Department of Emergency Medicine

Yale School of Medicine

20th ANNUAL RESIDENT RESEARCH DAY

Wednesday June 3, 2020

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Dear Colleagues:

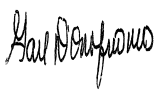
Welcome to our 20th Annual Emergency Medicine Research Day! Over the past several months, due to COVID-19, our department has faced enormous challenges both clinically and academically. We are incredibly proud of our graduating residents who have consistently been up to the task in responding effectively to these challenges. Today represents another opportunity for them to continue the tradition of Resident Research Day and present their projects virtually to faculty and peers.

Today's program highlights the scholarly works of our graduating residents. The completion of a scholarly work is required by the Emergency Medicine Resident Review Committee, and represents countless hours of preparation and action over the four years of residency. As the residents have learned, this endeavor often involves the 5 hard P's of Research: Prepare, Passion, Perseverance/Perspiration, People and inevitably Pain.

We would like to congratulate all the residents on their work and thank the numerous faculty members who have been involved from within the Department of Emergency Medicine and throughout the Yale University community.

Thank you for joining us on this important day.

Sincerely,



Gail D'Onofrio MD, MS
Chair and Professor
Department of Emergency Medicine

Leigh Evans MD
Resident Research Director
Associate Professor
Department of Emergency Medicine

RESEARCH PRESENTATIONS

9:00 am	*Opening Remarks: Leigh V. Evans MD*
9:10 am	Point-Of-Care Echocardiogram in Emergency Department Patients with Non-ST Elevation Acute Coronary Syndrome Requiring Cardiac Coronary Intervention *Ting Xu Tan MD*
9:20 am	The Impact of a Boot Camp Curriculum on Student Self-Assessment of Emergency Medicine Milestones *Pauline Holmberg MD*
9:30 am	Sound and Air: Ultrasonographic Measurements of Pediatric Chest Wall Thickness and Implications for Needle Decompression of Tension Pneumothorax *Rubayet Hossain MD*
9:40 am	Are we failing our high performers? A survey of resident self-assessment and implementation of individualized learning plans to facilitate education *Ali Kamran MD*
9:50 am	Hypertension and Acute Mountain Sickness in Himalayan Trekkers in Nepal: An Observational Cohort Study *Charles Duke MD, PhD*
10:00 am	Bored of Boarding: A Propensity matched examination of the association between ED Boarding and hospital Length of Stay *Henna Kochar MD*
10:10 am	Measuring the Microcirculation in a Mouse Model of Sepsis: A Pilot Study *Vinitha Jacob MD*
10:20 am	The association of sleep hygiene and drowsiness with adverse driving events in emergency medicine residents *Walter Green MD*

10:30 am	*Break*
10:40 pm	Just-in-Time clinical video review improves Sengstaken-Blakemore tube placement by emergency physicians: a randomized controlled simulation-based study *Joshua Pope MD*
10:50 pm	An Appraisal of Emergency Medicine Clinical Practice Guidelines: Do We Agree? *Gina Siddiqui MD*
11:00 am	Assessment of a Clinical Teaching Elective in the Emergency Department *Sandra Seelig MD*
11:10 am	Patient Perceptions of Emergency Department Billing and Costs *James Gaylor MD*
11:20 am	Utilizing System Dynamics Modeling to Evaluate Policy Interventions on Opioid Overdose Deaths in the State of Connecticut *Jason Buckert MD*
11:30 am	EMS Recognition of STEMI Equivalents and the Potential Effects *Nicholas Palladino MD*
11:40 am	Improving Burnout through Resident Shift Adjustments: A Wellness Innovation *Leah Manchester MD*
11:50 am	*Closing remarks: Gail D'Onofrio MD, MS*

Point-Of-Care Echocardiogram in Emergency Department Patients with Non-ST Elevation Acute Coronary Syndrome Requiring Coronary Intervention

Ting Xu Tan, MD, Donald Wright, MD, Seohyuk Lee, BSc, Christopher L. Moore, MD

Introduction: Focal wall motion abnormalities (FWMA) on echocardiogram (ECHO) are often present in patients with acute coronary syndrome (ACS) and may identify patients with non-specific electrocardiograms (EKGs) that require intervention. The primary objective of this study was to describe the diagnostic test characteristics of FWMA in point-of-care ultrasound (POCUS) among non-ST elevation ACS (NSTE-ACS) patients who subsequently underwent cardiac catheterization within 72 hours of ED presentation. The secondary objective was to perform subgroup analysis on NSTE-ACS patients receiving coronary intervention based on the presence of a positive troponin at any time in the emergency department (ED).

Methods: This retrospective observational cohort study included patients in an urban academic hospital system who had both ED POCUS and coronary catheterization over a two-month period. ECHOs were reviewed by an expert in POCUS who was blinded to outcome and categorized for presence or absence of FWMA. Coronary intervention was defined as attempted or successful angioplasty or recommendation for coronary artery bypass grafting which occurred within 72 hours of ED presentation and was abstracted from the cardiac catheterization reports. Troponin was considered positive if the troponin I was >0.08 ng/mL or troponin T was >0.01 ng/mL. Data analysis was performed in the R environment for statistical computing using the “tidyverse” and “epiR” packages.

Results: There were 17 patients meeting inclusion criteria from January-February 2019, with 7 (41%) receiving coronary intervention. Of the 17 patients, 9 (53%) had FWMAs. The presence of FWMA had a sensitivity of 71% and a specificity of 60% for coronary intervention. The positive likelihood ratio was 1.79, the negative likelihood ratio was 0.48. For patients with at least one positive troponin, the presence of FWMA had a sensitivity of 100% and a specificity of 50% for coronary intervention. The positive likelihood ratio was 2.00, the negative likelihood ratio was 0. In the subgroup of patients with negative troponin, the presence of FWMA had a sensitivity of 60% and a specificity of 75% for coronary intervention. The positive likelihood ratio was 2.40, the negative likelihood ratio was 0.53.

Conclusion: Based on this pilot data, FWMA on ED ECHO may have a role in the risk stratification of high-risk NSTE-ACS patients in the ED, particularly in patients with a positive troponin and an EKG that does not meet ST elevation myocardial infarction criteria. A larger study is underway to further assess this application.

The Impact of a Boot Camp Curriculum on Student Self-Assessment of Emergency Medicine Milestones

Pauline Holmberg, MD, Jessica Bod, MD, Brian Wood, MD, David Della-Giustina, MD

Introduction: In this study, we designed an EM bootcamp to address the basic skills that we believe are essential for new EM interns. We hypothesized that an Emergency Medicine bootcamp educational experience impacts graduating students' self-rating on EM milestone competencies in a positive way.

Methods: Students participated in a variety of educational experiences which focused on the basic principles of emergency medical knowledge and procedural skills that students are expected to be familiar with prior to starting residency. Students ranked their abilities on the first day of the bootcamp and then on the last day using the American Board of Emergency Medicine (ABEM) 23 EM Milestones. The averages of self-rated competence were taken on day one and compared to day three, the last day of the bootcamp.

Results: Student's average level of competence in each of the 23 milestones increased by the end of the bootcamp.

Conclusion: It is important that an EM bootcamp becomes an integral part of a graduating medical student curricula in order to increase competencies in core EM knowledge and to standardize EM medical student education prior to starting residency.

Sound and Air: Ultrasonographic Measurements of Pediatric Chest Wall Thickness and Implications for Needle Decompression of Tension Pneumothorax

Rubayet Hossain MD, Usama Qadri MD, Nathan Dembowski MD, Angelica Garcia MD, Lei Chen MD, Mark Cicero MD, Antonio Riera MD

Objectives: Needle decompression is potentially life-saving in cases of tension pneumothorax. While Advanced Trauma Life Support recommends an 8-cm needle for decompression for adults, no detailed pediatric guidelines exist, specifically regarding needle length or site of decompression.

Methods: Point-of-care ultrasound was used to measure chest wall thickness—the distance between skin and pleural line—bilaterally at the 2nd intercostal midclavicular line and the 4th intercostal anterior axillary line in children of various ages and sizes. Patients were grouped based on Broselow tape weight categories. Measurements were compared between left vs. right sides at the two anatomic sites. Interclass correlation coefficients were calculated to assess for interrater reliability.

Results: A convenience sample of 163 patients from our emergency department were enrolled. For patients who fit into Broselow tape categories, chest wall thickness at the 2nd intercostal midclavicular line ranged from 1.11 to 1.91 cm, and at the 4th intercostal anterior axillary line ranged from 1.13 to 1.92 cm. In patients larger than the largest Broselow category, 77% had a chest wall thickness less than the length of a standard 1.25-inch (3.175 cm) catheter. There were no significant differences in the measurements of chest wall thickness based on laterality nor anatomic site.

Conclusions: The standard 1.25-inch (3.175 cm) catheters are sufficient to treat most tension pneumothoraces in pediatric patients.

Are we failing our high performers? A survey of resident self-assessment and implementation of individualized learning plans to facilitate education

Ali Kamran MD, David Della-Giustina MD, D. Brian Wood MD, Katja Goldflam, MD

Intro: We surveyed emergency medicine residency leaders nationally regarding their use of resident self-assessment and, if performed, what areas were assessed. We further asked whether they required the development of an individualized learning plan (ILP) for each resident based on the assessment.

Methods: After an initial literature search, a survey was developed using Qualtrics (2019 Qualtrics, Provo, UT) software. This survey was sent to all ACGME-approved emergency medicine residency program leaders twice through the Council of Residency Directors in Emergency Medicine listserv. An additional individualized email request to complete the survey was sent directly to each non-responding program director. Results were obtained from February to April 2019.

Results: Out of 240 programs surveyed, 119 (49.5%) programs completed the survey. Seventy-nine percent of programs reported that they have all residents perform an individual self-assessment. These were completed semiannually in 68.6% of programs, annually in 19.1%, less than annually in 8% and quarterly or more frequently in 4%. Programs have residents assess themselves in the following areas: clinical (36.0%), academic (33.2%), leadership (19.6%) and other (11.2%). Of those programs requiring a resident self-assessment, 21.2% of programs had all of those residents complete a formal ILP, 40.4% only had lower performing residents complete an ILP, and 38.3% did not have any residents complete an ILP.

Conclusions: Most programs have residents complete a self-assessment, but there is a wide variation in what is assessed. Only 21% required all residents to develop an ILP with the majority having only lower performing or no residents developing an ILP. These findings call for development of a standardized self-assessment tool for residents, as well as discussion of whether the focus on lower performing residents may result in a failure to fully challenge average and higher performing residents.

Hypertension and Acute Mountain Sickness in Himalayan Trekkers in Nepal: An Observational Cohort Study

Charles B. Duke MD, PhD, T. Douglas Sallade DO, Jennifer Starling MD, Sushil Pant MD, Alison Sheets MD, Matthew K. McElwee MD, PhD, David S. Young MD, Richard Andrew Taylor MD, Linda E. Keyes MD

Intro/Background: A history of preexisting hypertension is common in people participating in mountain activities; however, the relationship between blood pressure (BP), preexisting hypertension, and acute mountain sickness (AMS) is not well studied. We sought to determine these relationships among trekkers in the Everest region of Nepal.

Methods: This was a prospective observational cohort study of a convenience sample of adult, nonpregnant volunteers trekking in the Everest Base Camp region in Nepal. We recorded Lake Louise Scores for AMS and measured BP at 2860 m, 3400 m, and 4300 m. The primary outcome was AMS.

Results: A total of 672 trekkers (including 60 with history of preexisting hypertension) were enrolled at 2860 m. We retained 529 at 3400 m and 363 at 4300 m. At 3400 m, 11% of participants had AMS, and 13% had AMS at 4300 m. We found no relationship between AMS and measured BP values ($P>0.05$), nor was there any relation of BP to AMS severity as measured by higher Lake Louise Scores ($P>0.05$). Preexisting hypertension (odds ratio [OR] 0.16; 95% CI 0.025–0.57), male sex (OR 0.59; 95% CI 0.37–0.96), and increased SpO2 (OR 0.93; 95% CI 0.87–0.98) were associated with reduced rates of AMS in multivariate analyses adjusting for known risk factors for AMS.

Conclusions: AMS is common in trekkers in Nepal, even at 3400 m. There is no relationship between measured BP and AMS. However, a medical history of hypertension may be associated with a lower risk of AMS. More work is needed to confirm this novel finding.

Bored of Boarding: A Propensity matched examination of the association between ED Boarding and hospital Length of Stay

Henna Kochar MD, Vivek Parwani MD, Andrew Ulrich MD, Craig Rothenberg MPH, Jeremiah Kinsman MPH, Arjun K. Venkatesh MD, MBA, MHS

Introduction: Emergency Department (ED) overcrowding has been linked to poor patient outcomes, including increased inpatient mortality. However, the relationship between ED boarding and operational measures, with quality, safety and financial implications for patients exposed to boarding as well as all other patients within capacity constrained hospitals, has not been significantly investigated. Specially, hospital length of stay (LOS) is a major outcome of interest, as there is well documented risk such as increased rates of nosocomial infections, hospital stagnancy, and greater inpatient costs to the patient and facility. Prior work has reported mixed results regarding the relationship between ED boarding and hospital LOS but has been subject to significant selection bias as patients exposed to boarding systematically differ in terms of demographics and care needs from those that do not board in the ED. Accordingly, we conducted a propensity matched analysis of ED hospital admissions to examine the association between boarding and in-hospital LOS involving select clinical conditions that allow for more predictable inpatient pathways.

Methods: We performed a retrospective propensity score-matched analysis of inpatient floor admissions originating in the ED between February 2016 and February 2018, in a large, tertiary care, urban academic hospital center. We constructed 7 condition-specific cohorts for propensity matching based on demographics, comorbidities, Emergency Severity Index (ESI), inpatient vs observation admission status, telemetry needs, and insurance type. We defined boarding as a time interval between admission order and ED departure > 4 hours. The primary outcomes were inpatient LOS (I-LOS, defined as the time from ED departure to hospital departure) and total hospital LOS (H-LOS, defined as time from ED arrival to hospital departure). Unadjusted non-propensity matched and adjusted matched linear regression analyses were conducted within each cohort for primary outcomes. In all regressions, LOS was log transformed to account for the differences in LOS distributions between boarded and non-boarded groups.

Results: A total of 9,222 patient encounters were included across the 7 diagnostic cohorts, of which 3,074 (33.3%) boarded in the ED for >4 hours. Differences in I-LOS between boarded and non-board patients were significant only for those admitted for intestinal obstruction/ileus, with an associated 20% lower time from ED departure to hospital

departure for patients who boarded. In multiple diagnostic cohorts, patients who boarded experienced longer H-LOS compared to their non-boarded counterparts: asthma/chronic obstructive pulmonary disease and bronchiectasis patients had a 12% higher H-LOS (95% confidence interval [CI] 5-19%), fluid and electrolyte disorders 19% (CI 9-30%), urinary tract infection 12% (CI 4-20%), skin and subcutaneous tissue infections 17% (CI 9-27%), and pneumonia 11% (CI 4-18%).

Conclusions: After rigorous patient matching, we found no broad association between ED boarding and inpatient length of stay, however there was a consistent relationship between ED boarding and total hospital length of stay. This suggests that patients boarding in the ED may be subject to a “no man’s land” of care with the initiation of inpatient care pathways delayed until ED departure. Integration of inpatient care into boarding time would likely result in reduced LOS, improvement in hospital efficiency, and reductions in the safety risks associated with limited accountability during boarding.

Measuring the Microcirculation in a Mouse Model of Sepsis: A Pilot Study

Vinitha Jacob, MD, PhD, Justin Belsky, MD, MPH, Maor Sauler, MD, So-Jin Kim, PhD, Patty Lee, MD

Intro/Background: Early identification of sepsis allows early intervention and improved patient outcomes. Microcirculatory dysfunction is a hallmark of sepsis and has important prognostic significance when altered in patients with sepsis. It can serve as an earlier predictor of end-organ damage when compared to global hemodynamic parameters such as blood pressure measured via traditional methods. In order to develop a translational model of early sepsis detection, we sought to determine the best tissues for evaluating microcirculatory perfusion defects in a mouse model of sepsis.

Methods: We used MicroScan (MicroVision Medical B.V., Amsterdam, the Netherlands), side-stream darkfield microscopy to attempt to measure the microcirculation in the lungs, conjunctiva, heart, cecum, small intestine, large intestine, kidneys and bladder of C57BL/6 mice between the ages of 6-8 weeks. Using standard techniques published by Daniel De Backer in 2007, we measured the heterogeneity index, microvascular flow index, the proportion of perfused vessels and the perfused vessel density in 12 mice injected intraperitoneally with either saline or lipopolysaccharide (LPS) - an established method to induce sepsis, at different time points.

Results: The microcirculation of the cecum, small and large intestine was successfully accessed and measured in saline and LPS treated mice. Due to the small sample sizes of each group, statistical analysis was not attempted.

Conclusions: We found that the mouse cecum, small intestine and large intestine were the most appropriate tissues for evaluating microcirculatory perfusion defects in a mouse model of sepsis. Further studies with larger sample sizes should determine if statistical differences exist at various time points and if different tissues exhibit microcirculatory defects at earlier time points than others. Our pilot study is an important step in the development of an animal model of early sepsis detection that will allow for easy translation to humans.

The association of sleep hygiene and drowsiness with adverse driving events in emergency medicine residents

Walter Green MD, Xiang Gao, MPH, Kaigang Li PhD, MEd, Barbara C. Banz PhD, Jia Wu, PhD, Michael J. Crowley PhD, Deepa R. Camenga MD, MHS, Federico E. Vaca MD, MPH

Introduction: Prior research shows that physicians in training are at risk for drowsy driving following their clinical duties, which may put them in danger of experiencing adverse driving events. This study explores the relationship between sleepiness, overall sleep hygiene, level of training, and adverse driving events following an overnight shift in emergency medicine residents.

Methods: Throughout the 2018-2019 academic year, 50 emergency medicine residents ranging from Post-Graduate Year 1 through 4 completed self-administered surveys regarding their sleepiness before and after their drive home following an overnight shift, any adverse driving events that occurred during their drive home, and their overall sleep hygiene.

Results: Fifty out of a possible 57 residents completed the survey for a response rate of 87.7%. Sleepiness was significantly associated with adverse driving events (Beta = 0.31; $p < .001$). Residents with high sleepiness levels reported significantly more adverse driving events. Residents reported significantly higher sleepiness levels after completing their drive home (Mean = 7.04, SD = 1.41) compared to sleepiness levels before driving home (Mean = 5.58, SD =1.81). Residency training level was significantly associated with adverse driving events (Beta = -0.59, $P < .01$). Senior residents reported significantly fewer adverse driving events compared to junior residents.

Conclusions: Emergency physicians in training are at risk for drowsy driving related motor vehicle crashes following overnight work shifts. Trainees of all levels underestimated their true degree of sleepiness prior to initiating their drive home, while junior residents are at higher risk for adverse driving events.

Just-in-Time clinical video review improves Sengstaken-Blakemore tube placement by emergency physicians: a randomized controlled simulation-based study

James W. Bonz MD, Joshua K. Pope MD, Ambrose H. Wong MD, Jessica M. Ray PhD, Leigh V. Evans MD

Intro/Background: Just-in-Time (JiT) Training medical education aspires to provide relevant instruction at the point of clinical care. Video is an optimal media choice just prior to actual performance and has a demonstrated a track record of success in medicine. We as EM physicians are responsible for successful completion of life-saving procedures that must be performed immediately, are of high consequence, and are infrequently performed. The success of these procedures may be positively influenced by a concise and practical Just in Time (JIT) intervention. Emergent insertion of a Sengstaken-Blakemore tube (SBT) for variceal hemorrhage is one such rare, high-consequence procedure.

Objectives: To create and evaluate a brief video review of a multi-step rarely performed procedure that may be used just prior to clinical performance.

Methods: We created a succinct three-minute Just in time (JIT) training video on Sengstaken-Blakemore tube (SBT) insertion. We recruited emergency medicine resident physicians to participate in a simulation scenario in which they had to quickly place an SBT. Participants were randomized to either procedure review by any online media they chose (control) or review of the JIT video (intervention). The media review was limited to three minutes to simulate the realistic time constraint in a clinical environment. Participants were graded as successful/unsuccessful by blinded reviewers using a pre-determined checklist.

Results: Of the 32 participants, examining pass rates in both training and control groups, 10 of 16 (62.5%) of participants in the training group reached a minimum pass score while only 2 of 16 (12.5%) of participants in the control group reached a minimum passing score of 18. A Pearson Chi-Square test indicates a significant difference in pass rates between groups ($C2 = 8.533$, $p= .003$). Videos were scored by a blinded reviewer and two additional raters. Interrater reliability was assessed using Fleiss' Kappa indicating substantial agreement ($k=0.640$) on codings among the three raters.

Conclusions: A readily available, focused JIT video may offer increased success for unexpected and complicated rare procedures like SBT insertion.

An appraisal of emergency medicine clinical practice guidelines: Do we agree?

Alyssa Zupon MD, Craig Rothenberg MPH, Katherine Couturier MD, Ting-Xu Tan MD, Gina Siddiqui MD, Matthew James MD, Dan Savage MD, Edward R. Melnick MD, MHS, Arjun K. Venkatesh MD, MBA

Intro/Background: Clinical practice guidelines, summarized syntheses of scientific evidence to aid in medical decision-making, have proliferated in recent years. Unfortunately, this proliferation may not be giving clinicians the clarity we seek. In 2013, the National Guideline Clearinghouse included 471 guidelines for hypertension and 276 for stroke, many offering contradictory recommendations. Clinical practice guidelines vary widely in their criteria for evidence, presence of bias, and applicability to a general population. This study aimed to examine the clinical guidelines published by the American College of Emergency Physicians (ACEP), using a validated instrument for guideline evaluation, to assess their suitability for use today, and to identify ways to make them better.

Methods: Five independent emergency medicine physician reviewers rated ACEP's current guidelines as of May 24, 2017 using the AGREE II tool, a systematic framework consisting of 23 key items across six domains: "Scope and Purpose," "Stakeholder Involvement," "Rigor of Development," "Clarity of Presentation", "Applicability," and "Editorial Independence." Reviewers also were prompted by the AGREE II tool to give an "Overall Assessment" on a 7-point Likert scale and a categorical yes/no recommendation for use in clinical practice. Order of clinical policy review was randomized for each reviewer.

Results: ACEP policies had the highest overall mean rating and lowest inter-rater variability for "Scope and Purpose" (mean 90%, coefficient of variation 0.03). "Applicability" had the lowest mean rating and highest variability (mean 35%, CV 0.16), followed by "Stakeholder Involvement (mean 53%, CV 0.08) The mean "Overall Assessment Rating" for all twenty clinical policies from the five appraisers was 69%, with 64% "yes" and 30% "yes with modifications" for their use by the appraisers in clinical practice. "Overall Assessment" rating was not associated with policy publication date, nor with being among the policies published after updates to the ACEP clinical policy development process in 2015. "Overall Assessment" had positive associations with two domains: "Rigor of Development" (r=0.70) and "Clarity of Presentation" (r=0.70).

Conclusions: Emergency physicians reviewing ACEP clinical guidelines found them to be consistently adequate in "Scope and Purpose" as defined by the AGREE II tool, but lacking in "Applicability." Applicability, or relevance to real-life clinical practice, is a challenging goal for

guidelines and further research is needed to disentangle the ways for a guideline to improve in this domain. The two domains that tracked with overall higher marks, “Rigor of Development” and “Clarity of Presentation,” as well as the second-lowest domain, “Stakeholder Involvement,” may provide more specific avenues for improvement.

Assessment of a Clinical Teaching Elective in the Emergency Department

Sandra Seelig MD, Jessica Bod MD, David Della-Giustina MD

Background: Bedside teaching is an integral part of emergency medicine. However, only a fraction of academic attendings and residents have formal education on how to teach. Electives in bedside teaching have been trialed in other specialties, yet none have been assessed in Emergency Medicine. This study has been designed to address the influence of a bedside teaching elective for senior EM residents.

Methods: Three senior residents over 2 years each participated in a month long elective whereby they taught a group of Sub-intern (SubI) medical students in the Emergency Department during dedicated teaching shifts (2 shifts per Sub-I). Thereafter, they were interviewed about their experiences and thoughts regarding the elective. Additionally, attendings, other residents working in the department, and the medical students were surveyed on their opinions about how the elective impacted emergency department dynamics and learning.

Results: The residents involved in the elective all found the experience valuable and would recommend it to their peers. The majority of attendings, non-teaching residents and medical students felt that the addition of a teaching resident added to the Emergency Department educational experience, improved patient care, contributed to the ED team and enhanced medical student education. It was found that over half of the 13 SubIs ranked the Yale EM Residency program higher on their residency rank list due to these teaching shifts.

Conclusions: Overall this elective has been found to have a positive influence on Emergency Department dynamics, individual resident learning and the sub intern experience. This study was limited by the small sample size. Further study is needed to quantify the effect of this elective.

Patient Perceptions of Emergency Department Billing and Costs

James M. Gaylor MD, Craig Rothenberg MPH, Vivek Parwani MD, Edwin Chan BA, Arjun Venkatesh, MD MBA MHS

Background: 'Surprise billing', or the phenomenon of unexpected coverage gaps in which patients receiving out-of-network medical bills after what they thought was in-network care, has been a major focus of policymakers and advocacy groups recently, particularly in the Emergency Department (ED) setting, where patients' ability to choose a provider is exceedingly limited. The United States Congress is currently debating several legislative interventions to address "surprise bills," with many of these proposals attempting to promote price transparency as a solution for billing irregularities. However, the knowledge and perceptions of patients regarding emergency care price transparency, particularly the degree to which ED patients are cost conscious is unknown. Accordingly, we sought to quantify that perception by measuring patients' direct predictions for the cost of their care.

Methods: We conducted an in-person survey of patients in Emergency Departments (EDs) over an 18-month period at two campuses within a large academic hospital system in southern Connecticut. We surveyed a convenience sample of patients at the bedside regarding demographics, care seeking perceptions and their estimates of the total and out-of-pocket costs for their ED care. Survey data was linked to institutional hospital finance datasets including actual charges and payments. We then later obtained the actual costs and billed amounts and compared these to the patients' estimates using a paired t-test. We also analyzed results according to certain patient demographics.

Results: A total of 600 patients were approached for survey, and data from 455 were available for the final analysis. On average, patients overestimated the cost of their care by $2484 and overestimated out-of-pocket cost by $144; both of these results met statistical significance ($p<.005$). Patients were better able to predict both total and out-of-pocket costs if they were: college educated or above; unemployed or retired; aged 65 or older; or had private insurance. Uninsured patients could better predict total cost but not out-of-pocket costs. One in 4 patients reported considering the cost of care prior to visiting the ED. Only 12 patients reported trying to look up that price before coming.

Conclusions: This study is the first to our knowledge that sought to quantify how patients perceive the cost of acute, unscheduled care in the ED. We found that ED patients generally do not consider the price before going to the ED, and subsequently overestimate the negotiated total

costs of acute, unscheduled emergency care as well as their out-of-pocket responsibility for care. Certain demographics are less predictive of this association. Notably, patients with Medicare/Medicaid and those with high school education or below were of the furthest off in predicting the actual cost of care. This lends credence to the established trend of patients' limited knowledge of the total cost of healthcare; moreover, that they overestimate the cost of their care could serve as a barrier to accessing that care particularly in more vulnerable groups. We hope that this finding adds useful information to policymakers in sculpting legislation around surprise billing.

Utilizing System Dynamics Modeling to Evaluate Policy Interventions on Opioid Overdose Deaths in the State of Connecticut

Jason Buckert MD, Rebekah Heckmann MD, MPH, MPA, Nasim Sabounchi PhD, MS, Jennifer Walker

Objectives: To use a previously described model to simulate various policy interventions and their impact on opioid overdose deaths in the state of Connecticut.

Methods: Utilizing a system dynamics modeling approach, the research team sought to simulate three hypothetical policy scenarios. The following are the potential policy interventions evaluated: (1) decreased drug arrests, (2) increased 911 calling rates during overdose incidents, and (3) modification of the CT PDMP.

Results: As simulations were based on available real-world data, effect sizes were generally modest. Based on simulation results, the research team found that not all interventions will be equally efficacious in combatting the opioid epidemic. Moreover, simulations performed using additional data from outside studies provided validation of the model's initial calibration.

Conclusions: Though systems-based predictive modeling does not perfectly replicate real world conditions, it does provide an attempt at a data approach to directing future policy initiatives. The model highlights areas in which further data collection could be useful to better calibrate the model. Also, a broadening of the scope of the model would be beneficial in order to allow for simulation of a broader array of interventions.

Policy implications: This system dynamics model demonstrates great potential by producing simulations that reveal multiple strategies to aid policy makers in determining the best public health interventions for combating the opioid crisis as well as identifying key areas where better data collection and further study are needed.

EMS Recognition of STEMI Equivalents and the Potential Effects

Daniel Joseph MD, David Cone MD, Ryan Coughlin MD, Aman Shah MD, Nicholas Palladino MD, Kevin Burns PA, EMT-P, Jeffrey McGovern BS

Introduction: It is well documented that early identification of need for catheterization in STEMI patients is associated with lower morbidities and mortality, so prehospital recognition of STEMIs can be key in shortening the door to balloon time. Recognizing that frequently STEMI equivalents also ultimately require catheterization led us to question whether there was a population of patients that could have triggered a catheterization lab activation sooner should we have screened for STEMI equivalents (i.e. aVR elevation, DeWinter's T waves, and Wellen's syndrome). Therefore, our study aim was to determine if patients that ultimately went to the catheterization lab during their hospitalization had a STEMI equivalent on their prehospital EKG.

Methods: We conducted a retrospective HER (electronic health record) review from a large urban tertiary care emergency department. We reviewed the prehospital EKG, or EKG upon arrival, of about 1600 patients who were hospitalized and required catheterization despite not triggering catheterization lab activation in the field between 6/30/17 and 3/30/19. The STEMI equivalents screened for included aVR elevation, DeWinter's T waves, and Wellen's syndrome. All patients that had a field activation for STEMI were excluded.

Results: Preliminary data for 862 of the original 1600 patients suggests that approximately 4.5% of patients who ultimately required catheterization despite not triggering an activation in the field did have STEMI equivalents. Of these patients, 2.8% (24) had aVR elevation, 0% (0) had DeWinter's T waves, and 1.7% (15) had Wellen's Syndrome

Conclusion: The preliminary data suggests that there are not a significant amount of patients whose prehospital EKG have STEMI equivalents. This study was limited by the availability of prehospital EKGs, as not every prehospital EKG was accessible through the electronic medical record. Furthermore, hospital EKGs tend to be higher quality than those obtained by EMS, which makes interpretation of EMS EKGs more difficult and prone to error. Future studies could be aimed at identifying confounding risk factors for missed STEMI equivalents and increasing the ease in which prehospital EKGs could be viewed through hospital EMRs for future studies.

Improving Burnout through Resident Shift Adjustments: A Wellness Innovation

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Background: According to the 2017 National Emergency Medicine (EM) Wellness Survey, 76% of EM residents report symptoms of burnout. Shift work is frequently cited as a leading source of burnout. Recent evidence identifies 8-hour shifts as ideal for EM, yet most residencies are not using such short shifts. Physician workload and emergency department (ED) crowding are also commonly cited contributors to burnout. Currently at this institution, post-graduate year (PGY) 2s and PGY3s work 10 hour shifts, and the majority of PGY2 shifts occur from early evening through 3am. Arrival data suggest that a single PGY3 is covering a large portion of the emergency department (ED) during one of the busiest times of the day. The objective of this innovation is to improve resident self-reported burnout by adjusting shift times and staffing.

Methods: This study includes both a randomized crossover study as well as a cross-sectional study, which were performed in the emergency department of a single quaternary care medical center. An initial residency-wide needs assessment cited concerns over long shift lengths and resident understaffing. In response, a pilot 4-week schedule was created by adjusting PGY2 and PGY3 schedules. This initiative reduced all resident shifts to 9-hours, which included a one-hour sign-out overlaps. Additional resident staffing was also scheduled based on historically busier times using arrival data. Residents were also scheduled for fewer evening “swing shifts”. Sign-out times were also closer to those of other residents to better allow for post-shift social opportunities. De-identified data was collected from residents via a Qualtrics survey from January through March of 2020. Multiple well validated surveys were administered: The Mini-Z, Professional Fulfillment Index (PFI), Patient Health Questionnaire 9 (PHQ-9), Generalized Anxiety Disorder 7 (GAD-7), Pittsburgh Sleep Quality Index (PSQI), and International Physical Activity Questionnaire (IPAQ), along with residency specific questions regarding shift work. Following the intervention pilot block which ran during the month of February, a repeat survey was sent to those residents who participated in the pilot. The study was approved by the local institutional review board and conducted in compliance with the Health Insurance Portability and Accountability Act regulations.

Results: Response rate to the initial survey was 77% (46 out of 60 residents), while response rate to the follow-up survey was 59% (10 out of 17 residents). Eighty-five percent of residents believed that ten-hour

shifts were too long, and 77% believed there was not enough coverage on the A green side of the ED. Baseline survey results revealed that the majority (57%) of residents are under stress, and about one third are experiencing true burnout (36%). Results trended towards the PGY3 faring the worst in measures of stress and job satisfaction. Following the pilot schedule intervention, there was a significant improvement in self-reported burnout in the PGY3 class from 2.5 to 1.8 on a 5 point scale ($p=0.02$), although no such improvement was observed in the PGY2 class. Depression and anxiety levels were both initially low, with 84% of residents reporting mild or no anxiety and 89% reported mild to no depression. Exercise levels met or exceeded to AHA recommendations at baseline, and sleep quality was varied widely. There were no significant changes were noted in any of these measures.

Conclusions: Resident-centered scheduling changes resulted in significant improvements in self-reported burnout.