ABSTRACTS FOR THE 2011 NAEMS SCIENTIFIC ASSEMBLY

These are the abstracts for the National Association of EMS Physicians Scientific Assembly, Bonita Springs, Florida, January 13–15, 2011.

1. Characteristics of Out-of-Hospital Airway Management in the United States

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Background. While prior studies characterize out-of-hospital advanced airway management interventions, outcomes, and complications in the United States. Methods. Using the 2008 National Emergency Medical Services Information System (NEMSIS) data set (containing data from 16 states—Alabama, Colorado, Florida, Hawaii, Iowa, Maine, Minnesota, Missouri, North Carolina, North Dakota, Nebraska, New Hampshire, New Jersey, New Mexico, Nevada, and Oklahoma), we identified patients receiving advanced airway management, including endotracheal intubation (ETI), alternate airways (AA—Combitube, laryngeal mask airway, King LT, esophageal obturator airway), and cricothyroidotomy (CRIC—needle and open). Results. Among 4,383,768 EMS activations, there were 3,173,361 patient care events, 10,356 ETIs, 2,246 AAs, and 88 CRICs.

The ETI success rates were: overall, 77.0% (95% confidence interval [CI]: 76.1–77.9%); cardiac arrest, 78.0% (76.7–79.2%); nonarrest medical, 72.8% (69.7–75.8%); nonarrest injury, 82.6% (79.0–85.8%); children aged <10 and 10–19 years, 74.3% (69.7–78.5%); children aged 10–19 years, 78.9% (73.7–83.5%); and RSI, 81.4% (77.0–85.3%).

The CRIC success was 61 of 70 (87.1%; 95% CI: 77.0–93.9%). Major airway complications included: bleeding, 84 (0.2%; 95% CI: 0.6–0.9%); vomiting, 80 (0.7%; 0.5–0.8%); and esophageal intubation, 12 (0.1%; 0.05–0.17%).

Conclusions. In this national series, we observed low and regional variations in out-of-hospital ETI success rates.

2. The Resuscitation Outcomes Consortium (ROC) PrIMed Impedance Threshold Device (ITD) Cardiac Arrest Trial: A Prospective, Randomized, Double-Blind, Controlled Clinical Trial


Background. Previous studies suggest that use of the impedance threshold device (ITD) during cardiopulmonary resuscitation (CPR) may improve survival for victims of cardiac arrest. Objective. We compared survival to hospital discharge with a modified Rankin score less than or equal to 3 in patients with out-of-hospital cardiac arrest treated with conventional chest compressions and CPR with a sham or active ITD. Methods. This prospective, double-blind, randomized, controlled clinical trial evaluated adult patients (greater than or equal to 18 years) with an active ITD device with end-tidal carbon dioxide waveform or colorimetric color change, auscultation of bilateral breath sounds, and improved or normal pulse oximetry reading. The independent variable was initial method utilized to secure the airway, the King LT-D or ETI. The association between first-attempt airway insertion success and initial airway device was analyzed using a test of independent proportions and logistic regression. Results. There were 351 adult, nontraumatic OOHCA, with 184 patients (52.4%) enrolled during the ITD period and 167 (47.6%) during the King LT-D period. There were 51 patients with no advanced airway attempted, 40 (21.7%) in the ETI group and 11 (6.6%); p < 0.001) in the King LT-D group. The frequency of first-attempt success was 57.6% in the ETI group and 87.8% in the King LT-D group. Patients in the King LT-D group were significantly more likely to experience first-attempt success versus standard ETI methods (odds ratio [OR] 5.3; 95% CI 2.9–9.5). In the ETI group, 60 patients (41.6%) had multiple attempts, with 22 (36.6%) ultimately experiencing a successful intubation. In the King LT-D group, 11 patients (7.0%) required multiple attempts, with eight (72.7%; p < 0.001) ultimately experiencing successful King LT-D placement.

Conclusion. Patients in the King LT-D group were significantly more likely to have had an advanced airway attempted, have experienced a first-pass success, and have had a successful advanced airway placed when multiple attempts were required.
4. Paramedic Contact to Balloon in Less than 90 Minutes: A Successful Strategy for STEMI Patients without an Immediate Cardiac Arrest Infarction Bypass to Primary Percutaneous Coronary Intervention in a Canadian Emergency Medical Services System

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Introduction. Few systems worldwide have achieved the benchmark of less than 90 minutes from the time of first medical contact to balloon inflation when using emergency medical services (EMS) contact time as the first medical contact. Objective. We describe a successful EMS systems approach using a combination of paramedic and 12-lead electrocardiogram (ECG) software application to facilitate an ST-segment elevation myocardial infarction (STEMI) bypass protocol. Hypothesis. The proportion of STEMI patients for whom the EMS contact-to-balloon (E2B) time was less than 90 minutes increases significantly after implementation of a paramedic-activated STEMI bypass protocol. Methods. We conducted a before-and-after, single-arm, cohort study over a 24-month consecutive period ending December 31, 2009. Included were all patients diagnosed with STEMI by paramedics trained in ECG-acquiring and transport and transported by EMS. Advanced emergency department (ED) notification by paramedics of a STEMI patient occurred in the “before” phase of the study, and patients stopped in the ED of the receiving center. In the 12-month “after” phase, the paramedics activated a STEMI bypass protocol in which STEMI patients were transported directly to the primary coronary intervention (PCI) suite, bypassing the local hospital EDs. Electrocardiogram transmission did not occur in either phase of the study. Results. We compared times for 95 STEMI patients in the “before” phase with times for 80 STEMI patients in the “after” phase. The proportion for whom the E2B time was less than 90 minutes increased from 28.4% before to 91.3% after (p < 0.001). The median E2B times decreased from 107 minutes (interquartile range [IQR] = 30) before to 70 minutes (IQR = 24) after. The median transport time to hospital door to balloon (D2B) time decreased from 83.0 minutes (IQR = 34) before to 35.4 minutes (IQR = 19) after. The median transport time to hospital (ED2E) time increased from 10.4 minutes (IQR = 17) to 30.5 minutes (IQR = 17) after. Median differences between phases were significant at p < 0.001. Conclusions. The proportions of patients with E2B times less than 90 minutes and PCI hospital D2B times were significantly improved through the implementation of a paramedic-activated STEMI bypass protocol.

5. Cervical Collars in the Prehospital Setting: How Well Do They Fit?

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Introduction. Little data exist to describe the ability of prehospital providers to correctly apply a cervical collar to patients suspected of having cervical spine injuries. Several studies have suggested that this poor performance may have significant consequences of improper application of cervical collars. Objective. The purpose of this study was to determine if patients arriving in our emergency department with cervical collars in place did in fact have those collars applied properly. Methods. Institutional review board approval was obtained. A convenience sample of patients with suspected cervical spine injury who arrived in our emergency department with a cervical collar in place were studied. Emergency department and emergency medical resident physicians utilized a standard research form to document the size of the collar, whether it was the appropriate size, and whether it was applied correctly or not utilizing the listed parameters. Also documented was the presence of any cervical spine injury. Descriptive statistics were utilized to present our findings. Results. Preliminary results of 88 ED patients indicated the following: Forty-five collars were applied incorrectly, 15 were too small, and 14 were too large. Thirty-six patients (40%) reported neck pain (38%) and 20 reported back pain. Eight-one percent of the collars used were adjustable collars. Nine patients had documented cervical spine fractures or injuries; four of those had improperly placed collars identified. No adverse effects were noted. Thus far, 51% of patients had incorrectly applied collars. Conclusion. Although data collection continues, it is apparent from these limited data that cervical collars continue to be a challenging issue in terms of selection of proper size and correct application in the prehospital setting. Further research is indicated to determine why proper selection and application are limited, and to determine the complications of improper application. References: Graziano AE, Costantino PM, Breslau NE, Eisinger CA, Baer L. A radiographic comparison of prehospital cervical immobilization methods. Ann Emerg Med. 1987;16:1127–31. Del Rossi G, Heffernan TP, Horodyski M, Rechtine GR. The effectiveness of extrication collars tested during the execution of spine-board transfer techniques. Spine J. 2004;4:619–23.

6. Resuscitation Outcomes Consortium (ROC) PRIMED TRIAL OF EARLY RHYTHM ANALYSIS VERSUS LATER ANALYSIS IN OUT-OF-HOSPITAL CARDIAC ARREST


Background. In a departure from the prior immediate defibrillation paradigm, the 2005 American Heart Association/International Liaison Committee guidelines for Resuscitation (AHA/ILCOR) resuscitation guidelines recommended that emergency medical services (EMS) rescuers could provide 2 minutes of cardiopulmonary resuscitation (CPR) before cardiac rhythm analysis. Objective. We compared brief CPR with early analysis versus longer CPR with delayed analysis. Methods. We conducted a cluster randomized crossover trial of adult out-of-hospital cardiac arrest (OOHCA) patients at 10 Resuscitation Outcomes Consortium sites in the United States and Canada between May 2007 and December 2008. Results in the before and after groups were analyzed as a before-and-after study. In the before group, 36% of CPR was performed before electrocardiogram (ECG) analysis. Results. We enrolled 9,934 patients. The results for the primary outcome, survival to hospital discharge with satisfactory function (Modified Rankin Scale score ≤3), did not differ between the Analyze Early and Analyze Later groups (5.9% versus 5.9%, p = 0.91) with a cluster-adjusted odds ratio of 0.95 (95% confidence interval [CI] 0.62–1.46). Analyses adjusted for confounders and a priori post hoc subgroup analyses showed no survival benefit for either study group. Conclusions. Exploratory analyses suggest that with the passage of time to first ECG analysis, survival does not improve, most notably for ventilator fibrillation/ventricular tachycardia patients with bystander CPR.

7. The Effect of Prehospital Continuous Positive Airway Pressure on Intubations

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Introduction. The benefit of continuous positive airway pressure (CPAP) as a noninvasive airway for patients experiencing acute pulmonary edema (APE) has been shown in emergency department (ED) and intensive care unit (ICU) settings. Patients have required fewer intubations, have had shorter ICU lengths of stay, and have had decreased mortality. Only a few small studies have been published looking at CPAP in the prehospital setting. Objective. The objective is to determine whether the introduction of prehospital CPAP results in fewer intubations. Methods. In this before-and-after study, all records in an urban two-tiered emergency medical services (EMS) system in which the advanced life support unit had a field impression of congestive heart failure (CHF) or APE were retrospectively reviewed from November 2005 to December 2008. Continuous positive airway pressure was initiated in May 2007. The period of November 1, 2005, to April 30, 2007, is the before-group period. The period of July 1, 2007, to December 31, 2008, is the after-group period. All patients transported in the 60 days between these periods. Prehospital records were reviewed for patient demographics, airway management interventions (noninvasive CPAP vs. intubation), vital signs, and other treatments. All records for patients transported to a single urban tertiary care center had hospital records reviewed for any airway interventions required. Analysis was performed using descriptive statistics, Fisher’s exact test, and logistic and linear regression models adjusted for age, gender, and known prior history of CHF/APE. Results: Of 1,341 prehospital patient records initially identified, 332 were included: 174 in the before group and 158 in the after group. In the after group, 82 of 158 (51.9%) received prehospital CPAP. In comparison of the before and after groups, there was a 20% relative reduction in prehospital intubations, nine vs. six (p = 0.61; odds ratio [OR] = 0.72 [confidence interval (CI) 0.25–2.10]). In addition to the relative reduction in hospital intubations, 16 vs. eight (p = 0.20; OR = 0.53 [CI 0.22–1.30]); and 36% relative reduction in all intubations (prehospital or hospital), 25 vs. 14 (p = 0.29–1.20). Conclusion. Prehospital CPAP results in a trend toward decreased intubation rates for patients experiencing CHF/PE. Because the prehospital period of a call for medical collusions, this trend was not statistically significant. Further investigation should include a larger patient population to strengthen the study’s power.
Background. Active compression–decompression cardiopulmonary resuscitation (ACD-CPR) plus an impedance threshold device (ITD) decreases intrathoracic pressure during the decompression phase of CPR, improving hemodynamics. We hypothesized that ITD + ACD-CPR would increase survival with good neurologic function after out-of-hospital cardiac arrest (OHCA). Methods. A prospective, randomized multicenter trial evaluated adults with OHCA treated by emergency medical services (EMS) in seven study sites in the United States, encompassing a population of 2.3 million. Patients were assigned to ITD + ACD-CPR (intervention) or standard CPR (control) on a one-to-one proportional basis. The decompression phase was initiated by the first arriving basic or advanced life support EMS provider. The primary endpoint was survival to hospital discharge with good neurologic function, defined as a modified Rankin score (MRS) <3. Secondary endpoints included major adverse events and neurologic evaluation using the Cerebral Performance Category (CPC) scale. Patients meeting final criteria (nontraumatic arrest, presumed cardiac etiology) were included in the primary intention-to-treat analysis. Results. Of 2,470 randomized patients, 1,653 met the final criteria. The two groups had similar clinical profiles. Survival to hospital discharge with an MRS <3 was 75 of 840 (8.9%) in the intervention group versus 45 of 813 (5.8%) in the control group (p = 0.019; odds ratio [OR], 1.07; 95% confidence interval [CI], 0.63–1.83). Survival to hospital admission was increased (manual CPR 14.2% vs. LDB-CPR 19.7%; adjusted OR, 2.50; 95% CI, 1.05–6.00). Survival to hospital discharge was increased (manual CPR 1.3% vs. LDB-CPR 3.3%; adjusted OR, 3.99; 95% CI, 1.06–14.3). Of 1,011 patients who survived to the LDB-CPR phase (August 16, 2007, to December 31, 2009), in the LDB-CPR phase, the LDB device was activated in 454 patients (82.3%). The patients in the manual CPR and LDB-CPR phases were comparable for mean age, gender, and ethnicity. Rates for ROSC were comparable for LDB-CPR (manual CPR 22.4% vs. LDB-CPR 35.3%; adjusted odds ratio [OR], 1.07; 95% confidence interval [CI], 0.63–1.83). Survival to hospital admission was increased (manual CPR 14.2% vs. LDB-CPR 19.7%; adjusted OR, 2.50; 95% CI, 1.05–6.00). Survival to hospital discharge was increased (manual CPR 1.3% vs. LDB-CPR 3.3%; adjusted OR, 3.99; 95% CI, 1.06–14.3). Conclusions. A resuscitation strategy using LDB-CPR in an ED environment was associated with improved survival to admission and discharge in adults with nontraumatic cardiac arrest.

10. OUT-OF-HOSPITAL CARDIAC ARREST OUTCOMES STRATIFIED BY RHYTHM ANALYSIS

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Background. Survival data for out-of-hospital cardiac arrest (OHCA) victims initially in pulseless electrical activity (PEA) or asystole who convert to a shockable rhythm during attempted resuscitation is key to an initial shockable rhythm, have never before been previously reported. Objective. This study was done to assess OHCA outcomes among a large cohort of adults in the Cardiac Arrest Registry to Enhance Survival data set stratified by rhythm categories: converted shockable (CS), initial shockable (IS), and never shockable (NS). Methods. The study was approved by the institutional review board. All adult in- or ex- or on-scene CPR data met the inclusion criteria. Median on-scene and transport data were obtained on the same patient; hence, we used the nonparametric Wilcoxon sign-rank test to compare paired proportions. One hundred forty-three patients with on-scene and transport CPR data were included. Median on-scene and transport data were obtained on the same patient: hence, we used the non-parametric Wilcoxon sign-rank test to compare paired proportions.

11. A COMPARISON OF CHEST COMPRESSION QUALITY BETWEEN TRANSPORT CARDIOPULMONARY RESUSCITATION

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Introduction. American Heart Association (AHA) guidelines recommend that chest compressions during cardiopulmonary resuscitation (CPR) have a depth of at least 2 inches and a rate between 100 and 120 compressions per minute. Recent studies show a substandard quality of manual CPR performed by emergency medical services (EMS) worldwide. Hypothesis. We hypothesized that transport CPR quality is significantly worse than on-scene CPR quality. Methods. We prospectively enrolled consecutive adult (>18 years old) patients receiving scene and transport chest compressions from 12 EMS sites across Minnesota and Wisconsin from May 2008 to July 2010. Chest compression resuscitation data were collected and exported with the ZOLL M-Series monitor using a sternally placed accelerometer that measures chest compression rate and depth. Compress-
12. TIME TO FIRST COMPRESSION USING MEDICAL PRIORITY DISPATCH SYSTEM: COST-EFFECTIVENESS OF PREARRIVAL INSTRUCTIONS DOES NOT VARY WITH DISPATCHER EXPERIENCE
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Introduction. In the absence of bystander cardiopulmonary resuscitation (CPR), cardiac arrest survival decreases 7%–10% for every minute of delay until defibrillation. Dispatcher-assisted CPR (D-CPR) has been shown to increase rates of bystander CPR and cardiac arrest survival, with chest compressions recognized as the most important component of bystander CPR. To facilitate the rapid delivery of chest compressions, the Medical Priority Dispatch System (MPDS) altered instructions for mouth-to-mouth ventilation (MTMV) and removed the pulse check, while making other minor changes to the D-CPR pre-arrival instructions. However, factors beyond the D-CPR algorithm that may affect time to first compression (TTFC), such as dispatcher experience, have not yet been evaluated. Objective. We sought to quantify the relationship between dispatcher experience and medical dispatcher (EMD) experience across MPDS versions 11.3 and 12.0 for all calls identified as cardiac arrest on call intake that did not require MVMTMV instructions. Methods. Audio recordings of all calls to a mixed urban/suburban emergency medical services (EMS) system receiving D-CPR instructions between May 2008 and June 2009 were reviewed to determine TTFC. The overall relationship between TTFC and months of EMD experience was analyzed using Pearson correlation. Differences in TTFC between less experienced months’ experience or less) and experienced (greater than 12 months) EMDs were compared using Student’s t-test. Results. Of the 235 calls analyzed, the mean (±standard deviation [SD]) TTFC was 247.6 (±79.7) seconds and the mean (±SD) dispatcher experience was 65.6 (±46.1) months. Overall, there was no correlation between TTFC and dispatcher experience (r = 0.02, p = 0.71), and there were no correlations when the two versions of the MPDS protocols were analyzed independently (r = –0.01, p = 0.87; and r = 0.07, p = 0.54, respectively). There was no difference in mean TTFC between novice and experienced EMDs (p = 0.97). Conclusions. For calls receiving compression-first instructions, regardless of which of these versions of the MPDS protocols, we found the mean overall TTFC to be 246 seconds, with no correlation with dispatcher experience. Our data suggest that the tightly scripted MPDS protocols can be applied by novice and experienced dispatchers alike, with little variation in TTFC.

13. HELICOPTER VERSUS GROUND AMBULANCE TRANSPORT FOR TRAUMA: THE THRESHOLD MORTALITY RISK REDUCTION NEEDED TO BE COST-EFFECTIVE
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Objective. To determine the minimum mortality risk reduction needed to justify choosing air versus ground ambulance transport for severely injured trauma victims from the field to the hospital setting. Although helicopter transport is faster and more expensive, the incremental costs and incremental risks of helicopter transport. Methods. We developed a decision-analytic Markov model from a societal perspective to compare the costs and outcomes of helicopter versus ground ambulance transport from the scene of injury to a level I trauma center when expected ground transport time is ≥30 minutes. The model followed patients from injury through transport, hospitalization, and throughout their lifetime until death. We applied the model to a population of 1,455 years with severe injury [Abbreviated Injury Scale (AIS) score ≥3] who had a mean baseline one-year mortality of 10.4% after treatment at U.S. level I trauma centers, from the National Study on Costs and Outcomes of Trauma (NSCOT). Transport costs and safety data were derived from the published literature. The primary outcome was the threshold relative risk (RR) reduction in inpatient mortality by helicopter transport needed to achieve incremental cost-effectiveness ratios (ICERs) of $50,000 and $100,000 per quality-adjusted life years (QALYs) gained compared with ground transport. We assessed robustness with multiple sensitivity analyses. Results. Helicopter trauma transport must provide at least a 5% RR reduction in mortality (i.e., 1 additional life/217 transports) for patients with mean characteristics of the NSCOT cohort (age 43 years, AIS 3.3) to achieve an ICER below $50,000/QALY and a reduction of 12% to be below $50,000/QALY. Greater RR reductions are needed for less severely injured and older patients. However, slight improvements in hospital mortality outcomes for helicopter transport would reduce the RR reduction needed for cost-effectiveness. In sensitivity analysis, commonly reported helicopter crash risks and costs were not influential factors in the model. Conclusions. Compared with ground ambulances, helicopter transport is cost-effective by current standards when the RR of 11.9 EMS deaths is reduced by more than 5% in severely injured patients. The results are not applicable to patients with minor injuries (AIS 1–2) or areas where long-distance ground transport is not feasible. Further study of the effectiveness of helicopter transport, especially disability outcomes, is warranted.

14. ABILITY OF PREHOSPITAL ELECTROCARDIOGRAM COMPUTER INTERPRETATION TO ACCURATELY IDENTIFY PATIENTS WITH ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION
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Background. Identifying ST-segment elevation myocardial infarctions (STEMIs) in the field can decrease door-to-balloon times. Most paramedics obtain electrocardiograms (ECGs) with computer interpretation. It is unknown how accurately the computer can identify STEMI. Objective. To evaluate the accuracy of the computer interpretation of prehospital ECGs in diagnosing STEMI and to determine the number of missed and inappropriate cardiac catheterization laboratory activations that would occur if the computer interpreted the ECGs with computer interpretation. Methods. Retrospective cross-sectional study of 200 prehospital ECGs acquired using Lifepak 12 monitors and transmitted by one of three variations of the emergency department (ED) of a large adult tertiary care center between January 1, 2007, and January 14, 2009. The ED sees 73,000 adult patients, receives over 4,000 prehospital ECGs, and treats 120 STEMI patients annually. The laboratory performs 3,400 catheterizations annually. The first 100 patients with a diagnosis of STEMI in the ED and 100 randomly selected patients without ST-segment elevation myocardial infarction from the ED were analyzed. For comparison, a control group of 100 other ECGs from patients without a STEMI were randomly selected from the laboratory. Data were generated using a random number generator. Data Analysis: For patients with STEMI, an accurate computer interpretation was “acute MI suspected.” Other interpretations were counted as misses. Specificity and sensitivity were calculated with confidence intervals. The sample size was determined with a priori power of 95% confidence. Results. Zero control patients were incorrectly labeled as “acute MI suspected.” Some STEMI had other interpretations, however, the most common of which was “data quality prohibits interpretation.” Specificity was 100% (100/100); 95% confidence interval [CI] 0.96–1.0, while sensitivity was 58% (58/100; 95% CI 0.48–0.67). This would have resulted in 42 missed catheterization laboratory activations, but zero inappropriate activations. Conclusions. A prehospital ECG computer interpretation of “acute MI suspected” is highly suspicious for identifying STEMI. Given a specificity of 100%, it may be efficient to activate the catheterization laboratory prior to patient arrival based on a positive reading; however, additional resources are needed to interpret negative ECGs.

15. GENDER DISPARITY FOR RESUSCITATION EFFORTS IN OUT-OF-HOSPITAL CARDIAC ARREST IN KOREA
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Objectives. The aim of our study is a comprehensive analysis of the association of gender with resuscitation efforts and outcomes after out-of-hospital cardiac arrest (OHCA) using large nationwide data. Methods. The national OHCA cohort database comprises OHCA patients who were transported by 119 ambulances throughout South Korea during 2008. Data from emergency medical services (EMS) run sheets and hospital records were reviewed using the Utstein style. The final study population included patients who had OHCA of presumed cardiac origin. We examined gender differences in the characteristics of arrest, resuscitation efforts in prehospital and hospital areas, and outcomes. The multivariate logistic regression analyses were performed to determine whether gender was independently associated with prehospital resuscitation efforts, especially application of automated external defibrillator (AED), and outcomes. Results. The study population included 13,922 patients who had OHCA of presumed cardiac origin, of which 57.0% (n = 3,903) were women. In the overall cohort, women were older (p < 0.001) and less likely to present with a shockable rhythm (p < 0.001). Women were less likely than men to have the AED applied in the prehospital setting (14.3% versus 9.6%, p < 0.001) and to receive cardiopulmonary resuscitation in the hospital (49.2% versus 42.2%, p < 0.001). Women received lower resuscitation efforts in the prehospital setting (adjusted odds ratio of AED application 0.77, 95% confidence interval 0.68–0.86). Although no significant difference was shown in the survival-to-admission rate in univariated analysis, woman had a greater likelihood of survival to admission than men after adjustment for confounders. Women had lower unadjusted survival-to-discharge rates (3.1% versus 1.8, p = 0.0001). This difference disappeared after multivariable adjustment. Conclusions. The underuse of AEDs in the treatment of women represents potential opportunities for reducing gender disparities in care after OHCA.

16. GEOGRAPHIC OPTIMIZATION OF AUTOMATED EXTERNAL DEFFIBRILLATORS IN TORONTO
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Introduction. Public-access defibrillation improves survival from cardiac arrest, but current usage is low. Current geographic
The deployment of public automated external defibrillators (AEDs) in the City of Toronto is limited by the lack of a data-driven optimization model to guide placement. **Objectives.** 1) To quantify the current coverage of public-location out-of-hospital cardiac arrests (OHCA) in Toronto; 2) to develop a strategy to optimize future AED placement using mathematical modeling techniques. The Resuscitation Outcomes Consortium Epistry—Cardiac Arrest is a large epidemiologic registry of consecutive EMS-treated OHCAs. To assess the current deployment of public AEDs, we measured distance and time metrics relative to public-location cardiac arrests in the City of Toronto occurring between January 2008, and July 15, 2010. Using geographic information systems technology and the maximal covering location model, we determined optimal locations for the placement of future AEDs. An OHCA episode was considered “covered” if it occurred within a 100-meter service radius. **Results.** We analyzed 1,302 public-location OHCA episodes. There were 1,669 preexisting registered AEDs providing coverage for only 37% of these episodes (23.5%). The average (± standard deviation) distance to the closest AED was 278 ± 226 meters. Approximately 86% of OHCA episodes were left within 500 meters of an AED. Using our optimization model, we determined that the top five locations for additional AED placement would cover an additional 57 OHCAs; the top 10, an additional 54 OHCAs; and the top 20, an additional 84 OHCAs. A minimum of 847 additional registered AEDs would be required to cover all targeted public-location OHCAs based on data. The OHCA locations were geographically clustered such that sequential priority placement of AEDs maximizing coverage of these clusters resulted in one-to-one coverage after approximately 100 new AEDs. **Conclusion.** Deployment of AEDs in the City of Toronto is suboptimal. The use of mathematical modeling and optimization has the potential to improve AED placement, usage, and survival after public-location OHCA.

**17. EMERGENCY MEDICAL SERVICES WORK–LIFE CHARACTERISTICS CONTRIBUTE TO CLINICALLY SIGNIFICANT EXCESSIVE DAILYTIME SLEEPINESS**


**Introduction.** Excessive daytime sleepiness affects approximately 5% of the general U.S. population. However, literature examining sleepiness in the emergency medical services (EMS) workforce is limited. **Objectives.** The objectives of this study were to quantify clinically significant excessive daytime sleepiness (CSEDS) in the EMS workforce and identify EMS work–life characteristics and demographics significantly associated with CSEDS. **Methods.** In 2009, EMS professionals who previously responded to the first Resuscitation Outcomes Consortium Attributes and Epidemiologic Study were asked to complete a questionnaire that included the Epworth Sleepiness Scale (ESS), EMS work–life characteristics and demographics associated with CSEDS. **Results.** Of the 1,603 individuals who received a survey, 1,078 responded, representing a response rate of 67.2%. The ESS was completed by 1,059 respondents (91% of those who received a survey). Of these, 397 were classified as having CSEDS. Simple logistic regression revealed that the following characteristics were associated with an increased odds of CSEDS: working shifts ≥24 hours, working ≥10 calls/week, working ≥60 hours/week, working rotating shifts, working mandatory or voluntary overtime, leaving EMS, being separated/widowed/divorced, obesity, and having fair/poor overall health. Individuals satisfied with their EMS assignment had decreased odds of CSEDS. Following model selection, working ≥24-hour shifts (OR = 1.79, 95% confidence interval [95% CI] = 1.20–2.65), mandatory overtime (OR = 1.55; 95% CI = 1.07–2.24), voluntary overtime (OR = 1.43; 95% CI = 1.00–1.95), leaving the EMS workforce (OR = 2.52; 95% CI = 1.49–4.26), being separated/widowed/divorced (OR = 1.79; 95% CI = 1.01–3.18), and reporting fair/poor health overall (OR = 2.67) remained significantly associated with CSEDS. **Conclusion.** Almost 40% of the study population reported CSEDS. Independent variables that increased the odds of CSEDS included working ≥24-hour shifts and working overtime. Working shifts ≥24 hours and avoiding overtime may decrease the burden of CSEDS in EMS. Future studies should be designed to examine relationships between CSEDS, patient safety, and occupational injury/illness.

**18. CREW CONFIGURATION DOES NOT AFFECT HELICOPTER EMERGENCY MEDICAL SERVICES ON-SCENE TIME**

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**Introduction.** Helicopter emergency medical services (HEMS) is intended to provide rapid transport of critical patients over long distances. In the United States, HEMS programs use a variety of configurations in an attempt to optimize cost, wait time, and on-scene time. **Objectives.** We evaluated whether different crew configurations affected on-scene time. **Methods.** Data were collected retrospectively from all on-scene calls from May 2006 to April 2007. A model and calendar year subgroups were created. Calls in both subgroups were analyzed to determine the presence of patients (833/1,920, 95% CI 0.41–0.46) waiting in a busy ED against which to measure interquartile ranges (IQRs). **Results.** Data were collected on 2,512 consecutive visits, with 592 excluded because of incomplete data, leaving 1,920 (76%) complete visits. The average turnaround time was 13 minutes 11 seconds (range 1 minute 12 seconds to 80 minutes 39 seconds) and the median 6 minutes 43 seconds (IQR 8 minutes 4 seconds to 15 minutes 24 seconds). Forty-three percent of the patients (833/1,920, 95% CI 0.41–0.46) were admitted in less than 15 minutes, leaving 547 (513/1,920, 95% CI 0.25–0.29) in greater than 15 minutes. Cumulative time spent waiting beyond 15 minutes totaled 72.5 hours over the 12-month period. Median time to ED (excluding weekends) was 8 minutes 24 seconds (range 1 minute 12 seconds to 80 minutes 39 seconds) and the median 6 minutes 43 seconds (IQR 8 minutes 4 seconds to 15 minutes 24 seconds). **Conclusions.** Radio frequency ID monitoring is a simple and effective method of monitoring interquartile ranges. Variations in wait times are seen and are a topic for future study.

**20. THE RELATIONSHIP BETWEEN SLEEP, FATIGUE, AND PATIENT AND PROVIDER SAFETY**

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**Background.** Poor sleep quality and fatigue affect cognitive and psychomotor skills, potentially jeopardizing emergency medical services (EMS) patient and provider safety. We examined associations between poor sleep...
quality, fatigue, and EMS provider-reported injuries, medical errors, and behaviors that may compromise provider safety and patient outcomes. We administered the Pittsburgh Sleep Quality Index (PSQI), Chalder Fatigue Questionnaire (CFQ), and EMS Safety Inventory (ESI) to a convenience sample of 1,368 EMS personnel from 30 EMS agencies. The ESI-SI is a 44-item questionnaire capturing EMS worker-reported injury (e.g., needlesticks), medical errors (e.g., medication errors or dislodged intubation), and behaviors that compromise patient and provider safety. Poor sleep quality (PSQI > 6) and severe fatigue (CFQ > 4) were associated with the associations between poor sleep quality, fatigue, and ESI-SI items were determined using the Wilcoxon rank sum test and Cochran-Mantel-Haenszel odds ratios. Results. We received 511 completed surveys (37% completion rate). Half of the respondents (55%) were paramedics and 78% were full-time personnel. Over half of the respondents had poor sleep quality (60%) and severe fatigue while at work (5%). Poor sleep quality was associated with increased odds of injury (e.g., “In the past three months I was injured during work” [OR 2.34; 95% confidence interval [CI]: 1.5–3.8]) and was associated with behaviors that may compromise patient and provider safety (e.g., “I have reported to work while under the influence of alcohol within the previous 8 hours,” “I knowingly recorded inaccurate information on a patient care report,” or “I exceeded the speed limit while routinely driving in non-emergency mode”). OR 2.79; 95% CI: 1.6–5.0) was associated with behaviors that may compromise patient and provider safety (e.g., “I have reported to work while under the influence of alcohol within the previous 8 hours,” “I knowingly recorded inaccurate information on a patient care report,” or “I exceeded the speed limit while routinely driving in non-emergency mode”). OR 2.79; 95% CI: 1.6–5.0). Fatigue at work was associated with increased odds of injury (OR 2.47; 95% CI: 1.6–3.9), compromised safety (OR 5.01; 95% CI: 2.6–9.8), and potential patient care errors and adverse events (e.g., “I did not check glucose in a patient with altered mental status” or “I did not perform a 12-lead on a patient with chest pain”). OR 2.27; 95% CI: 1.6–3.3). Conclusions. Poor sleep quality and fatigue among EMS personnel are independently associated with indicators and behaviors that may compromise EMS provider and patient safety.

21. Ambulance Relocation Model Design by Optimization and Simulation

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Introduction. Ambulance relocation refers to an operational protocol that, upon a departure of an ambulance within the fleet, relocates the remaining ambulances to achieve an optimal coverage with the reduced number of ambulances, thereby improving the system’s responsiveness. Designing an ambulance relocation model requires the determination of the optimal ambulance location for a current system state, i.e., the currently available number of ambulances, and criteria to trigger a relocation.

Objectives. In this study, we developed a dynamic ambulance relocation model using mathematical programming, and a computer simulation was conducted to determine triggering criteria and validate the effectiveness of the model. Methods. This study in Korea were selected for the study. Data were collected from the fire department database of ambulance run sheet from the three towns. Patients who used $199 or ambulances in 2009 in each town were included. In the first step, a mathematical programming model was constructed to derive an optimal solution. This solution described which ambulance should relocate to which location in the event of a departure of an ambulance within the fleet. Also considered was a model to prevent an emergency ride for an ambulance. Different levels of triggering criteria were tested to achieve balance between performance improvement and relocation frequency. The solution was then tested by experiments with a discrete event simulation model. Results. Simulation experiments for all three towns showed that introducing a dynamic relocation model improves the system performance. For the most aggressive relocation trigger protocol—relocating every time an ambulance leaves its station for service—the median of on-time arrival to scene increased by at least 35.8% and the fraction of on-time arrival to scene increases at least by 8% for all three towns, with 95% confidence intervals. With a more conservative trigger protocol, the improvement in performance becomes nearly identical to a reference model with no relocation. Conclusion. This study demonstrates that an ambulance relocation model can be systematically designed by utilizing mathematical programming and discrete event simulation technique. In addition, the results from the simulation experiments show that a key element for an ambulance relocation model is to find an optimal threshold value for triggering relocation.

22. Quality of the Data Informing Carbon Footprinting of Emergency Medical Services Systems

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Background. With mounting insecurity over domestic fuel supplies and public pressure to reduce environmental pollution, it is essential that emergency medical services (EMS) systems have valid energy use data to make evidence-based decisions on system sustainability and fuel shortage contingency planning. Previous research has demonstrated that EMS systems routinely collect energy consumption data needed to calculate greenhouse gas emissions directly produced by their operations (a Tier 2 carbon footprint), and that quantified emissions from a sample of North American EMS systems. Those previous efforts, however, depended in part on estimated data. Objective. The purpose of this secondary analysis was to test the hypothesis that data needed to calculate greenhouse gas emissions were previously reported carbon footprint data relied on estimated energy consumption, which may have artificially inflated reported greenhouse gas emissions for divergent EMS systems. National and North American EMS systems previously provided energy consumption data, with 10 systems providing complete Tier 2 carbon footprint data for a full year. Data forms were reviewed to determine the proportion of overall emissions produced from estimated versus directly measured energy consumption among the 10 systems providing complete Tier 2 data. Results. Of the 30,627,046 pounds of carbon dioxide equivalents (CO2e) produced by the 10 services, 96.5% arose from measured energy consumption and 1.8% arose from estimated energy consumption; the nature of the source data for 1.8% of the reported energy consumption could not be determined. Emission sources that contributed most to the EMS carbon footprint were also the sources with the highest proportion of direct measurement, including diesel fuel (99.5% measured), natural gas (99.1% measured (90.1% measured), and electricity (88.4% measured). Liquid propane (31.3% measured), business air travel (23.5% measured), and compressed natural gas (88.3% measured). Conclusions. With a more conservative trigger protocol, the solution was then tested by experiments with a discrete event simulation technique. In addition, the results from the simulation experiments show that a key element for an ambulance relocation model is to find an optimal threshold value for triggering relocation.
ATTEMPTS ATVASCULAR ACCESS

M. Arteaga, Lucas A. Myers, Christopher S. Russi, Grace M. Artega, Mayo Clinic Medical Transport

Introduction. Intraosseous (IO) access is attempted when intravenous (IV) access cannot be established during an emergency. The semiautomated, Food and Drug Administration (FDA)-approved IO placement device (EZ-IO: Vidacare Corporation, San Antonio, TX) has been shown to be a safe and effective approach to vascular access. Objective. This study aimed to examine the characteristics of pediatric patients receiving IO infusions and the primary emergency medical services (EMS) clinical impressions, success rates, and subsequent treatment delivered via manual IO vs. the semiautomated IO device. Methods. A Midwest, 12-site, randomized controlled study implemented the EZ-IO device, replacing a manual IO device. Retrospective analysis of placement rates and subsequent treatments of children (<18 years of age) was conducted. The manual placement group (January 2003 through February 2007) was compared with the semiautomatic group (March 2007 through May 2009). This study was approved by the institutional review board. Results. First-attempt success was achieved in 80.6% (25/31) of patients receiving manual placement and 83.9% (52/62) with the EZ-IO automated device. This is an absolute difference of 3.3%. The manual group made a total of 37 attempts to achieve 25 successful placements (67.6% success). The semiautomatic group made 72 attempts to achieve 58 successful placements (80.6% success), an absolute difference of 13.0%. Intravenous attempts were made prior to IO use at a rate of 35.5% (11/31) in the semiautomatic group and 1.7% in the semiautomatic group. This is a 33.8% absolute difference. Treatment (fluid resuscitation and medication use, excluding lidocaine for intubation) was established through the established IO occurred in 84.0% (21/25) of the manual group and 73.2% (41/56) of the semiautomatic group, an absolute difference of 10.8%. Conclusions. For the pediatric cohort, implementation of a semiautomated IO placement device in place of manual devices offers a marginally higher first-attempt success (2.6%) and an improved success per attempt (13.9%) compared with the manual IO device. The rate at which IO lines were utilized by EMS more than tripled after inception of the semiautomatic device.

25. THE INTRODUCTION OF A SEMIAUTOMATED (EZ-IO) DEVICE IN PEDIATRIC PREHOSPITAL CARE REPLACING A MANUAl INTRAOSSEOUS (IO) DEVICE IMPROVES THE SUCCESS RATE FOR ATTEMPTS AT VASCULAR ACCESS

Lucas A. Myers, Christopher S. Russi, Grace M. Artega, Mayo Clinic Medical Transport

Introduction. Intraosseous (IO) access is attempted when intravenous (IV) access cannot be established during an emergency. The semiautomated, Food and Drug Administration (FDA)-approved IO placement device (EZ-IO: Vidacare Corporation, San Antonio, TX) has been shown to be a safe and effective approach to vascular access. Objective. This study aimed to examine the characteristics of pediatric patients receiving IO infusions and the primary emergency medical services (EMS) clinical impressions, success rates, and subsequent treatment delivered via manual IO vs. the semiautomated IO device. Methods. A Midwest, 12-site, randomized controlled study implemented the EZ-IO device, replacing a manual IO device. Retrospective analysis of placement rates and subsequent treatments of children (<18 years of age) was conducted. The manual placement group (January 2003 through February 2007) was compared with the semiautomatic group (March 2007 through May 2009). This study was approved by the institutional review board. Results. First-attempt success was achieved in 80.6% (25/31) of patients receiving manual placement and 83.9% (52/62) with the EZ-IO automated device. This is an absolute difference of 3.3%. The manual group made a total of 37 attempts to achieve 25 successful placements (67.6% success). The semiautomatic group made 72 attempts to achieve 58 successful placements (80.6% success), an absolute difference of 13.0%. Intravenous attempts were made prior to IO use at a rate of 35.5% (11/31) in the semiautomatic group and 1.7% in the semiautomatic group. This is a 33.8% absolute difference. Treatment (fluid resuscitation and medication use, excluding lidocaine for intubation) was established through the established IO occurred in 84.0% (21/25) of the manual group and 73.2% (41/56) of the semiautomatic group, an absolute difference of 10.8%. Conclusions. For the pediatric cohort, implementation of a semiautomated IO placement device in place of manual devices offers a marginally higher first-attempt success (2.6%) and an improved success per attempt (13.9%) compared with the manual IO device. The rate at which IO lines were utilized by EMS more than tripled after inception of the semiautomatic device.

26. USE OF HUMAN SIMULATION TO EVALUATE OUT-OF-HOSPITAL MANAGEMENT OF ACUTE RESPIRATORY DISTRESS IN THE PEDIATRIC PATIENT AND A TRAINING CONCEPT FOR IMPROVEMENT

Brian Lanier, Valerie J. De Maio, Paul R. Hinchesy, Amar Patel, J. Brent Myers, Robert Lee, Joseph Zaklin, John L. Cabanas, Ashley Elkins, Kevin Paduchowski, for the CanAm Pediatric Study Group, WakeMed Health & Hospitals

Introduction. For children, prompt out-of-hospital management of respiratory distress may prevent further deterioration and even death. Objectives. Using human simulators, our objectives were to identify barriers to quality care for pediatric respiratory distress and to evaluate a focused educational intervention to address those barriers. Methods. This observational cohort included randomly selected paramedics from a large emergency medical service (EMS) system. Residents were recruited to develop critical incident stress debriefing (23% vs. 7%, p = 0.01) significantly more than the older medics. More formal education regarding grief need to be implemented surrounding debriefing sessions, counseling, or support groups need to be implemented surrounding cases of pediatric death. For children, prompt out-of-hospital management of respiratory distress may prevent further deterioration and even death. Objectives. Using human simulators, our objectives were to identify barriers to quality care for pediatric respiratory distress and to evaluate a focused educational intervention to address those barriers. Methods. This observational cohort included randomly selected paramedics from a large emergency medical service (EMS) system. Residents were recruited to develop critical incident stress debriefing. Participants reported greater emotional support for the grief reaction that followed the experience when they attended the simulation. Conclusions. High-fidelity human simulation was useful in identifying barriers with pediatric death that could likely lead to poor outcomes. Focused training proved to reduce deficiencies and resulted in more streamlined care that adhered more closely to system protocols and best practices.

27. EPIDEMIOLOGY OF PREHOSPITAL ACUTE DIARRHEAL ILLNESSES IN INDIA

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Background. Though India has traditionally suffered high rates of acute diarrheal illnesses, few studies have examined the epidemiology and prehospital care of these patients. In 2005, GVK Emergency Management and Research Institute (GVK EMRI) established India’s first centralized emergency medical services (EMS) system in the state of Andhra Pradesh (84 million residents). Objective. The objective of this study was to describe the demographics of patients with acute diarrheal complaints treated by GVK EMRI. Methods. In this prospective cohort study, every patient evaluated by GVK EMRI for possible acute diarrheal disease over twenty-eight twelve-hour periods (equally distributed over each hour of the day and day of the week) in December 2009–January 2010 was included. Cases were identified based on presenting complaints suggestive of an acute diarrheal disease. Demographic data, clinical findings, and prehospital interventions were obtained from prehospital care providers in real time using a standardized questionnaire. Follow-up data were collected at 48 hours and 14 days following transport. Results. Of the hundred ninety-five cases were enrolled during the study period. Follow-up rates were 85% and 92% at 48 hours and 14 days, respectively. The average age was 1.9 years and 10% of the patients were under the age of 12 years. Ninety-eight percent of the patients lived below the poverty line and 89% were from rural or tribal areas. Twenty-six percent of the patients identified a sick contact among their immediate cohabitants. Mortality ratios were 3.1% and 5.9% at 48 hours and 14 days, respectively. Overall mortality for infants less than 2 years old was 4.4%. Conclusions. This is the first study to describe the epidemiology of prehospital patients with acute diarrheal illness in India. The majority of these patients were of lower socioeconomic status, from rural areas, and living in proximity to sick contacts (thereby suggesting an infectious diarrheal etiology). By defining the baseline characteristics and rates of acute diarrheal illnesses among prehospital patients in India, it is our hope that centralized EMS could potentially be used for symptom-based surveillance and early (real-time) identification of emerging and epidemic epidemics.

28. IMPROVING PEDIATRIC MASS-CASUALTY Triage in Guatemala: A Pilot Program

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Background. Different methods of mass-casualty incident triage are used throughout the world; to the best of our
knowledge, there has been no published literature on the teaching of these methods in Latin America. The purpose of this study was to evaluate the efficacy of providing training in the triage of pediatric mass-casualty victims to prehospital personnel as well as to non-medical personnel. Methods: Triage training included pre- and post-intervention tests, a 12-hour education module, and a live-victim triage scenario intervention. The education module included slide and video presentations, followed by small-group sessions and tabletop exercises. These sessions were adapted from Pediatric Disaster Life Support (P-DisLife), a course developed at the University of Massachusetts Medical School. The triage methods taught were adapted from START (simple triage and rapid treatment) and JumpSTART triage methods. The live-victim triage scenario included 30 local school-aged children who were moulaged and dispersed throughout an auditorium that was dark in order to simulate a disaster. The preintervention test questions were scenario-based and asked students to place children into triage categories; the mean correct score was 43%. The postintervention test was given immediately following the training and asked the students to place a different set of hypothetical victims. The mean correct score on the postintervention test was 95%, which showed a marked improvement from the scores of the preintervention test. Conclusion: Providing disaster and triage education to prehospital personnel and physicians in Guatemala vastly improves the ability of these providers to accurately triage pediatric victims of disaster. Additional research is needed to determine the long-term efficacy of the education that was provided and to reevaluate the goals and objectives of PDLS taught in a Latin American country.

**30. NEW SURVIVAL TRENDS FOR NON-VENTRICULAR FIBRILLATION/VENTRICULAR TACHYCARDIA OUT-OF-HOSPITAL CARDIAC ARREST AFTER IMPLEMENTATION OF CONTINUOUS CHEST COMPRESSIONS, IMPENDENCE THRESHOLD DEVICE, AND THERAPEUTIC HYPOTHERMIA IN AN URBAN EMERGENCY MEDICAL SERVICES SYSTEM**

Jose G. Cabanas, Valerie J. De Maio, J. Brent Myers, Ryan Lewis, Robert Lee, Paul R. Hinchesy, Daniel Licatese, Wake County EMS, WakeMed Health & Hospitals Clinical Research Unit

**Background.** Initial presenting rhythms of asystole and pulseless electrical activity (PEA) account for almost 40% of all out-of-hospital cardiac arrests (OHCAs). Historically, resuscitation for these rhythms in the field was considered near futile as they offered a negligible chance of survival to discharge when compared with arrests with ventricular fibrillation or ventricular tachycardia (VF/VT). Objective. To evaluate survival outcomes for patients with OOHCA presenting with initial rhythm of either asystole or PEA before and after the implementation of continuous chest compressions (CCCs), use of the impedance threshold device (ITD), and therapeutic hypothermia (TH). Methods. This was an observational study of prospectively collected OOHCA cases between January 2004 and December 2008 in an urban/suburban emergency medical services (EMS) system with advanced life support care (population 897,000). Included were all adult OOHCA patients having an initial rhythm of either asystole or PEA before and after the implementation of continuous chest compressions. We calculated the specificity and sensitivity of misclassification plus outcomes not witnessed by bystander versus ALS (advanced life support) personnel, using the ALS TOR rule (OHCA not witnessed by EMS personnel and no prehospital automated external defibrillator use or return of spontaneous circulation) or the ALS TOR rule (BLS rule criteria plus OHCA not witnessed by a bystander and no bystander cardiopulmonary resuscitation). We calculated the specificity and positive predictive value of each TOR rule for identifying patients without one-month survival with favorable neurologic outcome. Results. Of 170,926 patients with cardiac arrests of presumed cardiac etiology, 4,267 (2.6%) had neurologically favorable survival. Of 129,841 patients (76%) who met the BLS criteria for TOR efforts, only 286 (0.2%) had neurologically favorable survival. Of 53,825 patients (22%) who met the ALS criteria for TOR efforts, only 87 (0.2%) had neurologically favorable survival. Conclusion. The North American BLS and ALS TOR rules both performed poorly in Japan, with misclassification rates of 0.2%. Implementation of these guidelines into current resuscitation practices in Japan deserves further consideration.

**32. UNEXPECTED CHANGE IN THE DURATION OF PATIENT DISPATCH AS A RESULT OF IMPLEMENTING A NEW OUT-OF-HOSPITAL CARDIAC ARREST PROTOCOL**

Kentaro Kajino, Mohamud Daya, Osaka Police Hospital, Emergency and Critical Care Medical Center

Introduction. In Japan, emergency medical services (EMS) treatment guidelines require that all out-of-hospital cardiac arrests (OHCA) be transported to a hospital regardless of the success or failure of resuscitation efforts. In an attempt to better utilize health care resources, basic life support (BLS) and advanced life support (ALS) prehospital termination-of-resuscitation (TOR) rules have been developed, validated, and implemented in North America. Objective. The purpose of this study was to assess the performance and impact of these BLS and ALS TOR rules in Japan. Methods. This was a retrospective cohort analysis of all persons aged 18 years or older who had OHCA of presumed cardiac etiology in Japan from January 1, 2005, through December 31, 2007. All data were prospectively collected using an Epic-system database. The primary outcome measure was one-month neurologically favorable survival (Cerebral Performance Category [CPC] = 2). Cases were dichotomized on the basis of whether they met the criteria for the BLS TOR rule (OHCA not witnessed by EMS personnel and no prehospital automated external defibrillator use or return of spontaneous circulation) or the ALS TOR rule (BLS rule criteria plus OHCA not witnessed by a bystander and no bystander cardiopulmonary resuscitation). We calculated the specificity and positive predictive value of each TOR rule for identifying patients without one-month survival with favorable neurologic outcome. Results. Of 170,926 patients with cardiac arrests of presumed cardiac etiology, 4,267 (2.6%) had neurologically favorable survival. Of 129,841 patients (76%) who met the BLS criteria for TOR efforts, only 286 (0.2%) had neurologically favorable survival. Of 53,825 patients (22%) who met the ALS criteria for TOR efforts, only 87 (0.2%) had neurologically favorable survival. Conclusion. The North American BLS and ALS TOR rules both performed poorly in Japan, with misclassification rates of 0.2%. Implementation of these guidelines into current resuscitation practices in Japan deserves further consideration.
COMPARISON OF RESUSCITATION OUTCOMES OF OUT-OF-HOSPITAL CARDIAC ARREST IN PEDIATRIC PATIENTS BY CASE VOLUME OF EMERGENCY DEPARTMENTS

Chang Bae Park, Sang Do Shin, Gil Joon Suh, Kyung Jun Song, Seoul National University College of Medicine

Introduction. It is unknown whether transporting victims of out-of-hospital cardiac arrest (OHCA) to an emergency department (ED) that experiences a high volume of cardiopulmonary resuscitation (CPR) is related to better outcomes. Objective. To determine whether CPR case volume of an ED is associated with the rate of survival to discharge for pediatric OHCA patients. Methods. We used the Korean nationwide OHCA cohort database (2006–2008). The database is composed of hospital chart reviews of OHCA patients treated by prehospital providers for nontraumatic OHCA and their impacts on patient outcome. Typically these studies focus on whether patients achieve return of spontaneous circulation (ROSC) and survive to discharge. Few have described the effect of the volume of new OHCA protocols on changes in the frequency of termination of resuscitation (TOR). Objective. The objective of this study was to compare the frequency of TOR before and after implementation of a new OHCA protocol. Methods. In August 2009, a large metropolitan emergency medical services (EMS) system implemented a cardiac arrest protocol to reduce variability in care. This retrospective study compares data from electronic patient care records prior to protocol implementation (July 1, 2006, to December 31, 2008) and after implementation (August 28, 2009, to June 30, 2010). Variables included the frequency with which patients had a final disposition of prehospital termination of resuscitation (TPR), pulse (P), patient was transported and treated but did not regain a pulse on hospital arrival, and ROSC. Patients were also stratified by presenting arrest rhythm (VF/VT, pulseless electrical activity, or asystole). Chi-square analysis was used to determine differences in the proportion of final disposition between before and after protocol implementation. Results. There were 1,311 patients in the pre group and 458 patients in the post group. There was a significant change in the distribution of final disposition (p < 0.01). Data indicated that between the pre and post phase there was an increase in TOR (14.5% vs. 19.2%), a decrease in NEP (60.9% vs. 49.8%), and an increase in ROSC (24.6% vs. 31.0%). Interestingly, the asystolic patients experienced both an increase in TOR (24.8% vs. 32.2%) and an increase in ROSC (12.4% vs. 21.0%). The VF/VT patients had the lowest frequency of TOR (2.1% vs. 7.0%) and the highest frequency of ROSC (45.1% vs. 49.6%). Conclusion. After implementation of a new OHCA protocol focused on increasing prehospital ROSC, these data showed an unexpected increase in the number of patients with prehospital TOR. This requires further investigation and a more refined TOR system to guide treatment of patients. Further research could be conducted to determine the appropriateness of these changes with respect to current TOR guidelines.

COMPREHENSIVE SYSTEM OF CARE ON SURVIVAL FROM OUT-OF-HOSPITAL CARDIAC ARREST

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Introduction. Optimal survival after out-of-hospital cardiac arrest (OHCA) depends on an integrated system of care ensuring implementation of all links in the chain of survival. However, creating such a system is a major challenge requiring intentional, systematic planning, collection of accurate outcomes data, and integration of bystander care, emergency medical dispatch, prehospital care, and in-hospital management. Hypothesis. Survival is improved by a full implementation of a statewide system of OHCA care. Methods. The state of Arizona implemented a multifaceted system of OHCA care that included the following: 2004—a statewide Utstein-style reporting network; 2005—an emergency medical services (EMS) quality improvement program endorsing minimally interrupted cardiac resuscitation (MICR) and a statewide system of cardiopulmonary resuscitation (CPR) program encouraging chest compression-only CPR (COCPR); 2007—formal recognition of Cardiac Receiving Centers (CRCs); and 2008—allowing EMS bypass to CRCs. The program covers approximately 80% of the state’s 6.6 million diverse residents. This study evaluated survival to hospital discharge, the rate of bystander CPR (including proportion of COCPR), the rate of EMS use of MICR, the proportion of OHCA treated at CRCs, and the use of therapeutic hypothermia (TH). Survival was determined by chi-square and test for trend. Results. The annual rates for survival, bystander CPR/COCPR provision, EMS MICR use, CRC use, and TH use increased significantly over time from 2005 to 2009 (p < 0.001). The OHCA survival increased as follows: overall—3.5% to 11.3%; and witnessed ventricular fibrillation (VF) arrest—31.0% to 53.1%. Emergency medical services use of MICR increased from 7.7% to 55.8%, the provision of any bystander CPR increased from 37.3% to 49.8%, and the provision of conventional CPR increased from 14.3% to 54.3%. From 2007 to 2009, the proportion of OHCA treated at CRCs increased from 0.2% to 43.3%, while the proportion of eligible patients receiving TH increased from 0.3% to 21.3%. Conclusion. It is feasible to implement major changes in OHCA care across widely diverse communities when local, regional, and state emergency health care jurisdictions partner to establish a comprehensive system of care. The implementation of such a statewide system has significantly improved patient outcome in a setting where survival rates were previously abysmal.

35. PREHOSPITAL TEXTBOOKS DO NOT DEFINE MOTOR VEHICLE INTRUSION

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Background. Motor vehicle intrusion is an important criterion in the Centers for Disease Control and Prevention Guidelines for Field Triage of the Injured Patient (CDC guidelines). However, it is unknown if prehospital providers are correctly taught how to define and measure motor vehicle intrusion. Objective. The purpose of our study was to determine the frequency with which motor vehicle intrusion is defined in prehospital textbooks. Methods. Using the Websites barnesandnoble.com and amazon.com, we compiled a list of the most commonly used prehospital textbooks. We then obtained copies of each textbook and extracted the following information: 1) Was motor vehicle intrusion listed in the index? 2) Was motor vehicle intrusion defined in the glossary? and 3) Was motor vehicle intrusion listed and/or defined in the text of the book? Results. Of the 13 textbooks we examined, no textbook had motor vehicle intrusion listed in the index or defined in its glossary. Three of the books did mention motor vehicle intrusion in the context of identifying serious potential injuries, but no book defined how to measure motor vehicle intrusion. The CDC guidelines utilize motor vehicle intrusion as a guideline for transport to a trauma center. The results of our study show that motor vehicle intrusion is not mentioned in the vast majority of textbooks written for prehospital providers. When motor vehicle intrusion was mentioned, it was usually in the context of defining significant mechanisms of injury. If prehospital providers are not taught how to correctly measure motor vehicle intrusion, then this mechanism-of-injury criterion loses its usefulness. Although we examined the 13 most popular prehospital textbooks, it is possible that there are other prehospital educational materials that do not define motor vehicle intrusion. In addition, prehospital educators may teach their students about motor vehicle intrusion through verbal instruction. Conclusion. The majority of prehospital textbooks do not define or teach prehospital providers how to measure motor vehicle intrusion. If motor vehicle intrusion is to remain an important part of prehospital triage protocols, prehospital textbook authors should emphasize motor vehicle intrusion in future educational materials.

36. TRAINING EMERGENCY MEDICAL SERVICES PROVIDERS IN THE USE OF THE EMERGENCY SEVERITY INDEX: A PILOT STUDY

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Background. There currently is no common definitive triage scale used by both in-hospital and prehospital providers for nontraumatic transports. Objective. This study examined the ability of emergency medical services (EMS) providers to be trained in the use of a widely accepted in-hospital triage scale, the Emergency Severity Index (ESI), and to
compare their performance with that of experienced emergency department (ED) registered nurse (RN) providers. With institutional review board approval, EMS providers, non-ED RNs with no prior exposure to the ESI, and trained ED RNs were recruited and consented to participate. All providers completed a demographic questionnaire and assigned an ESI score to 30 scenario-based questions as a pretest. This was followed by a two-hour training session with the standardized educational material published by the Agency for Healthcare Research and Quality. A second 30-item posttest was then administered. Comparisons between and within provider types were conducted with both pre- and posttest results using analysis of variance. Multivariate generalized linear regression was used to determine if provider type was predictive of pre- and posttest scores, when controlling for age, gender, and years of experience. **Results.** One hundred twenty-one providers (31 emergency medical technician–paramedics [EMT-Ps], 34 emergency medical technician–paramedics [EMTs], 29 non-ED RNs, and 27 ED RNs) participated in the study. All provider types significantly outperformed their standardized ED RN baseline (mean improvement = 18%, p < 0.05 for all groups), with mean posttest scores of 68%, 70%, 68%, and 80% for EMT-Bs, EMT-Ps, non-ED RNs, and ED RNs, respectively. The ED RNs were more likely to score higher than all other provider types on both the pre- and posttests (p < 0.001). The EMT-Bs scored significantly lower than EMT-Ps on the posttest (p < 0.05). There was no statistically significant difference in pre- or posttest scores between the paramedics and the non-ED RNs. These differences were not significant when controlling for age, gender, and years of experience. **Conclusions.** All provider groups showed comparable improvement from pretest to posttest, but the posttest scores remained relatively low. Our results from scenario-based questions suggest that practical experience with the ESI may be more important than working in an emergency setting or having a specific degree (e.g., EMT vs. RN). Future research on use of this system in the field is warranted.

37. HIGH-SCHOOL ALLIED HEALTH STUDENTS AND THEIR EXPOSURE TO THE PROFESSION OF EMERGENCY MEDICAL SERVICES

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Introduction. Ensuring a stable emergency medical services (EMS) workforce is a growing concern, and effective recruitment strategies are needed to attract young adults to the EMS profession. **Objectives.** We sought to assess the exposure of high-school allied health students to EMS as a career option, as well as measure their attitudes and beliefs towards the profession. **Methods.** A convenience sample of allied health students in a rural high-school system were surveyed about their exposure to the EMS profession across six high schools, 135 students responded. Only 20.7% intended to pursue EMS as a career, and 46.0% wanted to learn more about EMS. Most (68.2%) expressed interest in an emergency medical technician (EMT) course if one were offered alongside their high-school course. 84.3% and 80.0% were interested in a ride-along program. Independent predictors (odds ratio [OR], 95% confidence interval [CI]) of pursuing an EMT career included exposure to EMS outside of school (OR = 3.0, 95% CI 1.7–5.1) and class attendance (OR = 1.4, 95% CI 1.1–1.8). Other positive predictors included influence on career choice (9.6, 1.8–50.1), and the belief that EMS was mentally challenging (15.9, 1.1–216.6). Negative predictors included the beliefs that an EMT career was stimulating (0.05, 0.00–0.53) and physically challenging (0.06, 0.00–0.63), as well as prior exposure to an EMS job advertisement (0.14, 0.03–0.53). **Conclusions.** There is a lack of exposure to career and educational options in EMS among allied health students in this school system, and few students intended to pursue EMS after graduation. However, many students indicated they would like to learn more about EMS, including enrolling in an EMT course and ridealong programs. These findings suggest that, with proper exposure to the profession, more allied health students may potentially choose EMS as a career.

38. PRELIMINARY REPORT: CADEAVER LABORATORY VERSUS TRADITIONAL OPERATING ROOM EXPERIENCE FOR PARAMEDIC INTUBATION TRAINING

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Introduction. Endotracheal intubation (ETI) is an important paramedic skill that requires both didactic and experiential training to obtain proficiency. Many paramedic training programs are having difficulty securing a adequate operating room time for students. **Objectives.** We are conducting a long-term, prospective study to determine whether cadaver laboratory (CL) training is equivalent to traditional operating room training (OR training). **Methods.** Students in a community college–sponsored paramedic training program were recruited at the beginning of their course. Students who consented are randomized into OR and CL groups. Students in the OR group are trained according to the preexisting curriculum. The OR students must successfully perform at least three ETIs and one laryngeal mask airway (LMA) placement under the supervision of an anesthesiologist. The CL students attend two 2-hour sessions in groups of up to five students, during which they repeatedly perform ETI on eight different cadavers under the supervision of an emergency physician. **Results.** Thus far, 30 students have been enrolled. Five students left the course prior to completion of ETI training. The CL students spent four hours in training; the OR students spent an average of 13 hours in training (range 4–27 hours). The CL students averaged 57 (range 38–67) attempted and 56 (range 38–67) successful ETIs. The OR students averaged 4.4 (range 3–6) attempted and 3.1 (range 3–4) successful ETIs. In addition, the CL students observed an average of 76 (range 32–110) ETIs, while the OR students observed an average of 2.2 (range 0–8) ETIs. The CL students evaluated the learning experience higher than the OR students. **Conclusions.** While less realistic experience, CL training provided students with significantly more intubation attempts in a controlled environment compared with traditional OR training. After completion of the current training program, ETI success rates will be monitored for both groups, and an additional paramedic class will be enrolled.

39. AIRWAY MANAGEMENT AND ADVANCED LIFE SUPPORT PARAMEDICS: 12-MONTH FOLLOW-UP OF KNOWLEDGE AFTER AN INTENSE AIRWAY MANAGEMENT COURSE

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Introduction. Airway management is a high-acuity, time-sensitive intervention, representing one of the core life-saving skills in the scope of practice of the advanced life support (ALS) paramedic. Recent literature has questioned the role of prehospital endotracheal intubation, citing poor success rates and negative outcomes. Focused education for paramedics may lead to improvement in these areas. **Objectives.** This follow-up study assessed the airway management knowledge of ALS paramedics at six and 12 months after an intensive airway management course (Airway Interventions & Management in Emergencies [AIM]). **Methods.** The AIM course, previously only taught to physicians, was delivered to all ALS paramedics as part of the mandatory spring 2009 in-service. A written examination was given at six and 12 months after the intervention, identical to the examination administered at the beginning and end of the course. Immediate postcourse and delayed follow-up examinations have been presented previously. Differences between the mean score at all four time points were tested using analysis of variance and Tukey’s test. The participants were not matched to the corre-
working in university hospitals and 66% were hospital or university employees. Only 27% of the respondents had any EMS fellowship; 43% had been emergency medical techni-
cians (EMTs); and 66% had other specialized EMS training, most commonly hazardous ma-
terials and secondary toxicology. Forty-nine
percent had taken an EMS medical director’s course, of whom 72% had completed the National Associ-
ation of EMS Physicians (NAEMSP)-spon-
sored course. Forty-three percent were not mentioned in residence, and 29% (95% confidence in-
terval [CI] 20–40) felt somewhat or less pre-
pared (a 5 on a 10-point scale, mean 6.98) for
the position. Seventy-nine percent belonged
to NAEMSP, 88% to the American College
of Emergency Physicians (ACEP), and 65% to the Society for Emergency Medicine
(SAEM). Academic appointments were held by
96% of the respondents, mainly (81%) as asso-
ciate or assistant professors. Primary responsi-
bilities included resident education (89%), ad-
ministration (87%), EMT continuing education
(77%), and research (64%). Additionally, 91%
served on outside committees. Forty-two per-
cent dedicated 40–80% of their time to EMS, but
34% reported a part-time equivalent (FTE) or
greater position. The majority did not have a
physician associate director, secretary, or di-
agostics coordinator; however, these were one
EMT-level coordinator. Sixty-two percent earned the same salary as other faculty members. Eight-two per-
cent (95% CI 72–89) of respondents reported satisfied (4 or 5 on a 10-point scale) satisfaction (mean 7.45). Conclusions. Residency EMS di-
rectors are mostly male, EM residency–trained,
and right bundle branch blocks [LBBB, RBBB]). Ninety-
five percent (54/128, 95% CI 0.92–0.99) correctly
identified the anterior MI and 54%
(95% CI 0.80–0.85) identified the lateral MI.
Ninety-five percent (75/128, 95% CI 0.93–0.97) of
paramedics misinterpreted LHV, 56% (72/128,
95% CI 0.48–0.65) misinterpreted LBBB, and
52% (66/128, 95% CI 0.43–0.66) misinterpreted
ventricular pacing as a STEMI. Forty-two per-
cent (54/125, 95% CI 0.34–0.51) correctly
identified all three STEMs; however, only four
(3%) paramedics were correct in all of their inter-
pretations. Conclusions. Despite training and
ad avian level of confidence, our paramedics are
 abnormalities and normal MI. The causes
sequence of appropriate and missed activations.
44. A COMPARISON OF “FIRST RING” TO
BALLOON TIME FOR EMERGENCY MEDICAL
SERVICES ACUTE MYOCARDIAL INFARCTION
(AMI) PATIENTS VERSUS DOOR-TO-BALLOON
TIME FOR SELF-PRESENTING AMI PATIENTS
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Christiania Care Health System

Introduction. Patients with acute myocardial
infarction (AMI) presenting to emergency de-
partments (EDs) have many care intervals eval-
uated. The door-to-balloon (DTB) time is fre-
cently cited, measuring the time from ED ar-
ival to angioplasty. Patients with AMI experi-
ence symptoms before ED arrival. It is impos-
ible to accurately track symptom onset, and no
standard has been devised to identify the on-
set. Hypothesis. We propose that starting the
time interval at “first ring” into a public service
access point (PSAP) and continuing through
ami presentation can measure the interval for
emergency medical services (EMS) dis-
patch, evaluation, triage, and treatment of
AMI patients who call EMS. Methods. This

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retrospective observational study involved 50 EMS and 50 non-EMS patients presenting to a single hospital (Hospital, DE) and taken to the catheterization laboratory from the ED in 2009 with 572 suspected AMI patients being eligible for inclusion. Inclusions: Patients admitted from New Castle County (NCC), Delaware: 9-1-1 calls received at NCC dispatch; data available from the first telephone ring through catheterization laboratory procedure, including computer-aided dispatch (CAD) times, EMS reports, ED records, and catheterization report; and self-presenting patients had initial electrocardiogram (ECC) diagnosticians for AMI Exclusions: Delayed diagnostic ECC; non-NCC EMS transport; and incomplete records. We compared the standard DTB times for walk-in patients with the “first-ring-to-balloo” times for EMS patients. Results. Descriptive statistics showed 29 self-presenting AMI patients had fewer DTB minutes (median of 57.9 minutes) compared to 65 EMS patients have mean DTB minutes (median of 62.0 minutes). 417 during the night. STEMI patients had initial electrocardiogram (ECG) during daytime hours and 375 during the night. The evening group had a mean DTI of 62.0 minutes (median of 57.1 minutes) compared to the daytime and nighttime groups (mean of 43.8 vs. 44.3 minutes, respectively). Conclusions. Patients who present to the hospital during daytime hours, i.e., when the catheterization laboratory is open, have shorter DTI times than those who present at night. The low rate of emergent catheterization and revascularization among patients directly transported to PEC centers requires further investigation.

46. THE LAI PUBLIC'S EXPECTATIONS OF PREARRIVAL TIMES WHEN DIALING 9-1-1 . . . A DECADE LATER
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Introduction. Although the National Association of EMS Physicians (NAEMSP) considers prearrival instructions (PAI) a “mandatory function” of emergency medical dispatch, PAI are not universally provided by public safety answering points (PSAPs). Objective. Ten years after we published our original findings regarding the expectations of PAI, we sought to determine whether their expectations have changed. Methods. Research assistants made up to 1,000 calls to contact citizens from an originally generated list of 2,000 residential phone numbers. Citizens were questioned regarding their expectations of PAI provided they were at least 18 years of age and agreed to participate. Survey questions were based on the original survey, and results were compared with those of the original study. Results. We contacted 1,204 citizens. Of these, 526 (44%) met the inclusion criteria and provided oral consent. Ninety-four percent (94% confidence interval [CI]: 92%–96%) said they would dial 9-1-1 in an emergency and 39% (95% CI: 35%–43%) had actually called for an ambulance in the past 10 years. The percentages of respondents expecting PAI in particular situations were: 90% (95% CI: 88%–92%) for choking, 91% (95% CI: 89%–94%) for not breathing, and 85% (95% CI: 82%–88%) for childbirth. These results were similar to findings in the prior study when PAI were expected by 88% (95% CI: 85%–90%) for choking, 87% (95% CI: 84%–90%) for not breathing, and 88% (95% CI: 86%–91%) for childbirth. When asked about recent additional PAI, 73% (95% CI: 68%–78%) expected instructions to take aspirin for chest pain and 81% (95% CI: 77%–84%) expected instructions for a severe allergic reaction. Fifty-one percent (95% CI: 47%–55%) initially responded that they could perform cardiac resuscitation (CPR), but 89% (95% CI: 86%–92%) then responded they could perform CPR with instructions from a dispatcher. Conclusions. Prearrival instructions are an important, although often ignored, component of prehospital care. The lay public still expects PAI, despite the PAI in this study largely unmet. Finally, CPR PAI may lead to more citizens performing this lifesaving procedure.

47. STRUCTURED INSPECTION OF MEDICATIONS CARRIED AND STORED BY EMERGENCY MEDICAL SERVICES AGENCIES IDENTIFIES PRACTICES THAT REDUCE POTENTIAL ERRORS AND THE RISK OF PATIENT HARM
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Background. Medications are essential to emergency medical services (EMS) agencies when providing lifesaving care, but the EMS environment has challenges related to safe medication storage and transport. Objective. We developed a structured process to review medications carried by EMS to identify situations that may lead to medication error and to develop practices that reduce potential errors and the risk of patient harm. Methods. Using a structured process for inspection, an emergency medicine pharmacist and end-user practitioner reviewed the medication carrying and storage practices of all nine advanced life support ambulance agencies within a five-county EMS region. Because issues of climate on EMS medications have been addressed elsewhere, this study concentrated on potential for EMS medication administration errors exclusive of storage temperatures. Each carried and stored by the EMS agency was inspected for predeterined and spontaneously observed issues that could lead to medication error. These issues were documented and photographed.

Two EMS medical directors reviewed each potential error for risk of producing patient harm and assigned each to a category of high, moderate, or low risk. Results. When reviewing medications carried by the nine EMS agencies, 38 medication safety issues were identified (range 1 to 8 per EMS agency). Of these, 14 were considered to be high risk, 16 were moderate risk, and 8 were low risk for patient harm. Examples of potential issues included carrying expired medications, container labeling issues, different medications stored in look-alike containers in the same compartment, and carrying fluid solutions next to solutions premixed with medications. When reviewing medications stored at the EMS agency storage areas, 35 medication issues were identified (range 0 to 4 per station), including five moderate-risk and three low-risk issues. No agency had any high-risk medication issues related to medication storage in the station. Conclusion. We observed potential medication safety issues related to how medications are carried and stored at all nine EMS agencies in a five-county region. Understanding these issues may assist EMS agencies in reducing the potential for medication error and the risk of patient harm.

48. USE OF AN AMBULANCE SIREN LOW-FREQUENCY ENHANCER, THE HOWLER, IN A LARGE, URBAN EMERGENCY MEDICAL SERVICES SYSTEM—DO COLLISION RATES DECREASE?
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Background. Despite the use of traditional warning lights and sirens, ambulance collisions continue, resulting in morbidity and mortality. Objective. This study’s purpose was to retrospectively analyze the effects of adding a siren enhancer, Whelen Engineering’s Howler, on vehicle collisions in a large, urban emergency medical services (EMS) agency. Methods. The study focused on collisions involving agency-affiliated emergency vehicles and then analyzed collisions involving different agencies. Results. In total, 7 collisions were reported and maintained in a computerized database. The Howler was installed on all agency ambulances on February 1, 2009, and all agency ambulances were converted to use the Howler. Collisions occurring in the preceding 13 months (January 1, 2008–January 31, 2009) constitute the control group. Collisions occurring after Howler installation (February 1, 2009 – August 12, 2010) constitute the study group. Because of differences in lengths of time, number of ambulances utilized, and total ambulance mileage accrued per period, the study group was multiplied by a correction factor to allow comparative analysis using a primary formula of collisions/100,000 miles. The study group included classification as preventable or unpreventable, occurring during emergency lights.
and sirens utilization or normal traffic, and location of collision, specifically intersection or nonintersection. Total calls averaged 23, as well as excluded incidents involving stationary objects, such as light poles, were analyzed. Whelen Engineering did not associate with or fund this study. The study occurred at an annual rate of 3.6/100,000 miles in the control group. When excluding striking stationary objects, the control group collision rate was 1.9/100,000 miles. Preventable control group collisions occurred at a rate of 2.0/100,000 miles. Control group collisions during the use of warning lights and sirens occurred at a rate of 1.3/100,000 miles; intersection collisions in the control group occurred at a rate of 0.4/100,000 miles. Collisions in the study group occurred as follows: overall rate of 2.9/100,000 miles (−18.5%), excluding striking stationary objects at a rate of 1.5/100,000 miles (−21.9%), preventable at a rate of 1.6/100,000 miles (−19.6%), using warning lights and sirens at a rate of 1.0/100,000 miles (−17.4%), and at intersections at a rate of 0.1/100,000 miles (−84.8%). The reduction in intersection collisions was statistically significant, having nonoverlapping 95% confidence intervals.

Conclusion. Using comparative analysis with collision rates per adjusted 100,000 miles, installation of Howler low-frequency siren enhancers was associated with a 36.1% reduction in collisions. Subsequent collision rates within the study agency for all collision types, with statistical significance for intersection collisions.

49. EMERGENCY MEDICAL SERVICES (EMS) STRETCHER “MISADVENTURES” IN A LARGE, URBAN EMS SYSTEM: A DESCRIPTIVE ANALYSIS OF CONTRIBUTING FACTORS AND RESULTANT INJURIES

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Background. There is a paucity of data regarding emergency medical services (EMS) stretcher operation-related injuries. Objective. This study’s purpose was to describe and analyze characteristics associated with undesirable patient outcomes, based on resultant injury to patients and/or EMS professionals in a large, urban EMS agency. Methods. In the EMS agency studied, all stretcher-related “misadventures” are required to be documented by EMS personnel, regardless of whether injury results, using free-text incident-reporting software. All such stretcher-related reports for incidents that occurred between July 1, 2009, and June 30, 2010, were queried from the agency’s risk-management database in retrospective analysis, avoiding the Hawthorne effect in stretcher operators. Results. During the year studied, the EMS agency transported 129,110 patients; 23 stretcher incidents were reported (0.16 per 1,000 transports). No substantive patient injury occurred. Four EMS providers sustained minor injuries, two back-related and two knee-related. No time off work was requested by these injured personnel. There were three primary times of stretcher operation problems: unloading, loading, and surface movement. Fifteen of 23 (65.2%) occurred during unloading, five of 23 (21.7%) occurred during loading, and three of 23 (13.0%) occurred during surface movement. There were five contributing aspects to stretcher operation problems, with some incidents stemming from coordinators managing stretcher–ambulance safety latch mechanism, ground surface conditions, equipment failure, bariatric patient size, and combative patient behavior. Fourteen of 23 (60.9%) related to the stretcher’s not engaging its locking mechanisms on the ambulance floor; four of 23 (17.4%) related to poor ground surface conditions, especially related to equipment malfunction; two of 23 (8.7%) related to patient weight exceeding 450 lb, compounded by patient movement on the stretcher; and one of 23 (4.3%) related to combative patient movement. Among multiple analyses, from a personnel injury prevention perspective, there exists a significant relationship between combative patient movement and patient-related injuries related to stretcher operation, Fisher’s exact test = 0.048.

Conclusion. In a large, urban EMS system, the incidence of injury related to stretcher operations is markedly low, with few personnel injuries and no patient injuries incurred during the one-year study period. Emergency medical services personnel should be aware of the risk of injury to themselves that can occur during stretcher operations when moving combative patients.

50. PREDICTORS OF CRITICAL ILLNESS AMONG TRAUMA PATIENTS TRANSPORTED BY AERomedical EMERGENCY MEDICAL SERVICES

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Background. Aeromedical emergency medical services (EMS) is frequently utilized for transport of patients with significant traumatic injuries. Little evidence exists regarding which variables predict critical illness in this population. Objective. We sought to identify predictors of critical illness or need for emergent surgery among patients transported to the emergency department (ED) by helicopter. Methods. For this prospective cohort study, we retrieved statewide data on all trauma patients transported by helicopter from January 1, 2007, to December 31, 2009. Data included patient age, gender, race, Injury Severity Score (ISS), systolic blood pressure (SBP), respiratory rate (RR), Glasgow Coma Scale score (GCS), ED disposition (death, floor admission, intensive care unit [ICU] admission/immediate surgery/discharged), and mechanism of injury (MOI). The primary outcome was critical illness which we defined as either immediate surgery, ICU admission, or death. We used Pearson chi-square and Student’s t-tests for basic analysis, followed by logistic regression to determine independent predictors of critical illness. Results. Among 1,077 trauma patients transported by helicopter, 58 (5.4%) were labeled critical. Significant predictors of critical illness were age ≥80 years (relative risk [RR] 3.15, 95% Poisson exact confidence intervals [CI] 1.30–7.55), ISS ≥15 (RR 3.91, 95% CI 1.44–10.27), SBP <90 mm Hg (RR 2.63, 95% CI 1.22–5.65), and head injury (RR 2.96, 95% CI 1.16–7.53). Conclusion. Aeromedical transport of trauma patients is associated with a high risk of critical illness. Identification of factors predictive of critical illness may allow for triage within an aeromedical ambulance service that stratifies patients at higher risk for critical illness, resulting in earlier intervention in the ED with more rapid disposition to the ICU, decreasing supplemental utilization of EMS, and may be helpful to law enforcement, municipal planners, and many other state and national agencies.
regression analysis to control for potential confounders. **Results.** We included 5,126 patients; 2,894 patients (56.5% [95% confidence interval (CI): 55.1–57.8]) were critically ill. Predictors of critical illness were the same on basic and regression analyses, and included GCS, age, and MOI. Patients with SBP <100 mmHg were more likely to be critically ill (odds ratio [OR] = 1.90 [1.45–2.49]), as were patients with GCS <5 (OR = 5.20 [3.87–7.50]). GCS <15 (OR = 3.36 [2.60–4.04]), and age >65 years (OR = 1.36 [1.11–1.66]). The ISS was associated with critical illness, with each increment increasing the likelihood of critical illness (OR = 1.08 [1.07–1.09]). Women were less likely than men to be critically ill (OR = 0.85 [0.74–0.98]). Patients suffering burns (OR = 4.48 [2.82–7.11]), and age <27 years (OR = 2.79 [1.06–7.55]), other blunt trauma (OR = 1.77 [1.40–2.23]), or penetrating trauma (OR = 3.84 [2.91–5.07]) were more likely to be critically ill. Tachypnea, age <18 years, and race were not significantly associated with ICU admission, surgery, or death. One thousand one patients (19.5% [18.5–20.6]) underwent immediate surgery. The sensitivity, specificity, and accuracy of immediate surgery included SBP <100 mmHg, ISS, and penetrating trauma. Surprisingly, patients were less likely to undergo immediate surgery when they were aged 65 years or <18 years or had a GCS <15. **Conclusion.** More than half of patients transported by helicopter were critically ill, and nearly 20% underwent immediate surgery. Predictors of critical illness differed from predictors of the need for immediate surgery. This may have implications for future evidence-based guidelines regarding aeromedical trauma transport decisions and the need for trauma surgeon presence upon aeromedical EMS arrival.

**53. ACCURACY OF FOCUSED ASSESSMENT WITH SONOGRAPHS FOR TRAUMA (FAST) PERFORMED BY EMERGENCY MEDICAL TECHNICIANS**

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**Introduction.** It is important for emergency medical technicians (EMTs) to triage trauma patients in the prehospital setting for timely management of patients, including acute care, transport, and immediate trauma center prearrival notification. To triage trauma patients, focused assessment with sonography for trauma (FAST) is known to be very useful to detect the presence of free abdominal fluid. **Objective.** To evaluate the accuracy of FAST performed by EMTs. **Methods.** Five EMTs who had been working for the emergency department (ED) of Seoul National University Hospital under educational training that consisted of two-hour didactic lectures including the principles of ultrasonography and the anatomy of the abdomen and two-hour hands-on practice. The EMTs performed FAST on patients who visited the ED and underwent abdominal computed tomography (CT) scan. The sensitivity, specificity, positive predictive value, and negative predictive value were calculated based on the abdominal CT scan as a “gold standard.” **Results.** This is an interim report. From July 1, 2010, to September 30, 2010, 1,060 patients underwent an abdominal CT scan in the ED. Of these, 403 patients were given consent forms for this study, and 240 patients (59.1%) provided their consent. Eighty patients had an abdominal CT scan that showed free abdominal or pericardial fluid collection: 14 patients had a large amount of ascites, 15 patients had a small amount of ascites, and 51 patients had a small amount of ascites. Compared with the abdominal CT scan, FAST performed by EMTs had a sensitivity, specificity, and accuracy of 61.3% (95% confidence interval: 50.3–71.2), 96.3% (95% confidence interval: 91.8–98.3), and 84.6% (95% confidence interval: 78.3–89.8%); respectively. The positive predictive value and negative predictive value were 89.1% and 81.5%. **Conclusions.** The sensitivity of FAST performed by EMTs is low for small amounts of ascites. However, a small amount of ascites is hard to be detected by FAST. In the case of more than a medium amount of ascites, the detection rate of FAST performed by EMTs is 86.2 (95% confidence interval: 76.7–95.0%). After a short educational course on FAST for EMTs, the accuracy of FAST performed by EMTs should be as high as FAST performed by physicians. **54. EPIDEMIOLOGY OF TWO-WHEELER INJURIES IN INDIA: A PROSPECTIVE ANALYSIS**

Matthew Strehlow, Tina Hernandez-Boussard, Sreeram Sistla, Swetha V. Maradi, Stanford University School of Medicine

**Background.** Two-wheeler (scooter, motorcycle, bicycle) injuries represent nearly half of all road traffic injuries (RTIs) in India. Despite their frequency, few studies have described these patients. **Objective.** This study characterizes patients suffering injuries treated in the prehospital setting. **Methods.** In this prospective cohort study, every patient was enrolled in the Prehospital Emergency Management and Research Institute (GVK EMRS) for the complaint of RTI over twenty-eight 12-hour periods (equally distributed over each hour of the day and day of the week) in September–October 2009 was enrolled. Patients riding two-wheelers were identified and data were collected using standardized questionnaire fillers by real-time telephone from prehospital care providers. Follow-up information was collected at 48–72 hours and 30 days. **Results.** Fifty-six percent (n = 884) of all RTI victims enrolled during the study period used two-wheeler transport, corresponding to over 45,000 two-wheeler RTIs annually. Scooter/motorcycle injuries accounted for 90% of cases. The follow-up rate at 48–72 hours and 30 days was 70% and 65%, respectively. Ninety-one percent of patients were male, 66% were from rural/tribal areas, and 91% were from lower socioeconomic strata. The average call-to-scene time was 14 minutes (11, standard deviation [SD]) and the scene-to-hospital time was 20 minutes (14, SD). Only 6% of the patients reported having a helmet. Thirty-one percent (n = 272) of patients ≥12 years of age had signs of alcohol consumption at the time of injury. Prehospital evaluation identified the following rates of injury: extremity (75%), head/neck (37%), pelvis (4%), chest (3%), and abdomin al (1%). Twenty-one percent of patients had surgery within 48 hours. Mortality rates prior to hospital arrival, at 48 hours, and at 30 days were 2%, 6%, and 8%, respectively. Patient characteristics associated with increased mortality included abdominal injuries (38% vs. 3%), head/neck injuries (5% vs. 2%), receipt of intra venous (IV) fluids (6% vs. 2%), oropharyngeal airway/nasopharyngeal airway usage (14% vs. 3%), backboard placement (7% vs. 2%), oxygen requirement (4% vs. 1%), abnormal prehospital vital signs (24% vs. 2%), and bradycardia (33% vs. 2%) (p < 0.05 for all). Abnormal prehospital vital signs were the only significant predictor of mortality for both sexes and for known confounders (odds ratio: 4.4, p < 0.05). **Conclusion.** Two-wheeler injuries account for the majority of RTIs in India and are associated with significant mortality. Helmets are rare and alcohol consumption is common. **55. REAL-TIME TRANSMISSION OF PREHOSPITAL ULTRASOUND IMAGES BETWEEN A GROUND AMBULANCE AND THE EMERGENCY DEPARTMENT VIA AN INTERNET NETWORK**

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**Background.** Prehospital ultrasound is used to diagnose hemoperitoneum caused by abdominal trauma and to determine the appropriate level of trauma center at the prehospital stage. **Objective.** We developed a real-time transmission system of prehospital ultrasound between a ground ambulance and the emergency department (ED) via an Internet network. **Methods.** We developed a real-time image transmission system of prehospital ultrasound. In the system, the ultrasound image was acquired using portable sonography (SonoSite Inc., Bothell, WA, USA) and the ultrasound image is encoded and transmitted to the ED using a wireless broadband (WiBro) Internet network. In the ED, the transmitted image is visualized in real time. Two emergency physicians rode a ground ambulance and acquired the ultrasound image using portable sonography and a multipurpose phantom model 539 (ATS Laboratories, Bridgeport, CT, USA). Image acquisition and transmission system was located 1, 3, 5, 10, and 15 km from the ED and during migration between each site. We assessed the success rate of image transmission, image file size, and the image quality of transmitted ultrasound image was scored by one radiologist for spatial resolution (score: 0–11), maximum depth penetration (score: 0–8), functional resolution (score: 0–6), and scale and dynamic range (0–6). **Results.** A total of 15 image acquisitions and transmissions were attempted and the success rate was 13 of 15 (86%). The mean image file size was 686.0 kbyte (minimum 65.6, maximum 1535.4) and the mean transmission speed was 63.5 kbyte/s. Among 13 transmission success cases, the image quality was rated as follows: 2 cases were rated 1; 5 cases were rated 2; 6 cases were rated 3; 1 case was rated 4 for six cases, and 1 for three cases. **Conclusion.** Real-time transmission of prehospital ultrasound images showed a good success rate, and the quality of the transmitted images was acceptable. **56. A COMPARISON OF PROXIMAL TibIA, PROXIMAL Humerus, and DISTAL FemUR INFUSion Rates UNDER HIGH Pressure (>300 mmHg) USING THE EZ-Io INtraosseous DEVICE ON AN ADULT SWINE (ITALIC¿S US SCROFAITALIC¿) MODEL**

Julio Lairert, Vikhyat Beharta, Kimberly Lairert, Robert Kacprowicz, Christopher Lawler, Rebecca Pintott, Jerry Cowart, Anneke Bush, Wilford Hall Medical Center

**Objectives.** Comparison of intraosseous (IO) infusion rates through the proximal tibia, the distal femur, and the proximal humerus using high pressure (>300 mmHg) in the adult Sus scrofa swine model. **Methods.** We completed a prospective interventional study comparing infusion rates under high pressure through an EZ-Io needle between the proximal tibia, the distal femur, and the proximal humerus. A 25 mm EZ-Io needle was inserted into the proximal tibia bilaterally, an 18-gauge needle was inserted into the distal femur and proximal humerus bilaterally. Placement was confirmed by bone marrow aspiration, ease to saline flush, and measurement of continuous infusion. After establishment of central vein access, blood was removed until the mean arterial pressure (MAP) was decreased by 25% from baseline.
Infusion of normal saline was carried out at each site for a period of 10 minutes with a pressure of 90 mmHg to maintain a continuous fluid infusion as measured at the site. The pressure at the site during the infusion was also documented at 15-second intervals. Following euthanasia, the femoral sites were harvested and examined by a veterinary pathologist and processed for histopathologic examination. Statistical analysis of the infusion rates was performed using analysis of variance. Results. The average weight of the swine was 71 kg. The maximum mean infusion pressure was 580 mmHg (standard deviation [SD] 54.7 mmHg) for the tibia, 553 mmHg for the femur, and 499 mmHg (SD 59.2 mmHg) for the humerus. The mean infusion rate was 103 mL/min (SD 46.1 mL/min) for the tibia, 138 mL/min (SD 65.3 mL/min) for the femur, and 213 mL/min (SD 53.2 mL/min) for the humerus. Infusion rate comparison of all the sites revealed a p < 0.001. Post hoc analysis comparing flow rates of the humerus with the tibia and the femur using the Tukey honestly significant difference (HSD) revealed significant statistical significance with p < 0.001. On the other hand, post hoc analysis between the tibia and the femur did not reveal statistical significance, with p < 0.138. Histopathologic examination revealed findings consistent with IO placement. Conclusion. The rate of infusion of saline to the humerus was next step in comparison with the tibia and the femur. Additional studies are needed to further evaluate high-pressure infusions using IO devices.

57. SIGNAL CHARACTERISTICS OF TWO-DIMENSIONAL EPICARDIAL SURFACE AND LEAD II ELECTROCARDIOGRAPHY DURING UNITREATED VENTRICULAR FIBRILLATION AND CARDIOPULMONARY BYPASS RESUSCITATION

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Background. Quantitative waveform measures (QWMs) of the ventricular fibrillation (VF) electrocardiogram (ECG) are descriptors of electrical activity of the heart during VF. The correspondence between QWMs and the electrophysiology of the myocardium is not fully understood. This study evaluated the signal characteristics of the chest-surface ECG waveform to describe electrical activity of the heart at the epicardial level. Methods. Six domestic, mixed-breed swine were sedated, anesthetized, and mechanically ventilated with room air was provided. Prior to induction of VF, a left-side thoracotomy was performed, the pericardium was excised, and the heart was delivered. Surface ECG was monitored continuously via lead II ECG. Cardiac arrest was induced with a 3-second 100-mA transthoracic shock. A custom-built nine-electrode array with common ground was placed 1 cm to the right of the left anterior descending (LAD) coronary artery approximating 1 cm above the apex and manually held in continuous contact with constant pressure. Signals from the lead II ECG and the nine epicardial channels were recorded continuously for 15 minutes of untreated VF. After 15 minutes of VF, cardiopulmonary bypass (CPB) was initiated in two animals, and signals from the lead II ECG and the epicardial array were recorded for up to 10 minutes. Frequency spectra were calculated for 8-second data epochs. Amplitude spectrum area (AMSA), an established QWM, was then calculated from the spectra. The AMSA values were compared between lead II and epicardial channels during the untreated and resuscitation phases. Results. The trajectories of AMSA versus time were similar between lead II and epicardial array signals during untreated VF, with AMSA decreasing over time. Reperfusion via CPB resulted in recovery of AMSA in both signals. Conclusion. During untreated VF and subsequent reperfusion, the trajectory of at least one QWM applied at the surface avoids changes with activity at the localized epicardial level.

58. THE EFFECT OF PREHOSPITAL NALOXONE ADMINISTRATION ON VITAL SIGNS

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Background. Naloxone is frequently used by prehospital cardiac arrest personnel to suspected opioid overdoses. One of the most feared complications from its use is the development of noncardiogenic pulmonary edema. This entity is thought to be due to sudden changes in pulmonary pressures and vital signs after naloxone administration. However, previous studies have had poorly documented vital sign changes after naloxone administration. Objective. The objective of this study was to assess vital sign changes with the administration of naloxone prehospitality. Methods. A retrospective study was carried out. All prehospital patients during a 30-month period treated by a large, suburban, hospital-based emergency medical services (EMS) system were reviewed for the administration of naloxone. Data collected included patient characteristics, initial vital signs, initial oxygen saturation (by pulse oximeter), initial Glasgow Coma Scale (GCS) score, postnaloxone vital signs, postnaloxone oxygen saturation, and postnaloxone GCS score. Pre- and postnaloxone vital signs and GCS scores were compared using paired Student's t-test. A p < 0.05 was considered significant. This study was approved by the hospital and state institutional review board. Results. We identified and included 293 patients in this study; 54% were male, with an average age of 51 years. Statistically significant increases in oxygen saturation (91% to 95%, p < 0.0001) and GCS score (7.2 to 9.4, p < 0.0001) were noted. No significant changes were found in the systolic or diastolic blood pressure or heart rate. Conclusions. Naloxone usage prehospitality has minimal effects on blood pressure and heart rate, whereas it improves oxygen saturation and level of consciousness. These findings do not support the theory that sudden autonomic elimination of opioid-induced noncardiogenic pulmonary edema.

59. COMPARATIVE EVALUATION OF STROKE TRIAGE TOOLS FOR EMERGENCY MEDICAL DISPATCHERS

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Introduction. A crucial link in the stroke chain of survival, prehospital recognition, must be strengthened. Stroke emergency medical dispatchers (EMDs) using Card 28 of the Medical Priority Dispatch System (MPDS) protocol exhibit poor stroke recognition accuracy. In response, the National Academy of Emergency Dispatch (NAED) designed a new diagnostic tool using the Cincinnati Stroke Scale (CSS). The ability of EMDs to administer the CSS and their minimum effects on the dispatcher evaluation or no further diagnostic assessment. The time elapsed from initiation to completion of responses to Card 28’s six key questions and the time elapsed from randomization to completion of responses to the CSS’s three questions were recorded in the dispatch database. Means of the call time intervals with standard deviations (SDs) were calculated. Results. Of 1,143 medical aid calls received during the study period, 37 (3%) had a chief complaint suggestive of stroke; 20 of 37 (54%) met the inclusion criteria. Of those, 12 calls (60%) were randomized by confidence intervals of 7.6-cm needles. Objective. To measure chest wall thickness in trauma patients and determine the potential failure rate of common needle lengths at six insertion sites. Methods. This was a study of 100 consecutive adult trauma patients evaluated with a chest computed tomography (CT) scan at a Midwest urban level 1 trauma center. A 7.48 cm chest wall was measured on the right and left anteriorly at the midclavicular line, second intercostal space, and laterally at the anterior and midaxillary lines, fourth intercostal space. The measurements were used to predict the failure rate of two angiocatheter lengths. Sample size was determined a priori for a 95% confidence interval (CI) of ±10%. Data were analyzed with Stata to determine the mean chest wall thicknesses and failure rate of angiocatheters at each site. Results. Data from 95 adult patients were analyzed. The mean age was 43.3 years (CI 39.2 to 46.9). The left anterior chest wall had the smallest mean thickness (4.50 cm, CI 4.19 to 4.81), the left midaxillary line had the largest mean thickness (5.93 cm, CI 5.52 to 6.34). The predicted failure rates with a 5-cm angiocatheter ranged from 35% (CI 25 to 45) to 38% (CI 28 to 48) anteriorly on the left and right, respectively, the left midaxillary line had the largest mean thickness (5.93 cm, CI 5.52 to 6.34). The predicted failure rates with a 5-cm angiocatheter ranged from 35% (CI 25 to 45) to 38% (CI 28 to 48) anteriorly on the left and right, respectively, the left midaxillary line had the largest mean thickness (5.93 cm, CI 5.52 to 6.34). The predicted failure rates with a 5-cm angiocatheter ranged from 35% (CI 25 to 45) to 38% (CI 28 to 48) anteriorly on the left and right, respectively, the left midaxillary line had the largest mean thickness (5.93 cm, CI 5.52 to 6.34). The predicted failure rates with a 5-cm angiocatheter ranged from 35% (CI 25 to 45) to 38% (CI 28 to 48) anteriorly on the left and right, respectively, the left midaxillary line had the largest mean thickness (5.93 cm, CI 5.52 to 6.34). The predicted failure rates with a 5-cm angiocatheter ranged from 35% (CI 25 to 45) to 38% (CI 28 to 48) anteriorly on the left and right, respectively, the left midaxillary line had the largest mean thickness (5.93 cm, CI 5.52 to 6.34).
decompression with a 5-cm angiocatheter and some even with the longer angiocatheter. The angiocatheter was left in situ longer than lateral sites and should be the preferred site for needle thoracotomy.

61. VARIATIONS IN EMERGENCY MEDICAL SERVICES SHOCK DEMAND AND CARE

Henry E. Wang, Nathan I. Shapiro, Donald M. Yealy, University of Alabama at Birmingham

Introduction. The Institute of Medicine called for regionalized out-of-hospital care of critical illness. Limited insights detail the characteristics and regional distribution of critically ill emergency medical services (EMS) patients with traumatic and nontraumatic (septic, hypovolemic, cardiogenic) shock. Objective. We sought to describe clinical, demographic, and regional differences between EMS traumatic and nontraumatic shock patients. Methods. Using 2005–2008 statewide Pennsylvania EMS data, we identified adult (age > 18 years) non-cardiac arrest patients with shock, defined as initial systolic blood pressure <80 mm Hg. Excluding interfacility transports and cardiac arrests, we compared patient characteristics, demographic proportions, univariable odds ratios, Pearson’s correlation coefficient, and geographic information systems (GIS) mapping. Results. Of 3,339,009 adult, non-arrest patient contacts, shock occurred in 418,901 cases (12.54%; 95% confidence interval [CI]: 12.51–12.58%), including 120,640 traumatic (3.61%); 3,593–6.33%); and 298,261 nontraumatic (9.83%; 8.90–9.96%) cases. Annual per-capita shock rates were: total 1,137 per 100,000 population (1,131–1,143), traumatic 810 per 100,000 (805–815). Compared with rural EMS agencies (1.07; 1.03–1.09), but exhibited moderate correlation (rho = 0.09) or the Likert scale (r = –0.1 for Likert score). Conclusion. The SDxT may be a useful tool that sensitively identifies stroke patients. The SDxT should be moved higher in the emergency medical dispatch (EMD) protocol for stroke patients.

63. USE OF INTRAVENOUS FLUIDS IN EMERGENCY MEDICAL SERVICES AND ITS EFFECT ON DEGREE OF NAUSEA AND VOMITING

Paul Cheney, Scott Oglebee, Lynne Fullerton, Phil Froman, Steven Weiss, University of New Mexico

Background. While much has been written about the use of various medications for nausea and vomiting, study results conflict on whether crystalloidal alone improves nausea. In August 2009, our local emergency medical services (EMS) agency adopted a protocol for complete whenever a patient with nausea and/or vomiting was assessed and transported to one of the area hospitals. Patients were asked to rate their nausea vomiting (VAS) and Likert scale, and fluid administration and active vomiting were documented. Nausea medications were available to the agency during the pre-transport period of time. Hypothesis. The amount of intravenous (IV) saline administered during an EMS transport is related to the degree of improvement in nausea and vomiting before the SDxT was even administered as a standalone tool, the SDxT would have identified 60% of all strokes correctly. Telephone SDxT administration took an average of 44 seconds, with all administrations being under 1 minute. In the reverse-identified patients, the most common incorrect dispatch categories included unconsciousness, sick person, or fall. Conclusion. The SDxT may be a useful tool that 9–1–1 dispatchers can rapidly deploy to assist in the identification of possible stroke patients. To more rapidly identify a stroke and initiate a foam treatment cascade, the telephone SDxT should be moved higher in the emergency medical protocol (EMD) protocol for select patient complaints.

64. PERSHOCK PAUSE: AN INDEPENDENT PREDICTOR OF SURVIVAL

Sheldon Cheskes, Robert H. Schmicker, Jim Christsenson, James J. Menegazzi, Tom Rea, Judy Powell, Laurie Morrison, Susanne May, Lois Van Ottingham, David D. Salcido, Michelle Olsufka, Sarah Fenwick, Thomas Simonetti, Dana Edelson, Ian Stiell, Robert A. Berg, Ahamed Idriss, Rebecca Sell, Blair Bigham, Resuscitation Outcomes Consortium (ROC) Investigators, Sunnybrook Odor Center for Prehospital Care

Introduction. Pershock pauses, defined as the pauses before and after defibrillatory shock, interrupt chest compressions and are associated with reduced defibrillation success rates. Objective. We examined the relationship between pershock pauses and survival to hospital discharge in an out-of-hospital cardiac arrest (OHCA) registry. Hypothesis. Longer pershock pause intervals are associated with increased survival to discharge. Methods. We included OHCA patients in the Resuscitation Outcomes Consortium (ROC) Epistry–Cardiac Arrest who suffered cardiac arrest between December 2005 and June 2007, presented with ventricular fibrillation/ventricular tachycardia, and had cardiopulmonary resuscitation (CPR) process data for at least one shock (n = 839). Trained data abstractors used explicit definitions to record pershock pause intervals. We used multivariable logistic regression (for up to the first three shocks) to determine the association between survival and pershock pauses. Models were adjusted for ROC site, demographics (age, gender), circumstance (location, witnessed, bystander), and care (by advanced cardiac life support [ACLS] or emergency medical services response time) characteristics. Results. Descriptive: The median pershock pause (pre–post) was 30 seconds (s) (interquartile range [IQR] = 25–37 s). The median SDxT was 28 s (IQR = 22–34 s). The median pershock pause was 20 s (IQR = 14 s) and 22 s (IQR = 20 s). Multivariable regression using the longest pause showed the following hazard ratios: 1.02 (0.95–1.09) for patients with pershock pause <20 s, the odds of surviving to hospital discharge were 32% lower (odds ratio [OR]: 0.68; 95% confidence interval [CI]: 0.45–1.01) ever) from the beginning of the end to the transport, and the results on the Likert scale asking about the subjective change in the patient’s nausea (1 = a lot better, 5 = a lot worse). The scores on these two scales were compared with the amount of fluid given. We also determined the relationship between the presence of active nausea and vomiting in the ambulance and the amount of fluid given. Relationships were considered significant if the p-value was <0.05. Results. Two hundred sixty-five patients were included in the study. The average (± standard deviation) age was 49 ± 20 years. The average pre- and posttransport VAS rates were 70 ± 26 and 69 ± 28. The average change in VAS score was 1.5 ± 28. One hundred thirty-five of 228 patients (59%) received fluid, with an average of 265 ± 192 mL and ranging from 10 to 1,000 mL. On the VAS, 42 patients (32%) were worse. There was no correlation between the amount of fluid given and either the VAS (r = 0.09) or the Likert scale (r = 0.09) values. There was also no correlation between the amount of fluid and improvement in nausea among the 82 of 228 patients (36%) who were actively vomiting during EMS transport (∼0.2 for VAS change and –0.1 for Likert score). Conclusion. Administration of IV saline up to 1 liter is not associated with improvement in patient nausea during EMS transport, even among those actively vomiting.
Background. Ambulance Victoria provides out-of-hospital cardiac arrest (OHCA) resuscitation care for 500,000 people per year in metropolitan Melbourne, Australia. Of these, 400–500 achieve a sustained return of spontaneous circulation (ROSC). However, only 30% of these patients achieve survival to hospital discharge. Treatment of patients once ROSC has been achieved is based on the principle of goal-directed therapy for hemodynamic optimization; however, there is no established evidence supporting this treatment regimen in hospitals and none from the prehospital setting. Objectives. The aim of this study was to examine the association between prehospital systolic blood pressure and survival to discharge among post–cardiac arrest patients treated by intensive care paramedics. Methods. This was a retrospective case sheet review using data from the Victorian Ambulance Cardiac Arrest Registry (VACAR) from 2007 to 2009. Inclusion criteria were: age greater than 16 years, presumed cardiac etiology, and pulse on arrival at hospital. Data were analyzed using multivariate logistic regression adjusting for Utstein variables. Results. This study examined outcomes from 400 consecutive cardiac arrests. In patients who initially presented in ventricular fibrillation/ventricular tachycardia (VF/VT) who achieved ROSC, overall survival to discharge was 48%. In our system, prehospital systolic blood pressure of >100 mmHg was associated with significantly higher rates of survival to discharge (52% vs. 17%). On logistic regression analysis adjusted for Utstein variables (age, gender, bystander cardiopulmonary resuscitation, EMS response time, and witnessed arrest), prehospital systolic blood pressure was found to have an odds ratio of 1.08 per 10 mmHg for hospital discharge. Conclusion. Prehospital blood pressure was both a statistically and clinically significant predictor of survival to hospital discharge in OHCA patients who achieve ROSC. This association may represent a potentially treatable target to improve survival from OHCA.

65. REGIONAL IMPACT OF CARDIAC ARREST CENTER CRITERIA ON OUT-OF-HOSPITAL TRANSPORTATION PRACTICES

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Background. Cardiac arrest center (CAC) criteria are not well defined, nor is their potential impact on current emergency medical services (EMS) transportation practices for postarrest (PA) patients. The purpose of this study was to assess the availability of emergent cardiac catheterization (CATH) and therapeutic hypothermia (TH), high-volume centers and those with PA protocols have been associated with improved outcomes. Objectives. This study identified the PA treatment capabilities of receiving hospitals in a 10-county region EMS system without official CAC designation. Methods. We distributed a survey to 34 receiving hospitals to determine the availability and volume of CATH, TH, a PA protocol, and a 24-hour intensivist. We conducted a retrospective study of adult, nontrauma cardiac arrest patients transported with a pulse from 2006 to 2008 for 16 EMS agencies. The proportions of patients transported to hospitals meeting three different CAC criteria were compared: criteria A (availability of CATH and TH), criteria B (criteria A associated with >200 CATHs per year, and a PA protocol), and criteria C (criteria B and a 24-hour intensivist). Results. Data were obtained from 31 of 34 hospitals (91.1%), of which 11 (35.5%) met criteria A, seven (21.2%) met criteria B, and six (18.2%) met criteria C. Of 1,193 cardiac arrest patients, 46 (3.9%) were excluded because of transport to a pediatric, closed, or out-of-region hospital. There were 340 patients (82.5%) with return of spontaneous circulation at the destination transported to hospitals meeting criteria A, 304 patients (73.6%) transported to hospitals meeting criteria B, and 273 (66.1%) transported to hospitals meeting criteria C. Conclusions. In a region without official CAC designation, only one-third of hospitals meet basic CAC criteria (CATH and TH), but those facilities receive 82% of PA patients. Fewer patients (66%) are transported to hospitals meeting more stringent CAC criteria. These data provide a benchmark for the potential impact of developing a CAC policy based on current transportation practices.

66. IMPORTANCE OF PREHOSPITAL BLOOD PRESSURE AFTER RETURN OF SPONTANEOUS CIRCULATION ON SURVIVAL TO HOSPITAL DISCHARGE

Kate Cantwell, Janet Bray, Michael Stephenson, Kerry Power, Karen Smith, Stephen Bernard, Ambulance Victoria

Background. Ambulance Victoria provides out-of-hospital cardiac arrest (OHCA) resuscitation care for 500,000 people per year in metropolitan Melbourne, Australia. Of these, 400–500 achieve a sustained return of spontaneous circulation (ROSC). However, only 30% of these patients achieve survival to hospital discharge. Treatment of patients once ROSC has been achieved is based on the principle of goal-directed therapy for hemodynamic optimization; however, there is no established evidence supporting this treatment regimen in hospitals and none from the prehospital setting. Objectives. The aim of this study was to examine the association between prehospital systolic blood pressure and survival to discharge among post–cardiac arrest patients treated by intensive care paramedics. Methods. This was a retrospective case sheet review using data from the Victorian Ambulance Cardiac Arrest Registry (VACAR) from 2007 to 2009. Inclusion criteria were: age greater than 16 years, presumed cardiac etiology, and pulse on arrival at hospital. Data were analyzed using multivariate logistic regression adjusting for Utstein variables. Results. This study examined outcomes from 400 consecutive cardiac arrests. In patients who initially presented in ventricular fibrillation/ventricular tachycardia (VF/VT) who achieved ROSC, overall survival to discharge was 48%. In our system, prehospital systolic blood pressure of >100 mmHg was associated with significantly higher rates of survival to discharge (52% vs. 17%). On logistic regression analysis adjusted for Utstein variables (age, gender, bystander cardiopulmonary resuscitation, EMT response time, and witnessed arrest), prehospital systolic blood pressure was found to have an odds ratio of 1.08 per 10 mmHg for hospital discharge. Conclusion. Prehospital blood pressure was both a statistically and clinically significant predictor of survival to hospital discharge in OHCA patients who achieve ROSC. This association may represent a potentially treatable target to improve survival from OHCA.

67. BARRIERS TO DISPATCHER-ASSISTED CARDIOPULMONARY RESUSCITATION IN CARDIAC ARREST

David Slattery, Lorren Gorosh, Anna Huh, Allen A. Abello, University of Nevada School of Medicine and Las Vegas Fire and Rescue

Introduction. Favorable outcome after sudden cardiac arrest (SCA) hinges on the well-established chain of survival. Emergency dispatchers play a pivotal role in this chain by providing dispatcher-assisted cardiopulmonary resuscitation (D-CPR). Despite its importance, many SCA patients do not receive D-CPR. Objectives. 1) To quantify the prevalence, timing, and length of D-CPR for adjudicated SCA. 2) To describe the characteristics that contribute to failure to initiate D-CPR. Methods. The setting was an urban/suburban fine-based, advanced life support (ALS) agency serving a population of 800,000 and utilizing the Medical Priority Dispatch System (v. 12). We conducted a structured retrospective review of 9–1-1 recordings linked to our city’s Cardiac Arrest Registry to Enhance Survival (CARES) data. Inclusion criteria: Nontraumatic SCA occurring from January 2008 to January 2010 inclusive. A trained data extractor, blinded to the study hypothesis, collected explicit data using a standardized data extraction form. Interrater reliability was calculated from a sample of 45% (n = 59) of the data. Results. One hundred fifty-six consecutive cardiac arrest were reviewed. Of those, 104 patients received manual CPR (m-CPR) and 51 (39%) received D-CPR. Compared with patients who received CPR with the AutoPulse the AutoPulse had a higher rate of return of spontaneous circulation (ROSC) on arrival to the emergency department compared with those who received traditional CPR. The secondary objective was to determine if there was a difference in survival to hospital discharge between the two groups. Methods. A retrospective ambulance call report (ACR) review was conducted on all patients in Ontario County who had an out-of-hospital cardiac arrest from January 2008 to January 2010 inclusive. A trained data extractor, blinded to the study hypothesis, collected explicit data using a standardized data extraction form. Interrater reliability was calculated from a sample of 45% (n = 59) of the data. A significant difference existed in the primary endpoint of ROSC between the m-CPR group and the a-CPR group (p = 0.035). Conclusion. Prehospital systolic blood pressure was both a statistically and clinically significant predictor of survival to hospital discharge in OHCA patients who achieve ROSC. This association may represent a potentially treatable target to improve survival from OHCA.

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determine the final outcome in a total of two patients. Conclusions. The use of the AutoPulse to provide prehospital cardiac arrest care is associated with higher rates of ROSC. This difference did not translate into a greater proportion of patients surviving to hospital discharge. Furthermore, the potential long-term benefits of the AutoPulse should be performed before this technology is utilized throughout EMS systems.

69. PREHOSPITAL INDUCTION OF THERAPEUTIC HYPOTERMIA: A META-ANALYSIS

Cherie-Lee Adams, Caillin Langmann, Michelle Welsford, McMaster University–Emergency Medicine Residency

Background. Mild therapeutic hypothermia (TH) for comatose survivors of cardiac arrest has been demonstrated to provide dramatically improved neurologic outcomes when started in hospital. Some data suggest the degree of neurologic protection may decline with increasing time to attain target TH. Objective. This meta-analysis was conducted to determine whether infusion of cold intravenous crystalloid in the field or in the prehospital setting is an efficacious and safe method of inducing TH in cardiac arrest survivors. Methods. Two independent searches of the following databases were reviewed up to July 1, 2010: Medline, EMBASE, CINAHL–EBSCO, Cochrane Central, and Web of Science. Trials examining the effect of prehospital administration of cold, intravenous crystalloid on core body temperature as a means of attaining TH in adult cardiac arrest patients were included. Two authors independently reviewed the search results to identify trials meeting the inclusion criteria and to assess methodologic quality. A standardized template was used to extract data: authors; date of publication; study type; population; study design; exclusion criteria; definition of TH and maintenance; method of cooling; target TH; time to achieve TH; time at target TH; outcomes; and adverse events. Results. Data from three pilot studies involving 63 patients and three randomized, controlled trials involving 232 patients were analyzed. Pooled analysis demonstrated an average decrease in core temperature of 1.36°C (CI, −1.633, −1.088) for all data, and an average decrease of −1.46°C (95% CI, −1.770, −1.151) when randomized controlled trial (RCT) data were examined separately. To achieve these endpoints, patients were infused with a solution volume of 2 L or targeted a specific temperature. In the latter studies, trials either aimed to infuse a volume of crystalloid was infused. No differences were observed in the field or in the prehospital setting.

70. A SIMPLE METHOD OF MAINTAINING CHILLED SALINE IN THE PREHOSPITAL SETTING

Michael Pasirstein, Derek Isenberg, Keenan Early, Drexel University College of Medicine

Introduction. Hypothermia has been shown to improve neurologic outcomes after cardiac arrest. Hypothermia should be started as soon as return of spontaneous circulation occurs, ideally in the prehospital setting. Often, emergency medical services (EMS) agencies cannot place refrigerators in their ambulances because of cost or equipment restrictions. A previous study has shown that a cooler and ice packs can maintain saline chilled in a laboratory setting. Objective. We sought to determine whether a cooler and ice packs could keep saline cold under actual prehospital conditions. Methods. Two 600 mL bags of normal saline were placed in a standard cooler with three ice packs. An additional bag of 1,000 mL of 0.9% normal saline remained outside the cooler as a control. The saline was infused into each bag of saline. Over nine consecutive days, the temperatures of the ambient air, each bag of saline, and the control bag of saline were recorded every hour in four different ambulances. Results. The mean temperatures recorded for 24 hours ranged as follows: ambient temperature 24°C to 27.2°C, bottom bag 0.6°C to 3.5°C, top bag 1.4°C to 5.7°C, and control bag 9.8°C to 26.8°C. A t-test was used to compare the bottom bag and top bag of chilled saline against the control bag. Statistical significance (p < 0.05) was achieved at all time points. At 12 hours, 100% of the bottom bags and 93.9% of the top bags were <6°C; 100% of the bottom bags and 84.9% of the top bags were <4°C. At 24 hours, 93.6% of the bottom bags and 75% of the top bags were <6°C; 93.6% of the bottom bags and 56.3% of the top bags were <4°C. Results. Our data demonstrate that saline can be kept chilled for 24 hours using ice packs and coolers. The estimated cost is less than $30.00 per ambulance. Our experimental design required the cooler lids to be slightly ajar to allow for the temperature gradient. Thus, closing the coolers tightly should maintain the top bag at a lower temperature. Using coolers and ice packs, replaced daily, is an inexpensive way for EMS agencies to implement prehospital hypothermia.

Funding. This study was supported by Drexel University College of Medicine, Seoguipo Medical Center, Jeju, Korea

Hypothesis. We hypothesized that the benefit of being treated in high-volume centers could outweigh the risk of longer transport intervals up to a certain length of time. Methods. A systematic search of multiple databases and hand-searched reference lists. Data from three pilot studies involving 63 patients and three randomized, controlled trials involving 232 patients were analyzed. Pooled analysis demonstrated a significant decrease in core temperature of 1.36°C (CI, −1.633, −1.088) for all data, and an average decrease of −1.46°C (95% CI, −1.770, −1.151) when randomized controlled trial (RCT) data were examined separately. To achieve these endpoints, patients were infused with a solution volume of 2 L or targeted a specific temperature. In the latter studies, trials either aimed to infuse a volume of crystalloid was infused. No differences were observed in the field or in the prehospital setting.

71. BYPASSING FOR REGIONAL CENTERS WITH OUT-OF-HOSPITAL CARDIAC ARRESTS: HOW FAR CAN WE TRANSPORT? Won Chul Cha, Ki Ok Ahn, Sang Do Shin, Kyung Joon Song, Seung Sik Hwang, Department of Emergency Medicine, Seoguipo Medical Center, Jeju, Korea

Introduction. We conducted this study to determine if a relationship exists in this body of literature between study design and direction of evidence. A priori-defined clinical outcomes included rhythm terminations, survival to discharge, and adverse events. Results. Thirty-five reports were included; half were case reports (17/35). Only one prospective study with a control group was located. The reports included 1969 articles, 75 trials, 4618 patients (1 article, n = 2), and animals (3 articles, n = 45). The direction of evidence was mixed: 13 papers were supportive of PT, 10 were neutral, and 12 opposed PT. A significant relationship between study design and direction of evidence was found in human studies (chi-squared 16.476, p = 0.04), indicating publishing bias. The only evidence of successful rhythm conversion was from case reports and two cohort studies (combined, PT converted 37 of 82 episodes of VT). Other evidence did not support the ineffectiveness of PT in converting ventricular arrhythmias, and that PT can cause rhythm deterioration, fractured sternum, and stroke. Prehospital thump is less likely to be effective in ischemic myocardium if or the patient is receiving digitalis therapy. In the study with a control group, an improvement in survival was not found with PT versus standard resuscitation (n = 356, 5.6% versus 6.4%, p < 0.05). Conclusions. This is the most comprehensive review of PT to date. There is a lack of compelling data to support the effectiveness of PT. Therefore, it is recommended that all clinicians, responders, and laypeople should focus on quick initiation of cardiopulmonary resuscitation, defibrillation, and/or electrical cardioversion.
Chest compression release is significantly improved with visual feedback.

Background. Rescuers should fully release chest compressions (CCs) to allow for heart refilling; however, CC release is often suboptimal. Objective. This study was undertaken to determine the effect of audiovisual CC depth and rate feedback with and without novel release feedback on CC release. Methods. Twenty-one basic life support (BLS)-certified prehospital providers performed two 4-minute continuous CC sessions on a manikin. Chest compression quality data were recorded using PC Skill Reporting software (Laerlad) and an E Series defibrillator (ZOLL Medical). All audiovisual CC feedback available on the defibrillator was disabled in the first trial. For the second trial, rescuers were randomized to receive audiovisual feedback on depth and rate alone (DR, n = 8) or on depth, rate, and release (DRR, n = 13). Two-way analysis of variance and paired t-tests were utilized. Results. At baseline, subjects incompletely released 34% ± 43% (mean ± SD) CCs. Nineteen (86%) subjects incompletely released >10% of CCs, of which six incompletely released >90% of CCs. For participants with incomplete release at baseline (>10% incomplete release; n = 19), CC release substantially improved with use of any audiovisual feedback (trial 1 vs. trial 2, p = 0.002); however, CC release was superior in those receiving additional feedback on release (DRR vs. DR, p = 0.004). Specifically, CC release improved from 69% ± 36% incomplete release at baseline to 0% ± 1% with DRR feedback (p = 0.005) as compared with 32% ± 25% incomplete release with DR feedback (p = 0.2). Rescuers with incomplete release at baseline did not recognize their inability to release (39% ± 20% estimated incomplete release vs. 1% ± 1% measured, p = 0.0001).

Conclusions. Chest compression release is significantly improved with the use of visual feedback on release. Chest compression release is significantly improved with correction of depth and rate alone. Rescuers have difficulty estimating CC release.

Calculation of the Demand for Public-Access Defibrillation on the Basis of High-Risk Area Using a Geographic Information System in a Metropolitan City

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Background. The public-access defibrillation (PAD) program has been known as a major community intervention for improving the outcomes of out-of-hospital cardiac arrest (OHCA). It is unclear how many public-access defibrillators are needed to appropriately cover the potential areas. Professional organizations have recommended the historically high-risk area (HHRA) for implementing PAD when a site has been designated by the American Heart Association (AHA) or in two years (European Resuscitation Council). Objective. This study aimed to calculate the demand for PAD on the basis of the HHRA compared with the potentially high-risk area (PHRA). Methods. A metropolitan city with a population of 10 million people was studied. The PAD program had never been implemented before 2008. A lattice of 100 m × 100 m was drawn on the city map and the total number of lattices was calculated. Administrative and geographic information was utilized to determine distance. When a lattice was mapped on the living area (public and nonpublic area) among whole lattices, excluding lattices on mountains, rivers, and so on, we defined the lattice was within the city. When a lattice was mapped on the site where an OHCA had occurred within three years (2006–2008), we defined the lattice was an HHRA. We calculated the coverage rate of lattices on PHRAs. We simulated the coverage rate considering newly-added OHCA cases. Results. The total number of lattices in the whole city was 60,677. Of these lattices, 12,221 lattices on PHRAs were 33,811. For three years, the total number of OHCA cases was 85,867. Excluding noncardiac etiology, 6,764 cases were mapped on each lattice. The total number of lattices (HHRA) with one more case with OHCA was 4,559. Every year 7% of the lattice was newly added to the previous HHRA. The coverage rate was 13.4%. If we added 7% of the lattice to the previous HHRA, the coverage rates would be 19.5%, 25.2%, 30.4%, 35.3%, and 39.8% in the next five years (2009 to 2014). Conclusion. Historically high-risk areas are limited, and three cases using a geographic information system had a relatively lower demand for PAD than potentially high-risk areas.

The Energy Burden of Emergency Medical Services Activities

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Background. We have previously reported the greenhouse gas (GHG) emissions from emergency medical services (EMS) operations. Independent of environmental concerns is the basic premise that GHG emissions arise from energy consumption, and energy is becoming increasingly scarce and expensive. Objective. The purpose of this post hoc analysis was to explore the energy burden of EMS activities by converting previously reported GHG emissions data into standard energy consumption measures, and by creating a preliminary estimate of the total annual energy use of EMS systems in the United States. Methods. The annual GHG emissions data previously reported by 10 North American EMS systems were converted into the standard and raw energy measures “thousand British Thermal Units” (kBTU) and megajoules (MJ). Total energy consumption, per-response energy consumption, and per-capita energy consumption were calculated, as were the relative contributions of each energy source. The per-response and per-capita measures were respectively multiplied by the estimated number of annual ambulance responses (21 million) and approximate population (309 million) of the United States to form a preliminary estimate of the total annual energy consumption for U.S. EMS systems. Results. The participating EMS systems measured a total of 171,374,481 kBTU (180,809,674 MJ) of energy to provide 409,446 EMS responses to a population of 291 million (95% CI range 180,809,674 ± 13). Two-way analysis of variance predicted 85%/100% maximal HR. Data were exported and analyzed with NCSS statistical software; as appropriate, NHANES data were monitored/captured in real time by the investigators and the IC. Zephyr engineers provided technical support only. The primary performance measure was the proportion of time in which the remote monitoring successfully captured physiologic and body position. For the secondary performance measure, the proportion of time that the FFRs exceeded their age-predicted 85%/100% maximal HR. Data were analyzed and exported with NCCS statistical software as appropriate. Nine (2 men/3 women) were all successfully monitored for 3.5 hours during two separate live-burn drills. The mean (standard error of the mean) age was 40 (1.68) years. There were no data transmission/monitoring failures. The median and mean (95% confidence interval [CI]) times that the FFRs had HR > 85% maximum were 11.47 and 20.8 (6, 35) minutes, and the median and mean (95% CI) times with > 100% maximum were 4.2 and 3.1 (1, 9) minutes. The median and mean (95% CI) proportions of time in which the FFRs had HR > 85% maximum were 27.9% and 40.4 (14, 66) (range = 11–99%), and the proportions with HR > 100% maximum were 10.2% and 10.1 (1, 2) (range = 0–2%). The FFRs and their families correctly identified the monitoring strap/shirts favorably, and all reported that the monitoring did not interfere with their suppression duties. Limitations: Feasibility study, small sample size, and variability in the proportion of patients for whom the FFR system is feasible. Firefighters’ HRs routinely exceed 85% HR thresholds. Our results, if validated, may have implications for FFs testing and potential integration of remote physiologic surveillance to maximize FF safety/health during fire suppression.
77. EMERGENCY MEDICAL TECHNICIAN
PERCEPTIONS OF TEAMWORK AND CONFLICT
WITH FAMILIAR AND UNFAMILIAR PARTNERS

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Background. Teamwork is essential to care and optimal safety for patients and providers. Our goal was to develop a reliable and valid tool for emergency medical services (EMS) administrators to assess teamwork and conflict in emergency medical technician (EMT) partnerships. Methods. We adapted 13 validated and widely used survey scales (i.e., TeamSTEPPS) to assess EMT partnerships during shiftwork. We added new items based on input from medical directors, EMTs, and researchers. We administered a 122-item survey (EMT-TEAMWORK) to a convenience sample of 35 EMS agencies and 1,712 EMS personnel. Each respondent referenced him or her most recent (last) partner using a seven-point Likert scale (weighted from 0–strongly disagree to 6–very agree). We used exploratory factor analysis (EFA) to eliminate insignificant items and tested reliability (internal consistency) and instrument validity using Cronbach’s alpha and exploratory factor analysis (CFA). We used parametric (t-test) and nonparametric (chi-square) tests to compare item responses and composite domain scores across measured variables (e.g., total shifts worked with the last partner). Results. We received 553 surveys (32% mean agency response rate). The proportions of paramedics and full-time work experience were significantly higher in respondents than non-respondents (57% vs. 49% and 70% vs. 55%, respectively, p < 0.05). The EFA and CFA results confirm high reliability and construct validity with 27 items in eight domains of teamwork and conflict: 1) Team Orientation, 2) Team Structure and Leadership, 3) Partner Communication, Team Support, and Monitoring, 4) Partner Trust and Shared Mental Models, 5) Partner Adaptability and Back-up Behavior, 6) Process Conflict, 7) Task Conflict, and 8) Interpersonal Conflict. The EMTs rating teamwork in new partnerships (new partners) had less positive scores on items measuring Partner Trust and Shared Mental Models than did the respondents working with familiar partners. Comparison of mean values and domain scores for disagreements, arguments, and disputes (Process Conflict) were higher in less familiar partnerships (p ≤ 0.05). Conclusions. The EMT-TEAMWORK survey is a reliable and valid tool for evaluating EMT partner teamwork.

78. HOW WELL DO EMERGENCY MEDICAL DISPATCH CODES PREDICT ADVANCED LIFE SUPPORT PREHOSPITAL INTERVENTIONS IN A DIVERSE URBAN COMMUNITY? Karl A. Sporer, Keith G. Wilson, University of California, San Francisco

Background. The Medical Priority Dispatch System (MPDS) is an emergency medical dispatch (EMD) system that is widely used to prioritize 9–1–1 calls and optimize resource allocation. The computer-based EMD system that uses callers’ responses to scripted questions to categorize cases into groups, called “determinants,” based on complaint and perceived acuity. Objective. This study evaluated the ability of EMD codes to predict prehospital use of medications and procedures. All MPDS determinants were analyzed for advanced life support (ALS) interventions. Methods. All transported prehospital patients assigned a determinant by the MPDS from January 1, 2009, to December 31, 2009, in a diverse urban community were included in the study for prehospital electronic patient care record. The records of transported patients dispatched through EMD were queried for prehospital interventions and matched to the MPDS classification. Only MPDS determinants with 10 or more calls were included in the analysis. Patients receiving prehospital medications or procedures were considered ALS interventions, and rates of ALS interventions within MPDS determinants were directly compared. Results. A total of 38,005 patients met the inclusion criteria. Patients with chest pain, head or heart problems, or diabetic problems received the most medications. Procedure rates were highest in patients with cardiac or respiratory arrest, breathing problems, choking, and seizures. Medications were administered to 19% of all calls, while only 2% of all calls had a procedure performed. Individual MPDS determinants with the highest rate of ALS interventions were 661A (breathing problems, 76% for medications and 9E1 (cardiac arrest, 32%) for procedures. Higher rates of ALS interventions in higher-acuity categories (Alpha, Bravo, Charlie, etc.) were seen in several EMD categories, including unconsciousness/fainting, breathing problems, and abdominal pain, but this was not observed in any category, including seizure, sick person, traumatic injury, and hemorrhage/lacerations. Conclusions. This study demonstrated only a modest ability of the EMD system to predict the need for prehospital medications or procedures. Dispatch priority (Alpha, Bravo, etc.) did not consistently predict ALS intervention rate in each complaint category. Questioning the utility of the multiple subdivisions.

79. AN ADVANCED PARTNER INCREASES ON-SCENE TIME FOR SINGLE-PARAMEDIC AMBULANCES

Brian Clemency, Anthony Billittier, Kevin Pacheco, Kris Attwood, State University of New York at Buffalo

Introduction. In our commercial, urban/suburban multisset system, paramedic ambulances are allocated on a rotation per year. Each year we add a basic or intermediate emergency medical technician (EMT) partner. Intermediate EMTs receive approximately 225 hours of training, but four (6%) tracked survival to hospital discharge. The median drug-assisted intubation success rate was 90% (IQ 82%–96%). When a rescue device was added, the median success rate was 99% (IQ 95%–100%). Fifty-one (78%) complied with published guidelines for the selection of medication for sedation, but four (6%) used a long-acting agent for initial neuromuscular blockade. Conclusion. We found that in the United States, approximately one-third of ground EMS organizations provide drug-assisted intubation, with no minimum requirement for continuing training.

80. DRUG-ASSISTED INTUBATION BY GROUND-BASED EMERGENCY MEDICAL SERVICES: A CROSS-SECTIONAL SURVEY


Background. While the role of drug-assisted intubation in the out-of-hospital setting is uncertain, there are consensus guidelines for those organizations that choose to perform this intervention. The number of emergency medical services (EMS) organizations that provide drug-assisted intubation and the extent of compliance with the guidelines are unknown. Hypothesis. We hypothesized that a cross-sectional survey would allow us to estimate the number of organizations performing this intervention and that it focused only on the largest cities in the United States. Organizations were included if they were listed on the 2008 JEMS 200-city survey and provided ground-based advanced life support. In our survey, we sent surveys to the medical director, the quality assurance manager, and the administrative director. We sent the majority of surveys by U.S. mail, but in some cases we also sent the subjects an e-mail with a link to an online version of the survey. Non-responders were contacted up to three additional times to encourage participation. Results. We received a response from 177 of the 236 organizations we surveyed, giving a response rate of 75%. Sixty-five (37%) used drug-assisted intubation, with an interval range of 10 (interquartile range [IQR] 21–110) cases per organization per year. These 65 organizations averaged 21 drug-assisted intubations per 100,000 population per year. Each year had no minimum requirement for continuing training, 64% (98%) required detection of exhaled carbon dioxide for confirmation of tube placement, 54% (85%) tracked survival, and 9% (5%) tracked survival to hospital discharge. The median drug-assisted intubation success rate was 90% (IQ 82%–96%). When a rescue device was added, the median success rate was 99% (IQ 95%–100%). Fifty-one (78%) complied with published guidelines for the selection of medication for sedation, but four (6%) utilized a long-acting agent for initial neuromuscular blockade. Conclusion. We found that in the United States, approximately one-third of ground EMS organizations provide drug-assisted intubation, with no minimum requirement for continuing training.

81. THE USE OF RAPID-SEQUENCE INTUBATION BY INTENSIVE CARE PARAMEDICS FOR PATIENTS WITH DETERMINATIONS OTHER THAN TRAUMATIC HEAD INJURY

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Background. There is a long history of prehospital endotracheal intubation, with little investigation and analysis of the benefits and risks. What international research has been done is
not generalizable to all ambulance services in Australia, as paramedics here maintain a high level of trauma training and medical oversight and have appropriate tools such as pulse oximetry and end-tidal carbon dioxide monitoring. Although there have been many trials examining rapid-sequence intubation (RSI) on head-injured trauma patients, there are little published data on the effects of RSI on medical patients and those with non-traumatic head injury. This study examined the short-term effects of RSI on patients with conditions other than traumatic head injury and to describe the success rates of RSI on the first attempt and the use of a failed intubation drill.

Methods. A retrospective review was conducted using data from the Victorian Ambulance Clinical Information System from 2006 to 2007. Inclusion criteria were: age greater than 17 years, use of xamethasone, and no history of recent trauma. Data were analyzed using appropriate univariate statistical techniques.

Results. This study examined the results from 163 patients in whom paramedic evaluation found was cerebrovascular accident, with a Glasgow Coma Scale (GCS) score less than 10, with seizures and post-cardiac arrest airway management as the next most common. Invasive care paramedics in Melbourne, Victoria, had a 97% success rate at intubation, with 92.5% being intubated on the first attempt. Conclusions. In this small case series, the success rates and time to insertion of the King LTS-D were comparable to previous reports. Further prospective, randomized research comparing the use of the airway against endotracheal intubation in RSI helicopter emergency medical services patients is warranted.

83. NALOXONE IS OVERUSED IN THE PREHOSPITAL SETTING

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Background. Many clinicians would argue that the only appropriate use of naloxone in the prehospital setting is to improve a patient’s respiratory status, and administering it inappropriately could result in patient harm and complications. Objective. We sought to determine if there is any benefit to treating malignant hypertension prehospitaly. Methods. A large, suburban, two-tiered emergency medical services (EMS) system with approximately 25,000 advanced life support (ALS) requests per year. Design: Retrospective cohort study. Population: Consecutive patients treated prehospitaly with naloxone over an 18-month period. Vital signs on initial ALS arrival, and on arrival at the emergency department (ED) were recorded. A priori, hyperventilation was defined as an initial respiratory rate (RR) <9 breaths/min or a pulse oximetry value <90%. Groups were compared using a t-test. Results. Of 41,804 ALS requests, 524 (0.8%) patients were treated with naloxone; 54% were male and the average age was 51 years. Of these patients, 102 (31% [CI: 26–37%]) were hyperventilating at the time of initial paramedic evaluation. Of the hyperventi- lating patients, 50 patients (49% [CI: 39–59%]) had a positive response to the naloxone and 39 patients (38% [CI: 29–48%]) were intubated despite treatment. Conclusions. Two-thirds of patients whom our ALS providers treat with naloxone are not hyperventilating, suggesting that it is being administered for other reasons. This overuse could result in patient harm and complica-tions. Naloxone use should be limited to hypoventi-lating patients, where it is more effective and is a key prehospital advanced life support skill, but IV placement success rates are variable among providers. Limited information is known about what factors are associated with successful IV placement, limiting the ability to develop benchmarks for skill maintenance, such as requiring a specific number of IV placements per year. Objectives. We aimed to identify whether first-pass IV success was associated with the number of attempted or successful previous IV attempts. We hypothesized that IV success is associated with the number of successful IV placements in the prior month.

Methods. We retrospectively studied 800 consecutive charts with an IV attempt from 11 suburban and rural EMS agencies that use a single electronic charting system. The primary endpoint was successful first IV attempt identified. Potential predictor variables were collected and analyzed by univariate logistic regression, including
In this retrospective study, prehospital IV placement was not significantly associated (p = 0.066). These data fail to support requirements for a minimum number of yearly IV placements to be associated (p = 0.838). The large range and scope of issues that relate to building the evidence base for prehospital care requires some form of systematic assessment that identifies important gaps in knowledge and some means of prioritizing the importance of these gaps so that appropriate research programs can be developed. Our hypothesis was that the majority of PAD programs were being conducted in accordance with law and regulations. One hundred four (26%) of PAD programs have registered with the Department of Health, EMS Bureau. We excluded all PAD programs that were not registered with the EMS Bureau, or had been registered and failed to renew registration at the end of four years. Programs registered under a single director were considered single programs for the purpose of the study. One hundred twenty-nine active programs were included in the study. A survey tool was developed with 27 questions, to assess how well the PAD program performed based on the nine state standards. The study hypothesis was 63% (95% CI = 50–73), which equates to 45 or more positive responses for the nine state standards. This did not meet the study criterion of greater than 50% positive responses. This standard that was not met was to report all operational responses to victims of sudden cardiac arrest. The Emergency Medical Services (EMS) Bureau required nine specific standards, which included nine standards for program/medical direction, training in cardiopulmonary resuscitation/automated external defibrillators (AEDs), notification of 9–1–1 and EMS programs, monthly AED checks, and program reporting and program documentation. Hypothesis. Our hypothesis was that patient priorities and decision making when using EMS reflect the beliefs and values of the emergency medical services (EMS) “safety culture” reflects the beliefs and values of the EMS-SAQ safety domain scores and responses are significant better than 50% of the all standard except those related to reporting of operational responses. This is critical in understanding how to improve these programs.

87. BUILDING THE EVIDENCE BASE FOR PREHOSPITAL CARE
Janette K. Turner, University of Sheffield

Background. One of the recommendations of the 2005 review of ambulance services in England, Taking Heart: Patient was that “The Department of Health should commission a programme of work to build the evidence base for pre-hospital and out of hospital care.”

Conclusion. The project built on a 2007 Delphi consultation that identified 96 topics for prehospital care research. The project was conducted in several waves to identify topics potentially important for ambulance policy initiatives. 2) Rapid scoping reviews of current evidence were conducted for each identified topic. 3) A score was calculated for each topic based on evidence quality, current or planned research, and relevance to policy. This was then used to construct a prioritized list of topics to inform future research and commissioning. Results. Eighteen topics were identified within six broad headings: 1) Understanding how services are being used; 2) EMS workforce; 3) Patient assessment and management; 4) Alternatives to ambulance transport to the emergency department (ED); and 5) Information and performance measurement. A total of 11 evidence reviews were conducted to assess the 18 agreed-upon topic areas. For some topics, there was virtually no empirical evidence to inform service development. This was particularly true of patient involvement and whole systems approaches to designing prehospital care services. For other topics, there was relatively plentiful evidence but it was limited to only some condition types. The top three priorities were 1) patient involvement in the planning of emergency care; 2) alternatives to ambulance response or transportation to the ED, and 3) patient priorities and decision making when using EMS. The project resulted in a comprehensive report of evidence reviews and research priorities that can be used as an information resource and to inform research funders of identified priorities.

88. EPIDEMIOLOGY OF PATIENTS TRANSPORTED BY AMBULANCE WITH SHORTNESS OF BREATH IN ANDHRA PRADESH, INDIA: A PROSPECTIVE ANALYSIS
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Background. “Shortness of breath” is a frequent reason for patients to request prehospital emergency medical services. To date, no study has examined the epidemiology of patients with shortness of breath in the prehospital setting in India. GVK Emergency Management and Research Institute (GVK EMRI) was launched in 2005 and provides toll-free prehospital emergency medical services to 1.3 million residents of Andhra Pradesh, India. Objective. This study describes the characteristics and outcomes of patients transported by GVK EMRI with a chief complaint of shortness of breath. Methods. We prospectively enrolled a random sample of patients with a chief complaint of shortness of breath over twenty-eight 12-hour periods (equally distributed over each hour of the day and day of the week) during March/April 2010. Patients aged <18 years, not present at the scene, or who refused services were excluded. Results. During the 4-week study period, a total of 650 patients were enrolled, 64% of whom were male; the mean age was 53 years. Patients were more often from urban areas (69%) and had lower socioeconomic status (91%). Prehospital interventions included oxygen (92%), tracheal intubation (27%), IV line placement (18%), nebulized medications (17%), cardiac monitoring (6%), and bag–mask ventilation (4%). Follow-up at 30 days was achieved in 81% of cases. The mortality rates prior to hospital arrival were 48–72 hours, and 34%, 43%, and respectively. Predictors of death prior to hospital arrival were older age, heart disease (26% vs. 11%), and increased age (58 vs. 52 years) (p < 0.05 for all). Conclusions. Shortness of breath is a common condition for which people seek prehospital emergency medical services in India and is associated with a substantial early and late mortality.
at least one indicator/behavior that may have compromised provider or patient safety. Lower scores for Safety Climate, Teamwork Climate, Perceptions of Management, Working Conditions, and Job Satisfaction were associated with increased reports of provider injury (p < 0.05). Lower scores for Safety Climate, Teamwork Climate, Perceptions of Management, Working Conditions, and Job Satisfaction were associated with increased reports of errors or adverse events (p < 0.05). Lower scores for Safety Climate, Teamwork Climate, Perceptions of Management, Working Conditions, and Job Satisfaction were associated with increased reports of behavior that may have compromised provider or patient safety (p < 0.05). Conclusions. Emergency medical services personnel with lower safety culture scores have increased reports of patient and provider safety events.

90. PUBLIC AUTOMATED EXTERNAL DEFIBRILLATOR DEPLOYMENT, USE, AND PATIENT OUTCOMES IN PUBLIC CARDIAC ARREST


Objective. Our objective was to describe public automated external defibrillator (PAED) deployment, use, and patient outcome after public–location cardiac arrest in two urban/suburban communities. Methods. We performed a retrospective interview of bystanders of public–out–of–hospital cardiac arrests (OOHCAs) in two communities in Michigan. All OOHCAs from September 2004 to June 2010 were screened. Cases were excluded if the arrest occurred in a health care facility, street or highway, or unknown location. Locations were categorized according to National EMS Information System (NEMSIS) location criteria, and further post hoc categorization was made for the category “trade and business sites.” A structured telephone interview of bystanders or facility administrative staff was conducted for cases with an on–site PAED deployed for deployment and use. Useline–style cardiac arrest process and outcome variables were recorded, with the primary outcome being survival to discharge from the hospital. Results. One hundred sixty–seven cases of public OOHCA were identified, 119 of which were included. The average age of the adult victims was 60.7 years (range 17 to 90). Overall, 54.3% had a ventricular fibrillation, most (71.7%) received bystander–cardiopulmonary resuscitation, and 20.2% survived to discharge. A PAED was available in 38 (31.9%) cases and was applied in 24 (63.2%) cases.

91. INVESTIGATING THE INFLUENCE OF OCCUPATIONAL STRESS EXPOSURE ON THE DEVELOPMENT OF POSTTRAUMATIC STRESS SYMPTOMATOLOGY IN EMERGENCY MEDICAL SERVICES PERSONNEL

Elizabeth A. Donnelly, University of Windsor

Introduction. Emergency medical services (EMS) providers are routinely exposed to stressors associated with the profession. These stressors may be related to critical incidents (e.g., death of a child, mass–casualty incidents, injury/death of a fellow provider). They may be more chronic (e.g., inadequate equipment, long–work hours, conflict with colleagues or supervisors). Previous research has identified problematic rates of posttraumatic stress disorder (PTSD) among EMS providers; however, little is known about how different types of stress exposure influence the development of stress reactions such as PTSD. Methods. To investigate how different types of occupationally related stress may contribute to stress reactions, a probability sample of emergency medical technician–basics and paramedics (n = 1,633) completed an Internet–based survey. Respondents reported levels of chronic stress, critical incident stress, and posttraumatic stress symptomatology (PTSS). Results. Correlations revealed a significant relationship between chronic stress and PTSS (r = 0.513, p < 0.001) and between critical incident stress and PTSS (r = 0.386, p < 0.001). Ordinary least squares (OLS) regression illustrated that when demographic factors were controlled, chronic stress, critical incident stress, and alcohol use all were significant predictors of PTSS (p < 0.001). Inclusion of an interaction effect between chronic stress and critical incident stress (p < 0.001) as well as between chronic stress and alcohol use (p < 0.05) created a robust final model with an R² of 0.326. Conclusion. These findings indicate that exposure to both chronic and critical incident stressors increases the risk of EMS providers’ developing a posttraumatic stress reaction. Higher levels of chronic stress, critical incident stress, and alcohol use may independently increase the risk for an increased level of PTSS. Further, for those reporting high levels of alcohol use or critical incident stress, also having high levels of chronic stress may further exacerbate the risk for developing PTSS. For those interested in provider health, these findings indicate that attention must be paid to the level of stress associated with both critical incident exposure and the chronic stress providers experience on a day-to-day basis.

92. DOES CALL VOLUME AND TRAINING LEVEL RESULT IN LOWER RATES OF ERROR?

Paul Robinson, Matthew Davis, Adam Dukelow, Mike Lewell, Severo Rodriguez, Southwest Ontario Regional Base Hospital Program

Introduction. The Southwest Ontario Regional Base Hospital Program (SWORBHP) provides medical direction, education, and quality assurance to 11 emergency medical services (EMS) systems. Call volumes among the 11 systems range from approximately 300 to 83,000 calls per year. Objective. The objective of this study was to compare call volume and level of medical directive error between the two types of services were compared. Results. A total of 35,559 calls were audited and 1,419 errors were identified. Twenty–three (1.6%) critical, 24 (17%) major, and 1,155 (81.4%) minor errors were made. The HCV services had an error rate of 2.1%; the LCV services had an error rate of 6.5% (p < 0.01). Services that had a CPD level of care had a significantly higher rate of errors compared with those with a combined ACP/PCP level (4.6% vs. 3.8%; p < 0.01). Conclusion. Low–call–volume services have a significantly higher rate of medical directive errors. Services employing only PCPs have a significantly higher rate than those that employ both ACPs and PCPs. Paramedics with high call volumes have fewer opportunities to apply protocols and gain mastery in their execution.

93. A COMPARISON OF CANADIAN TRIAGE AND ACCUTY SCALE SCORING BETWEEN PARAMEDICS AND TRIAGE NURSES: A RETROSPECTIVE REVIEW

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Introduction. The Canadian Triage and Acuity Scale (CTAS) is an objective tool that enables emergency departments (EDs) to prioritize patient care by triaging patients according to the severity of their presenting signs and symptoms. The CTAS system is also used by emergency medical services (EMS) and EDs to communicate patient acuity and allow the most appropriate resources accordingly. To succeed, there needs to be reliability of the CTAS scoring between EMS and the ED. Objective. The objective of this study was to assess the interrater reliability of CTAS scores provided by EMS with those of the triage nursing staff (registered nurses [RNs]) and ED physicians. Methods. A retrospective medical record review was performed for patients 18 years of age or greater brought to the ED via EMS over a six–month period. The CTAS scores were obtained from the ambulance call record (ACR) and the nursing triage record. Interrater reliability between the scores was calculated. The patient’s chief complaint and vital signs were also obtained from the ACR and nursing triage record. These data were used to generate retrospective ED physician CTAS scores. The ED physician scores were compared with those established by EMS and RNs to assess interrater reliability. Results. A total of 126 charts were reviewed. The EMS CTAS scores and RN CTAS scores were in agreement in 73.0% of the charts reviewed (κ = 0.56, 95% confidence interval [CI] 0.42–0.70). The EMS CTAS scores compared with the ED physician CTAS scores showed 69% agreement (κ = 0.52, 95% CI 0.38–0.66). The RN CTAS score compared with the ED physician CTAS scores showed 72% agreement (κ = 0.75, 95% CI 0.64–0.86). Conclusions. Canadian Triage and Acuity Scale scoring by EMS showed only moderate agreement when compared with RNs or the retrospective ED physician scoring. The RN scoring had substantial agreement.
with the ED physician scoring. Continued paramedic CTAS training is required to acquire this consistency.

94. EVALUATING THE HELICOPTER EMERGENCY MEDICAL SERVICES MISSION ACCEPTANCE/TRIAGE PROCESS IN A PROVINCIALY BASED CRITICAL CARE TRANSPORT PROGRAM: A PROSPECTIVE STUDY

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Background. In order to maximize potential clinical benefits, improve integration with the broader system, and minimize exposure to unjustifiable safety risks, it is critical that patients be triaged appropriately to helicopter emergency medical services (HEMS). In many HEMS studies, overtriage rates are unacceptable high. However, in order to determine reasonable “overtriage” rates, the corresponding “undertriage” rates must be know. This prospective study aimed to assess the appropriateness of the mission acceptance process in a provincial helicopter air medical transport program.

Methods. This prospective study included all requests for air medical transport of adult patients (>16 years). Data were collected over an 18-month period (June 1, 2007–December 31, 2008). The unique mission acceptance process in this program requires physician-to-paramedic (or physician-to-paramedic in the case of scene calls) discussion about the merits of the case. The mission acceptance process is not appropriate and undertriage (request not accepted, but appropriate) were captured. Medical appropriateness was defined as a priori as death during transport or in the first 24 hours, Injury Severity Score ≥12 (trauma), Rapid Emergency Medicine Score (REMS) >10 (medical), admission to a critical care area, or requiring a time-dependent (<4 hours) diagnostic test to rule out life- or limb-threatening pathology. Results. Forty-eight hundred and forty-one patients were entered with nine being triaged for follow-up; 12.1% of these cases were scene call and 89.7% were interfacility calls. Overall, the overtriage rate was 2.8% and the undertriage rate of 2.8%. The group of undifferentiated trauma, the over/undertriage rate was 2.8 vs. 6.1%. This ratio in the medical group was 5.6 vs. 5.6% and in the cardiac group 0.6 vs. 1.8%. Conclusions. The mission acceptance process in this integrated provincially based critical care transport program resulted in less overtriage (using the suggested appropriateness definition) than is commonly reported in literature. Different cut points in the appropriateness definition yield different results.

95. THE EFFECT OF SHIFT LENGTH ON FATIGUE AND COGNITIVE PERFORMANCE IN AIR MEDICAL PROVIDERS

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Background. Inadequate sleep and fatigue are common among medical professionals and have been linked to medical error and poor cognitive performance. Fatigue among emergency medical services (EMS) providers may vary with shift length. Objective. To compare levels of sleep and cognitive abilities in air medical crews after 12-hour versus 24-hour shifts. Method. A convenience sample of 34 EMS providers employed by one air medical service completed the Pittsburgh Sleep Quality Index (PSQI) and the Chalder Fatigue Questionnaire (CFQ) to determine fatigue before and after 12-hour (n = 16) and 24-hour (n = 18) shifts. A battery of neuropsychological tests, including the University of Southern California Repeatable Episodic Memory Test, the Cardiopulmonary Resuscitation (CPR) test, the Mini-Mental State Examination, the Auditory Serial Addition Test (PASAT), Trail Making Test (TMT), and Stroop Word Recognition Test, was administered before and after a shift to measure changes in performance following the shift. We compared pre- and postshift changes in scores and stratified them by shift length using t-tests, the Wilcoxon signed rank test, and Fisher’s exact test. Results. Participants in the 12- and 24-hour shift groups had mean ± standard deviation scores of 36 ± 8 years and 39 ± 6 years, respectively, and were predominantly men (68.8% 12-hour, 61.1% 24-hour). The PSQI scores identified 50% of the 12-hour subjects and 50% of the 24-hour subjects as having poor sleep quality. Preshift fatigue (median = 2.0; interquartile range [IQR] = 2–4) declined by the end of the shift to a median of 1.0 (IQR = 1–2; p = 0.006). Fewer providers identified themselves as severely fatigued after the shift (15%) vs. before (33%; p = 0.003). There were no changes in performance on the cognitive tests following a shift in either group. Conclusion. One-third of EMS providers in our survey identified themselves as severely fatigued, and half get poor sleep. However, in this sample of air medical providers, shift length was not associated with changes in fatigue or cognitive function.

96. CARDIOPULMONARY RESUSCITATION OUTCOME OF TraUMATIC OUT-OF-HOSPITAL CARDIAC ARREST IN LOW-VOLUME VERSUS HIGH-VOLUME EMERGENCY DEPARTMENTS

Youngsun Ro, Sang Do Shin, Ki Oh Ahn, Soo Jin Kim, Kyoung sun Song, Eui Jung Lee, Seoul National University Hospital, Korea

Introduction. It is unknown whether transporting victims of traumatic out-of-hospital cardiac arrest (OHCA) to an emergency department (ED) that experiences a high volume of hospital cardiolopulmonary resuscitation (CPR) attempts in the prehospital setting have better outcomes. Objective. We aimed to determine whether hospital CPR case volume is associated with mortality for trauma OHCA victims. Methods. A nationwide Uststein-style OHCA database (2006–2008) was constructed from emergency medical services (EMS) medical record review. Cases were enrolled if the etiology was traumatic. Patients with unknown hospital outcome were excluded. The hospital CPR case volume was calculated for each ED from these data and sensitivity analysis was 35 cases per year (the adjusted OR for survival for trauma OHCA cohort was 1.882 [95% CI: 1.643–2.155] for the traumatic OHCA cohort and 1.321 [95% CI: 1.127–1.549] for the treated traumatic OHCA cohort. The adjusted OR for survival for trauma OHCA cohort was 2.119 [95% CI: 1.628–2.757] for the traumatic OHCA cohort and 1.787 [95% CI: 1.301–2.454] for the treated traumatic OHCA cohort.

97. REDUCTION IN CHEST COMPRESSION FRACTION DURING TRANSITION FROM PREHOSPITAL TO IN-HOSPITAL CARE

Tyler Vadeboncouer, Paul Dommer, Kyle McCarty, Pete Walka, Gary Smith, Annemarie Silver, Bentley Bobrow, Mayo Clinic

Introduction. Cardiopulmonary resuscitation (CPR) quality has a strong impact on survival from out-of-hospital cardiac arrest. Objective. The purpose of this investigation was to compare CPR quality during the early minutes at the emergency department (ED), when the patient is transferred from prehospital to in-hospital care. Methods. A defibrillator (E Series, ZOLL Medical) with an accelerometer-based system for measurement of chest compression (CC) quality was used during resuscitation attempts for 219 consecutive adult nontraumatic cardiac arrest patients treated by three EMS agencies and five receiving hospitals between September 2008 and February 2010. Real-time audovisual feedback was disabled. Minute-by-minute CC quality data were extracted for each minute of treatment at the scene, during transport, and at arrival at the ED (from arrival until removal of prehospital electrodes or defibrillator shutdown in which the patient was without spontaneous circulation). Faint CPR tests were defined as a CC quality during the early minutes of CPR, whether the CC quality in the prehospital and in-hospital settings. Variability was defined as the average of minute-by-minute standard deviations in depth or rate. Results. Valid compression data were available from the prehospital scene (mean ± standard deviation duration = 16 ± 6 minutes), during ambulance transport (8 ± 5 minutes), and in the early minutes in-hospital (4 ± 2 minutes) for 59 patients. The CC fraction (percentage of time CCs were performed) was substantially lower in the in-hospital compared with at the scene (60 ± 15%, p = 0.01) and during transport (65% ± 19%, p = 0.0001). Variability in CC depth (0.31 in/min in-hospital vs. 0.19 in/min scenario, p = 0.003) and rate (0.192 cpm vs. 0.18 cpm, p = 0.0001) were substantially higher in-hospital compared with prehospital. Variabilities in both CC depth and rate were similar for in-hospital and during ambulance transport (p = 0.1–0.9). Mean depths and rates of CCs did not differ between the in-hospital and prehospital settings (p = 0.1, 0.6). Conclusions. These results suggest that CPR quality is affected during transition from the field to ED. This may be due to the difficulties in performing high-quality CPR while transferring the patient into the ED and from prehospital to in-hospital providers. Manual CPR quality during this transition time may be an area in need of expanded training.

98. CHANGES IN BYSTANDER CARDIOPULMONARY RESUSCITATION RATES OVER TIME IN A LARGE URBAN EMERGENCY MEDICAL SERVICES SYSTEM

James S. Lee, Greg A. Vogelaar, Ian E. Blanchard, Laura Vernon, Tyler S. Williamson, Andy R. Antoon, University of Calgary

Background. Cardiac arrest is the leading cause of death in Canada and the United States. A patient is almost four times more likely to survive...
a cardiac arrest if bystander cardiopulmonary resuscitation (CPR) is given. Many emergency medical systems have implemented programs with the goal of increasing the rate of bystander CPR in the community. Some of these programs have included prearrangement with all-1-1 call takers, regular and mass CPR training, and high-school student training. **Objective.** The purpose of this study was to determine the change in bystander CPR rate over time. We hypothesized that the rate of bystander CPR should increase over time because of the cumulative effects of increased CPR awareness and training in the community. The setting of this study was an advanced life support (ALS) EMS system servicing an urban community of approximately 1 million people. This retrospective chart review reports a bystander CPR rate that consists of all adult, cardiac etiology, prehospital cardiac arrest cases where resuscitation was attempted (denominator), and all those in this group who received bystander CPR (numerator). The bystander CPR rate in a previously published historical cohort (1993–1996) from this jurisdiction was compared with a contemporary cohort using a two-sample independent test of proportions. These cohorts were chosen a priori and based on the presence of complete data following the Ubstein temporal framework. The historical cohort had 940 patients who met the inclusion criteria, with 34% receiving bystander CPR; the contemporary cohort had 1,663 patients, with 30% receiving bystander CPR. There was a 4% decrease in the rate of bystander CPR from the historical to the contemporary cohorts (p = 0.035; 95% confidence interval [CI]: 0.3%, 7.7%). **Conclusions.** While considerable effort has been made to promote CPR in this jurisdiction over the last decade, the aggregate rate of documented bystander CPR has not increased. While it is possible that there may be differences in the data-collection methods between cohorts, the differences are unlikely to be of sufficient magnitude to change the conclusions of this study. The reasons for poor community adoption of bystander CPR remains unclear and will be the subject of future research. 

99. TIME TO FIRST COMPRESSION USING MEDICAL PRIORITY DISPATCH SYSTEM (MPDS) PROTOCOLS FOR THE DETECTION OF NONTRAUMATIC CARDIOPULMONARY RESUSCITATION (

Lee M. Van Vleet, Michael W. Hubble, Wake County EMS

**Introduction.** Without bystander cardiopulmonary resuscitation (CPR), cardiac arrest survival decreases 7%–10% for every minute of delay until defibrillation. Dispatcher-assisted CPR (D-CPR) has been shown to increase the rates of bystander CPR and cardiac arrest survival. Other reports suggest that the most critical component of bystander CPR is chest compressions with minimal interruption. Beginning with version 11.2 of the Medical Priority Dispatch System (MPDS) protocols, instructions for mouth-to-mouth ventilation (MTMV) and pulse check were removed and a compressions-only pathway was introduced to facilitate rapid delivery of compressions. Additionally, unconscious choking and third-trimester pregnancy decision-making criteria were excluded all calls (n = 113 and 12.0, respectively. However, the effects of these changes on time to first compression (TTFC) have not been evaluated. We sought to identify the TTFC of MPDS versions 11.2, 11.3, and 12.0 for all calls identified as cardiac arrest on call intake that did not require MTMV in structured recording. Differences in TTFC across versions were compared using the Kruskal-Wallis test. **Results.** A total of 778 cases received D-CPR. Cases were excluded because they met criteria for MTMV (pediatric patients, allergic reaction, etc.) or were not initially identified as cardiac arrest. Of the remaining 319 calls with a median deviation of TTFC was 245 ± 236 seconds with little variation across the MPDS versions: 233 ± 187, 244 ± 365, and 248 ± 365 for versions 11.2, 11.3, and 12.0, respectively (p = 0.10). **Conclusions.** The following removal of instructions for pulse check and MTMV, as well as other minor changes in the MPDS protocols, we found the TTFC of 245 ± 236 seconds, with little variation across the three versions evaluated. This represents an improvement in TTFC compared with an earlier version (11.2). New CCP protocols have not been fully optimized with respect to minimizing TTFC. 

100. INCIDENCE OF OUT-OF-HOSPITAL ADULT NONTRAUMATIC CARDIAC ARREST PRESENTING AS A CONVULSION

Fabrice Dami, Vincent Fuchs, Bertrand Yersin, Olivier Hugli, Fondation Urgences-Santé, EMS Dispatch Center

**Introduction.** The majority of convulsions are due to an epileptic seizure or a convulsive syncope. The incidence of out-of-hospital cardiac arrest (OH-CA) presenting as a convolution is unknown. **Objective.** This study aimed to measure the incidence of nontraumatic OH-CA presenting as a convolution, a rate that has not been published so far, to the best of our knowledge. **Methods.** We prospectively collected all incoming calls with an out-of-hospital nontraumatic seizure as the chief complaint in patients >18 years old during a 24-month period. Among these calls, we collected cases identified as OH-CA by paramedics. **Results.** During the 24-month period, the emergency medical services (EMS) dispatch center received 531 calls reporting nontraumatic convulsion in an adult. Twelve cases were ultimately classified as CA. In this group, one bystander spontaneously reported that the patient was known for epilepsy. The incidence of OH-CA presenting as convulsions was therefore 2.1% of all calls for convolution. Over the same period, the EMS dispatch center received 1,035 data related to an adult nontraumatic OH-CA. Therefore, the rate of OH-CA presenting as a convolution represented 1.2% of all adult nontraumatic OH-CA. **Conclusion.** Only 12 cases out of the 531 calls for nontraumatic adult adult convulsions were confirmed OH-CA. This is a relatively low incidence of OHCA in Columbus was 0.44 per 1,000 people (standard deviation [SD] 0.38). Bystander CPR was administered to 22% of all OHCA patients in the county, and the overall survival to hospital discharge was 10.0% (n = 167). The majority of OHCA patients were white (n = 988, 59.1%), were male (n = 640, 58.9%), had a presenting rhythm of asystole (n = 800, 47.9%), and had the OHCA event occur at home (n = 1407, 84.2%). Local Morán’s I identified 28 high-risk census tracts, SaTScan identified 31 high-risk census tracts, and the empirical Bayes method identified 10 high-risk census tracts. Five census tracts were identified by all three methods, while an additional nine census tracts were identified by at least two out of the three methods. **Conclusion.** This is the first study to apply three different methods for the detection of high-risk areas using OHCA data. The five census tracts, identified in all three analyses, appear to be possible sites for targeted community-based interventions to improve CPR training and cardiovascular disease education efforts.

101. IDENTIFYING HIGH- RISK GEOGRAPHIC AREAS FOR CARDIAC ARREST: COMPARING THREE METHODS FOR CLUSTER ANALYSIS

Comilla Sasson, Michael T. Cudnik, Greg Scort, Arthur Hughes, David J. Magid, Michelle D. Kaye, David Kevorkian, Michael Szapocznik, Craig R. Warden, University of Colorado

**Objective.** To compare the results of three spatial statistical methods for the detection of high-risk census tracts, which are those areas that have a high incidence of out-of-hospital cardiac arrest (OHCA) and a high incidence of out-of-hospital cardiopulmonary resuscitation (CPR), in order to identify possible sites for a targeted community-based intervention. **Methods.** Secondary analysis of two prospectively collected registries in Franklin County, Ohio, which include the City of Columbus (~1.1 million population). Consecutive adult OHCA were restricted to those of cardiac etiology and treated by emergency medical services (EMS) from April 1, 2004, to April 30, 2009. Locations of OHCA were recorded with ArcGIS. Census tracts with a high incidence of OHCA (greatest tertile or quartile) and a low prevalence of bystander CPR (lowest tertile or quartile) were considered high-risk census tracts. We used the following three cluster analysis methods to identify high-risk census tracts: local Morán’s I, SaTScan, and empirical Bayes hot spot- adjusted rates. Over all three methods, high-risk census tracts between these three methods were then identified. **Results.** A total of 4,553 cardiac arrests in 264 census tracts occurred during the study period, with all arrests included in the final sample. The overall incidence rate for OHCA in Columbus was 0.44 per 1,000 people (standard deviation [SD] 0.38). Bystander CPR was administered to 29% of all OHCA patients in the county, and the overall survival to hospital discharge was 10.0% (n = 167). The majority of OHCA patients were white (n = 988, 59.1%), were male (n = 640, 58.9%), had a presenting rhythm of asystole (n = 800, 47.9%), and had the OHCA event occur at home (n = 1407, 84.2%). Local Morán’s I identified 28 high-risk census tracts, SaTScan identified 31 high-risk census tracts, and the empirical Bayes method identified 10 high-risk census tracts. Five census tracts were identified by all three methods, while an additional nine census tracts were identified by at least two out of the three methods. **Conclusion.** This is the first study to apply three different methods for the detection of high-risk areas using OHCA data. The five census tracts, identified in all three analyses, appear to be possible sites for targeted community-based interventions to improve CPR training and cardiovascular disease education efforts.

102. THE RELATIONSHIP BETWEEN EMERGENCY MEDICAL SERVICES (EMS) RESPONSE INTERVAL, ADVANCED LIFE SUPPORT INTERVENTIONS, AND THE RAPID ACUTE PHYSIOLOGY SCORE IN ADULT EMS PATIENTS

Scott Bourn, Daniel W. Spalte, Uwe Stolz, Dale Beskind, Joshua Garlic, Scott Bourn, Daniel W. Spaite, Uwe Stolz, Craig R. Warden, University of Colorado

**Background.** The relationship between emergency medical services (EMS) response intervals (RIs) and patient outcomes has been debated for decades, in part, because “lights and sirens” response has implicit the lack of evidence that RI impacts outcome in any EMS condition besides cardiac arrest, many systems have adopted strict RI standards. **Objective.** We evaluated the relationship between RI, advanced life support (ALS) interventions, and the Rapid Acute Physiology Score (RAPS) in EMS responses for adult patients who are not in cardiac arrest. **Methods.**
This was a retrospective analysis of a clinical database from a large national EMS provider (66,085 in 24 states; 2008–2009). All records for EMS calls for non-cardiac arrest, adult (≥18 years) patients were reviewed. Relationships were evaluated between RI and the following: initial and final RAPS; emergency medical technician/paramedic impression of criticality; performance of endotracheal intubation (ETI); administration of ALS medications; and patient’s ultimate disposition to the hospital. Results. A total of 763,681 EMS records met the inclusion criteria. Records were excluded because of incomplete data for RAPS calculation (7,126, 0.93%); or RI (63,593, 30.3%), leaving 642,277 records (59.2%) for analysis. Cases included a wide variety of traumatic and medical conditions. Correlation coefficients were calculated for the pertinent associations. As a whole, no meaningful correlations were found between the variables of interest. However, when data were stratified by RI, there were correlations between RI during the first 15 minutes (“short” RI) and RAPS ≥ 3 (0.694–moderate correlation), assessment of the patient as critical (0.765–good), medication administration (0.712–good), improvement of cardiac index (0.765–good), and increasing RI in the 6–20-minute range (“long” RI) was correlated with emergent return to the hospital (0.926–excellent). Conclusions. Across a wide variety of EMS systems, data suggest an association between RI and various parameters when stratified by short and long RI. In the short-RI group, shorter RI is correlated with increasing initial RAPS score, patient criticality, and frequency of ALS procedures. In the long-RI group, increasing RI is associated with a higher likelihood of emergent transport. While the associations between RI and patient condition/management are complex, describing these relationships across many systems is useful for hypothesis generation. Further study is necessary to determine whether causal relationships exist between various patient conditions and RI.

103. THE RELATIONSHIPS BETWEEN AMBULANCE CREW CONFIGURATION, EMERGENCY MEDICAL SERVICES (EMS) ON-SCENE INTERVAL, PROCEDURAL PERFORMANCE, AND THE RAPID ACUTE PHYSIOLOGY SCORE IN ADULT EMS PATIENTS

Scott Bourn, Uwe Stolz, Joshua Gaither, Kurt Denninghoff, Daniel W. Spaite, American Medical Response

Background. The ideal ambulance crew configuration is unclear despite considerable debate. Proponents of a double paramedic crew suggest that paramedic collaboration shortens on-scene interval (OSI), improves advanced life support (ALS) skill performance, and creates a safer patient care environment. Opponents cite cost and reduction in ALS skill performance due to “dilution” of procedural experience. Objective. We evaluated the relationship between crew configuration, OSI, ALS procedure performance, and the Rapid Acute Physiology Score (RAPS). Methods. Retrospective analysis of a clinical database from a large national emergency medical services (EMS) provider (63 operations in 24 states; 2008–2009). All records for EMS calls for adult (≥18 years) patients were reviewed. Cardiac arrest cases were excluded. Initial and final RAPS score, OSF, performance of ETI, medication administration (ETI); and ALS medication administration. Results. A total of 763,681 records met the inclusion criteria. A total of 557 patient accounts were excluded because they were treated by nurses, physicians, or nonparamedic crews. Distribution of the above-mentioned data was as follows: paramedic/emergency medical technician (1P) (90.7%); one paramedic (2P) (9.3%). Gender and age were well matched between the groups. Differences in RAPS was evaluated at p < 0.05. Mean initial RAPS scores were significantly different (1P = 1.597, confidence interval [CI] 1.592–1.601; 2P = 1.650, CI 1.635–1.665). Differences in average OSI (seconds) were also significant (1P = 891, CI 889–893; 2P = 955, CI 950–960). A larger percentage of patients in the 2P cohort received medical care (74.1%, 1P 69.9%, 2P 70.1%). Intubation rates were also significantly different (0.25% vs. 0.17%), and were transported emergent to the hospital (5.6% vs. 5.3%). Patients in the 2P cohort also had a greater mean RAPS improvement (0.39, CI 0.37–0.40 vs. 0.36, CI 0.35–0.36), but these changes were clinically insignificant given that RAPS is a 16-point scale. Conclusion. In a very large population of patients from widely varied types and sizes of EMS systems, there were only tiny variations in RAPS, OSI, RAPS improvement, medication administration, and ETI rates when dichotomized based on configuration. While the huge numbers allowed identification of subtle, but statistically significant differences between the two configurations, none were clinically significant.

104. TEMPORAL PATTERNS IN EMERGENCY MEDICAL SERVICES ON-SCENE INTERVALS FOR CARDIAC ARREST

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Introduction. Time to treatment is a critical factor in survival from cardiac arrest. Time is the primary determinant of the hospital setting, the greatest potential time bottleneck is the ambulance response time. Many factors can affect the time from dispatch to ambulance arrival, but it is not known whether response times vary in predictable longitudinal patterns. Objective. We sought to evaluate longitudinal emergency medical services (EMS) dispatch time data for the presence of periodic patterns. Methods. We obtained EMS dispatch time data from the Pittsburgh site of the multicenter Resuscitation Outcomes Consortium from January 1, 2007, to December 31, 2008. Cardiac arrest patients attended to by City of Pittsburgh EMS. Times were derived from the computer-assisted dispatch (CAD) service and included the following: time of call received, ambulance dispatch, arrival, patient transported, and patient at emergency department (ED). The following time intervals were calculated from the CAD data: dispatch to arrival, on-scene time, patient transport to ED arrival, and dispatch to first shock. Mean times were calculated by month for each interval and analyzed with a Yule-Walker autoregressive Fourier transform. Autoregressive integrated moving average (ARIMA) models of seasonally differentiated interval means were then constructed to assess the statistical significance of detected periodic variation. Results. We analyzed 637 cases of EMS-treated cardiac arrest. The mean ± (standard deviation) dispatch-to-arrival interval for the entire study period was 4.85 (0.12) minutes, the mean on-scene time was 29.74 (0.64) minutes, and the mean transport-to-ED time was 9.99 (0.55) minutes. Fourier analysis indicated the presence of a periodic pattern every six months (two/year) for dispatch-to-arrival and on-scene intervals, while the transport-to-ED interval showed peaks every one and six months. Of the three time intervals, only transport to the ED showed a statistically significant periodic component (p = 0.014). Conclusions. In this preliminary analysis of one EMS system over two years, the transport-to-ED interval showed a periodic component every three months. Periodicity in response times may provide useful information for improving system efficiency. These findings are limited by a short observation period in a single EMS system, but these methods could be applied elsewhere.

105. PATIENTS RESIDING IN URBAN AREAS UTILIZE EMERGENCY MEDICAL SERVICES AT HIGHER RATES THAN PATIENTS RESIDING IN SUBURBAN AREAS BUT DO NOT DIFFER IN THEIR HOSPITAL ADMISSION RATES

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Background. The study was conducted at two hospitals within the same hospital system; a level I trauma center and an urban-based community hospital. Both hospitals are located within the same state and county. Objective. We conducted this study to determine whether an urban patient population utilizes the emergency department (ED) or emergency medical services (EMS) resources more frequently than a suburban population based on EMS transport rates and hospital admission rates. Methods. We conducted a retrospective cohort study of EMS transports and hospital admission rates from the first Wednesday of alternating months in 2008. Subjects residing within the study county were sorted by home ZIP code and ED disposition. National census data was used to provide population data for each ZIP code. Four ZIP codes were identified as urban by geography (within city limits) and demonstrated the highest population densities. Eighteen ZIP codes were identified as suburban as they were not considered rural. We excluded three suburban ZIP codes because of closer proximity to another county hospital and small sample size. Statistical significance was determined using Pearson’s chi-square. Results. In total, 557 patient accounts (422 suburban, 145 urban) from 19 ZIP codes were reviewed. Our analysis showed that patients residing in urban ZIP codes had a transport rate of 15.59 per 10,000 persons, which was statistically higher than the transport rate of 10.27 per 10,000 persons for patients residing in suburban ZIP codes (p < 0.0001). Conclusion. Our data analysis indicates that patients residing in urban ZIP codes utilize EMS for transport at a statistically higher rate than patients residing in suburban ZIP codes, although they do not differ in their admission rates. We concluded that the urban populations utilize EMS more frequently for hospital transport, but their need for acute hospitalization is equal to that of their suburban counterparts. These results and future comparison studies may be helpful in identifying populations with unmet medical needs, and allocating adequate EMS resources within these populations.

106. RESULTS FROM THE EMERGENCY MEDICAL SERVICES PREVENTION AND PATIENT SAFETY INVENTORY TOOL

P. Daniel Patterson, Matthew Weaver, Chris Martin-Gill, Ronald Roth, Francis Guyette, Jon Rittenberger, Joe Suyama, Brian Suffoletto, Rollin J. Fairbanks, Michael Hubble, Dave Hostler, Henry E. Wang, Theresa Nguyen, Patrick Michael, Jon Rittenberger, Joe Suyama, Brian Suffoletto, Rollin J. Fairbanks, Michael Hubble, Dave Hostler, Henry E. Wang, Christiana Care Health System

Background. The study was conducted at two hospitals within the same hospital system; a level I trauma center and an urban-based community hospital. Both hospitals are located within the same state and county. Objective. We conducted this study to determine whether an urban patient population utilizes the emergency department (ED) or emergency medical services (EMS) resources more frequently than a suburban population based on EMS transport rates and hospital admission rates. Methods. We conducted a retrospective cohort study of EMS transports and hospital admission rates from the first Wednesday of alternating months in 2008. Subjects residing within the study county were sorted by home ZIP code and ED disposition. National census data was used to provide population data for each ZIP code. Four ZIP codes were identified as urban by geography (within city limits) and demonstrated the highest population densities. Eighteen ZIP codes were identified as suburban as they were not considered rural. We excluded three suburban ZIP codes because of closer proximity to another county hospital and small sample size. Statistical significance was determined using Pearson’s chi-square. Results. In total, 557 patient accounts (422 suburban, 145 urban) from 19 ZIP codes were reviewed. Our analysis showed that patients residing in urban ZIP codes had a transport rate of 15.59 per 10,000 persons, which was statistically higher than the transport rate of 10.27 per 10,000 persons for patients residing in suburban ZIP codes (p < 0.0001). Conclusion. Our data analysis indicates that patients residing in urban ZIP codes utilize EMS for transport at a statistically higher rate than patients residing in suburban ZIP codes, although they do not differ in their admission rates. We concluded that the urban populations utilize EMS more frequently for hospital transport, but their need for acute hospitalization is equal to that of their suburban counterparts. These results and future comparison studies may be helpful in identifying populations with unmet medical needs, and allocating adequate EMS resources within these populations.
Background. Measurement of safety-related events is an important step to ensuring a safe workplace. We developed and administered a computer-based survey to capture emergency medical technician (EMT) injuries, errors and adverse events, and indicators and predictors of patient safety and provider safety. Methods. We used input from medical directors, field providers, emergency medical services (EMS) educators, and survey researchers to develop a 44-item computer-based survey, the EMS Safety Inventory (EMS-SI). The EMS-SI was administered to a convenience sample of 1,488 EMSs and paramedics at 31 EMS providers (EMS and paramedics) who responded to items on events at work from the prior three months. Respondents used nominal and seven-point Likert scales. For each item, we considered an event to have occurred when an EMT recorded a “probably yes” or “definitely yes” for one scale or “ran out of time,” “forgot to perform,” or “did not think necessary” for the second scale. We calculated frequencies and percentages for each item. Results. We received 595 surveys (40% collection rate). Half of the respondents were male. Most (1,001) were paramedics and 31% had worked full-time. In the previous three months, 51% of the respondents reported to work without adequate rest, 32% were at an unsafe scene, 17% were injured, and 5% were working at an unsafe speed (>15 mph) while responding with lights and sirens, and 50% reported white nights greater than 1-minute conclusion. The EMS personnel voluntarily reported high rates of injury, errors, acts of commission and omission, and behaviors that may have compromised personal or patient safety. This inventory of safety items may serve as a foundation to ensure patient safety and workplace safety.

107. MEDICAL NECESSITY OF HELICOPTER EMS WORKPLACE SAFETY: A USEFUL TOOL FOR MONITORING AND BENCHMARKING

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Background. Sudden cardiac arrest in schools is infrequent but emotionally charged events. Objectives. The purposes of our study were: 1) to describe the characteristics and outcomes of school cardiac arrests and 2) to assess the feasibility of conducting bystander interviews to describe the events surrounding cardiac arrests, assess automated external defibrillator (AED) availability and use, and identify barriers to use of AEDs. We conducted a retrospective review of cardiac arrests occurring in kindergarten–12th grade (K–12) schools using the Cardiac Arrest Registry to Enhance Survival (CARES) database from December 2006 to April 2010. Utstein-style data were collected from the CARES database. A structured telephone interview of a bystander or administrative personnel was conducted for each event. The survey encompassed a descriptive summary of the event, including provision of bystander CPR (BCPR), and information regarding AED deployment, training, and use. Perceived barriers to AED use at the time of arrest were recorded. Descriptive data are reported. Results. During the study period, there were 23,519 cardiac arrests identified at CARES communities, of which 59 were educational institutions in 10 states. Of these, 40 (0.17%) events were at K–12 schools, with 20 (50%) being high school students and patients. A majority were children (15, 37.5%) <19 years old, most (32, 80.0%) had witnessed arrests, a majority (28, 70.0%) received BCPR, and 23 (57.5%) were witnessed initially by an individual in training (VF). Overall, 13 (32.5%) survived to hospital discharge. A telephone interview was completed for 25 of the 40 (62.5%) K–12 events. Seventeen schools had an AED on site. Most schools (84%) reported that an AED training program existed, and personnel were specified for its use. An AED was applied in 12 of 25 cases. The AED was available in 19 of 25, with 6 receiving high rates of injury, errors, and acts of commission. High rates of injury, errors, and acts of commission may serve as a useful tool for monitoring and benchmarking of workplace safety.
Background. Previous studies indicate that return of spontaneous circulation (ROSC) occurs in 25% of emergent medical services (EMS)-treated out-of-hospital cardiac arrests (OOHCAs), and that those who achieve ROSC, approximately 38% will experience return of spontaneous circulation (ROSC). The electrocardiogram (ECG) may indicate patients likely to experience ROSC. Objectives. We sought to categorize and quantify specific characteristics of the post-ROSC ECG waveform in patients with and without RA in OHCA. We hypothesized that there would be an increased rate of ROSC in patients experiencing RA. Methods. We identified defibrillation events for whom ECG tracings and audio recordings from EMS-treated cases of OOHCAs. We defined ROSC as EMS-announced pulses and/or greater than 1 minute of ECG findings indicative of pulse in the absence of compressions. We defined RA as EMS-announced loss of pulses, visually identified ventricular fibrillation (VF) or asystole, or any rhythm with asystole or cardiopulmonary resuscitation (CPR). The ECG data in the period following each instance of ROSC (until subsequent RA or hospital arrival) were analyzed for the following: run of premature ventricular contractions (PVCs) (IR 0.53, 95% confidence interval [CI] 0.33–0.82), single PVC (IR 0.65, 95% CI 1.16–1.57), ST-segment elevation or depression (IR 0.21, 95% CI 0.16–0.26); bradycardia (IR 2.14, 95% CI 1.46–3.09); and temporary morphologic change (IR 0.49, 95% CI 0.37–0.63). The R-on-T phenomenon and permanent morphologic changes were not significant. Conclusion. In this sample, the RA group had significantly higher rates of single PVCs and bradycardia, while the no-RA group had higher rates of runs of PVCs, ST-segment elevation and depression, and temporary morphologic changes. This study indicates that ECG analysis may help EMS providers predict patients likely to experience RA, and lead to a change in the treatment paradigm for OHCA patients.

111. EFFECT OF GENDER ON OUTCOME OF OUT-OF-HOSPITAL CARDIAC ARREST IN THE RESUSCITATION OUTCOMES CONSORTIUM

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Introduction. Over the last two decades, many studies have reported that certain medical conditions/diseases have innate gender-based predispositions toward their resolution. Women are likely to have unfavorable outcomes in cardiac arrest, with significantly lower unadjusted survival rates than men. Objective. This study examined the relationship between gender and outcome of nontraumatic out-of-hospital cardiac arrest (OHCA). Hypothesis. Gender is associated with the outcome of nontraumatic OHCA. Methods. All nontraumatic emergency medical services (EMS)-treated OHCA patients in the Resuscitation Outcomes Consortium between December 2005 and May 2007 prior to launching of the Resuscitation Outcomes Consortium (ROC) PRIMED (Prehospital Resuscitation using an Impedance valve and Early vs Delayed analysis) randomized controlled trial were included. Patient age was analyzed as a continuous variable. To further separate the groups by horizontal status, the patients were divided into two age cohorts: 15–45 and >55 years of age. Unadjusted chi-square tests and logistic regression models were employed to examine the relationship between gender and outcome. Results. This study enrolled 14,633 patients: 63.6% were male with a mean age of 64.2 years, and 36.4% were female with a mean age of 68.5 years. Women survived to hospital discharge less often than men (6.4% vs. 9.1%, p < 0.001); the unadjusted odds ratio (OR) for gender and outcome was 0.69 (95% confidence interval [CI] 0.61–0.79). When the Utstein predictors, the difference in survival rates between the genders did not reach statistical significance (p = 0.70, OR: 0.96, 95% CI: 0.73, 1.01). The unadjusted survival rate for younger women (age 15–45 years) was 11.1% vs. 9.8% for younger men (p = 0.52, OR: 1.15, 95% CI: 0.81, 1.62). In contrast, the unadjusted survival rate for older women (age >55 years) was lower compared to older men (5.5% vs. 8.4%, p < 0.001, OR: 0.63, 95% CI: 0.58, 0.6). When the Utstein predictors were included in the model, women survived less often than men in the 15–45-year cohort (p = 0.03, OR: 1.66, 95% CI: 1.04, 2.64), but no difference in discharge rates was observed in the >55-year cohort (p = 0.57, OR: 0.94, 95% CI: 0.70, 1.29). Conclusions. Survival rates to hospital discharge of OHCA patients differ between men and women, but this difference appears to be confounded by several Utstein predictors. No association of gender, a result that supports a protective hormonal effect among premenopausal women.

112. CHARACTERIZATION OF EVENTS SURROUNDING REAIRSTER AFTER RETURN OF SPONTANEOUS CIRCULATION DURING PREHOSPITAL TREATMENT OF CARDIAC ARREST

Don Lundy, Todd McGeorge, Ulrich Herken, Annemarie Silver, Charleston County EMS

Introduction. It has recently been reported that over a third of out-of-hospital cardiac arrest patients return with return of spontaneous circulation (ROSC) experience reairster in the prehospital environment after regaining pulses; however, the events surrounding reairster have not been well characterized. Objective. The purpose of this study was to describe the timing and cardiac rhythms associated with reairster. Methods. A retrospective analysis was conducted of patient cahirteric defibrillator files collected by a countywide EMS system from the treatment of adult nontraumatic cardiac arrest patients between January 2004 and January 2007. Patients who achieved ROSC (n = 148) and experienced reairster (n = 52) were included in the analysis. Results. Fifty-two patients experienced reairster after ROSC (32 experienced reairster once, 12 twice, 6 three times, and 2 four times), for a total of 82 reairster events. The most common rhythms upon reairster were sinus rhythm (83%), asystole (10%), and ventricular fibrillation (VF) (41%); events of PEA, 34% VF, 15% ventricular tachycardia (VT), 10% asystole). The likelihood of regain- ing pulses was affected by reairster rhythm (82% VF, 83% VT, 63% asystole, 50% PEA, p < 0.001). Forty-eight (95%) reairster events occurred at the scene and 34 (41%) occurred during transport. Patients who experienced reairster had significantly longer reairster time than those who did not experience reairster (mean 18.8 minutes). Inci- dence of rearrest/depression (IR 0.21, 95% CI 0.16–0.26); bradycardia (IR 2.14, 95% CI 1.46–3.09); and temporary morphologic change (IR 0.49, 95% CI 0.37–0.63). The R-on-T phenomenon and permanent morphologic changes were not significant. Conclusion. In this sample, the RA group had significantly higher rates of single PVCs and bradycardia, while the no-RA group had higher rates of runs of PVCs, ST-segment elevation and depression, and temporary morphologic changes. This study indicates that ECG analysis may help EMS providers predict patients likely to experience RA, and lead to a change in the treatment paradigm for OHCA patients.
Medicine to describe a rural EMS system’s experience

Objective. This study’s purpose was to describe 2010 EMS ACS care standards, with particular emphasis on suspected ST-segment elevation myocardial infarction (STEMI), that exist in a Southwestern U.S. state. Methods. The study utilized a standardized telephone survey conducted with all ground and air EMS transporting agencies having addresses within state borders. Agency size and structure ranged from an agency with 1 ambulance, staffed by volunteer basic life support providers, responding to fewer than 30 calls, to an agency with 59 ambulances, staffed by advanced life support providers responding to over 158,000 calls (2008 calendar year data). Telephone calls were directed toward agency EMS directors listed within the ambulance registry compiled by the State of Health for calendar year 2009. If an agency’s EMS director was not reachable, a clinical provider at that agency, self-reporting as knowledgeable with that agency’s ACS care standards, provided the survey responses. The survey was designed utilizing an Internet-based survey platform. Data were collected in a narrow time interval July 15, 2010–August 4, 2010) to minimize the effect of revisions in care standards. Data were collected within the survey platform for descriptive analysis. Results. One hundred eighty EMS agencies met the inclusion criteria, with responses collected from 185 agencies (100% survey population captured). All agencies reported the use of an ACS or equivalent treatment protocol. Among the 185 agencies, 160 (86.5%) reported staffing emergency medical technician–basics and 136 (73.5%) reported staffing paramedics. One hundred fourteen (61.6%) have the ability to acquire a 12-lead electrocardiogram (ECG) and 11 (5.9%) have the ability to transmit 12-lead ECGs to receiving hospitals. Forty-eight (26.1%) transport a suspected STEMI patient (based on 12-lead ECG analysis) to the closest hospital transport via a cardiac catheterization laboratory prior to hospital arrival, saving approximately two hours over typical transport time and resulting in aborted infarctions in one-fourth of patients. In a rural setting with lengthy transport times to PCI facilities, telemepacelapse appears to be a feasible prehospital intervention. Randomized controlled trials are needed to fully evaluate the safety and effectiveness of this intervention prior to widespread adoption.

115. PREHOSPITAL ADMINISTRATION OF TENOCTEPLASE IN A RURAL EMERGENCY MEDICAL SERVICES SYSTEM

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Introduction. In the setting of ST-segment elevation myocardial infarction (STEMI), early reperfusion yields better patient outcomes. Emergency medical services (EMS) is the first medical contact for the affected population, and prehospital thrombolysis may result in considerably faster reperfusion compared with percutaneous coronary intervention (PCI) in rural areas. However, there are few reports of prehospital thrombolysis in rural EMS systems. Objective. The objective of this study was to describe a rural EMS system’s experience with tenecteplase. Methods. Data were retrospectively abstracted from medical records of patients receiving tenecteplase using standardized methods. Primary outcomes included time saved by EMS-initiated thrombolysis, aborted infarctions, serious bleeding events, and inhospital mortality rates. Secondary outcomes included reinfarction, rescue angioplasty, and appropriateness of treatment. Time savings was defined as transport time after tenecteplase administration plus 90 minutes, which is the typical door-to-balloon time for PCI laboratories. Aborted infarction was defined as resolution of the cumulative ST-segment elevation to less than 50% of the initial ECG within two hours after treatment, and peak creatine kinase (CK)/CK-MB level less than twice the upper limit of normal. Results. Seventy-three patients received tenecteplase; 93.1% of these cases were determined to be appropriate. The mean patient age was 59 years, and 71.6% were male. Mean ± standard deviation scene arrival–to-drug time was 26.25 ± 11.49 minutes, scene arrival–to-hospital arrival time was 73.0 ± 20.6 minutes, and the mean transport time was 46.0 ± 11.1 minutes. Tenecteplase was administered to patients prior to hospital arrival, and the estimated reperfusion time savings over PCI was 125.9 ± 25.0 minutes. Aborted infarctions were observed in 24.1% of patients. Tenecteplase associated with 47.9% undertreated angioplasty, and 16.7% required coronary artery bypass grafting. Serious bleeding events occurred in 13 patients (20.5%), and four (5.5%) died. Conclusions. In this case series of rural STEMI patients, tenecteplase was administered 36 minutes prior to hospital arrival, saving approximately two hours over typical transport time and resulting in aborted infarctions in one-fourth of patients. In a rural setting with lengthy transport times to PCI facilities, tenecteplase appears to be a feasible prehospital intervention. Randomized controlled trials are needed to fully evaluate the safety and effectiveness of this intervention prior to widespread adoption.

116. FREQUENCY OF PREHOSPITAL CARDIAC CATHETERIZATION LABORATORY ACTIVATIONS NOT RESULTING IN INTERVENTIONAL TREATMENT BECAUSE OF A PROTOCOL VIOLATION

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Background. Prehospital cardiac catheterization laboratory (CCL) activation benefits patients presenting with ST-segment elevation myocardial infarction (STEMI). Early activation has associated costs, making proper identification of appropriate patients fiscally and clinically important. Objective. The objective of this study was to quantify the frequency of CCL activations that did not result in emergent interventional treatment as a result of a prehospital protocol violation (CCL). Methods. Study patients presented at one of three percutaneous coronary intervention centers in an urban county between May 1, 2007, and July 31, 2009, with a prehospital determination of STEMI using established prehospital criteria. A retrospective review of prehospital patient data sets identified 12-lead electrocardiograms (ECGs), and the patient’s in-hospital treatment was performed to assess compliance with local STEMI protocols. Patients were classified as having an appropriate prehospital CCL activation if they underwent emergent cardiac catheterization, died in the ED, presented a do-not-resuscitate order in hospital, left against medical advice, were found to have contraindications to catheterization, or were seen by an interventional cardiologist at the CCL. Unnecessary CCL activations due to a prehospital protocol violation occurred if the PCR did not indicate signs or symptoms of an acute coronary syndrome or if the prehospital ECG did not meet criteria for STEMI. Results. Three hundred seven patients were categorized as STEMI, with 53 (17.3%) patients potentially having an unnecessary CCL activation due to a prehospital protocol violation. There were 39 (12.7%) patients classified as having an unnecessary CCL activation due to a prehospital protocol violation. Of those patients, 15 (4.5%) presented cardiovascular symptoms and a nondiagnostic ECG, 11 (28.2%) had no symptoms but an ECG diagnostic for STEMI, and 22 (56.4%) had cardiac symptoms and a nondiagnostic ECG. Of those patients presenting with cardiac symptoms and a nondiagnostic ECG, 10 (45.5%) had a left bundle branch block pattern. Conclusion. In this population, a large proportion of unnecessary CCL activations due to prehospital protocol violation were associated with patients’ presenting in the prehospital environment with no symptoms of cardiac ischemia. We propose to use this data to identify clinical variables that were independently associated with these outcomes. Methods. We reviewed 487 consecutive STEMI patients in a large urban prehospital system receiving advanced medical services (EMS) system who were either triaged by paramedics for direct access to a PCI laboratory or transferred by EMS from an emergency department to a PCI laboratory between June 2008 and May 2009. All patients were transported by paramedics with an advanced-care scope of practice. We recorded predefined clinically important events and advanced treatment that occurred in each patient from initial medical contact to arrival at the PCI laboratory. Predefined clinical variables were tested through binary analyses to determine associations with these outcomes. Variables with significant association were tested through logistic regression analyses to assess for independent associations. Results. More clinically important events occurred in 106 (21.8%) patients. The most common were sinus bradycardia (62 events), hypotension (60 events), cardio-vascular arrest (12 events), and polymorphic ventricular tachycardia (3 events). Sixty-two (12.7%) patients received one or more advanced care treatments, most commonly morphine (48 cases), atropine (2 cases), and intubation (3 cases). Fourteen occurrences of cardiopulmonary resuscitation (CPR) or defibrillation were not included since these can be performed by almost all EMS responders. There were no clinical vari-
ables identified that were independently associated with either a clinically important event on intubation or a poor outcome. We present these associations here. Clinical factors are associated with the prehospital intubation and the effect on mortality. The over-65 population is at higher risk of adverse events, and it is important to assess these patients’ risk of aspiration and hemorrhage. We hypothesized that providers will perceive the device to be easier when using a video laryngoscope.

119. EVALUATION OF FOUR DIFFERENT VIDEO LARYNGOSCOPE USE IN A SIMULATED DIFFICULT AIRWAY SCENARIO: THE D2B TIME
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Objective. The purpose of this study was to compare insertion success rates and time to intubation with the videolaryngoscopy standard endotracheal intubation (ETI), and with the King LTS-D airway during a simulated complex airway scenario. Methods. Following institutional review board and emergency medical services (EMS) providers were briefly trained on each of the following devices: 1) ETI, 2) King LTS-D, 3) Storz C-MAC, 4) GlideScope, 5) McGrath, and 6) ProDol Airtraq. A short practice session with each device, all providers attempted to successfully place each airway within 60 sec. The order of device placement was random and in advance. Simulated emesis (blended mixture of oatmeal, mixed vegetables, water, and beer) was introduced into the manikin’s mouth. The manikin place attempt with each device via concealed tubing and a pump. The manikin’s neck was also fixed to simulate a blunt trauma scenario. Suction and gum elastic bougie was available to all providers. Placement success rates were compared using logistic regression, and times to successful placement were compared using repeated-measures analysis of variance. Results. Seventy EMS providers (17 emergency medical technician–basics [EMT-Bs], 53 paramedics) participated in the study. There were no differences in success rates for any device between the EMT-Bs and paramedics (p = 0.55). Cumulative success rates for both the EMT-Bs and paramedics with each device were as follows: ETI = 95.4%; C-MAC = 93.5%; GlideScope = 87.1%; McGrath = 48.8%; and Airtraq = 48.6%. The Airtraq and McGrath success rates were significantly lower than those of the ETI, C-MAC, and C-MAC success rates (p < 0.05 for each comparison). Average times to insertion (± standard deviation; seconds) with the ETI was 25.7 ± 18.1; C-MAC was 18.3 ± 18.7; GlideScope was 54.2 ± 23.7; Airtraq was 60.5 ± 22.9; and McGrath was 65.2 ± 29.7. The King LTS-D was placed significantly faster than all other devices (p < 0.001 for each comparison). The time to placement was significantly faster for ETI than for the GlideScope, Airtraq, and McGrath (p < 0.001 for each comparison). Conclusion. In a difficult-airway scenario, the Airtraq and McGrath had much lower success rates compared with the other devices. Time to successful placement was fastest with the King LTS-D.

120. PREHOSPITAL INTUBATION OF ACUTE STROKE PATIENTS IS ASSOCIATED WITH POOR OUTCOMES
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Introduction. Patients suffering from acute cerebrovascular accidents (CVAs) are often intubated; however, the factors predicting prehospital intubation and the effect on mortality and outcome in this population are unknown. Objectives. This study tested whether intubation was associated with outcomes in acute CVA patients, and also examined what clinical factors are associated with the prehospital decision to intubate. We collected 12 months (2008) of prehospital and inpatient care reports for patients diagnosed with CVA from a critical care transport service in Pennsylvania. Outcomes included GCS and modified Rankin score (MRS) at discharge, with a good outcome defined as an MRS <4, indicating the patient’s ability to care for himself or herself. We also examined the association between intubation, vitals signs, initial Glasgow Coma Scale (GCS) score, initial National Institutes of Health Stroke Scale (NIHSS) score (hemorrhagic vs. ischemic), and hospital discharge MRS. Results. Of the 357 patients transported for acute CVA, the median NIHSS score was 7 (interquartile range [IQR] 3–14), 227 were diagnosed with ischemic CVA, 97 with hemorrhagic CVA, and 34 with transient ischemic attack (TIA). Forty-two percent (111/267) received prehospital intubation. Among the intubated patients, most (60%) suffered hemorrhagic CVA, had an abnormal initial GCS score (median 5 [IQR 3–6]), and had a normal NIHSS score (median [IQR] 15–21). The likelihood of intubation decreased with increasing GCS eye score (odds ratio [OR] = 0.25, confidence interval [CI] 0.14, 0.59) and GCS motor score (OR 0.52, CI 0.18, 1.26), but not with vital signs, NIHSS score, CVA type, or location. No patient requiring intubation had a good outcome. Survival (OR 10.1, CI 4.9–20.6) was not likely among those intubated patients. Conclusion. In CVA patients transported by our service, prehospital intubation is infrequent and associated with high mortality and MRS. Lower GCS motor and eye scores are associated with the decision to intubate.

121. KETAMINE FOR SEDATION AND ANALGESIA IN HYPTENSION INTUBATED PATIENTS DURING AIR MEDICAL TRANSPORT: A CASE SERIES
Spencer Anderson, Michael Richards, Darren Braude, Department of Emergency Medicine, University of New Mexico
Introduction. Sedation and analgesia are often withheld or minimized in patients with absolute or relative hypotension (shock) because of concerns of increased intracranial pressure and blood pressure. Ketamine is the only intravenous (IV) anesthetic that provides both sedation and analgesia and increases blood pressure. Methods. This was a retrospective case series of intubated adult patients who received ketamine during air medical transport for sedation and analgesia under a protocol for management of hypotensive or hemodynamically unstable patients. Mean arterial pressures (MAPs) were measured before and after the first dose of ketamine administration by IV bolus and compared using a paired t-test. Cardiac arrest patients were excluded. Results. Intravenous ketamine was administered to 52 intubated, hemodynamically unstable/hypotensive patients during the two-year review. The mean age was 56.3 years (standard deviation [SD] = 18.4 years) and 48% (25/52) were male. Of the transports, 46% (24/52) were cardiac; 32.7% (17/52) were sepsis, 23.1% (12/52) were trauma, 3.8% (2/52) were gastrointestinal bleeding, and 25% (13/52) were unmonitored. The ketamine dose was 0.51 mg/kg (interquartile range [IQR] 0.50 to 0.64 mg/kg). The mean preketamine MAP was 74.8 mmHg (SD 16.6 mmHg) and the mean postketamine MAP was 74.8 mmHg (SD 19.5 mmHg), with a mean change in MAP of 5.7 mmHg (95% confidence limits 1.6, 9.8 mmHg), p < 0.01. Conclusion. The overall MAP improvement in this series suggests that ketamine may be a viable alternative to provide sedation and analgesia for intubated patients with absolute or relative hypotension during air medical transport. Prospective trials are necessary to further characterize the efficacy and safety of ketamine for this patient population.

122. PROVIDER PERCEPTION OF PREHOSPITAL VIDEO LARYNGOSCOPE USE
Kate Farrell, Paul Phrampus, Michele Kuszajewski, Francis X. Guyette, University of Pittsburgh
Background. Endotracheal intubation is increasingly being performed by prehospital providers using video laryngoscopy. Hypothesis. We hypothesized that providers will perceive intubation to be easier when using a video laryngoscope versus ETI. Objective. To evaluate the attitudes
of providers using a video laryngoscope (Storz C-MAC laryngoscope) for intubation by prehospital providers. We evaluated the incidence among aircraft with video laryngoscopes in addition to their standard airway management equipment. A video laryngoscope was used for all encounters on the selected aircraft. We documented all airway management by the crews using an electronic medical record. Participants rated their experience with the video laryngoscope on a five-point Likert (5 = much easier, 1 = much more difficult) scale relative to intubation by direct visualization. We also recorded data on intubation indication, method, location, and attempt success. Results. We recorded survey responses from 110 video-assisted intubations over a period of six months. Flight crews anticipated 47 of 110 (43%) as difficult airways. The majority were intubated on the first attempt (76%), using only the video screen (67%). Most intubations occurred at accident scenes (65%). Crew members described most video-assisted intubations as easier than direct laryngoscopy (median response of 4, interquartile range [IQR] 3, 5). Perceived ease of intubation was associated with greater first-attempt success (odds ratio [OR] 0.66). Conclusion. Flight crews preferred video laryngoscopy to direct visualization for prehospital intubation. Perceived ease of intubation did not associated with greater first-attempt success.

123. PREHOSPITAL USE OF CONTINUOUS POSITIVE AIRWAY PRESSURE: A RANDOMIZED CONTROLLED TRIAL AMONG PRIMARY CARE PARAMEDICS: A STUDY OF SAFETY Sheldon Cheskes, Linda Turner, Sue Thomson, Sunnybrook Osher Center for Prehospital Care

Introduction. Continuous positive airway pressure (CPAP) has been used effectively in the prehospital environment for a wide range of respiratory emergencies. The safety of CPAP when used by primary care paramedics (PCPs) has not been established. Objective. We sought to study the safety of prehospital CPAP when used by paramedics trained to the PCP level compared with those trained to the advanced care paramedic (ACP) level. Hypothesis. The safety of CPAP use by paramedics trained to the PCP level is similar to that of paramedics trained to the ACP level. Methods. We conducted an observational study of 302 consecutive cases of CPAP use over one year beginning July 2009 in two provincial emergency medical services (EMS) systems. We defined the “gold standard” for safety of CPAP use as 100% adherence to the Ontario provincial medical directive. The criteria for safe use of CPAP included specifics of patient presentation, vital signs, and appropriate documentation by the paramedic as well as proper use, titration, and discontinuation of CPAP equipment according to protocol. Data were abstracted from ambulance call reports. Results. Using the criteria set forth for safe CPAP use, the highest level of compliance among ACPs was 84.4% for titration of CPAP during treatment, and the lowest level of compliance among PCPs was 90% for adherence to criteria for CPAP application according to patients’ vital signs. The lowest level of compliance for ACPs was 84.4% for titration of CPAP during treatment, and the lowest level of compliance among PCPs was 90% for adherence to criteria for CPAP application according to patients’ vital signs. We defined all airway management by the crews using an electronic medical record. Participants rated their experience with the video laryngoscope on a five-point Likert (5 = much easier, 1 = much more difficult) scale relative to intubation by direct visualization. We also recorded data on intubation indication, method, location, and attempt success. Results. We recorded survey responses from 110 video-assisted intubations over a period of six months. Flight crews anticipated 47 of 110 (43%) as difficult airways. The majority were intubated on the first attempt (76%), using only the video screen (67%). Most intubations occurred at accident scenes (65%). Crew members described most video-assisted intubations as easier than direct laryngoscopy (median response of 4, interquartile range [IQR] 3, 5). Perceived ease of intubation was associated with greater first-attempt success (odds ratio [OR] 0.66). Conclusion. Flight crews preferred video laryngoscopy to direct visualization for prehospital intubation. Perceived ease of intubation did not associated with greater first-attempt success.

124. INTEGRATING ELECTRONIC PATIENT CARE REPORTS WITH EMERGENCY DEPARTMENT ELECTRONIC MEDICAL RECORDS Adam B. Landman, Christopher H. Lee, Camilla Sossina, Carin M. Van Gelder, Leslie A. Curry, Brigham and Women’s Hospital/ Harvard Medical School

Objectives. We sought to understand how emergency medical services (EMS) agencies are currently sharing information from their electronic patient care reports (e-PCRs) with emergency departments (EDs) and the barriers to integrating e-PCRs with ED/hospital electronic medical records (EMRs). Methods. As part of a study on experiences of EMS agencies with e-PCRs, we conducted semi-structured, qualitative interviews with EMS leaders from across the United States and Canada, including medical directors, administrators, and paramedics. Participants were recruited from the 2010 National Association of EMS Physicians (NAEMSP) annual meeting and supplemented with snowball sampling until thematic saturation was achieved (n = 20). Each participant was asked whether or how their agency provides handoff documentation to the ED with probes on whether and how e-PCR is integrated with ED/hospital EMR systems. Interviews were conducted in person or via telephone, were audiotaped, and were professionally transcribed. Three reviewers independently read each transcript and used the constant comparative method to identify recurrent and unifying themes. Results. Among the participants currently using e-PCR, multiple approaches for integrating prehospital documentation to ED staff were described. Most commonly, prehospital providers reverted to printing a hard copy of the e-PCR for ED staff through ambulance or ED printers. Some agencies provided no immediate documentation to the ED, but faxed or e-mailed e-PCRs upon completion, which could be minutes to days. Many agencies pursued more electronically integrated solutions by sending completed e-PCRs to an online database accessible to ED staff. Three communities described pilot projects with their regional health information organizations to exchange e-PCRs. However, no participants in this study achieved seamless, electronic, real-time e-PCR transmission to the ED. Barriers to real-time prehospital-to-ED/hospital-system integration were lack of technical interfaces between e-PCR and hospital EMR systems, lack of context, costs of network infrastructure, and security/privacy concerns. Conclusion. Moving to e-PCR does not ensure that prehospital records are electronically available for ED providers. This explored whether that e-PCR users are frequently reverting back to paper-based documentation to provide ED handoff documentation. Federal policy is currently promoting EMR and advanced prioritization, funding, and coordination are needed to allow electronic integration of e-PCR and ED/hospital EMR systems.

125. ASSESSING MEDICAL NECESSITY IN EMERGENCY MEDICAL SERVICES TRANSPORTS Matthew D. Weaver, Charity G. Moore, P. Daniel Patterson, Donald M. Yealy, University of Pittsburgh

Background. Medically unnecessary emergency medical services (EMS) transports can create financial challenges for agencies and affect care delivery for those with more emergent needs. Objective. We sought to describe the five-year trend in medically unnecessary non-Medicare EMS transports to the emergency department (ED). Methods. We used the 2003 to 2007 National Hospital Ambulatory Medical Care Survey (NHAMCS) data sets and a multiyear cross-sectional study design. We defined medically unnecessary transports based on the Neely Conference recommendations and the algorithm published by Paterson et al. (2006). This algorithm classifies International Classification of Diseases, Ninth Revision (ICD-9) diagnostic codes into three categories: medically necessary, medically unnecessary, or medically unnecessary. We applied the algorithm to primary diagnoses linked to each transport. Transports associated with a hospital admission were deemed medically necessary. We reported weighted means, proportions, and the corresponding 95% confidence intervals (CIs). Results. Over the five-year period, EMS-to-ED transports increased from 16.2 million to 18.4 million, and the proportion of medically unnecessary transports increased from 14% to 17%. Patients whose transports were classified as medically unnecessary were younger than patients whose transports were classified as necessary (48 years; 95% CI: 46–51, vs. 54 years; 95% CI: 53–56). The proportion of transports of vital signs (53%) did not vary over time. Nondependent abuse of drugs was the most prevalent diagnosis (14.6%) across all years, increasing 4% from 2003 to 2007. The second most common diagnosis, disorders of the back (4.4%) and urinary tract, decreased from 2003 to 2007 (7.8–5.4%). The third and fourth most common diagnoses, depressive disorders (4.6%) and unclassified back pain (4.4%) remained stable over time. Governmental non-Medicare insurance was the most common form of insurance linked to unnecessary transports. The proportion of these transports increased from 18% in 2003 to 32% in 2007. Conclusions. A sizable and growing minority of EMS transports to the ED may be medically unnecessary and could create opportunities for alternative strategies to optimize EM deployment.
remained 229 reports, there were 233 distinct safety incidents. These incidents were classified by parameter or behavior (72, 31%), medical or trauma/transportation (39, 17%), staffing or ambulance availability issue (27, 12%), communications (23, 10%), medical equipment (22, 9%), medication or medication administration error (14, 6%), patient safety or safety culture issues (18, 8%), procedure issues (14, 6%), medication issues (11, 5%), scene management/safety issues (6, 3%), and protocol issues (5, 2%). The majority of errors (89, 53%) were initially thought to be critical or major errors. After the completed audit response, 86 documentation errors (96.6%) were reclassified as documentation errors, 89 (53%) were initially thought to be critical or major errors. After the completed audit response, 86 documentation errors (96.6%) were reclassified as documentation errors. The EMS providers dealing with these errors were involved in the event represented the largest reporting group (83, 36%). We compiled a subjective list of system and policy changes that would be the response to these reports. Conclusion. This EMS safety incident reporting system identified situations that occurred in many categories of EMS care. These potential dangers present opportunity to assess, and ultimately change, policy and procedures to reduce errors and improve overall safety. A substantial number of cases were excluded to maintain the promise of anonymity within the system.

127. ANALYSIS OF PARAMEDIC ERROR ON AMBULANCE CALL REPORTS

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Introduction. In our emergency medical services (EMS) system, delegation of medical acts for paramedic practice is facilitated by base hospital quality assurance (QA) activities. Retrospective ambulance call evaluations (ACEs) are completed for all protocol-driven prehospital medical directives that are audited as having an error present. Errors considered “critical” or “major” result in remediation, decertification, or eventual decertification. The objectives of this study were to identify the proportion of errors eventually attributable to documentation and to determine if services utilizing electronic ambulance call records (eACRs) had different documentation error rates compared with services with paper ACRs. Methods. A retrospective study between January 1 and June 28, 2010, was undertaken. The QA process starts with the call log that identifies potential variation from protocols. Auditors used ACEs to determine the potential severity of the error (none, minor, major, or critical). Major and critical errors were confirmed in further evaluation (written response or interview). Professional standards specialists analyzed the ACE, ACR, and responses to determine whether errors were related to documentation or actual medical care. Results. A total of 4,557 ACRs were audited; 342 (7.5%) ACRs were determined to have an error, and 167 (48%) were eventually categorized as documentation errors. Of the 167 charts with documentation errors, 89 (53%) were initially thought to be critical or major errors. After the completed audit response, 86 documentation errors (96.6%) were reduced to minor or none. There was no difference (p = 0.23) in the documentation errors between the eACRs (89, 53%) and the paper ACRs (78, 47%). Conclusion. A large proportion of errors were eventually deemed related to documentation and were downgraded in severity. There no difference in documentation error rates between electronic and paper ACRs. These findings suggest that education is needed to improve documentation, and such training may decrease the workload of programs providing off-line medical control.

128. CHARACTERISTICS OF HOSPITALS DIVERTING AMBULANCES IN A CALIFORNIA EMERGENCY MEDICAL SERVICES SYSTEM

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Introduction. While several reports discuss controversies regarding ambulance diversion and mortality, financial, and resource effects, there is scant literature related to the effect of hospital characteristics. Objective. Our objective was to describe specific characteristics of paramedic receiving centers in our emergency medical services (EMS) system that are associated with ambulance diversion rates. Methods. The study was performed in a suburban EMS system with 27 paramedic receiving centers. The ascertainment period was from the beginning of the study period (2000–2008) was excluded because of lack of recent data. Hospital-level and population-level characteristics were gathered, including diversion rate, for-profit status, number of specialty services (such as trauma, burn, and vascular care), average inpatient bed occupancy rate, emergency department (ED) volume (patients per year), ED admissions (per year), and percentage of patients leaving without being seen. Demographic characteristics include percentage of persons in each hospital’s immediate census tract below the 100% and 200% poverty lines (each considered separately), and population density within the census tract. Bivariate and multivariate regression analyses were performed. Results. Diversion rates for the 27 centers ranged from 0.3% to 14.5% (median 4.5%). Average inpatient bed occupancy rate and presence of specialty services were correlated with an increase in diversion rate; occupancy rate showed an 0.08% increase in diversion hours per 1% increase in occupancy rate (95% confidence interval [CI] 0.01–0.16), and hospitals with specialty services had, on average, a 4.1% higher diversion rate than other hospitals (95% CI 1.9–6.67). Our results did not show a statistically significant effect. When a regression was performed, only the presence of specialty services was related to the ambulance diversion rate. Conclusions. Hospitals in our system providing specialty services such as trauma, burn, and vascular care were more likely to have higher diversion rates. This may result in increased attention among patients requiring specialty care to centers able to provide the needed level of service. Major limitations include the retrospective nature of the study, as well as reliance on multiple data systems.

129. AN ANALYSIS OF OCCUPATIONAL HEALTH EXPOSURES IN A SUBURBAN HOSPITAL EMERGENCY MEDICAL SERVICES SYSTEM: 2007–2009

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Introduction. Emergency medical services (EMS) providers are potentially exposed to various infectious disease hazards. Examining reported exposures would be useful in describing emerging trends as well as guidance with appropriate protective measures an EMS system should consider. Objective. To describe types of infectious, occupational health exposures and their current reporting at an urban EMS system. Methods. A retrospective review of all reported exposures was performed for a three-year period from January 1, 2007, to December 31, 2009. Descriptive analysis was performed on data such as provider demographics, types of exposures reported, confirmation of exposure based on patient follow-up and outcomes. Results. Forty-five patient encounters were reported, 37 (82%) were confirmed positive. The most commonly reported exposure was to meningitis (N = 131, 31.3%), followed by tuberculosis (TB) (N = 68, 16.3%), viridans streptococcal throat infections (VSTIs) such as influenza or H1N1 (N = 61, 14.6%), and body fluids to skin or mucous membranes (N = 59, 14.1%). Body fluid splashes involving the eyes accounted for 38 cases (10%), and needlestick injuries contributed to 80 cases (22.2%). The overall exposure rate was 1.1 per 1,000 EMS incidents. Two hundred sixty-five (51.6%) of all reported exposures required only follow-up with the infection control officer (ICO), whereas 131 (31.3%) required follow-up at a designated occupational health services or emergency department. Of these, only 24 (18.3%) required treatment. There was a significant trend of increasing VRI exposures from 2008 to 2009 (5.41% vs. 26.4%, p < 0.001), while a significant decrease in TB exposures was experienced during the same year (19.8% vs. 8.2%, p = 0.008). Conclusions. We report an overall exposure rate of 1.1 per 1,000 incidents over a three-year period. This rate is relatively low compared with other rates reported in the literature. Injuries related to needlestick injuries remained relatively low, whereas the highest types of exposures involved possible meningitis, TB, or VRI. Trends in our data suggest increasing exposure to occupational illnesses. Effective use of respiratory protection can potentially mitigate these risks.
hypotension was present in 11 cases (17.2%) and neurovascular compromise in the involved extremity was present in 21 cases (34.4%). In 37 cases (56.9%), prehospital IVAbx was administered; for 13 (35.1%), therapy began while the patient was still on scene.

**Conclusion.** Although the study sample was small, the data suggest that the prehospital EMS IVAbx administration resulted in a savings of 20 minutes as compared with the best-case possible of immediate IVAbx upon hospital arrival. Ongoing study is assessing the true time savings associated with prehospital IVAbx (by assessing actual hospital IVAbx times), and investigating (by chart review) whether early IVAbx impacts outcome.

### 131. A TEST OF OPERATIONAL THROUGHPUT CAPABILITIES DURING MASS-CASUALTY DECONTOAMINATION

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**Background.** Prehospital mass-casualty decontamination procedures and systems are well known. However, because of liability concerns, little information is provided by commercial tent operators on the true operational capacity of their decontamination systems. To address this lack of information, our CBRRNE (chemical, biological, radiological, nuclear, and explosive) response team executed a simulated mass-casualty decontamination incident in order to establish actual operational times using the TVI three-line decontamination system deployed in a two-ambulatory and one-nonautomobile footprint. **Methods.** To determine both total operational time and decontamination throughput time (time from entry to exit of the decontamination line) for 100 patients, we created a scenario involving a blast dissemination of an unknown chemical at a mock political rally. "Victim" profiles were created using published injury data from actual bombings, and volunteers were moulaged accordingly. To add the unpredictability of human behavior, the team was blinded to the scenario, and the "victims" were not given pre-event instructions on what to do. Timing was recorded using electronic chip timers attached to each patient.** Results.** The total operational time from blast to last victim exiting decontamination was 40.4 minutes. Patient extraction times from the blast site ranged from 5.2 minutes for the first ambulatory patient to 21.4 minutes for the last nonambulatory patient. Decontamination throughput time was 34.7 minutes for 100 patients, including 15 patients "recycled" for visible contamination. **Conclusions.** Emergency response assets need to be aware of decontamination throughput capacity for planning. Although our team demonstrated an ability to decontaminate approximately 180 patients/hour in a realistic scenario incorporating unpredictable human behavior, this number is limited in several ways. First, we utilized only 2-minute decontamination for an unknown chemical. This number in reality would be incident-specific and would impact throughput. Second, the team involved has experience with decontamination procedures and regularly practices these procedures. Part-time teams or assets with less familiarity may have difficulty recreating these numbers. Thus, each hospital department or hazardous materials team should perform realistic operational training to establish response standards of its own.
BCNs, treatment and management of patients involved in incendiary/explosives exposure, and treatment and management of patients involved in structural collapse. Descriptive statistics were calculated to quantify participation in ILPT and MDD. Four items, which mirrored the ILPT items, assessed an individual’s PoP. Individuals were asked to report on a six-point scale how much they agreed/disagreed with feeling adequately prepared to respond to disaster scenarios. Spearman rank correlation coefficients were calculated to determine whether ILPT was correlated with PoP. Results. Of the 46,127 individuals who had the opportunity to complete the survey, 30,570 (66.3%) responded. A complete case analysis was performed (n = 21,438). Overall, 19,551 (91.2%) individuals received ≥1 hour of ILPT and 12,828 (59.8%) individuals reported participating in MDD in the last 24 months. However, 40.9% (8,769) reported <1 hour of ILPT in the treatment and management of patients involved in structural collapse. Spearman rank correlation coefficients revealed that for each topic, more hours of ILPT were significantly correlated with increased PoP (for each topic area: Spearman’s rho > 0.40, p-values < 0.001). Conclusions. A majority of nationally certified EMT-Basics and paramedics reported participating in MDD and in more than one hour of ILPT. Participating in ILPT correlated with higher PoP. Emergency medical services leaders should focus attention on improvement in hours of training in the treatment and management of patients involved in structural collapse.