Navigation and Take-Home Naloxone on Mortality and Initiation of Medication Assisted Treatment by Emergency Department Opioid Overdose Patients

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## Background

In 2014, two Lifespan-affiliate EDs in Rhode Island (RI) began providing take-home naloxone and consultation with a community-based peer recovery coach for addiction treatment navigation. While naloxone distribution and peer recovery coaches are increasingly being utilized by EDs, their impact on repeat overdose, mortality, and initiation of medication assisted treatment (MAT) has yet to be evaluated.

## Method(s)

This is an observational, retrospective cohort study of ED patients treated and discharged after an opioid overdose two EDs, an academic medical center and a community hospital. Patients received usual care, take-home naloxone, or a recovery coach with take-home naloxone. Primary outcomes were repeat opioid overdose, all-cause mortality, and MAT initiation. Between group comparisons were made using chi-square testing and Kaplan-Meier estimated probability of overdose-free survival.

## Result

180 individuals were treated for opioid overdose during the study period. Seventy-four (41.1%) received usual care, 34 (18.9%) received take-home naloxone alone, and 72 (40%) individuals received take-home naloxone and consultation with a peer recovery coach. Eleven

(6.1%) participants died within one year of their ED visit. There were no significant differences between study arms ( $p=0.310$ ). Thirty-five (19.4%) had a repeat overdose within one year. There were no differences in frequency of repeat overdose between study arms (21.6% usual care vs 11.8% naloxone alone vs 20.8% recovery coach and naloxone,  $p=0.451$ ). Fifteen percent (28/180) initiated MAT within the year after their ED visit, but there was no significant differences between study arms (13.5% usual care vs 14.7% naloxone alone vs 18.1% recovery coach and naloxone,  $p=0.742$ ). No differences were observed in overdose-free survival estimates between study arms.

## Conclusion

There is a high frequency of death and repeat overdose in the year following an ED visit for opioid overdose. While the treatment arms had a lower rate of death and a greater proportion of patients initiating MAT following their ED visit, these findings did not reach statistical significance and there was no difference in overdose-free survival. Next steps include prospective outcome evaluation with larger sample size and identification of barriers to initiation of MAT.

## Keywords

Opioid OverdoseAddictionMedication Assisted TreatmentPublic Health



# Implementation of a Throughput Nurse To Increase Emergency Department Space Utilization

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## Background

Emergency Department (ED) volumes continue to increase with space often times being a barrier to throughput. Most EDs have a resource nurse who serves many functions including maximizing space utilization in the ED. This study was performed to analyze if a dedicated &quot;flow nurse would affect utilization of ED space.

## Method

This was a before and after study, conducted at an ED with 55 beds and 20 sanctioned hallway spaces, seeing a volume of ~57,000 patients a year. The before phase (07/01/2016-08/30/2016) involved having a resource nurse who served multiple functions, only one of which centered around ED throughput. The after phase (09/01/2016-10/31/2016) featured a separate &quot;flow nurse from 11AM to 11PM Monday through Friday. Their role centered around maximizing space utilization in the ED and efficient throughput. The outcome measure we compared was the minutes per hour where there were more than 5 patients in the waiting room (WR), no patients inside the ED waiting to be seen by physicians, and less than maximum occupancy in the ED. We termed this the utilization metric (UM). Linear regression was used to test for a significant association between the UM and presence of a flow nurse adjusting for confounders like day of week, hour of day and month. Another outcome measure we compared was the left without being seen (LWBS) rate. Fisher exact test was performed to test for significance.

## Result

A total of 1032 hours were compared, 516 in the both the before and after group. The UM improved an average of 205 minutes for the 60 hours per week when there was a flow nurse. Linear regression was performed with the UM as the dependent variable with the independent variables of day of week, month, hour of day, and presence of flow nurse as covariates. Presence of flow nurse was significantly associated with an improvement of UM ( $p = 0.001$ ) even adjusting for the other covariates. The other significant variable was hour of day which had a  $p = 0.01$ . During the before phase a total of 4022 patients were seen, with 87 LWBS (2.2%). The after phase had a total of 4346 with 110 LWBS patients (2.5%). Fisher exact test yielded a  $p=0.25$ .

## Conclusion

While the presence of a flow nurse did not significantly affect the rate of LWBS, it did significantly impact utilization of ED space to more effectively bring patients from the WR into the ED to be evaluated.

## Keywords

Operations, Nursing, Throughput



# Implementation of an Emergency Department Observation Pathway for Patients With Mild Traumatic Intracranial Hemorrhage

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## Background

Patients with mild (GCS  $\geq$  14) traumatic intracranial hemorrhage (t-ICH) are frequently transferred to hospitals with neurosurgical expertise. Such transfers are costly, resource intense and inconvenient for patients. We sought to investigate the safety and feasibility of an ED observation pathway for patients with mild t-ICH, including inter-facility transfers.

## Method(s)

Retrospective, single-center study of ED patients presenting to a Level 1 trauma center, 04/2016-08/2017. Inclusion criteria: Isolated head injury, GCS  $\geq$  14, minor positive CT findings (traumatic SAH, SDH  $\leq$  1 cm, contusion). Exclusion criteria: GCS  $<$  14, epidural hematoma, skull fracture, seizure, anticoagulant/antiplatelet use, physician discretion. All patients underwent neurosurgical consultation. Primary outcome: hospital admission (pathway failure). Secondary outcomes: neurosurgical intervention, ED/inpatient length-of-stay (LOS), radiologic evolution/hematoma growth.

## Result

There were 66 patients included, mean age 65.22.3 years, 44% female. Major ICH types: SDH (n=36), SAH (n=21), IPH (n=5). Fifty-one patients (77%) were enrolled in ED observation. Seven patients (10.6%)

subsequently failed observation, requiring admission; however, only one was admitted for sequela of t-ICH. LOS was significantly decreased among observed vs admitted patients (16.8 vs 88.4 hours,  $p=0.0001$ ). Repeat CT demonstrated increased SDH volume in two patients; no intervention was required. Among 50 inter-facility transfers, 37 (74%) qualified for observation; 32/50 (64%) were discharged after observation.

## Conclusion

In patients with minor t-ICH, ED observation is a safe option with significantly decreased LOS. Appropriately selected patients may benefit from an ED observation protocol. This pathway has potential for use in the community setting to prevent unnecessary transfers/admissions, and warrants further study.

## Keywords

traumatic intracranial hemorrhage, ED observation pathway, traumatic brain injury



# Improving Methods for Providing Feedback to Residents in the Emergency Department: A Faculty Survey

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## Background

There has been little formal research around the best modality and best practices for providing effective feedback to resident physicians in Emergency Medicine training programs. We sought to understand the current practices in place to provide feedback to Emergency Medicine residents, including the strengths of current feedback modalities and barriers to providing effective feedback. Additionally, we sought to understand how emerging mobile applications and technologies could enhance processes for providing resident feedback.

## Keywords

Education, feedback, Emergency Medicine residents

## Method(s)

We sent a 15-question electronic survey to a national sample of Emergency Medicine residency faculty via a listserv maintained by Council of Emergency Residency Directors (CORD). Our questionnaire solicited personal experiences from faculty around providing feedback to Emergency Residents, and invited qualitative reflections from faculty.

## Result

We determined that there is significant dissatisfaction among faculty in terms of the practices around providing feedback to Emergency Medicine residents. Key barriers to providing effective feedback include: a lack of private space, inadequate time, and difficulty designing a system to solicit feedback about relevant and meaningful areas. Further, our research has identified that there is significant opportunity for emerging technologies, specifically mobile applications, to enhance and improve the resident feedback process.



# In-Situ Simulation Exposes Challenges and Generates Strategies for Emergency Care of Children in Community Hospitals: A Mixed Methods Analysis

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## Background

Approximately 90% of pediatric emergency care is provided in community hospitals. However, the majority of research and training takes place at academic children's centers which may contribute to variable pediatric readiness in the community. Objective: Explore community hospital providers' perceptions of caring for ill and injured children and derive potential improvement targets.

## Method(s)

Pre-Simulation (SIM) survey targeted providers' experience and comfort in caring for sick children. Multi-disciplinary in-situ SIMs were conducted with scripted debriefings thereafter. Debriefings were facilitated by a single individual, recorded and professionally transcribed. Using grounded theory, three blinded authors undertook structured thematic analysis to identify emerging themes.

## Result

171 providers completed surveys (49% RNs, 22% MD/DOs, 23% CNAs). Most were Pediatric Advanced Life Support trained (70%) though many (61%) experienced less than 5 pediatric resuscitations in their careers. Medians with interquartile ranges (IQRs) targeting pediatric readiness noted participants were "neutral (3; IQR 2,4) to "feeling comfortable taking care of acutely ill children; and

"agreed (4; IQR 3,4) with: "pediatric equipment is easy to locate in our ED; "our resuscitation bay is well-equipped for pediatric resuscitation; and, "I am extremely stressed during a pediatric resuscitation. Eighty providers participated in 18 in-situ SIMs in six community hospitals. Eighteen debriefings were coded with thematic saturation occurring at 10 transcripts. Three major themes emerged: (1) knowledge and skill limitations attributed to event infrequency; (2) the emotional toll of caring for a sick child; and (3) pediatric specific quality and safety deficits. Subthemes focused on causes and potential mitigating factors contributing to pediatric readiness. A novel "partnering role of the local children's hospital emerged as a way to address the above challenges facing community hospitals.

## Conclusion

Despite reporting relative confidence in pediatric emergency care, in-situ SIMs illuminated issues and debriefings generated potential targets for improving pediatric readiness in the community setting.

## Keywords

Pediatrics Pediatric Readiness Community Hospital



# Increased Staff Satisfaction Can Occur Independent of Other Quality Improvement Metrics

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### Background

While Emergency Department (ED) quality improvement (QI) relies on ED staff as agents of change, principle outcomes are often operational metrics. The effects of QI activity on staff satisfaction are less well explored. We sought to determine whether a QI project targeting ED throughput time affected staff satisfaction using a combination of operational data and staff surveys.

### Method(s)

This was a retrospective study at a community ED with 16,500 annual visits. As part of a QI project, median length of stay for discharges and admissions are tracked monthly, and the ED staff is surveyed regarding satisfaction overall and about throughput times. We compared satisfaction before and after an intervention focusing primarily on throughput for patients being discharged, where the targeted goal was a 5% reduction in overall length of stay. The pre-intervention period was July 2016 to January 2017; the post-intervention period was February to September 2017. The main outcomes were changes in staff satisfaction with admission and discharge throughput times, measured on a five-point scale, and whether these were associated with changes in throughput times. Mann-Whitney tests were used for comparison of throughput times and staff satisfaction.

### Result

Median time to admission was 285 minutes in the pre-intervention period and 282 minutes post-intervention

( $p=0.13$ ), while median time to discharge was 172 minutes pre-intervention and 163 minutes post-intervention ( $p=0.17$ ). There were 39 respondents in the pre-intervention survey and 33 in the post-intervention survey. There was a significant improvement in overall satisfaction with admission throughput time ( $p=0.021$ ), while satisfaction overall ( $p=0.74$ ) and with discharge throughput time ( $p=0.18$ ) did not change.

### Conclusion

While we met our operational goal, there was no statistically significant reduction in length of stay. Our results do not suggest a direct relationship between changes in throughput time and staff satisfaction. Interestingly, we saw a significant improvement in satisfaction only for admissions throughput, which was not the target of our project. While our results are limited by sample size and lack of stratification by provider types, our results suggest that simply the act of engaging staff in QI projects can have a meaningful impact on morale.

### Keywords

Quality Improvement, Morale, Staff Satisfaction, Throughput



# Initiating buprenorphine after acute opioid overdose: An ED-based case series

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## Background

There is limited clinical experience or research on buprenorphine induction immediately after opioid overdose. Objective: To describe process data and outcomes in 12 patients who were initiated on buprenorphine for the treatment of opioid use disorder (OUD) during an ED visit for treatment of opioid overdose.

## Method(s)

We conducted an analysis of a subgroup of patients enrolled in a trial of ED-initiated treatments for OUD. Participants in the current analysis were out of treatment adult ED patients with opioid dependence (DSM-4) enrolled after naloxone reversal of an opioid overdose and randomized to buprenorphine induction. Patients received either buprenorphine 8 mg sublingual induction in the ED (ED induction) if their Clinical Opioid Withdrawal Scale (COWS) was  $\geq 12$  after clinical evaluation and study enrollment. Otherwise, patients received take-home sublingual buprenorphine with written instructions describing induction procedures and were advised to take 8 mg on day 1 (Unobserved Induction). All patients received instructions to take either 8 or 16 mg daily, guided by symptoms, until outpatient follow-up within 72 hours. Telephone clinical support was available through the ED or a research nurse. Patients were followed for 30 days and evaluated for engagement in formal addiction treatment and adverse events. Descriptive statistics were used.

## Result

Twelve participants received buprenorphine induction after opioid overdose (2= ED Induction, 10= Unobserved Induction). Patients were predominately male (10/12; 83%) and had a median age of 26 (25%-75% 22, 31; range 20-48). Urine toxicology showed: 12/12 (100%) positive for opiates, 0/12 positive for (0%) oxycodone, and 2/12 (17%) positive for benzodiazepines. Nine of the 12 patients (75%) were engaged in formal addiction treatment at 30 days. No adverse events were identified and no calls or ED visits with questions about induction, refill requests or precipitated withdrawal prior to follow-up visit occurred.

## Conclusion

Our preliminary data indicate that ED patients with acute opioid overdose who receive naloxone can receive ED or unobserved induction onto buprenorphine, and most were engaged in formal addiction treatment 30-days after ED visit.

## Keywords

buprenorphine, opioid use disorder, MAT, addiction



# Insurance Status is Not Associated With Emergency Department Boarding

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## Background

Emergency Department boarding is a growing problem in the United States. Boarding has been shown to be associated with increased mortality as well as decreased patient satisfaction. Various factors can contribute to the likelihood of a patient boarding. The objective of this study was to determine if the type of insurance or insurance status is associated with boarding for admitted patients.

## Method(s)

This is a retrospective cohort study performed at an academic hospital with an annual ED volume of ~55,000 patients. The study period was from 1/1/2017-9/30/2017. The electronic health records of all patients that were admitted were reviewed and various parameters were extracted. These include: age, gender, ICU admission, arrival day of week, arrival hour of day, and type of insurance. Type of insurance was then further broken down into dichotomous variables of those with and without insurance, and for those with insurance whether it was private or medicaid insurance. A multivariate logistic regression model was used to test for significance of all covariates with the primary outcome being boarding. Boarding was defined as a dichotomous variable with patients that have an admission bed request to inpatient bed assignment time greater than 2 hours. A Hosmer-Lemeshow goodness of fit test was performed to ensure no evidence of poor fit.

## Result

A total of 16,212 were admitted during the study period. A total of 6877 were identified as boarders (42%). The median boarding time was 2.2 hours. Patients who did not have insurance were not associated with boarding status ( $p = 0.44$ ), neither was having a Medicaid insurance plan ( $p = 0.64$ ). Patients with an hour of arrival from 3PM to 1AM ( $p = 0.01$ ), arrival days of week other than Saturday and Tuesday ( $p = 0.01$ ), ICU admission ( $p = 0.01$ ) and gender ( $p = 0.04$ ) were also associated with boarding. The Hosmer Lemeshow test did not have evidence of poor fit ( $p = 0.53$ ).

## Conclusion

Insurance status and type of insurance is not associated with ED boarding. However significant factors associated with boarding including arrival hour of day/day of week, gender, and ICU admission.

## Keywords

boarding, insurance, medicaid





# Inter-hospital Transfer is not a Predictor of In-hospital Mortality in Patients with Non-traumatic Intracranial Hemorrhage

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## Objectives

Inter-hospital transfer of patients requires many care transitions that introduce safety risks and are associated with worse outcomes among trauma patients. However, little is known about the relationship between inter-hospital transfers and outcomes for patients with neurologic emergencies. We examined the association between inter-hospital transfer and in-hospital mortality for patients with non-traumatic intracranial hemorrhages.

## Method(s)

We performed a retrospective, observational analysis of patients admitted to a tertiary academic hospital for non-traumatic intracranial hemorrhage between 1/2014 and 12/2015. We included all patients with intracranial hemorrhage and excluded those with trauma, ischemic stroke, age 18. A standardized data collection tool was used to abstract each patient chart and linked to the electronic data warehouse for additional data. We characterized each visit along 3 pathways: 1) inter-hospital transfer from other ED to our ED, 2) inter-hospital transfer from other ED to our ICU, and 3) no inter-hospital transfer (presented to our ED). The primary outcome was in-hospital mortality. We constructed logistic regression models to adjust for age, gender, Glasgow Coma Score (GCS), hyponatremia, hypoxia and elevated systolic blood pressure.

## Result

Of 1887 patients meeting initial screening criteria, 492 patients were included in the 2-year time frame of the study. 227 arrived via ED-to-ED transfer (1), 62 arrived via ED to ICU transfer (2), and 203 presented to our ED (3). We observed no significant difference in in-hospital mortality (1 vs 2, 17.6% vs 13%,  $p = 0.48$ ; 1 vs 3 17.6% vs 16%,  $p = 0.8$ ). After adjusting for patient factors we also found no statistically significant

difference in in-hospital mortality (OR 1.98, 95% CI -0.67 to 2.12).

## Conclusion

There was higher, but not significant, in-hospital mortality among patients transferred to our ED compared to those transferred to our ICU. The odds of mortality in comparison to patients initially presenting to our ED were no different even when controlling for predictors of mortality. This suggests a limited relationship between inter-hospital transfer and mortality for intracranial hemorrhage. Modest differences in mortality may not have been detectable by our sample size. Future studies should explore differences in processes of care or more rare safety outcomes.

## Keywords

Intracranial hemorrhage inter-hospital transfers patient safety



# Inter-rater Agreement of HEART Scores in Emergency Department Patients with Chest Pain.

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## Background

With a low risk of major adverse cardiac events (MACE) in validation studies, the HEART score is a popular aid used to risk stratify ED patients with chest pain. Previous studies have often derived HEART scores using research associates. No study has compared HEART scores generated during clinical practice with the standardized scores used in research. Exploring differences in real-world HEART scores is important given the multiple subjective variables and the small threshold between low and high-risk scores.

## Method(s)

A prospective, observational study at an academic STEMI receiving center comparing agreement between ED providers clinical HEART scores and research scores derived from structured data collection was created. A convenience sample of adult ED patients presenting with symptoms suspicious for acute coronary syndrome (ACS) were included. If using the HEART score in clinical practice, the treating provider was asked to complete a brief survey detailing their score. Following consent, the patient completed a structured interview with a trained research associate to generate a research HEART score. Patients were followed by phone and chart review at 6 weeks to evaluate for MACE (ACS, bypass surgery, or catheterization). Simple agreement and weighted kappa (WK) were used to describe inter-rater agreement.

## Result

165 of 182 participants completed the study. Eighty-three senior ED residents (50%), 46 advanced practitioners (28%), and 37 attending providers (22%) provided clinical HEART scores. Of the 165 patients, 111 (67%) were admitted and 22 had MACE events at 6 weeks, (12 unstable angina, 3 NSTEMI, 5 positive stress test, 1 coronary bypass, 1 death). There was poor agreement between providers and researchers HEART scores overall (25%, WK 0.31) and stratified by provider. While age revealed high agreement (93% WK 0.89), risk factors (67% WK 0.43) and history (44% WK 0.10) had moderate to poor agreement. Disagreement on low and high-risk HEART scores occurred in 26% of cases (provider low, research high-risk 17/165, provider high, research low-risk 22/165).

## Conclusion

Compared to a standard research HEART score, practicing ED providers demonstrated poor agreement. Inconsistencies in HEART score derivation and application may alter previous odds of future MACE and may ultimately influence the utility of the HEART score.

## Keywords

HEART score, agreement, chest pain



# Internet of Things Buttons to Optimize Ancillary Staff Operations in Emergency Departments

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### Background

The integration of Wi-Fi-capable devices into internet-connected networks known as the "Internet of Things (IoT) creates opportunities to optimize ED operations. IoT buttons are small devices that, with the press of a button, deliver pre-programmed messages via text or email that identify simple tasks to be performed. As part of our research into IoT buttons for just-in-time notification of common, repetitive ED tasks, we examined the use of IoT buttons to optimize restroom cleanliness.

### Method(s)

We deployed IoT buttons in all restrooms in our urban, academic ED with ~65,000 annual visits. Signage instructed users to press the button if the restroom needed cleaning. A secure email notification was sent to housekeeping supervisors and investigators. Upon notification, supervisors dispatched staff to clean restrooms after which a double press signaled task completion. We measured usage over ~2 months. Other parameters included response time of the cleaning staff to notifications, and time trends in notifications and response data.

### Result

Over 53 days, we recorded 101 restroom cleaning requests from IoT buttons. Twenty-three percent occurred from 7 AM - 3 PM, 42% occurred from 3 PM - 11 PM, and 36% occurred from 11 PM - 7 AM. No buttons were lost or stolen. In a qualitative component, housekeeping supervisors stated that the number of

true requests for cleaning (e.g., the bathroom was soiled and required cleaning) increased significantly since IoT buttons were deployed. Supervisors also reported great satisfaction.

### Conclusion

We demonstrated the feasibility of deploying IoT buttons to optimize an ED operation that linearly correlates with patient satisfaction surveys. Usability arises from the ease of generating notifications and improved efficiency and timeliness of outcome. We are extending our experience in IoT buttons to other ED (e.g., restocking supplies), hospital (e.g., room turnover) as well as research (e.g., investigator notification) operations.

### Keywords

IoT, Internet of Things, ED Operations, feasibility, buttons, AWS



# Intravenous Antibiotic Use and Antibiotic Associated Diarrhea in Patients Treated for Non-Purulent Cellulitis

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## Background

According to the Infectious Disease Society of America (IDSA) Guidelines, cellulitis should be treated with oral antibiotics unless the infection/patient meet certain requirements that justify intravenous (IV) usage. Nonetheless, IV antibiotics are still being used liberally for treatment of cellulitis throughout Emergency Department (ED), outpatient and inpatient settings. Antibiotic associated diarrhea (AAD) is a common side effect of antibiotics use and can lead to Clostridium difficile infection. Failure to follow the IDSA Guidelines can lead to overuse of IV antibiotics and thus AAD, complicating a patient medical care. Objective: Explore the relationship between antibiotic associated diarrhea and the use of intravenous antibiotics in treatment of non-purulent cellulitis.

## Method(s)

We conducted a prospective observational study as part of our cellulitis quality improvement project which included 252 patients aged 18 years or older who were clinically diagnosed with cellulitis in the ED from March 1, 2017 to May 31, 2017. Thirty to ninety days after discharge, follow-up calls focused on medication compliance, AAD, and patient-reported outcomes were completed. Of the 252 follow-up calls, 75 (29.7%) had sociodemographic and ED visit data extracted by chart review. All data was analyzed through the use of Stata. We constructed a logistic model predicting likelihood of AAD.

## Result

Of the 252 follow-up calls, 61 (24.2%) did not have their cellulitis infection go away, 75 (29.8%) required more antibiotics, 70 (27.8%) experienced diarrhea and 4

(0.16%) reported Clostridium difficile infection. Our logistic model showed that IV antibiotics (OR 2.65, 95% CI 1.06, 6.62) and female gender (OR 3.27, 95% CI 1.09, 9.80) were both significantly associated with AAD. Vancomycin was the most frequently used IV antibiotics (66.7%), but did not reach statistical significance in the model.

## Conclusion

With only 1 in 4 patients reporting clearance of infection at 90 days, treatment outcomes among patients presenting to the ED with cellulitis is poor. AAD is just as common as treatment failure, with higher associated risks seen among patients receiving IV antibiotics. Adherence to IDSA Guidelines may help improve patient outcomes while reducing AAD by restricting the use of IV antibiotics. However, more work may be needed in order to improve patient outcomes.

## Keywords

antibiotic associated diarrhea, cellulitis, IV antibiotics, treatment outcomes



# Investigation of Electrocardiogram Interpretation Errors by Senior Emergency Medicine Residents

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## Background

In our Emergency Department (ED), senior third-year emergency medicine residents (EM3) are the initial interpreters of all ED ECGs, which provides both increased exposure and practice in interpreting ECGs. While this is an integral part of emergency medicine (EM) resident education, the accuracy of ECG interpretations is unknown. Additionally, to our knowledge, there are no published studies investigating error rates of ECG reading by EM3s. The goal of this study was to analyze the error rate associated with senior EM resident ECG interpretations.

## Method(s)

Retrospective study of all ED ECGs read by EM3s between 10/13/15-9/14/16 at an urban, tertiary care, academic medical center with a three-year residency that treats 56,000 patients per year. We reviewed all cases referred to the ED Quality Assurance (QA) Committee during this time period. Referred ED cases were evaluated by an 8-point Likert scale assessing for error, preventable and non-preventable adverse events. Cases perceived to have an error or the potential for patient harm were referred to a 20-member committee of ED leadership, attendings, residents and nurses for further consensus review. 95% confidence intervals (CI) were calculated.

## Result

27,034 ECGs were read by EM3s between 10/13/15-9/14/16. Of the 920 ED QA cases reviewed during this time period, an error was identified in 103 cases (11.2%; CI 9.2-13.2%). Three of the 103 errors involved a resident ECG interpretation or failure to act on an ECG abnormality (2.9%; CI 0-6.14%). One case involved a senior resident who did not recognize evolving ECG changes during an ED visit, while another error resulted when a senior EM resident did not request an immediate evaluation of a patient in triage with an ECG that demonstrated sinus tachycardia at 140 bpm. The only case that had an adverse outcome involved a missed posterior ST-segment elevation myocardial infarction (STEMI).

## Conclusion

There appears to be a low error rate associated with ECG interpretation among the EM3s at this single academic tertiary care facility. We believe this supports the continued use of senior EM residents as the initial interpreter of ED ECGs.

## Keywords

electrocardiogram, ECG, education, curriculum



# Is Hospital Performance on Publicly-Reported Quality Measures Associated with Patient Outcomes?

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## Background

Measuring and reporting on process quality measures has become ubiquitous in healthcare, and the Emergency Department (ED) is no exception. How well process measures that focus on ED care correlate with subsequent patient outcomes is unclear.

## Method(s)

We used process measures that were publicly reported to the Centers for Medicare and Medicaid Services Hospital Compare program and examined how performance on those measures correlated with mortality rates. Specifically, we examined measures relevant to ED care for patients with acute myocardial infarction (AMI): percentage of patients receiving aspirin (ASA) within 24 hours of arrival or before transfer out of the ED and percentage of patients receiving percutaneous coronary intervention (PCI) within 90 minutes of hospital arrival. We grouped hospitals into quartiles of performance for each measure based on z-score. Using linear regression, we calculated risk-adjusted 3-, 7-, 14-, and 30-day mortality rates of ED admission for AMI among continuously-enrolled Medicare beneficiaries age 65 and older using the inpatient and denominator files from 2012-2015. We incorporated patient age, sex, and chronic conditions as covariates.

## Result

Among the 4,483 acute care hospitals in the United States, 2,446 and 1,399 had data in Hospital Compare on the ASA and PCI measure, respectively. The mean percentage of patients receiving ASA within 24 hours or before leaving the ED was 95.3% (standard deviation [SD], 6.7%). The mean percentage of patients receiving PCI within 90 minutes of arrival was 72.2% (SD, 39.7%). Among reporting hospitals, we found no statistically significant differences in risk-adjusted mortality at 3, 7, 14, or 30 days across the quartiles of process measure performance for either measure. For example, 7-day mortality among hospitals reporting the PCI measure was 7.6% in the first quartile, 7.8% in the second, and 7.7% in the third and fourth ( $p=0.29$ ). Among hospitals reporting the ASA measure, the 30-day mortality was 8.4% in the first quartile, 8.6% in the second, 8.3% in the third, and 9.4% in the fourth ( $p=0.81$ ).

## Conclusion

We found no evidence that hospitals performing better on these publicly-reported ED process measures had better outcomes for patients with AMI. Policymakers should carefully consider if the effort associated with reporting key process measures is justified.

## Keywords

Emergency department quality of care



# Is Palliative Care Cost-Effective in Low and Middle Income Countries? A Mixed-Methods Systematic Review

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## Background

Of the 40 million people globally in need of palliative care (PC), just 14% receive it, predominantly in high-income countries. Within fragile health systems that lack PC, incurable illness is often marked by pain and suffering, as well as burdensome costs.

PC addresses symptoms and provides support to families and caregivers. In high income settings, PC has been shown to decrease health care utilization, thus enhancing value, which, in turn, promotes the expansion of palliative medicine.

Similar cost-effectiveness models are lacking in low and middle income countries (LMIC) and with them, the impetus and funding to expand PC delivery.

## Method(s)

We conducted a systematic search of seven databases in order to gather evidence of the cost-effectiveness of PC in LMIC. We extracted palliative outcomes as well as economic data. This review adheres to PRISMA guidelines and includes a quality appraisal.

## Result

The search identified nine eligible papers that included palliative and economic outcomes in LMIC. Three studies provided a true cost effectiveness analysis in comparing the costs of PC versus traditional care, with PC offering cost savings and increased home death rates. Most studies focused on methods of low-cost delivery of PC and patient-related outcomes, but not economic outcomes.

## Conclusion

Despite the small number of included studies, wide variety of study types and overall lack of high quality studies, several patterns have emerged: (1) low-cost PC delivery in low and middle income countries is possible, (2) patient-reported outcomes are favorable, and (3) in the two studies which reported economic outcomes, PC is less costly than the alternative. This review highlights the extraordinary need for robust cost-effectiveness analysis of PC in LMIC in order to develop health economic models for the delivery of PC, direct resource allocation, and guide health care policy for PC delivery in these settings.

## Keywords

global health, palliative care, cost-effectiveness, low and middle income countries



# Ketamine Indications in Statewide Treatment Protocols

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## Introduction

Ketamine was discovered in the 1960s, and since that time has been used for multiple indications including pain control, procedural sedation, induction, depression, and excited delirium/behavioral disturbances. Ketamine has a more favorable hemodynamic profile than many of its alternatives for the same indications. It can be administered through the intravenous, intraosseous or intramuscular routes. The purpose of this investigation is to describe the overall prevalence of ketamine in STPs and the indications for which it can be utilized.

## Method(s)

Cross sectional study of STPs for inclusion of ketamine in any protocols. Protocol revision date was also captured.

## Result

Thirty one out of fifty (62%) states issue ALS STPs, seven of which serve as guidelines. 48% of STPs include ketamine as an approved medication in their pharmacopeia. Ten states (32%) include Ketamine for induction during rapid sequence intubation, and five states (16%) allow ketamine for procedural sedation. Six states (19%) include Ketamine in their pain control protocols. Eight states (26%) have excited delirium protocols which include the use of ketamine. One state also includes ketamine as an agent for shivering. 60% of states which include Ketamine in their protocols only allow its use for one indication. 75% of protocols have been revised since 2015 and all have been revised within the past 5 years.

## Discussion

Ketamine is a versatile medication with a variety of applications in prehospital care. Despite this, less than half of STPs include ketamine in their pharmacopoeia, and the majority of those that include it have limited indications. Ketamine is a hemodynamically stable option for pain control or induction for RSI, but a minority of states with STPs include ketamine for these indications. Ketamine has had a recent resurgence in emergency medicine, although as most protocols have been revised in the last 3 years, it is unlikely that protocol revision timing has been a barrier to ketamine adoption into STPs. Further study is needed to examine the barriers to introduction and indication expansion of ketamine in STPs.

## Keywords

Analgesia, EMS, Statewide treatment protocols, Ketamine, Intubation





# Lack of Sedation Protocols for Intubated Patients During Transport in Statewide Treatment Protocols

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## Background

In our constantly evolving healthcare system the transfer of intubated patients between facilities is an ever more common occurrence. While there is a paucity of literature regarding the impact of adequate sedation in the out of hospital environment, intensive care unit (ICU) studies have shown significant outcome measures such as ICU length of stay is associated with inadequate patient sedation. The purpose of this study was to describe current protocols for sedation of intubated patients during interfacility transfer (IFT), as well as the use of standardized sedation assessment scoring to guide sedative medication administration.

## Method(s)

Cross sectional study of STPs utilizing a standardized review to evaluate sedation protocols for intubated patients and the use of standardized sedation assessment scores. Protocol revision date was also captured.

## Result

Thirty-one out of fifty states (62%) issue ALS STPs. Of those thirty-one states, only one (3%) has a protocol for sedation of intubated patients. No STP incorporates or references any sedation scoring tool to help guide sedative administration or aid in patient assessment. 75% of protocols have been revised since 2015 and all have been revised within the past 5 years.

## Conclusion

Although there is little in the prehospital literature regarding patient outcomes with respect to inadequately sedated patients, self-extubation, excessive agitation on hospital arrival and vital sign abnormalities are complications well known to providers. This study demonstrates that current STPs do not provide paramedics with the tools to optimally assess and sedate intubated patients in the out of hospital environment. While sedation plans may be developed with medical control prior to transfer, a protocolized approach to sedation scoring and medication administration may be beneficial. This represents a serious deficiency in our ability to provide high quality care to intubated patients in the out of hospital environment. In the future, we hope to develop and validate a pre-hospital sedation scoring model and associated protocol for the management of intubated patients in the out of hospital environment.

## Keywords

Statewide Treatment Protocols, Intubated Transfers, Sedation



# Look Before You Leap: Mathematical decision modeling for acute stroke thrombectomy transport

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### Background

Delays to reperfusion therapy (tPA or endovascular thrombectomy [EVT]) for patients with ischemic stroke (IS) reduce the odds of functional independence.

Prehospital routing algorithms for patients with suspected large vessel occlusions (LVO) should account for likelihood of benefit from EVT, risk of tPA delays, and transport times. We built a probabilistic, cost-effectiveness model to give a real-time, location-based optimal EMS routing location based on local resources, transport times and patient characteristics.

### Method(s)

Using onset time, age, sex and pre-hospital stroke severity, we calculated odds of a favorable outcome for a patient with suspected LVO under 2 scenarios: direct to EVT-capable hospital vs. transport to the nearest tPA-capable hospital with transfer to EVT-capable hospital if appropriate. We incorporated disability, utility and cost to project lifetime outcomes. Multiple parameter sets of center-specific times (e.g., door to tPA) were randomly selected to account for the sensitivity to these estimates; at each iteration, the optimal strategy was defined as the most cost-effective outcome (threshold \$100,000/ QALY gained). After 1000 simulations, the most frequently occurring optimal strategy was the final recommendation, with its strength measured as the proportion of runs for which it was optimal.

### Result

Routing recommendations were highly sensitive to small changes in input parameters. Under many scenarios, the recommendations for direct transfer to the EVT site increased with increasing stroke severity and geographic proximity, but did not vary substantially with respect to sex, age or onset time. For example, for a 70 year old female 31 minutes from a tPA site and 48 to EVT site, the recommendation very weakly favors direct transport to EVT site for moderate stroke (NIHSS 10) but the strength of the recommendation increases for severe stroke (NIHSS 18), (53% [50%, 56%] vs. 74% [71%, 77%], p 0.001).

### Conclusion

We present a decision model that determines ideal prehospital routing recommendations for patients with suspected IS due to LVO to maximize patients long-term outcomes based on patient characteristics and location at onset. This can be further refined if real-time data on traffic patterns and actual EVT and tPA timeliness performance data are incorporated. Further studies are needed to verify model predictions.

### Keywords

large vessel occlusion, acute ischemic stroke, stroke triage, endovascular thrombectomy, model, quality of life, emergency medical services



# Loss of Epinephrine Auto-injector Time-To-Expiration at Purchase, a Hidden Premium on Cost

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## Background

The high cost of epinephrine auto-injectors has become a public health problem. When patients are forced to purchase these auto-injectors with a time-to-expiration less than the full 18 months allowed by the FDA, this is an additional premium on the cost.

## Method(s)

We surveyed a geographically diverse convenience sample of pharmacies to determine the remaining time-to-expiration at purchase of their in-stock epinephrine auto-injectors. Each pharmacy was asked to report both the quantity and the expiration dates of their EpiPens (0.3 mg / 0.3 ml), EpiPen Jr (0.15 mg / 0.3 ml), and generic brands of both. The remaining time-to-expiration for each auto-injector was determined by calculating the number of months between the date of pharmacy contact and the expiration month on each auto-injector.

## Result

Overall, 63 pharmacies were surveyed from every major region of the country. Of these, 36 pharmacies responded. Each pharmacy had 4.6 3.2 epinephrine auto-injectors in stock. In total, there were 264 auto-injectors evaluated. These had an average remaining

time-to-expiration of 11.3 3.2 months. None of the auto-injectors had the full 18-month time-to-expiration. The shortest time-to-expiration was 1 month. Our results do not reflect the variable impact of patient insurance. They further do not indicate if the loss of time-to-expiration represents normal supply chain challenges for medications of this type.

## Conclusion

In this convenience sample, the average loss of time-to-expiration of in-stock epinephrine auto-injectors was 37.3%. This is equivalent to a cost premium of similar magnitude. Dispensing an epinephrine auto-injector with a short time-to-expiration may constitute a substantial hidden cost. Depending on a patient insurance status and financial means, this may represent an additional obstacle to accessing a potentially life-saving medication.

## Keywords

Epinephrine auto-injector, EpiPen, Expiration date, Anaphylaxis



# Missed Serious Neurological Conditions in Emergency Department Patients Discharged With Nonspecific Diagnoses

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### Background

Serious neurological conditions can be missed on initial ED visit and the discharge diagnosis oftentimes remains a nonspecific symptom. The miss rate and specific diagnoses are unclear. The objectives of this study are to estimate the percentage of ED patients discharged with nonspecific diagnoses of headache and back pain who return with a serious neurological diagnosis, identify these specific missed diagnoses, and determine any risk factors for missed diagnosis of these patients.

### Method(s)

Retrospective cohort study of discharged adult ED patients using the population-based data of six U.S. states from the State Emergency Department Database and State Inpatient Database from 2006 to 2012. Patients discharged from the ED with a diagnosis of atraumatic headache and atraumatic back pain that had a return visit within 3 days and were found to have a serious neurological diagnosis were identified. International Classification of Diseases, Ninth Edition (ICD-9) codes of revisit diagnoses were obtained. We stratified the analysis by age group. Data were analyzed using descriptive statistics.

### Result

During the study period, there were 2,101,081 ED discharges with a nonspecific diagnosis of headache and 1,381,614 discharges with with a nonspecific diagnosis of back pain. 0.33% of the headache patients (95%CI 0.33-0.34) and 0.05% of back pain patients (95%CI 0.05-

0.05) returned with a serious neurological diagnosis within 3 days of ED discharge. The most common missed diagnosis for headache was acute cerebrovascular disease (35.8%), including cerebral artery occlusion (13.8%) and subarachnoid hemorrhage (8.6%). The most common missed diagnosis for back pain was central nervous system infection and poliomyelitis (38.4%), largely due to intraspinal abscess (36.5%). The proportion of return visits for serious neurological diagnosis was 3 times higher in patients age 85 years or greater (0.7% [95%CI 0.6%-0.8%]) compared to those age 18-39 years (0.2% [95%CI 0.2%-0.3%]).

### Conclusion

A small but significant number of ED patients discharged with nonspecific diagnoses of headache and back pain returned with a serious neurological condition within 3 days. This rate is 6 times higher for headache compared to back pain. Older patients had a higher rate of misdiagnosis with these complaints.

### Keywords

misdiagnosis, neurological emergencies, headache, back pain



# National Trends in Emergency Medicine Residency Electrocardiogram Curriculum and Interpretation Practices

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## Background

There are no mandatory guidelines to standardize electrocardiogram (ECG) curriculum or interpretation practices across emergency medicine (EM) residencies. Little is known regarding who performs the initial ECG interpretation and how resident reads are supervised by attendings. Our ECG educational model at Beth Israel Deaconess Medical Center (BIDMC) utilizes the senior resident as the primary interpreter of all ECGs within the emergency department (ED). We sought to investigate the diversity of ECG interpretation patterns and curriculum across EM residency programs.

## Method(s)

A survey was performed to collect data regarding the ECG curriculum and practice patterns of 166 EM residencies recognized by the Accreditation Council for Graduate Medical Education (ACGME) in February 2017. Each program director received a unique, de-identified survey link via a secure web-based application, Research Electronic Data Collection (REDCap), requesting information regarding their residency demographics, ECG reading patterns and curriculum. Responses were summarized and compared by region, program length, and primary interpreter of ECG. 95% confidence intervals (CI) were calculated.

## Result

Sixty one percent of residencies participated (n=102). Eighty-nine programs report an attending as the primary ECG interpreter (87%; CI 79.2-92.5%), while only 13 institutions allow the senior resident to perform primary interpretation (13%; CI 7.4-20.7%). Of these 13 programs, many require attending interpretation within 11-30 minutes (69.2%). There are a variety of required and elective ECG curriculum models.

## Conclusion

EM attendings are the primary interpreters of ECGs at the majority of residency programs. A small minority provide senior residents the opportunity to perform primary interpretation. Most programs utilize mandatory didactic lectures to disseminate ECG interpretation knowledge, while a much smaller portion use innovative teaching modalities such as flipped classroom and online modules. Further studies are needed to investigate error or miss rates attributed to resident and attending ECG interpretation.

## Keywords

ECG, electrocardiogram, education, residency curriculum



# National Trends in Low-Value Syncope Care after 2007 ACEP Clinical Guidelines

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## Background

In 2007, ACEP clinical policy on ED syncope care recommended against routinely performing head imaging and suggested limiting hospitalization to high-risk patients. Since then, there has been a concerted effort to reduce low-value imaging (including Choosing Wisely) and hospitalizations for ED syncope patients. We hypothesized that national trends in advanced imaging and hospitalization rates for syncope decreased from 2007-2015 compared to 2002-2007.

## Method(s)

We performed an interrupted time-series study using the 2002-2015 National Hospital Ambulatory Medical Care Survey ED sample data. We first calculated annual rates of advanced imaging (CT/MRI) use for ED visits where syncope was a reason for visit or ED diagnosis. We then calculated annual hospitalization rates, including inpatient, observation, and hospital-to-hospital transfer admissions, for ED visits where the principal ED diagnosis was syncope, implying a negative ED evaluation for clinically significant cause of syncope. We assessed the change in the yearly trends of the rates of CT/MRI use and hospitalization, before and after 2007, using survey-weighted multivariable regression, controlling for patient, visit, and hospital characteristics.

## Result

In 2002-2015, 40.1% (95%CI 38.2-42.1) of all ED visits with syncope as a reason for visit or ED diagnosis

received CT/MRI imaging. From 2002 to 2007, the CT/MRI rates increased by 2.7% (95%CI 1.4-4.0) yearly. From 2007 to 2015, CT/MRI rates had no significant annual trend (-0.4% yearly; 95%CI -1.3 to 0.5). The change in yearly trends before and after 2007 was statistically significant (-3.2%; 95% CI -4.8 to -1.6). Of visits with principal ED diagnosis of syncope, 33.6% (95%CI 31.4-36.0) were hospitalized. From 2002 to 2007, hospitalization rates had no significant annual trend (0.3% yearly; 95%CI -1.1 to 1.8). From 2007 to 2015, hospitalization rates declined significantly by 2.4% yearly (95%CI -3.3 to -1.4). The change in yearly trends before and after 2007 was statistically significant (-2.7%; 95%CI -4.5 to -0.9).

## Conclusion

Advanced imaging and hospitalization rates for syncope ED visits declined after the 2007 ACEP syncope guidelines. High-visibility dissemination of ED guidelines may be an effective approach for reducing low-value ED care. Future efforts should assess the impact of these changes on patient outcomes.

## Keywords

Syncope, Advanced Imaging, Admission, Hospitalization, Testing Utilization, Low-Value, Choosing Wisely



# Optimization of patient management in the emergency department following opioid overdose

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## Background

As the opioid overdose epidemic continues with an increased focus on emergency medicine management of this crisis we developed a standard approach to opioid overdose patient. To increase compliance with this approach we introduced a smartphrase in August 2017 to both standardize documentation and provide a reminder to providers of the expected steps in the management of patients presenting after a suspected opioid overdose.

## Method(s)

Charts were reviewed for all patients presenting to the emergency department following a suspected opioid overdose from August 1, 2017 through November 18, 2017. Data collected included date, means of arrival, providers, disposition, substance abuse counseling while in the emergency department, naloxone kit, and referral to outpatient substance abuse recovery center. Providers were given feedback via email regarding utilization of the smartphrase and referral to substance abuse recovery center.

## Result

All patients presenting following suspected opioid overdose who were subsequently discharged from the emergency department were included. Of the 131 patients presenting with suspected opioid overdose, 87 (66%) were discharged from the emergency department. The opioid overdose smartphrase was utilized for 57 (66%) of the 87 patients who were discharged. Naloxone kit was given to 81% of patients in August 2017 and 64% of patients in November 2017. Referral to the substance abuse recovery center was 30% in August 2017 and 43% in November 2017.

## Conclusion

Addition of a smartphrase has not increased the naloxone kit distribution. Referral to outpatient substance abuse recovery center has increased. We hope that with continued provider feedback we will be able to further standardize the management of patients presenting after a suspected opioid overdose.

## Keywords

opioid; overdose; substance abuse



# Outpatient Health Care Experience Assessment of Rhode Island Cambodian Community with Providers

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## Background

The Cambodian community is the largest Southeast Asian (SEA) ethnic group in Rhode Island (RI) with high poverty rates and limited health care access. The underuse of medical care amongst SEA nationally is multifactorial and there are limited studies describing their unique health care experiences.

## Method(s)

This was a cross-sectional observational survey study conducted from September 2016 to February 2017. Questions were selected from a prior study using a validated survey for Asian Americans (AA) and reviewed for cultural sensitivity with the RI Cambodian Society leadership. Finalized bilingual surveys, recruitment forms and gift card raffles were offered to all eligible 18 years or older Cambodians visiting the Center for Southeast Asian-RI. The study protocol was exempt by the RI Hospital IRB.

## Result

123 surveys were collected; this analysis focused on the 98 (79.7%) participants with regular providers (physicians, nurse-practitioners, physician-assistants). Majority of subjects did not have a provider gender (70%) or race preference (81%). 98% of subjects trusted their providers, but only 59% understood information provided, specifically: 29% had difficulty reading

prescriptions and 30% had trouble understanding written information. 68% reported better comprehension if they had medical interpreter services, but only 50% reported this service was available. There were no significant differences in the expressed confidence level of providers or race preferences biases between RI Cambodians or AA from prior research. There was a significant greater reporting of 'poor communication with the healthcare provider (60% [RI] vs. 27% [AA]), and 'decreased understanding of prescriptions (35% vs. 66%) and providers (32% vs. 44%).

## Conclusion

Language barrier is identified as the most alarming and significant challenge among the surveyed Cambodians compared to AA from prior research. Even though medical interpreters were desired, only half received this service. This was reflected in lower endorsement of satisfactory communication with the provider and poor comprehension of prescriptions and healthcare instructions. We hypothesize that increased services such as medical interpreters can improve patient understanding and patient compliance.

## Keywords

Rhode Island, Cambodian, healthcare assessment, health disparity





# Would You Have Done Something Differently? A Novel Marker to Identify Error in Emergency Medicine

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### Background

When using chart review to assess physician decision making, one needs to distinguish between errors (failure to follow the standard of care) versus medical judgment. Errors require that a particular or general rule be broken whereas medical judgement allows for differences in how two physicians may reasonably approach a particular situation. ObjectiveTo compare error classification based on the question "Did an error occur?" to "Would you have done something differently?" in identifying consensus committee classified error in Emergency Medicine (EM).

### Method(s)

Prospective, observational cohort study of consecutive patients presenting to an urban, tertiary care academic medical center ED with an annual volume of 57,000 patients between 1/08-11/17. Our hospital has an electronic Quality Assurance (QA) system that allows trained physician evaluators not involved with the patients care to review electronically assigned cases. "Did an error occur?" and "Would you have done something differently?" are asked of all reviewers. Reviewers used a structured 8-point Likert scale to assess each case for the possibility of error and adverse events (score  $\geq 4$ ) and if found cases were referred to a 20-member QA committee of EM physicians and nurses who made a final consensus based determination as to whether or not an error or adverse event occurred (gold standard outcome).

### Result

Of 2274 total cases reviewed, in 16.71% (380) the reviewer would have done something differently. Of these 380 cases in 38.42% (146) the initial reviewer found there to be an error, in 61.58% (234) management was thought to be within the standard of care by the initial reviewer and in 24.74% (94) the QA committee agreed with the reviewer determination of error. On final review of all 2274 cases by QA committee 5.10% (116) were found to have an error. Of these 116 cases in 18.97% (22) the initial reviewer would have done something differently but did not find an error.

### Conclusion

Asking the question "Would you have done something differently?" of trained EM QA case reviewers appears to be a novel and high yield marker to help identify error in EM and may be an underutilized quality assurance tool, reducing the risk of attribution bias in single reviewers assessment of physician performance. Secondary assessment may be to compare adverse outcome rates among the two questions.

### Keywords

error, quality assurance, quality improvement, risk reduction, patient safety



# Participation in Emergency Medicine Bootcamp Improves Clinical Knowledge Lost During Fourth-Year

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### Background

The final months of the fourth-year are variable in educational and clinical experience, and its effect on clinical knowledge is unclear. Furthermore, medical students are concerned about their readiness for residency. Specialty-specific “bootcamps” are a growing trend in medical education aimed at increasing clinical knowledge, procedural skills and confidence prior to the start of residency. We developed a four-week EM-specific bootcamp offered during the final month of medical school to improve clinical knowledge and confidence. The goal of this study was to determine the impact of an EM bootcamp on clinical knowledge at the end of fourth-year. We hypothesized that there would be a loss of specialty-specific clinical knowledge over the course of fourth-year that could be improved through participation in an EM bootcamp.

### Method(s)

This was a prospective, observational study of graduating fourth-year students from our affiliated medical school who matched in EM and participated in the EM bootcamp. During the 2015-16 and 2016-17 academic years, bootcamp participants took the SAEM M4 version 1 as a pre-test on the first day of bootcamp and SAEM M4 version 2 as a post-test on the last day of the course. Individual scores were de-identified and an unpaired t-test performed compared to national averages for the pre- and post-tests.

### Result

Nine total students took the bootcamp during the 2015-16 and 2016-17 academic years. Students scored 3.8 points lower than national average on the pre-test (74.3

vs 78.1, 0.02, 95%CI 0.744-6.789). On the post-test students scores improved and were at the national average (79.2 vs 82.1,  $p < 0.05$ , 95%CI -0.059 to 5.882).

### Conclusion

The variability in clinical education at the end of medical school may lead to a deterioration of clinical knowledge prior to the start of residency. End of fourth-year students scored significantly lower compared with the national performance by end-of-rotation sub-interns. Participation in an EM bootcamp brings participants clinical knowledge back to within normal range of their sub-internship level and highlights the importance of end-of-year clinical EM courses.

### Keywords

Emergency Bootcamp; Pre-internship education



# Pediatric Burn Management by Emergency Medicine Trained Non- Physician Clinicians in Rural Uganda

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## Background

Burns are a significant global health problem known to be a common cause of disability, disfigurement and death. This is especially true in pediatric patients though there are few studies that look at the medical management and outcomes of this vulnerable population. This study aims to highlight the strongest predictors of mortality in pediatric burn patients at 72-hours and the role that non-physician clinicians had in caring for these patients.

## Method(s)

This is a retrospective study of data from all children under 5 who presented with burns to a rural district hospital Emergency Department in Rukungiri, Uganda between November 2009 and July 2014.

## Result

109 patients presented with burns and were admitted to the hospital during the study time. At 72-hour follow-up 82 patients remained on an inpatient ward, 16 had been discharged, 7 died, and 4 were lost to follow-up. Patients who presented with hypothermia has the highest rate of mortality. Analgesia medication, including ketamine sedation, was provided to more than 90% of patients. Though not significant given the limited sample size, there was no suggestion of increased mortality in children sedated by ketamine by non-physician clinicians.

## Conclusion

This study suggests that trained non-physician clinicians were able to manage pediatric patients with burn injuries and provide initial assessment, treatment, and crucial analgesic administration.

## Keywords



# Penalty Minute Rule Change Effect on Disqualifications and Injuries in High School Hockey

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## Background

In the US, ~12000 players 19 years and younger seek care in emergency departments (ED) for ice hockey injuries annually. Recent efforts have focused on reducing dangerous play at all levels of hockey. Rule changes and behavioral modifications such as Fair Play have proven successful in reducing injury risk, but have not been widely implemented. The purpose of this study is to determine the effect of a 2015-2016 rule change in Rhode Island (RI) HS boys' ice hockey, in which a system that penalizes players who exceed a maximum number of penalty minutes (PIM) during the regular season and playoffs was implemented. We hypothesized that a PIM restriction would reduce game disqualification (DQ) penalties and injuries in HS hockey players.

## Method(s)

Retrospective cohort study. Injury data collected at Lifespan hospital system (RI), game/penalty data collected via RI Hockey Coaches' website. Participants included HS boys hockey players age 13-19 years presenting to 4 RI hospital ED for hockey related injuries from December 2012 to April 2017. Injuries classified as bodychecking related or non-bodychecking related, comparing injuries before and after the rule change. Study approved by Lifespan IRB.

## Result

During the study a total of 1557 HS hockey games were played. Of 81 game related injuries presenting to 4 EDs, 49 (60.5%) were due to bodychecking. Game DQ

penalties/season were significantly reduced >2 fold, occurring in 5.4% of games before and 2.5% of games after the rule change ( $\Delta = 53.72\%$ ; 95% CI 51.21-56.21,  $p = 0.003$ ). Odds of sustaining a bodychecking injury requiring an ED visit were higher prior to the rule change (OR 1.3, 95% CI 0.45-3.75). Concussion and closed head injury ED visits per season were reduced 4.5 fold (9/season to 2/season), but this trend was not statistically significant.

## Conclusion

A statewide PIM restriction rule change reduced the mean game DQ penalties/season in HS boys hockey. Bodychecking injuries and closed head injuries receiving ED care were reduced following rule change, but these trends for injuries were not statistically significant. Limitations of this study include small sample size and under-reporting of bodychecking due to paucity of detail in clinician narratives. A larger multicenter study following regional /national adoption of a similar rule change has potential to show penalty and injury reductions on a broader scale.

## Keywords

Hockey, Injury Prevention, Concussion, bodychecking



# Performance of CURB-65 in Predicting Critical Care Interventions in Patients With Pneumonia

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## Objective

CURB-65 is a clinical prediction rule that stratifies hospitalized patients with pneumonia by expected mortality. In our study, we assessed the predictive performance of CURB-65 to the more proximal endpoint of receipt of critical care intervention (CCI) in Emergency Department (ED) patients admitted with pneumonia.

## Method(s)

We performed a retrospective analysis of electronic health records from a single tertiary center for ED patients admitted with a primary diagnosis of pneumonia from 2010 to 2014. The relationship between CURB-65 and receipt of CCIs (i.e. vasopressors, large volume intravenous fluids, invasive catheters, assisted ventilation, insulin infusions, or renal replacement therapy) and in-hospital mortality was determined.

## Result

There were 3,851 patients admitted with pneumonia during the study period; 1,147 (29.8%) were admitted to the ICU within 48-hours of ED triage and 636 (55.4%) received a CCI. Of patients with a CURB-65 0-1, 357 (18.7%) were admitted to the ICU, 182 (9.5%) received a

CCI, and 38 (2.0%) died. Among patients with CURB-65<sup>≥2</sup>, 790 (40.6%) were admitted to the ICU, 454 (23.4%) received a CCI, and 168 (8.6%) died. The AUROC for CCI and mortality were 0.68 and 0.71, while sensitivity of CURB-65 <sup>≥2</sup> to predict CCI was 71.4% and mortality 81.6%.

## Conclusion

Patients with CURB-65<sup>≥2</sup> were often admitted to the ICU and received CCIs. Given this finding and the low sensitivity of CURB-65 for CCI, clinicians should exercise caution when utilizing CURB-65 to guide disposition. Future ED-based clinical decision or prediction rules may benefit from calibration to more proximal endpoints.

## Keywords

clinical prediction rule pneumonia critical care interventions



# Pharmacologic Opioid Alternatives for Pain Control in Statewide Treatment Protocols

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### Introduction

There has been an increasing focus on reducing opioid use across healthcare in light of the opioid epidemic. There are multiple pharmacologic options for treating pain in the prehospital setting including ketamine, nitrous oxide, acetaminophen, ibuprofen, ketorolac and aspirin. The majority of states issue statewide treatment protocols (STPs) that are either mandatory, or serve as a guide for medical directors. The purpose of this investigation is to describe the extent to which STPs include alternatives to opioids for pain control.

### Method(s)

Cross sectional study of STPs, utilizing a standardized review of pharmacopeia in pain control protocols. Protocol revision date was also captured.

### Result

Thirty-two of fifty states (64%) issue STPs; 78% are mandatory. 38% of STPs limit pain management to opioid medications only. 62% of STPs provide for pharmacologic alternatives to opioids for pain management. Pharmacologic alternatives for pain control are variable across STPs and include Nitrous oxide (50%), ketamine (19%), Tylenol (25%), ketorolac (25%), Ibuprofen (16%) and aspirin (6%). 75% of protocols have been revised since 2015 and all have been revised within the past 5 years. All ALS statewide treatment protocols have explicit orders for opiates in their pain control protocols.

### Discussion:

The opiate epidemic in the US has led to an increased focus on the use of alternatives to narcotic medications in healthcare. Pain management is an important part of pre-hospital care, however many states do not provide pharmacologic alternatives to narcotic medications. While no studies have identified prehospital narcotic administration as a cause of or contributor to the opiate epidemic, we should strive to reduce the use of narcotics when appropriate alternatives exist. Despite the majority of STPs undergoing protocol revisions within the last two years which is during the ongoing opiate epidemic, STPs have not fully incorporated alternatives to opiates for pain control. This represents a significant opportunity to improve our STPs to include alternatives to narcotic medication for the management of pain, and do our small part to help combat the opiate epidemic. Further study is needed to better understand the barriers to adoption of non-opiate pharmacologic treatment or adjuncts for pain treatment.

### Keywords

EMS, Statewide Treatment Protocols, Narcotics, Opiates, Pain control



# Physician Variability in the Emergency Department

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### Background

Aggregate direct spending on emergency department (ED) care accounts for 5-10% of national health care expenditures. Proposals to control costs in EM include reducing unnecessary diagnostic testing. Previous studies have shown physician variability in test utilization, with the focus on individual tests. Less is known about broader measures of ED practice intensity. In this study, we used ED charges of diagnostic studies defined by the Medicare fee schedule as a proxy for resource utilization. We hypothesized that there is significant quantifiable inter-physician variability in diagnostic resource utilization.

### Method(s)

Study was done on an ED data set from 2010-2014 at a community teaching hospital in Providence, RI with an annual volume of 61,000 visits. We reviewed 92,630 adult patient encounters by 35 ED attending physicians who saw at least 250 patients each year and had similar schedules and assignments. Each encounter was coded to a total charge in United States dollars based on the total laboratory and radiological studies ordered during the encounter according to the 2014 Medicare fee schedule. We used a linear mixed model to calculate overall average per encounter and individual physician average expenditure.

### Result

The overall average Medicare charge per patient was \$197.30 (95%CI \$176.35-\$218.25), with significant variability ( $p = 0.0001$ ) in the group. Of the 35 providers, 7 had an average charge significantly below the mean, and 16 were significantly above the mean. The highest average charge was \$265.82 per encounter (95%CI

\$240.53-\$291.10) - 34.7% higher than average. The lowest average charge was \$144.76 (95%CI \$126.32-\$163.19) - 26.6% lower than average. Highest charges were for patients with chief complaints of abdominal pain with a mean of \$386.68 (95%CI \$373.00-\$400.36) and testicular problem with a mean of \$465.11 (95%CI \$421.98-\$508.24).

### Conclusion

These findings indicate that there is statistically significant variation among ED physicians diagnostic resource utilization across a spectrum of ED presentations. Given the diverse training backgrounds and experience of the physicians studied, this variation likely occurs in other EM groups. The variability in practice patterns suggests that there are potential savings from implementing clinical decision rules or pathways that might streamline and standardize care.

### Keywords

Emergency Medicine Variation Variability Expenditure Health Policy Physician Decision



# Pigtail Catheter and Chest Tube Complications in the Emergency Department

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### Background

Emergency clinicians increasingly turn to pigtail catheters as a less invasive technique for management of pneumothoraces and simple effusions. Several studies have demonstrated this technique to be safe, reliable, and efficacious, but these were under-powered to detect rare but important complications. We aim to compare complications seen with pigtail catheters and large bore chest tubes in the emergency department.

### Method(s)

We performed a retrospective analysis of all medical records of pigtail or chest tube placements placed between July 2015 and February 2017 at a single tertiary academic emergency department. Procedures performed by surgical consulting teams were excluded. Chi-squared test with Yates' continuity correction was used to nonparametrically compare the complication rate between pigtail catheters and large-bore chest tubes.

### Result

95 thoracostomies were performed by emergency physicians comprised of 45 pigtail catheters and 40 chest tubes. Of the 45 pigtail catheters, 5 (11.6% [6.3-15.7% 95% CI]) had complications. Of the 40 chest tubes, 3 (7.5% [3.3-11.7% 95% CI]) had complications. Chi-square test did not demonstrate significance ( $p=0.84$ ).

### Conclusion

Pigtail catheters are associated with similar rates and severity of complications as chest tubes. Both procedures have significant complications, and therefore, caution should be used when performing thoracostomies in the emergency department.

### Keywords

pneumothorax thoracostomy chest tube complications





# Pilot Study of Noncontact Vital Signs Acquisition in Emergency Department Patients

**Carlin Chuck, Presenting Author**

## Background

Noncontact acquisition of vital signs (VS) such as heart rate (HR) and temperature through video photoplethysmography (vPPG), motion analysis (MA), and infrared thermography (IR) may facilitate patient assessment in Emergency Departments (ED).

Investigators studied the feasibility of live environment clinical research with a vPPG-MA/IR system through a pilot study which compared ED patient VS obtained concurrently with contact monitors (CM) and experimental methods.

## Method(s)

The prospective observational study recruited ED patients if they had no contraindications to CM leads; did not require oxygen masks; and were able to consent/assent. A study cart was configured with vPPG-MA prototype, FLIR T300 and FLIROne cameras, bedside CM access computer, lightmeter, and ambient thermometer. Each vPPG-MA recording acquired 10 non-contiguous 60s segments over an hour. Age, gender, Fitzpatrick skin tone, Emergency Severity Index (ESI), oral/rectal and IR temperatures, ambient light, and room temperature were recorded. All data were compiled with Excel and Splunk; vPPG-MA and CM measurements were compared with Bland-Altman analyses for pre-defined ED use-cases: Triage (unprimed) 30s, Routine 30s, Abbreviated 10s, and Full 60s.

## Result

Forty-eight (47%) of 102 approached patients participated: at least 5 subjects each in 0-12mo, 1-5y, 6-12y, 13-17y cohorts, and at least 2 subjects each in 18-29y, 30-39y, 40-49y, 50-59y, 60-69y, 70-79y, 80+y cohorts were enrolled. Subjects were 40% female with a

mean ESI of  $2.7 \pm 0.6$  [range 2-4], Fitzpatrick score of  $3.0 \pm 1.7$  [1-6], CM HR of  $88 \pm 23$  bpm [44-115 bpm], and temperatures of  $98.5 \pm 0.9$  °F [93.6-101.5 °F]. vPPG-MA acquired 61.2% of Full HR measurements with a mean difference from CM of  $+3.2 \pm 8.8$  bpm. The vPPG-MA Triage use-case application acquired 73.9% of HR measurements and resulted in ESI VS groupings matching those based on CM measurements for 95.5% of patients. Mean differences from core temperature for T300 and FLIROne were  $-4.7 \pm 2.5$  °F and  $-5.3 \pm 2.0$  °F. vPPG-MA acquisition of respiratory rate and pulse oximetry are being pursued.

## Conclusion

Clinical research applications of vPPG-MA/IR technologies in ED settings are feasible and have shown promising results. The study protocol is actively being used in a large cohort live ED study.

## Keywords

biomedical technology assessment; body temperature; emergency medicine; emergency treatment; heart rate; infrared spectrophotometry; medical informatics; patient assessment; patient safety; photoplethysmography; thermography; triage; vital signs



# Point-of-care Cardiopulmonary Ultrasound for the Diagnosis of Acute Decompensated Heart Failure: A Systematic Review and Meta-analysis

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## Background

Acute dyspnea is a common presentation encountered in the emergency department (ED). Point-of-care cardiac, pulmonary and inferior vena cava (IVC) ultrasound (US), when performed at the same time, have been proven to be highly practical in diagnosing acute decompensated heart failure (ADHF). Our objective is to perform a meta-analysis of eligible studies to determine the sensitivity and specificity of combined cardiac and pulmonary ultrasound (CPUS) protocols in diagnosing ADHF in patients presenting to the ED with undifferentiated dyspnea.

## Method(s)

A systematic review was conducted of all published literature indexed on PubMed, EMBASE, Cochrane database, and Web of Science. Included articles were prospective cohorts of patients that presented to the ED with acute undifferentiated dyspnea. Two independent reviewers screened abstracts for inclusion. A third reviewer was used when conflicts arose to gain consensus. Articles included for full review were assessed with the Quality Assessment of Diagnostic Accuracy Studies Statement (QUADAS) tool. Pooled estimates of sensitivity and specificity of CPUS in diagnosis of ADHF were calculated using Review Manager 5. The reference standard was considered clinical diagnosis based on review of medical records.

## Result

Initial search resulted in 3,980 unique articles. After reviewing their titles and abstracts, 31 articles were chosen for full text review, out of which a total of eight articles were identified that met the final inclusion criteria. The total number of patients was 3,276. In all studies CPUS was performed in the ED. In 7 studies emergency physicians performed the CPUS, in one study it was performed by cardiologists using the same CPUS approach. The pooled sensitivity of CPUS to diagnose ADHF was 82.8% (95% CI: 65.5-92.4%) and the pooled specificity was 94.8% (95% CI: 89.0-97.6%). Pooled positive likelihood ratio was 16.0 (95% CI: 8.0-31.8) and pooled negative likelihood ratio was 0.18 (95% CI: 0.09-0.38).

## Conclusion

In our study, CPUS was highly sensitive and specific in differentiating ADHF from other etiologies of undifferentiated dyspnea in the ED. Our analysis showed that using combined cardiac, pulmonary and IVC ultrasound protocols could increase diagnostic utility and accuracy of bedside ultrasound.

## Keywords

Point-of-care ultrasound; Cardiopulmonary ultrasound; Acute decompensated heart failure; Undifferentiated dyspnea



# Practice Patterns of Residents in an Academic Pediatric Emergency Department

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## Background

Despite significant differences in training, emergency medicine (EM) and pediatrics residents are expected to perform the same roles in pediatric emergency departments. Previous data suggest that these two resident groups do not perform equally in terms of patients per hour seen and preferences around seeing specific patient populations.

## Method(s)

Electronic medical records for 24,192 patients seen by pediatric or EM residents in a tertiary-care children hospital ED over the 2016-2017 academic year were analyzed by resident program and post-graduate year. Data from resident scheduling software were used to determine shifts worked. All shifts were 10 hours, with varying start times; overnight shifts were restricted to senior residents. Residents were free to assume care of any arrived patients, and rooms were not districted. 57 EM (15 PGY-1, 14 PGY-2, 15 PGY-3, 13 PGY-4) and 59 pediatric residents (20 PGY-1, 20 PGY-2, 19 PGY-3) were included in the study. T-tests were used to compare residents by PGY levels within the same program and between programs by patients-per-hour efficiency. Chi-squared tests were used to test for practices by EM or pediatrics residents to preferentially see more acutely ill (Emergency Severity Index (ESI) level 1) or younger (age 1 year) patients.

## Result

EM residents saw more total patients (12,584 vs 11,608) and more patients per hour than pediatrics residents (EM mean 1.30, CI 1.24-1.35; pediatrics mean 1.15, CI 1.08-1.21, 0.001), despite working fewer total hours (EM: 9,610 hours, pediatrics: 10,120 hours). Patients per hour trended upwards by PGY year 1 through 3 in both EM and pediatrics residents; this effect was significant between PGY-1 and 2 for both residencies (0.05 for EM, 0.001 for pediatrics), and between pediatric PGY-2 and 3 groups (0.05), but not between EM PGY-2, 3, and 4. Among 65 ESI-1 patients seen in this data set, 43 were seen by EM residents and 22 by pediatrics residents (0.05). Compared to pediatrics residents, EM residents also saw fewer patients &lt;12 months of age (0.01).

## Conclusion

Practice and efficiency variations do exist between pediatric and EM residents working in the same environment. Further work is needed to determine the source of these variations, their significance towards quality of training for residents, and how to address them.

## Keywords

Pediatrics, residents, efficiency, education,



# Preliminary Results from the Wrist Reduction Instruction with Simulation Technology (WRIST) Interdisciplinary Emergency Medicine and Orthopedic Surgery Study

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## Background

Distal radius (Colles) fractures account for one sixth of all adult fractures and one third of pediatric fractures in Emergency Departments (ED). While Colles fractures are frequently reduced in the ED, prior studies have found that one third can be inadequately reduced and approximately 7% require further treatment. Advances in medical simulation allow for realistic practice of Colles' fracture management with reliable performance metrics validated in the orthopedic literature.

## Method(s)

Investigators aimed to develop and implement an interdisciplinary simulation-based training intervention based on a deliberate practice framework to improve Colles' fracture reduction skills in ED providers. Twenty Emergency Medicine residents (each participant with less than 5 adult Colles fracture reduction clinical experience) are being enrolled at a tertiary-care academic hospital in 2017. Learner performance is being assessed objectively with fluoroscopic images of post-reduction/-splinting fracture angulation and displacement on a commercial Colles fracture simulator model. All subjects will complete two sequential reductions, a video didactic and hands-on training on Colles fracture reduction techniques, then a third reduction attempt.

## Result

The first 10 subjects have demonstrated mean improvements from baseline to third simulations of 4.8° (NS) and 3.1% (NS) in radial angulation and displacement, and 17.8° (0.01) and 11.8% (NS) improvements in dorsal angulation and displacement towards expert-defined acceptable tolerances.

## Conclusion

Preliminary data suggest that junior ED providers can improve their reduction skillsets with use of a Colles fracture model with video didactic and hands-on training from senior orthopedic clinicians. Additional study will be required to determine whether the video didactic alone can improve post-reduction angulation. To the investigators' knowledge, this study is the first experimental, interdisciplinary simulation-based fracture reduction training initiative between orthopedic surgery and emergency medicine. If core research objectives are successfully met, the materials developed for project use are scheduled to be openly disseminated for extramural use.

## Keywords

distal radius fracture reduction, simulation, education



# Protein Biomarkers for Identifying Appendicitis and Assessing Risk of Complex Disease

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## Background

Multiple biomarkers have been proposed to diagnose the presence and severity of appendicitis. We evaluated candidate biomarkers [ESM1, IL6, C-reactive protein (CRP), and procalcitonin (PCT)] to differentiate between those with and without appendicitis, and between simple and complex disease.

## Method(s)

We performed a prospective, observational cohort study in a convenience sample of patients from two urban academic emergency department (ED) patients (age  $\geq 17$ y) with appendicitis (n=79) and control ED patients without infectious/inflammatory disease (n=42). Patients with appendicitis were classified as having simple (n=52) or complex (perforation or abscess, n=27) disease by operative findings, imaging, and pathology. We collected blood specimens for ELISA and compared differences using Wilcoxon test (non-normal data) between those with and without appendicitis (no/yes), and between simple and complex appendicitis (simple/complex). For each biomarker and outcome, we calculated area under the curve (AUC).

## Result

In patients with appendicitis compared to controls, median levels of ESM1, IL6, and CRP were significantly elevated (0.001 for all), whereas procalcitonin (PCT)

levels did not differ between groups (p=0.48). For no/yes, medians were: ESM1: 2.2 (IQR, 2.1-2.5) vs 2.7 (2.3-3.3); IL6: 0.0 (0.0-2.5) vs 28.5 (4.3-81.7); CRP: 3.6 (1.2-10.5) vs 12.0 (11.6-12.4); and PCT: 1.4 (1.0-2.8) vs 2.6 (1.0-2.7). AUCs for no/yes: ESM1: 0.70 (95%CI, 0.60-0.80); IL6: 0.86 (0.79-0.92); CRP: 0.84 (0.75-0.93); and PCT: 0.54 (0.43-0.65). For simple vs complex, median levels of IL6 and CRP were significantly elevated (0.01), whereas ESM1 and PCT levels were similar (p = 0.05 and p=0.48, respectively). For simple vs complex, medians were: ESM1: 2.6 (2.2-3.1) vs 2.9 (2.5-3.5); IL6: 18.9 (2.9-39.4) vs 54.9 (23.4-267); CRP: 11.9 (10.6-12.2) vs 12.1 (11.9-13.3); and PCT: 2.6 (1.5-2.7) vs 2.6 (1.0-2.7). AUCs simple/complex were: ESM1: 0.64 (0.51-0.76); IL6: 0.76 (0.64-0.87); CRP: 0.69 (0.58-0.81); and PCT: 0.55 (0.42-0.69).

## Conclusion

ESM1, IL6 and CRP showed significant differences in patients with and without appendicitis, and between simple and complex disease; IL6 and CRP had the greatest AUC. Assay of inflammatory markers is potentially useful to separate healthy controls from those with simple and complex appendicitis.

## Keywords

appendicitis, biomarkers, diagnostic testing



# Quality Assessment of Clinical Practice Guidelines in Emergency Medicine: Can We AGREE?

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## Background

Clinical practice guidelines (CPGs) have been published by ACEP since 1990 to advance the delivery of emergency care. ACEP CPGs have raised controversy, and research shows many CPGs are based on lower classes of evidence and expert opinion despite Institute of Medicine recommendations. The rigor of development and overall quality of ACEP CPGs remain unknown. We sought to evaluate the quality of ACEP CPGs using a recognized, validated appraisal instrument: Appraisal of Guidelines for Research and Evaluation (AGREE II).

## Method(s)

Systematic review and meta-analysis of current ACEP Clinical Policies using AGREE II. This instrument, cited in over 650 publications, contains 23 appraisal items (scored on a 1 - 7 scale) in six domains and two overall assessments. Appraisals were done independently and in random order by five trained appraisers (AGREE II recommends at least two). Primary outcomes were AGREE II scores for each item, domain, and overall assessment. Domain and overall assessment scores were standardized for analyses. Secondary analyses examined associations between AGREE II scores and date of CPG publication, implementation of methodology updates in 2015, strength of the CPG underlying evidence, and the CPG proportion of Level C recommendations.

## Result

Twenty guidelines published from October 2008 to November 2017 were included. Of the six domains, Scope and Purpose scored highest (mean 90%) and Applicability scored lowest (mean 35%). These domains had the lowest and highest variability, respectively (coefficient of variation (CV) 0.03 and 0.16). The other domains (Stakeholder Involvement, Rigor of Development, Clarity of Presentation, and Editorial Independence) had mean scores of 53% - 78% and CVs 0.03 - 0.14. Overall assessment mean score was 69% (CV 0.13) and was not associated ( $p > 0.05$ ) with CPG publication date, strength of underlying evidence, or proportion of Level C recommendations.

## Conclusion

Based on validated criteria, ACEP CPGs have identifiable areas of strength and weakness. The overall assessment of CPG quality did not improve after methodological updates in 2015 and is not explained by the quality of underlying evidence. ACEP CPGs can be improved by addressing barriers to their application, resource implications of their implementation, and strategies for integrating recommendations into practice.

## Keywords

Clinical Decision Guidelines, Clinical Practice Guidelines, CPG, ACEP, AGREE II, Quality Appraisal



# Repeat Visits to ED in Patients With Syncope

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### Background

Syncope is a common presentation to the Emergency Department, accounting for approximately 13% of all ED visits and up to 6% of hospital admissions. This high admission rate is based on physician concerns for potential adverse outcomes such as recurrent syncope, if further evaluation and workup is delayed. We sought to evaluate outcomes of patients returning to the ED within 30 days following a syncopal event.

### Method(s)

This was a secondary analysis of a prospective cohort study of Emergency Department patients with syncope. We included patients from 04/11/14-11/03/14 initially presenting with syncope or near-syncope (defined as lightheadedness and impending fainting) to a tertiary-care ED with a census of 56,000 patients/year. Patients were followed through medical records and phone follow-up to determine 30 day outcomes.

### Result

Of 489 syncope patients identified, 162 (33%; 95% CI 29-38%) were admitted and 96 (20%; 95% CI 16-23%) were placed in ED observation initially. Of the 489 patients, 40 (8%; 95% CI 6-11%) returned to the ED within 30 days. Twenty nine (72.5%; 95% CI 56-85%) were admitted to the hospital, 4 (10%; 95% CI 3-24%) were admitted to ED observation, and 7 (17.5%; 95% CI 7-33%) were discharged home. Subsequently, 19/40 (47.5%; 95% CI 31-64%) returned for a recurrent episode of syncope. The other 21 (52.5%; 95% CI 36-68%) patients returned for other reasons unrelated to syncope, such as abdominal pain or chest pain. Of those 19 who returned for syncope within 30 days, 11 (58%; 95% CI 33-80%) were subsequently admitted, 2 (11%;

95% CI 1-33%) were placed in observation overnight and then discharged home, and 6 (32%; 95% CI 13-57%) were discharged home after ED evaluation. All patients initially discharged from the ED had benign diagnoses of syncope.

### Conclusion

Few patients who present to the ED with syncope return within 30 days of discharge, and only half return with syncope. The majority of the patients who returned to the ED for syncope within 30 days were previously admitted. This data suggests that if a worrisome etiology of syncope was not identified on initial ED visit, syncope patients are unlikely to return to the ED with a significant adverse outcome at 30 days.

### Keywords

syncope, Boston Syncope Pathway, clinical operations, ED observation unit, decision guidelines



# Respiratory virus epidemiology of infants with severe bronchiolitis: Prospective multicenter studies

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## Background

Bronchiolitis is the leading cause of infant hospitalization in the US. However, little is known about respiratory virus epidemiology, such as geographical and temporal patterns, among infants hospitalized for bronchiolitis (severe bronchiolitis). We investigated the differences by US regions and admission months of the 5 most common respiratory viruses in infants with severe bronchiolitis.

## Method(s)

We analyzed the data of infants (less than 1-year-old) hospitalized for bronchiolitis from 2 prospective cohort studies enrolled from November to March, 2007-2014 (27 sites from 17 states). Nasopharyngeal aspirates were tested for 17 viruses by RT-PCR. The states were divided into 4 census regions (Southern, Northeastern, Midwestern, and Western). The outcomes were the likelihoods of having each of the 5 most common viruses. To examine virus differences across regions and months, we fit logistic regression models adjusting for age, sex, and race/ethnicity. To investigate the interaction between region and month, we performed likelihood ratio test.

## Result

The analytic cohort comprised 2,848 infants with severe bronchiolitis with 96% virus detection. The 5 most common viruses were respiratory syncytial virus-A (RSV-A, 49%), RSV-B (29%), rhinovirus (RV, 24%), adenovirus (6%), and human metapneumovirus (6%); coinfection

(mostly RSV and RV) was present in 29%. There were significant regional differences in RSV-A and -B (both 0.001) and differences in admission month in all viruses (0.001) except for adenovirus. For example, patients in Western region were more likely to have RSV-A, and less likely to have RSV-B than those in the other regions. RV was the dominant virus in November, but RSV (A or B) was dominant in all other months, with a peak in January. The multivariable models confirmed significant interactions between regions and months with regard to RSV-A and -B (both 0.001).

## Conclusion

During 7 consecutive fall/winter seasons, we observed different geographical and temporal patterns for the most common respiratory viruses causing severe bronchiolitis in US infants. Our findings provide guidance for optimal timing of RSV immunoprophylaxis by region and may assist in the development of preventive (e.g., vaccinations) and therapeutic (e.g., antiviral agents) interventions in a larger population of infants.

## Keywords

bronchiolitis, infant, hospitalization, respiratory virus, epidemiology, geography





# Serial Bedside Ultrasound for Small Bowel Obstruction (SUSSBO)

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## Background

Evidence suggests that bedside ultrasound is an accurate diagnostic modality for small bowel obstruction (SBO) but is not widely used in clinical practice. In addition, there is no evidence to date examining the correlation between ultrasonographic and clinical resolution of SBO. The primary objectives of this study were to determine if ultrasound findings of SBO correlate with clinical course and to describe the performance of bedside ultrasound in patients with confirmed SBO.

## Method(s)

Patients aged 18 or older were enrolled prospectively in the Emergency Department. Inclusion criteria was an admission diagnosis of SBO confirmed by CT scan. Patients with planned operative management were excluded. Initial ultrasound images were obtained at time of diagnosis. Serial images were then obtained daily until resolution, surgical intervention, or patient discharge. The primary outcome was time from confirmation of SBO to resolution of ultrasound findings. Secondary outcomes were the sensitivity and specificity of ultrasound for SBO and the association between ultrasound findings and final disposition.

## Result

Twenty-four of 28 patients enrolled had SBO by initial ultrasound. Of the 22 of 28 patients who underwent serial ultrasounds, 36.4% resolved by the first day and 54.6% by day two. There was a statistically significant difference in the proportion of patients with a positive enrollment ultrasound (92.3%) versus final exam (50.0%,  $p = 0.001$ ). Compared to CT ultrasound had

sensitivity = 100%; specificity = 50%; PPV = 95.8%; NPV = 100%. Only 60% of X-rays were positive. No significant relationship between the findings on final ultrasound and final disposition was found (Fisher Exact Test = 1.000, power = 0.80). Subgroup analysis of subjects receiving  $\geq 2$  ultrasounds was also not significant. On expert review of final ultrasound images, there was moderate agreement ( $\kappa = 0.55$ , 95% CI 0.19-0.9) between ultrasound findings and disposition.

## Conclusion

Bedside ultrasound outperforms X-ray when compared to CT, the gold standard. Positive ultrasound findings of SBO at the bedside were significantly reduced by time of final disposition, but no significant relationship with ultimate clinical course was found. There was moderate agreement between ultrasound findings and final disposition on expert image review.

## Keywords

bedside ultrasound, point of care ultrasound, small bowel obstruction, abdominal pain



# Serial Ultrasound in Small Bowel Obstruction

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## Background

Point-of-care ultrasound is an accurate diagnostic test for small bowel obstruction (SBO) in the emergency department. There is little evidence examining the correlation between the sonographic and clinical resolution of SBO, or the role of ultrasound in the conservative management of SBO. We sought to determine whether serial ultrasound findings were associated with clinical course and disposition of SBO patients managed initially with a non-operative approach.

## Method(s)

We prospectively enrolled adult patients with a diagnosis of SBO confirmed by computed tomography (CT) and a plan for non-operative management. Subjects were all cared for by surgeons blinded to the ultrasound findings. Initial ultrasound images were obtained at time of diagnosis. Serial ultrasound images were then obtained daily until resolution of SBO, surgical intervention, or patient discharge. The primary outcome was time from confirmation of SBO to resolution of ultrasound findings. Secondary outcomes included the sensitivity and specificity of the initial ultrasound for SBO; the association between final ultrasound findings and disposition; and other imaging studies obtained during patients hospital course.

## Result

We enrolled 26 patients; all had SBO by initial ultrasound. Four patients failed conservative management and were treated surgically. Of 22 patients with serial ultrasounds, 36.4% had resolved findings of SBO at the initial follow up scan (24 h) and 54.6% at the second follow up scan (24 - 48 h). Median duration of admission was 95 h. Expert review of the final ultrasound images showed a significant association between ultrasound findings and disposition (Fisher exact test = 0.014, power = 0.80). All patients treated surgically had persistent findings of SBO at disposition. Patients underwent a mean of 0.9 additional imaging studies (CT or radiographs) during their hospital course after their initial diagnostic test.

## Conclusion

Point-of-care ultrasound allows visualization of resolving SBO. Serial ultrasound findings are associated with disposition in patients with SBO managed with a non-operative strategy; persistent findings of SBO are associated with a need for operative management. Point-of-care ultrasound use in patients with SBO may represent an opportunity to reduce radiation exposure.

## Keywords

Ultrasound, gastrointestinal disorders, diagnostic test



# Sex Differences in 90-day Outcomes After Mechanical Thrombectomy for Acute Ischemic Stroke

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## Background

Women have worse 90-day outcomes after ischemic stroke. Despite knowledge of the overall effectiveness of mechanical thrombectomy for ischemic strokes resulting from large vessel occlusion, it is unknown whether outcomes after mechanical thrombectomy in non-clinical trial populations differ by sex. We investigated sex differences in independence at 90 days in patients receiving mechanical thrombectomy.

## Method(s)

Data on adults treated with mechanical thrombectomy for large vessel occlusion at a single academic comprehensive stroke center between July 2015 and April 2017 were included. Data on patient demographics, clinical characteristics, and co-morbidities were abstracted by trained research staff. Logistic regression was used to determine the association between sex and independence at 90 days, adjusting for age, race, marital status, primary payer, co-morbidities, pre-stroke functional status, stroke severity, and onset to groin puncture.

## Result

We included 279 patients; 52.0% (n=145) were women, and 13.6% (n=35) were non-white. Compared to men, women were older (median years (IQR) 81.0 (70-88) vs. 71.5 (60-81), 0.001), had higher baseline NIH stroke scale (mean SD 18.2 7.5 vs. 16.0 7.1, p=0.02), were less likely to be married (38.2% vs. 67.5%, n=0.004), and were more likely to have government sponsored insurance (86.8% vs. 73.1%, p=0.004). Similar proportions of men and women had pre-stroke modified Rankin scale  $\leq 2$  (73.3% vs. 67.1%, p=0.27). After adjusting for all co-variates, women were less likely to be independent at 90 days post stroke (adjusted OR 0.38, 95%CI 0.17-0.85). Younger age, pre-stroke modified Rankin scale  $\leq 2$ , and lower stroke severity were all significantly associated with independent outcome at 90 days.

## Conclusion

Women were less likely to be functionally independent at 90 days following mechanical thrombectomy for large vessel occlusion, even after adjusting for age, baseline functional status, and stroke severity. Future research should investigate contributors to worse outcomes.

## Keywords

stroke, sex differences, thrombectomy



# Socioeconomic Status and Bronchiolitis Severity Among Hospitalized Infants

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## Background

Bronchiolitis is the leading cause of hospitalization for U.S. infants. The goal of this study was to investigate the relationship between socioeconomic factors and bronchiolitis severity among hospitalized infants.

## Method(s)

We performed a 17-center, prospective cohort study from 2011 to 2014. Children 1-year old hospitalized with a physician diagnosis of bronchiolitis were enrolled. We defined higher severity as receipt of intensive care treatment (i.e., admission to intensive care unit or receipt of continuous positive airway pressure or intubation). Socioeconomic factors included estimated median household income (MHI) per home ZIP code, parent-reported income per household, number of adults and children in household, and insurance type. Multivariable logistic regression was used to analyze the association between socioeconomic factors and bronchiolitis severity, with the final model adjusted for potential clustering by site.

## Result

Among 1016 infants hospitalized for bronchiolitis, the median age was 3.2 months (IQR 1.6-6.0 months), 60% were male, 42% were non-Hispanic white; and 16% received intensive care treatment. In multivariable models adjusted for demographic and clinical characteristics, estimated MHI was the socioeconomic factor that was most strongly associated with severity. Compared to infants with an intermediate MHI (\$40,000 - \$79,999), odds of receiving intensive care treatment may have been increased among those with MHI of \$40,000 (adjusted odds ratio [OR] 1.60, 95%CI 0.95-

2.69), but were significantly higher for those with MHI of  $\geq$ \$80,000 (adjusted OR 2.01, 95%CI 1.23-3.30). No significant associations were found for the other socioeconomic factors (all  $P > 0.30$ ). In a separate model combining the two sources of income data, infants with high-high income status were at even higher odds of intensive care treatment (adjusted OR 4.20; 95%CI 1.78-9.94).

## Conclusion

In this multicenter study of infants hospitalized with bronchiolitis, we identified estimated median household income as a risk factor for intensive care treatment. Our findings encourage further research on mechanisms for the observed associations; this work may yield important insights for the future management of infants with bronchiolitis. They also support ongoing efforts to reduce socioeconomic disparities.

## Keywords

Bronchiolitis; Socioeconomic status; Income; Intensive care; Children



# Standard Video Interview Score Does Not Correlate With Medical Student Communication Skills

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## Background

As of 2017, EM residency applicants are required to complete the Standard Video Interview (SVI) as part of their application. This series of six videos aims to assess knowledge of professional behaviors as well as interpersonal and communication skills as rated by trained third-party reviewers. Its purpose is to add breadth to the application and give programs an additional tool to assess applicants. It is unclear how SVI scores relate to validated, patient-centric measures of communication. The goal of this study was to determine if a correlation exists between SVI score and patient assessment of communication. We hypothesized that the SVI score would correlate positively with patients assessments of students communication skills as measured by the validated Communication Assessment Tool (CAT).

## Method(s)

This was a retrospective, observational study conducted at an academic, urban, tertiary care ED that has both a three-year residency and fourth-year EM clerkship. As part of the existing clerkship curriculum, a convenience sample of the discharged patients seen by medical students were asked to complete the CAT. This 14-item questionnaire uses a Likert scale with a maximum score of 70 and measures provider communication skills from the patient perspective. Fourth-year clerkship students who applied to our residency program during the 2017-18 application season were included. Students SVI scores were obtained from residency applications and

compared to their CAT scores. The score distributions were checked for normality using the Shapiro-Wilk Test and correlation determined by Spearman Rho.

## Result

Of the 24 medical students who completed both our fourth-year clerkship and applied to our EM residency program, 19 had both CAT and SVI data available. The median SVI score was 20 (IQR 18-20) and the median CAT score was 70 (IQR 69-70). Neither score had a normal distribution (Shapiro-Wilk with  $p < 0.01$  for both SVI and CAT). The two scores were not significantly correlated (Rho 0.13,  $p = 0.36$ ).

## Conclusion

This analysis demonstrated no significant correlation between patient evaluation of applicants communication skills and SVI score. Further studies are needed to assess this relationship with larger sample size and to assess the utility of the SVI and how it translates to other measures communication.

## Keywords

Standard Video Interview, Communication, Assessment



# Standardized Video Interview Scores Do Not Correlate With Attending Evaluations

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## Background

The Standardized Video Interview (SVI) was developed and implemented by the American Association of Medical Colleges for the 2017-18 application year to assess professionalism and communication skills. It is currently required of all EM residency applicants. Applicants are asked to respond to six scenarios in real-time and are given a numerical score by trained raters. To date, there is no published data on the validity of the SVI and it is unclear whether the scores correlate with ED attending evaluation of professionalism and patient communication. The goal of this study is to determine whether there is a correlation between the SVI scores and attending evaluation of professionalism and patient care/communication.

## Method(s)

This was a retrospective, observational study of EM residency applicants. Medical students who enrolled in the fourth-year EM clerkship at our institution and who applied to the EM residency match were included in the analysis. SVI scores were extracted from their residency applications and compared with attending evaluations of the students professionalism and patient care/communication performance during their EM clerkship. SVI scores were provided as a composite score from 6-30, while attending evaluation scores were provided as individual scores from 1-5 (with 5 the highest) for each domain. A Spearman rank correlation

was performed comparing SVI to professionalism and SVI to patient care/communication scores.

## Result

Twenty-four students from the EM clerkship applied to our program. The mean SVI score was 20.44. The mean professionalism score was 4.27, while the mean patient care/communication score was 4.17. Students had a median of 8 attending evaluations. SVI score did not correlate with attending evaluation of professionalism ( $\rho=0.06$ ,  $p=0.38$ ) or patient care/communication scores ( $\rho=0.08$ ,  $p=0.27$ ). Conclusion: SVI scores do not correlate with ED attending evaluations of professionalism and patient care/communication. While the SVI may provide additional information, attending evaluations of real-time patient interaction may prove more valuable in assessing applicants professionalism and communication skills. Further studies are required to identify the best modality for assessing these skills.

## Keywords

Attending evaluation; standardized video interview; professionalism and communication



# Status of Sex and Gender in Emergency Medicine - a five year follow up report

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## Background

Despite a need for the inclusion of sex and gender based medicine in emergency medicine (SGEM), a 2011 review showed that EM, unlike the fields of cardiology, psychiatry and oncology, fails to apply sex/gender considerations to research design with 2% examining sex/gender as a primary outcome and 29% within the the study analysis.<sup>1</sup> This project provides a 5-year follow up on SGEM status following the 2014 AEM consensus conference on sex/gender research within EM.

## Objectives

The objective was to evaluate the scope of the inclusion of sex and gender in publications by emergency medicine researchers.

## Method(s)

Using MEDLINE, the term "emergency" was used to identify all English-language, EM-affiliated studies of adult human subjects published between 1/2014 and 2/2017 in which the first, second, or last author belonged to an EM section, division, center, or institution functioning as an emergency department. Five trained abstractors reviewed the data using a standardized data abstraction form. Articles were coded for sex/gender composition, use of sex/gender as a control variable, independent variable or a component of the primary objective. Inter-rater reliability (IRR) was calculated with 95% confidence intervals (CI).

## Result

The search revealed 6442 articles using the selected "emergency" terms and 2628 original studies coded as EM-affiliated publications were reviewed, 2233 met inclusion criteria and were analyzed. The five study areas contributing the most articles were cardiovascular (20%), administration/crowding (17%), infectious diseases/sepsis (10%), trauma (10%) and emergency medical services (7%). Ninety percent of the published studies were descriptive and 10% experimental. Eighty six percent (n=1921) articles reported the sex/gender composition of the sample and 0.4% (n=8) reported transgender identity. Thirty four percent reported sex/gender in the study composition, with 27% (n=609) reporting it as a control variable, 24% (n=543) as an independent variable; and 2% using sex/gender as a component of the primary outcome. The adjusted IRR for data abstraction was 97% (95% CI =95.4%, 98.6%).

## Conclusion

Compared to 2011 report, the number of EM driven scholarship reporting sex/gender in its study composition has increased from 29% to 33%, while those evaluating it as a primary outcome remains unchanged.

## Keywords

sex, gender, transgender, emergency.



# Systematic Review on Chronic Non-Communicable Disease in Disaster Settings

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## Background

Non-communicable diseases (NCDs) are the lead cause of mortality worldwide accounting for 70% of deaths. In addition, the frequency and magnitude of natural disasters, and humanitarian emergencies are at an all-time high. In this study, we completed a systematic review on chronic NCDs in the disaster setting in Low and Middle-income Countries (LMICs). According to our knowledge, this is the first study of its kind on the leading global NCDs: cardiovascular disease, cancer, chronic respiratory disease and diabetes, and that spans across WHO regions. We aim to guide further research, to inform intervention development, and to drive policy change.

## Method(s)

We performed a comprehensive search of databases: Ovid MEDLINE, Web of Science, Scopus, Africa Wide (Ebsco), Ovid EMBASE, CINAHL, and NLM PubMed for unindexed materials. All searches were run on July 15, 2015. Both English and foreign language articles were eligible and no date restrictions were used. The search strategies used relevant controlled vocabulary terms and synonymous free text words and phrases to capture concepts. Two separate screeners evaluated titles, abstracts and full text of eligible articles independently for inclusion with vetting by a third reviewer.

## Result

Of 4,430 articles identified, 88 studies were included. By WHO region, we found 45 studies from the Eastern Mediterranean, 15 studies in Europe, 9 in South East Asia, 11 in the Western Pacific, 2 in the Americas, and 4 in Africa. We found 29 studies on CVD, 34 on diabetes, 12 on cancer, and 14 on chronic respiratory disease. The majority of studies were epidemiologic in nature. Primary reasons for exclusion included studies originating from high-income countries (HICs) which included migrants in HICs who were felt to have unique access to resources as compared to counterparts in LMICs. Studies on veterans were also excluded given distinctive risk factors.

## Conclusion

We found few studies overall focused on chronic NCDs in disaster settings in LMICs despite a burgeoning problem. The bulk of studies originated from the Eastern Mediterranean region, and focused on Syrian and Palestinian refugees. Focus on the remainder of WHO regions is lacking, as are studies on approaching NCDs in these settings. Prioritization from policy makers, international relief organizations, and academics alike will aid in bringing the NCD epidemic to the forefront.

## Keywords

disasters, NCDs, systematic review, non-communicable diseases, chronic diseases, low and middle income countries





# Teaching Strategies to Promote Healthcare Equity: Impacts of an Interdisciplinary Faculty Development Workshop

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## Background

There is an increasing emphasis on communication instruction in medical education. Our hospital sought to increase teaching of topics regarding four aspects of health care equity: social determinants of health, access to care, healthcare disparities and understanding of unconscious biases. With improved education, providers can reduce patients barriers to care and achieve better health outcomes. We developed a workshop to equip faculty with the necessary tools to teach these topics. We hypothesize that comfort with and understanding of health care equity would increase after a faculty development workshop.

## Method(s)

This was a prospective survey based research project conducted at a tertiary care referral center in a major urban teaching hospital. Faculty from EM, obstetrics/gynecology and internal medicine were included. Participants took part in a three hour faculty development workshop. They were invited to complete pre and post workshop surveys. A Likert scale of 0-10 was utilized and mean scores before and after the educational intervention and p values were calculated.

## Result

Both surveys were completed by 18 of the 28 individuals who attended the sessions. Respondents reported increased thinking about social determinates

of health (mean before 5.88 95%CI 4.76-7.00, mean after 8.18 95%CI 7.57-8.78), barriers to medical care (mean before 5.94 95%CI 4.83-7.05, mean after 8.12 95% CI 7.55-8.69), and unconscious bias (mean before 4.47 95%CI 4.76-7.00, mean after 7.82 95%CI 6.99-8.66). They also reported improvement in how comfortable they were teaching social determinates of health (mean before 4.88 95% CI 3.68-6.09, mean after 7.24 95% CI 6.50-7.97), barriers to medical care (mean before 5.12 95%CI 3.89-6.35, mean after 6.88 95%CI 5.76-8.00), and unconscious bias (mean before 4.18 95% CI 2.90-5.45, mean after 7.00 95%CI 6.27-7.73). All results reported had p values  $\leq$  0.001.

## Conclusion

Following an interdisciplinary faculty development workshop, clinician-educators demonstrated statistically significant improvement in their comfort incorporating explicit discussions of health care disparities in their clinical teaching. Enhanced faculty skills in teaching these topics will hopefully lead to improved trainee performance, more equitable care, and better patient outcomes.

## Keywords

Education, professional development, health care equity



# Technology in Emergency Medicine Training

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### Background

Medical education is faced with evolving technology, social media, and the millennial learner. There is an abundance of podcasts, blogs, and apps that can be both helpful and overwhelming. While there have been studies looking at use of one specific form of technology, no study has evaluated what platforms emergency medicine (EM) residents are actively using. The purpose of this study was to gain a better understanding of the electronic resources and social media platforms residents are using, their value, and their integration into EM curriculum.

### Method(s)

A survey was sent to ACGME accredited EM residencies with a total of 161 participants.

### Result

The study found that 98.8% (n=159) of residents used medical apps and were utilizing them an average of 3 times per shift. The most popular apps were MDCalc (68.9% utilization) and UpToDate (58.4% utilization). The study also found that 90.7% (n=146) of residents were listening to podcasts for an average 4.7 hours per month and 95% (n=153) were reading Free Open-Access Medical Education (FOAM). The most popular podcasts and FOAM sites were EMRap (80.1% utilization) and EMCrit (61.5% utilization); and Life in the Fast Lane (90.7% utilization) and Academic Life in Emergency Medicine (72% utilization). Social media was used by only 27.3% (n=44) of residents for medical purposes. A majority of residents (93.2%) report residency is supportive of technology during training. The majority of residents are required to use FOAM (95%) and podcasts (93.2%) as part of mandatory education.

Residents felt these resources were effective learning modalities.

### Conclusion

Knowing that residents are learning from apps, podcasts, and FOAM and which resources they are using will help to evolve the future of residency education as information technology continues to be integrated into medical education.

### Keywords

Medical education, technology, social media, FOAM, podcast, apps



# The Association Between Physician Empathy And Admission Rates

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### Background

There is substantial variation in emergency physician hospital admission rates across a variety of conditions. The factors that contribute to variation between individual providers are not well understood. Empathy may play a mediating role in physician-patient relationships and in clinical outcomes. Despite the importance of empathy in providing adequate and satisfactory patient care, there is a lack of empirical research on the association of empathy with physicians clinical decision-making including admission rates. Our aim was to provide empirical evidence of the relationship between level of empathy as described by the Jefferson Scale of Physician Empathy with annual visit count and annual hospital admission rate of emergency department physicians.

### Method(s)

The Yale University Institutional Review Board approved this study protocol. We approached all attending emergency physicians in the Yale-New Haven Hospital system. Physicians who consented to participate completed the 20-item Jefferson Scale of Physician Empathy. We used chart review to determine the annual visit count and annual hospital admission rate of each physician. We used SAS version 9.4 to analyze the data. We used Pearson bivariate correlations to examine the relationship between level of empathy, annual visit count, and annual hospital admission rate. We used Student t-tests to examine the group differences in empathy and annual hospital admission rate by gender.

### Result

Of the 91 attending physicians approached, 44 agreed to participate. Seventeen participants were female (38.6%). The mean empathy score was 113.34 (+12.5). Annual hospital admission rate ( $p=0.47$ ) was not significantly correlated with level of empathy. There was no significant difference in empathy by gender ( $p=0.47$ ).

### Conclusion

We found that empathy does not appear to be correlated with hospital admission rate. We also found that there was no difference in level of empathy in female or male physicians. While empathy is likely an important mediator in patient satisfaction and outcomes, it may not be related to emergency department physician hospital admission rate.

### Keywords

Empathy, admission



# The Development and Implementation of a Resident-Led Orientation Bootcamp for Emergency Medicine Interns

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## Background

EM interns begin residency with variable clinical, procedural, and interprofessional skills. Programs commonly offer a dedicated orientation curricula, however the clinical rotation schedule dictates that most interns will start the academic year on off-service rotations. This makes it challenging for program leadership to ensure that an entire class transitions cohesively into residency and to identify critical knowledge gaps. To address these problems, we designed a 1-month orientation Boot Camp, and suspected that this intervention would help mitigate the heterogeneity within the class with regard to clinical acumen, procedural and interprofessional skills.

## Method(s)

A team of residents, with mentorship from residency leadership, designed a 1-month rotation that included 11 clinical shifts, simulation, bedside ultrasound teaching, and a lecture series with accompanying asynchronous content. This mix was influenced by a needs assessment completed by current EM interns and feedback from education faculty. 15 interns completed pre- and post-innovation self-assessments using a visual analogue score from 0 to 100 on perceived comfort with performing specific procedures and recognizing various life-threatening emergencies.

## Result

15/15 current EM interns completed the needs assessment to help identify which topics should be included in the rotation. 15/15 reported that ECG interpretation, pain management, and placing ultrasound-guided IV lines "must be" included. Teaching sessions for each of these topics were developed along with asynchronous online content. Other teaching sessions included sepsis, respiratory distress, evaluating trauma, and bias in clinical decision making. For 7/7 (100%) of procedures, average perceived comfort post-innovation increased from the pre-innovation average. The same was true for identifying 5/5 (100%) life-threatening emergencies.

## Conclusion

We report an education innovation at our residency program, which focused on helping new interns transition from medical school to residency. The innovation was well-received by participating interns and education stakeholders at our residency. All teaching sessions were led by senior residents. Interns reported an increased perception of comfort with performing important procedures and identifying life-threatening emergencies.

## Keywords

medical education, intern orientation, transitions in residency



# The Effect of Emergency Physicians Working Concurrently on Individual Physician Throughput

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## Background

Studies in operations research and industrial psychology have demonstrated that as more people work simultaneously on a common task, individual effort tends to decrease, a phenomenon known as social loafing. While a variety of psychological and stochastic explanations have been proposed for this phenomenon, it is unclear if it also affects emergency physicians (EPs). We sought to determine if EPs are less productive when working concurrently than when working independently, and what effect this has on patient throughput.

## Method(s)

This was a retrospective cohort study, conducted in four suburban community hospital emergency departments, in which physicians pick up patients ad libitum. Consecutive physician shifts were evaluated for timestamps of patient arrival, physician assignment, and disposition. A generalized estimation equation was constructed to model physicians time-to-decision, based on the number of concurrent working physicians. To remove the potential effects of patient availability, congestion, and ancillary staffing, the number of patient arrivals and time of day were included as covariates. A secondary analysis was conducted on door-to-doctor times and patients overall lengths of stay (LOS).

## Result

11,706 physician shifts worked by 78 EPs were evaluated from 2014-2016 across the four sites. Physicians took an average of 35 (95% CI 4.75 - 66.5) more minutes to see and determine a patient disposition for each additional physician working concurrently, independent of other factors. This was associated with an increase in door-to-doctor time of 12 minutes (95% CI 10.8 - 13.2) and an overall increase in LOS of 103 minutes (95% CI 88.8 - 119.1). Individual site models were consistent with the four site-aggregate model.

## Conclusion

When working alongside other physicians, EPs take longer to disposition patients and sign up for available patients than they would when working alone, with an associated increase in patients LOS. Systems that assign patients on an automatic basis, or blind physicians to their colleagues workloads, are potential strategies to mitigate this phenomenon.

## Keywords

operations, queueing, throughput



# The Effect of Shared Decision-Making on Patients' Likelihood of Filing a Complaint or Lawsuit

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## Objectives

To determine how the use of Shared Decision-Making (SDM) affects patients perceptions of fault and liability in the context of an adverse outcome after an ED visit.

## Method(s)

We surveyed a national sample of adults aged >18 years using a vignette-based questionnaire. Participants were instructed to imagine an ED encounter for abdominal pain. Informed by the literature, a survey of emergency physicians (n=301), and expert input, we developed three versions of the encounter, varying the degree of SDM (No SDM, Brief SDM, Extensive SDM). The description of the medical care did not vary, and all versions ended with an adverse outcome (a repeat ED visit finding ruptured appendicitis). After extensive pretesting and piloting, we administered the survey via Amazon MTurk, an online marketplace that provides access to a diverse group of potential volunteers. Participants were randomized to No, Brief or Extensive SDM, and the primary outcome was respondents reported likelihood of contacting a lawyer regarding litigation. They also reported their perceptions of fault, liability, trust in the physician, and overall care received.

## Result

Responses were obtained from 804 adults, ages 19-73 residing in the US. Participants were 46% female, 79% white, 10% Latino, and 88% reported they had visited an ED as a patient or friend/family. In the "No SDM group, 41% reported they were "somewhat or "very likely to contact a lawyer to discuss litigation regarding the adverse outcome, while 12% and 11% of the Brief and Extensive SDM groups reported the same (OR 5.1, 95%CI: 3.2-8.2; 5.8, 95%CI: 3.6-9.5). Participants in the SDM groups reported greater trust, gave higher overall scores, and were less likely to consider the physician to be at fault for the adverse outcome.

## Conclusion

This study provides preliminary evidence that the use of SDM in the ED may change patients perceptions of fault and liability. These findings suggest that SDM may have downstream consequences such as improving perceptions of overall care and decreasing litigation and related costs.

## Keywords

shared decision making, malpractice



# The effect of traumatic brain injury on development of acute mountain sickness and cognitive dysfunction

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### Background

As many as 40% of people ascending above 3000 meters may experience acute mountain sickness (AMS). Research has shown changes in cognitive function at altitude, but it is unknown if these correlate with symptoms of AMS, or if they have a relationship to mild traumatic brain injury (TBI). Limited data suggests higher rates of AMS in individuals with a history of TBI. As part of a larger study, we performed a subgroup analysis to compare rates of AMS and high altitude cognitive dysfunction in trekkers with a history of TBI. This is the largest cohort of individuals correlating TBI with AMS and the only one including cognitive testing.

### Method(s)

We performed a combined cross-sectional and prospective cohort study of trekkers in Nepal with subgroup analysis of individuals who reported a history of TBI. Each participant was tested at both 3500 and 4500 meters for AMS using the Lake Louise Score, and for cognitive function with the Montreal Cognitive Assessment (MoCA). AMS was diagnosed if the LLS  $\geq$  3 with presence of a headache, and the MoCA was positive for cognitive dysfunction if the total was  $\leq$  25.

### Result

There were 259 enrollees in the study, of which 22 had a history of TBI. 228 individuals completed the study. At 3500 meters, there was an overall 13.95% incidence of AMS, rising to 20.61% at 4500 meters. At 3500 meters, individuals with a history of TBI had a 29.41%

incidence of AMS compared with 15.12% in the group with no history of TBI, with an odds ratio of 1.95 ( $P = 0.22$ ) and a relative risk of 1.73 ( $P = 0.20$ ). The NNH for those with TBI developing AMS at the first altitude was 10.4. At 4500 meters, the incidence of AMS among those with TBI was 30%, compared with 19.71% for those without TBI, with an odds ratio of 1.69 ( $P = 0.31$ ) and a relative risk of 1.49 ( $P = 0.28$ ), with a NNH of 10.2. Individuals with a history of TBI did not demonstrate increased risk for cognitive dysfunction compared to the non-TBI group (RR 0.75 and 1.04). The TBI cohort ascended more slowly (2.77 days vs. 3.31 days). During the ascent, acetazolamide use was similar (25% TBI vs. 29.8%).

### Conclusion

Individuals with a history of mild TBI are at higher risk for AMS compared to those without TBI. This increased risk persists with altitude gain, despite slightly increased time for acclimatization in the TBI group. In subjects with a history of TBI, there was no significant impairment in cognitive function at either altitude.

### Keywords

Wilderness Medicine Acute Mountain Sickness Cognitive Dysfunction Traumatic Brain Injury



# The Impact of Ridesharing Applications on Alcohol-Related Motor Vehicle Crash Visits to the Emergency Department

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## Background

For each ED visit related to a motor vehicle crash (MVC) fatality, there are approximately 100 non-fatal crash-related visits, and seven hospital admissions. This non-fatally injured population represents a substantial public health and cost burden. Ridesharing applications (apps) have changed the way in which the urban commuter approaches transportation. The evaluation of ride-hailing apps and alcohol-related MVC visits to an urban ED will provide an assessment of its impact on the larger number of alcohol-related crash ED visits. We aim to identify the impact of ridesharing apps on alcohol-related MVC visits to the ED and the effect on ED resources. We hypothesize that the rate of alcohol related MVC ED visits decreased after the implementation of ridesharing.

## Method(s)

We retrospectively reviewed charts of all MVC visits to one large urban academic ED before and after the start of ridesharing. The pre-intervention period is defined as 1/1/11 to 12/31/13, and the post-intervention period is defined as 1/1/14 to 12/31/16. We included all adult MVC patients who met ED trauma activation criteria. We abstracted data to include demographics, alcohol use, ED length of stay, and frequency data for radiologic studies. We analyzed data using tests of proportions and summary statistics by intervention period.

## Result

Of the 4166 MVC charts reviewed, 196 were from pre-intervention and 3970 were post-intervention. There was no difference in mean age between the pre-intervention 41.16, SD $\pm$ 17.80 and post intervention group 40.76, SD $\pm$ 17.67 ( $p=0.76$ ). The proportion of alcohol related MVC increased from 0.112 pre-intervention to 0.224 (D 0.13, 95% CI .084-.176,  $p=0.0001$ ). We noted a significant increase in the mean number of radiology tests ordered, before and after the intervention (D7.22, 95%CI 5.85-8.89,  $p=0.0001$ ). There was no significant change in length of stay, pre-mean 349.4 mins vs. post-mean 356.2 mins (D6.78, 63.47-76.06,  $p=0.85$ ).

## Conclusion

We found an increase in the proportion of alcohol related MVC visits and radiology studies ordered after the start of ridesharing in this population. This study had some limitations including the small sample of electronically available records of the pre-intervention limiting stratified analyses such as based on age; our approach does not account for other changes during this post-intervention period.

## Keywords

alcohol, motor vehicle crash, ride-sharing





# The Impact of Socioeconomic Status on Emergency Department Outcome in a Low-Income Country Setting

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## Background

The impact of socioeconomic status on health has been established via a broad body of literature, largely from high-income countries. Investigative efforts in low- and middle-income countries have suffered from a lack of reporting standardization required to draw comparisons across countries of varying economic strata. In this study we aimed to evaluate the impact of socioeconomic status on emergency department outcomes in a low-income African country using international data classification systems.

## Method(s)

This study was conducted at a tertiary care center in northern Madagascar. Data were abstracted from paper charts into an electronic registry using Integrated Public Use Microdata Series codes for occupation, Nam-Powers-Boyd (NPB) scores for socioeconomic status, and Clinical Classifications Software ICD-9 equivalents for diagnosis. Outcome was dichotomized to the combined disposition of death or transfer directly to operating theater (OT) versus discharge. We used t-tests to compare baseline characteristics between these groups. We used chi-square analysis to test the association between occupational class and diagnosis. Finally, multivariate logistic regression analysis was performed examining the impact of NPB score on death/OT outcome, adjusting for age, gender, diagnosis and occupation.

## Result

5271 patients were seen during the 21 month study period with a death/OT rate of 9.7%. Older age and male gender were more common in death/OT patients (both 0.001), and were shown to have positive hazard ratios for this outcome in multivariate modeling (0.006 and 0.001). Occupational class was found to influence diagnosis for all classes (0.001) except Sales and Office. Adjusting for these 4 factors, we found a strong independent association between NPB quartile and death/OT outcome. Relative to the 1st quartile, the hazard ratio in the 4th quartile was 2.9 ( $p=0.004$ ), the 3rd quartile 1.8 ( $p=0.094$ ), and the 2nd quartile 3.1 (0.001).

## Conclusion

To our knowledge, this is the first Malagasy study describing the relationship between socioeconomic status on emergency care outcomes. We found a stronger effect on health in this setting than in high income countries, highlighting an important healthcare disparity. By using standardized classification systems we hope this study will serve as a model to facilitate future comparative efforts.

## Keywords

international emergency medicine; socioeconomic status; Madagascar; global health



# The Impact of Telemedicine on Neonatal Resuscitation in Emergency Departments: A Simulation-Based Trial

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## Background

Delivery and initial resuscitation of an infant is a required but rarely practiced skill in Emergency Medicine. In the absence of an in-person specialist, telemedicine can provide real-time access to neonatal sub-specialists. We hypothesize that access to a Neonatal Resuscitation Program (NRP)-trained pediatric specialist via telemedicine will improve adherence to four critical actions reflecting NRP guidelines in a simulated neonatal resuscitation.

## Method(s)

Twelve senior Emergency Medicine residents were randomized into a telemedicine (intervention) or standard care (control) group. Each was presented with a standardized, simulated, apneic and bradycardic neonate. The scenario was scripted with a confederate nurse present in the room. Each participant had access to a limited supply of resuscitation equipment and an NRP cognitive aid. In the telemedicine group, a pediatric specialist took over leadership, while in the control group, subjects continued the resuscitation without telemedicine support. Adherence to NRP guidelines was evaluated using four critical actions reflecting their focus on simple, high-yield interventions and optimization of ventilation: basic warming and stimulation, initial use of 21% oxygen, positive pressure ventilation (PPV) attempted prior to intubation, and

intubation prior to initiation of chest compressions. Data was collected via video and assessed by three trained physician reviewers.

## Result

The intervention group had better adherence to the four critical NRP actions than the control group in three of the four items. No members of the control group started with 21% oxygen for initial resuscitation or held chest compressions until after intubating the patient; all members of the intervention did ( $p=0.002$ ). Additionally, only one member of the control group remembered to clean, dry, and stimulate the patient for at least 25 seconds, compared to all of the intervention group ( $p=0.015$ ). There was no statistically significant difference between the use of PPV in each group.

## Conclusion

The use of telemedicine was associated with improved adherence to critical actions reflecting NRP guidelines in our simulated neonatal critical care study. This study suggests that telemedicine may be a helpful resource to provide decision-making support and real-time access to a specialist in high-risk, low-frequency events.

## Keywords

telemedicine, neonatal resuscitation, simulation research



# The Path Forward: Substance Use Disorder Evaluations (SUDE) in the Emergency Department

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## Background

In July 2016, Massachusetts enacted legislation requiring all patients presenting to emergency departments (EDs) after an opioid overdose be offered a Substance Use Disorder Evaluation (SUDE), a behavioral health intervention that identifies patterns of substance use, determines appropriate levels of addiction care, and motivates patients to pursue treatment. We sought to investigate the acceptance and effect of SUDE during its implementation in our ED.

## Method(s)

A retrospective chart review was performed at a large, urban, academic ED. Electronic medical records were queried using the terms "overdose" and "heroin." Charts were categorized as pre-implementation (PRE, 6/1/15-6/30/16) or post-implementation (POST, 7/1/16-2/28/17), then selected for analysis using systematic random sampling methodology. Data abstracted included: whether a patient received a SUDE, ED disposition, length of stay (LOS), and repeat visits for opioid-related complaints.

## Result

PRE included 58 cases; POST included 71 cases. POST was subdivided into two groups: patients who received a SUDE (SUDE+, n=15) and those who did not (SUDE-, n=56). None of the SUDE cases were dispositioned to addiction treatment programs (PRE=8.5%, SUDE+=6.9%, SUDE-=0.0%). The SUDE group had the highest percentage of cases where the patient eloped or left against medical advice (SUDE=28.8%, PRE=15.3%, SUDE-=10.3%). Median LOS was 5h11m for SUDE+ vs.

2h13m for SUDE-. 17.2% of SUDE+ patients had  $\geq 1$  subsequent opioid-related visit within three months of initial encounter, compared to PRE (23.7%) and SUDE- patients (21.4%). Discussion: A minority of eligible patients actually received a SUDE. Longer LOS may discourage patients from accepting the SUDE or result in patients eloping before receiving it. Patients who received a SUDE were less likely to have an opioid-related ED visit in the following three months, although disposition to detox does not appear to differ. Limitations include small sample size and retrospective, single-center methodology.

## Conclusion

SUDE is a novel behavioral health intervention that seeks to enhance ED-based overdose care. Potential barriers, such as delay to SUDE and obstacles to entering treatment, must be identified and addressed to optimize acceptance by its target population.

## Keywords

Opioid overdose, Substance Use Disorder Evaluation



# The quick Sepsis-related Organ Failure Assessment Score Predicts Emergency Department and Hospital Mortality Among Emergency Care Patients in Kigali, Rwanda: A Retrospective Cohort Study

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### Background

The quick Sepsis-related Organ Failure Assessment (qSOFA) score was developed as a clinical tool to identify patients with infectious diseases (ID) at increased risk for poor outcomes due to sepsis, but its utility in emergency department (ED) settings in low- and middle- income countries (LMICs) has not been researched. This study aimed to evaluate the utility of the qSOFA score to predict risk for emergency department (ED) and hospital mortality among patients seeking care in a sub-Saharan Africa (SSA) ED.

### Method(s)

This retrospective cohort study was carried out at a tertiary-care hospital, in Kigali, Rwanda and included patients  $\geq$  15 years, presenting for ED care during 2013 with an ID diagnosis. Trained personnel reviewed and identified records for inclusion and data were abstracted using standardized instruments. Descriptive analyses were undertaken for the cohort. ED and overall hospital (aggregated ED and inpatient) mortality were evaluated using multivariate models with the qSOFA score as the primary predictor (reference: qSOFA=0) to yield adjusted relative risks (aRR) with 95% confidence intervals (CI). Models were adjusted for covariates associated with sepsis mortality (age, comorbidities, duration of care, IVF and antimicrobial treatments).

### Result

Among 15,748 screened cases, 760 met inclusion and were analyzed. The median age was 36 years (IQR: 26, 51) and 45.9% of cases were female. Over half of cases had prior comorbidities (54.3%) with HIV being the most common. The most frequent diagnoses were malaria, intra-abdominal infections and Tuberculosis (TB). Prevalence of ED and hospital mortality were 12.5% and 25.4%, respectively. Trends in ED mortality significantly increased with higher qSOFA score and were 3.0% for those with a score of 0, 15.6% with a score of 1 and 27.3% with a score  $\geq$  2, respectively (0.001). ED mortality aRR was 4.8 (95% CI 1.9-12.0) for a qSOFA score equal to 1 and 7.8 (95% CI 3.1-19.7) for qSOFA scores  $\geq$  2. The aRR for hospital mortality in the cohort was 2.6 (95% CI 1.6-4.1) for a qSOFA score equal to 1 and 3.8 (95% CI 2.4-6.0) for qSOFA scores  $\geq$  2.

### Conclusion

The qSOFA score provided risk stratification for both ED and hospital mortality outcomes in the setting studied, indicating utility in sepsis care in SSA, however further prospective study in LMIC populations is needed to more robustly inform care.

### Keywords

sepsis; qSOFA; mortality; emergency care; Rwanda; Africa



# The Transcriptional Signature of Appendicitis

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## Background

Appendicitis is a common reason for Emergency Department (ED) presentation, yet reliable diagnostic markers are lacking. The objective of this study is to use transcriptomics to categorize the host response during appendicitis, the inflammatory specific response, and to identify novel diagnostic targets.

## Method

Prospective cohort study. Population: convenience sample of adult (age  $\geq 17$  years) ED patients with pathology-confirmed appendicitis and a comparator set of ED patients without infectious/inflammatory disease. Setting: urban academic ED with 55k annual visits. Procedures: we performed RNA-seq on samples from appendicitis and control patients to determine transcriptional signatures for each condition, we quantified counts using the bcbio-nextgen (nextgen.readthedocs.io/) pipeline with salmon. We completed differential gene expression analysis using DESeq2 with a BH-adjusted P value cutoff of 0.01 and a log<sub>2</sub>-fold change ratio cutoff of 0.5. We also screened 41,073 genes with a highly significant threshold ( $p \leq 1e-6$ ), and principal component analysis. We similarly examined the expression patterns after restricting genes to those with an inflammatory-related function as defined by the Gene Ontology accession term for "inflammatory response" (GO:0006594). Finally, we report the most significantly up- and down-regulated genes to explore new diagnostic targets.

## Result

We included 22 patients with appendicitis and 25 non-infected controls. Among 41,073 genes detected, 2,219 (5.4%) were significantly upregulated and 1,062 (2.6%) significantly downregulated. Using a highly significant P threshold ( $1e-6$ ), there were 258 upregulated and 7 downregulated genes. Principal component analysis performed on the differentially expressed genes revealed clear separation between appendicitis and control patients (PC1: 52% of variance). Among a total of 447 inflammatory genes, we found 90 (20.1%) genes upregulated and 10 (2.2%) genes downregulated. The most significantly upregulated transcripts were S1008A ( $1.8e-15$ ), CLEC4D ( $8.4e-13$ ), and CASP5 ( $3.5e-12$ ), and the most downregulated transcripts were ILF-3 ( $1.2e-6$ ) and AKT3 ( $2.2e-6$ ).

## Conclusion

Transcriptional analysis of the general and inflammatory transcriptome represents a potentially useful approach to develop novel diagnostics in appendicitis.

## Keywords

appendicitis, transcriptomics



# Tracking Violations of Newly Implemented Behavioral Emergency Treatment Protocol

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## Introduction

In September 2014, Massachusetts statewide Emergency Medical Services (EMS) protocols authorized the use of haloperidol and/or a benzodiazepine for management of behavioral emergencies. The newly adopted protocol allows for medication administration with contraindications of age less than 18, history of seizures, or prolonged QT interval. Geriatric dosing was also reduced by 50%. The new protocol was implemented following a standard training module. The purpose of this investigation is to describe the frequency and type of protocol violations observed during the implementation of a new protocol, with the goal of helping to better understand the types of errors, so as to improve implementation of future treatment protocols. This will help to determine what further training if any is needed and plan for future protocol roll out difficulties.

## Method(s)

Retrospective chart review of calls occurring between October 1st, 2014 and June 30, 2015, in which the new behavioral emergencies protocol was utilized. Cases were reviewed for protocol violations and the type of violation was recorded.

## Result

There were a total of 56 calls during the study period that utilized the new behavioral emergencies protocol including the administration of haloperidol. Protocol deviations were identified in 29% (95%CI 18-42%) of cases. The most common protocol violation at 13%

(95%CI 6-24%) was having a seizure history of or reported seizure; other violations included pediatric administrations at 4%(95%CI 1-13%) and haloperidol administrations that were not reduced for geriatric use at 9%(95%CI 4-20%). While not required by the protocol, Online Medical Control (OLMC) was contacted in 14% (95%CI 7-27%) of calls.

## Discussion

Standard Treatment Protocols allow for rapid implementation of care by prehospital providers, without the need to contact OLMC. Little is known about the type and frequency of errors observed when adopting a new protocol and this analysis can provide useful insight to help better tailor training for new protocol implementation. Additionally, unnecessary calls to OLMC were observed, suggesting a lack of familiarity or confidence with the new protocol. This investigation demonstrates potential risks in new protocol implementation and we recommend further study to develop best practices for training and implementation of new clinical protocols.

## Keywords

EMS Behavioral Emergency Protocol Violation



# Training for Failure: A Simulation Program for PGY-1 Emergency Medicine Residents to Improve Communication Skills in Service Recovery

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## Background

The unpredictable nature of the emergency department (ED) makes it prone to service failures such as unexpected delays and breakdowns in communication.

Service recovery describes the actions taken by an organization in response to service failures.

Recommended service recovery behaviors include: apologizing, fixing the problem quickly and offering atonement. We propose that a simulation based education program will improve the service recovery communication skills of PGY-1 emergency medicine (EM) residents, as assessed with a modified Master Interview Rating Scale (MIRS) completed by EM faculty and patient instructors (PIs).

## Method(s)

This study was a prospective repeated measure design. Cases were developed by EM faculty that required service recovery behavior to address emotionally charged, yet common ED patient interactions. A modified MIRS was selected as an evaluation tool as it is widely used in the evaluation of training programs that aim to impart physician communication skills. 18 PGY-1 EM residents participated in 6 cases in a randomized order. PIs provided real time feedback on each case, and after completing 3 cases residents were debriefed on ideal service recovery behaviors. A PI and two EM faculty completed MIRS evaluations for each case. The pre and post debrief average scores by rater type were

summarized by mean and standard deviation and compared by a paired t-test. The intra-class correlation coefficient between rater types and the 95% confidence interval were calculated before and after the intervention.

## Result

The pre and post debrief average scores as scored by patient instructors were not statistically different ( $p=0.852$ ). In contrast, the post average score was significantly better than the pre score when scored by faculty ( $0.001$ ). The score distributions of the six cases by patient instructors were significantly different ( $0.001$ ), but not when scored by faculty ( $p=0.528$ ,  $0.134$ ).

## Conclusion

This simulation based program was effective at teaching service recovery communication skills to PGY-1 EM residents as evaluated by EM faculty. The faculty evaluations noted improvement in service recovery skills with simulated practice and debriefing. No change was noted in PI scoring. This pilot program supports further exploration into the use of PI simulation to teach these very challenging communication skills to EM residents.

## Keywords

Simulation, Resident Education, Communication



# Transgender Health in a Regional Emergency Department: Patient Perspectives on Barriers to Emergency Care and Care Quality

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### Background

People identifying as transgender or gender nonconforming (TG) are among the most vulnerable in our country. TG patients experience challenges in accessing health care that may contribute to poorer health and outcomes. Little evidence describing barriers to emergency care is available; therefore, the aims of this study were to explore TG patients' experiences in seeking emergency (ED) care, perceptions of care quality, and perspectives on barriers to care.

### Method(s)

This mixed-methods study included an electronic survey and semi-structured interviews. Survey items included demographics, care-seeking experiences, perceptions of care and providers, and barriers encountered. The survey link was distributed using posters, billboards, business cards, social media and electronic mail. A purposive sample of interviewees was recruited and an interview guide was used to conduct audiotaped interviews that were transcribed verbatim. Interviews expanded on the survey further exploring participant perceptions regarding ED care. Quantitative analyses summarized data. Qualitative analyses followed a qualitative descriptive approach and an iterative process that included constant comparison as themes and sub-themes emerged. Findings were verified with members of a local TG advocacy organization.

### Result

51 participants completed the survey and 10 the interviews (median age 30, range 18-62; 96% white, non-Hispanic). Only 9% of participants reported that the ED provides TG-competent care; 15% felt that the ED is a safe space for TG patients, and 52% reported at least some discomfort in seeking ED care locally. 47% had delayed an ED visit and 33% altered their gender presentation prior to an ED visit. 28% felt their medical providers were competent in addressing TG-specific health needs. Interview participants elaborated on barriers to care, identifying three main barrier types: interpersonal (clinician and staff knowledge, attitudes, and empathy), societal (pervasive negative societal attitudes), and the physical hospital structure (gender neutral restrooms; electronic record).

### Conclusion

Findings suggest that TG patients face significant interpersonal, societal, and physical plant-related barriers in seeking ED care. Future work addressing modifiable barriers such as knowledge deficits and gender-neutral restrooms is recommended.

### Keywords

transgender, emergency medicine, emergency services, access to care, vulnerable populations, sex and gender





## Use of Non-Face-to-Face Modalities for ED-SBIRT (-Screening, Brief Intervention and Referral to Treatment) for High-Risk Alcohol Use: A Scoping Review

### Background

The purpose of this review was to examine and chart the 'scope' of strategies and outcomes reported in ED-SBIRT (-screening, brief intervention and referral to treatment) studies that employ non-face-to-face (nF2F) modalities for high-risk alcohol use; and to identify research gaps in the scientific literature.

### Method(s)

Population included study participants with high-risk alcohol use patterns and study participants targeted for primary public health prevention (e.g., adolescent ED patients). Core concepts included SBIRT components among intervention studies that incorporated some form of nF2F modality (e.g., self-administered computer assessment). Context encompassed ED-based studies or trauma center studies, regardless of geographic location. After screening a total of 1,526 unique references, reviewers independently assessed 58 full-text articles for eligibility.

### Result

A total of 30 full-text articles were included. Articles covered a period of 14 years (2003-2016) and 19 journal titles. Authors reported the use of a wide range of nF2F modalities across all three ED-SBIRT components: 'screening'—e.g., computerized screening—'brief intervention'—e.g., text-message-based brief interventions—and 'referral to treatment'—e.g., computer-generated feedback with information about alcohol treatment services. The most frequently used nF2F modality was computerized screening and/or baseline assessment. The main results were mixed with respect to showing evidence of ED-SBIRT intervention effects.

### Conclusion

There is an opportunity for ED-SBIRT researchers to focus on the specific needs of several populations—e.g., ED patients with co-occurring problems such as substance use disorder and violence victimization—and on several methodological issues—e.g., ED-SBIRT theory-of-change. Emergency medicine researchers should take the lead on establishing guidelines for the reporting of ED-SBIRT studies, including categorization schemes for various nF2F modalities. This would facilitate both secondary research (e.g., meta-analyses) and primary research (e.g., future study design).

### Keywords



# Variation in Patient Experience Performance and Response Rate Across the Payer Continuum

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## Background

There is growing interest in patient experience (PE) as a value-based metric among emergency department administrators. While the link of patient experience scores to quality and safety remains controversial, few would argue the reality of payment based models contingent on PE data. A key component to enhancing PE is the identification of contributory factors. The objective of this study was to determine the level of variation in PE scores and response rates for patients based on primary insurance status.

## Method(s)

Retrospective study of Emergency Department PE surveys from one northeastern US health system composed of five Emergency Departments (one tertiary care academic and four community based). Survey results from January 2014 to December 2016 were reviewed. PE Surveys were sent to a random sampling of discharged patients. Each returned survey was linked to an EHR chart which was subsequently queried for primary payer status. Performance scores were compared using Kruskal-Wallis test and difference in response rates were compared using a chi-square goodness of fit test.

## Result

There were 1,034,602 patient visits in the ED during this time period with 757,501 patients discharged. Amongst all discharged patients, the payer mix included 28.9% Commercial, 14.9% Medicare, 47.7% Medicaid, 7.1%, Self-Pay/Unknown, 1.4% Workers Comp. 21,130 complete PE Surveys were returned during study time period. The mean overall score for the entire group was 87.1. By insurance: Commercial 8,974 surveys with overall score of 85.9; Medicare 7,860 surveys with overall score of 90.4; Medicaid 3,273 surveys with overall score 82.6, Self-Pay/unknown 611 surveys with overall score 85.3, and workers comp with 412 returned surveys with an overall score 87.0. 2.8% of all discharged patients returned a survey. Differences in performance scores and response rates were statistically significant,  $p < 0.05$ .

## Conclusion

The highest frequency of response was found in those who were commercially insured. Patients covered by Medicare provided the highest scores. The lowest scores and response rate was among Medicaid patients. Nonetheless the power of study provides valuable insight into the frequency of response and patient experience ratings across patients enrolled in varied insurance products.

## Keywords

patient experience, insurance status



# Visual Estimation of Tricuspid Annular Plane Systolic Excursion by Emergency Medicine Providers

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## Introduction

Tricuspid Annular Plane Systolic Excursion (TAPSE) is established as an ultrasound marker of right ventricular (RV) systolic function. Previous studies have demonstrated that EM providers can adequately estimate left ventricular (LV) systolic function. The objective of this study was to evaluate if EM providers can visually estimate RV function using TAPSE compared to a gold standard m-mode measurement.

## Method(s)

A convenience sample of EM providers at an academic medical center were shown a 5 minute video on TAPSE. Subjects then viewed 20 apical 4-chamber ultrasound clips and recorded whether TAPSE was normal ( $\geq 1.9$  cm), borderline (1.5-1.9 cm) or abnormal ( $< 1.5$  cm), as well as their estimate of TAPSE distance in centimeters. For borderline assessments, distance estimate was used to define subject TAPSE categorization as normal ( $\geq 1.7$  cm) or abnormal ( $< 1.7$  cm). Sensitivity and specificity of visual TAPSE categorization was calculated using m-mode measurement as the criterion standard. Subjects also reported their comfort with assessing TAPSE on a 5 point Likert scale before and after participation in the study. Mann Whitney U test was used to compare sensitivity and specificity between training levels. Wilcoxon signed-rank test was used to evaluate TAPSE comfort level before and after the intervention.

## Result

70 EM providers including 20 PGY 1-4 residents, 22 attending physicians, and 28 Physician Assistants (PAs) participated in the study. The pooled sensitivity and specificity for visual assessment of TAPSE was 88.6% (95% CI 85.4-91.7%) and 81.6% (95% CI 78.2-84.4%) respectively. The sensitivity and specificity for the clips (16/20) in which the measured TAPSE was 1.5 cm or  $\geq 1.9$  cm was 91.4% (95% CI 88.4-94.3%) and 90.8% (95% CI 87.7-93.9%) respectively. There was no significant difference in sensitivity ( $p=0.269$ ) or specificity ( $p=0.546$ ) between resident and attending physicians or between physicians and PAs ( $p=0.173$  for sensitivity,  $p=0.811$  for specificity). Mean TAPSE assessment comfort score increased from 1.64 to 3.20 (0.0001) after participation in the study.

## Conclusion

A wide range of EM providers demonstrated good accuracy for visual estimation of TAPSE. If this finding is replicated in larger studies, it may suggest that, as with LV function, visual estimate may be a reasonable surrogate for calculated measurements of RV function.

## Keywords

Ultrasound, Echocardiography, Cardiology, Education, Point-of-care



# X, Y and Z axis dimensional analysis of Human Stampedes' reports to predict mechanism of injury

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## Background

Human stampedes (HS) result in mass casualty incidents (MCI) that occur due to complex physics which yet to be described between individuals, collective crowd and space. We performed analysis of HS using basic Physics principles to better understand the dynamic kinetic variables that give rise to HS.

## Method

A review of medical and non-medical sourced databases, Library of Congress databases, and online sources. We first searched for HS and obtained 25,123 references. A filter set excluded all non-human linked "stampede resulting in 265 references. We applied enrolment criteria of MCI with injury and/or death reported in media reports, documented photography, and/or footage. A final of 116 references met our criteria, out of these only 73 reports had photographic / footage documented. Predefined Physics principles were identified by qualified physicists: unit mass, density change, average velocity, XYZ axis motion, fluid dynamics and nozzle effects. Phrases containing these principles of physics were identified and abstracted in each report. Then, these phrases grouped based on the shared physics variables to determine HS as mechanism of injury. Data collection used single entry method of each 116 event. Analysis used R v3.4. a descriptive statistic measuring the frequency of each observed variable. Central tendency of the mode for each phrase from each of 116 events was measured, we calculated frequencies of phrases in each principle of Physics group to give us the final

proportions of the presence of predefined principles of Physics.

## Result

In 116 reports of HS resulting in injury or death we found the following percentages of concurrent conditions: density change in a limited capacity-45%, XY axis motion failure-100%, loss of proxemics-100%, deceleration with average velocity of zero-90%, Z axis displacement pathology (falls)-92%, associated structure with nozzle effect-93%. Matched fluid dynamic of high pressure stagnation of mass gathering-100%.

## Conclusion

Basic principles of physics were seen in differing percentage in 116 reports, supporting the conclusion that a cascade of physics events during a mass gathering lead to HS. These include XY axis motion failure of deceleration that leads to loss of human to human proxemics, and high stagnation pressure resulting in the Z axis displacement effect (falls) causing injury and death.

## Keywords

Disaster Medicine, Human Stampede

