RESEARCH DRIVING PRACTICE

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PREHOSPITAL CARE RESEARCH FORUM UCLA

INTERNATIONAL SCIENTIFIC EMS SYMPOSIUM

Established in 1992, the Prehospital Care Research Forum (PCRF) is dedicated to the promotion, creation, and dissemination of prehospital research. In this, our second year in partnership with EMS World, we are proud to feature selected abstracts from the International Scientific Symposium, to be held during EMS World Expo, Oct. 29–Nov. 2 in Nashville, as well as proceedings from the 23rd annual National Association of EMS Educators Symposium, which occurred in September.

The PCRF is proud to highlight the work of EMS providers who are advancing the profession with science. We believe it is the responsibility of emergency medical professionals worldwide to practice evidence-based medicine and develop a body of evidence that examines prehospital emergency care.

Each year we make research more accessible and understandable through the publication of these abstracts. We hope you will join us in creating a culture of science in EMS by participating in our symposia, workshops, and monthly journal clubs.

On the second Monday of every month at 1 p.m. Eastern, podcasts focus on the content of Dr. Tony Fernandez's "Turning Research Into Practice" (Trip Report) column in *EMS World* Magazine. New this year we are adding a joint podcast with the National Association of EMS Educators during which Dr. Megan Corry will focus on the "PCRF Research Alert" articles she authors for EMSWorld.com. Register for all podcasts at www.prehospitalcare.org.

We would like to thank our volunteer board of advisors and 33 associates. Without the dedication of these volunteers, none of this would be possible. In addition to the hard work of many people, much of our success can be attributed to the commitment of organizations dedicated to research in prehospital care. I would like to acknowledge our strategic partner, EMS World; education partner, the National Association of EMS Educators; founder, iSimulate; benefactor, ESO Solutions; partners, FirstWatch, Limmer Creative, and Jones & Bartlett Learning; and friends, Fisdap, Pocket Nurse, and Weber State University. The generous support of these fine organizations and our affiliation with the National Association of EMTs and the International Academies of Emergency Dispatch are what enable the PCRF to fulfill our mission.

The future of EMS depends on the quality and quantity of research we produce. We invite you to take a stand, conduct research in your community, and submit it in 2019 for the greater benefit of EMS. Our PCRF mentors are standing by to assist you.

Sincerely,

David Page, MS, NRP

Director, Prehospital Care Research Forum at UCLA

PCRF SALUTES OUR SUPPORTING ORGANIZATIONS:

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CLINICAL ABSTRACTS

The Effects of Drug-Assisted Airway Management on Mean Arterial Pressure and Shock Index in the Presence of Trauma

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Introduction—Airway management is a key component of prehospital care for seriously injured patients. Drug-assisted airway management is not a common intervention in the prehospital setting. Pharmacological and airway interventions can lead to adverse hemodynamic changes. Measuring mean arterial pressure (MAP) and shock index (SI) before and after a drug-assisted airway attempt could provide insight into the physiologic consequences of drug-assisted prehospital airway management in the trauma patient.

Objective—To measure changes in MAP or SI associated with drug-assisted advanced airway management.

Methods—A retrospective study was conducted using North Carolina Prehospital Medical Information System (PREMIS) data from July 1, 2012, to Dec. 31, 2012. Inclusion criteria consisted of prehospital trauma patients 12 years of age or more who received advanced airway management. Airway management was classified as drug-assisted if the patient received a paralytic, dissociative, benzodiazepine, or opiate medication. Generalized linear regression models were estimated. The semi-elasticity of drug-assisted airway management's effects on MAP and SI were estimated.

Results—A total of 577 patients met inclusion criteria. Of those, 257 (44.5%) received drug-assisted airway management, with 36.9% receiving a dissociative, 40.6% a paralytic, 31.5% a benzodiazepine, and 17% an opiate drug. Analysis revealed a 72% decrease in MAP associated with attempted drug-assisted airway intervention (-0.72, p=0.002). No statistically significant difference was noted in SI with drug-assisted airway attempts (-0.15, p=0.597). A statistically significant decrease in MAP was associated with paralytics (-0.48, p=0.029), dissociatives (-0.58, p=0.007), and opiates (-0.69, p=0.004). However, benzodiazepines had no statistically significant effect on MAP (-0.38, p=0.068).

Conclusion—Mean arterial pressure decreased with the use of paralytics, dissociatives, and opiates. Administration of benzodiazepines did not significantly decrease MAP. The impact of drug-assisted airway management on shock index was not statistically significant.

The Influence of Prior Ambulance Transport on Reported Perceptions of Patient Satisfaction During Subsequent Ambulance Transports in a High-Volume EMS System

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Introduction—Tracking patient satisfaction data can help an EMS system pursue targeted improvements by adapting to meet the predisposed patient expectations.

Objective—To explore and describe any extraneous influence of prior ambulance transport on perceived patient satisfaction during subsequent ambulance transport.

Methods—This quality improvement study involved the planned secondary analysis of prospectively collected data from a systemwide patient satisfaction initiative. A third-party vendor conducted telephone surveys aimed at obtaining 500 complete responses per month using a random sample from 130,000 local 9-1-1-initiated incidents resulting in ambulance transport. Incomplete responses and nonemergency calls were excluded. The instrument contained six questions intended to measure various aspects of patient satisfaction using a four-point ordinal scale (strongly disagree to strongly agree) along with a net promoter item. A single additional question was temporarily added to determine if a respondent had previously been transported by an ambulance before the current incident. This distinction was then used as a basis of comparison against reported patient satisfaction in each category.

Results—Over the three-month study period, 1,508 complete patient responses were obtained. Most patients (74%) indicated they had been transported in an ambulance on at least one occasion before the incident for which they were being surveyed. Patients who had been transported previously reported higher levels of satisfaction in all categories measured. However, the categorical differences were minimal, with only patient perception of 9-1-1 call-taker professionalism demonstrating a statistically significant difference c2 (3, n=1,508)=8.930, p=.03. The top box score (very satisfied) of those having prior transport experience was 45%, compared to 37% for those who had never been transported via ambulance.

Conclusion—Despite potential limitations of homogeneity within our sample, these results still provide a meaningful context for the interpretation of our patient satisfaction data. These results also contribute to a void in the literature specific to patient satisfaction in the context of value-related characteristics of EMS.

Work-Related Burnout Is Associated With Higher Odds of Turnover Intention, Sickness Absence, and Injury in EMS

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Introduction—Work-related burnout is associated with higher odds of turnover intention, sickness absence, and injury in EMS. EMS professionals frequently encounter high-risk, high-stress, and emotionally demanding situations that could increase risk of occupational burnout. Few studies have explored potential negative outcomes related to burnout in EMS.

Objective—To assess the relationship between work-related burnout and sickness absence, turnover intentions, and occupational injury in EMS.

Methods—The study used a cross-sectional analysis using an electronic survey administered to all licensed, practicing EMS professionals in South Carolina. Work-related burnout was measured using the Copenhagen Burnout Inventory. Generalized estimating equations with robust standard error estimates were used to account for clustering at the EMS agency level and control for confounding variables. Confounding variables were identified using directed acyclic graphs and included age, sex, full-time employment status, certification level, and years of EMS experience. Sickness absence, intent to leave EMS, and occupational injury were self-reported. High sickness absence was defined as more than 10 days over the most recent 12 months based on data from the Bureau of Labor Statistics. A nonresponder survey was conducted.

Results—Of 8,059 surveys sent out, 1,490 were returned (19%). After excluding emergency medical responders and those who had not provided patient care in the last 30 days, 1,271 were included in the analysis. More than one third (38%) were experiencing work-related burnout. Odds of high sickness absence were 83% higher for those experiencing burnout (OR 1.83; 95% CI, 1.01–3.32). There was more than a fourfold increase in odds of intending to leave the profession within the next 12 months for those with burnout (OR 4.12; 95% CI, 2.84–6.00). Work-related burnout was associated with more than a twofold increase in odds of having suffered an injury in the past 12 months (OR 2.60; 95% CI, 2.02–3.33). No differences were detected between responders and nonresponders in terms of work-related burnout.

Conclusion—Burnout among EMS professionals was associated with increased odds of sickness absence, turnover intentions, and occupational injury. Nevertheless, causality cannot be inferred from these cross-sectional data.

Continuing Education Improves Performance on the International Paramedic Registry Cognitive Exam in Latin-American Countries

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Introduction—Latin-American countries have varying educational processes for medical care professionals. A review of the literature revealed the common types of continuing education included repetitive task training and face-to-face programs. The International Paramedic Registry (IPR) cognitive exam provides data to understand the level of knowledge in all areas of prehospital medicine throughout Latin America.

Objective—To understand if CE is the variable that differentiates the results of the IPR cognitive exam.

Methods—A total of 507 participants attempted the IPR cognitive exam in Spanish. A subsample of 183 (36.23%) from Mexico, Colombia, and Panama was considered for analysis (listwise deletion was used to remove cases with incomplete data). CE was defined as any education post-graduation.

Results—The mean score of the IPR test was 56.72% (SD=8.4), stratifying data by level of education. An ANOVA test showed a nonsignificant difference between level of education and IPR test global score (p=0.236). Analyzing by area of knowledge, the data show a significant difference in the pediatric area score (p=0.013) between providers who graduated with a bachelor's degree or three years of university education. In the analysis of CE hours, 50.3% had fewer than 100 hours, 26.8% 100–500 hours, 12.6% 500–1,000 hours, 2.7% 1,000—1,500 hours, 2.7% 1,500—2,000 hours, and 4.9 % 2,000 hours or more. The data of students receiving fewer than 1,000 hours of CE represented 89.6% of the sample. An ANOVA test showed a significant difference between CE hours and score in IPR test (p=0.019). A post-hoc Tukey test located an improvement in IPR scores among the group having 100–500 hours (p=0.022) of CE.

Conclusion—This study showed no significant difference between level of CE and IPR exam score. Providers with fewer than 500 hours of lifetime CE performed significantly better on an international cognitive exam. More research is needed to determine the amount and types of education of EMS providers in Latin America.

The Effects of Cellular Coverage on Patient Survival in the Rural Setting

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Introduction—Cellular coverage is an essential element that contributes to the success of communication among patients, emergency dispatch centers, and first responders. Coverage is

substantially limited and unreliable in rural regions compared to urban centers. Cellular telephones have largely replaced traditional landlines, with fewer than 40% of households with a dedicated landline telephone. Given the time-sensitive nature of EMS calls, this puts residents of rural communities at a disadvantage in regard to prehospital treatment and ultimate survival of cardiac arrest events. Patients in poor cellular coverage areas may be at an increased risk of death-on-arrival (DOA) status on arrival of EMS.

Objective—To review the effects of cellular coverage on DOA status on arrival of EMS.

Methods—A medium-size rural North Carolina county (located within a metropolitan statistical area) reported EMS call data from January 2015 through December 2017. Patients with a primary dispatch disposition of "cardiac arrest" were included. Multivariate logistic regression with time-fixed effects was conducted. Control variables included mean age, sex proportion, minority proportion, poverty rate, and median home price at the zip code level. To quantify cellular coverage, GIS (geographic information system) analyses were performed on publicly available cellular coverage maps and grouped into four categories: excellent, above average, below average, and poor.

Results—There were 532 cardiac arrest patients who met inclusionary criteria, with a DOA of EMS rate of 37%. Overall 21% of patients were located in areas with excellent cellular coverage and 29% in poor cellular coverage areas. Statistical analysis revealed a negative correlation between cellular coverage and DOA status. Patients in poor coverage areas were 64% more likely to be DOA (OR 1.6409; 95% CI, 0.3614–1.0276, p=0.063) than those in an excellent coverage area. This finding is statistically significant at a 10% alpha level.

Conclusion—Cardiac arrest is an incredibly time-sensitive condition, and patient survival is highly dependent on how quickly treatment arrives. Rural areas, such as the county in this study, disproportionately experience limited cellular coverage. The results of this study show that patients in rural areas are at an unnecessarily increased risk of cardiac arrest death prior to arrival of EMS. Further study is needed to expand the geographic area of analysis and drive policy change within the telecommunications sector.

Evaluation of Workplace Violence in the Prehospital Environment

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Introduction—The threat of physical or verbal assault while in the field is high for EMS and first responders. This study focused on EMS' and first responders' opinions on workplace violence.

Objective—To understand EMS professionals' opinions about workplace violence.

Methods—This retrospective observational study examined all responses obtained via a questionnaire that was built using Lime Survey, an online open-source survey software. The survey was distributed via multiple listservs for EMS and first responders operating in North Carolina in June 2018. The survey questions were structured to gauge both the frequency with which people experienced workplace violence and the likelihood they would document these experiences if a reporting portal were available. Answers were reported on a five-point Likert scale.

Results—A total of 1,203 respondents completed this survey. Overall, 54.78% reported they had physical violence directed at them within the last 24 months, and further categorized the type of assault experienced as verbal (26.85%), physical (8.48%), or both (35.41%). When asked if they felt safe while working, 22.22% reported not feeling safe, 33.86% were neutral, and 34.20% reported feeling safe. Regarding the likelihood of being injured by a patient while working during the next six months, 25.29% did not think there was a chance, 24.96% were neutral, and 39.98% thought there was a chance.

Conclusion—Workplace violence is a serious issue that should be addressed in order to ensure the safety of EMS and first responders in the field. The results of the survey show that many see the potential for violence as a valid threat to personal safety and, given the opportunity, would use a reporting portal to document these instances.

Characteristics of EMS Transport Refusal Following Glucose or Naloxone Administration

Author: Jeffrey Jarvis, MD, MS, EMT-P
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Introduction—EMS responses resulting in transport refusal are of interest due to clinical outcome, liability, and financial risks. Treat-and-release protocols are being increasingly developed for hypoglycemia and opioid overdose. Scant literature exists comparing the characteristics of refusals between patients given naloxone, glucose, or neither medication.

Objective—To describe the characteristics of transport refusal among patients who received glucose, naloxone, or neither medication.

Methods—Using 2017 data from the ESO Solutions national database, a retrospective analysis of all 9-1-1 responses with patient contact was conducted. The outcome was transport refusal. Patients were classified as having received naloxone,

glucose, or neither. Multivariable logistic regression was used to control for other covariates including response characteristics (time of day, day of week), agency characteristics (type, volunteer status), and patient characteristics (age, gender, race/ethnicity). Adjusted odds ratios and 95% confidence intervals are reported.

Results—There were 1,219 patients excluded because they received naloxone and glucose, leaving 2,778,921 records. Overall, 399,766 (14%) resulted in transport refusal; 2,838 (7%) of those given naloxone refused, 16,548 (39%) given glucose refused, and 380,380 (14%) given neither drug refused (p<0.001). Of patients given naloxone, 60% were male, compared to 53% for glucose and 46% for neither (p<0.001). More patients receiving naloxone were white, non-Hispanic (80%) compared to those given glucose (67%) or neither (71%) (p<0.001). About half (47%) of those given naloxone were 18–39 years old, compared to 14% of those given glucose and 22% of those given neither. After controlling for patient, agency, and response characteristics, odds of nontransport for patients given glucose were more than fourfold higher (aOR 4.67; 95% CI, 4.57–4.77) and odds of nontransport for patients given naloxone were 54% lower (aOR 0.46; 95% CI, 0.44–0.48) compared to patients given neither.

Conclusion—In this large multiagency sample of EMS patient contacts, transport refusal rates were higher for those given glucose and lower for those given naloxone compared with those given neither. Patients given naloxone tended to be younger, male, and white, non-Hispanic. Limitations include retrospective analysis and use of data from a single ePCR vendor.

First-Pass Success Rates of Out-Of-Hospital Advanced Airway Management in Adults and Children

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Introduction—Prehospital advanced airway management (AAM, including endotracheal intubation [ETI] and supraglottic airway insertion [SGA]) of children is difficult. Multiple AAM attempts are associated with increased adverse events.

Objective—To compare advanced airway management first-pass success (FPS) rates between adults and children in a national cohort of EMS agencies.

Methods—The study reviewed 2017 clinical data from the ESO Solutions national database encompassing more than 2,000 EMS agencies. Subjects were all patients receiving any AAM attempts. FPS was self-reported. Using multivariable logistic regression, we compared the odds of ETI FPS between adults (age 14 years or more) and children (age less than 14 years), adjusting for gender, ethnicity, primary impression, and drug facilitation. The analysis was repeated for SGA FPS. First-pass success rates between pediatric age subsets (less than 1 year, 1–5 years, 6–10 years, 11–14 years) were also compared.

Results—During the one-year period, 731 EMS agencies attempted AAM on 29,369 patients (median=18 per agency, IQR 6, 43), including 28,846 (98.2%) adults and 523 (1.8%) children. Most AAM were ETI: adults 22,049 (76.4%) and children 471 (90.1%). Most patients were white (65%), male (60.5%), and underwent AAM for cardiac arrest (67.3%). ETI FPS was lower in children than adults (58.6% vs. 72.7%; OR 0.56; 95% CI, 0.46–0.68; p<0.001). SGA FPS was similar between children and adults (84.6% vs. 89.8%; OR 0.62; 95% CI, 0.30–1.43, p=0.31). Among children ETI FPS was higher with increasing age: less than 1 year 55.7% (42.4%–68.5%), 1 to less than 6 years 54.8% (48.9%–60.7%), 6 to less than 10 years 62.7% (48.1%–75.9%), 10 to less than 14 years 73.5% (61.4%–83.5%, p<0.001). Among children SGA FPS was not associated with increasing age group: less than 1 80.0% (28.4%–99.5%), 1 to less than 6 95.2% (76.2%–99.9%), 6 to less than 10 57.1% (18.4%–90.1%), and 10 to less than 14 84.2% (60.4%–96.6%, p=0.44).

Conclusion—ETI FPS is lower in children than adults. SGA FPS does not differ between children and adults.

Response, Agency, and Patient Characteristics Associated With EMS Transport Rates

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Introduction—The EMS 9-1-1 transport rate has important implications for current reimbursement practices and risks of negative outcomes related to nontransport. Little research exists regarding factors linked to EMS transport rate for 9-1-1 response.

Objective—To identify response, agency, and patient characteristics associated with EMS transport rates.

Methods—A retrospective analysis used all 9-1-1 responses with patient contact in 2017 in the ESO Solutions national database. Agencies without transport capability were excluded. Independent variables of interest were identified *a priori*: agency type, agency volunteer status, time of day, day of week, patient sex, patient race/ethnicity, and patient age. Multivariable logistic regression modeling was used to assess for an association between the independent variables and EMS transport. Adjusted odds ratios and 95% confidence intervals are reported.

Results—We analyzed 2,786,615 records; 85% resulted in EMS transports by more than 900 agencies. Compared to third-service agencies, private agencies demonstrated 80% greater odds of transporting (aOR 1.80; 95% CI, 1.78–1.84). Compared to nonvolunteer agencies, volunteer agencies had 31% increased odds of transport (aOR 1.31; 95% CI, 1.26–1.36). Hispanic patients

had 26% decreased odds of transport compared to non-Hispanic white patients (aOR 0.74; 95% CI: 0.73–0.75). Compared to patients aged 18–39, older patients had progressively greater odds of transport with each age group, the largest aOR being 2.62 (95% CI, 2.59–2.65) for those older than 79 years. Patients younger than 18 years had lower odds of transport (aOR 0.74; 95% CI, 0.73–0.75). Compared to calls occurring between 7 a.m. and 3 p.m., odds of transport were lower between 3 p.m. and 11 p.m. (aOR 0.83; 95% CI, 0.83–0.85) and between 11 p.m. and 7 a.m. (aOR 0.88; 95% CI, 0.87–0.88). Smaller differences in transport rates, likely not clinically significant, were seen for sex, day of week, and fire-based agencies.

Conclusion—This analysis encompassing a broad range of EMS systems in various practice settings identified differences in transport rates by agency characteristics, time of day, patient race/ethnicity, and age. Further work is needed to elucidate the underlying causes of these differences for each variable. Limitations include information bias due to documentation practices and potential selection bias from analyzing a single PCR provider.

Prehospital Use of Ketamine, Morphine, or Fentanyl for the Management of Acute Pain Following Traumatic Injury

Author: Jeffrey Jarvis, MD, MS, EMT-P
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Introduction—Ketamine has shown equivalent analgesia when compared to morphine and fentanyl in hospitalized patients.

Objective—To compare the analgesic effects of low-dose ketamine, fentanyl, and morphine in the treatment of acute, traumatic pain in the prehospital setting.

Methods—Using data from the ESO Solutions national database, we performed a retrospective chart review on all 9-1-1 calls answered by 883 EMS agencies between Jan. 5, 2017, and Dec. 31, 2017, in which patients were treated with ketamine, fentanyl, or morphine following traumatic injury. Patients included were greater than 12 years old, had pain of traumatic etiology, an initial pain score of more than 5, at least one subsequent pain score, and administration of either low-dose ketamine, fentanyl, or morphine. Due to poor weight documentation, low-dose ketamine was defined as less than 70 mg parenterally. The primary outcome measure was differences in the proportion of patients in each group with a clinically significant reduction in pain, defined as a decrease of more than 1.3 points on the numeric rating scale. A chi-square test on the binomial proportion of pain reduction was performed and changes in Glasgow Coma Scale, pulse oximetry, end-tidal CO2, systolic blood pressure, heart rate, and respiratory rate following therapy are discussed.

Results—Of 35,906 patients who met inclusion criteria, 28,738 (80.0%) received fentanyl, 6,534 (18.2%) morphine, and 634 (1.8%) ketamine. The following showed a clinically significant reduction in pain: 84.8% in the ketamine group, 85.8% in the fentanyl group, and 83.6% in the morphine group. There was no significant difference in pain when the ketamine group was compared to either the fentanyl group or the morphine group, but fentanyl was associated with clinically significant reduction in pain compared to morphine ($p<0.0001$). The median single dose of ketamine was 15 mg, fentanyl 50 mcg, and morphine 4 mg.

Conclusion—In the prehospital setting ketamine, compared to fentanyl and morphine, was associated with an equivalent proportion of patients with significant pain reduction. Fentanyl, compared to morphine, was associated with a larger proportion of patients with significant pain reduction. Limitations include an inability to calculate weight-based doses and the possibility of underdosing of morphine.

EMS Can Safely Predict Large Vessel Occlusions

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Introduction—Patients with large vessel occlusion (LVO) strokes or significant intracranial hemorrhage (ICH) are better served by direct transport to a hospital with endovascular thrombectomy and neurosurgical capabilities. The VAN scale (visual, aphasia, and neglect) is a new screening tool focusing on early emergency department LVO prediction.

Objective—To examine the effectiveness of early VAN scale use in the prehospital setting primarily for LVO.

Methods—EMS personnel in a hospital-based 9-1-1 service were trained for three months before VAN use. After implementation a VAN stroke evaluation was required for any patient who met the Cincinnati Stroke Scale criteria for arm drift. Through the hospital's quality improvement process, data were obtained for all patients who tested positive for new or worsening CSS arm drift and were transported to a specific primary stroke center. Patient outcomes were obtained through manual chart review.

Results—From July 2017 to January 2018, all 105 prehospital code stroke activations transported to the stroke center were included for the study. Of these 105 patients, 61 (58%) were VAN-positive as determined by the EMS paramedic on scene. Twelve (19.6%) of the VAN-positive patients were later diagnosed with an LVO through CTA imaging. Eight (7.6%) of the VAN-positive patients were diagnosed with a significant ICH causing cerebral dysfunction. No patient had both an LVO and ICH before hospital intervention. One patient (1.6%) was missed by the VAN tool. For LVO alone the VAN scale showed sensitivity

of 0.92, specificity of 0.52, and diagnostic accuracy of 0.61. When the VAN screening tool was expanded to predict either an LVO or significant ICH, it showed sensitivity of 0.95, specificity of 0.63, and diagnostic accuracy of 0.74.

Conclusion—For the prehospital setting, the study suggests that by expanding the VAN screening tool's application to include both LVO or ICH, it offered a high degree of accuracy when deciding which patients would directly benefit with transport to a facility that includes endovascular thrombectomy or neurosurgical interventions.

Community Paramedic Partnership: Impact on Healthcare Utilization of Partnership Between a Municipal Fire/EMS Agency and the Local Level I Trauma Center

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Introduction—A public-private partnership between a Level I trauma center and an urban, municipal fire/EMS department for patients discharged from the hospital with an acute exacerbation of congestive heart failure (CHF) was launched in 2014. This program aimed to improve healthcare utilization and reduce readmissions through a unique community paramedic partnership.

Objective—To quantify the impact of a postdischarge community paramedic program on the rates of healthcare utilization during the 90 days and 180 days following hospitalization for patients admitted with an acute CHF exacerbation.

Methods—Inpatients with CHF were offered visits by a community paramedic for up to 30 days postdischarge. Inclusion criteria included local residency, no home-care services at discharge, diagnosis of CHF, English-speaking, and consent to home visits by a community paramedic. The community paramedic visited the patient in the home 1 to 2 times per week for four weeks following discharge. At each visit the paramedic conducted medication reconciliation, a physical exam, home safety evaluation, coordination of follow-up care and referral to additional resources as needed. Healthcare utilization was analyzed descriptively using means and standard deviations and was compared to a control population not receiving community paramedic visits using Wilcoxon rank sum tests.

Results—During the study period of February 2015 through June 2018, 115 patients were enrolled. As of July 2018 50 had completed the program and had complete data. When compared to control patients, community paramedic patients had fewer hospital admissions during the 90 days (p=0.265) and 180 days (p=0.0311) following completion of paramedic visits. There was no difference in emergency department visits at 90 days; however, patients in the community paramedic program had significantly fewer visits in the 180 days following community paramedic visit completion (p=0.0486). Though in general clinic visits were lower in the community paramedic group, there was no statistically significant difference in clinic visits during the 90 and 180 days following completion of community paramedic visits between the two groups.

Conclusion—Partnership between a fire/EMS department and a Level I trauma center for a community paramedic program can be successful. Community paramedics providing postdischarge care could result in reduced admissions/ED visits.

Epinephrine vs. Defibrillation: Does Operational Order Matter in Out-of-Hospital Cardiac Arrest?

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Introduction—The administration of both vasopressors and defibrillation has been shown to increase the rate of return of spontaneous circulation (ROSC) in out-of-hospital cardiac arrest (OHCA).

Objective—To determine the significance of operational order (the first chronological intervention of either a vasopressor or defibrillation) of vasopressors and defibrillation in OHCA.

Methods—A retrospective study of OHCA patients was conducted using data from the Prehospital Medical Information System (PreMIS) from Jan. 1, 2012, to June 30, 2014. Included were adult patients with a witnessed arrest who presented in a shockable rhythm. Patients were excluded if the etiology of their arrest was drowning, electrocution, trauma, or unknown. A chi-square test was used to evaluate the direct relationship between operational order and ROSC. A logistic regression was used to identify predictors of ROSC after controlling for confounders.

Results—A total of 736 patients were evaluated within the studied timeframe. Of those, 556 patients (75.5%) were male, 164 patients (22.3%) were minorities, and mean age was 62.79 (ffl14.29) years. ROSC occurred in 401 patients (54.5%), and 352 patients (47.8%) received lay person CPR. A total of 181 patients (24.9%) received a vasopressor first. A chi-square of the relationship between the operational order of first-line treatment and the influence on ROSC was not significant (p=0.239). A logistic regression model showed operational order was not significant (OR 0.836, p=0.31) when controlling for other OHCA-related factors.

Conclusion—No significant relationship existed between the operational order of first-line treatment and ROSC. A higher-than-expected proportion of patients in the sample received vasopressors as first-line treatment despite best practice-based protocols as determined by the American Heart Association.

Impedance Threshold Devices and Mechanical CPR in Out-of-Hospital Cardiac Arrest: Does Any Combination Increase ROSC?

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Introduction—Impedance threshold devices (ITDs) have been used in the treatment of out-of-hospital cardiac arrest (OHCA) by increasing circulation through negative pressurization during CPR. Mechanical CPR (mCPR) devices have also seen increased usage, despite questionable utility. Few studies have examined the concurrent use of both adjuncts in OHCA.

Objective—To determine whether the use of an ITD coupled with either mechanical or manual CPR during the management of an OHCA increases the probability of return of spontaneous circulation (ROSC).

Methods—A retrospective analysis of OHCA patients from July 2012 to June 2014 was conducted using data from the North Carolina Prehospital Medical Information System (PreMIS). Patients greater than 18 years old who suffered an OHCA before or after EMS arrival were included. Descriptive statistics were used to analyze the overall sample, while logistic regression was used to analyze the relationship between ROSC and combinations of receipt of an ITD and type of CPR (mechanical vs. manual), while controlling for potential confounders.

Results—A total of 15,395 patients met inclusion criteria, of which 9,241 (60.03%) were male; 10,507 (68.24%) were Caucasian; 5,947 (38.62%) received bystander CPR; 2,802 (18.2%) had a shockable presenting rhythm; and 5,832 (37.88%) achieved ROSC. ROSC was three times more likely in patients with shockable presenting rhythms (OR 3.00, p<0.001) and 2.17 times more likely with the receipt of lay person and/or first responder CPR (OR 2.17, p<0.001). The odds of ROSC were 19% less likely with males (OR 0.81, p<0.001) and 35% and 29% less likely with the provision of mCPR with (OR 0.65, p<0.001) or without (OR 0.71, p=0.007) the use of an ITD respectively. Patient age and use of standard CPR in conjunction with an ITD were not statistically significant in this cohort.

Conclusion—The achievement of ROSC was shown to be less likely in patients who received mCPR with or without the use of an ITD. As has been seen in previous studies, patients in this cohort directly benefited from the provision of lay person and/or first responder CPR and were twice as likely to achieve ROSC when presenting in an initially shockable rhythm. These results might be useful for EMS resource allocation.

Effect of Time of Day and EMS Performance Criteria on the Odds of Return of Spontaneous Circulation for Out-of-Hospital Cardiac Arrest

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Introduction—Time of day might affect the expediency with which out-of-hospital cardiac arrest (OHCA) patients receive critical interventions. EMS professionals working extended shifts might be less likely to perform skills in a timely manner, and this delay in treatment might reduce the odds of achieving return of spontaneous circulation (ROSC) in the prehospital setting.

Objective—To analyze time-of-day variation in the likelihood of attaining ROSC.

Methods—A retrospective analysis of cardiac arrest patient records in the North Carolina Prehospital Medical Information System (PreMIS) database was conducted. Included were OHCAs occurring in adults between Jan. 1, 2012, and June 30, 2014. Excluded were traumatic arrests, unwitnessed arrests, arrests with on-scene termination of efforts, and records missing demographic or treatment variables. Time of day was stratified into morning (0700–1459), afternoon (1500–2259), and night (2300–0659) shifts. A logistic regression model for ROSC was fitted using time of day (referent=morning), demographic, and treatment variables as predictors.

Results—This study analyzed a total of 8,779 cardiac arrest patients, of whom 2,889 (32.9%) achieved ROSC in the field. The proportions of patients attaining ROSC were 33.8%, 35.2%, and 27.6% for morning, afternoon, and night respectively. In comparison to patients experiencing cardiac arrest during the morning hours, patients arresting at night were less likely to attain ROSC (OR 0.804, p=0.00) while arrests occurring during the afternoon were not statistically different from morning arrests (OR 0.939, p=0.26). Females (OR 1.33, p=0.00), patients with shockable presenting rhythms (OR 2.64, p=0.00), and patients receiving bystander CPR (OR 1.90, p=0.00) were more likely to attain ROSC. Each additional year of age (OR 0.996, p=0.00), unwitnessed arrests (OR 0.313, p=0.00), and each additional minute of EMS response time (OR 0.964, p=0.00) reduced the likelihood of ROSC.

Conclusion—Within the limitations of the study design, patients experiencing cardiac arrest at night were 20% less likely to attain ROSC after controlling for other confounding variables.

Effect of County Poverty Ratio on ROSC in OHCA: A Statewide Analysis

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Introduction—It is well established that factors such as age, race, gender, urbanicity, and socioeconomic status affect survival in out-of-hospital cardiac arrest (OHCA). However, extant research has not studied the effect of a locale's poverty ratio on the return of spontaneous circulation (ROSC) in OHCA.

Objective—To examine the effect of county poverty ratio on the likelihood of achieving ROSC in OHCA for a mixed urban, suburban, and rural state.

Methods—A retrospective study of OHCA was conducted using a statewide EMS patient database. All adult, nontraumatic arrests in North Carolina between Jan. 1, 2012, and June 30, 2014, were included. Data from the U.S. Census Bureau's Small Area Income and Poverty Estimates (SAIPE) program were used to determine the 2012 poverty rate for each of North Carolina's 100 counties. A logistic regression model was then used to quantify the influence of poverty ratio on ROSC while controlling for other patient demographics and EMS response variables.

Results—A total of 7,280 patients met inclusion criteria. Overall ROSC was achieved in 2,810 (39%) patients. For every 1% increase in the poverty rate, patients were 4.1% less likely to achieve ROSC (OR 0.959, $p<0.001$). Male patients were 29% less likely to achieve ROSC (OR 0.71, $p<0.01$). Additionally, for every minute increase in EMS response time, ROSC was 2.9% less likely to be achieved (OR 0.971, $p<0.01$). ROSC was more likely achieved by receiving lay person or first responder CPR prior to EMS arrival (OR 1.29, $p<0.001$), in arrests witnessed by a bystander (OR 2.40, $p<0.001$) or healthcare provider (OR 2.70, $p<0.001$), and with an initial shockable rhythm (OR 1.29, $p<0.001$). Age (OR 1.001, $p=0.702$) and minority status (OR 0.894, $p=0.053$) were not significant predictors.

Conclusion—In this retrospective analysis, patients were more likely to achieve ROSC based on their county's poverty ratio, gender, receipt of CPR prior to EMS arrival, witnessed arrest, and initial shockable rhythm. Further study of this relationship in a variety of geographical settings is needed to better understand potential inequities of ROSC achievement.

Does Prehospital Treatment of Significantly Injured Trauma Patients Vary by Age?

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Introduction—Research has explored the frequency and success of attempted interventions within patient age groups. Yet available research fails to compare attempted interventions between patient age groups who have a similar acuity. Additional research is needed to compare interventions used among patient age groups.

Objectives—To determine the frequency with which prehospital providers attempt interventions in significantly injured trauma patients across all age groups.

Methods—A retrospective observational study of trauma patients was conducted using the North Carolina Prehospital Reporting System (PreMIS) data from July 1, 2012, to Dec. 31, 2012. Inclusion criteria consisted of patients with a Glasgow Coma Score of 10 or less. Trauma patients were divided into adult (17–65 years), pediatric (0–16 years), and geriatric (65 years or more). Logistic regressions were used to calculate the odds ratios for advanced airway and vascular access attempts controlling for specified age groups, gender, minority status, and patient acuity as determined by GCS and the revised trauma score. Additionally, a linear regression was used to determine the effects of age groups, gender, minority status, and acuity on total prehospital on-scene time.

Results—A total of 1,192 patients met the inclusion criteria, of which 888 (74.6%) were adult, 53 (4.4%) pediatric, and 250 (21%) geriatric. Advanced airway attempts were not statistically significant for pediatric or geriatric patients when compared to adults. Vascular access attempts were less likely in geriatric patients (OR 0.40, $p=0.00$). Males were more likely to receive an advanced airway (OR 2.12, $p=0.00$) or vascular access attempt (OR 1.34, $p=0.04$). Minorities were less likely to receive a vascular access attempt (OR 0.61, $p=0.01$). As GCS and RTS scores increased, the airway (OR 0.81, $p=0.00$; OR 0.71, $p=0.00$) attempts decreased. As GCS scores increased, the vascular access (OR 0.91, $p=0.01$) attempts decreased. Age, gender, and RTS were nonsignificant for total on-scene time. EMS personnel spent less time on scene with minorities ($\beta=-2.12$, $p=0.04$).

Conclusion—This study found disparities in procedure attempts in the geriatric population and on-scene times among minorities. Additional investigation is warranted to determine the rationale for these disparities.

Can a Community Paramedic Reduce Hospital 30-Day Readmissions for Patients Discharged With a Diagnosis of CHF?

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Introduction—In some systems community paramedics conduct home visits for recently hospitalized patients. The effectiveness of these visits in reducing readmissions in patients with heart failure was examined.

Objective—To understand if a home visit by a community paramedic can reduce 30-day hospital readmissions for patients discharged with a diagnosis of congestive heart failure (CHF).

Methods—A firefighter/CP assigned to an urban/suburban community hospital evaluated CHF patients in the hospital and again at home 48 hours following hospital discharge, along with a wellness telephone call after the visit. Thirty-day readmission data were obtained. IRB approval was obtained for both the baseline data and postinterventional phases of this study.

Results—During the study period, 154 patients were consented, and 107 received a CP home visit and wellness phone call; readmission data were obtained for 103 (96%). There were 16 (16%) readmissions: 1 at more than 30 days, and 1 patient died in less than 30 days, resulting in a study population of 101. The overall less-than-30-day readmission rate for CHF patients with an intervention by a CP was 14/101 (14%). Of the 14 readmissions at less than 30 days, 5 (36%) were CHF-related and 9 (64%) were for other causes. During the year prior to this study, the CHF less-than-30-day readmission rate was 24%.

Conclusion—In this study a CP was able to reduce overall less-than-30-day CHF patient readmission rates by more than 42%.

EMT-Basic and Paramedics-Performed Simulated Pediatric Anaphylaxis—Standard Syringe / Color-Coded Syringe / Epi Auto-injector

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Introduction—Onset of anaphylaxis requires prompt treatment with an intramuscular injection of epinephrine. Much of the rural public is only served by EMTs. Autoinjectors are typically the only mechanism within the EMT scope of practice. Autoinjectors have recently become prohibitively expensive and only provide discrete doses. A color-coded syringe (CCS) that corresponds to a pediatric tape-based dosing system might provide a facile EMT "check and inject" mechanism.

Objective—To determine if EMTs would perform equally to paramedics in the administration of epinephrine using three delivery devices: EpiPen, standard syringe (SS), or CCS.

Methods—This was a randomized three-period, three-sequence, three-treatment repeated-measures full-consent crossover study of the EpiPen (standard and EpiPen Jr), SS, and CCS. Participants were educated on all three delivery mechanisms by a member of the study staff. The subjects were randomly assigned a training manikin to simulate either a 6-month-old or 8-year-old child. The administration order was randomized, and each participant delivered three doses of epinephrine to the assigned manikin. Study staff visualized each dose before administration. Dosing errors and critical dosing errors were documented.

Results—The study recruited 12 EMTs and 12 paramedics. There was no difference in age or experience between the EMTs and paramedics: 39 vs. 41 years old, and 13 plus/minus 8 vs. 15 plus/minus 6 years of experience, respectively. In all cases subjects using the CCS administered the epinephrine dose closest to the expected dose of the SS or autoinjector. The autoinjector uniformly overdosed the 6-month-old by a factor of more than 2, and the SS had the highest degree of deviation from expected. There was no difference between EMT and paramedic with respect to the dosage delivered by any device. Five autoinjector administrations had to be excluded due to early removal. There was no difference between EMTs and paramedics on the number of dose errors.

Conclusion—EMTs performed equally to paramedics in the delivery of epinephrine to a child, and both performed best using a color-coded syringe versus standard syringe or auto injector.

Deployment of Low-Titer O-Positive Whole Blood in the Prehospital Environment

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Introduction—Trauma patients bleed whole blood. Over the last three decades trauma patients requiring resuscitation have typically received blood component therapy: red blood cells, primarily, although recently plasma and platelets have been added in a 1:1:1 ratio. Blood-based resuscitation is within the scope of very few prehospital providers. Providing transfusion at the point of injury has resulted in improved clinical outcomes.

Objective—To examine the deployment of low-titer O-positive whole blood (LTOWB) to the prehospital environment.

Methods—The Southwest Texas Regional Advisory Council for Trauma led a multidisciplinary, multi-institutional regional prehospital LTOWB program in Southwest Texas. The program capitalized on existing rural air-medical capabilities and two adult Level I trauma centers (one county-based and one military). Protocols developed by the Army Blood Program for LTOWB were adopted by the South Texas Blood and Tissue Center, which in turn established a donor recruitment program (Brothers in Arms)

to meet the needs for sustainability of a large regional LTOWB program. Healthcare providers were trained on administration of LTOWB. In an effort to minimize wastage and maximize use, a system for cycling product to the county-based Level I trauma center was established.

Results—The LTOWB rollout to 14 rural and urban air-medical bases began in January 2018. There have been several documented uses of LTOWB under this program; outcomes appear favorable initially. To date no complications have occurred, and zero LTOWB has been wasted due to cycling prehospital units into the Level I trauma center three weeks before expiration. Five additional air-medical bases outside of the original program participants have begun carrying LTOWB. A large urban ground EMS agency in the region anticipates deployment of LTOWB by special operations and supervisor vehicles as part of systemwide program expansion.

Conclusion—A robust whole blood program required the integration and collaboration of an interdisciplinary stakeholder team to provide clinical and administrative education, cold chain management, and donor sustainability; and ensure product accessibility and prudent utilization. The LTOWB program identified necessary infrastructure to scale to additional prehospital platforms and other trauma systems in order to improve clinical outcomes for trauma.

An Assessment of the Use of Spine Immobilization by EMS Professionals in South Carolina

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Introduction—The National Association of EMS Physicians and American College of Surgeons Committee on Trauma state that use of backboards for prehospital spinal immobilization (SI) should be considered only when potential benefits outweigh risks.

Objective—To identify factors related to prehospital SI for trauma patients in South Carolina.

Methods—This retrospective observational study examined all 2016 9-1-1 EMS trauma calls in South Carolina. Study data were obtained from the South Carolina EMS data system. Independent variables included whether the patient met the 2011 Centers for Disease Control and Prevention (CDC) criteria for transport to a trauma center, community size, and patient age, gender, and race. Patient age in years was categorized as 1 or below, greater than 1–7, 8–17, 18—54, and 55 or more. Race was categorized as white (referent group), black, or other. Univariate and multivariable logistic regression modeling was performed.

Results—In 2016 there were 135,902 trauma calls in South Carolina. SI was performed on 24,699 (18.2%). There were 3,341 (2.5%) trauma patients who met CDC criteria; all had SI performed. Among patients who did not meet CDC criteria, 21,358 (16.1%) had SI performed. CDC criteria predicted SI perfectly; therefore, it was omitted from logistic regression analysis. Univariate analyses revealed significant ($p<0.05$) relationships between SI and all independent variables. These relationships remained significant after multivariable modeling. Urban patients had decreased odds of SI (OR 0.79; 95% CI, 0.77–0.82, $p<0.001$). African-Americans had decreased odds of SI (OR 0.97; 95% CI, 0.94–0.99, $p=0.03$). No difference was noted among other races (OR 1.05; 95% CI, 0.96–1.13, $p=0.28$). Males had increased odds of SI (OR 1.28; 95% CI, 1.24–1.31, $p<0.001$). All age groups had decreased odds of SI when compared to those 18–54 and 1 and below (OR 0.25; 95% CI, 0.19–0.33, $p<0.001$), 1–7 (OR 0.35; 95% CI, 0.31–0.40, $p<0.001$), 8–17 (OR 0.89; 95% CI, 0.84–0.95, $p<0.001$), and 55 or more (OR 0.54; 95% CI, 0.52–0.55, $p<0.001$) The multivariate logistic model demonstrated good fit ($p=0.43$).

Conclusion—EMS professionals in South Carolina appear to be considering risks and benefits of SI. All those who met the CDC criteria for transport to a trauma center had SI. Younger and senior patients were much less likely to have SI.

Using Telehealth and Alternative Transportation for Nonurgent EMS Care

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Introduction—The use of telehealth in prehospital emergency medical services has historically been limited to small pilot studies or specific emergent conditions, such as stroke and acute cardiovascular care.

Objective—To analyze the impact of telehealth on agency operational efficiency.

Methods—A prospective case-control study design was used to assess the effect of using telehealth technology on two dependent variables: percent of patients transported by ambulance and cost-effectiveness. The intervention procedures consisted of telehealth technology with field-based videoconferencing between the patient and a board-certified emergency medicine physician, which guided disposition (i.e., ED or clinic) and transportation (i.e., ambulance or taxi) decisions. Inclusion criteria were adults with low-acuity, nonurgent complaints. Mean differences were calculated between the intervention cases and a control group consisting of all similar complaint codes during a 36-month period (2015–2017). Resource utilization was measured from the agency perspec-

tive, and cost-effectiveness ratios were calculated for all fixed and variable costs. T-tests were used to analyze univariate differences between groups.

Results—There were 15,065 patients in the intervention group. The subjects were majority female (53%), 44.1 years old (+/-19), and black/African-American (56.3%). There was a statistically significant 76% difference in the frequency of ambulance transports between the case and control groups (11% intervention, 47% control, p<0.001). Use of lower-cost taxi transportation was offered instead of ambulance transport. After all technology, operational, personnel, vehicle, and indirect costs were measured, cost-effectiveness analyses showed a $103 mean difference per encounter ($270 intervention vs. $167 control, p<0.001). Total agency cost savings for this sample was $1.55 million USD.

Conclusion—In this single-site study, we found a telehealth intervention significantly reduced the number of ambulance transports and resulted in cost-effectiveness. A randomized clinical trial is needed to further explore if telehealth is superior to traditional care.

Are All Children Created Alike? Differences in MTP Across Three Age Groupings (0–5, 6–12, & 13–17)

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Introduction—Hemorrhage due to trauma is a leading cause of death in pediatric patients. Massive transfusion protocols (MTPs) potentially reduce mortality in pediatric trauma patients, but triggers for MTP activation are ill-defined.

Objective—To characterize pediatric trauma patients requiring transfusion in the first 24 hours to evaluate potential triggers for MTP and transfusion in the prehospital setting.

Methods—Using a Level I trauma center's registry, all pediatric trauma patients (0–17) from January 2015 to August 2017 who required transfusion in the first 24 hours of their stay were selected. Patients were categorized by age: 0–5, 6–12, and 13–17 years old. Several variables were studied using the independent samples t-test and chi-square test to assess for differences between survivors and nonsurvivors.

Results—The all-cause mortality was 26% (18/70), with 22% (4/18) of deaths due to bleeding. The odds of death were higher for blunt trauma compared to penetrating (OR 1.19; 95% CI, 0.79–1.81). Eighteen patients received massive transfusion, 78% (14/18) of whom were of adolescent age (13–17 years old). The mortality rate in the adolescent group was 21% (7/33) despite a higher pulse pressure in the adolescent patients who died. Of note, prehospital times were routinely longer than 60 minutes.

Conclusion—Despite not finding any valid transfusion triggers, the prolonged prehospital time, high mortality rate, and need for massive transfusion in this study support the inclusion of adolescent patients in prehospital whole blood transfusion programs.

A Retrospective Analysis of the Impact of EMD on Cardiac Arrest in North Carolina in 2017

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Introduction—Emergency medical dispatch (EMD) is a critical part of the American Heart Association cardiac arrest "chain of survival." EMD must quickly identify cardiac arrest, dispatch the proper response, and compel lay persons to initiate CPR through prearrival instructions. Frequent evaluations should be made to assess if EMD impacts patient disposition.

Objective—To determine if EMD prearrival instructions significantly impacted cardiac arrest patients' prehospital disposition in North Carolina.

Methods—This retrospective observational study examined all 2017 9-1-1 EMS cardiac arrest patients in North Carolina. Study data were obtained from the North Carolina EMS Data System. During the study period protocols allowed termination of resuscitation efforts on scene for cardiac arrest patients who had no signs of reversal. If efforts were terminated, the patient was not transported. Transported patients were either successfully resuscitated or showed signs of reversal. Descriptive statistics and univariate odds ratios were calculated to determine if EMD prearrival instructions were associated with the decision to transport or not transport a cardiac arrest patient.

Results—There were 10,247 9-1-1 calls dispatched as cardiac arrests by EMD. Data were available for prearrival instructions delivery on 7,099 (69.3%) calls. Of these, prearrival instructions were provided on 5,570 (78.5%) and not provided on 1,529 (21.5%). Patient disposition was available on 4,184 calls. Of these, 728 (17.4%) patients were not transported, and 3,456 (82.6%) were. Of the 399 calls that were not transported, prearrival instructions were provided on 310 (77.7%), and no instructions for 89 (22.3%). Among 2,364 calls that were transported, 1,865 (78.9%) received prearrival instructions, and 499 (21.1%) did not. This difference was not statistically significant (OR 1.01; 95% CI, 0.97–1.06, p=0.589).

Conclusion—EMD is a critical part of the system of care and essential to the cardiac arrest chain of survival. However, this study did not identify an association between the delivery of EMD prearrival instructions and patient disposition for those in cardiac arrest. Further study should be conducted to determine the impact of EMD on patient outcomes.

The Effects of Stress on the Driving Abilities of Paramedic Students

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Introduction—Previous research has demonstrated that stress has a negative impact on the performance of paramedics performing medical-related tasks. The driving abilities of the general population has been shown to be negatively impacted by acute stress, resulting in an increase in the number of critical driving errors performed. No literature was found that discussed the effects of stress on the driving abilities of paramedics.

Objective—To study the driving abilities of paramedic students in stressful situations.

Methods—Paramedic students underwent a driving ability assessment in a driving simulator before and after exposure to a stress-inducing medical scenario. The number and types of errors were documented before and after stress stimulus.

Results—A total of 36 students participated in the study. Following exposure to a stressful medical scenario, paramedic students demonstrated no increase in overall error rate compared to an assessment before the scenario. They did demonstrate an increase in three critical driving errors: failure to wear a seat belt (3 pre-stress vs. 10 post-stress, $p=0.0087$); failing to stop for red lights or stop signs (7 pre-stress vs. 35 post-stress, $p<0.0001$); and losing control of the vehicle (2 pre-stress vs. 11 post-stress, $p=0.0052$).

Conclusion—Paramedics are routinely exposed to acute stress during their working day, and this stress could increase the number of critical driving errors that occur. The results of this study demonstrate the need for further research into the impacts of stress on paramedics and highlight the potential need for increased driver training and stress management education to mitigate the frequency and severity of driving errors made by paramedics.

EDUCATIONAL ABSTRACTS

Peak Performance: How Education and Experience Affect Paramedic Readiness

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Introduction—Education and experience are strongly contested predictors of classroom performance and paramedic readiness. A 2017 paper found nursing students who only graduated high school performed significantly worse than students with a bachelor's degree. In contrast, a 2015 study showed an inverse relationship between years of experience and pass rates. This study sought to determine if education or years of experience related to paramedic readiness exam pass rates.

Methods—A retrospective review of paramedic student data from Fisdap, an online database for EMS and healthcare education, was analyzed for self-reported education and experience levels. Only students who attempted a paramedic comprehensive exam were included. A one-way ANOVA was used to determine association in variables in Fisdap paramedic exams pass rates (72.5% or better) among students with varying education levels and years of experience. Logistic regression models were fitted ($a=0.05$) using nominal predictor variables for education level (high school diploma/GED, associate degree, and bachelor's degree) and years of experience in the field (less than 1 year, 2–5 years, 6–10 years, or more than 10 years).

Results—According to this study, students with a degree are more likely to pass the readiness exam. The act of completion of the degree matters more than its level. Students with 2–10 years' experience are more likely to pass the readiness exam than students with less than 1 or more than 10 years' experience.

Conclusion—Predicting paramedic student readiness is important to program success. Paramedic programs might consider evaluating candidates' education and levels of experience before admission with the goal of selecting the best candidate for paramedic school, or consider setting experience and education requirements for entry.

Test Language Matters: Questioned Words by Saudi Arabian Paramedic Students

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Introduction—Item-writing guidelines for multiple-choice assessments have raised concerns regarding the focus, grammar, and language. Guidelines include: items should be important to learned content and not trivial information; use of concise, simple vocabulary; homogenous content and structure; and avoiding trick items. Difficult vocabulary places some students at risk because it affects the reading demand. The use of simplified language is supported as an effective way to reduce the influence of reading ability, a source of construct-irrelevant variance when the assessment is intended to measure something else.

Methods—In May 2015 44 senior paramedic students in Riyadh, Saudi Arabia, attempted Fisdap's 200-item Paramedic Readiness Exam 4 (PRE4), a valid and reliable cognitive multiple-choice assessment. The students' program was based on the standard U.S. curriculum and used U.S. textbooks. Participants wrote down words they did not know while taking PRE4.

Results—A total of 127 words were reported. Tables report words (n=56) questioned by multiple participants, words questioned by a single participant, the group's overall performance on PRE4, and the correlation between words questioned by multiple students (n=56) and PRE4 topic areas.

Conclusion—This study reported a mixture of questioned nonmedical and medical words. Items phrased with construct-irrelevant words introduced an unfair disadvantage for those learning English or with different cultural backgrounds. The language used within an assessment should reflect standards, guidelines, and reference materials, and it should adhere to a universal design for maximum accessibility.

Traditional vs. Accelerated EMT Courses: A Paradigm Shift

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Introduction—According to the National EMS Education Standards, the length for an EMT course is estimated to be approximately 150–190 hours. These courses traditionally span several months, but accelerated EMT courses are becoming more common. Anecdotal evidence suggests many in the EMS community believe students are more successful in traditional-length courses. This project was designed to determine whether there is a difference in student success in traditional vs. accelerated formats. EMS program directors could benefit from this information to guide course scheduling, and students could benefit with help deciding which type of course they enroll in.

Hypothesis—EMT students are more successful in traditional-length courses.

Methods—A retrospective review of an EMT program that offered both traditional and accelerated courses was conducted. The program offered traditional courses spanning four months and accelerated courses spanning seven weeks. Both courses consisted of 200 hours of training. Five years of student data was examined retrospectively to determine student success. Indicators of student success used in this study were course completion and score on the written state certifying exam.

Results—A total of 432 student records were examined. Of those, 312 students (72.2%) were in the traditional format, and 120 students (27.8%) were in the accelerated format. Of the 312 students enrolled in the traditional format, 131 (42%) did not complete the program. Of the 120 students enrolled in the accelerated format, 35 (29.2%) did not complete it. When comparing completion rates of both groups statistically, the Z-score is 2.45 with a p-value of 0.014, making the result statistically significant ($p<0.005$). Student state certifying exam scores were compiled and compared with a t-test. Students enrolled in the traditional-format course had a mean score of 78.10 on the state certifying exam, while students enrolled in the accelerated format had a mean score of 79.54. The t-value was 1.38 and the p-value 0.17, making this result not statistically significant ($p<.005$).

Conclusion—The hypothesis was disproved. Students enrolled in a traditional class were less likely to complete the course, and there was no statistical difference in scores on the state certifying exam.

Evaluating Hybrid EMT Courses in South Carolina

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Introduction—To keep up with constant changes in technology as well as the increased number of courses offered, EMT programs in South Carolina have begun using a hybrid delivery style to instruct initial EMT students. In the traditional format, students sit in a classroom with an instructor lecturing to the class. The hybrid format uses a combination of traditional classroom time and online lectures, with classroom time normally dedicated to practicing skills and taking exams. All EMT students must obtain their National Registry EMT (NREMT) certification before obtaining their South Carolina EMT certification. It is unknown if students who attend hybrid courses perform as well on the NREMT exam as those who attend traditional courses.

Objective—To evaluate first-time successful pass rates of EMT students who received initial EMT training using a hybrid format versus the traditional format.

Methods—Data were obtained from the South Carolina EMS data system. NREMT first attempts from 2016 to 2017 were included, and the outcome of interest was pass/fail. Courses were categorized as hybrid or traditional. Descriptive statistics, univariate odds ratios (ORs), and 95% confidence intervals were calculated. Multivariable logistic regression was performed to adjust for student age and gender.

Results—During the study period, 1,690 people completed their first attempt of the NREMT exam in South Carolina. Of these, 1,314 (77.8%) passed. Course format information was available for 1,688 (99.9%), of which 1,490 (88.3%) were traditional. There were 198 (11.7%) whose classes were hybrid. There was no statistically significant difference when comparing course format and success on the first attempt of the NREMT exam, with 1,156 (77.6%) who attended traditional courses passing vs. 156 (78.8%) who attended hybrid courses (OR 1.07; 95% CI, 0.75–1.54, p=0.702). This relationship remained statistically insignificant after adjustment for student age and gender (OR 1.08; 95% CI, 0.75–1.55, p=0.677).

Conclusion—This study suggests students who attend hybrid EMT courses have similar first-time pass rates on the NREMT exam when compared to traditional courses. Students should be encouraged to choose course formats that fit their preferred learning style.

EMT Student Self-Confidence and Its Effect on a Summative Examination

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Objective—The connection between academic performance and self-efficacy (i.e., self-confidence) is well-established in many disciplines. Yet this relationship among entry-level EMT students remains to be determined. This study seeks to identify a correlation to serve as a predictive measure between EMT student self-efficacy and academic performance on a summative EMT exam. Student self-confidence scores were compared in relation to their respective summative Fisdap EMT Readiness Exam 2.0 (ERE2) scores.

Method—A retrospective analysis of the ERE2 was performed utilizing Fisdap educational data. Fisdap is an online database for EMS and healthcare education. Analysis employed the Fisdap precourse general self-efficacy evaluation. Multivariate linear regression analyses were conducted using robust standard errors while controlling for potential confounders.

Results—A sample of 11,680 EMT students was included for analysis. Students scoring above the mean on the general self-efficacy evaluation scored an average of over six points higher on the ERE2 (B=6.44, p<0.0001).

Conclusion— Results indicated that student-reported self-confidence is a positive predictor of success on the ERE2. Similar to other fields, self-efficacy of EMT students appears to have a positive relationship with end-of-course academic performance. As EMT training grows in demand and scope, educators must be highly cognizant of their incoming students' emotional readiness and self-efficacy. The results of this study might aid the efficient allocation of educational resources in the classroom and beyond.

With Age Comes Wisdom? Student Age as a Predictor of Success on an EMT Readiness Exam

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Objective—Most states mandate an EMT candidate reach 18 years of age before initial certification/licensure. Additionally, many EMS employers require potential employees reach the age of 21 before employment. At the same time, EMT courses administered through high schools have grown in popularity. Given the disparity between regulatory policies and educational program requirements regarding candidate age, the predictive nature of student age on EMT course success warrants closer examination.

Method—This study evaluated student age as a predictive measure in relation to the summative Fisdap EMT Readiness Exam 2.0 (ERE2). A retrospective analysis of the ERE2 exam was performed utilizing Fisdap, an online database for EMS and healthcare education data. Analysis employed student age as a predictive measure of ERE2 success. EMT students aged 14 to 99 years were included for analysis. Multivariate linear regression analyses were conducted using robust standard errors while controlling for potential confounders.

Results—A sample of 26,482 EMT students was included for analysis. Results indicated that age is a positive predictor of success on the ERE2. Students under 25 (referent) had statistically significant lower scores than older students. These lower scores ranged from 1–6 points (p<0.0001) on a typical 100-point scale. Students over 45 years of age showed no statistically significant differences in ERE2 score.

Conclusion—As EMT educational offerings continue to target an increasingly younger student population, educators must carefully assess the readiness of incoming students. Older students earn higher scores on the ERE2 than do their younger peers.

Student Measurement of Achievement on a Readiness Test (SMART): The Predictive Validity of an EMT Entrance Exam on Candidate Readiness

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Objective—Continued growth in EMS has driven increasing demand for educational training. Thus, EMS programs must utilize effective precourse evaluative tools to identify candidates most likely to be successful and those who may require additional support. This study evaluates the use of the Fisdap EMT Entrance Assessment (EMTEA) as a valid predictive tool on the summative EMT Readiness Exam 2.0 (ERE2).

Method—A retrospective analysis of EMTEA and ERE2 exams was performed using data from Fisdap, an online database for EMS and healthcare education. EMTEA scores and exam subcategory scores (math, anatomy and physiology, medical terminology, and biology) were tested for predictive validity on the ERE2. Multivariate linear regression analyses were conducted using robust standard errors and controlling for potential confounders.

Results—A sample of 134 EMT students was included for analysis. Higher scores on the EMTEA positively correlated with higher scores on the ERE2 (B=0.290, p<0.0001). Higher scores in the domains of math (B=0.092, p=0.006), anatomy and physiology (B=0.158, p<0.001), and medical terminology (B=0.133, p=0.001) on the EMTEA also positively correlated with performance on the ERE2. Scores in the biology domain within the EMTEA were not predictive for overall ERE2 score.

Conclusion—As the demand for placement into EMS courses increases, educators must carefully assess the potential readiness of incoming students. The results of this study demonstrate a need for thorough consideration of a precourse entrance assessment. This will not only ensure student preparedness but will also help dictate EMT program resources necessary to provide for ultimate student success.

Reflections on Reflective Practice Among Prehospital Emergency Care Practitioners in Ireland

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Background—This paper examines the level of engagement of Irish prehospital emergency care practitioners with reflection and reflective practice. It also explores the attitudes of practitioners to reflection and methodologies designed to support reflective practice, such as reflective discussion and video-assisted structured reflection. Finally it outlines the main barriers to reflection, both individually and collaboratively, and reflective practice gaining widespread acceptance as key learning strategies among prehospital emergency care practitioners and educators in Ireland.

Methods—This paper is part of a larger project which consisted of three cycles of action research. Data were collected via an online questionnaire and a series of semistructured interviews with stakeholders including practitioners from all three clinical levels and educators from emergency service providers, private ambulance services, and voluntary organizations.

Results—Many practitioners consider themselves to be reflective practitioners. However, very few of them use a structured model of reflection. Reflection and reflective practice are not part of the education standards for practitioners in Ireland and consequently receive very little attention in most education programs. Practitioners within volunteer organizations perceived that reflective practice was encouraged by their organization in greater numbers than those from other professional organizations. Collaborative forums were perceived to be beneficial, although concerns were raised about their potential for abuse and misuse. These concerns appear to emanate from a lack of trust within certain organizations.

Recommendations—The authors recommend the following goals:

- Include reflective practice in the education standards for all levels of practitioners in Ireland.
- Develop and roll out an education program for existing practitioners regarding reflection, reflective learning, reflective practice, and structured models of reflection as part of their CPC requirements.
- Provide education for all EMS course faculty regarding reflection, reflective learning, reflective practice, and structured models of reflection.
- Develop a learning contract for all participants and faculty, including a confidentiality agreement, that must be in place before the establishment of any collaborative forums.
- Conduct research to explore the reasons for lack of trust within organizations.
- Conduct research to explore the reasons for the disparity of opinion between volunteer and professional organizations regarding the encouragement of reflective practice.

The Effect of Affect on Paramedic Student Performance

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Introduction—The affective domain of learning is recognized as a vital component of paramedic education as described in the National EMS Education Standards and national accreditation standards. This study explored the potential relationship

of students who did not pass the affective domain evaluation on cognitive and noncognitive (psychomotor and capstone field internship) student outcomes.

Methods—A retrospective records analysis of graduated paramedic students in Fisdap, an online database for EMS and healthcare education, was conducted. Completed affective domain (professional behavior) evaluations were reviewed to determine association with cognitive performance (results on the PRE3 or PRE4 exam) and noncognitive performance (team leader performance score on lab and field daily evaluations). The evaluations consisted of 11 criteria on the Fisdap professional behavior evaluation and were dichotomized by preceptors as "competent" or "not yet competent," with an overall rating of pass or fail.

Results—Data were collected from 25,534 professional behavior student evaluations. Failing scores on the affective domain were assessed in 151 (0.6%) assessments for 93 students. Data for individual questions (n=282,051) were extracted, with 1,661 (0.6%) items scored as "not yet competent." Item competency failures ranged between 74%–89%. Self-motivation, self-confidence, communication, time management, and careful delivery of service were items that were most often reported as "not yet competent." Due to the extremely low number of failures, no association between affective domain and cognitive or noncognitive performance was discovered.

Conclusion—The results of the study were unable to demonstrate any association between affective scores and cognitive or noncognitive performance. Results did, however, indicate nearly all students passed their professional behavioral evaluations. The findings suggest several possibilities, including a flaw in the affective domain evaluation tool, evaluators not accurately evaluating the affective domain, evaluator reluctance to issue failing affective scores, or EMS students naturally having an underlying good affect. Further study of affective domain evaluation is recommended to determine the reason or reasons for the nearly 100% pass rate.

An Exploration of Program Director Leadership Practices in Nationally Accredited Paramedic Education Programs

Author: Gordon Kokx, PhD, NRP

Introduction—The number of paramedic education programs participating in the national accreditation process has nearly tripled in the past several years. Although accreditation standards describe program director roles and responsibilities, nothing has been formally studied regarding their leadership practices.

Purpose—The purpose of this study was to explore leadership practices of program directors in nationally accredited paramedic education programs.

Methods—The study was designed with an a posteriori epistemological stance, incorporated a constructivist perspective, and was conducted using qualitative methodology. It explored the perceptions and observations of uniquely qualified, elite subject matter experts (SMEs) to determine the leadership practices of nationally accredited paramedic education program directors. Twelve SMEs were selected based on the inclusive criteria of EMS educator, program director, and accreditation board member experiences. A series of in-depth, semistructured interviews using interpretive inquiry were conducted to explore the context, challenges, and best practices of program director leadership.

Results—EMS educator experience totaled 379 years (range: 10–40 years/SME). Program director experience totaled 223 years (range: 4–36 years/SME). Accreditation board experience totaled 87 years (range: 1–16 years/SME). Site visitor experience totaled 149 years (range: 1–32 years/SME). Participants ranked the specific positive leadership theories of "authentic, servant, ethical" as most important; whereas "charismatic, spiritual, and transformational," although recognized, were less significant. The leadership skills theory (including human, technical, and conceptual skills) was also important to the sphere of leadership responsibilities of program directors. Findings revealed context and best practice themes which included a critical need for understanding and establishing a culture of quality. Significant challenge themes included the existence of an EMS identity crisis and generational dissonance.

Conclusions—Program director leadership is responsible for 75.44% of a program's success, yet no formalized leadership curriculum or training exists. Subsequently, there is both a need for the development of a program director leadership curriculum as well as program director leadership training. This study added to the research literature and identifies leadership practices that may improve paramedic education programs. Further study in the field of paramedic education program director leadership practice is recommended.

Characteristics Associated with Examination Persistence After an Unsuccessful First Attempt at the National EMT Cognitive Examination

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Introduction—Recruiting EMS professionals is essential to meet increasing demands for emergency care. EMT certification is often the entry point for EMS as well as firefighting careers. A prerequisite for obtaining licensure to practice in most states is successful completion of the National EMT certification (National Registry) cognitive examination (NREMT-C). Candidates who are unsuccessful at their first NREMT-C attempt and never return for

any of the five remaining attempts represent a loss of potential EMS providers. Identifying factors related to a candidate's decision to reattempt is important for informing future interventions to improve retesting behaviors.

Objective—To identify characteristics associated with reattempting the NREMT-C following an unsuccessful first attempt.

Methods—Using NREMT test data from 2007–2014, this investigation employed descriptive statistics and multivariable logistic regression analyses to evaluate the relationship between examination reattempts and previous NREMT-C cognitive ability score, examination payer type, candidate demographic characteristics, and program characteristics.

Results—Sixty-three percent (70,661/112,213) of eligible candidates reattempted the exam at least once. Increased age category (25+) was associated with reduced odds of reattempting the exam compared to those aged 18–25 years. (e.g., 36+ years, OR 0.85; 95% CI, 0.82–0.89). Males had 38% greater odds of making a second exam attempt (OR 1.38; 95% CI, 1.34–1.42). Candidates who identified as Hispanic had 12% lower odds of making a second attempt compared to those who identified as white, non-Hispanic (OR 0.88; 95% CI, 0.85–0.91). Candidates who paid for the first attempt themselves had reduced odds of retesting (OR 0.90; 95% CI, 0.86–0.93). EMT candidates whose programs were affiliated with an accredited paramedic program had increased odds of making a second exam attempt (OR 1.10; 95% CI, 1.07–1.13).

Conclusions—More than one-third of eligible EMT candidates never reattempted the exam. Candidates who were female, had a high school education, had self-pay status, attended a school not affiliated with an accredited paramedic program, or identified as Hispanic had reduced odds of making a second exam attempt. Further research is needed to identify underlying causes for the differences observed in this study and identify additional factors associated with the decision to persist after an unsuccessful NREMT-C EMT examination attempt.

Using Video-Assisted Structured Reflection in Simulated Clinical Scenarios and Real-Life Clinical Experiences in the Flipped Classroom

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Background—This paper explores the attitudes of practitioners to the use of video-assisted structured reflection in simulated clinical scenarios and real-life clinical experiences in the context of a flipped classroom to encourage and support reflection and reflective practice among prehospital emergency care practitioners in Ireland. It also examines the experiences of practitioners who participated in this process.

Methods—This paper is part of a larger project which consisted of three cycles of action research. Data were collected via an online survey questionnaire and by conducting a series of semistructured interviews with various stakeholders. These included all three clinical levels of prehospital emergency care practitioners and educators from emergency service providers, private ambulance services, and volunteer organizations.

Findings—When combined, a simulation experience with audiovisual recording and a structured model of reflection in the context of a flipped classroom has become a powerful learning experience. The process of a simulation experience with audiovisual recording and a structured model of reflection appears to dovetail nicely with the concept of the flipped classroom. The review of footage from audiovisual recording in the real-life clinical context provides a reliable and accurate means of evaluating clinical performance. At the same time, concerns were raised about the potential for abuse and misuse of audiovisual recordings. There are perceptions that audiovisual footage of real-life clinical experiences could potentially be used for unintended purposes, such as disciplinary procedures.

Recommendations—Since the process of combining a simulation experience with audiovisual recording and a structured model of reflection in the context of a flipped classroom has shown great promise as a learning experience, a larger-scale pilot study is proposed.

- Develop a pilot program with student practitioners during their undergraduate internship and evaluate its findings.
- Develop a policy that clearly defines the use of audiovisual recording footage prior to commencement of the pilot program.
- A learning contract for all participants and faculty, including a confidentiality agreement, must be in place prior to establishment of the process.

It's Good to Talk! Reflective Discussion Forums to Support and Develop Reflective Practice Among Prehospital Emergency Care Practitioners in Ireland

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Background—Since the mid-1980s, reflective practice has become formally acknowledged and adopted as a key strategy for learning and has become one of the cornerstones of medical education for doctors, nurses, and many allied healthcare professions. In the education of prehospital emergency care practitioners in Ireland, it is only in the last decade that the notion of reflective practice has been tentatively approached. Indeed, until recently it has largely been ignored by practitioners and educators alike. This paper explores the attitudes of practitioners about the use of a reflective discussion forum to encourage and support reflection and reflective practice among prehospital emergency care practitioners in Ireland. It also examines the experiences of practitioners who participated in a collaborative reflective discussion forum.

Methods—This paper is part of a larger project which consisted of three cycles of action research. Data were collected via an online survey questionnaire and by conducting a series of semistructured interviews with participants in the reflective discussion forum. These included all three clinical levels of prehospital emergency care practitioners and the three hierarchical levels within the organization.

Findings—The collaborative reflective discussion forum was found to be beneficial. Among the benefits cited were: the opportunity to draw on the experience of more experienced colleagues; the development of critical thinking skills; and the potential for use as part of a mentoring process. It was also felt that the collaborative nature of the forum had the potential to improve workplace relationships through empowerment of the staff. Concerns were raised regarding the potential for abuse and misuse, particularly in relation to the areas of patient confidentiality and a lack of trust within organizations.

Recommendations—The establishment of a regular reflective discussion forum within organizations is a key learning strategy. Any collaborative forum must be chaired by a trusted, experienced, and highly skilled facilitator. A learning contract for all participants and faculty, including a confidentiality agreement, must be in place before the establishment of any collaborative forum.

The Answer to the Big Flippin' Question

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Introduction—A flipped classroom model is based on out-of-class learning (e.g., via the Internet) for core content followed by in-class application-level activities. Flipped classrooms are thought to enhance learning through interactive activities among instructors and peers. Data from a 2016 pilot study found a marginal increase in NREMT cognitive exam scores in a flipped OB module.

Research question—Is there a difference in NREMT cognitive pass rates between traditional and flipped classrooms within the institution? Is there a difference in NREMT cognitive pass rates between national and individual programs? Is there a difference in exam scores between flipped classrooms and the national Fisdap scores in 2017?

Hypothesis—Flipped-classroom students will score higher on cognitive exams than traditional EMT students.

Methods—Four geographically different EMT programs self-identified to use a flipped-classroom delivery for the entire EMT class. Students took the unit exams and ERE2. On completion of the course, students also took the NREMT cognitive exam. Nonparametric bootstrap tests were used to determine differences in the mean achievement scores between students from flipped and traditional classrooms using different measures. For each measure, a Monte Carlo p-value was computed using 4,999 bootstrap duplicates from the data. Each p-value computed is a corrected p-value using the suggestion by Davison Hinkley (1997).

Results—Data from 51 students were included in the study. Nonparametric bootstrap tests found p-values were statistically significant in all unit exams and the ERE2. For each of the measures, this is evidence against the null hypothesis of no mean differences and suggests students from flipped and nonflipped classrooms may differ in each measure. EMT students in the flipped classroom also had higher cognitive scores than national averages on the NREMT cognitive exam.

Conclusion—Flipped-classroom students had higher scores than the national NREMT cognitive exam average. These flipped-classroom students also had significantly higher scores on all six unit exams and the ERE2. While further research with a larger geographic distribution and number of participants is needed to generalize these findings, these results align with evidence from other disciplines suggesting that EMT students have higher cognitive competency in a flipped-classroom setting.

Differences in Paramedic Education by Student Demographics

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Introduction—During paramedic training, students encounter multiple opportunities to perform psychomotor skills on actual patients under realistic conditions. In some cases, however, the student does not perform the skill, but rather simply observes a preceptor do so. This investigation examines whether student demographic variables influence psychomotor skill engagement during paramedic training.

Hypothesis—Demographic variables influence the performance of psychomotor skills during paramedic training.

Methods—This retrospective analysis utilized a 2x2x3 factorial design. We abstracted data from Fisdap, an online database for EMS and healthcare education, for student-patient encounters that occurred during a 39-month interval from November 2014 through January 2018. All students consented to the use of their data, and instructors verified accuracy. The dependent