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DOES COMPLIANCE WITH THE AHA GUIDELINE RECOMMENDATIONS FOR CPR QUALITY PREDICT SURVIVAL FROM OUT-OF-HOSPITAL CARDIAC ARREST?

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Background: Measures of chest compression fraction (CCF), compression rate, compression depth and pre-shock pause have all been independently associated with improved outcomes from out-of-hospital cardiac arrest (OHCA). However, it is unknown whether compliance with the American Heart Association (AHA) guideline recommendations for cardiopulmonary resuscitation (CPR) quality predicts survival from OHCA. **Methods:** We performed a secondary analysis of prospectively collected data from the Resuscitation Outcomes Consortium Cardiac Arrest Epistry database. As per the 2015 AHA guidelines, high quality CPR was defined as CCF >0.8, chest compression rate 100-120/minute, chest compression depth 50-60 mm, and pre-shock pause <10 seconds. Multivariable logistic regression models controlling for Utstein variables were used to assess the relationship between compliance with AHA CPR quality benchmarks and survival to hospital discharge and neurologically intact survival with Modified Rankin Score (MRS) ≤ 3 . The reference standard was cases that did not meet all CPR quality benchmarks. Due to potential confounding between CPR quality metrics and cases that achieved early return of spontaneous circulation (ROSC), we performed a subgroup analysis restricted to patients who obtained ROSC after ≥ 10 minutes of EMS resuscitation. **Results:** 35,445 defibrillator records were collected over a 4-year period ending in June 2015 of which 19,558 (55.2%) had complete CPR quality data. For the primary model (CCF, rate, depth), there was no significant difference in survival for resuscitations that met all CPR quality benchmarks compared to the reference standard (OR 1.26; 95% CI: 0.80, 1.97). When the dataset was restricted to patients obtaining ROSC after ≥ 10 minutes of EMS resuscitation ($n=4,158$), survival was significantly higher for those resuscitations that met all CPR quality benchmarks (OR 2.17; 95% CI: 1.11, 4.27) compared to the reference standard. For this subset of patients, compliance with all CPR benchmarks was also associated with greater odds of neurologically intact survival with MRS ≤ 3 (OR 2.95; 95% CI: 1.12, 7.81). **Conclusions:** Compliance with the current AHA guidelines for CPR quality was associated with improved survival for resuscitations with ROSC after ≥ 10 minutes of EMS resuscitation. Our findings suggest CPR quality is an important predictor of survival when controlling for length of resuscitation.

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ADVANCED VS. BASIC LIFE SUPPORT IN THE TREATMENT OF OUT-OF-HOSPITAL CARDIOPULMONARY ARREST IN THE RESUSCITATION OUTCOMES CONSORTIUM

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Background: Prior studies using hospital-based insurance claims data suggest higher survival after out-of-hospital cardiac arrest (OHCA) with basic (BLS) rather than advanced life support (ALS) prehospital care. We sought to compare the association of ALS care upon OHCA outcomes using prospectively collected clinical data from the Resuscitation Outcomes Consortium (ROC). **Methods:** Included were consecutive adults with non-traumatic OHCA treated by participating emergency medical services (EMS) agencies between June 1, 2011 and June 30, 2015. We defined BLS as receipt of cardiopulmonary resuscitation (CPR) and/or automated defibrillation and ALS as receipt of an advanced airway, manual defibrillation, or intravenous therapy. We compared outcomes among: 1) BLS-only; 2) BLS + early ALS (<6 minutes from BLS arrival); 3) BLS + late ALS (6 minutes), and 4) ALS-only. Using multivariable logistic regression, we evaluated the associations between care and return of spontaneous circulation (ROSC), survival to hospital discharge, and survival with good functional status (modified Rankin score, mRS ≤ 3), adjusting for age, sex, witnessed arrest, bystander CPR, shockable initial rhythm, public location, EMS

arrival \leq 6 minutes, CPR fraction, rate, depth, pre- and post-shock pauses, and ROC site. **Results:** Among 35,065 patients with OHCA, characteristics were median age 68 years (IQR 56-80), male 63.9%, witnessed arrest 43.8%, bystander CPR 50.6%, and shockable initial rhythm 24.2%. Care received was 4.0% BLS-only, 17.2% BLS + early ALS, 31.5% BLS + late ALS, and 47.3% ALS-only. Compared with BLS-only care, ALS care with or without initial BLS care was independently associated with increased adjusted hospital survival (ALS-only OR 2.63 [95% CI: 1.06-6.54]; BLS + early ALS 2.80 [1.12-6.97]; BLS + late ALS 2.48 [1.00-6.14].; BLS-only reference). **Conclusions:** ALS care with or without initial BLS care was associated with increased ROSC and hospital survival after OHCA.

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VENTRICULAR FIBRILLATION QUANTITATIVE ELECTROCARDIOGRAM MEASURES ASSOCIATED WITH RETURN OF ORGANIZED RHYTHM IN OUT-OF-HOSPITAL CARDIAC ARREST

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Background: Out-of-hospital cardiac arrest (OHCA) is a major cause of mortality, and ventricular fibrillation (VF) is a common electrocardiogram (ECG) presentation of OHCA. Quantitative ECG (QECG) metrics of the VF waveform, including Amplitude Spectrum Area (AMSA), median slope (MS), and centroid frequency (CF), may have utility for guiding defibrillation and CPR. Even so, VF QECG measures have yet to be translated to prehospital care. We sought to use data from a large contemporary resuscitation trial to further understand their utility. We hypothesized that QECG metrics would be associated with return of organized rhythm (ROOR) in OHCA. **Methods:** Data from prehospital, EMS-treated cardiac arrests from 2011 to 2015, enrolled in the Continuous Chest Compression trial, were obtained from 7 ROC sites. Data were downloaded from monitors using manufacturer software. Signal data were then extracted from the downloaded files using a custom Matlab program (Mathworks Inc, Natick, MA). ECG pre-shock segments used for QECG analysis included ECG following the last chest compression before a shock, up to the time immediately before the shock. Return of organized rhythm (ROOR) was defined as a regularly occurring complex, regardless of rate or QRS width, during the largest compression gap in a 3-minute period post-shock. AMSA, MS, and CF, were calculated as the mean of all available consecutive 3-second ECG segments that were free of compression artifact. Logistic regression was performed for each QECG measure using an outcome of ROOR, with separate models for total shocks and first shocks. Statistics were performed with STATA (StataCorp LP, College Station, TX). **Results:** 3,941 total shocks and 999 first shocks were found in 1,842 unique OHCA cases. ROOR rate for all shocks was 25.7% and ROOR rate per case was 40.28%. QECG odds ratios for ROOR in total shocks were AMSA 1.07(1.05-1.09) $p < .001$, MS 1.48(1.33-1.65) $p < .001$, CF 7.89(.75-8.78) $p = .130$. QECG odds ratios for ROOR from first shock were AMSA 1.06(1.03-1.09) $p < .001$, MS 1.37(1.18-1.58) $p < .001$, CF 4.52(.728-28.01) $p = .105$. **Conclusions:** In this large cohort of EMS-treated OHCA patients with a recorded shock, AMSA and MS were significantly associated with ROOR.

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DETECTION OF SPONTANEOUS PULSE USING ACCELERATION SIGNALS ACQUIRED FROM CPR FEEDBACK SENSOR IN PORCINE MODEL OF CARDIAC ARREST

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Background: Reliable detection of return of spontaneous circulation (ROSC) without long interruptions of chest compressions is part of high-quality cardiopulmonary resuscitation (CPR) and routinely done by checking pulsation of carotid or femoral arteries. The purpose of the current study was to investigate whether acceleration signals acquired from a CPR feedback sensor can be used to distinguish perfusing rhythm from pulseless electrical activity (PEA) in a porcine model of cardiac arrest. **Methods:** The experimental data were collected from 50 male adult pigs with prolonged cardiac arrest (45 ventricular fibrillation and 5 asphyxia) and CPR. ECG, arterial blood pressure and acceleration signals were synchronously recorded at a sample rate of 300 Hz. The acceleration signal (ACC) was acquired from an accelerometer-based CPR sensor (CPR-D-padz, ZOLL Medical Corporation, Chelmsford, MA, USA) that

was placed on the surface of the animal's chest over the heart. During chest compression pauses 3-second segments of signals were extracted. ROSC was defined as systolic arterial pressure (SAP) >60 mmHg and pulse pressure (PP) >10 mmHg in the presence of an organized rhythm. ACC was pre-processed using a narrow band-pass filter with the center frequency from 0.5 to 7.5Hz. Cross-correlation function was calculated between ECG and filtered ACC to obtain the peak correlation coefficient (CCp). Area under the receiver operating characteristic curve (AUC) was used to evaluate the ability of CCp to detect ROSC. **Results:** A total of 216 segments were obtained with 63 in perfusing rhythm and 153 in PEA. The filtered ACC tracings (ACC') in perfusing rhythm showed periodic oscillations synchronized with R waves, but no periodic oscillations were observed for PEA. Compared with PEA, heart rate (159.0±50.7 vs. 86.0±44.9 bpm, p<0.01), SAP (143.3±38.3 vs. 18.9±13.3 mmHg, p<0.01), pulse pressure (42.3±14.5 vs. 5.6±8.3 mmHg, p<0.01) and CCp (0.443±0.171 vs. 0.096±0.085, p<0.01) were significantly higher for perfusing rhythm. The AUC was 0.95 when CCp was used to differentiate ROSC from PEA. Using a cut-off threshold of 0.244, the sensitivity and specificity were 90.5% respectively. **Conclusions:** In this animal model, the acceleration signals acquired from a CPR feedback sensor can be used to distinguish perfusing rhythm from PEA.

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COMPRESSION-TO-VENTILATION RATIO AND INCIDENCE OF REARREST: A SECONDARY ANALYSIS OF THE ROC CCC TRIAL

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Background: When an out-of-hospital cardiac arrest (OHCA) patient achieves return of spontaneous circulation (ROSC), but subsequently has another cardiac arrest prior to hospital arrival, the probability of survival to hospital discharge is significantly decreased. Very few modifiable factors for re-arrest are known. We examined the association between re-arrest and compression-to-ventilation ratio during cardiopulmonary resuscitation (CPR) and outcomes. We hypothesized that re-arrest incidence is similar between cases treated with 30:2 or continuous chest compression (CCC) CPR, but inversely related to survival and good neurological outcome. **Methods:** This was a secondary analysis of a large randomized controlled trial of CCC versus 30:2 CPR for the treatment of OHCA between 2011 and 2015 at 8 sites of the Resuscitation Outcomes Consortium (ROC). Patients were randomized through an emergency medical services (EMS) agency-level via cluster randomization design to receive either 30:2 or CCC CPR. Case data were derived from electronic prehospital patient care reports, digital defibrillator files, and hospital records. The primary comparison was the proportion of patients with a re-arrest between cases stratified by compression-to-ventilation as-treated group. We also assessed the association between re-arrest and both survival to hospital discharge and favorable neurological outcome (Modified Rankin Score MRS ≤ 3) using multivariable logistic regression adjusting for age, sex, initial rhythm and measures of CPR quality. **Results:** There were 14,109 analyzable cases who have definitively received either CCC or 30:2 CPR. Of these, 4,713 had prehospital ROSC and 2,040 (43.2%) had at least one re-arrest. Incidence of re-arrest was not significantly different between CCC and 30:2 groups (44.1% vs. 42.8%, p = 0.12). After controlling for patient and treatment characteristics, re-arrest was significantly associated with lower survival (OR: 0.46, 95%CI: 0.36-0.51) and worse neurological outcome (OR: 0.46, 95%CI: 0.38, 0.55). **Conclusions:** Re-arrest occurrence was not significantly different between patients receiving CCC and 30:2, and was inversely associated with survival to hospital discharge and MRS.

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EMERGENCY MEDICAL SERVICES RESPONSE TIME AND PEDIATRIC MORTALITY AND MORBIDITY IN TWO URBAN CENTRES IN ALBERTA, CANADA

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Background: Many Emergency Medical Services (EMS) systems target an 8-minute response time for ground ambulance operations, but the evidence on how this affects outcomes is unclear. The objective of this study was to determine the association between an 8-minute EMS response and mortality/morbidity in the pediatric trauma population. This study is important to the EMS community as trauma is the leading cause of death for those under the age of 18 as there is very little research to guide evidence-based decision making. **Methods:** A retrospective cohort of all pediatric events made to two urban Advanced Life Support EMS systems between April, 2010 and September, 2013 was created. Events were manually reviewed to determine pediatric physical trauma. Patients were excluded if they were >18 years old, were attended to outside of the study region, or suffered a medical complaint unrelated to injury. EMS records were linked to hospital records with a deterministic linkage strategy using healthcare number, sex, and receiving facility. Response time was defined as the interval from 911 call to first ambulance on-scene, and dichotomized at 8 minutes. Outcomes were mortality, admission to hospital, and admission to ICU. Risk ratios were calculated using robust standard error Poisson regression. Mortality risk ratios were adjusted for age and sex. Admission to hospital and admission to ICU were adjusted for age, sex, and determinant code. **Results:** There were 42,620 total pediatric events over the study period, with 6,778 suffering physical trauma. 52 trauma patients died, 628 were admitted to hospital and 76 patients were admitted to the ICU. The adjusted all cause mortality risk ratio with a response time >8 minutes was 0.635 (95% CI: 0.346-1.166, p=0.143). The adjusted hospital admission risk ratio with a response time >8 minutes was 1.165 (95% CI: 0.985-1.379, p=0.075). The adjusted ICU admission risk ratio with a response time >8 minutes was 1.131 (95% CI: 0.713-1.795, p=0.602) **Conclusions:** A response time of 8 minutes was not associated with a significant difference in all cause mortality, hospital admission, or ICU admission for pediatric trauma patients.

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THE MULTI-YEAR IMPACT OF CONTINUING A COMPREHENSIVE DISPATCHER-ASSISTED CPR GUIDELINES ON BYSTANDER CPR AND SURVIVAL FROM OUT-OF-HOSPITAL CARDIAC ARREST IN A HORIZONTAL DISPATCH SYSTEM

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Background: The resuscitation guidelines indicate pre-arrival dispatcher-assisted telephone CPR (DATCPR) instructions and measurement to increase the rate of bystander CPR (BCPR). However, its short-term impact on survival is unsatisfied. This study is to investigate the multi-year impact of continuing a comprehensive program implementation of DATCPR guidelines on BCPR and survival from OHCA in a horizontal computerized-aided dispatch (CAD) system. **Methods:** A centralized CAD system in a metropolitan EMS is studied. Routinely in system the time from an EMS call to ambulance dispatch should be within 60 seconds. A comprehensive program to enhance DATCPR included guideline-based protocol changes, staff training, ergonomic CAD interface, computerized audit, feedback, and leadership rebuilt has been implemented and consistently run. The proportions of BCPR and survival 3 years after implementation (P1), by collecting a six-month database from a community-wide OHCA e-Registry, are compared with that of the same month period in the prior year as control group (P0), using regression analysis for statistics. **Results:** There were 3,582 OHCAs [1,734 P0, 1,848 P1, 65% male, median age 76 (IQR: 58-86)]. The rate of BCPR went from 17.6% in P0 to 35.3% in P1 (p<0.001). Outcome of sustained ROSC (return to spontaneous circulation) was significantly higher in P1 compared to P0 (26.8% vs. 22.3% p=0.02), as was survival to hospital discharge (10.6% in P1 vs. 5.7% in P0 p<0.001), and good neurological outcome (CPC 1or2: 6.7% in P1 vs. 2.1% in P0 p<0.001). After adjusting for witnessed arrest, shockable rhythms, age, sex, prehospital time intervals, endotracheal intubation, intravenous epinephrine, extracorporeal CPR, and targeted temperature management, good neurological outcome was still significantly higher in P1 vs. P0 (adjusted odds ratios: 2.1 [95%CI 1.2-3.9]). **Conclusions:** The multi-year continuous implementation of a comprehensive program of DATCPR in a metropolitan horizontal CAD system was associated with significant improvements in the rates of BCPR and good neurologic outcome after OHCA.

WIDESPREAD IMPLEMENTATION OF A PREHOSPITAL SELECTIVE SPINAL MOTION RESTRICTION PROTOCOL IS NOT ASSOCIATED WITH INCREASED SPINAL CORD INJURY

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Background: The traditional approach of comprehensive spinal immobilization (SI) has evolved into a more selective process in order to reduce morbidity associated with long spine boards and cervical collars. While relatively small studies have shown selective SI, or spinal motion restriction (SMR), to be safe, large outcome studies are limited. We sought to determine the prevalence of spinal cord injury (SCI) before and after the implementation of selective SMR protocols by multiple EMS agencies across Arizona. **Methods:** EMS encounters entered into the State EMS database (660,084) were matched to hospital discharge data between January 1, 2013 and June 30, 2015 with a linkage rate of 86% (567,719). Pre- and post-SMR protocol implementation cohorts were identified based on agency protocol implementation date, excluding a 3-month run-in period. EMS encounters with unknown implementation dates and duplicate encounters were excluded. The primary outcome was to compare the prevalence of SCI (ICD-9 codes 806.x or 952.x) between the pre- and post-SMR cohorts. The prevalence of SCI was determined using the entire population as well as three sub-groups: trauma (T) (ICD-9 code 800-959), spinal trauma possible (ST-P) (CDC Barell Injury matrix: other head, face, neck, spine and back) and spinal trauma verified (ST-V) (ICD-9 952.x, 839.x, 806.x, or 805.x). Analyses were performed using Chi-squared tests. **Results:** Sixty-three EMS agencies with a known SMR implementation status were included in the analysis. Of these, 52 transitioned to an SMR protocol. Of the 417,979 EMS encounters included in the full study population, three sub-groups were identified: 99,065 T cases, 47,686 ST-P cases, 4,505 ST-V cases. There were a total of 226 SCI cases. The prevalence of SCI in the pre- and post-SMR implementation cohorts was: 0.05% v 0.06%, 0.22% v 0.24%, 0.45% v 0.50%, and 4.86% v 5.14%, in the four populations. There was no statistically significant difference between the proportion of patients with SCI before or after SMR protocol implementation (p-values > 0.400 for all populations). **Conclusions:** No significant increase in the prevalence of SCI was observed across a very large population and multiple sub-groups following the widespread implementation of selective SMR protocols.

THE IMPACT OF BURNOUT ON THE EMS WORKFORCE

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Background: Burnout is a major workforce concern for Emergency Medical Services (EMS). However, no national estimates exist. Our objectives were to 1) estimate the prevalence of burnout among Emergency Medical Technicians (EMTs) and paramedics, 2) identify characteristics predictive of burnout and 3) assess the relationship between burnout and factors that negatively impact the workforce. We hypothesized that burnout would be associated with more reported sick days and greater reported likelihood of leaving EMS. **Methods:** A random sample of 21,160 nationally-certified EMTs and paramedics was selected to receive an electronic questionnaire. The questionnaire utilized the Copenhagen Burnout Inventory (CBI), a validated instrument that measures burnout in three dimensions: personal, work-related and patient-related. Survey weights for non-response by certification level, gender and race/ethnicity were applied. Multivariable logistic regression models were used to estimate adjusted odds ratios (ORs) and 95% confidence intervals (95%CI) to quantify the association of employment characteristics with burnout in each dimension. We also assessed the association of burnout with reporting more than 10 sick days over the past 12 months and reported likelihood of leaving EMS. **Results:** We received 2,650 responses (response rate=13%). More paramedics exhibited burnout in each dimension compared to EMTs: personal (38.3% vs. 24.9%, p<0.05), work-related (30.1% vs. 19.1%, p<0.05), and patient-related (14.4% vs. 5.5%, p<0.05). The final model for

personal burnout was adjusted for provider level, experience, sex, agency type and weekly call volume. Predictors of work-related burnout included provider level, experience, agency type and weekly call volume. Variables associated with patient-related burnout included provider level, sex, weekly call volume and education. After controlling for variables associated with each dimension, increased odds of reporting 10 or more sick days were observed for those with personal (OR:2.32, 95%CI:1.39-3.87), work-related (OR:2.30, 95%CI:1.39-3.83), or patient-related burnout (OR:2.35, 95%CI:1.25-4.42). Odds of reporting being likely to leave the EMS profession were elevated for those with personal (OR:2.70, 95%CI:1.94-3.74), work-related (OR:3.43, 95%CI:2.47-4.75), or patient-related burnout (OR:3.69, 95%CI:2.42-5.63). **Conclusions:** Burnout was associated with greater reported sickness absence and likelihood of leaving the EMS profession. Future initiatives to reduce burnout among EMS professionals may positively impact the workforce.

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EVALUATION OF PREHOSPITAL HYPOXIA “DEPTH-DURATION DOSE” AND MORTALITY IN MAJOR TRAUMATIC BRAIN INJURY

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Background: Prehospital hypoxia dramatically increases mortality in Traumatic Brain Injury (TBI). However, nearly the entire literature is based upon the simple dichotomy of whether patients had a hypoxic event [O₂ saturation (SpO₂) <90%] or not. Thus, essentially nothing is known about the influence of the depth or duration of prehospital hypoxia on outcome. Using the statewide, comprehensive, linked EMS data in the Excellence in Prehospital Injury Care (EPIC) TBI Study (NIH-1R01NS071049) that contains all recorded SpO₂s/associated times, we evaluated the association between the prehospital hypoxia, “depth-duration dose,” and mortality in major TBI. **Methods:** We evaluated the moderate/severe TBI cases (CDC Barell Matrix-Type 1) in the EPIC pre-implementation cohort (before TBI guideline implementation, 16,711 cases, 1/07-6/15). Logistic regression was used to determine the association between the probability of death and the depth-duration dose (“dose,”) of hypoxia, adjusted for potential confounders and other risk factors. Hypoxic dose was defined as the area circumscribed by the patient, ‘s SpO₂ curve over time and the 90% threshold for the entire duration that a patient is hypoxic (units: percent-minutes). **Results:** After exclusions [age<10 (6.8%), transfers (29.3%), and less than two valid SpO₂ measurements with time stamps (19.4%)] 7,432 cases remained (median age 41, 70.1% male). The logistic model revealed a monotonically increasing relationship between hypoxic dose and adjusted probability of death [(adjusted OR = 1.16 (95% CI 1.11-1.22) for log₂ dose]. Thus, with other factors being equal, in patients with hypoxia, a doubling of the hypoxic dose yields an increase of 16% in adjusted odds of death. Case example: SpO₂ drops to 80% for 10 min (dose=100 percent-min) has 16% higher odds of dying than one with hypoxic dose of only 50 (e.g., 85% for 10 min or 80% for 5 min). **Conclusions:** Historically, oxygenation has been assessed dichotomously in TBI (either the patient was hypoxic or not). These results demonstrate that the depth-duration, “dose,” of prehospital hypoxia is strongly associated with mortality and may differentiate risk among hypoxic patients. Thus, hypoxia may exert a spectrum of effects, and its influence on outcome may be much more complex than is inferred by the current literature.

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CAN EMS PROVIDERS PROVIDE APPROPRIATE TIDAL VOLUMES IN A SIMULATED ADULT-SIZED PATIENT WITH A PEDIATRIC-SIZED BAG-VALVE-MASK?

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Background: In the prehospital setting, Emergency Medical Services (EMS) professionals rely on providing positive pressure ventilation with a bag-valve-mask (BVM). Multiple emergency medicine and

critical care studies have shown that lung-protective ventilation protocols reduce morbidity and mortality. Our primary objective was to determine if a group of EMS professionals could provide ventilations with a smaller BVM that would be sufficient to ventilate patients. Secondary objectives included 1) if the pediatric bag provided volumes similar to lung-protective ventilation in the hospital setting and 2) compare volumes provided to the patient depending on the type of airway (mask, King tube, and intubation). **Methods:** Using a patient simulator of a head and thorax that was able to record respiratory rate, tidal volume, peak pressure, and minute volume via a laptop computer, participants were asked to ventilate the simulator during six, 1-minute ventilation tests. The first scenario was BVM ventilation with an oropharyngeal airway in place ventilating with both an adult- and pediatric-sized BVM, the second scenario had a supraglottic airway and both bags, and the third scenario had an endotracheal tube and both bags. Participants were enrolled in convenience manner while they were on-duty, and the research staff was able to travel to their stations. Prior to enrolling, participants were not given any additional training on ventilation skills. **Results:** We enrolled 50 providers from a large, busy, urban fire-based EMS agency with 14.96 (SD= 9.92) mean years of experience. Only 1.5% of all breaths delivered with the pediatric BVM during the ventilation scenarios were below the recommended tidal volume. A greater percentage of breaths delivered in the recommended range occurred when the pediatric BVM was used (17.5% vs. 5.1%, $p < 0.001$). Median volumes for each scenario were 570.5mL, 664.0mL, 663.0mL for the pediatric BMV and 796.0mL, 994.5mL, 981.5mL for the adult BVM. In all three categories of airway devices, the pediatric BVM provided lower median tidal volumes ($p < 0.001$). **Conclusions:** The study suggests that ventilating an adult patient is possible with a smaller, pediatric-sized BVM. The tidal volumes recorded with the pediatric BVM were more consistent with lung-protective ventilation volumes.

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PREDICTORS OF BEING DISPATCHED AS STROKE AND IMPACT ON PREHOSPITAL CARE OF ISCHEMIC STROKE PATIENTS

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Background: Emergency medical dispatch information may influence emergency medical services (EMS) provider assessment and care, which is particularly important for ischemic stroke where treatment is time-sensitive. The purpose of this study was to identify predictors of being dispatched as stroke and assess whether being dispatched as stroke was associated with 1) EMS providers performing the Cincinnati Prehospital Stroke Scale (CPSS) and 2) EMS providers providing prenotification to hospitals of an incoming stroke patient. **Methods:** A retrospective cohort study was performed using the Get With the Guidelines-Stroke (GWTG-S) registry at two hospitals to identify confirmed ischemic stroke patients who arrived via EMS between January 2013 and December 2015. Data from prehospital care reports (PCRs) were abstracted and merged with GWTG-S registry data. Dispatch codes were classified as either stroke or not stroke. Log-binomial regression modeling identified statistically significant predictors of being dispatched as stroke. Separate multivariable log-binomial regression models estimated relative risks (RRs) of the association between being dispatched as stroke and EMS providers performing the CPSS and providing prenotification. **Results:** PCRs for 602 (out of 647) ischemic stroke patients were available and abstracted. Median age of the sample was 73 years (interquartile range [IQR]: 60-84), 71% were white, 51% were female, and 50% were dispatched as stroke. Race (white vs. non-white [RR: 1.25, 95% CI: 1.03, 1.52]), marital status (married vs. not married [RR: 1.24, 95% CI: 1.06, 1.45]), and dispatch time (6:00 PM to 11:59 PM vs. 6:00 AM to 11:59 AM [RR: 1.28, 95% CI: 1.06, 1.54]) were significantly associated with being dispatched as stroke. After adjustment for relevant covariates, being dispatched as stroke was significantly associated with EMS providers performing the CPSS (RR: 1.40, 95% CI: 1.25, 1.56) and providing prenotification (RR: 1.65, 95% CI: 1.40, 1.94). **Conclusions:** Among ischemic stroke patients, white race, married status, and EMS dispatch time between 6:00 PM and 11:59 PM were identified as significant predictors of being dispatched as stroke. Being dispatched as stroke was independently associated with EMS providers performing the CPSS and providing prenotification. These

findings highlight the impact of accurate emergency medical dispatch information on prehospital stroke care.

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DIFFERENTIAL CORRELATION OF ETCO₂ AND CPR QUALITY BETWEEN OUT-OF-HOSPITAL ARRESTS OF CARDIAC AND RESPIRATORY ETIOLOGY

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Background: While modest correlation between end-tidal CO₂ (ETCO₂) and CPR quality has been reported among patients who have arrested from presumed cardiac etiology, it is unknown whether this correlation exists in arrests of respiratory etiology. We compared the correlation between ETCO₂ and CPR quality among these two groups. **Methods:** ETCO₂ was monitored with side-stream CO₂ (Philips/Respironics or Oridion) and CPR quality with an accelerometer-based system (E/X Series, ZOLL Medical) during treatment of consecutive adult (age 18+) OHCA patients with presumed cardiac or respiratory etiology by two EMS agencies in Arizona (October 2008-June 2015). Minute-by-minute ETCO₂ and CPR quality data were extracted. Linear mixed effect models were fitted to use (log transformed) ETCO₂ level to predict four CPR variables: chest compression (CC) depth, (log) CC rate, CC release velocity (CCRV), and (log) ventilation rate (VR). An interaction term was used to test for differential correlation between the 2 groups. A random intercept for each case was included and a spatial power covariance structure assumed for measurements over time. **Results:** A total of 399 subjects (median age: 68 yrs, 63% male, 374 cardiac etiology, 25 respiratory) with 2,812 minutes of data were studied. ETCO₂ was correlated with CC rate for respiratory etiology ($p = 0.011$) but not for cardiac etiology and the difference was marginally significant ($p = 0.085$). ETCO₂ was correlated with VR for cardiac etiology ($p < .0001$) but not for respiratory etiology ($p = 0.009$ for the difference between etiologies). Doubling ETCO₂ was associated with an increase of 8.7mm/s (95% CI: 3.9, 13.5) in CCRV for cardiac etiology and 12.1mm/s (95% CI: -1.8, 26) for respiratory etiology, but the difference between etiologies was not significant. Correlation between ETCO₂ and CC depth was similar between the 2 groups. In both cohorts, ETCO₂ explained <10% of the variance in each CPR variable. **Conclusions:** Correlations between ETCO₂ and certain CPR variables were different for patients with cardiac vs. respiratory etiology. ETCO₂ may be not be an adequate substitute for CPR quality monitoring in either situation. Future studies are needed to determine how ETCO₂ and CPR quality monitoring can be used in combination to optimize CPR.

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CHANGES IN PHYSIOLOGIC MEASURES FOLLOWING PREHOSPITAL MIDAZOLAM ADMINISTRATION: A QUALITY ASSURANCE STUDY

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Background: Midazolam has recently gained favor in the prehospital realm. Although prior studies have reported instances of hypotension, hypoxia, and apnea following midazolam administration, there has been a lack of consistency in demonstrating clinically significant adverse effects associated with specific dosing parameters. Our objective was to evaluate the potential impact of midazolam dosing parameters on physiologic measures as part of a safety analysis following initial deployment of midazolam in a high volume EMS system. **Methods:** Records were reviewed for all patients who received midazolam during the 6-month period from August 20, 2015 through February 20, 2016 to collect dosing parameters (indication, route, total dose, number of doses) and physiologic measures (HR, RR, MAP, SpO₂, ETCO₂, and GCS) as part of a retrospective quality assurance review. Duplicate, incomplete, and specialty team records were excluded. Mean changes in physiologic measurements were compared with dosing parameters using ANOVA. Correlations were examined between total dose administered and mean change in physiologic parameters. **Results:** This analysis included 391 unique patients who received 519 total doses. The most common indications were seizure ($n=183$) and chemical restraint ($n=180$), while

the most frequent routes were intravenous (n=194) and intranasal (n=135). 71% of patients (n=279) received a single dose, while 25% received a second (n=98), and only 4% (n=12) received a third. Mean individual dose was 5.48 mg (range 1-10) with a mean total dose of 6.86 mg (range 2-20). Mean changes in physiologic parameters (first to last) were HR -4.57, RR -0.59, MAP -4.84, SpO₂ 0.69, ETCO₂ -0.57, and GCS 0.21. Total dose was not associated with changes in any of the physiologic parameters. There was no significant difference in physiologic parameter changes associated with route or number of doses. There was a significant difference in MAP change associated with the indication for administration [F(3, 391)=2.994, p=0.03], although the effect size was small ($\eta^2=0.07$). **Conclusions:** Changes in physiologic parameters following midazolam administration were small regardless of indication, route, or dose and are not likely to be clinically impactful.

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AN OBSERVATIONAL MULTICENTER STUDY OF A DIRECT-TO-CT PROTOCOL FOR EMS-TRANSPORTED PATIENTS WITH SUSPECTED STROKE

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Background: In an effort to decrease door-to-needle times for patients with acute ischemic stroke, some hospitals have begun taking stable EMS patients with suspected stroke directly from the ambulance to the CT scanner, then to an emergency department (ED) bed for evaluation. Minimal data exist regarding the potential for time savings with such a protocol. The study hypothesis was that a direct-to-CT protocol would be associated with decreases in both door-to-CT-ordered and door-to-needle times.

Methods: An observational, multicenter before/after study was conducted of time/process measures at hospitals that have implemented direct-to-CT protocols for patients transported by EMS with suspected stroke. Participating hospitals submitted data on at least the last 50, "EMS stroke alert," patients before the launch of the direct-to-CT protocol, and at least the first 50 patients after. Time elements studied were arrival at the ED, time the head CT was ordered, and time tPA was started. Data were submitted in blinded fashion (patient and hospital identifiers removed), the lead investigator was unaware of which data came from which hospital. Simple descriptive statistics were used, along with the Mann-Whitney test to compare time medians (due to non-normal data distribution). **Results:** Four hospitals contributed data on 760 patients (394, "before," and 366, "after,"), 354 were male, and 399 had final diagnoses of ischemic stroke, of whom 221 received tPA. Another 58 had final diagnoses of hemorrhagic stroke, 63 of transient ischemic attack, and 240 of other. The median door-to-CT-ordered time for all patients was 7 minutes in the, "before," phase, and 5 minutes after (difference 2 minutes, p=0.0023). The median door-to-needle time for all patients given tPA was 37 minutes before, and 42 minutes after (no difference, p=0.24). Two of the four hospitals had modest decreases in door-to-CT-ordered time (median 9 min to 5 min, and median 5 min to 3 min, both p<0.05), but no hospital had a decrease in door-to-needle time.

Conclusions: A minimal reduction in door-to-CT-ordered time, but no change in door-to-needle time, was found for EMS patients with suspected stroke taken directly to the CT scanner, compared to those evaluated in the ED prior to CT.

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FACTORS PREDICTING A NEGATIVE PERCEPTION OF PATIENT SAFETY IN THE EMS WORKPLACE

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Background: Perception of patient safety among healthcare providers is an important element of a culture of safety. Research regarding factors that impact EMS providers,' perception of patient safety is scant. Our objective was to describe key factors associated with EMS providers,' perceptions of patient safety practices at their agency. We hypothesized that job dissatisfaction would be associated with a negative overall agency patient safety rating. **Methods:** This was a large, cross-sectional survey of nationally-certified EMS professionals. Data collected included safety perceptions, demographics and agency characteristics. Respondents were asked to rate their main EMS agency,'s overall safety using a

5-point scale dichotomized to ,‘safe,’ (excellent/very good/good) or ,‘unsafe,’ (fair/poor). Inclusion criteria consisted of currently practicing providers (EMT or higher) in non-military and non-tribal settings. A multivariable logistic regression model was constructed using investigator-controlled forward selection to identify variables associated with perceiving one’s agency as ,‘unsafe,’. **Results:** A total of 35,588 responses were received (response rate=11%) with 23,773 meeting inclusion criteria. There were 3,285 respondents (14%) who rated their agency as unsafe. Predictors of a negative patient safety rating included certification level, years of EMS experience, agency type, weekly call volume, community size, and job satisfaction. EMS professionals who reported being dissatisfied demonstrated a nine-fold increase in odds of perceiving their agency as unsafe (OR 9.44, 95%CI:8.59-10.38). ALS providers (AEMTs/paramedics) had higher odds of perceiving negative safety practices at their agency compared to BLS providers (EMTs) (OR 1.58,95%CI:1.43-1.75). Compared to those at fire-based agencies, there was over a two-fold increase in odds of reporting negative safety ratings among those at private agencies (OR 2.10,95%CI:1.89-2.32). For years of EMS experience, there was a stepwise increase in odds of perceiving one’s agency as unsafe (e.g., 3-10 years: OR 1.36,95%CI:1.20-1.53, referent: less than 3 years of experience). Likewise, a stepwise increase was noted for weekly call volume (e.g., 5-19 calls: OR 1.64,95%CI:1.44-1.86, referent: less than 5 calls per week). **Conclusions:** This study identified variables significantly associated with negative agency patient safety ratings. Understanding the dynamics between these factors and provider safety perceptions may guide interventions that impact patient safety culture in EMS.

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REMOTE ISCHEMIC CONDITIONING TO REDUCE REPERFUSION INJURY DURING ACUTE STEMI: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: Remote ischemic conditioning (RIC) is a non-invasive therapeutic strategy that uses brief cycles of inflation and deflation of a blood pressure cuff to reduce ischemia-reperfusion injury during acute ST-elevation myocardial infarction (STEMI). The primary objective of this systematic review was to determine if RIC initiated prior to catheterization increases myocardial salvage index, defined as the proportion of area at risk of the left ventricle salvaged by treatment following emergent percutaneous coronary intervention (PCI) for STEMI. Secondary outcomes included infarct size and major adverse cardiovascular events. **Methods:** Electronic searches of Medline, EMBASE and Cochrane Central Register of Controlled Trials were conducted, and reference lists were hand-searched. Randomized controlled trials comparing PCI with and without RIC for patients with STEMI published in English were included. Two reviewers independently screened abstracts, assessed quality of the studies, and extracted data. Data were pooled using random-effects models and reported as mean differences (MD) and risk ratios (RR) with 95% confidence intervals (CIs). The Grading of Recommendations, Assessment, Development and Evaluation (GRADE) criteria were used to evaluate the quality of evidence of outcomes. **Results:** Nine RCTs were included with a combined total of 999 patients (RIC+PCI = 534, PCI = 465). The myocardial salvage index was higher in the RIC+PCI group at 3 and 30 days, mean difference 0.09 (95% CI: 0.04, 0.15) and 0.12 (95% CI: 0.03, 0.21), respectively. Infarct size was reduced in the RIC+PCI group at 3 and 30 days, mean difference -3.82 (95% CI: -8.15, 0.51) and -4.00 (95% CI: -7.07, -0.93), respectively. There was no statistical difference with respect to death and re-infarction, however there was a reduction in heart failure with RIC+PCI at 6 months, RR: 0.43 (95% CI: 0.19, 0.99). All outcomes were judged to be of moderate quality of evidence using GRADE criteria except for heart failure, which was determined to be low quality. **Conclusions:** RIC is emerging as a promising adjunctive treatment to PCI for the prevention of reperfusion injury in STEMI patients. Ongoing, multicenter clinical trials will help elucidate the effect of RIC on clinical outcomes such as hospitalization, heart failure and mortality.

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CPR QUALITY DURING OUT-OF-HOSPITAL CARDIAC ARREST TRANSPORT

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Background: Previous studies have demonstrated significant associations between cardiopulmonary resuscitation (CPR) quality metrics and survival to hospital discharge following out-of-hospital cardiac arrest (OHCA). No large study has explored the relationship between location of resuscitation (scene vs. transport) and CPR quality. We sought to determine the impact of CPR location on CPR quality metrics during OHCA. **Methods:** We performed a retrospective cohort study of prospectively collected data from the Toronto RescuNET Epistry - cardiac arrest database. We analyzed CPR quality data from all treated adult OHCA occurring over a 39-month period beginning January 1, 2013. We included OHCA patients who underwent resuscitation by emergency medical services (EMS) and had CPR quality metric data for both scene and transport phases of the resuscitation. High quality CPR (based on 2010 AHA guidelines) was defined as chest compression fraction (CCF) > 0.70, compression rate >100/min. and compression depth > 5.0 cm. Scene and transport CPR quality metrics were compared for each patient using a two-sided Wilcoxon rank-sum paired-samples test. The proportion of patients who received high quality CPR (defined as meeting all 3 CPR quality benchmarks) was compared between resuscitation locations using a chi-square statistic. **Results:** Among 842 included patients (69.5% male, mean (SD) age 66.8, ±17.0), median compression rate was statistically higher on scene compared to transport (105.8 vs. 102.0, Δ 3.8, 95% CI: 2.5, 4.0, $p < 0.001$), while median compression depth (5.56 vs. 5.33, Δ 0.23, 95% CI: 0.12, 0.26, $p < 0.001$) and median CCF (0.95 vs. 0.87, Δ 0.08, 95% CI: 0.07, 0.08, $p < 0.001$) were statistically higher during the transport phase. The proportion of patients meeting the definition of high quality CPR was similar on scene compared to during transport (45.8% vs. 42.5%, Δ 3.3, 95% CI: -1.4, 8.1, $p = 0.17$). **Conclusions:** High quality CPR metrics were identified in both (scene and transport) locations of resuscitation and exceeded current CPR quality benchmarks. These results suggest that high quality, manual compressions can be performed by well-trained EMS systems regardless of location. Further study is required to determine whether these metrics can be replicated in other EMS jurisdictions.

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HEAD UP CARDIOPULMONARY RESUSCITATION LOWERS INTRACRANIAL PRESSURE AND IMPROVES CEREBRAL PERFUSION PRESSURE DURING PROLONGED CPR IN A PORCINE MODEL OF VENTRICULAR FIBRILLATION

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Background: The head up position (HUP) during CPR has recently been found to improve cerebral perfusion pressure (CerPP) and cerebral blood flow (CBF). It is unknown if HUP over a prolonged period of CPR will result in decreased cerebral flow due to pooling of blood in the abdomen and lower extremities. We therefore assessed CBF and CerPP during prolonged CPR. **Methods:** Female pigs (38-42 kg) were sedated, intubated, and anesthetized. Vascular and intracranial access were obtained for monitoring and injection of microspheres for measurement of blood flow. Ventricular fibrillation was induced and after 8 minutes, automated Active Compression Decompression (ACD) CPR with an Impedance Threshold Device (ITD) was performed (compression: ventilation ratio of 30:2) for 2 minutes. Pigs were then prospectively randomized to the HUP or supine position (SUP) and CPR continued for another 18 minutes. Microspheres were injected at baseline, 5, and 15 minutes. The primary endpoint of this ongoing study is CBF at 15 minutes. Secondary endpoints include CerPP at 19 minutes and other hemodynamic parameters at 19 minutes. Endpoints were analyzed using an unpaired t-test and expressed as mean \pm SD. **Results:** Baseline data were similar between groups. To date, cerebral and cardiac blood flow respectively (ml/min/g) after 15 min of CPR were similar but trended higher: 0.80 ± 0.83 , 0.80 ± 1.10 for the HUP (n = 7) group and 0.39 ± 0.49 , 0.66 ± 0.75 in the SUP (n = 7) group ($p = n.s.$). After 19 minutes of CPR, CerPP (mmHg) in the HUP group (n = 10) was higher than the SUP (n = 8) group (25 ± 13 vs. 9 ± 17 , $p = 0.038$). Coronary Perfusion Pressures were similar (HUP 11 ± 12 vs. SUP 5 ± 15 , $p = n.s.$). Mean ICP was lower in the HUP group (mmHg, -2.6 ± 3 vs. 12 ± 3 , $p < 0.0001$). **Conclusions:** In this

ongoing study, CerPP was higher and ICP values lower with HUP CPR vs. SUP CPR over a prolonged CPR period. Further animals are needed for definitive determination of cerebral and cardiac blood flow.

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THE PREVALENCE AND CHARACTERISTICS OF NON-TRANSPORTED EMS PATIENTS IN NOVA SCOTIA

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Background: An undefined yet potentially significant risk for Emergency Medical Services (EMS) systems are patients who access 911 with an ambulance response who are not transported to hospital (non-transport). Our objective was to determine the prevalence of non-transport and potentially adverse non-transport and identify associated characteristics in Nova Scotia. **Methods:** We conducted a secondary analysis of pooled cross-sectional, population-based administrative data in a provincial EMS system that provides care to 920,000 residents. Electronic patient care record (ePCR) data was retrospectively analyzed for one calendar year (2014). The dependent variables were non-transport status and potentially adverse non-transport status. Potentially adverse non-transport status was defined as a repeat call within 48 hours for a related complaint with the outcome of transport or death. Independent variables include patient characteristics, (age, sex, vitals and paramedic clinical impression), operational (crew type and response code) and environmental (time, date, and location). For both objectives we determined the prevalence of the outcome of interest, and associated characteristics. **Results:** Of 74,293 emergency responses, 18.9% (n=14,072) were non-transport and of those, 5.6% (n=798) were potentially adverse. The characteristics statistically significantly and independently associated with both were: age, paramedic clinical impressions, number of co-morbidities, and incident location type. Non-transport was more likely for child patients 0-15 years old (OR: 1.7, 99.9% CI: 1.5 - 2.0) relative to middle-aged adults, and patients with glycemic issues (OR: 6.7, 99.9% CI: 5.5 - 8.2) or wellness checks (OR: 8.6, 99.9% CI: 7.5 - 9.8) relative to trauma. Potentially adverse non-transport was more likely for older patients 66 or more years old (OR: 1.5, 99.9% CI: 1.1 - 2.1) compared to adult patients 36-66 years old, and patients with 7 plus co-morbidities (OR: 2.4, 99.9% CI: 1.6 - 3.5) compared to 0-2 co-morbidities. **Conclusion:** This study demonstrated that a significant portion of patients (18.9%) had a non-transport outcome, of which a limited number (5.6%) were considered potentially adverse. The results of this study provide timely information to policy makers and healthcare practitioners on the scope of this issue, and suggest potential directions for future study and clinical decision making.

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FEASIBILITY OF AMPLITUDE SPECTRUM AREA ESTIMATION IN VENTILATION PAUSES DURING CARDIOPULMONARY RESUSCITATION

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Background: Amplitude spectral area (AMSA) calculated from ventricular fibrillation (VF) waveform not only predicts defibrillation outcome, but may also reflect effectiveness of chest compressions. However, reliable VF waveform analysis usually requires rescuers to stop compressions. In the present study, we investigated whether AMSA could be accurately estimated in ventilation pauses during cardiopulmonary resuscitation (CPR). **Methods:** A total of 40 out-of-hospital cardiac arrest patients with VF as the initial rhythm were included in this study. All patients received resuscitation with 30:2 compressions to ventilation ratio. ECG data and chest compression waveforms before first defibrillation were extracted. Each episode included at least one full ventilation cycle consisting of 30 compressions followed by a ventilation pause, and a pre-shock pause with artifact-free VF signal. AMSA was continuously calculated using a sliding window of 2 seconds duration with sliding step size of 1 sampling point. Ventilation pauses were identified by the chest compression waveforms. Mean AMSA value during chest compression (AMSA_c), together with minimal AMSA value during ventilation pause (AMSA_p) were compared with the AMSA measured in noise-free VF (AMSA_{nf}) during the pre-shock pause. **Results:** 20 patients received mechanical CPR while another 20 patients received manual chest compressions. The ventilation pause was 3.19±0.62 sec for mechanical CPR and 5.96±2.06 for manual CPR. AMSA_c was

significantly higher than AMSA_p ($32.4, \pm 30.0$ mVHz vs. $6.6, \pm 3.9$ mVHz, $p < 0.01$) and AMSA_nf ($32.4, \pm 30.0$ mVHz vs. $6.0, \pm 3.5$ mVHz, $p < 0.01$). As shown in Figure 1, AMSA_nf was strongly correlated with AMSA_p ($r = 0.90$, $p < 0.01$) but not with AMSA_c ($r = 0.50$, $p = 0.11$). **Conclusions:** AMSA could be reliably estimated in ventilation pauses during CPR without additional compression pause but would be overestimated if measured during chest compressions.

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HOW MOBILE IS IMMOBILIZATION? SPINAL MOTION RESTRICTION VERSUS IMMOBILIZATION DURING AMBULANCE TRANSPORT

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Background: There is little evidence to support different stabilization options for suspected spinal injuries during ambulance transport. This study characterized head and trunk motion during ambulance transport and compared two common stabilization procedures. **Methods:** Healthy volunteers ($n = 13$) were transported on a closed course with SI (spinal immobilization: long backboard, cervical collar, head blocks) and SMR (spinal motion restriction: collar only), in balanced order. Driving tasks included 25m-radius turns, speeding up, and braking, performed across different speeds (15, 25, 30, 40 km/hr, speeding up/braking also tested at 50 km/hr). Angular orientation and linear accelerations of the head, torso and stretcher were acquired using wireless, miniature inertial measurement units (XSens MTw) and compared with repeated measures ANOVA. **Results:** Compared to SI, SMR was associated with more angular motion during turning (15-30km/hr: $+5.5 \pm 1.5^\circ$, 40 km/hr: $+12.6 \pm 2.9^\circ$, $p < .05$), which consisted of increased axial rotation ($+5.2 \pm 1.6^\circ$, $p < .01$) across all speeds and an additional $7.2 \pm 2.8^\circ$ side-flexion at 40 km/hr ($p < .001$). The head-trunk differential acceleration was also greater during turns performed with SMR vs. SI (15-25 km/hr: $+1.25 \pm 0.43$ m/s², 30-40 km/hr: $+2.72 \pm 0.71$ m/s², $p < .01$). For either SI or SMR, overall angular motion ($p < .001$) and head-trunk acceleration ($p < .01$) during turns increased with speed, ranging from 11.6 ± 1.0 to $29.0 \pm 3.6^\circ$ and 1.39 ± 0.21 to 3.63 ± 0.34 m/s², respectively. In contrast, SMR was associated with only a small increase in motion during speeding up ($+2.3 \pm 0.6^\circ$, $p < .05$, all speeds), no difference during braking ($p > .36$) and no difference in head-trunk acceleration ($p > .16$). Overall angular motion and head-trunk acceleration was greater during braking (15.0 ± 2.4 to $25.5 \pm 3.2^\circ$, 0.56 ± 0.04 to 1.56 ± 0.21 m/s²) compared to speeding up (5.6 ± 1.0 to $12.5 \pm 1.6^\circ$, 0.27 ± 0.40 to 0.81 ± 0.09 m/s²), likely due to greater ambulance accelerations (braking: 1.78 ± 0.12 to 7.61 ± 0.36 m/s², speeding up: 1.58 ± 0.29 to 3.15 ± 0.10 m/s², turning: 3.77 ± 0.21 to 8.96 ± 0.46 m/s²). **Conclusions:** Overall motion varied by task and exceeded previously published values derived from voluntary motion and simulated transport. Compared to SI, SMR was associated with more motion in some cases. Clinically relevant thresholds for both angular motion and differential acceleration remain unknown. The methods employed here could be adapted for future research that includes actual patients and correlates findings with clinical outcomes

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ACTIVE INTRATHORACIC PRESSURE REGULATION DURING POST-CARDIAC ARREST CARE SIGNIFICANTLY REDUCES VASOPRESSOR REQUIREMENTS, IMPROVES CEREBRAL BLOOD FLOW AND NEUROLOGICALLY INTACT SURVIVAL

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Background: Post-cardiac arrest care is a critical aspect of survival after cardiac arrest. Active intrathoracic pressure regulation (a-IPR) therapy consists of the delivery of a positive pressure ventilation followed by a sub-atmospheric expiratory phase pressure of -10 cmH₂O. A-IPR has previously been shown to improve cerebral hemodynamics in subjects with brain injury and low perfusion states. This study tested the hypothesis that a-IPR applied during a 6-hour post-ROSC period would enhance cerebral hemodynamics and require less vasopressor support. **Methods:** After 10 minutes of untreated ventricular fibrillation and 6 minutes of active compression decompression (ACD) CPR plus an impedance threshold device (ITD), 12 female pigs (38.9 ± 0.9 kg) were randomized into 2 post-ROSC

treatment groups, one with continuous a-IPR therapy, the other without a-IPR therapy. A target mean arterial pressure (MAP) of 75 mmHg was achieved through controlled infusion of an epinephrine solution (0.002 mg/ml). MAP, vasopressor requirements and cerebral blood flow (CBF) were recorded continuously for 6 hours. Student's t-tests were used for statistical comparisons. Data are expressed as mean \pm SD. **Results:** MAP throughout the study was matched between groups (78.2 ± 1.9 vs. 74.5 ± 1.9 for a-IPR) through careful control of vasopressors. Total epinephrine during the post-ROSC period was significantly reduced with a-IPR (0.08 ± 0.09 vs. 0.29 ± 0.12 mg, $p < 0.01$). Vasopressor support was most needed during the second hour of post-ROSC care with the control group requiring four times more epinephrine than the a-IPR group (0.05 ± 0.07 vs. 0.19 ± 0.07 mg, $p < 0.01$). Mean CBF was significantly higher in the a-IPR group for the first 5 hours of post-ROSC care (30.4 ± 6.6 vs. 19.1 ± 9.8 ml/100gm/min, $p < 0.05$). All of the a-IPR treated animals had a cerebral performance category score at 24 hours of 1, whereas the non a-IPR treated animals had CPC scores of 1 (n=3), 2 (n=2), and 5 (n=1). **Conclusions:** Addition of a-IPR therapy post-ROSC required less vasopressor support and improved cerebral hemodynamics. A-IPR has the potential to treat cardiovascular instability and brain injury during the post-ROSC period, two major detriments to survival after cardiac arrest.

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PREHOSPITAL UTILIZATION OF INTRAVENOUS CATHETERS IN CHILDREN

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Background: Obtaining prehospital intravenous (IV) access in children may be difficult and time-consuming. Although Emergency Medical Service (EMS) protocols dictate IV placement, these catheters may not be needed, especially with the availability of alternative medication delivery modalities. The scene time associated with attempting IV access in children is unknown. Our objective was to examine differences in scene time associated with prehospital IV catheter placement and the frequency and manner in which they are utilized. **Methods:** Three non-blinded investigators reviewed and abstracted EMS and hospital records of children 0-18 years of age transported by EMS to a pediatric emergency department (ED), excluding aeromedical transports, inter-facility transports, and psychiatric complaints. We compared patients in which prehospital IV access was attempted to those with no documented attempt. Our primary outcome was powered to detect a 5-minute difference in prehospital scene time, assuming a 15% prevalence of IV insertion for a sample size of 550 patients. **Results:** We reviewed 1,138 records, 556 meeting inclusion criteria. IV catheter placement was attempted in 27% (n=149) with success in 74% (n=111). Patients with IV catheters attempted were older (10.8 vs. 6.5 years) with no difference in presence of hypotension or median GCS. Mean scene time (12.5 vs. 11.8 minutes) and transport time (+2.3 minutes) were similar between groups. Prior to ED arrival, IV medications were given in 38.7% (43/111) and isotonic fluids in 12.6% (14/111) with fentanyl (n=25), midazolam (n=6), and ondansetron (n=6) being the most frequent medications administered. One patient received a prehospital medication with no alternative intranasal, intramuscular, or oral route. Among patients with a prehospital IV attempt, 31% (46/149) received IV medications and 23% (34/149) received IV fluids in the ED. Mean time to use of the IV in the ED was 70 minutes after arrival. **Conclusions:** Prehospital IV catheter placement in children is not associated with an increase in scene or transport time. Prehospital IV catheters were used in a fraction of patients with only 8% of all patients reviewed receiving prehospital IV therapy. Further study is needed to determine which children may benefit most from IV access in the prehospital setting.

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THE PROLIFERATION OF MOBILE TELEPHONES HAS REDUCED SOME MOTOR VEHICLE CRASH NOTIFICATION TIMES, BUT NOT CRASH FATALITY RATES

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Background: One presumed benefit of proliferation of mobile phones is faster EMS notification about serious motor vehicle crashes (MVCs) and therefore a reduction in MVC fatality rates. The purpose of

this study was to evaluate whether increased proliferation of mobile telephones has been associated with decreased MVC notification times and/or decreased MVC fatality rates in the United States (U.S.).

Methods: This retrospective ecological study used World Bank annual mobile phone market penetration data and U.S. Fatality Analysis Reporting System (FARS) fatal MVC data for 1994-2014. For each year, phone proliferation was measured as mobile phones per 100 population. Crash-specific FARS data were used to calculate MVC notification time (time EMS notified – time MVC occurred) in minutes. Summary FARS data were used to determine the MVC fatality rate per billion vehicle miles travelled (BVMt). We used basic vector auto-regression modeling to explore relationships between changes in phone proliferation and subsequent (following year, two years later, and three years later) changes in median and 90th percentile MVC notification times, as well as MVC fatality rates. Underlying unrelated time trends were accounted for by analyzing second differences in the data. **Results:** From 1994 to 2014, mobile phone proliferation in the U.S. increased from 6.1 to 98.4 phones per 100 people. Median MVC notification times decreased from 3 minutes to 1 minute, and 90th percentile MVC notification times decreased from 15 to 10 minutes. MVC fatality rates decreased from 17.3 to 10.8 fatalities per BVMt. Larger year-over-year increases in phone proliferation were associated with larger decreases in 90th percentile notification times for MVCs occurring during daylight hours ($p=0.004$) and on the national highway system ($p=0.046$) two years subsequent, and crashes off the national highway system three years subsequent ($p=0.023$). There were no significant associations between changes in phone proliferation and subsequent changes in median notification times. There were also no significant associations between changes in phone proliferation and subsequent changes in MVC fatality rates. **Conclusions:** Increased mobile phone proliferation has been associated with shorter 90th percentile EMS notification times for a subset of U.S. MVCs, but not with reduced MVC mortality rates.

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COMPULSORY USE OF THE BACKBOARD IS ASSOCIATED WITH INCREASED FREQUENCY OF THORACOLUMBAR IMAGING

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Background: Backboards have been shown to cause pain in uninjured patients. This may alter physical exam findings, leading emergency department (ED) providers to suspect a spinal injury when none exists and as a result order additional imaging of the thoracolumbar spine. New York had traditionally employed a "Spinal Immobilization" Protocol that included compulsory backboard application for all patients with suspected spinal injuries. In 2015, New York instituted a new "Spinal Motion Restriction" protocol that made the use of the backboard optional for these patients. The objective of this study was to determine if this change in protocol was associated with decreased backboard utilization and ED spine imaging. **Methods:** This was a retrospective before-and-after chart review of subjects transported by a single EMS agency to one of 4 EDs for calls dispatched as motor vehicle collisions (MVC). EMS and ED data were included for all calls within a 6-month interval before and after the protocol change. The protocol change was implemented in the second half of 2015. Subject demographics, backboard use, and spine imaging were reviewed for the intervals January - June 2015 and January - June 2016. **Results:** There were 818 subjects in the before period and 796 subjects in the after period. Subjects were similar in terms of gender, age and type of MVC in both periods. A backboard was utilized for 440 (54%) subjects in the before period and 92 (12%) subjects in the after period ($p < 0.001$). ED thoracic spine imaging was performed on 285 (35%) subjects in the before period, and 235 (30%) subjects in the after period ($p= 0.02$). ED lumbar spine imaging was performed for 335 (41%) subjects in the before period, and 281 (35%) subjects in the after period ($p=0.02$). **Conclusion:** A shift from a spinal immobilization protocol to a spinal motion restriction protocol was associated with a decrease in backboard utilization by EMS providers and a decrease in thoracolumbar spine imaging by ED providers.

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ACCURACY OF PREHOSPITAL DOCUMENTATION OF HYPOXIA COMPARED TO CONTINUOUS NON-INVASIVE MONITOR DATA TRACKING IN MAJOR TRAUMATIC BRAIN INJURY

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Background: It is well established that prehospital hypoxia dramatically increases mortality in Traumatic Brain Injury (TBI). Thus, in EMS TBI research, case ascertainment and risk-adjustment are highly dependent upon documentation of in-field O₂ saturation. Our objective was to compare the rate of hypoxia identified by EMS personnel and documented in EMS patient care records (PCR) versus the actual rate of hypoxia recorded by continuous, non-invasive monitoring in TBI. **Methods:** A subset of major TBI cases (moderate/severe) in the Excellence In Prehospital Injury Care (EPIC) TBI Study (NIH 1R01NS071049) were evaluated (March 30, 2013-June 26, 2015). Cases from 4 EMS agencies that report continuous monitor data (Philips MRx™) as part of EPIC were included. All monitor data available for post-hoc review were displayed and accessible to the providers during EMS care. We compared PCR documentation of hypoxia (O₂ sat <90%) to actual recorded monitor data on each patient (Fisher's Exact Test, $\alpha=0.05$). **Results:** 77 cases were included (median age: 52, 65% male). The monitors displayed and recorded 16 hypoxic cases (20.8%), but only 6 (37.5%) were documented. Thus, while the rate of actual hypoxia was 20.8%, the case ascertainment was only 7.8% (6/77) when PCR documentation alone was used ($p=0.036$). **Conclusions:** Among patients with major TBI, monitor-identified hypoxia occurred much more frequently (20.8%) than was documented by EMS personnel (7.8%). Only 37.5% of cases with actual hypoxia were recorded in the PCRs. This may be explained, in part, by the fact that pulse oximetry occurs continuously. Thus, ongoing care responsibilities and scene distractions may cause providers to miss low readings as they fluctuate moment-by-moment. This has significant clinical implications as a potential hidden contributor to poor outcomes if hypoxia goes unrecognized (and untreated) rather than simply not being documented. Furthermore, these findings have important implications for case ascertainment, confounding, and risk-adjustment in EMS TBI studies. Whenever possible, quality improvement and research projects should utilize continuous non-invasive monitor data to identify and evaluate hypoxic patients in the setting of TBI. These findings may also have implications for identifying hypoxia in EMS patients with other critical conditions.

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PROSPECTIVE PREHOSPITAL EVALUATION OF THE CINCINNATI PREHOSPITAL STROKE SEVERITY SCALE

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Background: A simple, easily adoptable scale with good performance characteristics is needed for EMS providers to appropriately triage suspected stroke patients to comprehensive stroke centers (CSC). Many existing tools are complex, require substantial training, or have not been prospectively validated in the prehospital setting. We describe the feasibility and effectiveness of prehospital implementation of our previously retrospectively derived and validated Cincinnati Prehospital Stroke Severity Scale (CPSSS) to identify subjects with severe stroke (NIHSS ≥ 15) among all prehospital patients with clinical suspicion of stroke/TIA. Secondly, we evaluated the tool's ability to identify subjects with NIHSS ≥ 10 , large vessel occlusion (LVO), or needing services available only at a CSC. **Methods:** Without formalized training, Cincinnati Fire Department providers performed standard stroke screening ("face, arm, speech, time" FAST) and CPSSS as part of their assessment of suspected stroke/TIA patients. Outcomes for patients brought to the region's only CSC or assessed by the regional stroke team were determined through structured chart review by a stroke team nurse. CPSSS test characteristics for each outcome were calculated with 95% confidence intervals. **Results:** Complete prehospital and outcome data were available for 58 FAST-positive subjects among 158 subjects with prehospital suspicion for stroke/TIA. Subjects were excluded if FAST was negative ($n=22$), FAST or CPSSS was incompletely documented ($n=24$), if the patient was taken to a non-CSC and did not receive a stroke team consult ($n=48$), or if outcome data were missing ($n=6$). CPSSS sensitivity and specificity for each outcome were: NIHSS ≥ 15 , 77% (95% CI 46-95) and 84% (95% CI 69-93), NIHSS ≥ 10 , 64% (95% CI 41-83) and 91% (95% CI 76-98), LVO, 71% (95% CI 29-96) and 70% (95% CI 55-83), overall CSC need 57% (95% CI 34-78) and 79% (95% CI

61-91). **Conclusion:** In this pilot prospective evaluation performed in the prehospital setting by EMS providers without formalized training, CPSSS is comparable to other published tools in test characteristics and may inform appropriate CSC triage beyond LVO ascertainment alone.

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IMPLEMENTATION OF THE CANADIAN C-SPINE RULE BY PARAMEDICS: A SAFETY EVALUATION

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Background: The Canadian C-Spine Rule (CCR) was validated by emergency physicians and triage nurses to determine the need for radiography in alert and stable Emergency Department trauma patients. It was modified and validated for use by paramedics in 1,949 patients. The prehospital CCR calls for evaluation of active neck rotation if patients have none of 3 high-risk criteria and at least 1 of 4 low-risk criteria. This study evaluated the impact and safety of the implementation of the CCR by paramedics. **Methods:** This single-centre prospective cohort implementation study took place in Ottawa, Canada. Advanced and primary care paramedics received on-line and in-person training on the CCR, allowing them to use the CCR to evaluate eligible patients and selectively transport them without immobilization. We evaluated all consecutive eligible adult patients (GCS 15, stable vital signs) at risk for neck injury. Paramedics were required to complete a standardized study data form for each eligible patient evaluated. Study staff reviewed paramedic documentation and corresponding hospital records and diagnostic imaging reports. We followed all patients without initial radiologic evaluation for 30 days for referral to our spine service, or subsequent visit with radiologic evaluation. Analyses included sensitivity, specificity, kappa coefficient, t-test, and descriptive statistics with 95% CIs. **Results:** The 4,034 patients enrolled between January 2011 and August 2015 were: mean age 43 (range 16-99), female 53.3%, motor vehicle collision 51.9%, fall 23.8%, admitted to hospital 7.0%, acute c-spine injury 0.8%, and clinically important c-spine injury (0.3%). The CCR classified patients for 11 important injuries with sensitivity 91% (95% CI 58-100%), and specificity 67% (95% CI 65-68%). Kappa agreement for interpretation of the CCR between paramedics and study investigators was 0.94 (95% CI 0.92-0.95). Paramedics were comfortable or very comfortable using the CCR in 89.8% of cases. Mean scene time was 3 minutes (15.6%) shorter for those not immobilized (17 min vs. 20 min, $p=0.0001$). A total of 2,569 (63.7%) immobilizations were safely avoided using the CCR. **Conclusions:** Paramedics safely and accurately applied the CCR to low-risk trauma patients. This significantly reduced scene times and the number of prehospital immobilizations required.

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PREDICTING SURVIVAL AFTER PEDIATRIC OUT-OF-HOSPITAL CARDIAC ARREST

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Background: Pediatric out-of-hospital cardiac arrest (OHCA) is unique in terms of epidemiology, treatment, and outcomes. There is a paucity of literature examining predictors of survival to help guide resuscitation in this population. The primary objective was to examine predictors of survival to hospital discharge. The secondary objective was to determine the probability of return of spontaneous circulation (ROSC) over the duration of resuscitation. **Methods:** A retrospective cohort study of non-traumatic OHCA (<18 years) treated by EMS from the Toronto Regional RescuNET Epistry-Cardiac Arrest database from 2006 to 2015. We used competing risk analysis to calculate the probability of ROSC over the duration of resuscitation. We then used multivariable logistic regression to examine the role of Utstein factors and duration of resuscitation in predicting survival to hospital discharge. Candidate variables were limited to Utstein factors and duration of resuscitation due to the number of events. We used area under the receiver operating characteristic (ROC) curve (AUC) to determine the predictive ability of our logistic regression model. **Results:** A total of 658 patients met inclusion criteria. Survival to discharge was 10.2% with 70.1% of those children having a good neurologic outcome. The overall

median time to ROSC was 23.9 minutes. (IQR 15.0,36.7). However, the median time to ROSC for survivors was significantly shorter than the time to ROSC for patients who died in hospital (15.9 min. (IQR 10.6 to 22.8) vs. 33.2 min. (IQR 22.0 to 48.6), P value <0.001). Older age (OR 0.9, 95% CI 0.86,0.99), and longer duration of resuscitation (OR 0.9, 95% CI 0.88,0.93) were associated with worse outcome while initial shockable rhythm (OR 5.8, 95% CI 2.0,16.5), and witnessed arrests (OR 2.4, 95% CI 1.10,5.30) were associated with improved patient outcome. The AUC for the Utstein factors was fair (0.77). Including duration of resuscitation improved the discrimination of the model to 0.84. **Conclusion:** Inclusion of duration of resuscitation improved the performance of our model compared to Utstein factors alone. However, our results suggest there are a number of other important factors for predicting patient outcome.

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ACCREDITED PARAMEDIC PROGRAM GRADUATES HAVE HIGHER STUDENT ABILITY ESTIMATES

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Background: While institutional and program accreditation has long been required for physician and nursing education, paramedic education program accreditation was largely voluntary until recently. In 2013, the National Registry of EMTs (NREMT) began requiring paramedic program accreditation through the Commission on Accreditation of Allied Health Education Programs (CAAHEP) for eligibility to take the National Paramedic Certification examination. Little research exists regarding the impact of paramedic program accreditation. Our objective was to assess the relationship between paramedic program accreditation and student cognitive ability performance measured through the National Paramedic Certification examination. We hypothesized that students graduating from accredited paramedic programs would exhibit higher mean ability estimate scores than graduates of non-accredited programs. **Methods:** National Paramedic Certification cognitive examination results for 2012 graduates of paramedic programs were analyzed. Students' first-attempt cognitive mean ability estimates (MAE) were calculated using Rasch logit ability measures. Content area MAE were assessed for: 1) Airway/respiration/ventilation, 2) Cardiology/resuscitation, 3) Trauma, 4) Medical/obstetrics/gynecology and 5) EMS operations. MAE of graduates from accredited versus non-accredited paramedic programs were analyzed. Descriptive and comparative statistics were calculated. Significance was evaluated using two-sample t tests. **Results:** In 2012, 8,404 paramedic program graduates attempted the National Paramedic Certification cognitive examination. Most graduated from accredited programs (87%, n=7,317) while 13% (n=1,087) attended non-accredited programs. First-attempt MAE for all paramedic students was 511. The first-attempt MAE of paramedic students graduating from accredited programs was significantly higher than that of students from non-accredited programs (514 vs.488, p<0.001). Paramedic students from accredited programs demonstrated significantly higher cognitive ability in medical/obstetrics/gynecology (526 vs. 488, p<0.001), trauma (535 vs. 502, p<0.001), airway/respiration/ventilation (525 vs. 495, p<0.001), cardiology/resuscitation (512 vs. 487, p<0.001). No differences were observed in MAE between accredited and non-accredited program graduates for the content area of EMS operations (514 vs. 514, p=0.94). **Conclusion:** Students graduating from accredited paramedic programs exhibited significantly higher first-attempt MAE scores overall, and across all content areas with the exception of EMS operations compared to non-accredited graduates. Program accreditation is associated with paramedics who perform above the entry-level competency standard to perform safe and effective prehospital care.

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POST-RESUSCITATION HYPEROXIA AND HYPOXIA ARE ASSOCIATED WITH INCREASED CARDIAC ARREST MORTALITY

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Background: Prior studies have examined the associations between hyperoxia, hypoxia and survival after cardiac arrest, with conflicting results. We sought to determine if hyperoxia and hypoxia in the first 24 hours after return of spontaneous circulation (ROSC) are associated with increased mortality in adult out-of-hospital cardiac arrest (OHCA). **Methods:** We used multicenter data from the Resuscitation Outcomes Consortium. We included all adult OHCA with sustained ROSC ≥ 1 hour after Emergency Department arrival. We excluded patients with no arterial blood gas (ABG) measurements. Using all ABG collected during the first 24 hours of hospitalization, we defined hyperoxia as PaO₂ ≥ 300 mm Hg and hypoxia as PaO₂ < 60 mm Hg. We identified hyperoxia and hypoxia for the initial, final and any ABG. Using logistic regression, we fit a series of multivariable models evaluating the associations between hyperoxia and hypoxia and hospital mortality, adjusted for age, sex, witnessed arrest, bystander chest compressions, initial electrocardiogram rhythm and ROC clinical site. **Results:** Of 57,383 treated OHCA, we included 9,186 in the analysis. Hospital mortality was 60.1%. Patients received a median of 3 ABG measurements (IQR: 2-5). Mean time to first ABG was 1.9 \pm 2.8 hours. Initial, final and any hyperoxia occurred in 1,753 (19.1%), 551 (6.0%) and 2,465 (26.5%), respectively. Initial, final and any hypoxia occurred in 774 (8.1%), 705 (7.7%) and 1,743 (19.0%), respectively. On multivariable analysis, initial hyperoxia was not associated with hospital mortality (adjusted OR 1.10, 95% CI: 0.97-1.26), final (1.59, 1.25-2.02) and any hyperoxia (1.25, 1.11-1.41) were associated with increased hospital mortality. Initial (adjusted OR 1.57, 95% CI: 1.25-1.97), final (1.64, 1.40-1.92) and any hypoxia (1.72, 1.51-1.97) were associated with increased hospital mortality. **Conclusions:** In adult OHCA, initial hyperoxia is not associated with hospital mortality. Hyperoxia at other time points within the first 24 hours after ROSC is associated with increased mortality. Hypoxia at any time within the first 24 hours after ROSC is associated with increased mortality.

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PREHOSPITAL USE OF NASAL CANNULA END-TIDAL CO₂ MONITORING IN NON-INTUBATED MAJOR TRAUMATIC BRAIN INJURY PATIENTS

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Background: Little is known about end-tidal CO₂ monitoring using nasal cannula sensors in non-intubated patients (NC-ETCO₂). Our objective was to describe the patterns of NC-ETCO₂ seen during the prehospital care of spontaneously-breathing, major Traumatic Brain Injury (TBI) patients. **Methods:** Continuous NC-ETCO₂ data were evaluated from a subset of non-intubated, major (moderate/severe) TBI cases (April 24, 2013-April 20, 2015) in the Excellence in Prehospital Injury Care (EPIC) TBI Study (NIH-1R01NS071049). Cases from 4 EMS agencies that are reporting monitor data (Philips-MRx™) were included. Descriptive statistics were used to evaluate case and NC-ETCO₂ attributes. **Results:** Among the 56 cases included (median age-51, 63% male), 91% had median respiratory rate (RR) > 15 /min and 57% had median RR > 20 . Six cases (11%) had a median NC-ETCO₂ 45mmHg. Several common NC-ETCO₂ patterns emerged: 1) while the final level varied among patients, the vast majority of cases (46, 82%) attained a stable “plateau” with relatively small variation after that point, 2) ETCO₂ often “ramped up” from < 10 mmHg to the plateau during the initial 10-30 sec of monitoring (24, 43%), 3) many patients (34, 61%) had near-normal (30-34mmHg) or even normal (35-45mmHg) ETCO₂ plateaus. In 70% of the cases with normal ETCO₂ plateaus, these levels were maintained despite high RR and/or dramatic variations in RR. **Conclusion:** We believe this is the first report of the use of NC-ETCO₂ monitoring in non-intubated EMS patients. After initial “ramp up,” the vast majority of cases achieved stable readings even though dramatic variations in RR were common. Most patients (57%) were spontaneously hyperventilating at rates more than twice “normal.” Despite this, over half of them had ETCO₂ plateaus that were normal or near-normal throughout their course. It is unclear whether the “very low” ETCO₂ readings (< 30 mmHg) represent true physiological hypocapnea or simply “washout” due to the sensors being in open

ventilatory space (the naris) with continuous ambient O₂ flow. Future studies comparing NC-ETCO₂ to measured arterial pCO₂ are needed to identify the accuracy of NC-ETCO₂ as a tool for evaluating ventilatory physiology in EMS.

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TO TUBE OR NOT TO TUBE? ALS PROVIDERS PERSPECTIVES' ON PEDIATRIC INTUBATION AND AIRWAY MANAGEMENT IN THE FIELD

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Background: To describe Advanced Life Support (ALS) providers' prospective on educational and clinical practice considerations surrounding prehospital management of the pediatric airway. Pediatric endotracheal intubation (pETI) by prehospital providers remains an area of debate. There is a paucity of data demonstrating improved outcomes when ALS providers perform pETI. There is a need for research which evaluates the opinions and perspectives of the ALS providers performing the intubations.

Methods: This was a prospective study using a structured questionnaire to interview EMS providers within the state of Maryland. ALS providers with pETI in their scope of practice were included within the study. Incomplete interviews were excluded. ALS providers were provided a 23-question survey. Topics included pETI, video laryngoscopy (VL), and pediatric rapid sequence intubation (RSI). Each interview was transcribed and audio recorded by the same researcher, and then reviewed by the researcher and an independent reviewer. Three types of questions were asked in the questionnaire: open-ended, semi-structured and Likert scale questions. Statistics were calculated using Microsoft Excel. **Results:** 79 ALS providers were interviewed throughout the state of Maryland representing all five regions of the state. The median age was 40-50 years old, and median years of experience were 5-19 years. 90% were EMT-Ps. Of 47 ALS providers who have intubated children 69% stated they have been successful with 100% of their pediatric intubations. 88% of providers felt VL would be helpful. 100% of ALS providers interviewed were of the opinion that pediatric intubation should be within their scope of practice. 100% of the ALS providers reported they would benefit from additional training focused on pediatric intubation, airway management and other pediatric emergencies. **Conclusions:** These ALS providers want ongoing pediatric airway training. Focus on use of high fidelity tools, operating room access, education by pediatric airway specialists, may prove beneficial in providing ALS personnel with the additional training they desire. Videolaryngoscopy may be a helpful tool to successfully manage the pediatric airway. The perspectives of the ALS providers themselves represent an important component in the evaluation of education and clinical practice relating to pediatric airway management.

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PERFORMANCE OF THE PEDIATRIC EMERGENCY CARE APPLIED RESEARCH NETWORK (PECARN) CERVICAL SPINE INJURY (CSI) RISK MODEL USING EMERGENCY MEDICAL SERVICES (EMS) PROVIDER OBSERVATIONS

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Background: Strict spinal precautions (rigid cervical collar and immobilization on a longboard) for trauma transport are advocated due to concern for missed CSI and the theoretical risk that patient movement during transport will worsen or induce neurologic injury. Recently, the use of spinal precautions has been challenged due to potential harms associated with their use. Adult clinical decision rules have been developed to aid in limiting the use of spinal precautions. Similar decision rules are lacking in children. We aimed to determine the performance of the previously identified PECARN CSI risk factors based on EMS provider observations. **Methods:** We conducted a 4-center, prospective observational study of children < 18 years who experienced blunt trauma and were transported from the scene of injury by EMS. Children were excluded if they had penetrating trauma exclusively, were transferred to another facility for definitive care, were in the State's custody, or had a substantial

language barrier. Data was gathered from EMS providers regarding a previously reported model for CSI risk in children: high-risk motor vehicle collision, altered mental status, focal neurological deficits, neck pain, limited range of neck motion by report or exam, and substantial torso injury. We calculated the sensitivity and specificity and the negative and positive predictive values for the PECARN CSI model among EMS providers. **Results:** There were 1,372 eligible children who arrived by EMS scene response and we were able to obtain EMS provider observations. The mean age was 11.0 years (SD 4.9), 841 (61.3%) were male, and 435 (31.7%) were involved in motor vehicle crashes. Most (1,077, 78.5%) children arrived with one or more spinal precautions in place. Twenty-five children (1.8%) were diagnosed with CSI. The PECARN CSI risk model demonstrated 96.0% (95% CI: 88.3-103.7) sensitivity, 38.5% (35.9-41.1) specificity, 99.8% (99.4-100.2) negative predictive value, and 2.8% (1.7-3.9) positive predictive value. On retrospective review, the one child missed by the model had a PECARN risk factor noted in the medical record. **Conclusions:** Our findings support the previously identified PECARN model for CSI in children and the development of a prehospital pediatric CSI risk assessment tool using these risk factors.

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EVALUATING THE PROVISION AND OUTCOME OF DISPATCH-ASSISTED CARDIOPULMONARY RESUSCITATION USING THE CARDIAC ARREST REGISTRY TO ENHANCE SURVIVAL (CARES)

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Background: Dispatch-assisted CPR (DA-CPR) has been shown to improve rates of bystander CPR (BCPR) and survival in select communities. Performance standards for dispatch agency performance have been proposed but not externally validated (Lewis M, et al *Circulation*. 2013,128(14):1522-1530). We sought to determine whether DA-CPR is associated with improved patient survival, and to compare performance by a sample of dispatch agencies to these standards. **Methods:** We reviewed dispatch data from audits of audio recording of OHCA calls in the United States from January 1, 2014-December 31, 2015. Recordings were reviewed by agency supervisors and entered into the CARES dispatch registry. Cases were included if the dispatcher could talk to the caller. Data elements included whether dispatchers recognized OHCA, instructions were given, DA-CPR was initiated, and associated time intervals. OHCA Utstein data was also captured from the parent database. We compared outcome (survival to discharge) of patients who received BCPR prior to the 911 call, after DA-CPR, and not until EMS arrival (no BCPR). Multivariate analysis was performed. **Results:** We identified 2,674 cases from 28 dispatch agencies in 9 states of OHCA with dispatch and outcome data. CPR was performed prior to EMS arrival in 1,528 (57.1%) cases. As expected, survival was improved with CPR provision on scene (BCPR 17%, DA-CPR 12%, No BCPR, 8%). In a multivariable analysis, BCPR was associated with significantly improved survival (OR=1.50, 95% CI 1.04, 2.08), and DA-CPR a non-significant improvement in survival (OR=1.20, 95% CI 0.88, 1.64). We identified 1,983 cases eligible for DA-CPR instructions. Dispatchers recognized cardiac arrest in 83.1% cases (1,418/1,706), median (IQR) time to recognition was 80 (58, 120) sec, with 32% (273/858) calls recognized in <60 seconds, DA-CPR instructions were initiated in most (N=1,254) cases with compressions initiated in 74.0% (928/1,254), median (IQR) time to DA-CPR was 180 (130, 240) seconds and was performed within 2 minutes of call in 21.4% (167/781) of cases. **Conclusions:** In this convenience sample of dispatch cases, OHCA was frequently recognized and DA-CPR performed but was not associated with a significant improvement in survival. Temporal measures of dispatch performance were substantially below proposed national standards.

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PARAMEDIC PROGRAM ACCREDITATION AND STUDENT PERFORMANCE ON THE NATIONAL PARAMEDIC CERTIFICATION EXAMINATION

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Background: Starting January 1, 2013, the National Registry of Emergency Medical Technicians (NREMT) required graduation from an accredited paramedic program to be eligible to take the National Paramedic Certification examination. Little is known about the potential impact of accreditation on student performance. Our objective was to assess the relationship between paramedic program accreditation and student performance on the National Paramedic Certification examination. We hypothesized that graduates of accredited programs would have higher first and cumulative third attempt pass rates compared to their non-accredited counterparts. **Methods:** National Paramedic Certification cognitive examination results for all students who completed paramedic programs in 2012 were analyzed. Paramedic program status was categorized as either accredited or non-accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP). Individual performance on the National Paramedic Certification in terms of first-attempt and cumulative third-attempt pass rates were analyzed. Descriptive statistics were calculated and Chi-square tests were used to compare pass rates between accredited and non-accredited graduates. Univariable logistic regression was used to assess the impact of program accreditation status on first-attempt pass/fail. **Results:** A total of 8,404 students that graduated from paramedic programs in 2012 were included in the analysis. Of these, 87.1% (n=7,317) graduated from an accredited paramedic program. The first-attempt pass rate for graduates of accredited programs was significantly higher than that of their non-accredited counterparts (75.6% vs. 67.3%, p<0.001). Likewise, the cumulative pass rate after three attempts was significantly higher for graduates of accredited programs at 88.9% compared to 81.9% for graduates of non-accredited programs (p<0.001). Graduates of accredited programs had 51% greater odds of passing the National Paramedic Certification examination compared to non-accredited graduates (OR:1.51, 95%CI:1.31-1.73, p<0.001). **Conclusions:** Students graduating from accredited paramedic programs exhibited significantly higher first-attempt and cumulative third-attempt pass rates compared to graduates of non-accredited programs. Individuals seeking a career in prehospital EMS should consider program accreditation status when selecting a program as accreditation was associated with greater odds of first-time success on the National Paramedic Certification examination. Future efforts should evaluate the impact of expanding accreditation to all levels of EMS education.

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IMPACT OF EMS ALERTS AND PARALLEL HOSPITAL WORKFLOW ON DOOR-TO-TREATMENT TIMES IN ELVO: THE MEMORIAL STROKE EXPERIENCE

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Background: Endovascular mechanical thrombectomy is now standard of care for acute strokes with emergency large vessel occlusion (ELVO). Time to reperfusion is a significant predictor for favorable outcomes in strokes caused by ELVO. Prehospital notification by EMS has been shown to reduce treatment times in small vessel strokes. Our objective was to assess the impact of prehospital EMS alerts and parallel activation of the neurointerventional team on door-to-puncture times in patients with ELVO. **Methods:** A process improvement initiative was launched at Memorial Healthcare System's Comprehensive Stroke Centers (CSC) with implementation of a parallel workflow for potential ELVO patients: 1) EMS prehospital stroke alerts, 2) immediate notification of NeuroInterventionalist (NI) if presence of dense MCA syndrome, 3) early activation (i.e., pre-imaging) of cath lab team based on clinical judgement of NI. **Results:** A total of 164 acute stroke patients with ELVO underwent mechanical thrombectomy from August 2014 to July 2016. The median NIHSS score was 17. Prehospital stroke alerts by EMS were called in 80% (n=132) of treated patients. Among patients with EMS alerts, the NI was notified pre-imaging in 64% (n=80) of cases and the cath lab team was mobilized in parallel for 33 patients. The median door-to-puncture times for patients with EMS alerts + pre-imaging cath lab activation vs. EMS alerts + post-imaging cath lab activation vs. no EMS alerts were: 66, 79, and 100 minutes, respectively (p<0.05). The impact of field notification was more pronounced after hours: median door-to-puncture time 76 minutes with EMS alerts (n=70) compared to 111 minutes without EMS alerts (n=21). For patients treated with bridging therapy (IV tPA+IA thrombectomy), the picture-to-

puncture interval was shorter among patients with EMS alerts, 62 vs. 80 minutes ($p < 0.05$). **Conclusions:** We demonstrate a stroke system of care designed to optimize time to treatment in patients with ELVO, utilizing EMS alerts and parallel in-hospital workflow. In the era of mechanical thrombectomy, this is the first study to show the feasibility and efficacy of prehospital EMS stroke notifications triggering early activation of the neurointerventional team in patients with possible ELVO. Development of stroke protocols that align EMS with efficient hospital processes are paramount.

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PREHOSPITAL qSOFA SCORES HAVE LOW SENSITIVITY BUT HIGH SPECIFICITY FOR IDENTIFICATION OF PATIENTS WITH SEVERE SEPSIS

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Background: Sepsis is a common and deadly disease process for which early recognition and intervention can significantly improve clinical outcomes. Despite this, sepsis remains under-recognized and therefore undertreated in the prehospital setting. Recent recommendations by the Society of Critical Care and European Society of Intensive Care Medicine advocate use of the qSOFA (quick Sequential [Sepsis-related] Organ Failure Assessment) score in non-ICU settings to screen for septic patients at greater risk for poor outcomes. **Methods:** We retrospectively evaluated the sensitivity and specificity of a qSOFA score > 2 for prehospital identification of patients with severe sepsis and septic shock based on emergency department (ED) ICD-9 diagnosis codes consistent with infection or physiologic dysfunction. ED patients were classified as having infection without sepsis ($n=71$), sepsis ($n=38$), or severe sepsis/septic shock ($n=43$), where designation of severe sepsis/septic shock required evidence of end-organ dysfunction, hypoperfusion (lactate > 2) or vasopressor requirement. **Results:** We found that a prehospital qSOFA score > 2 was 16.3% sensitive (95% CI 6.8 – 30.7%) and 97.3% specific (95% CI 92.1 – 99.4%) for patients ultimately diagnosed with severe sepsis/septic shock in the ED. Adding an additional point to the prehospital qSOFA score for a pulse > 100 , nursing home residence, age > 50 , or reported fever increased the sensitivity to 58.1% (95% CI 42.1 – 73.0%) and decreased the specificity to 78.0% (95% CI 69.0 - 85.4%). During their ED stay, approximately two-thirds of patients meeting severe sepsis/septic shock criteria eventually met qSOFA criteria with a sensitivity of 67.4% (95% CI 51.5 – 80.9) and specificity of 86.2% (95% CI 78.3 – 92). The failure to meet qSOFA criteria prehospital was predominantly due to a systolic blood pressure and respiratory rate that did not yet meet predetermined thresholds. **Conclusions:** These findings suggest that the dynamic nature of sepsis can make sensitive detection difficult in the prehospital setting, although combining qSOFA with other clinical information (age, nursing home status, fever and tachycardia) can identify more patients with sepsis who may benefit from time critical interventions.

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BASIC LIFE SUPPORT VERSUS ADVANCED LIFE SUPPORT: COMPARISON OF NEUROLOGICAL OUTCOME IN OUT-OF-HOSPITAL CARDIAC ARREST BASED ON INITIAL RHYTHMS

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Background: Previous studies suggest that basic life support (BLS) care may be more effective than advanced life support (ALS) in out-of-hospital cardiac arrests (OHCA) when analyzed for neurological outcomes at discharge. It is unclear, however, if BLS or ALS transfer impacts the outcome of OHCA patients when the initial rhythm is either Ventricular Fibrillation (VF) or Ventricular Tachycardia (VT). This study evaluates the neurological outcomes of patients receiving either ALS or BLS care stratified by initial rhythm. **Methods:** This is a retrospective cohort study of 1,596 patients who experienced non-traumatic OHCA in Detroit, MI and were enrolled in the Cardiac Arrest Registry to Enhance Survival (CARES) from January 1, 2014 to December 31, 2015 as part of the Save-MI-Heart initiative. All patients were initially categorized into two cohorts by initial rhythm, shockable (VF/VT) and unshockable (all other pulseless rhythms). The cohorts were subsequently clustered based on ALS and BLS care. For all

cases, resuscitation was attempted and neurological outcome was evaluated at hospital discharge for good cerebral performance (CPC 1 or 2) or moderate cerebral disability (CPC > 2). Fisher's exact and chi-squared tests were used to determine statistical difference. **Results:** Of the 1,596 OHCA patients, 56% were African Americans and 55% were male with a mean age of 60.2 years (SD ±20.7). Within the unshockable cohort, 8 of 653 (1.2%) ALS patients and 27 of 763 (3.5%) BLS patients were discharged with CPC 1 or 2 ($p < 0.01$). In the shockable cohort, 2 of 60 (3.3%) ALS patients and 4 of 120 (3.3%) BLS patients were discharged with CPC 1 or 2 ($p = 1.00$). On average, the time of call to time in the ED was about 10 minutes longer in the ALS group. **Conclusions:** CARES registry data shows BLS care to have better neurological outcome at hospital discharge than ALS in the unshockable cohort. The results do not provide evidence that patients experiencing OHCA with an initial rhythm of VF/VT have better neurological outcomes when receiving BLS or ALS care.

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HELICOPTER USAGE ON OVERALL MORTALITY IN OUT-OF-HOSPITAL INJURIES: IS THERE AN IMPACT FROM CHANGE IN UTILIZATION AFTER A CRASH?

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Background: Helicopter crashes spark a debate on the association between helicopter usage and mortality among patients with out-of-hospital injuries. Delaware implemented its trauma system in 2000 with a decrease in mortality rates and an increase in usage of helicopters for transport. In 2008 a helicopter crash killing the crew and two patients drastically changed usage patterns. Since then, helicopter usage has reduced dramatically in Delaware. The purpose of this study is to determine the odds of mortality for patients with severe trauma (ISS > 24) transported via air versus ground. A change in the mortality odds ratio is expected with decreased helicopter usage. **Methods:** This is a retrospective study of de-identified data from the Delaware State Trauma Registry during a 14-year time period between 1999 and 2012 representing 3,621 patients. Differences in demographic and clinical characteristics including age, gender, race/ethnicity, injury type, ISS score, anti-coagulant use, hospital or ICU length of stay, place of injury and type of trauma center were examined with a chi-square for categorical variables and a t-test for continuous variables. A Mann Whitney U test was performed to explore mean differences between non-normally distributed variables. Multivariable logistic regression models were employed to examine the association between transportation mode (helicopter vs. ambulance) and mortality. The data was analyzed in two time periods: from 1999-2008 and 2009-2012. The models were used to compute the odds of mortality. **Results:** After adjusting for the demographic and clinical characteristics, the odds of mortality did not change if transported by helicopter compared to ambulance (OR = 1.35, 95% CI: 0.968, 1.886). The odds of mortality for helicopter compared to ambulance were similar in the early years (OR = 1.40, 95% CI: 1.02 to 1.92) compared to the later years (OR: 1.47, 95% CI: 0.809 to 2.66). **Conclusions:** The association between transportation mode and mortality remained the same despite changes in helicopter usage. This adds to the debate of trauma helicopter usage and further study in a wider geographic area is necessary to understand the risks and benefits of transportation mode.

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FATIGUE, SHIFTWORK AND SAFETY OUTCOMES IN CANADIAN PARAMEDICS

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Background: Research conducted on American paramedics has illustrated an empirical link between fatigue and safety-related outcomes. However, significant structural differences exist in the delivery of paramedicine in the United States and Canada. Therefore, it is necessary to explore if the established relationships between fatigue and safety outcomes, including paramedic injury, behaviors that may compromise patient and provider safety, and medical errors, are also evident in Canadian paramedics. The purpose of this study was to determine if fatigue, shift length, hours worked weekly, and shift type

were related to safety outcomes in Canadian paramedics. **Methods:** An online survey was conducted with 10 EMS services with a 40.5% response rate (n= 717). Respondents reported levels of fatigue using the Chalder Fatigue Scale, safety outcomes, work patterns (types of shifts, hours worked weekly) and demographic characteristics. Univariate and chi-square analyses were used to assess for significant differences. **Results:** In this sample, 55% of paramedics reported being fatigued at work. Primary Care Paramedics were more likely to be fatigued than Advanced Care Paramedics (OR 1.6, 95% CI 1.1, 2.3). Paramedics who worked over 40 hours weekly were more likely to be fatigued (OR 1.7, 95% CI 1.1, 2.4). Fatigued paramedics were more likely to report injuries (OR 2.7, 95% CI 1.8, 4.0), more likely to report safety compromising behaviors (OR 3.9, 95% CI 1.6, 10.0), and medication errors (OR 1.6, 95% CI 1.1, 2.0). Paramedics who rotate between day and night shifts were more likely to report injury (OR 1.9, 95% CI 1.2, 2.8) and medication errors (OR 1.7, 95% CI 1.2, 2.4). Paramedics who worked 12 or more hours per shift were more likely to report injury (OR 3.1, 95% CI 1.4, 7.0) and medication errors (OR 3.7, 95% CI 1.6, 8.5). Finally, paramedics who worked over 40 hours weekly were more likely to report injury (OR 2.0, 95% CI 1.3, 3.1) and were more likely to report safety compromising behaviors (OR 5.9, 95% CI 2.6, 13.4). **Conclusions:** Despite significant structural differences in American and Canadian paramedicine, fatigue remains a significant predictor of injury, safety compromising behaviors, and medication errors.

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NEUROLOGICAL FAVORABLE OUTCOME ASSOCIATED EMS COMPLIANCE WITH ON-SCENE RESUSCITATION TIME PROTOCOL

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Background: Korean national emergency care protocol for EMS providers recommends a minimum of 5 minutes of on-scene resuscitation before transport to hospital in cases of Out-of-Hospital Cardiac Arrest (OHCA). We compared survival outcome of OHCA patients according to scene time interval (STI)-protocol compliance of EMS. **Methods:** EMS assessed and treated adult OHCA patients with presumed cardiac etiology during 2-year period were analyzed. Non-compliance was defined as hospital transport with STI less than 6 minutes without return of spontaneous circulation (ROSC) on scene. Propensity score for compliance with protocol was calculated and based on the calculated propensity score, 1:1 matching was performed between compliance and non-compliance group. Univariate analysis as well as multivariable logistic model was used to evaluate effect of compliance to survival outcome. **Results:** Among total of 28,100 OHCA patients, EMS transported 7,026 (25.0%) cardiac arrest without achieving ROSC on scene with STI less than 6 minutes. 6,854 cases in each group were matched using propensity score matching. Overall survival to discharge rate did not differ in both groups (4.6% for compliance group vs. 4.5% for non-compliance group, p=0.78). Adjusted odds ratio of compliance for survival to discharge were 1.12 (95%CI 0.92 – 1.36). More patients with favorable neurological outcome was shown in compliance group (2.5% vs. 1.7%, p<0.01) and adjusted odds ratio was 1.91 (95% CI 1.42 – 2.59) **Conclusions:** Although survival to discharge rate did not differ for patient with EMS non-compliance with STI protocol, lesser patients survived with favorable neurological outcomes when EMS did not stay for sufficient time on scene in OHCA before transport.

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COMPARING THE ACCURACY OF MASS CASUALTY TRIAGE SYSTEMS IN A PEDIATRIC POPULATION

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Background: Until recently, it was not possible to compare accuracy between different mass casualty triage systems because there was no gold standard for determining the “correct” triage category. An expert panel recently published a gold standard for each triage category allowing triage systems to be compared. Our objective was to compare the accuracy of 4 different mass casualty triage systems (SALT, JumpSTART, TriageSieve, and CareFlight) when used for children. **Methods:** We observed the ED triage of patients <18 years presenting to the only pediatric specialty/Level 1 trauma hospital in the county. A

single certified EMS provider observed each patient's initial triage and recorded all findings that were necessary to categorize the patient using each of the four triage systems. These data were used to electronically assign a triage category to each patient for each triage system. Hospital medical records were reviewed for each enrolled patient, and the gold standard triage category was assigned based on the treatments received and final outcome. Descriptive statistics, including 95% confidence intervals (CI), were used to compare accuracy, over- and under-triage rates for each of the triage systems.

Results: 110 subjects were enrolled. Of those, 50.9% were male and 55.5% were transported by ambulance. When compared to the gold standard definitions, SALT was narrowly found to be the most accurate (59.1%, CI: 49.9-68.3) compared to JumpSTART (56.4%, CI:47.1-65.6), CareFlight (55.5%, CI: 46.2-64.7), and TriageSieve (55.5%, CI:46.2-64.7). SALT had the lowest rate of under-triage (34.5%, 95%CI: 25.7-43.4) compared to JumpSTART (39.1%, CI:30.0-48.2), CareFlight (39.1%, CI:30.0-48.2) and TriageSieve (39.1%, CI: 30.0-48.2). SALT had the highest over-triage rate (6.4%, CI: 1.8-10.9) compared to JumpSTART (4.5%, CI:0.7-8.4), CareFlight (5.5%, CI:1.2-9.7) and TriageSieve (5.5%, CI: 1.2-9.7). For each triage algorithm, the most common error was designating a patient as "minimal" that should have been triaged as "delayed" according to the gold standard. **Conclusions:** We found that the four most popular mass casualty triage systems performed similarly in an ED-based pediatric population. None of them was extremely accurate, with the rate of under-triage unacceptable. Differentiating between "minimal" and "delayed" should be the focus of future studies, since this was the most common inaccuracy.

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ADVANCED EMERGENCY TELEMEDICINE SERVICE REDUCES UNNECESSARY EMERGENCY MEDICAL SERVICE TRANSPORTS AND EMERGENCY DEPARTMENT VISITS FROM SKILLED NURSING FACILITIES

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Background: In medical emergencies, there are limited alternatives to Emergency Medical Services (EMS) and Emergency Department (ED) visits in skilled nursing facilities (SNF) particularly during off hours. Literature suggests that many of these visits are unnecessary and avoidable. Our objective was to demonstrate the feasibility of an Emergency Telemedicine Service (ETS) staffed by Emergency physicians and Emergency Medical Technicians (EMTs) in order to reduce the need for EMS and ED visits in SNFs.

Methods: Emergency Providers delivered care at the bedside using a novel telemedicine platform. The staffs at 2 selected SNFs were trained to activate the ETS to evaluate patients in the same manner that SNF staff would call the patient's physician or EMS in other emergencies. Patients were evaluated and treated at their bedside by the ETS physicians with the aid of the SNF staff and specially trained EMTs. Patient care included, but was not limited to, review of medical history and medications, modified physical exam, diagnostic testing, and administration of certain medications. Key quality metrics, including chief complaint, the ability to avoid transfer to the ED and patient outcomes were tracked during a 9-month pilot period. All patients were reviewed and monitored for delays in care, adverse events, and medical errors. Descriptive statistics and confidence intervals were calculated. **Results:** 654 patients were seen by the ETS since the inception of the program. 70.2% (CI 66.6-73.8%) of patients avoided transport to the ED by EMS. 29.1% (25.5-32.6%) of patients were transferred to the ED. Frequent presentations included shortness of breath (n=97) and altered mental status (n=70). These presentations avoided transfer, 76.3%(67.7-84.9) and 58.6% (46.8-70.3), respectively. 85.0% (73.7-96.3) of patients who presented for abnormal vital signs (n=40) avoided transfer. There were no significant delays in care or serious adverse events resulting from medical error or not activating EMS. **Conclusions:** An advanced ETS safely and efficiently managed patients with emergent medical conditions in SNFs dramatically reducing EMS activations and ED visits. Further investigation needs to be done to understand the scope of practice, potential cost saving, and integration with EMS of an ETS in SNFs and other settings.

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DISPARITIES IN MEDICAL CARE FEEDBACK IN EMERGENCY MEDICAL SERVICES

Background: Feedback to EMS professionals regarding the medical care they have provided may lead to improved patient care and outcomes. Our objective was to describe the prevalence of and identify characteristics associated with receiving this feedback. We hypothesized that more providers at higher certification levels (AEMTs/paramedics) would receive medical care feedback. **Methods:** This was a cross-sectional survey of nationally-certified EMS providers. Demographic/agency characteristics and information related to medical care feedback received in the prior 30 days was collected. Inclusion criteria consisted of currently practicing patient care providers (EMT or higher) in non-military, non-tribal settings. Descriptive statistics were calculated, and multivariable logistic regression was used to assess the association between receiving medical care feedback and demographic/agency characteristics. A non-respondent survey was administered to assess for non-response bias. **Results:** Responses from 32,314 EMS providers were received with 15,766 meeting inclusion criteria (response rate=11%). There were no differences between respondents and non-respondents in receiving feedback. In the 30 days preceding the survey, about half (55%) of respondents received feedback regarding medical care they provided. ALS providers (AEMTs/paramedics) had greater odds of receiving medical care feedback compared to BLS providers (EMTs) (OR: 1.21, 95%CI:1.11-1.31). Providers at hospital-based agencies demonstrated increased odds of receiving medical care feedback compared to those at fire-based agencies (OR: 1.22, 95%CI:1.09-1.35). Compared to those whose agencies primarily provide 911 services, those at air medical services had a three-fold increase in odds of receiving medical care feedback (OR: 3.00, 95%CI:2.36-3.82) while those at services that primarily provide medical/convalescent transport had significantly reduced odds of receiving medical feedback (OR: 0.48, 95%CI:0.41-0.55). EMS providers belonging to a racial/ethnic minority group had lower odds of receiving medical feedback compared to their white, non-Hispanic counterparts (OR: 0.90, 95%CI:0.81-0.99). Compared to those with fewer than 3 years of EMS experience, more experienced providers had decreased odds of receiving medical feedback (e.g., 3-10 years: OR: 0.71, 95%CI:0.65-0.78). **Conclusions:** Nearly half of EMS professionals reported not receiving medical care feedback. Disparities in medical care feedback exist in regards to minorities and medical transport providers, while higher level providers have a higher probability of receiving medical care feedback.

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DECLINE IN CHEST COMPRESSION VELOCITY OVER TIME IS RELATED TO OUT-OF-HOSPITAL CARDIAC ARREST PATIENT OUTCOME

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Background: High chest compression release velocity (CCRV) has been independently associated with improved survival from out-of-hospital cardiac arrest (OHCA). Previous studies demonstrate that repeated compressions soften the chest and may contribute to changes in compression dynamics. We assessed the change in CCRV over time and its association with favorable outcomes. **Methods:** CCRV was measured using an accelerometer connected to a defibrillator (E/X Series, ZOLL Medical) during adult OHCA resuscitations from 2 EMS agencies in Arizona between 10/2008 and 06/2015. All subjects had at least 20 compressions and compression duration of at least 1 minute within the first 10 minutes. Mean CCRV was summarized for the first and second 5-minute intervals and the rate of change in CCRV between intervals was estimated via linear regression. Patient-level mean and rate of change were summarized within each subgroup by the median and interquartile range, and were compared across subgroups by the Kruskal-Wallis test. All tests were two-sided with significance level of 0.05. **Results:** A total of 1,308 subjects were included. For each subject, the median number of compressions was 785 and median compression duration was 518.9 seconds. CCRV was significantly higher during minutes 0-5 in patients with survival to hospital discharge compared to non-survivors [373 mm/sec (IQR 315-412) vs. 338 (289-392), $p=0.0013$] and in patients with favorable (CPC=1 or 2) compared to unfavorable neurological outcome [378 (319-414) vs. 338 (289-392), $p=0.001$]. CCRV remained significantly higher for

survivors compared to non-survivors in minutes 5-10 [355 (294-391) vs. 332 (285-382), $p=0.02$] but was similar for neurological outcome [353 (293-385) vs. 332 (285-382), $p=0.2$]. The decline in CCRV was greater in patients with survival to discharge, favorable neurological outcome, and ROSC ($p<0.05$).

Conclusions: CCRV is highest throughout the first 10 minutes of CPR for OHCA survivors and patients with favorable neurological outcome. However, the rate of decline in CCRV is greater for patients with positive outcomes, possibly due to significantly higher CCRV in minutes 0-5.

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AN EVALUATION OF NAVY EN ROUTE CARE TRAINING USING A HIGH-FIDELITY MEDICAL SIMULATION SCENARIO OF INTERFACILITY PATIENT TRANSPORT

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Background: Military prehospital and en route care (ERC) impacts patient outcomes. Provider knowledge and skills are critical variables in the effectiveness of care delivered. Simulation technology facilitates a standardized patient encounter to enable complete, prospective data collection while studying the effect of an independent variable, i.e. provider type. Our study objective was to evaluate and compare performance between SMTs and Navy Nurses in a high-fidelity patient transport simulation scenario. **Methods:** A prospective, multi-site, observational study using high fidelity simulation was conducted. Participants completed an ERC scenario caring for a post-operative patient (Laerdal SimMan® fitted with intravenous arm and amputated leg) from collection at a Role II facility through transport in a simulated 20-minute MH-60 “flight,” to hand-off at a Role III facility. Participants were equipped with standardized ERC equipment, medications, and supplies. Blinded expert evaluators observed participant performance. Specific in-flight knowledge and skills evaluated included identification and treatment of both extremity hemorrhage and tension pneumothorax. Completion of task (yes/no), and action performed correctly (yes/no) were recorded by two evaluators with discordant observations reviewed by a third evaluator using recorded audio-visual files. Data were analyzed and compared by provider type. Chi-square or Fischer’s Exact tests were performed, and results were reported as percentages. **Results:** Participants included 30 nurses and 29 SMTs. At least one intervention was performed by 100% nurses and 93% SMTs ($p=0.09$). Tourniquet application was performed by 60% of nurses and 72% of SMTs ($p=0.31$). Of those, 44% of nurses and 90% of SMTs applied the tourniquet correctly ($p<0.01$). Blood administration was attempted by 79% of nurses and 17% of SMTs ($p<0.01$). Needle decompression was performed by 79% of nurses and 33% of SMTs ($p<0.01$). Of these, 83% of nurses and 67% of SMTs performed needle decompression correctly ($p=0.34$). **Conclusions:** Based on our findings, we recommend significant improvements to the training pathways for both SMTs and Navy Nurses if they are expected to independently perform critical care patient transport missions.

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RIGID CERVICAL COLLAR DOES NOT AFFECT CEREBRAL BLOOD FLOW INDEX, BUT POSITIONING DOES

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Background: The process of protecting the spine during EMS transport after a traumatic event has become a focus of debate. Historically, patients at risk for spine fracture or spinal cord injury have been placed in a rigid cervical collar (c-collar) and positioned supine on a rigid long spine board with the head secured with foam headblocks. To maximize effectiveness, the c-collar must be properly fitted, so as to provide the needed support without impinging upon blood flow or airflow. The goal of this project was to study the effect of c-collar and subject positioning on cerebral blood flow. **Methods:** This was conducted as a serial n-of-one study, where each subject was subjected to multiple conditions using a non-invasive cerebral blood flow monitor to establish cerebral blood flow index (CBFI). The CBFI data were then collected: standing, sitting up, 45 degrees, 30 degrees, 10 degrees, and supine, with and without c-collar. Descriptive statistics were used for CBFI in each condition, t-test was utilized to identify

significant change in CBF. **Results:** Five volunteers were recruited. Subjects were tested in 6 positions each with or without c-collar. Mean age was 49 ±15 years and 60% male. The CBF mean of means was 71.0 with the c-collar and 69.4 without the c-collar. Only one subject demonstrated a statistically significant difference in CBF with c-collar. The CBF mean of means for position was 72.6 for head of bed greater than 30 degrees and 68.1 for less than 30 degrees. All subjects demonstrated >99% confidence for a statistically significant difference in CBF when dichotomized using head of bed at 30 degrees.

Conclusions: Elevation of the head of the bed has greater influence on CBF than does the c-collar. While this may not be clinically significant in healthy volunteers, this change in cerebral perfusion may have clinical significance in a TBI population. Continued research is needed to identify best practice for patient positioning during transport to protect the cervical spine and optimize cerebral perfusion. The current cervical spine motion restriction practice of supine and secured on a long spine board may be suboptimal.

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DOES THE INTRODUCTION OF A PREHOSPITAL SEPSIS SCREENING TOOL RESULT IN BETTER IDENTIFICATION OF SEPSIS BY PARAMEDICS?

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Background: Early identification of severe sepsis is associated with increased survival. However, identification of sepsis in the prehospital setting is challenging due to the lack of diagnostic tools and formal training. To address this issue, an interactive learning package was developed that included a sepsis screening/notification tool. The objective was to measure the impact of this screening/notification tool on the frequency and appropriateness of prehospital sepsis documentation and emergency department (ED) notification. **Methods:** We performed a medical record review of ambulance call reports (ACRs) during two 5-month periods (Nov 1 – Feb 28), before and after completion of a 1-hour sepsis education session in October 2015, to both primary and advanced care paramedics. We enrolled a convenience sample of patients with a documented history of fever and/or documented fever >101°F (38.3°C), assessed by paramedics. The data was analyzed using descriptive, chi-square and t-test statistics where appropriate. **Results:** We reviewed 254 adult patients, 133 in the before-group and 121 in the after-group, with the following characteristics: mean age 64.8, male 48.8%, on antibiotics 23.2%, hx of sepsis 2.0%, treated by advanced care paramedic 57.1%, prehospital temperature documented 32.7%, documented sepsis on ACR 4.3%, urgent transport to hospital 13.0%, patch to emergency department 33.1%, final diagnosis of respiratory distress (24.0%), final diagnosis of general illness/weakness (44.5%). Overall, 45 (17.7%) met the sepsis notification criteria and of those, 10 (22.2%) had a temperature >101°F (>38.3°C), 22 (48.9%) patched to the ED, and only 5 (11.1%) documented sepsis on the ACR. The proportion of patients fitting the sepsis notification criteria did not differ between the before and after group (18.8% vs. 16.5%, p=0.64) nor was there a difference in temperature (p=0.76), ED patch (p=0.82) or sepsis (p=0.46) documentation rates. **Conclusions:** Sepsis documentation did not improve following education of a sepsis notification tool, and documentation of prehospital temperature remains low. Further studies are needed to explore the potential barriers associated with adopting the notification tool and to establish what educational structure and feedback can best facilitate knowledge translation and change in practice.

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DETERMINING EMS PROVIDER KNOWLEDGE OF PEDIATRIC AND OBSTETRIC PATIENT CARE: KNOWLEDGE TEST CREATION, VALIDATION AND DEPLOYMENT

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Background: For EMS professionals, pediatric and obstetric patients represent two high-risk, but low-volume, patient populations. The objectives of this study were: 1. Create a valid knowledge test on pediatric and obstetric care, 2. Deploy the knowledge test to NC EMS providers to assess overall

competency, and 3. Determine if EMS System or provider demographics contribute to changes in knowledge test scores between T0 and T1. **Methods:** Ten expert EMS physicians and EMS System administrators were recruited to aid in assessing face validity and content validity of knowledge test questions. Face validity was determined through judgment of team members and experts. Content validity index (CVI) was determined during the validation process. Thirteen EMS providers were recruited to pilot the knowledge test. EMS providers in four urban and five rural NC EMS Systems were recruited to take the validated knowledge test twice between May and November 2015. Knowledge test results were calculated and compared using EMS System and provider demographics (e.g., urbanicity, age, gender, race) via t-tests and linear regression modeling. **Results:** From an initial 179 questions, a 100-question knowledge test was developed and validated using face validity, content validity, and pilot testing among EMS providers. Questions were considered valid if they met the criteria of expert opinion face validity and received a CVI ≥ 0.86 . The mean knowledge test scores among the nine EMS Systems at T0 (n=619, response rate=52.06%) and T1 (n=260, response rate=24.34%) were 72.64% (SD=10.57) and 73.39% (SD=10.68). Among EMS Systems who participated in both testing periods (n=212), there was no significant change in knowledge test score ($p>0.05$). Linear regression models revealed no association between individual EMS System or provider demographics and knowledge test scores ($p>0.05$). **Conclusions:** EMS providers' knowledge of pediatric and obstetric patient care is stable and unaffected by EMS System and provider demographics. However, this does not translate to a comprehensive understanding of prehospital care for these patient populations. EMS providers should be given access to further education with these patient populations to increase their overall knowledge, construct validity should be measured when such an educational plan is implemented.

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BARRIERS AND FACILITATORS OF TEAMWORK IN EMERGENCY MEDICAL SERVICES

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Background: Effective communication & teamwork has been shown to optimize patient safety in several healthcare settings. Unfortunately, research on teamwork in EMS is limited. As part of a doctoral dissertation centered on teamwork in EMS, we conducted a hypothesis-generating qualitative study among emergency medical services (EMS) providers to evaluate the current state of teamwork in EMS, and assess the facilitators/barriers of teamwork in the out-of-hospital setting. **Methods:** Upon IRB approval, we recruited providers from a fire-based EMS agency in Houston, TX, for anonymous phone interviews to discuss teamwork in EMS. A convenient sample was recruited through medical director emails, fire stations visits, and announcements at training conferences. Full-time employees with a valid EMT/paramedic license were eligible. Using a semi-structured interview guide based on a teamwork process model (Marks et al), and pilot-tested among personnel from a separate agency, we queried respondents on daily task/team functions performed, and the enablers/obstacles of teamwork in their organization. Phone interviews were recorded and transcribed. Initial codes were based on our model. Emergent concepts were identified during coding. Analytic memos during coding and analysis identified potential themes, which were reviewed/refined, and compared against our theoretical framework. Data analysis was facilitated via NVivo v11. **Results:** Upon reaching theoretical saturation of data, we thematically analyzed 32 respondents' phone interview transcripts (28/32 paramedics, 30/32 males), median experience was 15 years (range=1-40 years). Overall, coordination, strategy formulation, systems monitoring, team monitoring/backup, and conflict management were cited as central to teamwork in EMS. Emergent themes related to consistent crew scheduling helps to nurture unit cohesion and mutual trust, which in turn formed the foundation for a shared mental model. Greater unit cohesion was related to higher job satisfaction. Surprisingly, it was noted that as crews became more familiar with one another (i.e., greater unit cohesion), reliance on verbal communication alone during critical events was diminished. **Conclusions:** Using a theory-based approach, we identified several key themes and emergent concepts related to teamwork in EMS. This data will inform our evolving framework, and will be used in a subsequent project on assessing the impact of a teamwork training intervention among EMS providers.

CHARACTERIZATION OF INJURY AT THE MINNESOTA STATE FAIR USING GEOSPATIAL INFORMATION

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Background: Geospatial information (GSI) is a tool often used in the fields of epidemiology and public health to track disease. It has been used in past studies to identify areas of high trauma volume. Geospatial analysis of mass gatherings has the potential to assist in the efficient deployment of EMS resources based on identification of areas with the highest EMS call density. The Minnesota State Fair (MSF) covers 320 acres and in 2015 had over 1.7 million attendees. Our primary aim was to perform a geospatial analysis of the injuries seen at the MSF using data collected by the MSF Safety Team. Our secondary aim was to identify clusters of trauma and further identify any unique characteristics of these areas. **Methods:** This was a retrospective chart review of the data collected by the MSF Safety Team for quality assurance purposes in 2015. Dates encompassed the duration of the MSF, August 27, 2015 to September 7, 2015. We included all traumatic injuries reported to the MSF Safety Team. Injuries were classified by the injury type. Data included patient age, mechanism of injury, time of day injury occurred, geographical location of injury, injury description and disposition. A free online tool called "Google Fusion" was used to identify areas of increased activity. **Results:** There were a total of 453 logged safety team reports at the MSF in 2015. Of these, 173 (38.2%) had a complaint related to a traumatic injury. The majority of these injuries were categorized as abrasion/contusion/laceration (54.9%). Using "Google Fusion" multiple clusters of increased injury incidence were identified. A cluster of traumatic injuries occurred at the "Kidway" and was presumed to represent a cluster of pediatric trauma patients. Another area of high injury density was the primary entrance/exit of the State Fair. **Conclusions:** GSI can provide predictive injury patterns which could be useful to planners of the MSF. Deployment of additional pediatric trauma equipment at the "Kidway" will occur in 2016 based on this data. GSI analyses of other large events may be useful as a tool for both pre-event planning and real-time operations in event medicine.

PREDICTORS OF EMERGENCY MEDICAL SERVICES USAGE BY DIALYSIS PATIENTS

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Background: Patients receiving chronic dialysis often require Emergency Medical Services (EMS), but little is known about clinical characteristics associated with high EMS utilization. The purpose of this study was to evaluate dialysis patient characteristics associated with increased rates of EMS utilization. **Methods:** We analyzed a cohort of chronic dialysis patients within the Nova Scotia Health Authority renal program from January 1, 2009-December 31, 2013 (last follow up 01 July 2015) who required treatment by EMS and transport to a facility for further care. Dialysis patient data was linked to Emergency Health Services (EHS) data. Time to EHS use or death was the outcome of interest and analyzed using a multivariable Anderson-Gill Cox Regression model for multiple recurring events. Variables of interest for inclusion in the model were patient demographics (age, Caucasian race, sex), albumin level, comorbidities (including cause of end-stage renal disease, coronary artery disease, congestive heart failure and peripheral vascular disease) and dialysis characteristics (modality, access and referral time). In addition, we evaluated frailty using a validated clinical frailty scale (CFS) that categorizes patients from 1 (very fit) to 7 (severely frail) based on clinician impression at the time of dialysis start. **Results:** 468 patients were included in this study, of whom 264 (56%) required treatment and transport by EMS. There were 782 EMS treated and transport events and 191 deaths (total time at risk of 1237 years). The highest severity of frailty using the CFS was associated with a 5 fold higher relative hazard for EMS use (HR 5.21, 95% CI [3.09-8.80] P<0.001. Frailty severity scores of 4-6 were also associated with a higher relative hazard for EMS use. Other factors associated with EMS use included central venous dialysis access (HR 1.25, 95% CI [1.04-1.51]) and select comorbid conditions. **Conclusions:** There are multiple clinical factors that are associated with a high use of EMS in dialysis patients. A

greater frailty severity is associated with a considerable increased relative hazard for EMS use and should be further explored to determine ways to reduce EMS use for this vulnerable patient population.

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FATIGUE MITIGATION IN AIR-MEDICAL EMERGENCY CARE SYSTEMS: PRELIMINARY REPORT ON THE SLEEPTRACKTXT2 RANDOMIZED CONTROLLED TRIAL

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Background: The SleepTrackTXT pilot trial (Clinicaltrials.gov NCT02063737) showed that use of mobile phone text-messages could impact EMS clinician self-reported fatigue during shift work. The purpose of the SleepTrackTXT2 trial (Clinicaltrials.gov NCT02783027) is to: 1) determine the short-term impact of the enhanced SleepTrackTXT2 intervention on air-medical clinician fatigue reported in real-time during and at the end of shift work, and 2) determine the long-term impact of the intervention on sleep quality and sleep health indicators including hours of sleep and recovery between shift work. **Methods:** We designed a multi-site, two-arm parallel, randomized, controlled and single blinded trial of 100 EMS workers using a 1:1 allocation. Recruitment is limited to 4 air-medical systems located in the Midwest, Northeast, and Southern United States. Control and intervention arms will involve text-message assessments of sleepiness, fatigue, and difficulty with concentration at the beginning, during, and end of scheduled shifts. Intervention participants reporting high levels of sleepiness, fatigue, or difficulty with concentration will receive intervention messages to promote a change in behavior that influence alertness during shift work. Intervention participants will receive a report each Friday of the study period showing sleep debt over 7-days. Both arms receive inter-shift text assessments of perceived recovery between shifts. We based our power calculation on detecting a clinically meaningful difference of 3 points on the Pittsburgh Sleep Quality Index (PSQI) tool from baseline to 120-days. **Results:** Enrollment began June 2016. As of July 29, 2016, 14 participants have been randomized and 173 total shifts documented (mean=12.4, SD=8.0). Baseline sleep quality for most participants (78%) was classified as poor (mean=8.4, SD=2.6). Response to text queries is high for 2,973 intra-shift and 1,034 inter-shift text assessments (intra-shift=87.9%, inter-shift=92.5%, respectively). Mean sleep hours preceding shift work was 5.5 (SD=3.6). Mean inter-shift recovery was 3.9 (range 0=Not at all recovered-to-5=Very much recovered), with 20% of recovery ratings <2. **Conclusions:** This trial will determine if real-time fatigue assessment and intervention are effective tools for fatigue risk mitigation in air-medical settings. Preliminary findings support the feasibility of the study design.

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THE RELATION BETWEEN TEAM MODEL OF EMS RESPONDING TIERS AND OUTCOMES OF OUT-OF-HOSPITAL CARDIAC ARREST (OHCA)

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Background: To investigate the optimal model of EMS tiers and the number of paramedics responding at scene for better patient outcomes after OHCA, which has been a major academic research concern for OHCA. **Methods:** A prospective one-year community-wide observational database collected from an OHCA e-Registry in a metropolitan EMS composed of two-tiered ambulance teams (ALS vs. BLS) was studied. The EMS ambulance teams capable with endotracheal intubation, intravenous medications, manual defibrillation and advance life support skills were ALS tier, teams capable with supraglottic airway device, intravenous fluid and AED were BLS. Routinely there were two staffs in each team. Outcomes included prehospital ROSC, 2-hour sustained ROSC, survival at discharge (SAD), and cerebral performance category scale. All patient prehospital characteristics and outcome relations were evaluated by regression analysis. **Results:** Among a total of 138,452 EMS calls, 3,430 were OHCA and 2,721 patients were actively resuscitated. For tier model, two-team model based on ALS dispatched first (ALS plus ALS or BLS) had better univariate outcomes than single ALS team only (prehospital ROSC:

17.9% vs. 7.9%, $p=0.02$, SAD: 21.9% vs. 6.4%, $p<0.01$, CPC1or2: 15.9% vs. 5.0%, $p=0.01$), and SAD remained significantly better after adjustment (adjusted OR (aOR): 3.37 [95%CI: 1.03-10.96], $p=0.04$). On the contrary, two-team model based on BLS dispatched first (BLS plus ALS or BLS) had worse adjusted outcomes than single BLS team only (2hr ROSC: 20.9% vs. 23.2%, aOR: 0.7 [95%CI: 0.5-0.9], $p=0.04$, SAD: 5.3% vs. 9.0%, aOR: <0.42 [95%CI: 0.24-0.74], $p<0.01$, CPC1or2: 3.2% vs. 5.0%, aOR: 0.3 [95%CI: 0.1-0.6], $p<0.01$). **Conclusions:** For two-tiered EMS system, in situation of ALS team dispatched first, two-team model of response may predict better survival for OHCA compared with single ALS team only. On the contrary, in situation of BLS team dispatched first, two-team model may have worse survival outcomes than single BLS team response.

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THE USE OF FENTANYL IN PEDIATRIC TRAUMA PATIENTS POST-IMPLEMENTATION OF THE HANDTEVY FIELD GUIDE

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Background: There are multiple barriers to prehospital analgesia administration for traumatic pain to children. Younger children are often not treated with the same frequency as older children and barriers cited include the need for intravenous access, fear of complications, and fear of giving the incorrect dose. The introduction of a field guide with customized dosing recommendations for intravenous and intranasal opioid delivery that is age specific may improve treatment of pain on the prehospital setting. The objective of our study was to evaluate the change in prehospital fentanyl administration to children after the introduction of the Handtevy field guide in our hospital-based medical Emergency Medical Service (EMS) system. **Methods:** We conducted a data analysis of patients entered into our EMS patient care registry 1 year before and after introduction of the Handtevy system in July 2015. We examined the care delivered to patients aged 0-14 years with trauma who were transported by our EMS agency. We compared the difference in treatment proportions between the two time periods and examined if age and route (intravenous versus intranasal) were associated with change in administration of fentanyl. **Results:** During the study period, a total of 3,419 patients met enrollment criteria, 1,649 patients were transported before and 1770 patients transported after the introduction of the Handtevy System. The two groups were similar with regard to age and gender. The proportion of patients treated with fentanyl increased after the pain field guide implementation (13.2% vs. 17.9%, $P<.01$). The population with the greatest increase was among children 0-5 years receiving intranasal fentanyl (OR 4.1, 95% CI 1.9, 8.6). **Conclusions:** The introduction of the Handtevy field guide with pre-calculated doses of opiate medication increased analgesia delivery to our patients age < 5 years, an age group often not treated in the prehospital setting. Future research is needed to identify ways to maximize appropriate pain treatment for children in the out-of-hospital setting.

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DOES THE USE OF VIDEO LARYNGOSCOPY IMPROVE FIRST-TIME SUCCESS RATES OR OVERALL SUCCESS RATES IN HEMS?

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Background: Prehospital pediatric ETI has shown no survival benefits compared to bag-valve mask ventilation. However, the use of video laryngoscopy (VL) has not been studied in this setting. We hypothesized that VL (CMAC®) would significantly increase first attempt and final success rates over direct laryngoscopy (DL). **Methods:** Pediatric patients (age <18) transported between January 1, 2010 and October 31, 2015 with an attempted intubation were identified. Demographics (age group, sex), first attempt success and total attempts by intubation type were abstracted. Age groups were categorized as birth-12 months, 13 months – 5 years, 6-12 years and 13-17 years. Basic comparisons of categorical variables were completed using unadjusted Chi-squared and unadjusted t-tests for continuous variables. Stratified ANOVAs were calculated to examine total attempts with each device

based on age group. **Results:** Sixty-six pediatric patient runs were abstracted (35 DL and 31 VL). There were no significant differences between the DL and VL groups based on gender (DL, 49% male vs. VL, 61% male, $p=0.30$) or age group ($p=0.29$). Analyses of first attempt success rate between DL and VL showed no difference (DL, 74.29% success vs. VL, 74.19% success, $p=0.993$). There was no difference between final success rate between DL and VL (DL, 94.74% vs. VL 96.77%, $p=0.325$). Analyses of first attempt success by age group was not significant ($p=0.715$) with the likelihood of an attempt being equivalent for all age categories. Statistical results examining the total number of attempts by age group for DL and VL also showed no significant differences (DL, $F(3,31)=1.25$, $p=0.31$ vs. VL, $F(3,27)=0.47$, $p=0.71$). 100% of patients in both groups were successfully ventilated. **Conclusions:** This trial is the first to evaluate VL in the prehospital, pediatric population. The hypothesis is disproven, video laryngoscopy did not improve first time success or final success rate. Given our subjective experience in the adult cadaver lab, these results surprised us. We feel they may be due to the limitation of this being a small trial. We recommend a larger study to fully evaluate the use of field VL in the pediatric population.

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NEW INSIGHTS INTO CPR OPTIMIZATION THROUGH A FLOW PER COMPRESSION ANALYSIS OF CHEST COMPRESSION GENERATED BLOOD FLOW

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Background: During cardiac arrest and CPR, the two primary pumps of the cardiovascular circuit (the right and left ventricles) are supplanted by a single pump, the chest compression. In pre-clinical experiments, blood flows are reported as the amount of flow per minute (L/min). Characterizing flow on a per minute basis is highly dependent on chest compression (CC) rate. Analysis of flow generated by each compression (“cardiac output” in L/comp) could reveal important information relevant to lung perfusion and how the circuit as a whole is responding to CPR. It was hypothesized that increasing CC rate would improve per minute blood flow but reduce flow on a per compression basis. **Methods:** CPR was performed on nine domestic swine (~30 kg) using standard monitoring. Flow was measured in the right common carotid and abdominal aorta. Ventricular fibrillation was electrically induced. Mechanical CC were started after ten minutes of untreated VF. CC were delivered at rates of 50, 75, 100, 125, or 150 compressions per minute (cpm) and a depth of 2” for a total of 54 min. CC rates were changed every 2 min and were randomized. **Results:** Across all rates, per minute flows were strongly rate dependent in minutes 0-10, favoring fast rates, and were weakly rate dependent in minutes 10-20, favoring rates near 100 CPM. Across all rates, per compression flow had a weaker rate dependence in minutes 0-10, favoring rates less than 100 CPM, but during minutes 10-20 had a strong rate dependence, also favoring rates less than 100 CPM. **Conclusions:** While CC rates greater than 100 cpm may provide more total blood flow early during CPR, analysis of blood flow per compression indicates that they can become detrimental after 10 minutes of ongoing CPR. During a prolonged resuscitation, a longer time after a given compression might be needed for venous refill thereby favoring rates of 100 cpm or less.

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CLINICAL AND DEMOGRAPHIC FACTORS ASSOCIATED WITH EMERGENCY MEDICAL SERVICES ARRIVAL TO A PEDIATRIC EMERGENCY DEPARTMENT

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Background: To examine demographic and clinical factors associated with emergency medical services [EMS] use in a pediatric emergency department [PED]. **Methods:** We performed a retrospective cross-sectional review of encounters with patients aged 0-21 years during calendar years 2014-2015 in an urban academic PED with two campuses, a tertiary-care site and an urban satellite community site. Encounters with patients arriving by interfacility or police transport were excluded. Acuity was classified by Emergency Severity Index [ESI]. Chi-square and logistic regression were used to analyze associations between demographic and clinical factors and EMS arrival. **Results:** There were 220,792 eligible

encounters over a 2 year period, with 15,605 encounters arriving by EMS (7.1%). In bivariable analysis, patients arriving by EMS were more likely to have encounters involving seizure (OR 10.19, 95%CI 9.55-10.87), poisoning (OR 6.22, 5.51-7.03), psychiatric concerns (OR 2.05, 1.87-2.27) and injury (OR 1.86, 1.79-1.92). In multivariable analysis of demographic factors, EMS arrival was associated with gender (aOR 0.85, 95%CI 0.80-0.89 for females) and older age (aOR 0.75, 0.69-0.82 for infants, aOR 0.64, 0.60-0.68 for ages 1-4, and aOR 0.72, 0.67-0.77 for ages 5-11 compared with ages 12-21). The odds of EMS arrival for Hispanic patients was lower (aOR 0.59, 0.55-0.64) and for non-Hispanic white patients was greater (aOR 2.0, 1.86-2.19) than the odds EMS arrival for non-Hispanic black patients. These demographic associations were not significant in analysis of the highest acuity patients. Patients with public insurance had decreased odds of EMS arrival (OR 0.80, 0.77-0.83) but no significant difference after adjusting for acuity. Subgroup analysis showed patients living within the surrounding city limits with public insurance had increased odds of EMS arrival (aOR 1.30, 1.18-1.43) after adjusting for acuity. Patients arriving by EMS had increased odds of admission (OR 3.33, 3.18-3.45) and this remained true in the subgroup of lowest acuity patients, ESI levels 4-5 (aOR 2.44, 2.07-2.92). **Conclusions:** Pediatric encounters for seizure, ingestion, psychiatric concerns, and injury are more likely to utilize EMS. Odds of EMS arrival to PED varies with age, gender, and race. Associations between public insurance and EMS use may vary with proximity to the hospital or jurisdiction.

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EFFECTS OF A TRANSIT STRIKE ON EMS TRANSPORTS AND EMERGENCY DEPARTMENT PATIENT VOLUMES

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Background: Increasing utilization of Emergency Medical Services (EMS) and Emergency Department (ED) resources, coupled with the desire to optimize system performance, makes identification of incidents impacting these resources critical. Previous studies have demonstrated that the ED is a primary care resource for many patients, and non-emergency transport options play a role in ED volumes. However, little is known about how barriers to public transit access impact EMS and ED utilization. Anecdotal evidence suggests a public transit strike may increase EMS utilization and decrease ED volumes. The purpose of this study was to examine the effects of a transit strike on EMS transports and ED visits. **Methods:** During summer of 2015, a 42-day bus strike eliminated the only available form of public transportation in Tucson, AZ. We evaluated the impact of this strike on EMS and ED resource utilization by conducting a retrospective review of hospital data from two large Tucson receiving facilities. Mean daily ED volumes and patient mode of arrival (EMS, personal vehicle, other) were compared across the 2015 transit strike and with corresponding matched dates from the preceding year using paired t-tests. Subgroup analysis compared EMS and ED resource utilization across days of the week and week of the strike. **Results:** Combined mean daily EMS arrivals and total ED patient visits during the strike period compared to the previous year were 83.5 v. 84.0 and 353.7 v. 341.4 ($p=0.174$ and 0.932 , respectively). Similarly, no significant difference was found at individual facilities. Subgroup analysis demonstrated that EMS and ED resource utilization varied by day of the week. A statistically significant, yet likely clinically insignificant, difference was found in EMS hospital transports on Saturdays, with a combined daily mean of 88.5 during the strike compared to 83.3 the year before ($p<0.001$). No difference in resource utilization was found between these two facilities with subgroup analysis by week of the bus strike. **Conclusions:** In this community, a transit strike did not have a clinically significant effect on EMS or ED utilization. Further study is necessary to determine if strikes in cities with greater dependence on public transit have similar results.

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REDUCING HOSPITAL RE-ADMISSIONS USING A COMMUNITY PARAMEDIC PROGRAM

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Background: Hospital readmission data demonstrates patients with Congestive Heart Failure(CHF), Chronic Obstructive Pulmonary Disease (COPD), and Pneumonia have high rates of hospital re-admissions. Our objective was to develop a multidisciplinary group and integrated care model using paramedics to visit patients post-discharge to provide follow-up care to reduce unnecessary hospital re-admissions. The aim was to reduce re-admissions on high-risk patients who do not qualify for Home Health Care(HHC) or did not have insurance to cover the cost of HHC. **Methods:** Patients discharged with a diagnosis of CHF, COPD or pneumonia were evaluated for inclusion. Patients who did not qualify for HHC, or were uninsured were eligible for enrollment. Patients were excluded if they had an active psychiatric condition. Patients that declined enrollment formed the control group. The multidisciplinary group consisted of case managers, nurses, physicians, and paramedics. We partnered with a private ambulance company to provide paramedics to perform home visits. The paramedics received 80 hours of additional training on home health assessment, and pulmonary assessments, and spent clinical time in the pulmonary clinic, and accompanying home health nurses on patient care visits. Paramedics visited each patient within 4 hours of hospital discharge, or the next morning. They performed a home safety assessment, medication reconciliation, and patient assessment. The paramedics contacted the patient's PMD for additional orders. The patients were then re-visited per the instructions of the PMD for next 30 days. **Results:** A total of 223 patients were screened from January 2015 thru October 2015. 24 qualified for home healthcare and were excluded. Of the remaining 199 patients, 86 consented to take part in the study. 113 declined participation and were included in the control group. A total of 471 patient visits were completed. The 30 day re-admission rate (CHF,COPD,pneumonia) was 5.8% vs. 44.2%. RR=0.13(95% CI 0.06-.032) NNT=2.6 =(95% CI 2.0-3.7). The 30 day re-admission rate (all causes) was 11.6% vs. 66.4%. RR=0.18(95% CI 0.10-0.32) NNT=1.8(95% CI 1.5-2.3). All P values < 0.001. **Conclusions:** A community paramedic program is an effective method for reducing 30 day hospital re-admission rates for CHF, COPD and pneumonia patients.

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CLASSIFICATION OF BYSTANDER CPR USING 911-CALL REVIEW VERSUS FIELD REPORT

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Background: Bystander CPR is usually captured by paramedic observation on scene, though some prehospital systems are starting to classify this based on 911 call review. The objective was to compare rates of bystander CPR using 911-calls compared to paramedic report on scene. **Methods:** This was a retrospective review of Los Angeles Fire Department (LAFD) 911-calls and electronic health records for cases of LAFD-attended OOHCA with attempted resuscitation from January to March 2014, as well as January to March 2015. Trained non-LAFD abstractors listened to all recorded calls, and documented if chest compressions were initiated. Field personnel are supposed to document if bystander chest compressions were initiated either through bystander interrogation or direct observation. The primary outcome was inter-rater agreement (Cohen's Kappa test) between 911-call reviewers and field personnel for the presence of bystander CPR. **Results:** Of 1027 calls during the study period, 13 were unavailable, and 372 calls met one or more exclusion criteria, leaving 642 calls. The overall bystander CPR rate on 911-call review was 59.3%, while it was 52.1% on field care reports, for a primary outcome kappa value of 0.37 (95% CI 0.29-0.44), indicating fair agreement. In 182 cases (31.4%), the records from 911 call review and field report were discordant regarding the presence of bystander CPR: 12% of cases had no bystander CPR on 911 call review but were reported by field personnel to have bystander CPR, and 19% of cases had bystander CPR on 911 call review but not by field personnel. A similar total percentage of discordance was noted among both English-speaking callers (31.3%, $\kappa=0.35$) and limited-English proficiency callers (32.8%, $\kappa=0.37$), patients in residential (30.0%, $\kappa=0.40$) vs. public settings (31.8%, $\kappa=0.39$), patients under 65 (34.5%, $\kappa=0.30$) and over 65 years old (28.4%, $\kappa=0.43$), and in minority (33.8%, $\kappa=0.33$) and white non-Hispanic patients (22.2%, $\kappa=0.52$). **Conclusions:** Inter-rater agreement on the presence of bystander CPR using 911-call review and field report is only fair, and up to one-third of cases may be misclassified. Given the extraordinary resources dedicated promoting

bystander-CPR, clearer consensus should be developed on how to accurately measure community bystander CPR rates.

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PROSPECTIVE EVALUATION OF A PROTOCOL TO LIMIT UNNECESSARY TRANSPORT OF PATIENTS WITH SIMPLE FALLS IN ASSISTED-LIVING FACILITIES: A PARTNERSHIP BETWEEN EMS AND PRIMARY CARE

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Background: Emergency Medical Services (EMS) often transports patients with simple falls in assisted living facilities (ALFs). An EMS “falls protocol” could avoid unnecessary transport for many of these patients. Our objective was to prospectively validate a protocol that creates shared decision-making with primary care providers regarding transport for elderly falls patients. **Methods:** We conducted a prospective cohort study of patients with simple falls in a subset of ALFs served by a specific primary care group in our urban EMS system (pop. 1 million) from November 2012 to April 2016. Our protocol utilized history and exam criteria applied by an advanced practice paramedic, and consult with on-call primary care as necessary, to recommend transport vs. no transport with close primary care followup at home. The primary outcome was need for “time-sensitive intervention” (TSI), met by patients who had wound repair or fracture, admission to the ICU, OR, cardiac cath lab, or death within 72 hours. Data were analyzed using descriptive statistics and confidence intervals. **Results:** The 953 consented patients had 842 falls for analysis during the study period. Patients were mean age 85 and 149 falls (18%) required TSI. EMS did not transport 543 falls (64%). The EMS protocol recommended transport for 142 of 149 TSI patients, for sensitivity 95% (95% CI: 91 to 98%). Specificity was 77% (95% CI: 73% to 79%) and negative predictive value 99% (95% CI 97% to 99%). Six of the 142 transport-recommended TSI patients had immediate primary care followup on-site or patient/family requested primary care followup instead of transport. Of 543 non-transported falls patients, 13 required TSI. Of these, 12 had minor wounds requiring repair, or fracture (none required operation). These 13 patients had median time to primary care followup of 2.5 hours (90th percentile 16.8 hours). Limitations include the generalizability of this protocol. **Conclusions:** An EMS and primary care protocol for ALF patients with simple falls may have sufficient sensitivity to safely allow for non-transport of a subset of these patients. Evaluation of this protocol and establishment of similar EMS-primary care relationships in other communities is necessary to validate these results.

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A SYSTEMATIC REVIEW OF THE ASSOCIATION BETWEEN EMS TIME FACTORS AND SURVIVAL

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Background: EMS time factors such as prehospital, activation, response, scene and transport intervals have been used as a measure of EMS system quality with the assumption that shorter EMS time factors save lives. The objective of this study was to conduct a systematic review of the association between EMS time factors and survival to determine if, for adults and children accessing ground EMS (population), operational time factors (intervention and control) were associated with survival at hospital discharge (outcome). These results may be important for making evidence-based operational decisions, such as performance metrics and care strategies involving closest hospital bypass. **Methods:** Medline, EMBASE, and CINAHL were searched up to January, 2015 for articles reporting original data that associated EMS operational time factors (prehospital, activation, scene, and transport intervals) and survival. Response interval and combined activation and response interval studies retrieved by this search have been previously reported. Conference abstracts and non-English language articles were excluded. Two investigators independently assessed the candidate titles, abstracts, and full text with discrepant reviews resolved by consensus. **Results:** A total of 10,151 abstracts were screened for potential inclusion in this review. Of these, 199 articles were reviewed in full-text, and 24 met inclusion

criteria. All articles were observational study designs with 10 (41.7%) reporting time factors within the primary analysis, and the remainder assessing time factors as a secondary analysis. Of the primary analysis studies, eight used multivariable analysis, and three of these found statistically significant findings. One study reported shorter combined scene and transport intervals associated with increased survival in acute heart failure patients. Two studies in trauma patients had somewhat conflicting results with one study reporting shorter prehospital interval associated with increased survival whereas the other reported increased survival associated with longer scene and transport intervals. **Conclusions:** Our systematic review identifies some studies that demonstrate an association between shorter EMS time factors and increased survival. However, this finding is not consistent across studies, and there is both clinical and statistical heterogeneity. Interpretive caution is required before translating these findings to practice.

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PEDIATRIC OUT-OF-HOSPITAL CARDIAC ARREST IN SOUTHERN ONTARIO

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Background: Pediatric out-of-hospital cardiac arrest (OHCA) is a rare but devastating event, with few survivors. Most cardiac arrest literature is focused on adult patients. There is little known about the pediatric population. Our objective was to describe the incidence, demographics, treatment, and outcomes of OHCA in southern Ontario. **Methods:** A retrospective cohort study of consecutive non-traumatic OHCA (<18 years) from the Toronto Regional RescuNET Epistry Cardiac Arrest database. Cases were included between 2006 and 2015. We calculated the incidence of OHCA and used descriptive analyses to examine the characteristics, treatment processes, and outcomes of cardiac arrest care. **Results:** A total of 792 non-traumatic pediatric OHCA occurred during the study period, 667 (84%) treated by EMS. The incidence of OHCA was 6.3/100,000 population/year, and the incidence of treated OHCA was 5.3/100,000 population/year. The mean age (standard deviation) for treated OHCA was 5.4 (+/- 6.4) with 60% male. Only 15% of OHCA occurred in a public location and the majority of cases (67%) were unwitnessed, with 27% witnessed by bystanders and 6% by EMS. Bystander CPR was performed in 47% of OHCA, however AEDs were applied in only 12 (1.5%) cases. EMS response time was on average 6.1 minutes (+/-2.3) and only 10% of patients were found with initial shockable rhythm. The majority of cases were attended to by advanced life support providers (90%), had epinephrine administration (60%) and an advanced airway (68%). Of cases with CPR quality measures (n=156) paramedic CPR was consistent with guideline recommendations with a median chest compression rate of 107/min (IQR 100,125), a median chest compression fraction of 0.76 (IQR 0.65,0.85) and a median depth of 4.2cm (IQR 3.4cm,4.9cm). Of the treated OHCA 40% had a return of spontaneous circulation, and 10% survived to hospital discharge, 78% of these patients with good neurological outcome (mRS<3). Survival to hospital discharge for bystander witnessed OHCA with an initial shockable rhythm was 45%, 83% with good neurological outcome (mRS<3). **Conclusions:** The incidence of OHCA in this study was low. Although we noted many factors typically associated with poor outcome, the survival rates for OHCA were similar to that of the adult population.

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IMPORTANCE AND IMPACT OF HR4365: PROTECTING PATIENT ACCESS TO EMERGENCY MEDICATIONS ACT OF 2015 ON PREHOSPITAL CONTROLLED SUBSTANCE ADMINISTRATION

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Background: Controlled substances are utilized in the prehospital setting for lifesaving and pain reducing indications, which are often time sensitive. In 2011, the DEA notified a Kentucky EMS agency that controlled substances cannot be administered under standing orders, but instead be patient and issue specific, therefore requiring a direct medical control order. This prompted the recently proposed

legislation HR4365 "Protecting Patient Access to Emergency Medications Act of 2015", which will allow standing orders for prehospital providers to administer controlled substances. The purpose of this investigation is to describe both the extent to which states using statewide treatment protocols (STP) include standing order administration of controlled substances, and the frequency of their use.

Methods: Standardized review of all STPs for controlled substance protocols. NEMSIS database was queried for counts of encounters and medication administrations by year. Counts for not applicable, not reported, not reporting, not available and not known were excluded. **Results:** Thirty out of fifty states issue STPs. All thirty states allow for administration of both benzodiazepines and narcotic medications under standing orders, one of which requires local authorization for standing orders. In 2015, there were a total of 218,896 administrations of benzodiazepines and 813,712 narcotic administrations out of 29 million total EMS encounters. Controlled substance administration accounted for 8.8% of all medications administered, and increases to 16% when excluding oxygen and normal saline. **Conclusions:** Controlled substances are an important tool in the prehospital pharmacopeia, used for a variety of time sensitive indications, including airway management, seizures, excited delirium, and pain control. Wuerz et al. found mean OLMC contact time was more than four minutes, which can represent a considerable delay in time sensitive conditions. Without the passage of HR4365, we anticipate a significantly increased burden for OLMC as 2.5% of EMS encounters in which controlled substances were used would now all require OLMC orders. Further, this could potentially result in the reduced use of these medications by providers due to the barrier created by requiring patient specific orders for controlled substances and unnecessary delays for critical interventions.

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EXPANDING NALOXONE AVAILABILITY TO FIRST RESPONDERS AND EMTs: TREATING MORE PATIENTS FASTER

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Background: In response to the opioid overdose crisis, advocates are working to increase the availability of naloxone to first responders and to the public. As of October of 2015 the state legislature mandated naloxone be carried on all licensed EMS vehicles, leading to the development of a protocol for medical first responders (MFRs) and Basic Life Support Emergency Medical Technicians (BLS-EMTs) to treat suspected opioid overdose with intranasal naloxone. We hypothesized that the protocol change would result in an increased number of patients being treated for opiate overdose. We hypothesized that more rapid delivery would be associated with improved clinical response. **Methods:** The majority of transport in the system is by BLS-EMT ambulance. MFR engines also respond to the highest priority calls. The nearest ambulance is dispatched to a call regardless of provider level. This is a retrospective chart review of the six-month period prior to the institution of the MFR/BLS naloxone protocol and a weekly review of the six-month period after protocol adoption. The prehospital patient care record for each patient treated with naloxone was reviewed. A positive response to naloxone was defined as an increase in Glasgow Coma Score ≥ 6 or an increase in respiratory rate ≥ 6 from a baseline rate ≤ 8 . Secondary measures include the amount of time from dispatch to arrival at patient, dispatch to naloxone delivery, and route of naloxone delivery. **Results:** 150 and 336 cases were analyzed for the periods before and after institution of the new protocol respectively. There were 25 MFR and 159 BLS administrations of naloxone after the new protocol. 53% and 65% of patients had a positive clinical response in respective to each period ($p < 0.05$). Shorter dispatch to treatment time was associated with a higher clinical response rate, 17 minutes vs. 14 minutes ($p < 0.01$). **Conclusions:** Naloxone protocol for MFR and BLS providers more than doubled the number of patients treated in our predominately BLS system. Overall clinical response rate also improved, which may be the result of focused training on the new protocol and faster time to treatment. More study is warranted on expanded naloxone use.

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RELATIONSHIP BETWEEN CLINICAL QUALITY IMPROVEMENT AND MEDICAL DIRECTION IN EMERGENCY MEDICAL SERVICES

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Background: With increasing integration of Emergency Medical Services (EMS) into the medical community and a healthcare reform movement emphasizing quality care, EMS agencies must embrace continuous clinical quality improvement (QI) programs. Yet, there exists significant variation among EMS agencies in both QI efforts and medical direction. We hypothesize that physician involvement increases the rigor of EMS QI programs by providing the required expertise and leadership to support EMS providers in the clinical sphere. The purpose of this study is to provide insight in to current national EMS clinical QI practices and the relationship between clinical quality and medical direction. **Methods:** A 46-question survey developed by the NAEMSP QI Committee to explore current QI practices was distributed nationally via State EMS Offices to EMS agencies nation-wide using SurveyMonkey. Univariate and bivariate analyses were conducted to describe demographics and relationships between outcomes of interest and their covariates using SAS 9.3. **Results:** 1733 surveys were received, with 1060 complete responses from EMS agencies in 47 states representing over 6.23 million 911 responses annually. 70.5%(747) agencies reported dedicated QI personnel and 62.5%(663) follow clinical metrics. 33.3%(353) participate in external quality/research registries. Medical director hours varied greatly with 61.5% (649) of EMS agencies reporting less than 5 hours per month. Increased medical director time was correlated with increased quality tracking ($r = 0.21$, $p < 0.0001$) and paid medical direction correlated with presence of agency-tracked clinical quality metrics (OR 2.07, CI: 1.33-3.22). **Conclusions:** In this sample of EMS agencies, there is a connection between the intensity of medical direction and agency attention to clinical quality. Many agencies have limited or no medical director involvement possibly due to limited availability of qualified physicians, limited financial resources or variation in regulatory requirements for medical oversight. This is a self-reported sample that may not represent the complete spectrum of EMS agencies. Variation in state regulation was not assessed in this data set. As EMS works to define metrics to measure clinical quality, meaningful medical direction can support and encourage agencies' quality efforts. Further studies are required to understand the impact on patient outcome data.

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RACIAL AND ETHNIC DIFFERENCES IN OUTCOMES AFTER OUT-OF-HOSPITAL CARDIAC ARREST: HISPANICS FARE WORSE THAN NON-HISPANIC WHITES AND BLACKS

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Background: To evaluate differences in out-of-hospital cardiac arrest (OHCA) characteristics, interventions, and outcomes by race/ethnicity. **Methods:** This is a retrospective analysis from a regionalized cardiac system serving a diverse metropolitan population. Patients treated for OHCA with return of spontaneous circulation (ROSC) are transported to specialized receiving centers with percutaneous coronary intervention (PCI) capability and targeted temperature management (TTM) protocols. Outcomes are reported to a single registry, from which all adult patients were identified from 2011-2014. Characteristics, treatment, and outcomes were evaluated stratifying by race/ethnicity with White as the reference group. The adjusted odds ratio (OR) for survival with good neurologic outcome (cerebral performance category 1 or 2) was calculated. **Results:** There were 5178 patients with OHCA, 290 patients were excluded for unknown race, leaving 4888 patients of whom 50% were White, 14% Black, 12% Asian, 23% Hispanic, and 0.8% Pacific Islander. Compared with Whites, Black patients were less likely to undergo angiography (14% vs. 22%, RD -8% [95%CI -11,-5%]) and to require PCI when angiography was performed (32% vs. 54%, RD -22% [95%CI -32,-12%]). Asians were less likely to undergo angiography (15% vs. 22%, RD -7% [95%CI -10,-4%]), presented less often with a shockable rhythm (27% vs. 34%, RD -7% [95%CI -11,-3%]), and had lower survival to hospital discharge (32% vs. 37%, RD -5% [95%CI -9,-1%]) and lower survival with good neurologic outcome (17% vs. 24%, RD -7% [95%CI -10,-4%]). Hispanic patients had fewer witnessed arrests (82% vs. 86%, RD -4% [95%CI -7,-1%]), less

bystander CPR (37% vs. 44%, RD -7% [95%CI -10,-4%]), and lower survival with good neurologic outcome (21% vs. 24%, RD -3% [95%CI -6,0%]). Adjusting for age, gender, arrest characteristics and interventions, Hispanic ethnicity was associated with decreased good neurologic outcome (OR 0.78 [95%CI 0.63-0.96]). This was also the case for Asians, though not statistically significant (OR 0.79 [95%CI 0.60-1.05]). Outcome for Blacks was similar to Whites (OR 0.98 [95%CI 0.76-1.25]). **Conclusions:** There are important differences in characteristics and outcomes of patients with OHCA according to race/ethnicity. They may have implications for targeted interventions, for example CPR instruction in Hispanic communities, to improve outcomes.

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IMPLEMENTATION OF AN EDUCATIONAL PROGRAM TO IMPROVE THE CARDIAC ARREST DIAGNOSTIC ACCURACY OF AMBULANCE COMMUNICATION OFFICERS: A CONCURRENT CONTROL BEFORE-AFTER STUDY

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Background: Most ambulance communication officers receive minimal education on agonal breathing, often leading to unrecognized out-of-hospital cardiac arrest (OHCA). We sought to evaluate the impact of an educational program on cardiac arrest recognition, and on bystander CPR and survival rates. We also sought to determine if the intervention could result in chest compressions and injuries for patients not in OHCA. **Methods:** Ambulance communication officers in Ottawa, Canada received additional training on agonal breathing, while the control site (Windsor, Canada) did not. Sites were compared to their pre-study performance (before-after design), and to each other (concurrent control). Trained investigators used a piloted-standardized data collection tool when reviewing the recordings for all potential OHCA cases submitted. OHCA was confirmed using our local OHCA registry, and we requested 911 recordings for OHCA cases not initially suspected. Two independent investigators reviewed medical records for non-OHCA cases receiving telephone-assisted CPR in Ottawa. We present descriptive and chi-square statistics. **Results:** There were 988 confirmed and suspected OHCA in the “before” (540 Ottawa, 448 Windsor), and 1,076 in the “after” group (689 Ottawa, 387 Windsor). Characteristics of “after” group OHCA patients were: mean age (68.1 Ottawa, 68.2 Windsor), Male (68.5% Ottawa, 64.8% Windsor), witnessed (45.0% Ottawa, 41.9% Windsor), and initial rhythm VF/VT (Ottawa 28.9, Windsor 22.5%). Before-after comparisons were: for cardiac arrest recognition (from 65.4% to 71.9% in Ottawa $p=0.03$, from 70.9% to 74.1% in Windsor $p=0.37$), for bystander CPR rates (from 23.0% to 35.9% in Ottawa $p=0.0001$, from 28.2% to 39.4% in Windsor $p=0.001$), and for survival to hospital discharge (from 4.1% to 12.5% in Ottawa $p=0.001$, from 3.9% to 6.9% in Windsor $p=0.03$). “After” group comparisons between Ottawa and Windsor (control) were not statistically different, except survival ($p=0.02$). Agonal breathing was common (25.6% Ottawa, 22.4% Windsor) and present in 18.5% of missed cases (15.8% Ottawa, 22.2% Windsor $p=0.27$). In Ottawa, 31 patients not in OHCA received chest compressions resulting from telephone-assisted CPR instructions. None suffered injury or adverse effects. **Conclusions:** While all OHCA outcomes improved over time, the educational intervention significantly improved OHCA recognition in Ottawa, and appeared to mitigate the problem of agonal breathing.

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ADDITIONAL LIVES SAVED BY THE RESUSCITATION OUTCOMES CONSORTIUM: CARDIAC ARREST

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Background: The National Institutes of Health, the Canadian Institutes of Health Research, and other agencies, established the Resuscitation Outcomes Consortium (ROC) to conduct clinical trials of out-of-hospital cardiac arrest (OHCA) and trauma resuscitation. ROC was comprised of 11 Regional Clinical Centers and a Data Coordinating Center, as well as over 250 high-functioning EMS systems. We sought to estimate if and how many additional lives may have been saved by ROC. **Methods:** We analyzed all non-redundant results from ROC clinical trials to determine the actual number of survivors to hospital

discharge. We used the first ROC Epistry- Cardiac Arrest report (Nichol, et al. 2008), which was prior to any ROC clinical trial, as the expected rate of survival. We determined how many additional lives were saved (observed) compared to the baseline rate of 7.9% overall survival. For the ALPS trial we used the rate of 21% survival, as these were all cases with ventricular fibrillation. We analyzed only EMS-treated cases from clinical trials and inter-trial gaps that came after the 2008 report. **Results:** There were 61,364 cases of EMS-treated cardiac arrest, of which 49,466 were enrolled in ROC clinical trials and post-2008 gaps. The ALPS trial enrolled 3,023 of these. The expected number of survivors for all ECG rhythms was 3,668 in the 46,440 non-ALPS studies. The observed number of survivors was 4334 (666 additional survivors). In the ALPS trial the expected number of survivors was 635, and the actual number of survivors was 702 (67 additional survivors). **Conclusions:** In the period following the 2008 report, we estimate that an additional 733 lives of OHCA patients were saved in the ROC EMS systems.

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PARAMEDIC SAFETY CULTURE ACROSS EASTERN ONTARIO

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Background: Safety culture is defined as the shared beliefs that an organization's employees hold relative to workplace safety. Perceptions of workplace safety culture within paramedic services have been shown to be associated with patient and provider safety outcomes as well as safe work practices. We sought to characterize paramedics' perceptions of the organizational safety culture across Eastern Ontario, Canada to provide important benchmarking data to evaluate future quality initiatives.

Methods: This was a cross-sectional survey study conducted September 2015 - January 2016 in 8 paramedic services across Eastern Ontario. We distributed an abridged version of Patterson's previously published EMS-SAQ survey, measuring six domains of workplace safety culture, to 1,083 paramedics during continuing medical education sessions. The questions were presented for rating on a 5 point Likert scale (1=strongly agree, 5= strongly disagree) and a response of 1 or 2 was considered a 'positive perception' response. We present descriptive statistics and chi-square tests where appropriate.

Results: We received responses from 1057 paramedics (97.6%), with a response rate varying between 88.0% and 100% across the 8 paramedic services. One third (33.6%) were Advanced Care Paramedics (ACPs) and 39.4% of paramedics had more than 10 years' experience. The percentage of positive responses for each domain were: Safety Climate 31.2% (95% CI 28.4 – 34.1), Teamwork Climate 29.3% (95% CI 26.6 – 32.1), Stress Recognition 56.8% (95% CI 53.8 - 59.8), Perceptions of Management 67.0% (95% CI 64.0 – 69.8), Working Conditions 42.6% (95% CI 39.6 – 45.7), Job Satisfaction 41.6% (95% CI 38.6 – 44.6). Primary care paramedics had more positive perception responses for Job Satisfaction (45% vs. 35%, $p=0.002$), whereas ACPs had more positive perception responses for Stress Recognition (61.5% vs. 54.1%, $p=0.022$). No association was found between gender or years of experience and a positive perception of any safety domain. **Conclusions:** The results provide valuable workplace safety culture data that will be used to target and evaluate needed quality improvement initiatives while also raising paramedic awareness of important factors related to patient and provider safety.

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A DICHOTOMIZED CINCINNATI PREHOSPITAL STROKE SCORE PREDICTS LARGE VESSEL OCCLUSIONS IN PATIENTS WITH ACUTE ISCHEMIC STROKE

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Background: Recent clinical trials established that patients with acute ischemic stroke (AIS) from large vessel occlusions (LVO) benefit from timely mechanical thrombectomy (MT), prompting emergency medical services (EMS) systems to consider using stroke severity screens to triage severe stroke patients to hospitals offering MT. The Cincinnati Prehospital Stroke Scale (CPSS), scored from 0 to 3, is easily taught to EMS providers. We hypothesize that using the CPSS with a threshold cut-off for a positive

screen (i.e., “dichotomized”) predicts LVO. **Methods:** A retrospective registry study of confirmed AIS patients arriving by EMS between August 2012 and April 2014 to a high-volume stroke center in a large city with a single municipal EMS provider was performed. The highest CPSS score was abstracted from the EMS record, and any CPSS element not documented was scored as 0. LVO was defined as any basilar, intracranial vertebral, or proximal anterior circulation artery occlusion. Youden index identified the optimal dichotomized CPSS cut-off. Multivariate logistic regression controlling for age, sex, and race determined the odds ratio (OR) for LVO. **Results:** In total, 144 patients were analyzed. The median age was 68.5 (IQR 25-81.5) years, 51% were male and 57% were white. Vessel imaging was performed in 97.9% of patients at a median of 6.0 (IQR 3.6-10.3) hours from hospital arrival, and 45.4% had a LVO. Intravenous tissue-type plasminogen activator (IVtPA) was administered to 30 patients, of which 13 had no LVO on subsequent vessel imaging. The optimal CPSS cut-off to predict LVO was 3, with a Youden index of 0.28, sensitivity of 0.40, and specificity of 0.88. Among those with CPSS=3, the adjusted OR for LVO was 4.8 (95%CI 2.0-11.7, $p<0.0005$), and 72.7% had a LVO, compared to 37.0% of patients with $CPSS\leq 2$ ($p<0.0005$). **Conclusions:** Dichotomization of the CPSS with a cut-off of 3 predicts LVO. This study is limited to single-center data, and vessel imaging was performed after IVtPA administration. Further prospective study is needed to confirm these findings, compare the dichotomized CPSS to prehospital stroke severity screens requiring more extensive provider education, and test dichotomized CPSS integration into EMS dispatch and triage protocols.

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911 DISPATCH INITIATED STROKE ASSESSMENT: HOW TO DECREASE TIME TO TREATMENT AT STROKE CENTERS

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Background: Reducing prehospital times for stroke victims is critical to reducing time to hospital stroke interventions. Our objective was to describe the effect that the implementation of a 911 paramedic initiated stroke alert protocol and continuing education had on stroke prehospital times in a large, urban EMS system. **Methods:** Prehospital times were analyzed utilizing a retrospective observational study of prospectively collected prehospital patient care data. A dispatch-initiated stroke alert, implemented on December 1, 2015, sent a stroke alert message to the ambulance MDT along with a verbal notification over the radio. A continuing education training component informing paramedics of the goal to decrease scene times to less than 10 minutes was implemented concurrently. The video and rolling in-class training provided content to improve early recognition of stroke symptoms and reduce on-scene time. Four months of prehospital stroke alert data prior to and after dispatched stroke alert implementation was evaluated to determine any change in response, scene, transport and total prehospital times. Data from a prehospital paramedic field activation of stroke alert from June 1, 2015, through September 30, 2015 was analyzed. A two month implementation period was allowed and data was taken from February 1, 2016, through May 31, 2016. A t-test was utilized to compare the sets of data. **Results:** A total of 466 stroke activations were evaluated. 222 scene stroke activations were analyzed before implementation of the new stroke alert protocol, with 246 field stroke activations analyzed after the new protocol. Average dispatch to door time decreased 1 min and 35 seconds, from almost 33 minutes to 31 minutes and 20 seconds ($p= 0.0373$ and a 95% CI of 0.0940 to 3.0960) and on-scene times were decreased by over a minute ($p= 0.0400$ and 95% CI 0.0550 to 2.3530). Average transport and response times trended towards decreased time, but were statistically insignificant. These findings were independent of patient age. **Conclusions:** A statistically significant reduction in on-scene time and total prehospital time was noted after implementation of a dispatched stroke alert protocol and continuing education.

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HELICOPTER VS. GROUND INTER-FACILITY TRANSFER OF STEMI PATIENTS

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Background: The gold standard of care for patients who are having a ST-segment elevation Myocardial infarction is Percutaneous Coronary intervention within 90 minutes of the onset of symptoms. Many patients however, do not present to a hospital facility with this capability and must then be transferred via ambulance to a facility with these capabilities. We aim to compare the patient characteristics and outcomes STEMI patients transported by air ambulance to those transported by ground EMS. **Methods:** We performed a retrospective chart review of Prehospital and In-hospital Data of 217 STEMI cases from 2014 through 2015. These cases were then divided into two treatment groups: STEMI patients that were transferred by helicopter ambulance and those transferred via ground ambulance. We characterized patients by initial vital signs, need for vasopressors or advanced airway support. In-hospital data was used to determine peak troponin levels (area under the curve), Day 1 MSOFA score, Ejection fraction, and in-hospital mortality for each treatment group. Prehospital Data was used to determine, transport time, distance, and crew configuration for each group. The two treatment groups were then compared using regression. **Results:** There were a total of 212 STEMI patients transferred in our regional health system during this time period. We transported 156 (73%) by air and 56 (27%) by ground. The patients were 39% Female and averaged 63.5 (SD13.5) years of age. The air and ground cohorts did not differ with respect to age, gender, or initial vital signs (SBP, HR, GCS). Air transports were longer 62 min (IQR 46,71) vs. ground 37min (IQR 33, 43) and mortality was higher 9.6% vs. 3.6%. When adjusted for time, use of vasopressors, modified organ failure assessment, hypotension, and mode of transport there was no difference in mortality or post PCI ejection fraction. **Conclusions:** STEMI patients transported by air in our regional health system had a higher mortality and required longer transports than the ground cohort. Mortality and ejection fraction did not differ when adjusted for severity of illness.

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ASSESSMENT OF PAIN MANAGEMENT DURING TRANSPORT OF INTUBATED PATIENTS IN A PREHOSPITAL SETTING

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Background: While methods have been developed to assess pain and provide analgesia to hospitalized intubated patients, little is known about current EMS practices in providing similar care during air and land medical transfers. Therefore, we sought to determine if opioid analgesia is provided to intubated patients during transportation in out-of-hospital setting. **Methods:** We conducted a health record review examining electronic records of intubated patients transported by Ornge in 2015. Ornge is the exclusive provider of air and land transport of critically ill patients in Ontario, Canada with over 18,000 transports per year. We identified cases using Ornge's database and selected intubated patients meeting inclusion criteria. A standardized data extraction form was piloted and used by a single trained data extractor. The primary outcome was frequency of administration and dose adequacy of an opioid analgesic. Secondary outcomes included: choice of analgesics used (Fentanyl, Hydromorphone or Morphine), adverse events, and impact of age, sex, or reason for transfer on pain management. We present descriptive statistics. **Results:** Our strategy identified 500 potential cases, of which 448 met our inclusion criteria. Among those 448 patients, 154 (34.4%) were females, 328 (73.4%) received analgesia and 211 (64.3%) received more than one dose during transport (median frequency of 2 doses, IQR = 1 to 3). The average transport time was 2h28min and repeated dosing (>1 repeat dose) occurred primarily (45.5%) in transports of over 3h. Fentanyl was the most commonly used analgesic (97.6%) and most commonly used dose was 50µg (51.8%). Adverse events occurred in 8 (2.5%) patients with 5 patients having hypotension (MAP<65). There was no significant difference in administration of analgesia based on patient's age or sex (68.8% of females and 75.3% of male patients received analgesia). Interestingly, 30.8% of patients repatriated to home-hospital received analgesia compared to 72.3% of patients receiving analgesia for all other reasons for transfers. **Conclusions:** More than 73% of intubated patients transported by Ornge received an opioid analgesic, primarily in the form of Fentanyl. We found no clinically relevant difference in the administration of analgesics based on age, sex or reason for transfer other than home repatriation.

60 SECONDS TO SURVIVAL: A DISASTER TRIAGE VIDEO GAME AND IMPROVED TRIAGE ACCURACY FOR PREHOSPITAL CARE PROVIDERS

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Background: Disaster triage training for emergency medical service (EMS) providers is not standardized. Simulation training is costly and time-consuming. In contrast, educational video games enable low-cost and less time-consuming standardized training. We hypothesized that players of the video game “60 Seconds to Survival” (60S) would have greater improvements in disaster triage accuracy compared to control subjects who were not exposed to 60S. **Methods:** Participants recorded their demographics and highest EMS training, and were randomized to play 60S (intervention) or serve as controls. At Time 1, all participants completed a live school-shooting simulation in which manikins and standardized patients depicted 10 adult and pediatric victims. The intervention group then played 60S until 13 weeks later (Time 2). Players triaged 12 patients in three scenarios (school shooting, house fire, tornado) and received automated, in-game performance feedback. At Time 2, the same live simulation was conducted for all participants. Controls had no formal disaster training during the study. The main outcome was improvement in triage accuracy in live simulations from Time 1 to Time 2. Physicians and EMS providers determined expected triage level (RED/YELLOW/GREEN/BLACK) via modified Delphi method. **Results:** There were 39 participants in the intervention group and 23 controls. There was no difference in gender, level of training, or years of EMS experience (median 4.0 years intervention, 4.5 years control, $p=0.72$) between the intervention and control groups. At Time 1, median triage accuracy was 80% [IQR 70-90%] for both groups. At Time 2 the intervention group had median triage accuracy of 90% [IQR 80-100%, $p<0.001$ compared to Time 1]. The control group also had median Time 2 accuracy of 90% [IQR 80-100%, $p<0.001$], with no difference compared to the intervention group ($p=0.073$). **Conclusions:** Both groups demonstrated improved triage accuracy from Time 1 to Time 2. There was no significant difference between the intervention and control groups. These results may be due to small sample size, the Hawthorne effect or lack of impact of this iteration of 60S. Future directions include assessment of the game’s effect on triage accuracy with a larger, multiple site cohort and iterative development to improve 60S.

ASSOCIATION BETWEEN BLOOD PLATELET COUNT DURING RESUSCITATION AND NEUROLOGICAL RECOVERY IN OUT-OF-HOSPITAL CARDIAC ARREST

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Background: Cardiac arrest is one of the complicated coagulopathic conditions with low survival outcome. It is unclear whether the blood platelet count (PC) at or during cardiopulmonary resuscitation is associated with better neurological recovery or not. This study aims to test the association between serum platelet count at cardiopulmonary resuscitation (CPR) and neurological recovery after out-of-hospital cardiac arrest (OHCA) transported by emergency medical services (EMS). **Methods:** This study is one of the cross-sectional analysis series from the Cardiac Arrest Pursuit Trial with Unique Registration and Epidemiologic Surveillance (CAPTURES) project. EMS-treated OHCA with cardiac etiology and 18 years or older from 27 emergency departments (EDs) in South Korea in 2014 were enrolled, excluding transported cases from the scene or other hospital after return of spontaneous circulation (ROSC), from nursing home, and with unknown platelet level. The main exposure was a platelet count measured upon arrival at ED during CPR, categorized as low platelet count (Low PC), less than 150000/mm³, and normal platelet count (Normal PC), above 150000/mm³, from a sensitivity analysis using the restricted cubic splines analysis (RC Spline). The primary outcome was a good neurological recovery (cerebral performance category 1 or 2, CPC) at hospital discharge. Adjusted odd ratios (OR) and 95% confidence intervals (CI) adjusting for confounders (individual factors, clinical risk factors, emergency treatment,

and clinical presentation) from multivariable logistic regression analysis were calculated. **Results:** Among 1,616 OHCA patients, 960 (59.4%) patients were analyzed, excluding children (n=19), unknown platelet level (n=333), interhospital transportation patients (n=187), nursing home arrest (n=10), and prehospital ROSC patients (n=107). The median (Q1-Q3) of platelet count for total patients was 170,00 (109,00-221,00), with non-linear distribution for the outcome from RC Spline, and good CPC was 4.4%. Low PC group was 380 (39.6%) with 1.4% of good CPC, while Normal PC group was 580 (60.4%) with 6.4% of good CPC (p=0.002). Adjusted OR (95% CI) of Low PC versus Normal PC group for good CPC was 0.36 (0.13-0.99). **Conclusions:** Thrombocytopenia (less than 150000/ mm³) was significantly associated with poor neurological recovery from the multicenter observational study for OHCA patients who were not resuscitated at the field.

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FACTORS ASSOCIATED WITH RECEIVING FEEDBACK IN THE PREHOSPITAL SETTING

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Background: Feedback is a critical component for optimizing care and outcomes in the prehospital setting. However, there is a paucity of data concerning the extent, type and factors associated with receiving feedback in the prehospital setting. The objective of this study was to describe factors associated with receiving feedback among EMS providers. We hypothesized that a greater proportion of advanced level EMS providers would report receiving feedback. **Methods:** This was a cross-sectional survey of nationally-certified EMS providers concerning feedback received in the prior 30 days. Inclusion criteria consisted of currently practicing patient care providers (EMT or higher) in non-military and non-tribal settings. Data were collected on provider characteristics along with feedback received. Descriptive statistics were calculated and a multivariable logistic regression model was constructed to assess the association between receiving feedback and demographic/agency characteristics. A non-respondent survey was administered to assess for non-response bias. **Results:** Responses from 32,314 EMS providers were received (response rate=11%) with 15,766 meeting inclusion criteria. There were no significant differences with regards to receiving feedback between respondents and non-respondents. In the 30 days preceding the survey, 69%(n=10,879) of respondents received feedback. ALS providers (AEMT/paramedic) had increased odds of reporting having received feedback compared to BLS providers (EMT) (OR 1.21, 95%CI:1.12-1.31). Compared to providers at fire-based agencies, those at hospital-based agencies demonstrated lower odds of receiving feedback (OR 1.46, 95%CI:1.08-1.33). Compared to individuals at agencies that primarily provide 911 services, providers at air medical services had a nearly four-fold increase in odds of receiving feedback (OR 3.87, 95%CI:2.81-5.33) while those providing medical transport/convalescent services had decreased odds (OR 0.61, 95%CI:0.53-0.71). Compared to those with fewer than three years of EMS experience, more experienced providers had reduced odds of receiving feedback (e.g., 3-10 years: OR 0.75, 95%CI:0.68-0.82). **Conclusions:** Feedback to EMS providers is critical to improve prehospital care. In this study, nearly a third of providers did not receive any type of feedback in a 30-day period. Disparities in the frequency of feedback exist in different provider levels, service settings, and reported feedback decreases with years of experience in the profession.

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IMPACT OF EMS DIRECT REFERRAL TO COMMUNITY CARE ON SERVICES RECEIVED

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Background: The Community Referral by Emergency Medical Services (CREMS) program was implemented in January 2015 in Southwestern Ontario. The program allows Paramedics, who are interacting with a patient as a direct result of a call to 911, to directly refer patients in need of home care support to their local Community Care Access Centre (CCAC) for needs assessment. If indicated, subsequent referrals are made to specific services (e.g. nursing, physiotherapy and geriatrics) by the

CCAC. Ideally, CREMS connects each patient with appropriate, timely care, supporting individual needs. Similar referral programs have been implemented in communities with preliminary data showing positive results. Our objective was to evaluate the success of the CREMS program by determining the number of referrals made by EMS in London-Middlesex to CCAC since implementation as well as the proportion of referred patients receiving a new or increase in service due to EMS referral. **Methods:** Data for all CCAC referrals from London-Middlesex EMS was collected for a thirteen month period (February 2015-February 2016). Data was evaluated for quantity of referrals and proportion that led to a patient receiving new or increased home care service. **Results:** There were 436 referrals made in the study period which represented 391 individuals. 54% of patients were between 65-84 years of age. Of the 391 patients, 162 (41%) were not known to CCAC and of those 119 (73%) received a new service due to EMS referral. The most common new services were occupational therapy (61%) and nursing (47%). Of the 229 (59%) of patients that were already known to CCAC, 101 (44%) received an increase in service due to EMS referral. No patients refused a new or increase in service. **Conclusions:** Of all patients referred to CCAC, 56% received a new service or had a change in existing services which suggests that a large number of patients benefited from early EMS referral to community services. The results of this project provide impetus to continue and expand the CREMS program. Future studies will evaluate if the implementation of this program has reduced patient reliance on 911 requests for paramedic care as well as Emergency Department transports.

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IMPROVEMENT IN REAL-TIME ECG TRANSMISSION FROM FIELD TO HOSPITAL WITH WEEKLY TEST TRANSMISSIONS

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Background: Field identification of ST-Elevation Myocardial Infarction (STEMI) and advanced hospital notification decreases first-medical-contact-to-balloon (FMC2B) time. A recent study in our system found that ECG transmission following a STEMI alert was frequently unsuccessful. We hypothesized that instituting weekly test ECG transmissions from paramedic units to our hospital would increase successful transmission of ECGs and decrease FMC2B and door-to-balloon (D2B) times. **Methods:** This is a natural experiment of consecutive patients with field-identified STEMI transported to a single PCI-capable hospital in a regional STEMI system before and after implementation of scheduled test ECG transmissions. In November 2014, paramedic units began weekly test transmissions. The mobile intensive care nurse (MICN) confirms the transmission, or if not received, contacts the paramedic unit and the department's nurse educator to identify and resolve the problem. Per system-wide protocol, paramedics transmit all ECGs with interpretation of STEMI. Receiving hospitals submit patient data to a single registry as part of ongoing system quality improvement. The frequency of successful ECG transmission and time to intervention (FMC2B and D2B times) in the 18 months following implementation was compared to the 10 months prior. Post-implementation, the time the ECG transmission was received was also collected to determine the transmission gap time (time from ECG acquisition to ECG transmission received) and the advanced notification time (time from ECG transmission received to patient arrival). **Results:** There were 388 patients with a field ECG interpretation of STEMI, 131 pre-intervention and 257 post-intervention. The frequency of successful transmission post-intervention was 73% compared to 64% prior (RD 9%, 95%CI 1-18%). In the post-intervention period, the median FMC2B time was 82 minutes (Inter-quartile range (IQR) 69-106) versus 86 minutes (IQR 71-106) pre-intervention (p=0.9), and the median D2B time was 61 minutes (IQR 46-79) versus 60 minutes (IQR 50-85) pre-intervention (p=0.6). The median transmission gap was 3 minutes (IQR 1-8) and median advanced notification time was 16 minutes (IQR 10-25). **Conclusions:** Weekly test ECG transmissions improved successful real-time transmissions, which provided a median advanced notification time of 16 minutes. In a hospital meeting recommended treatment times, this did not result in a decrease in FMC2B or D2B times.

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BARRIERS TO DISPATCH-ASSISTED CARDIOPULMONARY RESUSCITATION INSTRUCTION

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Background: DA-CPR instructions (DA-CPRi) have been shown to significantly increase rates of bystander CPR (BCPR) provision. Dispatch agencies are either Primary Public Safety Answering Points (pPSAP) or Secondary PSAPs (sPSAP). Our objectives are to describe barriers to DA-CPRi provision in a sample of dispatch agencies and to assess whether operational differences impact DA-CPRi provision. **Methods:** We conducted a retrospective study of dispatch data from all OHCA calls to a convenience sample of US EMS dispatch centers from 1/1/14-12/31/15. Both pPSAPs and sPSAPs were included, and were identified through a survey of participating agencies. OHCA dispatch recordings were reviewed by agency supervisors using a web tool (Cardiac Arrest Registry to Enhance Survival (CARES) dispatch registry). Temporal elements, operational and logistical barriers to DA-CPR instruction, and text comments were recorded (multiple dispatcher comments per case). Cases were excluded if CPR was in progress, caller was not with the patient, or OHCA was in a healthcare facility, nursing home, or post-EMS arrival. Descriptive data are reported. **Results:** We identified 2391 cases from 28 dispatch agencies in 9 states with data for review. Population served was 10.3 million. Twenty agencies were pPSAPs (N=1316 calls), 8 were sPSAPs (N=1077 calls). There were 912 calls with barriers to DA-CPRi. Barriers to DA-CPRi were more commonly cited for sPSAPs than pPSAPs, (564, 55.4% vs. 348, 28.3%), with the most common barrier being a failure to transfer the caller from a pPSAP to sPSAP in 263/1077 (24.4%) calls. Other barriers were the inability of the caller to move the patient (272, 11.4%), caller too distraught (142, 5.9%), caller left phone (96, 4.0%), and did not differ by PSAP type. Data was recorded on dispatcher recognition of cardiac arrest in 1678 cases, of these, 1209 (72.4%) callers received DA-CPRi. CPR was initiated after instruction in 881 (72.9%) of cases. **Conclusions:** In this convenience sample of dispatch agencies, the provision of DA-CPRi resulted in a high rate of CPR provision. Inability to move the patient was a major reason for not performing CPR. Improving the transfer of calls from pPSAPs to sPSAPs for DA-CPRi may have a substantial impact on the provision of BCPR.

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MENTAL HEALTH TRIAGE HELPS TREAT AND NAVIGATE PSYCHIATRIC PATIENTS TO APPROPRIATE RESOURCES

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Background: Mental health needs make up a significant proportion of emergency department (ED) use. Patients in this group, face a complex and fragmented healthcare system. ED services lack the appropriate resources to efficiently treat psychiatric patients, leading to increased costs and continual loss of productivity. The objective of this study was to evaluate a novel mental health triage program, which comprises an emergency response vehicle and a team of three: a fire paramedic, a police officer and a behavioral health clinician. The triage works together to respond to and assess behavioral health crises and divert them away from the ED and to appropriate resources. **Methods:** This was a descriptive study of our program, looking at the total number of incidents from January-December 2015. The study sample consisted of incidents that involved behavioral health issues within the target city (194.9 square miles), and served anyone in the police and fire service area. **Results:** Overall, the program responded to 2,337 incidents and treated 1,516 patients, 658 (43%) mental or behavioral health issues, 533 (35%) suicidal crises and 325 (21%) incidents that fell outside of the main psychiatric categories. 45% of patients were treated in place, and 30% were transported to the local Crisis Stabilization Unit. An additional 9% were transported by the response vehicle to an alternative psychiatric facility and 15% fell out of the program's criteria and were transported to the ED for further evaluation. **Conclusions:** Our program has demonstrated the value of innovative approaches to behavioral health interventions in emergency medical services (EMS). Before launch of the triage, 98% of psychiatric patients reached the ED and in 2015, only 15% reached the ED. Additionally, because the team responded to over 2,000 incidents, fire and police crews were not consumed and available to respond to high-acuity emergency calls. Without collaboration across EMS services, psychiatric patients will continue to inefficiently utilize

ED services, putting an unnecessary strain on the healthcare system. Our program may serve as a model for other communities to adopt in order to improve the inefficiencies that persist in psychiatric patients' overuse of ED services.

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PREDICTORS OF RESUSCITATION SUCCESS PRIOR TO EMS ARRIVAL IN OUT-OF-HOSPITAL CARDIAC ARREST PATIENTS TREATED WITH A PUBLIC ACCESS AED

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Background: In some instances, out-of-hospital cardiac arrest (OHCA) patients receiving bystander CPR and/or defibrillation by a public access AED (PAD) are successfully resuscitated prior to EMS arrival. The purpose of this study was to describe the factors that predict restoration of spontaneous breathing prior to EMS arrival in OHCA patients treated with a PAD. **Methods:** A retrospective analysis was performed on data collected through a web-based AED management system (PlusTrac™, En Pro Inc.) from US customers between 2008 and 2015. Following each AED use, customers completed an anonymous online survey to describe characteristics and estimate times of resuscitation efforts. Multivariate logistic regression was used to determine the independent predictors of restored spontaneous breathing prior to EMS arrival. **Results:** Out of 576 reported AED uses, 217 patients (56 ± 15 yrs of age, 89% male) received at least one shock and were considered in confirmed OHCA. Of these, 153 (71%) suffered a witnessed arrest. Location of event was categorized as Retail (19%), Hotel/Resort (11%), Business/Corporation (25%), Government Organization (7%), Fitness Center (35%), or Nursing Home (4%). Bystander CPR was performed by a medical professional or AED-trained individual for 63% of patients. Time to AED retrieval was 2 min (IQR 1,5) and patients received 1 shock (IQR 1, 2). Spontaneous breathing was restored prior to EMS arrival for 80 patients (37%). Multivariate logistic regression revealed that witnessed arrest was a positive predictor of restoration of breathing [OR 4.80 (95% CI, 2.00-11.5)] whereas time to retrieve an AED [0.87(0.77-0.98)], total number of shocks [0.40 (0.23-0.69)], and arrest in a hotel [0.17 (0.03-0.92)] or nursing home (predicted failure perfectly) were negative predictors. **Conclusions:** A significant proportion of OHCA patients that receive a shock from a PAD regain spontaneous breathing prior to EMS arrival. Time to AED retrieval, number of shocks delivered, witnessed arrest, and location of arrest are significant predictors of restored breathing.

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TERMINATION OR WITHHOLDING OF RESUSCITATION IN TRAUMATIC CARDIAC ARREST IN STATEWIDE TREATMENT PROTOCOLS

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Background: The National Association of EMS Physicians (NAEMSP) issued a joint policy statement with the American Society of Surgeons: Committee on Trauma (ACS-COT) in March 2003 titled "Guidelines for withholding or termination of resuscitation in Prehospital Traumatic Cardiopulmonary Arrest." This statement strongly advocates for the termination of resuscitation (TOR) or withholding of resuscitation in traumatic cardiopulmonary arrest in the prehospital setting. Traumatic cardiopulmonary arrest has an extremely poor prognosis, particularly in blunt trauma. The majority of states issue statewide treatment protocols (STPs) that are mandatory or serve as a guide for medical directors. The purpose of this investigation is to describe the extent to which STPs incorporate the policy statement on traumatic cardiac arrest into their protocols. **Methods:** Standardized review of all STPs for termination of resuscitation protocols. Revision was also captured. **Results:** Thirty out of fifty states issue STPs. Of those thirty states, thirteen have no termination of resuscitation protocol for traumatic cardiac arrest. Of the seventeen remaining states, 4 only allow termination of resuscitation in blunt traumatic arrest and 8 allow termination in both penetrating and blunt cardiac arrest with no pulse or organized electrical activity. The 5 remaining states allow for termination of resuscitation only in conjunction with online medical control. **Conclusions:** Prehospital care is increasingly driven by evidence-based practices,

and reinforced by professional policy statements from organizations such as NAEMSP and ACS-COT. Despite this, there is still variation in implementation. This leads to inconsistent care and transport of unsalvageable and high utilization traumatic arrest patients. STPs also have considerable variability in regards to TOR in blunt versus penetrating traumatic cardiac arrest patients, as well as duration and appropriateness of resuscitation. There is variability in the requirement of online medical control for termination, as only 12 states allow for termination or withholding of resuscitation as a standing order. As every State included has protocol revisions since the policy statement, revision cycles are unlikely a contributing factor. Further studies to better understand attitudes toward futile resuscitation as well as barriers to termination of resuscitation are needed.

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PREHOSPITAL EMS PROVIDER PERCEPTIONS OF ERRORS AND SAFETY

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Background: Developing and maintaining a culture of safety is a significant priority for the high-risk, time-sensitive field of EMS. Recognition and response to errors are important elements for fomenting a culture of safety. Our objective was to assess EMS providers' perceptions of their agency's patient safety and to compare reported practices regarding errors among those who rated their agency as 'safe' or 'unsafe'. We hypothesized that individuals who provided a negative agency safety rating would report poorer practices with regards to errors and near miss events. **Methods:** A cross-sectional survey of nationally-certified EMS providers was conducted. Demographic and agency characteristics were collected along with information focused on perceptions of practices regarding errors. Respondents were asked to rate their main EMS agency's overall safety using a 5-point scale ranging from 'excellent' to 'poor', dichotomized to 'safe' (excellent/very good/good) or 'unsafe' (fair/poor). Inclusion criteria consisted of currently practicing providers (EMT or higher) in non-military, non-tribal settings. Descriptive statistics were calculated and significance was evaluated using Chi-square tests. **Results:** A total of 23,773 of the 35,588 respondents met inclusion criteria(response rate=11%). The majority rated their agency as safe (86%,n=20,488). Significantly more of those who rated their agency as safe reported that near miss events are documented most of the time or always compared to those at unsafe agencies (56% vs. 15%,p<0.01). Similarly, 74% of respondents who provided safe agency ratings agreed that mistakes have led to positive changes compared to 20% of respondents who gave an unsafe agency rating(p<0.01). Fewer respondents at perceived safe agencies agreed that it feels like individuals are punished when an event is reported compared to those at perceived unsafe agencies (28% vs. 65%,p<0.01). Over half (57%) of respondents at perceived safe agencies demonstrated willingness to report mistakes observed compared to only 15% of respondents in perceived unsafe agencies(p<0.01). **Conclusions:** Respondents who rated their agency as unsafe reported poorer practices regarding errors. Even at perceived safe agencies, nearly half of respondents reported infrequent documentation of near miss events and a reluctance to report mistakes demonstrating the need for further efforts to promote a culture of safety in EMS.

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FAILURE TO COMMUNICATE: A PROSPECTIVE OBSERVATIONAL STUDY OF PATIENT HANDOFF FOLLOWING A SIMULATED INTER-FACILITY EN ROUTE CARE MISSION

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Background: Multiple exchanges across the continuum of care are expected when evacuating a patient from the modern battlefield. Effective patient handoffs are critical to patient outcomes. The purpose of this study was to evaluate patient handoff to a receiving nurse at a Role III facility and compare Navy Nurses and Search and Rescue Medical Technicians (SMT) in a standardized simulated En Route Care (ERC) environment. **Methods:** We conducted a prospective, observational study of a patient handoff following a simulated ERC scenario involving the transport of a critically injured patient from a Role II to

a Role III facility. Upon arrival at the Role III, two independent, blinded and unseen observers evaluated the patient handoff. Critical actions were recorded to include initial patient history, current assessment, medications administered, and ERC interventions performed. A standard rubric was used to determine if the action was performed correctly. Analyses were exploratory and findings are reported as percentages and frequencies. Data were compared by provider type (nurses vs. SMTs) using chi-square or Fischer's Exact tests. **Results:** This study included 30 nurses and 29 SMTs. Of the 81% percent of providers who relayed the initial patient history to the receiving nurse, 69% did so correctly with no difference between provider types. SMTs were more likely to verbalize a current patient assessment (nurses, 75% vs. SMTs, 97%, $p=0.03$). We did not identify a difference in the communication of medication administration (nurses, 82% vs. SMTs, 62%, $p=0.14$) nor in relaying interventions performed en route (nurses, 100% vs. SMTs (93%), $p=0.49$). Overall, 41% of participants performed all four handoff elements correctly (nurses, 47% vs. SMTs, 34%, $p=0.34$). **Conclusions:** Despite very different initial and sustainment training modalities, both SMTs and nurses performed comparably when executing a patient handoff. With only 41% of participants performing all actions in this critical skill set appropriately, additional emphasis on patient handoff training is warranted.

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FIRST 100 CASES OF BLS FIRST RESPONDER-ADMINISTERED NALOXONE IN A STATEWIDE EMS SYSTEM

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Background: In October 2015, a midwestern state law mandated that all BLS first responder (FR) agencies be trained and equipped to administer naloxone to suspected opioid-overdose patients. Although well intentioned, several questions have arisen: does naloxone use displace emphasis on early positive pressure ventilation (PPV), is naloxone being appropriately administered, and does the mandate affect patient outcome. The purpose of this study is to evaluate the first 100 cases of FR administered naloxone (FR-naloxone) for administration appropriateness and state protocol adherence which calls for intranasal naloxone after PPV initiation and when ALS is delayed by >5 minutes. **Methods:** A retrospective chart review was performed utilizing the statewide EMS information system, filtering on "naloxone" as a medication administered. Beginning with the implementation date of 10/15/2015, the first one-hundred first-responder naloxone administrations were reviewed by a three-investigator panel. Data were abstracted from each case, including initial impression of mental and respiratory status, airway interventions performed, known history of opioid abuse, and timing of ALS arrival. Data were analysed using standard descriptive statistics. **Results:** Of the first 100 patients, 71% were male, and the median age was 35.5 (18-89) years. Seventy-five percent of naloxone administrations were provided to patients with pulses and inadequate respirations. PPVs were given prior to naloxone in 51.3% of patients with inadequate respirations. History of prior drug use was reported by the FR in 66% of cases. FRs initiated PPV in 39.4% of known drug abuse patients versus 61.7% in those without known abuse ($p=0.0337$). ALS reportedly arrived within 5 minutes of FR arrival in 38% of cases, >5 minutes in 17% of cases, and in 57% of cases there was no reference to ALS response time. **Conclusions:** Adherence to the state naloxone protocol appears poor among FRs. Based on initial patient evaluation, the majority of patients given naloxone had an inadequate respiratory effort. Pre-naloxone PPV was frequently not reported in patients with decreased respirations. A history of known drug abuse was associated with less frequent PPV. ALS arrived within 5 minutes of FR-naloxone in at least one-third of patients.

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ASSESSMENT OF AN IDEAL WEIGHT FOR AGE-BASED DOSING EDUCATION FOR EMS USING SIMULATED ENCOUNTER

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Background: During pediatric EMS calls, the patient's weight is unknown and difficult to estimate expeditiously. This could lead to challenges in calculating an appropriate weight-based dose as well as longer time to administration (TTA) of the medication. Weight-based dosing is the most accurate

method to determine accurate dosing, but calculations can be timely. Our objective was to assess an ideal weight for age dosing education tool on the accuracy and ease of dosage calculation as well as TTA for medications during simulation. **Methods:** 35 EMS providers consented to participate in our study. All subjects underwent a refresher course on PALS Pharmacology and took a written pre-test. In their current practice to estimate weight, they utilize length based weight tape (Broselow tape) and calculate dosing as illustrated on it. Subjects were block randomized into pre and post-assessment groups. The pre-Assessment group first went through a simulation of a child in status epilepticus. Subjects announced any medications, doses and route, and delivered them to a mannequin. An assessor recorded the information and TTA. The post-Assessment group first underwent training on ideal weight for age dosing tool for drug dosages. The groups switched and the post-assessment group went through an identical simulation while the pre-assessment group received the new training. Pre-test scores were compared by Mann Whitney U test, years of experience and TTA were compared by t-test, and correct doses were compared by chi-squared test. **Results:** 18 providers were in the pre-assessment group and 17 were in the post-assessment group. The average TTA compared between pre and post-assessment decreased by 69.4 seconds ($p=0.001$) for benzodiazepine administration, decreased by 53.9 seconds ($p=0.002$) for dextrose administration and decreased by 28.0 seconds ($p=0.048$) for epinephrine administration. Dose accuracy was higher in the post group for benzodiazepenes (88.2% vs. 72.2%, $p=0.15$) and dextrose (61.1% vs. 70.6%, $p=0.03$). Accuracy of epinephrine was 100% in both groups, though the Broselow tape gives dosage without calculation. **Conclusions:** During simulation exercise, using a weight for age dosing tool to estimate ideal weight significantly reduced TTA for all three resuscitation medication types and improved the dose accuracy for dextrose.

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A SCOPING REVIEW OF HOW FRAILITY IS IDENTIFIED IN EMS AND EMERGENCY DEPARTMENT SETTINGS

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Background: Frail patients require adaptations of care, personalization of interventions, and modifications of standard protocols. Consensus has not yet been reached on how frailty should be measured and choosing among the many options available can be confusing to health care professionals. Our objective was to conduct a scoping review to identify the nature and extent of research evidence related to measuring frailty in acutely ill patients in EMS and emergency department (ED) settings. **Methods:** Six electronic databases (MEDLINE, CINAHL, Embase, PsychINFO, Cochrane, and Eric) were searched for original research articles, published after 2000, that included acutely ill patients in prehospital and ED settings and identified their participants as "frail" either in the title, abstract, and/or text. **Results:** The search strategy yielded 8697 articles. After an initial screening of all titles and abstracts, 3313 articles remained from which full text were obtained. Of these articles, 632 identified frailty in acutely ill patients. 16% ($n=102$) of the studies were performed in ED (14%) or EMS (2%) settings. Among the studies that were conducted in EMS or EDs, 70% did not measure frailty but identified their patients as frail, 15% used a frailty scale, 7% used other scales to measure frailty, and 8% used other ways to measure frailty. The most commonly used scales were: Frailty Index (7 studies), Clinical Frailty Scale (4 studies), Identification of Seniors at Risk (3 studies), the frailty phenotype (3 studies) and Vulnerable Elders Survey (1 study). 26 studies showed that frailty was predictive of an adverse health outcome. **Conclusions:** The evidence about frailty in EMS and ED settings is limited. Within this context, the majority of studies identified their patients as frail without measuring frailty and among the studies that measured frailty the most commonly used scales were the frailty index, clinical frailty scale and the Identification of Seniors at Risk scale. Most studies showed that frailty tools are predictive of adverse health outcomes.

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THE EFFECTS OF HURRICANE SANDY ON THE EMERGENCY DEPARTMENT AND EMS SYSTEM AT STATEN ISLAND UNIVERSITY HOSPITAL SOUTH CAMPUS

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Background: To analyze and identify trends in patient volume, demographics, admission rates, conditions treated, and emergency medical services (EMS) utilization during Hurricane Sandy at Staten Island University Hospital –South (SIUH-S) in Staten Island, New York. **Methods:** Retrospective chart review of patients presenting to SIUH-S in the days surrounding Hurricane Sandy. Data was obtained for October 26, 2012 through November 2, 2012, and compared to the respective days of the previous year. We examined daily patient volume, age, sex, admission rates, mode of arrival, primary diagnosis and diagnosis categories in the days surrounding the storm using mean, percentage, and p-value calculations. **Results:** On the day of the storm (Day 0) we saw a dramatic decrease in volume by 33% compared to the control week. Subsequently, we saw a rebound to above normal volumes on Days 1, 2, and 3. The admission rate was significantly higher Day 0 and Day 1, at 38% and 33% compared to the 2012 annual average of 21%. We saw a shift in the patient’s mode of arrival to the hospital on Day 0 and 1 with patients arriving predominately by private automobile. The use of the EMS declined on these days from an average of 19%, to 11% and 5%, respectively. Finally the diagnosis categories seen during the storm were notable for power-outage complications, 7%, cold related illness, 5%, and increase in shortness of breath complaints, 12% compared to a control of 6% ($p = 0.07$). **Conclusions:** The daily ED volume had a significant decline on the day of the storm with a rebound to double the typical volume on Day 2. The acuity of patients presenting during the storm was higher than average as extrapolated from the admission rate. The presenting conditions varied from our usual pattern. Most prominent was an increase in respiratory disease and conditions incurred as a direct result of the storm, including diagnoses of power outage complication, cold water exposure and hypothermia. The percentage of patients utilizing EMS transportation was decreased during the storm, possibly reflecting inaccessible areas and self-triage away from the hospital for lower acuity 911 medical calls.

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PREHOSPITAL TRIAGE OF ACUTE ISCHEMIC STROKE PATIENTS TO AN INTRAVENOUS TPA-CAPABLE VERSUS ENDOVASCULAR-CAPABLE HOSPITAL

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Background: American Stroke Association guidelines for prehospital acute ischemic stroke recommend against bypassing an intravenous tPA-capable hospital (ICH) if additional transportation time to an endovascular-capable hospital (ECH) is greater than 15-20 minutes. However, it is unknown when the benefit of potential endovascular therapy at an ECH outweighs the harm from delaying thrombolytic therapy at a closer ICH, especially since large vessel occlusion (LVO) status is initially unknown. Our objective was to calculate the optimal prehospital triage strategy for acute ischemic stroke patients. **Methods:** A decision analytic model was constructed using a comprehensive literature review and interventional trial data containing time-dependent modified Rankin Scale distributions. Base case was a 69-year-old patient triaged by Emergency Medical Services (EMS) 110 minutes after stroke onset. Base case triage choices were (1) transport to the closest ICH (12 minutes away), (2) transport to the ECH (60 minutes away) bypassing the ICH, or (3) apply the Cincinnati Stroke Triage Assessment Tool (C-STAT) and transport to the ECH if positive for LVO. Sensitivity analyses were conducted to determine the impact of onset to EMS triage interval, ICH and ECH transportation times, probability of LVO, and alternative prehospital triage tools. Outcomes were assessed using quality-adjusted life years (QALYs). **Results:** In the base case, utilizing the C-STAT yielded the highest expected utility (8.48 QALYs). Sensitivity analyses demonstrated direct ECH transport was superior to ICH transport until the ECH was >56 minutes away (44 additional minutes due to ICH bypass). ICH transport was superior when the onset to EMS triage interval was long, while ECH transport was optimal with shorter intervals. As the probability of LVO increased, ECH transport was optimal at longer onset to EMS triage intervals. The optimal triage strategy was highly dependent on specific interactions between the onset to EMS triage interval, ICH transportation time, and ECH transportation time. **Conclusions:** Acute ischemic stroke guidelines for ICH

bypass time should be increased. No absolute time difference between ECH and ICH transportation is capable of optimizing EMS triage for all patients. Prehospital triage tools for LVO have utility in further optimizing triage.

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DIRECT VERSUS INDIRECT LARYNGOSCOPY FOR PREHOSPITAL INTUBATION: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: The use of video and other forms of indirect laryngoscopy (IDL) for intubation has gained recent popularity, especially among acute care areas of the hospital. In the prehospital setting, utilization of IDL has also seen an increase, but widespread implementation may be associated with significant cost and challenges. To our knowledge, a systematic review and meta-analysis of the literature has not yet been performed assessing the use of IDL compared to direct laryngoscopy (DL) in the prehospital setting. Our objective was to determine whether the use of IDL provides an improvement in overall and first-pass endotracheal intubation success rates in the prehospital setting when compared to DL. **Methods:** A systematic search was performed of the Pubmed, Embase, and SCOPUS databases through May 2016 using search terms related to the setting and procedure. As part of the inclusion criteria, studies had to: use living human subjects in the prehospital setting, be published in English, and include data that allowed for the calculation of overall and/or first-pass success/failure rates. Data were extracted separately by two reviewers and a meta-analysis was then performed using a random effects model. Begg's test and funnel plots were used to assess for publication bias. **Results:** 472 articles were collected, of which 8 eligible studies were identified. When stratified by provider type the pooled relative risk (RR) estimate for overall intubation failure using IDL was 20.77 (95% CI 5.46, 79.05) and 0.44 (95% CI 0.19, 1.00) among studies using physicians and non-physicians, respectively. For first-pass intubation failure the pooled RR estimate for using IDL was 2.98 (95% CI 1.93, 4.62) and 0.56 (95% CI 0.36, 0.85) among studies using physicians and non-physicians, respectively. There was moderate to significant heterogeneity noted between studies. There was no evidence of publication bias. **Conclusions:** Among non-physician providers, IDL may provide benefit over DL in the prehospital setting. However, among physician providers with significant DL experience, introducing IDL may not improve overall or first-pass success rates and may be associated with decreased performance. Studies were heterogenous and further research is needed on the use of prehospital IDL.

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WHICH MPDS DISPATCH CODES GENERATE THE HIGHEST LIGHTS AND SIREN EMERGENCY TRANSPORT RATE FROM SCENE TO HOSPITAL?

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Background: Predicting which 911 calls result in lights and sirens (L&S) transports may help determine which calls require higher resource utilization. Our primary goal was to determine which Medical Priority Dispatch System (MPDS) codes are associated with the highest L&S return rate from scene to hospital. Our secondary outcomes included L&S transport incidence based on time-of-day, day-of-week, and acuity level of call. **Methods:** We performed an IRB-approved, retrospective, descriptive study using data from Albuquerque Ambulance Service for all consecutive 911 calls with MPDS codes 1-32 from 1/1/2012 to 1/1/2016. We excluded 911 calls that resulted in non-transport and incomplete data. We focused on dispatch codes that occurred more than 100 times and generated >15% L&S return rates. **Results:** During our study, there were 354,275 total dispatches. We excluded non-transports (N= 109,458) and incomplete records (N= 12,381). Of the remaining 232,456 calls that resulted in transports, 5.9% (N= 13,668) were L&S, and 94.1% (N= 218,768) were non-emergent. Of the calls that occurred more than 100 times in our data set, the codes that generated greater than 15% L&S transports were 27D (penetrating injury), 9E (cardiac arrest), 28C (stroke), 29D (MVC), 27B (penetrating injury), 24D

(childbirth), 13D (diabetic problem), 17D (fall), and 31D (unconscious) at 54.1%, 46.8%, 27.1%, 22.0%, 21.6%, 20.3%, 16.8%, 16.6%, and 16.3% respectively. These codes made up 36.5% of the total L&S transports. Of all transported calls, our most common MPDS codes were, in descending order, 23B (overdose), 26A (sick), 29B (MVC), 6D (breathing problem), and 32B (unknown), with L&S frequencies of 0.7%, 2.3%, 3.9%, 12.1%, and 2.7% respectively. Sunday had the highest L&S transport rate (6.1%), and 7-8am was the highest L&S transport hour (8.8%). L&S transports occurred more frequently for higher level of dispatch acuity (Alpha 1.8%, Bravo 2.2%, Charlie 7.3%, Delta 13.9%, and Echo 44.3%).

Conclusions: We were able to determine that a significant proportion of L&S transports were generated from 9 different MPDS codes. Also, we determine that of the most common 911 calls, none of them had L&S transport rates higher than 15%. These findings may have significance in the future for determining which dispatch calls may require greater resource allocation.

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EMS EDUCATION PROGRAM QUALITY PREDICTS NATIONAL CERTIFICATION EXAMINATION PASS RATES

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Background: Educational practices among EMS training programs vary widely throughout the nation while scant research exists regarding impact on student performance. Our objective was to assess how program quality impacts student performance on the National EMS Certification cognitive exam. We hypothesized that students graduating from high-performing programs would have greater odds of passing on their first attempt. **Methods:** National EMS Certification cognitive examination results for graduates of paramedic and EMT programs in 2013 were analyzed. Using a modified Margolis method, programs were classified as high-performing if the program first-time pass rate was greater than or equal to the 2012 national average or low-performing if the first-time pass rate fell below this benchmark. The 2012 benchmark was 68% for paramedic and 65% for EMT. Descriptive statistics were calculated. Univariable logistic regression was used to assess the impact of program performance on first-attempt pass/fail. **Results:** In 2013, 11,177 students graduated from 746 paramedic programs, while 67,716 students graduated from 2,242 EMT programs. A total of 57% (n=425) of paramedic programs were classified as high-performing and 69% (n=2,333) of EMT programs were high-performing. Nearly two-thirds (65%, n=7,262) of paramedic students attended high-performing programs while this figure was 59% (n=40,237) for EMT students. The mean first-time pass rate was 69% for paramedic students and 64% for EMT students, and cumulative third-attempt pass rate as 83% for paramedics and 75% for EMTs. The mean first-time pass rate among high-performing paramedic programs was 88% versus 44% among low-performing programs (p<0.01). The mean first-time pass rate among high-performing EMT programs was similar at 83% versus 43% for low-performing programs (p<0.01). After three attempts, the cumulative pass rate for low-performing paramedic programs was 67% and 60% for low-performing EMT programs. High-performing program graduates had approximately a four-fold increase in odds of passing on their first attempt (paramedic: OR:4.68, 95%CI:4.29-5.12, EMT: OR:3.63, 95%CI:3.51-3.76). **Conclusions:** Students graduating from high-performing programs had significantly greater odds of passing the National EMS Certification exam on their first attempt. Even after three attempts, low-performing program graduates did not achieve the first-attempt success rates of high-performing programs.

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USING DELAYED SEQUENCE INTUBATION TO PREVENT PERI-INTUBATION HYPOXIA

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Background: Rapid Sequence Intubation (RSI) is a commonly used EMS technique. Safely using this technique depends on adequate pre-oxygenation and de-nitrogenation. Delayed Sequence Intubation (DSI) is a process that involves a delay between the administration of ketamine and a paralytic to allow appropriate pre-oxygenation in the presence of hypoxic agitation. Our EMS system identified peri-intubation hypoxia as an area for improvement and implemented a DSI strategy as part of our CQI efforts to address these occurrences. **Methods:** We identified charts of non-cardiac arrest patients in

our mid-sized suburban EMS system who were intubated between October 2013 and July 2016. We replaced our RSI process with a DSI protocol in January 2016. Using a before-and-after approach, we analyzed the differences between these groups in several metrics: lowest peri-intubation SpO₂, percentage of moderate (80-89%) and severe (<79%) hypoxic episodes. These groups were compared with a two-tailed t-test. Our DSI protocol prohibited intubation unless a pre-intubation SpO₂ >93% was maintained for at least three minutes. To assist with this, each ambulance was equipped with a stopwatch and mandatory checklist. The protocol required the use of high-flow nasal cannula oxygen, a BVM with PEEP and the use of ketamine for sedation. **Results:** The RSI and DSI groups had 73 and 30 patients respectively. The RSI vs. DSI average lowest peri-intubation SpO₂ was 82.3% vs. 97.9% ($p = 0.0006$), the percentage of cases with moderate hypoxia was 39.7% vs. 0.0% ($p < 0.0001$) and the percentage of cases with severe hypoxic episodes was 65.8% vs. 0.0% ($p < 0.0001$). **Conclusions:** In this CQI process involving non-cardiac arrest intubations in this suburban system, we noted an increase in the lowest peri-intubation SpO₂ and an elimination of hypoxic episodes. This was not a controlled or randomized trial, it was a before-and-after analysis of a CQI effort, and had different size groups. Although these groups seem similar, it is possible that there was a difference in the DSI group that biased the results against RSI. A randomized, controlled trial is needed to confirm the effect seen in this case series.

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STUDENT ABILITY ESTIMATES IN HIGH- AND LOW-PERFORMING EMS EDUCATION PROGRAMS

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Background: Despite efforts to standardize and accredit EMS education, program practices vary widely. Little research exists regarding program quality and student cognitive ability measures. Our objective was to assess the relationship between program performance and student cognitive ability estimates measured through the National EMS Certification examination. We hypothesized that students graduating from high-performing programs would exhibit higher mean cognitive ability scores.

Methods: National EMS Certification cognitive examination results for 2013 graduates of paramedic and EMT programs were analyzed. Using a modified Margolis method, programs were classified as high-performing if the program first-time pass rate was greater than or equal to the 2012 national average or low-performing if this measure fell below the benchmark. The 2012 benchmark was 68% for paramedic and 65% for EMT. Students' first-attempt mean ability estimates (MAE) were calculated using Rasch logit ability measures transformed to a 0-1000 scale. Content area MAE were assessed for: 1) Airway/respiration/ventilation, 2) Cardiology/resuscitation, 3) Trauma, 4) Medical/obstetrics/gynecology and 5) EMS operations. Descriptive and comparative statistics (t-test) were calculated.

Results: In 2013, 11,177 students graduated from 746 paramedic programs, and 67,716 students graduated from 2,242 EMT programs. Nearly two-thirds (65%, $n=7,262$) of paramedic students attended high-performing programs while this figure was 59% ($n=40,237$) for EMT students. First-attempt MAE for all paramedic students was 462 and 599 for EMT students. The MAE of paramedic students from high-performing programs was significantly greater than that of students from low-performing programs (515 vs. 365, $p<.01$). First attempt MAE for EMT students from high-performing programs was 639 and 540 for students from low-performing programs($p<.01$). Paramedic students from high-performing programs demonstrated significantly higher cognitive ability in each content area with the largest difference in medical/obstetrics/gynecology (529 vs. 361, $p<.01$) and the smallest difference in EMS operations (497 vs. 398, $p<.01$). Similarly, EMT students from high-performing programs demonstrated higher cognitive ability in each content area with the largest difference in medical/obstetrics/gynecology (658 vs. 551, $p<.01$) and the smallest difference in EMS operations (640 vs. 561, $p<.01$). **Conclusions:** Students graduating from high-performing EMS education programs exhibited significantly higher first-attempt cognitive ability scores overall, and across all content areas. These differences may be used to target interventions for improvement of low-performing programs.

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DESCRIPTIVE STATISTICS OF PULSEPOINT APP ACTIVATIONS IN SAN DIEGO CITY 2014-2016

Background: PulsePoint is a mobile device application designed to improve cardiac arrest survival rates through increased bystander CPR. San Diego County implemented PulsePoint in July 2014 and, as of 7/20/16, has 66,557 subscribers. Our objective was to analyze activation of the City of San Diego PulsePoint by demographics, outcome, and dispatch determinant codes using two years worth of accumulated data. **Methods:** Retrospective descriptive analysis with matched data using common incident numbers from PulsePoint, CARES registry and ImageTrend EMS Service Bridge database for the City of San Diego from 7/2014 to 7/2016. **Results:** 103 PulsePoint activations requiring CPR for cardiac arrest were identified. 65 of these were unwitnessed, 38 witnessed. Average age was 65. AEDs were applied before EMS arrival in 17 instances. First CPR was done by lay persons in 70 cases, 22 by EMS, and 11 by first responders. ROSC was obtained in 32 cases. 51 were in asystole, 24 in Vfib, 24 in idioventricular/PEA, 2 in VTach and 2 were unknown shockable rhythm. Regarding outcomes, 42 were dead in field, 27 were transported and resuscitation was terminated in the ED. 17 died in the hospital after admission. 4 discharges from hospital with good cerebral function were recorded, 2 with moderate cerebral disability, and 4 with severe cerebral disability. Survival to hospital discharge was 9.7%. Average number of eligible responders amounted to 2.69 per activation. Average time from call received to first CPR was 7 minutes and 29 seconds. Dispatch determinant codes were respiratory arrest/death in 101 cases, convulsion/seizure in 1, and a single case was marked 'other'. 280 PulsePoint activations were collected which included activations not requiring CPR. Dispatch determinant codes were categorized cardiac or respiratory arrest/death in 239 cases, choking in 30, convulsions/seizure in 4, unconscious in 3, diabetic problems in 2, and drowning in 2 cases. **Conclusions:** This is a basic descriptive statistics of 2 years of PulsePoint app data as a start to improve its utility. Further analysis of data comparing numbers to non-PulsePoint activated cardiac arrests are necessary.

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TIME-CRITICAL DIAGNOSIS CARE IN MISSOURI: A GEOSPATIAL ANALYSIS OF ACCESS TO STATE-DESIGNATED STROKE CENTERS

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Background: In 2012, Missouri passed Time Critical Diagnosis (TCD) legislation to designate hospitals as stroke and STEMI centers. In 2015, the state announced the first round of stroke center designations. These facilities now represent the standard of stroke care in Missouri, and are the preferred destination for EMS crews transporting patients with stroke symptoms. Missouri has many rural areas that are distant from population centers. We hypothesized that under the current distribution of state-designated stroke centers, all rural residents of Missouri can reach a stroke center within the 3-hour window to be eligible for thrombolytic therapy. **Methods:** Population data: Block data from the 2010 census imported into ArcMap and modeled as centroids. Each of the 343,565 census blocks was assigned a single central point, or centroid, to represent the location of the population associated with the census block, similar to previous nationwide analyses. (Adeoye 2014) Facility data: All hospitals registered with the Missouri Board of Healing Arts as of August 2015 were evaluated for inclusion in the analysis. Inclusion criteria: 24h Emergency Department operations within the state of Missouri. Exclusion criteria: pediatric hospitals, Department of Veterans Affairs facilities. 119 total hospitals were dichotomized as TCD stroke designees (levels 1, 2, or 3) (n=43) or those without TCD stroke designation (n=76). Service area calculations were performed for the 43 hospitals designated as stroke centers. Transportation network data: The network analyst extension of ArcMap 10.1 (ArcGIS, Redmond WA) was used for all calculations. Each stroke center's service area was modeled to find the centroids from which one could reach the hospital in 15-minute increments. The analysis presumes obeying standard speed limits, no adjustments were made for EMS utilization (Carr 2006). Population centroids were assigned a drive-time based on the calculated network transit time. **Results:** In the first 15 minutes, 4.5% of Missouri's land mass but 54% of residents can reach a stroke center. All of Missouri's residents can reach a stroke center within 165 minutes. **Conclusions:** The stroke network contains visually striking

service gaps due to slow surface roads in rural areas. Rural stroke patients may miss the thrombolytic window if transport is delayed.

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ACTIVE INTRATHORACIC PRESSURE REGULATION IMPROVES MEAN ARTERIAL PRESSURE DURING CARDIOPULMONARY RESUSCITATION

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Background: Active intrathoracic pressure regulation (a-IPR) is a novel, noninvasive therapy that actively generates a continuous negative intrathoracic pressure of -9mmHg between positive pressure ventilations. A-IPR has been shown to increase circulation and survival in animal models of resuscitation, brain injury, and cardiac arrest. We compared the data from two sites utilizing a-IPR during CPR and evaluated mean arterial pressure (MAP), end-tidal carbon dioxide (EtCO₂), and rate of return of spontaneous circulation (ROSC) versus patients not receiving a-IPR at one of the sites. **Methods:** All patients were treated initially with manual CPR. When a-IPR-trained medics arrived on scene, the a-IPR device (CirQLATOR, ZOLL Medical, Minneapolis, MN) was attached to the patient's advanced airway for the intervention group and CPR was continued. Control patients received manual CPR without the addition of a-IPR. MAP and EtCO₂ were measured by the research team without interfering with resuscitation efforts. Values are expressed as mean \pm SD and were compared using unpaired t-tests, difference in ROSC rate was compared using a Fisher's exact test. P-values of <0.05 were considered statistically significant. **Results:** Data were analyzed for 13 patients who received a-IPR and 8 patients in the control group who received CPR without a-IPR. During CPR with a-IPR therapy, average MAP was 63.6 ± 30.7 mmHg compared to 40.0 ± 13.6 mmHg for patients in the control group ($p=0.03$). End-tidal was also different between the two groups, with an average level of 47 ± 30 mmHg for a-IPR patients versus 23 ± 16 mmHg in the control group ($p=0.06$). Of the patients who received a-IPR, 5/13 (38.5%) ultimately had ROSC while only 1/8 (13.0%) of those who did not receive a-IPR achieved ROSC. **Conclusions:** MAP was significantly higher in patients receiving a-IPR therapy. EtCO₂ also trended higher and there was a three-fold increase in rate of ROSC with a-IPR. These findings demonstrate that circulation and potential for ROSC during CPR may be improved by the addition of a-IPR, which generates a negative end expiratory pressure between each breath.

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PARAMEDIC-PHYSICIAN TELECOMMUNICATIONS IN A LARGE REGIONAL PREHOSPITAL SYSTEM

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Background: High quality paramedic-physician telecommunications (patches) are crucial in prehospital systems supplemented with on-line direction but very little has been published regarding the quality of these calls. The objective of this study is to examine the quality of patches in a prehospital system where on-line medical direction is done with a dedicated group of nine physicians. **Methods:** A single reviewer abstracted data from routinely collected audio and written documentation of patches spanning 14 consecutive days in December 2015 using a standardized electronic database with predefined criteria. A second reviewer reviewed 10% of the records. The prehospital system covers a geographic area of 12,628 square kilometers with a population of over 2 million, with nine separate land ambulance services. Nine dedicated physicians provide on-line medical direction to nearly 1200 paramedics. **Results:** There were 5521 service calls and 150 patches (2.7%) in the 2-week timeframe. Ninety-one patches (61%) were mandatory patch points in the paramedics' medical directives. The most common reason for a mandatory patch was for return of spontaneous circulation or for cardiac arrest, including for consideration of termination of resuscitation (37.3%). Non-mandatory patches for orders outside of medical directives totaled 59 (39%), with the most common being for analgesia beyond what is available within the directives (24%). In 21 of 22 quality indicators, both paramedics and physicians did very well, with more than 95% calls being rated as satisfactory or excellent. One quality indicator ("paramedic

communication begins with a request”) only received 82% satisfactory scores. **Conclusions:** In this prehospital system, paramedics demonstrated autonomy by using on-line direction rarely. However, when patches were used, the paramedics often advocated for patients for non-mandatory reasons. Quality indicators were generally high, except for one moderately-performing paramedic indicator. Future research will address whether if these quality indicators could be improved by a targeted education intervention and if expanding the indications in some of the current medical directives can safely reduce the number of patches.

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A PREHOSPITAL SEPSIS ALERT PROTOCOL DECREASES DOOR TO ANTIBIOTIC TIME BUT PERFORMS POORLY IN IDENTIFYING PATIENTS ADMITTED WITH SEPSIS

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Background: A prehospital sepsis alert protocol was implemented utilizing: 1) emergency medical services (EMS) provider’s assessment of a suspected infection, 2) presence of two or more Systemic Inflammatory Response Syndrome (SIRS) criteria, and 3) presence of hypotension or altered mental status. We hypothesized that admitted sepsis patients identified as a prehospital sepsis alert would have decreased door to antibiotic and door to disposition times compared to those not identified as an alert.

Methods: A structured retrospective review of hospital and prehospital records was performed on adult patients arriving via EMS who were subsequently admitted with an emergency department (ED) diagnosis of sepsis, severe sepsis, or septic shock. A standardized data abstraction instrument was utilized to collect the following: Patient demographics, Emergency Medical Dispatch Code, Prehospital impression, lowest blood pressure, highest heart rate, highest respiratory rate, lowest EtCO₂, and presence of altered mental status, time of ED arrival, antibiotic order, and disposition, and ED disposition. Patients who received a prehospital alert were compared to patients who did not using bivariate analyses. Kaplan-Meier survival curves with log-rank tests were used for time to event analyses. **Results:** The records of 150 consecutive patients admitted with an ED diagnosis of sepsis were available for abstraction. Prehospital alerts only occurred in only 20 (13%). The presence of all three sepsis alert criteria identified only 4/150 (3%) patients, while two criteria identified 49/150 (33%), and the presence of only one criterion identified 110/150 (73%) patients admitted with sepsis. Alerts were more likely to have altered mental status, an elevated respiratory rate, and required admission to a higher level of care (intensive care unit or step-down) than non-alerts ($p < 0.01$). Alerts had a shorter median time to antibiotic administration (60.5 vs. 103.0 minutes, $p < 0.005$) but not time to disposition (198.5 vs. 238.5 minutes, $p = 0.14$). **Conclusions:** Although a prehospital sepsis alert protocol is associated with a decreased median time to antibiotic administration, a protocol utilizing an assessment of suspected infection along with the presence of two or more SIRS criteria and the presence of hypotension or altered mental status performs poorly in identifying patients admitted with sepsis.

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STATE REGULATION OF COMMUNITY PARAMEDICINE PROGRAMS: A NATIONAL ANALYSIS

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Background: Community Paramedicine (CP) is a rapidly evolving field within prehospital care where paramedics step outside of their traditional roles of treating acute conditions to provide elements of primary and preventive care. It is unclear if current state oversight regarding the scope of practice (SOP) for paramedics provides clear guidance on the novel functions provided and skills performed by Community Paramedicine programs. Our objective was to determine the process and authority, as currently defined by state legislation and regulations in the United States, to expand paramedic SOP in order to perform CP roles and to assess state EMS agencies’ interpretation of paramedic SOP as it applies to CP. **Methods:** We conducted a systematic review of laws, regulations and policies from the 50 US states in effect between February and June 2016 that define or apply to paramedic SOP. We

determined if each state's SOP included skills applicable to CP. Specifically, we searched for 21 potential community paramedicine activities within the following skill sets: assessment, treatment & intervention, referrals, and prevention & public health. Legislation was also queried for mechanisms for expanding SOP, alternate destinations, and community paramedicine for each state. Additionally, we surveyed representatives from US state Emergency Medical Services (EMS) agencies and asked which of these skills were a part of their their current SOP. All data was coded into Excel™ and analyzed using descriptive statistics. **Results:** All 50 US states had legislation involving EMS. 41 states (84%) had specific statewide guidance on paramedic scope of practice. Of these, 20 states (49%) had a clearly defined mechanism for expanding SOP. 16 states (32%) had legislation specific to CP. 7 states (12%) allowed for alternate destinations. Of the 21 skills surveyed, on average there were 8.63 (6.41-10.85) fewer skills found in legislated SOP than were reported as being a part of a state's SOP. All skills demonstrated variability between the legislative review and survey results with 13.04 - 96.15% concordance.

Conclusions: There is a lack of guidance and consistency regarding CP programs and scope of practice. Further studies are needed to understand best practices around regulation and oversight of community paramedicine.

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ASSESSMENT OF THE SAFETY OF A NEWLY IMPLEMENTED BLS-D STEMI BYPASS PROTOCOL

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Background: Paramedic transport of ST-segment elevation myocardial infarction (STEMI) patients for percutaneous coronary intervention (PCI) is well-established. Recent evidence suggests basic life support-defibrillation trained (BLS-D) providers with a restricted scope of practice can safely transport many STEMI patients. Our objective was to evaluate the safety of transport of BLS-D identified STEMI patients under a newly implemented protocol. **Methods:** In April 2015, Toronto Paramedic Services implemented the following BLS-D bypass protocol: 1) BLS-D transport to PCI centers based on predefined stable criteria, 2) ALS-rendezvous for transport based on any predefined unstable criterion (heart rate below 50 or above 120, systolic blood pressure below 80mmHg, requires ventilation), 3) redirection to the closest ED if cardiac arrest with nonshockable rhythm or no return of spontaneous circulation despite two shocks or unmanageable airway. Ambulance call reports between April 2015-May 2016 from consecutive BLS-D identified STEMI patients were reviewed. The primary outcome was the proportion of patients meeting predefined criteria for each group. Secondary outcomes were the proportions of BLS-D patients requiring advanced care interventions (ACI) and ALS-rendezvous patients receiving an ACI. Prehospital outcomes of patients experiencing cardiac arrest were determined.

Results: Of 365 patients (mean age: 66, 72% male, median transport time: 9.54 minutes), 235 were transported by BLS-D only, and 130 were ALS-rendezvous transports. No patients were redirected. Of the BLS-D patients, 177/235 (75%) met stable criteria compared with 66/130 (51%) of ALS-rendezvous patients (χ^2 , $p < 0.001$). Additionally, 19/235 (8%) BLS-D only patients had indications for an ACI, while 34/130 (26%) ALS-rendezvous patients received an ACI. Fluid boluses ($n=14$) and atropine ($n=8$) were the most common missed opportunities for an ACI in BLS-D patients. Fluid boluses ($n=29$) and dopamine ($n=9$) were the most common ACIs performed among ALS-rendezvous patients. Of 11 patients who experienced prehospital cardiac arrest (3 BLS-D only, 8 with shockable rhythms), 10 were successfully resuscitated. **Conclusions:** BLS-D providers reasonably followed the protocol according to stable and unstable criteria. That 8% of BLS-D only patients had an indication for an ACI while 26% of ALS-rendezvous patients received one or more suggests that this protocol is safe in an urban setting where ALS-rendezvous is available.

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A DESCRIPTIVE ANALYSIS OF MEDICAL CARE PROVIDED BY US LAW ENFORCEMENT PERSONNEL PRIOR TO EMS ARRIVAL

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Background: Law enforcement is increasingly viewed as a key component in the out-of-hospital chain of survival, with expanded roles in cardiac arrest, narcotic overdose, and traumatic bleeding. Little is known about the nature of care provided by law enforcement prior to the arrival of emergency medical services (EMS) assets. The purpose of the current study was to perform a descriptive analysis of events reported to a national EMS database. **Methods:** Descriptive analysis of the 2014 National Emergency Medical Services Information System (NEMSIS) public release research data set, containing EMS emergency response data from 41 states. Code E09_02 1200 specifically identifies care provided by law enforcement prior to EMS arrival. **Results:** A total of 25,835,729 unique events were reported. Of events in which pre-arrival care was documented, 2.0% received prior aid by law enforcement. Patients receiving law enforcement care prior to EMS arrival were more likely to be younger (52.8 ± 23.3 vs. 58.7 ± 23.3 , $p < 0.01$), male (54.8% vs. 46.7%, $p < 0.01$), and white (80.3% vs. 77.5%, $p < 0.01$). BLS EMS response was twice as likely in patients receiving prior aid by law enforcement, no difference in ALS response was noted. Multiple patient incidents were 5 times more likely with prior aid by law enforcement. Compared with prior aid by other services, law enforcement pre-arrival care was more likely with motor vehicle accidents (1.4x), firearm assaults (2.7x), knife assaults (2.4x), blunt assaults (1.6x), and drug overdoses (3.3x), and less likely at falls (0.55x). Cardiac arrest was significantly more common in patients receiving prior aid by law enforcement (16.5% vs. 2.6%). Naloxone was administered in 1685 cases. Hemorrhage control, including tourniquet use and hemostatic agents, was more common in the law enforcement prior aid group. **Conclusions:** Where noted, law enforcement pre-arrival care occurs in 2% of EMS patient encounters. The majority of cases involve cardiac arrest, motor vehicle accidents, and assaults. Better understanding of the nature of law enforcement care is required in order to identify potential barriers to care and to develop appropriate training and policy recommendations.

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FEASIBILITY OF TRAINING AND USE OF THE RAPID ARTERIAL OCCLUSION SCALE (RACE) BY GROUND PARAMEDICS: PRELIMINARY DATA FROM PHASE ONE OF PROTOCOL IMPLEMENTATION

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Background: Stroke is a leading cause of death and disability in the United States, afflicting 795,000 individuals annually. Recent studies have demonstrated improved outcomes in patients with strokes caused by large vessel occlusion (LVO) treatment with endovascular therapies. There is a need for a prehospital diagnostic tool that can identify patients with LVO and facilitate prehospital triage to comprehensive stroke centers. We evaluated the feasibility of implementing the Rapid Arterial Occlusion Evaluation (RACE) scale in the prehospital setting to improve the ability of prehospital personnel to identify patients with stroke due to LVO. **Methods:** As part of a quality improvement project, paramedics from eight Emergency Medical Services (EMS) agencies under UPMC medical command received in-person training on the RACE scale. Training consisted of a didactic presentation, scenario based videos, and hands-on demonstrations. A step-by-step scoring sheet was created to guide the paramedics performing the RACE exam. Data elements of the RACE scale were collected prospectively upon completion of the prehospital electronic health record (PEHR) through a survey integrated into the EHR (emsCharts). Responses were emailed to the program coordinators for entry into a quality improvement registry. For patients transported in our health system, a project coordinator obtained in-hospital data elements. **Results:** From December 2015 to July 2016, a prehospital RACE scale was completed for 129 patients with suspected stroke. Of these, 40 had a RACE scale of ≥ 5 , a cut-off score shown to have a high specificity for predicting LVO in the scale's derivation. Of these 40 cases, in-hospital data was available for 31 cases, 15 (48.4%) were ischemic strokes, 5 were transient ischemic attack (16.1%), 4 (12.9%) were intracerebral hemorrhages and 6 were stroke mimics (19.3%). Of the 31 patients with outcomes and RACE scale ≥ 5 , 9 (29.0%) had a large vessel occlusion and 3 (9.7%) received endovascular therapies. **Conclusions:** Paramedics are capable of performing the RACE scale after in-person training and that implementation of the RACE scale in the prehospital setting is feasible.

DOCUMENTATION OF CAPACITY ASSESSMENT IN 911 PATIENTS WHO REFUSE EMS TRANSPORT

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Background: Patients who are evaluated by EMS and subsequently refuse transport Against Medical Advice (AMA) make up as much as 30% of EMS call volume. The legal ramifications of AMAs have become increasingly important in recent years, as they constitute 50–90% of lawsuits against both EMS agencies and personnel. The purpose of this study was to evaluate the frequency of adequate documentation of decisional capacity in patients who initially AMA, but who subsequently return to the 911 system. **Methods:** Retrospective chart review was performed on 911 calls in an urban-suburban EMS system for a convenience sample of AMA calls during the study period of May 2016. Patients with a call determinant of Motor Vehicle Accident were excluded. Patient care reports were reviewed for documentation of decisional capacity assessment, including explanation of specific risks and consequences, and demonstration of patient understanding, of refusing transport. **Results:** Of the 146 cases evaluated, 128 (87%) had a documented capacity assessment. Of those, 83 (65%) documented specific risks of refusal, of whom 49 (59%) demonstrated an understanding of the risks which had been described. Patient understanding was documented in 70 (54%) patients, regardless of whether specific risks were adequately described. Four (3%) patients were able to respond with specific risks of refusal, even when those risks were not documented. **Conclusions:** In a retrospective review of patients who refused transport, adequate documentation was performed in only one-third of cases. These results demonstrate the need for ongoing education and quality assurance of decisional capacity assessment by EMS providers.

USE OF INTERACTIVE MULTIMEDIA INSTRUCTIONAL DESIGN IN EMT-BASIC TRAINING EDUCATION AND ITS ASSOCIATION WITH KNOWLEDGE RETENTION

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Background: New technologies have allowed for significant advances in instructional design, however few studies have rigorously assessed the impact of interactive multimedia instructional modules on short and long term knowledge retention. We primarily describe the effectiveness of using commercially available iPad-based instructional modules in place of traditional lectures during initial Emergency Medical Technician (EMT) training and secondarily report student perceptions of the use of the iPad modules. **Methods:** As part of an NIH funded SBIR grant, five consecutive university-based EMT classes substituted commercially available interactive iPad-based modules for traditional lectures (Medrills, ArchieMD). Each class was assigned a different pattern of traditional and iPad modules, the first module of each was taught with traditional methods and served as a constant comparator. Test scores for each module were compared using one-way ANOVA with post hoc Bonferroni testing. Student perceptions were measured after course completion with surveys containing 5-point Likert scale questions. **Results:** Three instructors taught 52 total students through 5 EMT classes over three semesters. Students were younger [mean (SD) 26(9) years] and 58% male. Most (68%) had taken college level classes previously and 70% had a grade point average ≥ 3.0 . Smartphone use was near-universal (96%), 60% owned a tablet, and 80% felt comfortable using new technology. One EMT class of 18 students was excluded because the instructor used a different testing schedule, and results were unable to be reconciled with the other classes. Variation among module test scores for EMT classes was observed, mean test scores ranged between 79% and 92% ($p < 0.05$). On post hoc testing, all observed differences in module test scores were due to one EMT class outperforming all others, regardless of module or mode of instruction. Most students found the iPad modules relevant (75%) and useful (65%) to their education, and 55% would use the modules for continuing education. However, 80% preferred standard lecture at least as much as the iPad modules for initial learning. **Conclusions:** iPad-based educational modules may

offer an alternative method of initial EMT education, but significant instructor-level variation exists. While students find the iPad method useful, the traditional classroom is preferred by most.

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IMPACT OF THE IMPLEMENTATION OF A PROVINCE-WIDE PREHOSPITAL ECG PROGRAM ON TREATMENT DELAYS IN PATIENTS WITH ST-ELEVATION MYOCARDIAL INFARCTION

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Background: Two previous Quebec Health Ministry mandated audits of ST-elevation myocardial infarction (STEMI) management demonstrated suboptimal timeliness overall with wide variations in treatment delays. One area of concern was the early identification of STEMI. In response, a major system change has been the province-wide implementation of a prehospital ECG program. Our objective was to compare treatment delays in STEMI patients before and after the implementation of province-wide prehospital ECGs. **Methods:** We performed a third systematic, province-wide evaluation of STEMI care in Quebec over the same 6-month period. We included patients with a discharge diagnosis of acute myocardial infarction who met study criteria for STEMI (presenting symptoms and core laboratory-verified ECGs), who arrived by ambulance or other means at one of 82 hospitals and were treated with fibrinolysis or primary percutaneous coronary intervention (PPCI). Experienced medical record librarians extracted data from medical charts. Results for the 2 previous audits with similar methodology (2006-7 and 2008-9) were combined (n= 2918) and compared to confirmed STEMI patients for 2013-2014 (n=1668). **Results:** After implementation of a province-wide prehospital ECG program, direct admission to PPCI hospitals increased from 31% to 46% while inter-hospital transfer for PPCI decreased from 50% to 38%. Fibrinolytic treatment remained limited (19% vs. 16%). Compared to previous audits, median delay from FMC-to-device for direct admission PPCI improved from 102 min (25-75%: 81-129) to 90 min (75-110). For fibrinolysis, door-to-needle delay decreased from 30 min (20 – 48) to 26 min (16-41). However, delay for PPCI after interhospital transfer remained long, the median FMC-to-device delay decreasing only slightly from 131 min (107-166) to 128 minutes (101-172). **Conclusions:** Following the implementation of a province-wide prehospital ECG program, we observed some reductions in delay within Quebec's system of STEMI care. Specifically, direct admission PPCI increased and its treatment delay improved. However, while inter-hospital transfer for PPCI decreased, its treatment delay remained excessively long, pointing to the need to re-evaluate this treatment modality.

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TELECOMMUNICATOR-ASSISTED CPR FOR CALLERS WITH LIMITED-ENGLISH PROFICIENCY

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Background: Bystander CPR rates among minority populations in Los Angeles have been shown to be significantly lower. In 2015 the Los Angeles Fire Department (LAFD) implemented a new medical dispatch system. The objective of the study was to assess the impact of this new system on TC-CPR among callers of limited-English Proficiency. **Methods:** This was an interrupted time series (before-after design) of cases of field-confirmed OOHCA with LAFD 911 call takers using Medical Priority Dispatch System® (MPDS) ("MPDS Cohort," from January 1 through March 31, 2014) versus those occurring after instituting a new medical dispatch system (Los Angeles Tiered Dispatch System -LA-TDS) ("LA-TDS Cohort" January 1 through March 31, 2015). Trained non-LAFD abstractors listened to all recorded calls, and recorded if TC-CPR was initiated, and time elapsed until key events. The primary outcome was prevalence of TC-CPR in OOHCA where 911-callers had limited-English proficiency (LEP) versus proficiency in English (EP). **Results:** Of 1,027 calls during the study period, 13 recordings were unavailable for review, and 417 calls met one or more exclusion criteria, leaving 597 911-calls for review: 289 in the MPDS cohort (263 EP, 26 LEP), and 308 in the LA-TDS cohort (273 EP, 35 LEP). There

were no differences between MPDS or LA-TDS patients in age, gender, known comorbidities, arrest location, witnessed status or caller party. The prevalence of TC-CPR for patients with LEP-callers was significantly greater in LA-TDS (69%) compared to MPDS (28%) (OR 5.657, 95% CI 1.79-17.85, p=0.003). For EP callers, the prevalence of TC-CPR improved from 55% (MPDS) to 67% (LA-TDS, OR 1.66, CI 95% 1.15-2.41, p=0.007). Using the new dispatch system, LEP-callers had a trend toward earlier description of ineffective breathing (0.07), and a significant decrease in time to telecommunicator recognition of cardiac arrest (OR 0.59, 95% CI 0.41-0.85, p=0.005) and dispatch of resources (OR 0.71, 95% CI 0.54-0.94, p=0.012). **Conclusions:** The new Los Angeles Tiered Dispatch System significantly outperformed MPDS® in promoting telecommunicator-assisted CPR among OOHCA patients with limited-English proficiency, helping to close the gap in bystander CPR rates for patients with non-English speaking callers.

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PREHOSPITAL TIME INTERVALS AND MANAGEMENT OF ISCHEMIC STROKE PATIENTS

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Background: Ischemic stroke treatment is time-sensitive and many stroke patients arrive to the emergency department via emergency medical services (EMS). The purpose of this study was to 1) quantify prehospital time intervals, and 2) describe prehospital management of ischemic stroke patients. **Methods:** A retrospective cohort study was performed using the Get With the Guidelines-Stroke (GWTG-S) registry at two hospitals to identify confirmed ischemic stroke patients who arrived via EMS between January 2013 and December 2015. Data from prehospital care reports (PCRs) were abstracted. The following prehospital time intervals were determined: chute time (EMS dispatch to EMS starts moving), response time (EMS starts moving to EMS at patient), on-scene time (EMS at patient to EMS leaving scene), transport time (EMS leaving scene to reaching hospital), and total prehospital time (EMS dispatch to reaching hospital). The proportion of patients who received the following was determined: Cincinnati Prehospital Stroke Scale (CPSS) assessment, prehospital notification, blood glucose assessment, vascular access, and 12-lead electrocardiography (ECG). For blood glucose assessment, 12-lead ECG, and vascular access, the location (on-scene vs. en route) in which these procedures were performed was described. **Results:** PCRs for 602 (out of 647) patients were available and abstracted. Median age was 73 years (interquartile range [IQR]: 60-84), 71% were white, and 51% were female. Median total prehospital time was 39 minutes (IQR: 33-48) and comprised the following intervals: chute time: 1 minute (IQR: 0-2), response time: 9 minutes (IQR: 7-12), on-scene time: 15 minutes (IQR: 11-21), and transport time: 14 minutes (IQR: 10-19). EMS providers performed the CPSS in 66% of patients and provided prenotification for 52% of patients. Blood glucose assessment, vascular access initiation, and 12-lead ECG acquisition was performed on 83%, 71%, and 67% of patients, respectively. Further, 60% of blood glucose assessments, 50% of vascular access initiations, and 52% of 12-lead ECGs were performed on-scene. **Conclusions:** On-scene time was the largest contributor to total prehospital time and several procedures were performed on-scene for most patients. These results suggest the greatest impact in minimizing total prehospital time may be to limit on-scene performance of certain procedures.

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DEMOGRAPHICS OF ACGME ACCREDITED EMS FELLOWSHIP PROGRAMS

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Background: There is little demographic data available regarding EMS fellowship programs. The purpose of this study was to obtain demographic data regarding ABEM accredited EMS fellowship programs. **Methods:** A survey was sent to program directors at all ABEM accredited EMS fellowships. Data collected includes: year program started, year program accredited, unfilled fellow positions, number of EMS faculty, females, minorities, etc. Females and minorities in EMS were compared to Emergency

Medicine (EM) using data from the American Association of Medical Colleges, and analyzed using chi squares ($\alpha=0.05$). **Results:** The response rate for the survey was 71% (37/51). The first two EMS fellowship programs began in 1990. Yet ABEM accreditation occurred for 42% of these programs in 2013, 26% in 2014, 18% in 2015, 5% in 2016, and 8% answered other. Since accreditation, 89 EMS fellows have graduated and 36 positions have remained unfilled. The average number of EMS fellow positions per program was 1.9, with a range of 1-4. The mean number of physician response vehicles per program was 1.2. The mean number of EMS faculty was 6.6, with a range of 3-16. The mean number of female EMS faculty was 1.3 with a range of 0-4, with 24% of programs having no female EMS faculty. The mean number of minority EMS faculty was 0.8 with a range of 0-4, with 49% of programs having no minority EMS faculty. There was a significant difference between the percentage of female faculty in EM departments (38.0%, 949/3107) vs. EMS programs (11.8%, 29/244) OR = 3.2, 95%CI: 2.2-4.8. A significant difference was noted between the percentage of minority faculty in EM departments (19.7%) vs. EMS programs (11.9%), OR = 2.1, 95%CI: 1.4-3.1. There was a significant difference between the percentage of female residents in EM (38%, 2,193/5,777) vs. female EMS fellows (61%, 54/89), OR = 2.0, 95%CI: 1.4-3.2. **Conclusions:** Since accreditation of EMS programs, the total number of unfilled EMS fellow positions was 36. The percentage of females and minority faculty in EMS programs was much lower than for EM. Further studies should be focused on future work force needs of EMS physicians.

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THE CHALLENGE OF "NOT" IN NEMSIS

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Background: The National EMS Information System (NEMSIS) Project is a cooperative effort designed to collect EMS call data in a National Database in order to improve patient outcomes based on evidence. We hypothesize that it is difficult for EMS providers to accurately enter data when possible responses include "Not Values", and that these values limit the overall utility of the data. "Not Values" in NEMSIS Version 2.2.1 includes: Not Applicable, Not Reporting, Not Available, Not Recorded, and Not Known. **Methods:** A retrospective analysis of publicly-accessible count data obtained from the NEMSIS Data Cube was performed. The NEMSIS v2 Data Dictionary was used to identify categorical required National elements that include "Not Values". A subset of these were included (Delay, Cardiac Arrest, Disposition). Counts and percentage of total responses were calculated as a proportion of the total yearly responses for 2014 and 2015. **Results:** There were 25,532,157 and 29,070,740 encounters in 2014 and 2015 respectively. Utilization of "Not Values" varies widely both within and among data elements. Use of Not Applicable 1.92%-55.17%, Not Available 0.43%-9.49%, Not Known 0.08%-5.76%, Not Recorded 2.57%-23.01%, and Not Reporting 0.68%-21.95%. Across all elements "not values" were used for Delay 0.46-21.95%, Cardiac Arrest 0.08-53.38%, and Disposition 0.56-11.01%. Not Recorded and Not Reporting are utilized in 2.68-23.01% and 0.68-21.95% of elements respectively. **Conclusions:** The NEMSIS database provides researchers with a unique opportunity to access EMS-specific information. The quality of data and ability to draw conclusions depends upon the data being both precise and accurate. The use of "not values" coupled with the frequency which they are used decreases the strength and utility of the database. The frequent use of "not values" may be due to the design of electronic patient care report software, lack of provider knowledge on proper use of not values, or lack of understanding the importance of complete and accurate documentation. While NEMSIS is exceptionally valuable, this study highlights a limitation of the NEMSIS Project and identifies an opportunity for improvement. Further study is warranted to identify the reasons behind the frequent use of "not values" in hopes that their use can be reduced or eliminated.

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PEDIATRIC TRANSPORT PRACTICES AMONG PREHOSPITAL PROVIDERS

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Background: In 2012 NHTSA / USDOT released Best-Practice Recommendations for the Safe Transportation of Children in Emergency Ground Ambulances. This group reported that up to 1,000 ambulance crashes involve pediatric patients each year and there are approximately 4 child fatalities per year. Since its publication information published about Emergency Medical Services (EMS) providers' knowledge and opinion about safe transport of pediatric patients has been minimal. The purpose of our survey was to measure EMS providers' knowledge and opinions of how to safely transport pediatric patients. Additionally, we wanted to gather information about barriers to safe transport of this patient population. **Methods:** A survey examining providers' level of training, years of experience, exposure to pediatric patients, knowledge of best practices, and opinions about barriers to safe transport of pediatric patients was created. One urban and two suburban EMS agencies were able to complete this survey anonymously. **Results:** 100 EMS providers answered the survey. The majority (63%) were BLS providers and had >10 years of experience in EMS. Most providers (96%) reported they transported 0-5 pediatric patients/week. 20% reported being trained specifically on pediatric safe transport practices. 32% of providers reported that personnel did not drive more quickly when transporting a sick pediatric patient. The majority (86%) reported it was unsafe to transport a child on a parent's lap, but 27% reported it was appropriate to transport a newborn on the stretcher with mom. One third of providers reported equipment such as monitors and oxygen are not always secured during transport. Less than half (38%) were comfortable identifying the proper restraint system for patients and only 35% were comfortable using these devices. Reported barriers to safe transport included lack of: exposure to pediatric patients, experience/tools to address parental/patient anxiety, familiarity with restraint systems, training on safe practices, and an ideal transport device suited for pediatric patients. **Conclusions:** Our survey demonstrates that despite the existence of published best practices many providers are unfamiliar with the safest way to transport pediatric patients and barriers still exist that potentially create unsafe transport conditions for this group of patients.

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CHANGES IN CHEST COMPLIANCE OVER TIME AS MEASURED THROUGH CHANGES IN ANTERIOR POSTERIOR CHEST HEIGHT DURING CARDIOPULMONARY RESUSCITATION IN HUMAN CADAVERS

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Background: Chest compliance plays a fundamental role in the generation of circulation during conventional (C) CPR and active compression decompression (ACD) CPR. To study potential changes in chest compliance over time, anterior posterior (AP) chest height measurements were performed on fresh (never frozen) human cadavers during ACD-CPR before and after 5 minutes of automated C-CPR. We tested the hypothesis that after 5 minutes of C-CPR chest compliance would be significantly increased. We also wanted to measure, for the first time, the resulting AP changes with various levels of decompression force (lift). **Methods:** Static compression (30, 40, and 50 kg) and decompression forces (-10, -15) were applied with a manual ACD-CPR device (ResQPUMP, ZOLL, Chelmsford, MA) on 9 cadavers. Lateral chest x-rays were obtained with multiple reference markers to assess changes in AP distance before and after 5 minutes of automated C-CPR. **Results:** In 6 male and 3 female cadavers (75±17 years) with a height of 174±11 cm and a weight of 66±16 kg, the initial mean AP distance measured 22.5±2.1 cm. Changes (mean ± SD) in the AP distance (cm) during the applied forces were 2.1±1.2 for a compression force of 30 kg, 2.9±1.3 for 40 kg, 4.3±1.0 for 50 kg, 1.0±0.8 for a decompression force of -10 kg and 1.8±0.6 for -15 kg. After 5 minutes of automated C-CPR, the AP distance measured 22.3±1.6 cm and AP excursion distances were significantly greater (p<0.05). AP distance (cm) increased 3.7±1.4 for a compression force of 30 kg, 4.9±1.6 for 40 kg, 6.3±1.9 for 50 kg, 2.3±0.9 for a -10 kg of lift and 2.7±1.1 for -15 kg of lift. **Conclusions:** These data demonstrate chest compliance increases significantly over time as demonstrated by the significant increase in the measured AP distance after 5 minutes of C-CPR. In addition, it requires at least 10 kg of lift force to increase the AP distance 1 cm initially (as provided by the suction cup during active decompression) and greater decompression forces result in additional thoracic lift. These findings suggest that adjustments in compression and decompression forces may be needed to optimize CPR over time.

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PARAMEDIC AND NURSE-STAFFED RURAL COLLABORATIVE EMERGENCY CENTRES: THE RATE OF RELAPSE FOR DISCHARGED PATIENTS

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Background: Collaborative Emergency Centres (CECs) provide access to care in rural communities. After hours, registered nurses and paramedics work together in the CEC emergency department (ED) with telephone support by an emergency medical services (EMS) physician. The safety of such a novel emergency care model is unknown. Relapse visits are often used as a proxy measure for safety in emergency medicine. The primary outcome is to determine the rate of unscheduled relapse visits to emergency care after patients are seen at a CEC staffed by a paramedic and nurse. **Methods:** Cases were selected from a query of the electronic patient care record database for all patients who visited two CECs in one health authority from April 1, 2012 to April 1, 2013. Data was abstracted by an investigator. Records were searched for each discharged CEC patient to identify unscheduled relapses to emergency care, defined as presenting back to EMS, CEC, or ED within the health authority within 48 hours of CEC discharge. **Results:** There were 894 CEC visits, of which 66 were excluded due to missing data. The dispositions from CEC were: 131/828 (15.8%) transferred to regional ED, 264/828 (31.9%) discharged home, 488/828 (58.9%) discharged with follow up visit booked, and 11/82 (1.2%) left the CEC without being seen. There was 37/828 (4.5%) visits which relapsed back to emergency care, all of whom were discharged from CEC or left without being seen: 3/828 (0.4%) relapsed back to EMS (two taken to regional ED and one to CEC), 16/828 (1.9%) relapsed to regional ED (by walking-in), and 18/828 (2.2%) had a relapse to the CEC (walk-in). 516/828 (62.3%) CEC visits were resolved in a single visit. **Conclusions:** Albeit a proxy measure, the rate of patients who relapse to emergency care was under 5% in this case series of two CECs. Most patients had their concern resolved in a single visit to a CEC. Further research is underway to determine the effectiveness, optimal utilization and safety of this collaborative model of rural emergency care.

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NEEDS MATCHED TIME APPROPRIATE RESOURCE ALLOCATION : A NOVEL TRIAGE AND DISPATCH PROGRAM FOR MOBILE INTEGRATED HEALTHCARE

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Background: Patients requesting unscheduled care may be appropriately telephonically triaged by nurses utilizing a scripted system coupled with dispatch of or referral to appropriate clinicians in an Mobile Integrated Healthcare (MIH) practice while decreasing unnecessary Emergency Medical Service (EMS) transport and emergency department (ED) utilization without increase in 30-day mortality. The transfer to nurse advice lines from 911 centers has resulted in low percentage of successful EMS/ED avoidance while traditional nurse advice lines result in frequent transfer to 911/recommendation for Emergency Department evaluation. We present a description of a physician led, clinical practice model of needs matched, time appropriate resource allocation (NMTARA) in an MIH environment for a Medicare Advantage population. **Methods:** This observational trial includes data from the first 9 months of NMTARA implementation via a dedicated toll-free number distributed to ~ 5,000 high-risk Medicare Advantage members. Licensed Vocational Nurses performed initial triage, utilizing a five level proprietary system, with one indicating immediate dispatch of an EMS resource, two to four indicating dispatch of an MIH resource in 1 to 24 hours, and 5 indicating a scheduled appointment with a MIH provider or primary care physician. After initial scoring, physician assistants, nurse practitioners, and/or physicians were available for subsequent conversation with callers and, when appropriate, modification of response. **Results:** From November 8, 2015 to July 29, 2016, 339 NMTARA requests were processed. 36 (8%, 5 – 11% 95% CI) were referred to 911 for EMS dispatch, 238 (70%, 65 – 75%, 95% CI) were evaluated by the MIH practice in 1 to 24 hours, and 73 (22%, 18% – 22%, 95% CI) were referred for appointment. Two patients (0.5%, -0.25% – 1.252.15%, 95% CI) experienced 30-day mortality. Both

were transported to hospital as a result of their MIH interaction and admitted prior to death.

Conclusions: In this observational cohort, a substantial proportion of patients seeking unscheduled care received interventions from an MIH practice without transport to an emergency department while all patients who experienced 30-day mortality were appropriately transported to an emergency department.

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PREHOSPITAL PAIN MANAGEMENT: DISPARITY BY AGE AND ETHNICITY

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Background: Historically, pain management in the prehospital setting, and specifically pediatric pain management, has been inadequate despite the fact that a large proportion of EMS evaluations and transports are related to traumatic injury. The National Emergency Services Information System (NEMSIS) database is the largest national registry of prehospital data and can be used to assess the current patterns of EMS pain management across a large cross-section of society. Our objective was to analyze prehospital management of pain using NEMSIS data and to assess if variables such as patient age and/or race/ethnicity are associated with disparity in treatment of pain. **Methods:** We queried the NEMSIS database for a 3-year span (2012-2014) for patients evaluated for 3 painful medical impressions (fracture, burn, penetrating injury) to assess presence of pain as a symptom and to assess if the patient received treatment with any of the 6 most commonly used analgesic medications (morphine, fentanyl, dilaudid, nitrous oxide, acetaminophen, and ibuprofen). Results were analyzed according to type of pain medication given, age categories, and race/ethnicity of the patients. **Results:** During the study period, there were 276,925 EMS records in the NEMSIS database for patients evaluated for an EMS primary impression of burn, fracture, or penetrating injury. Pain was listed as a primary or associated symptom for 29.5% of these patients. The youngest children were least likely to have pain documented as a symptom (14.6%). Only 15.6% of all transports for these 3 impressions received any pain medications. Children <4 years of age were least likely to receive any pain medication. Morphine and fentanyl were the most commonly administered medications to all age groups. Black patients, regardless of age, were less likely to receive pain medication in the prehospital setting than other racial groups. **Conclusions:** Documentation of pain as a symptom and pain treatment continue to be inadequate in the prehospital setting in all age groups, especially young children. In addition, there appears a racial disparity with black patients less often treated with analgesic medication. The broad incorporation of NEMSIS data from across the nation suggests that these inadequacies are a national challenge deserving further attention.

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ASSOCIATION OF EMERGENCY MEDICAL SERVICE ACTIVATION TO EMERGENT CORONARY ANGIOGRAPHY TIME WITH SURVIVAL AND NEUROLOGICAL OUTCOME AFTER OUT-OF-HOSPITAL CARDIAC ARREST

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Background: It is uncertain whether earlier emergency coronary angiography (CAG) has clinical benefit among patients with out-of-hospital cardiac arrest (OHCA). The purpose of this study was to evaluate the effect of emergency medical service (EMS) activation to emergency CAG time in outcomes of OHCA. **Methods:** A population-based observational study was conducted on OHCA of adult, witnessed, and cardiac etiology in South Korea who survived to admission between 2013 and 2014. All enrolled patients were received emergent CAG in same day of OHCA. Multivariable logistic regression analysis was performed to assess the associations between EMS call to needle time (C2N time) and outcomes (survival to discharge and favorable neurological outcome). Confounders were adjusted for calculating odds ratio (OR) and 95% confidence interval (CI). **Results:** A total of 418 OHCA were analyzed. Faster than 90 minutes of C2N time group (group 1) had 91 patients. From 90 minutes to 120 minutes of C2N time group (group 2) had 139 patients. Later than 120 minutes of C2N time group (group 3) had 188 patients. Survival discharge rate was 82.4%, 75.5%, 63.8%, respectively (p value < 0.01). Good

neurological outcome rate was 67.0%, 61.9%, 47.3%, respectively (p value < 0.01). Adjusted ORs (95% CIs) for survival compared with group 3 were 2.59 (95% CI 1.27-5.31) for group 1, 1.71 (95% CI 0.97-3.02) for group 2, respectively. Adjusted ORs (95% CIs) for good neurological outcome compared with group 3 were 2.16 (95% CI 1.12-4.17) for group 1, 1.93 (95% CI 1.12-3.33) for group 2, respectively. **Conclusions:** This study shows some evidence that earlier emergent CAG in witnessed OHCA has a probable benefit of survival and good neurology.

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EXAMINING CURRENT PRACTICES FOR SAFE TRANSPORT OF CHILDREN IN GROUND AMBULANCES

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Background: The National Highway Traffic Safety Administration (NHTSA) published the Working Group Best-Practice Recommendations for the Safe Transportation of Children in Emergency Ground Ambulances in 2012. Current prehospital and hospital documentation may not capture methods used to safely restrain children inside of ambulances. The primary aim of this study was to determine how pediatric patients transported to a tertiary children's hospital were restrained inside of ground ambulances. The secondary aim was to establish a reliable method to document prehospital safe transport practices. **Methods:** This was an observational retrospective cohort study conducted between July 2014 and March 2016. A novel way to document prehospital methods of safe restraint was created within the electronic medical record (EMR) emergency department (ED) nursing triage note. Records for patients less than 18 years arriving to the ED by ground ambulance were identified in the EMR information system. Neonatal critical care transports were excluded. Charts were reviewed seven months after introduction of the new triage note (Period 1). Staff reeducation occurred during the following seven months (Period 2), and charts were again reviewed in the final seven months (Period 3). Appropriate restraint was defined as patient arriving alone on the gurney and restrained with recommended restraint straps or pediatric device, including car seat. **Results:** During the 21-month study period, 10,083 charts were identified for review. During Period 1, 310 of 3,260 charts (10%) had adequate triage documentation. After staff reeducation, the proportion of charts with adequate triage documentation increased to 22% (771 of 3,473) in Period 3. Of charts with adequate documentation, the most common inappropriate restraint was child transported on gurney with another person. This was documented in 38 of 310 charts (12.3%, 95% CI 9.0-16.4) in Period 1 and 89 of 771 charts (11.5%, 95% CI 9.5-14.0) in Period 3. **Conclusions:** A large proportion of ambulance transports are missing safe transport documentation, however, the prevalence of inappropriate restraint is not negligible, with approximately 10% of children arriving on a gurney with another person. The EMR can be an important tool for injury prevention initiatives, but requires staff education and reminders to be effective.

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A COMPARISON OF DISTANCE FROM THE HOSPITAL AND OUTCOMES IN PATIENTS WITH SEVERE SEPSIS/SEPTIC SHOCK

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Background: Sepsis, a common ED presentation, is a leading cause of death and disability. Studies show that early goal directed therapy (EGDT), including timely administration of fluids and antibiotics, reduces sepsis morbidity and mortality. Most sepsis patients arrive at the hospital via EMS from varying distances away from the hospital. The purpose of this study is to determine whether increased EMS transport times and greater distance traveled is associated with worse outcomes in sepsis. We hypothesize that patients from more distant areas experience worse outcomes, including increased hospital length of stay, end organ damage, or likelihood of mortality. **Methods:** Data included 2,336 patients admitted to the hospital with a diagnosis of severe sepsis or septic shock between 1/1/2009 through 9/1/2015. Only patients who arrived via ambulance or air transport were included. Overall mortality, length of hospital stay, days on dialysis and peri-dialysis, those requiring continuous renal

replacement therapy (CRRT), and days on a ventilator were compared to the distance traveled to the hospital. **Results:** Of the study patients, 201 (8.59%) required hemodialysis, 12 (0.51%) required peridialysis, 116 (4.96%) required CRRT, and 1097 (46.90%) required mechanical ventilation. Mean distance to the hospital was 43.7 miles, N=1240 30 miles. Increasing distance demonstrated statistically significant associations with inpatient length of stay ($p < 0.0001$, Spearman's correlation $r=0.092$), ventilator days ($p < 0.0001$, $r=0.138$), and use of CRRT ($p = 0.0020$, $r = 0.064$). The relationship between distance traveled and hemodialysis ($r=0.0014$) or peri-dialysis days ($r=0.014$) was not significant. Patients more than 30 miles from the hospital more often required mechanical ventilation (54% vs. 43%, $p < .0001$, OR of 1.57, CI 1.32 – 1.85). Similarly, these patients had a greater likelihood of requiring CRRT (7% vs. 4%, $p = 0.0056$, OR of 1.69, CI 1.16 – 2.45). **Conclusions:** The results suggest that patients with longer EMS transport times suffer more complications from sepsis. We acknowledge that other factors affect patient outcomes, such as access to health care. More research needs to be done in this area including if EGDT started with EMS in the prehospital setting could result in more positive outcomes.

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LATIN AMERICA INTENSIVE CARE UNIT DISASTER PREPAREDNESS: RESULTS FROM A WEB-BASED KAP SURVEY

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Background: Pandemics, terrorism, and natural disasters place an undue burden on hospital emergency intensive care units. This burden is increased in Latin America where hospital resources, intra-hospital disaster simulations, and perceived level of preparedness varies greatly among different communities. Our objective was to assess Latin American ICU leaders knowledge and attitudes regarding disaster preparedness. **Methods:** We developed a ten item web-based knowledge, attitudes and practice survey administered via a LATAM ICU leaders online forum. Survey items included size and location of their institution, disaster preparedness activities and perception of opportunities and future challenges. Descriptive statistics were used. Epi Info™ software was used for analysis. Chi-square and Fisher exact test with a p value <0.05 was implemented for statistical significance and odds ratio was used to measure the strength of association among variables. **Results:** There were 40 respondents in the survey. Countries represented include: Venezuela (1/40, 2.5%), Ecuador (6/40, 15%), USA (1/40, 2.5%), Costa Rica (7/40, 17.5%), Mexico (4/40, 10%), Guatemala (4/40, 10%), Panama (1/40, 2.5%), Nicaragua (1/40, 2.5%), Dominican Republic (6/40 15%), Puerto Rico (1/40, 2.5%), Argentina (1/40, 2.5%), Columbia (1/40, 2.5%), El Salvador (2/40, 5%), Bolivia (1/40, 2.5%), Belize (1/40, 2.5%) N/A (2/40, 5%). 9/40 (22.5%) respondents felt prepared for disasters. 14/40 (35%) worked at hospitals with 250+ beds and 26/40 (65%) represented hospitals with less than 250 beds. 19/40 (47.5%) participated in hospital committees for disaster, 16/40 (40%) participated in simulations or drills, and 19/20 (47.5%) participated in trainings or courses for disasters. Feeling prepared for disasters did not correlate to hospital size (OR=1.68 (95% CI: 0.3692, 7.6445), $p=0.6935$), participation in hospital committees for disaster (OR=2.7692 (95% CI: 0.5826, 13.1619), $p=0.2647$), participation in simulations or drills (OR=4.2 (95% CI: 0.8674, 20.3359), $p=0.1198$), or participation in disaster trainings and courses (OR=5.5417 (95% CI: 0.9827, 31.2498), $p=0.0601$). **Conclusions:** Among the 40 centers represented, the majority did not feel their institution to be adequately prepared for disasters. A small sample size represents the major limitation of this study.

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STRUCTURE OF TERMINATION OF RESUSCITATION PATCHES

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Background: Prehospital telecommunications (patches) are a specific type of conversation between two people used to transfer information for decision making e.g. for a termination of resuscitation (ToR). During analysis of data from a study of paramedic-physician telecommunications it was observed that patches had a common structure. Understanding patch structure allows manipulation of the patch

process in order to improve telecommunication used for critical clinical decisions. **Methods:** Retrospective analysis of all ToR patches recorded by the Central Ambulance Communication Centre between physicians providing on-line-medical-control and paramedics from 4 paramedic services between January 01 to December 31, 2014. Three services had only Primary Care Paramedics (PCP) and 1 service had PCP and Advanced Care Paramedics (ACP). MP3 patch recordings were transcribed by 2 authors. Anonymized transcripts were read multiple times, coded, and analyzed using mixed methods - quantitative descriptive statistics and qualitative thematic framework analysis. **Results:** 466 pages of transcripts from 127 ToR patches (PCP 120, ACP 7) comprised the data set. 116 (91.3%) patches followed a common structure (CS). Mean length of CS patches was 234 sec (95%CI: 215,252). Mean non-CS patch length was 287 sec (95%CI: 241,332). CS patches began with an introduction – establishing who was talking to whom. Paramedics then presented the ‘data’ of the call - average 81 words (95%CI: 74,88). During CS patches paramedics provided enough data to correctly apply the ToR rule 44.8% of the time. Physicians required clarification in 100 (78.7%) patches before making the clinical decision. This was followed by exchanging administrative information (numbers, times, name spellings) and sign off. This section took a mean of 200 words (95%CI: 172,228), an average 84 seconds or 35.3% of the patch length. After giving the ToR order physicians sought additional case data in 17 (13.4%) patches. **Conclusions:** The most common patch structure consisted of participant introduction, data presentation, clarification of data, making the clinical decision, exchange of administrative information, and a sign off. Deviation from this patch structure resulted in significantly longer patches. Patching paramedics were unavailable to help with patient care 25% longer when an unusual patch structure occurred.

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WHAT INFLUENCES SAFETY IN EMS? INVESTIGATING STRESS, FATIGUE, AND SAFETY OUTCOMES

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Background: Extant research has linked fatigue to safety-related outcomes in EMS personnel. Fatigue has been tied to an increased risk of negative safety outcomes. These outcomes include paramedic injury, behaviors that may compromise patient and provider safety, and adverse events/medical errors. However the relationship between fatigue and safety related outcomes has yet to be tested in relation to other types of workplace stress, including organizational stress (the stress of working in a particular organization), operational stress (stress associated with the provision of EMS services), critical incident stress (stress associated with patient care), and post-traumatic stress symptomatology (PTSS). The purpose of this study was to assess the influence of a multiplicity of workplace stressors and fatigue on safety outcomes. **Methods:** An online survey was conducted with ten EMS services with a 40.5% response rate (n= 717). Using validated instruments, respondents reported levels of operational and organizational chronic stress, critical incident stress, post-traumatic stress symptomatology (PTSS), fatigue, safety outcomes and demographic characteristics. ANCOVA analyses were used to assess for significant differences. **Results:** In this study, 80% of paramedics reported an injury or exposure to pathogen, 95% reported safety compromising behaviors, and 76% reported making medical errors in the past three months. Injury was significantly related to fatigue ($p<.02$), organizational stress ($p<.05$), critical incident stress ($p<.01$) and PTSS ($p<.01$) and Paramedic Service ($p<.01$). Safety compromising behaviors were significantly associated with fatigue ($p<.01$), organizational stress ($p<.01$), critical incident stress ($p<.01$), and Paramedic Service ($p<.05$). Finally, medication errors were significantly related to fatigue ($p=.01$) and Paramedic Service ($p<.05$). **Conclusions:** These findings further illustrate that a host of different stressors may influence safety-related behaviors. For those interested in safety, these findings point to the need for a holistic focus on fatigue and stress in EMS providers. More research is needed to further elucidate the relationship between workplace stress and safety.

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LUCAS MECHANICAL COMPRESSION DEVICE ASSOCIATED WITH POORER NEUROLOGIC OUTCOMES IN OUT-OF-HOSPITAL CARDIAC ARREST

Background: Out-of-hospital cardiac arrest (OHCA) is a major cause of death and morbidity in the United States. Quality CPR has been proven to be a key factor in improving survival. The aim of our study was to investigate the outcomes of OHCA when mechanical CPR (LUCAS device) was utilized compared to conventional CPR. We hypothesize that review of our prospectively collected data would show a statistically significant association with survival to hospital discharge with a good neurologic outcome when utilizing the LUCAS Device. **Methods:** A metropolitan fire department providing emergency medical services to a population of 1.4 million residents geographically distributed the LUCAS device on 11 of their 33 paramedic ambulances. On average, this department responds to approximately 1200 OHCA per year. Data was collected over a 24-month period and outcomes of cardiac arrests utilizing or not utilizing the LUCAS device were investigated. The primary outcome measure was survival to hospital discharge with a cerebral performance category (CPC) score of 1 or 2. **Results:** This series had 2361 OHCA reports for all causes of cardiac arrest, of which 1902 had outcome data and met the inclusion criteria. Of these, 1219 had standard manual CPR (control group) and 683 utilized the LUCAS device. The primary outcome was observed in 6.4% (78/1219) of the control group, and 3.9% (27/683) in the LUCAS group, $p = 0.0276$. The control group had sustained ROSC in 292 patients and the LUCAS group had sustained ROSC in 170 cases, $p = 0.6560$. Arriving to ED with a pulse had 326 patients in the control arm and 201 in the LUCAS arm, for a $p = 0.2195$. In survival to hospital admission, the control group had 343 patients and LUCAS group had 202, for a $p = 0.5260$. **Conclusions:** In this data set, resuscitation of OHCA patients utilizing the LUCAS device demonstrated a statistically significant worse outcome than the standard CPR group. Subgroup analysis of the study's findings showed no statistical significance between the groups in ROSC attained by EMS, arrival in the emergency department with sustained ROSC, or survival to hospital admission.

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UTILIZATION OF ALS LEVEL OF CARE BY AUTOMATIC ALS ACTIVATION AND DISPATCH CODE

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Background: The current Medical Priority Dispatch System (MPDS) uses caller interrogation and standardized dispatcher coding to determine call severity and expected resource needs. For the EMS calls reviewed in this study, 18 previously determined MPDS dispatch codes were set to automatically send the closest Advanced Life Support (ALS) capable unit (Auto-ALS), along with any in-territory Basic Life Support (BLS) unit. The objective of this study was to correlate Auto-ALS dispatch with utilization of ALS level services, and to assess applicability of the Auto-ALS dispatch codes. Dane County, Wisconsin has approximately 500,000 residents, with a population density of 394 people per square mile. A mixture of urban and rural communities, it's served by 21 municipal EMS districts with combinations of EMT-Basic, Advanced EMT and Paramedic certifications. All municipalities signed an Intergovernmental Agreement (IGA) to allow border drops for auto response of ALS services out-of-district. **Methods:** The Dane County Communication Center supplied all Auto-ALS calls for the 2014 calendar year. All 2,079 calls were retrospectively reviewed by a research coordinator and audited by Emergency Medicine Resident Physicians. **Results:** Of the 2,079 calls, 376 were determined to follow a different coding system and initially excluded. Of the remaining 1,703, 1,514 (89%) were evaluated by Paramedics (ALS), the other 189 were managed by A-EMT or EMT-B (BLS) services alone. Of the ALS evaluations, 1,428 (94%) required an ALS level intervention (certain medications, EKG interpretation, endotracheal intubation) or had MD-determined medical complexity necessitating Paramedic evaluation. The reviewed MPDS codes most frequently needing ALS care were cardiac and pulmonary complaints, seizure, and loss of consciousness. Of the 189 (11%) patients managed by BLS services alone, the majority were deceased at the scene, had ALS cancelled after initial assessment, or were in a BLS district closer to an Emergency Department than any ALS unit. **Conclusions:** This retrospective review supports the current dispatch determinants and continued use of the Auto-ALS system in Dane County. Further

evaluation is needed to identify additional codes that may benefit from Auto-ALS dispatch. Additional research should be considered in communities that currently do not have boundary dropping or Auto-ALS practices.

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EMERGENCY MEDICAL SERVICES UTILIZATION AND INTERVENTIONS IN PALLIATIVE AND HOSPICE PATIENTS

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Background: Adults with serious illnesses visit the emergency department several times in their last months of life, with over half of older Americans presenting in their last month. Often these ED visits are preceded by activation of and transport by emergency medical services, providing opportunities for early interventions. Few studies identify the common triggers for use of EMS by the seriously ill or explore the prehospital aspect of care of these patients. This study aims to characterize the reasons for use of EMS and the interventions commonly provided by EMS in hospice and palliative care patients.

Methods: Retrospective chart review of patients transported by EMS during the study period of March-June 2015. Patients were included in the study if they had 1) received an in-hospital palliative care (PC) consultation and 2) used EMS in the study period. Data included patient demographics, reasons for EMS dispatch, advance directive documentation and concordance with EMS care, pain and symptom interventions, and if there was repeat use of EMS. **Results:** Of the 463 inpatient PC consultations, there were 232 EMS encounters. Excluding repeat consultations and repeat EMS usage, 125 unique PC patients used EMS. Of the 232 EMS encounters, top reasons for dispatch were respiratory distress 32% (75) and altered mental status 15% (34). Patient was documented having pain in 34% (79) of EMS charts, 40% (32) with a pain scale of 1 or higher (1-10), however, only 16% (5) of these patients received pain medications. Many, 38% (47) of PC patients re-used EMS, 5% (5) for cardiac arrest. Advance directive documentation was seen in only 3% (6) charts and none of these patients received prehospital intubation or CPR. **Conclusions:** Patients under hospice care and those with clearly identified PC needs frequently use EMS, many with repeat use. Common triggers for EMS activation are respiratory distress and AMS. Pain is often documented by EMS providers but prehospital use of pain medications remains low as does overall documentation of advance directives. When documented, EMS care shows concordance with patient wishes. These identified areas may present opportunities to target further EMS quality improvement or provider education initiatives.

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LEAVING AND RETURNING TO EMS: WHY PROVIDERS LEAVE AND CHARACTERISTICS ASSOCIATED WITH A DESIRE TO RETURN

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Background: Inadequate staffing of agencies, increasing career attrition rates, and frequent turnover of personnel make employee retention an ongoing concern for EMS. The objectives of this study were three-fold: 1) Describe the proportion of individuals that left EMS and their likelihood of returning to the profession, 2) Compare demographic and employment characteristics of individuals who reported being likely to return to EMS versus those who reported being unlikely to return, 3) Assess the prevalence of key factors contributing to the decision to leave EMS. We hypothesized that EMS providers who left the profession would be unlikely to return and one of the main factors contributing to the decision to leave would be pursuit of higher education. **Methods:** This was a cross-sectional study of nationally-certified EMS providers. As part of a larger survey, respondents who reported not currently performing EMS work were directed to a subsection of items regarding leaving the profession. Data were collected on demographic/employment characteristics, likelihood of returning to EMS, and factors influencing the decision to leave EMS. Descriptive and comparative statistics (Chi-square) were calculated. **Results:** The overall response rate for the full survey was 10% (n=32,114). A total of 1,247 (4%) respondents reported

leaving the profession and completed the exit survey. The majority reported that they definitely/probably will return to EMS (n=891, 72%). Males (n=453, 70%) and females (n=370, 72%) equally reported a likelihood of returning (p=0.58). A stepwise decrease in reported likelihood of returning was seen for years of EMS experience (e.g., 2 or less years of experience: n=505, 83%, 16 or more years: n=104, 52%, p-trend<0.001) and months away from EMS (e.g., 0-2 months: n=213, 89%, more than 12 months: n=272, 57%, p-trend<0.001). The most common factors reported to influence the decision to leave included: desire for better pay/benefits (n=707, 65%), decision to pursue further education (n=656, 60%), dissatisfaction with organization's management (n=595, 55%), and desire for career change (n=581, 54%). **Conclusions:** Despite leaving EMS, many respondents reported that they would likely return to the profession. Key factors in the decision to leave were related to compensation, educational advancement, and job dissatisfaction.

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DESCRIPTION OF PREHOSPITAL PEDIATRIC EMERGENCY CALL TYPES THROUGHOUT NORTH CAROLINA

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Background: Statewide assessments of the most common types of pediatric emergency calls are scant. The objective of our study was to characterize pediatric emergency medical service (EMS) calls throughout North Carolina (NC) in 2015. **Methods:** The retrospective analysis includes all emergency calls in NC for patients under 16 years old from January 1, 2015 to December 31, 2015. Data were obtained from the NC statewide EMS data system. The provider's primary impressions, protocols used, and common demographics were evaluated. Comparisons were made based on community size (statewide, urban, and rural). Descriptive statistics were calculated. **Results:** In 2015, there were a total of 1,386,028 calls to 911 out of which 64,186 were pediatric emergency calls. Of these patients, 32,788 (52.3%) were males and 6,191 (9.8%) were Hispanic. When assessing race, white (26,900, 41.9%) was the largest category reported followed by black (24,420, 38.0%) and other (6,527, 10.2%). The majority of calls were in urban areas (74.4%). There were 34,531 provider's primary impressions documented. The most common primary impression was traumatic injuries (statewide: 12,842, 37.2%, rural: 2,872, 39.1%, urban: 9,611, 36.5%). Respiratory Distress accounted for 5,414 (15.7%) statewide, 1,051 (14.3%) in rural and 4,258 (16.2%) urban. Seizures were reported 5,303 (15.4%) times statewide, in rural 1,117 (15.2%) and in urban 4,050 (15.4%). There were a total of 44,812 protocols used. The most common, statewide, was the universal patient care protocol with 27,115 (60.5%). This protocol was reported 19,057 (56.8%) in urban and 7,443 (71.5%) in rural. The next most often reported were injury protocols (statewide: 3,918, 8.7%, rural: 493, 4.7%, urban: 3,360, 10.0%), respiratory distress protocols (statewide: 2,601, 5.8%, rural: 467, 4.5%, urban: 2,099, 6.3%), seizure protocols (statewide: 2,567, 5.7%, rural: 428, 4.1%, urban: 2,098, 6.3%), fever control protocols (statewide: 1,137, 2.5%, rural: 284, 2.7%, urban: 834, 2.5%), and pain management protocols (statewide: 1,107, 2.5%, rural 124, 1.2%, urban 974, 2.9%). **Conclusions:** Pediatric emergency medical services are frequently utilized for injuries, respiratory distress, and seizures. Describing EMS providers' interaction with children provides the opportunity to target improvements in treatment, training, and research.

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RELATIONSHIP BETWEEN EMS AGENCY SIZE AND QUALITY IMPROVEMENT: A NATIONAL SURVEY

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Background: Continuous Quality Improvement (CQI) and performance measurement has become the standard in many areas of healthcare. However, there is wide variation in how EMS agencies utilize CQI across the US. The 2011 National EMS Assessment gave a broad analysis of EMS variability, however, did not address agency level CQI data. This study explores whether agency size (annual calls) is associated with CQI activity. **Methods:** A 46-question survey was developed by the NAEMSP Quality Improvement Committee to explore the variation between agencies on EMS QI and measurement. This survey was

distributed nationally via State EMS Offices to EMS agencies nationwide. Univariate and bivariate analysis of the survey data was conducted using SAS 9.3. **Results:** 1,733 surveys were collected, with 1,060 complete responses from EMS agencies in 47 states, representing over 6.23 million EMS 911 responses annually. Distribution of agency size was as follows: 493 agencies with 1-1,000 911 calls/year, 321 had 1,001 – 5,000 calls, 142 had 5001 – 25,000 calls, 43 had 25-100,000 calls, and 11 had greater than 100,000 calls (40 agencies didn't answer). Analysis demonstrated that agency size was associated with greater use of CQI metrics (OR=2.15 (95%CI: 1.60, 2.88)), dedicated QI hours per week ($r = 0.47$, $p < 0.0001$), and greater likelihood of using specialized QI software (OR 1.30 (95%CI: 1.15, 1.48)). Of note, the percent of agencies with QI staff increased with size category (58.4%, 79.44%, 87.32%, 90.71%, 90.91%). The presence of QI staff increased likelihood that CQI Metrics were tracked (OR 3.25 (95%CI: 2.14, 4.95)). **Conclusions:** In this national survey, there was a significant association between larger agency size and the breadth of CQI efforts within that agency, as well as the resources to support those efforts. Many factors likely contribute to this issue including limited financial resources within small agencies and a lack of minimum quality reporting or performance standards. Policy makers should consider strategies to support more robust quality activities, particularly in smaller agencies, and to improve the rigor of quality measurement among agencies of all sizes.

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A NEW ERA IN SPINAL IMMOBILIZATION?

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Background: It has long been the standard of care for trauma patients to receive treatment with spinal immobilization via long spine board and a cervical collar, head blocks, and some variation of straps to secure the patient to the board. Many prehospital agencies have taken steps to reduce or eliminate the utilization of the long spine board because there is no additional benefit to patients that lacked symptoms of neurological deficit. A new spinal immobilization protocol was developed to restrict use of long spine boards to cases in which the patient demonstrated symptoms of a spinal injury without change in mental status. All other trauma patients received only a cervical collar. We hypothesized that implementation of the new spinal immobilization protocol will have no impact on patient outcomes and will result in a significant decrease in the utilization of long backboards. **Methods:** Data was collected through electronic databases in the agency and at the receiving hospital. Trauma services provided information on every patient that had diagnosed spinal fractures, spinal cord damage, and neurological deficits. Using this data, patients were cross-referenced with a list of all patients in the same period that received treatment with long spine boards. **Results:** A total of 122,326 EMS calls were logged in the two-year study period. Baseline data from the first year yielded 2182 trauma patients placed on long spine boards using the standard protocol. The new protocol was implemented the second year which resulted in 981 patients who met criteria for long spine board placement. Based upon call volume, there was a 62.5% reduction in long board use. Patients that had spinal injury without deficit and did not receive a long spine board had no change in their injury pattern. This resulted in no changes in patient outcomes in the period of study. **Conclusions:** Use of the new immobilization protocol supported the hypothesis that there would be no impact on patient outcomes while significantly decreasing the use of long backboards.

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A DESCRIPTIVE ANALYSIS OF PREHOSPITAL MIDAZOLAM AS A CHEMICAL RESTRAINT IN COMBATIVE PATIENTS

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Background: Paramedics are often required to manage violent or combative patients. In order to do so safely, chemical sedation may be required. There are a number of pharmacologic agents which may be used. However, there is a paucity of evidence as to the optimal agent. Our objective was to provide a descriptive analysis of a single base hospital's experience with combative patients and to determine the

efficacy and any adverse events associated with midazolam use in these patients. **Methods:** A retrospective chart review of calls from 2 urban centers, from January 2012 to December 2015 was completed. All cases of combative patients were examined. Patients were excluded if they were 17 or younger. **Results:** Of approximately 350,000 calls over the study period, there were 269 patients that were combative. Of these, 186 (69.1%) received midazolam for sedation. Multiple dose administration was required in 33.3% of patients. Depending on route of administration, the average total dose administered was 6.27mg (SD 3.98mg) intramuscular, 10.7mg (SD 4.00mg) intranasal and 4.95mg (SD 3.81mg) intravenous. Midazolam was documented as effective in treating the combativeness in 133 (71.6%), ineffective in 28 (15.1%), and not documented in 25 (13.4%) calls. Adverse events post midazolam administration, defined as: hypotension, bradypnea, bradycardia or need for airway intervention, were encountered in 3 (1.61%) calls (respiratory rate of 8, hypotension of 88/59 that responded to intravenous fluid and asymptomatic bradycardia of 59). Of the 186 calls, 71 (38.2%) had documented drug ingestion and 117 (62.9%) required police presence. There was a trend of increasing number of combative patients each year over the study period, with a significant difference in the number of combative calls requiring midazolam administration in 2012 and 2015 (50.0% vs. 72.8%, $p=0.007$). **Conclusions:** Prehospital use of midazolam for combative patients appears to be safe, with minimal adverse events. However, midazolam was ineffective in 15.1% and a third of all patients required multiple doses, prolonging the combative period and compromising paramedic safety. Further research is underway examining this cohort's emergency department (ED) sedation needs and any associated adverse events within 1 hour of ED arrival.

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SHOULD BLS CARRY AND ADMINISTER ALBUTEROL? A COMPARISON OF ALBUTEROL TREATMENT AND TIME TO ADMINISTRATION BY BLS AND ALS PROVIDERS

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Background: Albuterol therapy is restricted by scope of practice to Advanced Life Support (ALS) in many Emergency Medical Services (EMS) systems throughout the United States. In Delaware's two-tiered EMS system, Basic Life Support (BLS) arrives on scene prior to ALS in approximately 60% of respiratory distress calls, but BLS providers have not previously been authorized to carry and administer albuterol. We sought to evaluate the use of albuterol by BLS and the timing of administration compared to ALS. **Methods:** We conducted a retrospective observational study using data collected between July 2015 and January 2016 throughout a statewide BLS albuterol pilot program. 22 out of 72 State prehospital BLS agencies participated in the study. Pilot BLS agencies attended a training session on the indications and administration of albuterol, and were authorized to carry and administer albuterol. Heart rate, respiratory rate, and pulse oximetry were obtained before and after albuterol administration by BLS and ALS. We then compared the time of BLS arrival to the administration of albuterol by pilot BLS agencies versus ALS. All encounters required both BLS and ALS response to patients in respiratory distress. Data was analyzed using chi-square and t-test as appropriate. **Results:** 245 incidents were reviewed. 176 patients received albuterol by BLS pilot agencies and 69 patients received albuterol by ALS. After albuterol administration, BLS pilot treatment patients showed improvements in heart rate ($p < 0.01$), respiratory rate ($p = 0.04$), and pulse oximetry ($p < 0.01$). BLS control/ALS treatment patients showed improvement in heart rate ($p=0.21$), respiratory rate ($p=0.04$), and pulse oximetry ($p < 0.001$). A comparison of BLS arrival time to albuterol administration time showed significantly shorter times in the BLS pilot group compared to the BLS control/ALS group [4.18 minutes, 95% CI 3.42-4.92 vs. 7.42 minutes, 95% CI 4.90-9.93, respectively, ($p < 0.01$)]. **Conclusions:** Patients improved similarly but received albuterol significantly sooner when treated by BLS agencies carrying albuterol than by BLS agencies who required ALS arrival for albuterol therapy. Two-tiered EMS systems should consider allowing BLS to carry and administer albuterol for effective and potentially faster treatment of patients with respiratory distress amenable to albuterol.

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EVALUATION OF NALOXONE USE COMPARED TO PROTOCOL IN A LARGE GROUND AND AIR-BASED EMS SERVICE

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Background: In light of the recent epidemic in opioid overdoses in the United States, the administration of naloxone by EMS providers, first responders, and law enforcement has received significant attention. Naloxone has been in use by EMS agencies before the opioid epidemic developed, however little data is available regarding the compliance of EMS providers with protocols directing use of naloxone as part of treatment for suspected opioid overdoses in the out-of-hospital setting. This study seeks to identify the rate of naloxone-related protocol compliance among providers in our large ground and air-based EMS service. **Methods:** A retrospective chart review was conducted encompassing all cases where naloxone was documented as an intervention following implementation of a new suspected opioid toxicity protocol on 01 July 2015. Each case was reviewed for the indication for naloxone, the single and total doses of naloxone, and the use of manual ventilation proximate to naloxone administration. These case elements were then compared to our suspected opioid toxicity protocol to check for compliance with indication, dosing, and provision of BLS airway interventions. Case demographics were also collected. **Results:** Between 01 July 2015 and 16 June 2016 our agency administered naloxone 456 times. Our review included 327 of these cases. Patient age ranged from 0-99 (mean 43.2±18), mode 29), and 57.3% were male. In only 37 (11%) of cases, naloxone was given for the proper indication, at appropriate dose, and in conjunction with appropriate manual ventilation. Naloxone was provided for appropriate indications in 153 (46.8%) cases. An appropriate initial dose was provided in 187 (57.2%) cases. Total dose exceeded 2mg in 36 (11.1%) cases. Providers provided manual ventilation concomitantly with naloxone in 75 (22.9%) cases. **Conclusions:** Compliance with protocol-based naloxone indications, dosage, and co-administration of artificial ventilation was notably poor among EMS providers in our agency, despite focused training. This suggests the need for additional staff education and ongoing surveillance of provider interventions for suspected opioid toxicity. EMS and public safety agencies choosing to utilize naloxone as part of their reaction to the opioid toxicity epidemic should ensure appropriate utilization of both assisted ventilation and naloxone.

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MEDICAL DIRECTOR FEEDBACK AND CREW EDUCATION SUFFICIENT TO DECREASE THE RATE OF LIGHTS AND SIRENS TRANSPORT TO THE HOSPITAL

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Background: Medical direction perceived an overuse of potentially dangerous lights and sirens transport (LAST) to the hospital in our EMS system for patients that were sick yet unlikely to benefit from small decreases in transport time. At the same time, medical direction believed that a policy prohibiting LASTs would be poorly received by crews and could negatively impact care in some cases. An approach of education, encouragement and continuous quality improvement (CQI) was selected. We sought to retrospectively evaluate whether this more passive approach was effective at changing provider practice and limiting LASTs. **Methods:** In 2013, a broad-based intervention was made by the Rio Rancho Fire Rescue Medical Director to decrease the frequency of LASTs. This effort included 1) education on the risks of LAST, 2) encouragement to restrict LAST to those cases where a substantial time savings was anticipated or if the patient required a time-urgent treatment that could not be provided in the field, 3) a request that crews provide rationale for LASTs in their reports, and 4) 100% quality assurance (QA) review of all LASTs with feedback from the medical director on whether he agreed or disagreed with the transport mode. The final decision on LAST always remained with the crews and no disciplinary action resulted from their decisions. The number of LASTs from a one-year period prior to this intervention (October 2011 thru September 2012) was compared with the number of LASTs the year after the intervention (October 2013 thru September 2014). **Results:** In the year prior to the intervention, there were 205 LASTs out of 2819 total transports (7.3%). In the year following the intervention, there were 113 LASTs out of 2390 total transports (4.7%). We therefore observed a 35.6% relative decrease in the

rate of LAST. **Conclusions:** This retrospective observational data suggests that medical directors may significantly reduce LASTs through education, encouragement and CQI initiatives without implementing mandatory policies, punitive actions or eliminating provider autonomy. A prospective trial would be necessary to ascertain the impact of this practice on patient outcome.

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IMPACT OF A NEW MEDICAL DISPATCH SYSTEM ON TELECOMMUNICATOR-ASSISTED CPR

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Background: In 2015, the Los Angeles Fire Department (LAFD) implemented a new medical dispatch system, which emphasizes rapid recognition of cardiac arrest and early provision of TC-CPR. **Methods:** This was an interrupted time series (before-after design) of cases of field-confirmed OOHCA with LAFD 911 call takers using Medical Priority Dispatch System® (MPDS) (“MPDS Cohort” from January 1, 2014 through March 31, 2014) versus those occurring after instituting a new medical dispatch system (Los Angeles Tiered Dispatch System -LA-TDS) (“LA-TDS Cohort” January 1, 2015 through March 31, 2015). LAFD electronic health records were reviewed for all cases of OOHCA. Inclusion criteria were: all LAFD non-traumatic OOHCA with attempted resuscitation, not witnessed by EMS providers, not occurring in a clinical setting, CPR not yet in progress. Trained non-LAFD abstractors listened to all calls, and recorded if TC-CPR was initiated, as well as the time elapsed until key events. The primary outcome was prevalence of TC-CPR. **Results:** Of 1,027 calls during the study period, 13 recordings were unavailable for review, and 417 calls met one or more exclusion criteria, leaving 597 911-calls for review (289 in the MPDS cohort, and 308 in the LA-TDS cohort). There were no differences between MPDS or LA-TDS patients in age, gender, known comorbidities, arrest location, witnessed status or caller party. The prevalence of TC-CPR was significantly greater in LA-TDS (57%) compared to MPDS (43%) (OR 1.86, 95% CI 1.3-2.6, $p<0.001$). Although there was no significant difference in the elapsed time to first description of agonal breathing ($p=0.07$), the LA-TDS cohort had a statistically significant decrease ($p<0.001$) in time to recognition, time to dispatch, and time to first TC-CPR chest compression. For cases where the telecommunicator had the opportunity to assess consciousness and breathing, there was a trend toward improved recognition of cardiac arrest (0.09), and a statistically significant improvement ($p<0.001$) in cardiac arrest recognition in <1 min, prevalence of TC-CPR, and TC-CPR started in <2 min. **Conclusions:** The new Los Angeles Tiered Dispatch System significantly outperformed MPDS® in promoting telecommunicator-assisted CPR. Further studies are needed to identify elements of this new dispatch system responsible for improved TC-CPR.

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ESTIMATING THE PROPORTION OF PATIENTS THAT COULD BE SAFELY TREATED AND RELEASED ON SCENE VIA A “VIRTUAL ED” VIDEO LINK WITH AN EMERGENCY PHYSICIAN

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Background: An estimated 11% to 52% of emergency medical service (EMS) transports have been reported to be unnecessary. EMS services could identify these low risk patients and potentially treat and release them on scene. Our objective was to identify patients that could be safely treated on scene via a “virtual emergency department (ED)” program, that is, a hospital-based ED physician assessing patients and guiding on-scene treatment by an extended care paramedic via telemedicine technology. **Methods:** From nearly 13,000 ambulance call reports (ACRs) of patients aged ≥ 18 years transported by EMS to a Toronto tertiary facility in 2014, we initially selected the approximately 6000 ACRs where the patient had normal vital signs, no obstetric condition, no chest pain requiring a 12-lead ECG, and was not transported from a public place. Additional criteria to identify low risk patients were selected by consensus of emergency care experts based on Canadian Triage and Acuity Scale (CTAS) clinical complaint categories. To simulate the program, paramedics applied the CTAS criteria to a random selection of 1000 of the 6000 ACRs that met the initial screening criteria and presented each to 1 of 2 ED

physicians via a video link. Physicians further judged patient program eligibility. Patient ED outcomes were abstracted from hospital charts. **Results:** Deemed eligible were 46 of the 1000 cases (4.6%, 95% confidence interval, 3.3%-5.9%), representing approximately 2.1% (1.5% to 2.7%) of the 13,000 transported patients. Hospital information was available for 44 of the eligible cases. Of these, 4 were admitted to hospital and 12 received imaging or other procedures not available in a virtual ED. **Conclusions:** The low proportion of cases eligible could be attributed to exclusion of all CTAS complaint categories that potentially included any higher risk patients. Even some patients that met the predetermined low risk criteria were admitted to the hospital or received testing not available through a virtual ED. A limitation of the study is that judgment of eligibility was limited to information recorded on ACRs rather than on-scene physical examination. Case-by-case selection of low risk patients rather than selection based on predetermined global criteria may increase the number eligible.

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RACE TO THE MOST APPROPRIATE STROKE CENTER: CAN PREHOSPITAL PERSONNEL APPROPRIATELY USE RACE SCORES TO IDENTIFY LARGE VESSEL OCCLUSION (LVO) STROKES

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Background: Ischemic strokes involving large vessel occlusions (LVO) present with more devastating deficits and have mortality rates as high as 90%. Previous studies have noted that many times LVO strokes do not respond to Tissue Plasminogen Activator alone and require endovascular intervention to restore perfusion. Ideally prehospital personnel would be able to identify those suffering from an LVO versus a small vessel occlusion (SVO) stroke, transporting LVO strokes to a comprehensive stroke center(CSC) and avoiding delays. This study sought to determine if the Rapid Arterial Occlusion Evaluation(RACE) score could be feasibly implemented in Alachua County to discriminate between stroke patients with LVO or intracranial hemorrhage(ICH) versus SVO stroke. **Methods:** Crews were trained on performing RACE scores as an additional evaluation tool for stroke patients in Alachua County. These scores were documented by the paramedics, then compared to the diagnosis as documented by imaging results. **Results:** 130 patients met inclusion criteria. Our scoring model considered a score of 5 or greater as positive and 4 or less as negative. Imaging results were reviewed for diagnosis, we considered CT perfusion scans, identifying a LVO or ICH as positive and those with a SVO or other diagnosis as negative. 52 patients were RACE positive for an LVO, 20 had the diagnosis of LVO or ICH. Yielding a sensitivity of 76% and a PPV of 38%. 78 patients were RACE negative, 72 with negative imaging. Yielding a specificity of 69% and NPV of 92%. **Conclusions:** A PPV of 38%= high number of false positives, but we felt that the risk in “overtriaging” these patients to a CSC, where they would receive appropriate care is minimal. A NPV of 92%, shows the RACE score proved to be an effective tool for accurately ruling out an LVO in patients without a LVO stroke, so the number of falsely-negative patients taken to a facility without interventional capabilities was kept low. EMS agencies across the US have unique resources and transport times, therefore each agency must consider these when creating their protocols. We feel more research needs to be done to determine its usefulness in different settings.

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CLINICAL FEEDBACK FROM PREHOSPITAL USE OF A NOVEL TRAUMATIC BRAIN INJURY DASHBOARD

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Background: Traumatic brain injury (TBI) patients must be carefully monitored and treated in the prehospital setting to prevent secondary brain injury from hypoxia, hypotension, and/or hyperventilation. A novel technology, the TBI dashboard, was developed to provide a focused display of clinically relevant parameters and an adjustable ventilation timer to assist clinicians in the care of TBI patients. The purpose of this project was to assess the usability of the TBI dashboard technology and remote display in the prehospital setting. **Methods:** Clinical parameters (SpO2, ETCO2, SBP) were wirelessly streamed from a defibrillator monitor to a mobile smartphone device and displayed in a trend

graph format together with an adjustable ventilation timer during prehospital treatment of TBI patients. After use of the TBI dashboard display, clinicians completed an anonymous online survey describing their experiences with the technology. **Results:** Twenty-nine prehospital clinicians (26 paramedics, 3 EMTs) completed surveys after 26 clinical uses of the TBI dashboard. The individual parameters of the TBI Dashboard (SBP, SpO₂, and ETCO₂) were viewed frequently or continuously 66-72% of the time. When asked to rate the usefulness of the different features on a scale of 1 (not useful) to 5 (extremely useful), the SpO₂, ETCO₂, and SBP features were rated 4 (median, IQR=3,4 for all features). There were not enough cases requiring assisted ventilation (n=2) to test the usefulness of the ventilation timer. The clinicians generally had a positive (55%) or neutral (33%) opinion of the remote display and 11% disliked it somewhat. The TBI Dashboard was less frequently viewed on scene (45% viewed) and rarely during patient extrication (14% viewed) but viewed frequently during transport (93% viewed). Clinicians rated that they would definitely (28%) or probably (38%) use the TBI dashboard on a remote display in the future whereas 24% had a neutral opinion and 10% would not use the feature again. **Conclusions:** Prehospital clinicians generally viewed the TBI Dashboard positively and found SpO₂, ETCO₂, and SBP trending to be useful, especially during patient transport. Further testing is needed to evaluate the usefulness of an adjustable ventilation rate timer.

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IMPACT OF AN ON-SITE MASS GATHERING ALCOHOL SOBERING FACILITY ON EMERGENCY MEDICAL SERVICES AND EMERGENCY DEPARTMENT RESOURCE UTILIZATION

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Background: Alcohol at mass gatherings has been associated with increased need for medical services. Patients with alcohol intoxication are frequently excluded from care at traditional on-site medical tents due to their disruptive behavior or need for prolonged observation and require additional Emergency Medical Services (EMS) or Emergency Department (ED) resources. The purpose of this study was to determine if, at a very large mass gathering, the addition of an on-site alcohol sobering facility to existing on-site medical resources was associated with changes in EMS and ED resource utilization during an annual mass gathering. **Methods:** This retrospective observational study of a large annual mass gathering included prospectively collected data before implementation of an on-site alcohol sobering facility, 1 year (EMS data) or 2 years (ED & event data) and 3 years after an on-site alcohol sobering facility was added to existing event medical support services. Outcomes were compared across the pre- and post-implementation time periods. The primary outcome was EMS transports to the hospital from the mass gathering. Secondary outcomes included ED patient volume and ED length of stay (LOS). Unadjusted odd ratios with 95% confidence intervals (CI) were then used to describe observed changes in EMS and ED resource utilization between the pre- and post-implementation groups. **Results:** Average single day event attendance was 176,116 in the 2 years before the sobering facility was implemented and 183,544 in the 3 years following implementation. The odds of an EMS transport from the event to the ED decreased in the post-implementation period, OR 0.37 (95% CI=0.16-0.86, p=0.01). ED volume increased by 7.23% (p = 0.56) and ED LOS increased by 1.29% (p = 0.97) in the post-implementation period. **Conclusions:** In this retrospective observational study of a single mass gathering, addition of an on-site alcohol sobering facility to existing medical support services was associated with a decrease in EMS transports, but no change in ED resource utilization. Further work is needed to determine if these findings can be reproduced at other mass gatherings.

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REGIONAL "CALL 911" EMERGENCY DEPARTMENT PROTOCOL TO REDUCE TRANSFER DELAY OF ST-ELEVATION MYOCARDIAL INFARCTION PATIENTS

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Background: Regional cardiac care systems have achieved timely percutaneous coronary intervention (PCI) for patients with ST-elevation myocardial infarction (STEMI) transported by EMS to PCI-capable centers. However, the goal of 120 minutes or less first-medical-contact-to-balloon (FMC2B) time for transfer patients is rarely achieved. We evaluated the FMC2B time for STEMI patients after implementation of a “Call 911” protocol for STEMI inter-facility transfers (IFTs) in a regional cardiac system. **Methods:** This is a retrospective cohort study of consecutive patients with STEMI requiring IFT from a non-PCI hospital, STEMI referral facility (SRF), to one of 35 PCI-capable STEMI receiving centers (SRC). The “Call 911” protocol, implemented in August 2010, allows the referring physician to activate 911 to transport a patient with STEMI to the nearest SRC for primary PCI. SRCs report treatment and outcomes for all STEMI patients transported via 911 to a registry, from which IFT patients were identified over a 4-year period (2011-2014). The primary outcome was median FMC2B time and the proportion achieving the 120-minute goal. Although primary 911 transports are inherently different and cannot serve as a direct comparison, FMC2B for primary 911 transports were calculated to serve as a system reference. **Results:** There were 2504 STEMI patients transferred to SRCs during the study period, of whom 1973 (79%) had emergent coronary angiography and 1428 (57%) received PCI. The median age was 61 (inter-quartile range (IQR) 52-71) with 73% male. The median FMC2B time was 111 minutes (IQR 87-154) with 56% of patients meeting the 120-minute goal. The median SRF door-in-door-out (DIDO) time was 53 minutes (IQR 37-89), EMS transport time was 9 minutes (IQR 7-12), and SRC door-to-balloon (D2B) time was 44 minutes (IQR 32-60). For primary 911 patients, the median FMC2B time was 81 minutes (IQR 67-97), 90% of patients were treated within 120 minutes of FMC. While the FMC2B was shorter for primary 911 transports, time at the SRC was longer, D2B 63 minutes (IQR 50-78). **Conclusions:** Using a “Call 911” protocol in this regional cardiac care system, STEMI patients requiring IFT had a median FMC2B time of 111 minutes, with 56% meeting the 120-minute goal.

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THE 2015-16 EMERGENCY MEDICAL SERVICES FELLOWS

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Background: The 2015-16 academic year was the fourth year since the Accreditation Council for Graduate Medical Education (ACGME) accredited emergency medical services (EMS) fellowships, and the first year an in-training examination was given. ACGME accredited fellowship education will be the sole path to EMS board certification when the practice pathway closes after 2019. The objective of this study was to describe the current class of EMS fellows at ACGME accredited programs. **Methods:** A cross sectional survey of current EMS fellows in ACGME accredited programs was conducted in conjunction with the first EMS in-training examination. Fellows were asked to complete a 14-question survey composed of multiple choice and free response questions. Basic frequency statistics were performed on their responses. **Results:** Fifty fellows from 35 ACGME accredited programs completed the survey between April and June 2016. Forty-eight (96%) fellows reported previous training in Emergency Medicine. Twenty (40%) were undergoing fellowship training at the same institution as their prior residency training. Twenty-five (50%) fellows performed direct patient care aboard a helicopter during their fellowship. Thirty-three (66%) fellows had a dedicated physician response vehicle for the fellows. All fellows reported using the NAEMSP textbooks as their primary reference. The majority of fellows felt most prepared for the Clinical Aspects questions and least prepared for Quality Management and Research questions on the board exam. **Conclusions:** These data provide insight into the characteristics of EMS fellows in ACGME accredited programs.

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ANALYSIS OF RUN SHEETS OF EMS SERVING A METROPOLITAN COMPREHENSIVE STROKE CENTER

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Background: The aim of this study is to analyze the content of the run sheets of patients brought by EMS with acute ischemic stroke. **Methods:** Institutional Get With The Guidelines (GWTG) database was used to identify ischemic stroke patients. We retrospectively reviewed the run sheets of EMS patients, abstracted the examination findings reported by EMS, and correlated these findings with the initial National Institute Stroke Scale (NIHSS) score documented upon arrival of the patient to the emergency room (ER). **Results:** Seven hundred and six patients were included (mean age 69±15 years, 45% were women). EMS patients (n=477, 63.3%) were significantly older (72±14.9 vs. 64±14 years, p<0.0001), had a significantly higher median (interquartile range [IQR]) initial NIHSS (6 [2-14] vs. 2 [0-43], p<0.0001), had faster median time from onset to ER (106 [54-573] vs. 697 [221-2073] minutes, p<0.0001), and had higher rate of IV alteplase administration (17% vs. 2.4%, p<0.0001) and mechanical thrombectomy (8.3% vs. 0, p<0.0001). Seventy-five run sheets (17%) were missing. Level of consciousness was assessed in 336 patients (81%) with a comment on level of alertness (61.3%), attention/awareness (37.1%), and/or a non-specific statement such as 'altered mental state' (23.5%). Focal extremity weakness was reported in (39.8%), facial weakness (26.6%), aphasia (9.2%), and hemihypesthesia (2%). Non-specific terms were used frequently: slurred speech (25.5%), generalized weakness (14.5%), dizziness (5.4%), blurred vision (2%), diplopia/gaze deviation (0.7%). Extinction, visual field cut, and ataxia were never reported or commented on. Only aphasia, facial weakness, focal weakness, diplopia/gaze deviation, and non-specific mental state change were associated with high NIHSS and high IV alteplase utilization. **Conclusions:** EMS patients have better quality metrics and higher chance of receiving IV alteplase. EMS documented assessment allows for the diagnosis of stroke in general but cannot identify large vessel occlusion because the assessment of cortical signs is very limited. Any future planning of assessment and triaging of LVO on the field will have to include focused training of EMS personnel.

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PEDIATRIC PREHOSPITAL MEDICATION DOSING ERRORS: A NATIONAL SURVEY OF PARAMEDICS

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Background: Pediatric drug dosing errors occur at a high rate in the prehospital environment. **Objective:** To describe paramedic training and practice regarding pediatric drug administration, exposure to pediatric drug dose errors and safety culture among paramedics and EMS agencies in a national sample. **Methods:** An electronic questionnaire was sent to a random sample of 10,530 nationally certified paramedics. Descriptive statistics were calculated. **Results:** There were 1,043 (9.9%) responses and 1014 paramedics met inclusion criteria. Nearly half (43.0%) were familiar with a case where EMS personnel delivered an incorrect pediatric drug dose. Over half (58.5%) believed their initial paramedic program did not include enough pediatric training. Two-thirds (66.0%) administered a pediatric drug dose within the past year. When estimating the weight of a pediatric patient, 54.2% used a length-based tape, while 35.8% asked the parent or guardian, and 2.5% relied on a smart phone application. Only 19.8% said their agency had an anonymous error-reporting system and 50.7% believed they could report an error without fear of disciplinary action. For solutions, 89.0% believed an EMS-specific Broselow-Luten Tape would be helpful, followed by drug dosing cards in milliliters (83.0%) and changing content of standardized pediatric courses to be more relevant (77.7%). **Conclusions:** This national survey demonstrated a significant number of paramedics are aware of a pediatric dosing error, safety systems specific to pediatric patients are lacking and that paramedics view pediatric drug cards and eliminating drug calculations as helpful. Pediatric drug-dosing safety in the prehospital environment can be improved.

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REDUCTION OF BYSTANDER TIME-TO-CHEST COMPRESSIONS USING A DISPATCHER-GUIDED CPR ALGORITHM

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Background: The earlier bystander compression-only CPR is initiated has a significant effect on outcome of out-of-hospital cardiac arrest (OHCA). Dispatcher-assisted CPR is known to increase rates of bystander CPR. This study evaluates the effect of a novel dispatch guided bystander CPR algorithm on the time between 911 call receipt and initiation of bystander compression-only CPR. **Methods:** We conducted a retrospective review of all cardiac arrests that received prearrival instructions from dispatchers in our secondary public safety answering point following implementation of our algorithm. Each case was analyzed for time between call receipt and initiation of chest compressions by bystanders. Outcome data was extracted from our CARES registry. The primary outcome was the time between call receipt and initiation of bystander chest compressions, and the secondary outcome was patient survival. **Results:** A total of 85 cardiac arrests were identified in our review from 5/1/2014 to 5/1/2016. Our algorithm underwent serial revision during the study period, and each version of the algorithm covered the following number of cases V1.0 (14), V1.1 (22), V1.2 (30), V1.3 (5), V1.4 (7) and V1.5 (7). The average patient age was 58.6 years, and 65.9% were male, with no significant differences in patient age or gender between the cohorts. Seconds from call receipt to bystander compression occurred as follows: Algorithm V1.0 (137), V1.1 (181), V1.2 (173), V1.3 (177), V1.4 (203), and V1.5 (151). Our algorithm shortened the time to bystander compressions by 59 seconds compared to our pre-algorithm baseline of 210 seconds. Our pre-algorithm rate of ROSC was 0.7% and 31.8% for pre and post EMS arrival. At the end of our study period, our ROSC rates were 1.2% and 27.8% pre and post-EMS arrival. Survival from cardiac arrest before algorithm implementation was 8.0% (n= 31) compared to a survival of 8.9% (n=55) at the end of our study period. **Conclusions:** Implementation and revision of a dispatcher guided algorithm for bystander compression-only CPR achieved a shorter interval from call receipt to time of first compression, but initially appears to have had only a small impact on survival from OHCA.

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FREQUENCY AND ETIOLOGY OF PEDIATRIC OUTPATIENT EMERGENCIES

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Background: Office based emergencies pose a significant issue to pediatric providers. Greater than 50% of pediatric offices report seeing between one and five patients a week requiring emergent treatment. We hypothesize that outpatient emergencies in pediatric patients occur at a different frequency and are due to other etiologies than what is currently described in the medical literature. **Methods:** We retrospectively extracted data from EMS charts for the city of Indianapolis for all patients less than 18 years cared for from 1/1/2012 to 12/31/2014. Probabilistic matching of pick-up locations was performed with addresses of outpatient medical facilities taken from the Indiana Physician Workforce study to isolate patients requiring emergency care in an outpatient setting. We reviewed these patients' EMS records to categorize the types of illnesses and interventions provided in route to definitive care. Basic demographic data pertaining to the patients and practices was also collected. Finally, accuracy of EMS reporting with regard to pick-up location was determined. **Results:** A total of 38,841 pediatric patients were transported by Indianapolis EMS. Of these patients, we identified 1132 based on matching criteria picked up at a medical facility. 805 of these patients were transported between hospitals or from an unidentified location, leaving 327 patients meeting criteria for analysis. Average patient age was 5.6 years. 58.1% of patients were categorized as respiratory distress with the other most common illness categories being behavioral issues including suicidal ideation (6.4%), seizures (6.1%), and syncope (5.5%). 27.2% of patients required supplemental oxygen during transport, 26.9% received albuterol, and 9.2% required IV access. Of the predetermined critical care interventions, 1.5% of patients required benzodiazepine administration, 1.5% required a fluid bolus, and 1.2% required epinephrine (IM or racemic). No patients required bag mask ventilation, an artificial airway, intraosseous access, or CPR. **Conclusions:** The majority of patients requiring emergent transport from an outpatient facility presented with respiratory distress. Patients rarely required any critical care interventions. This study will better categorize pediatric outpatient emergencies and help prepare EMS for dealing with these

patients. Additional analysis will help identify the frequency of these emergencies and differences in patient and practice characteristics.

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EMT DETERMINATION OF PATIENT SUITABILITY FOR DIVERSION TO URGENT CARE

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Background: The goal of this prospective survey-based study was to examine the ability of emergency medical technicians to decide if patients could be appropriately and safely diverted from the Emergency Department to an urgent care center. As non-emergent activation of Emergency Medical Services continues to increase, appropriate diversion may represent an effective means of limiting or eliminating excess cost and resource utilization. Previous investigations have relied heavily on mock decision making and advanced life support evaluation, with a 2009 systematic review and meta-analysis finding profound heterogeneity among studies and calling for more research into the practice. **Methods:** This was a prospective survey-based study. Emergency Medical Technicians (EMTs) transferring care of patients to the Emergency Department of a Level 1 urban teaching hospital completed a brief survey regarding patient suitability for diversion to an urgent care center. Faculty emergency physicians, masked to the treating EMTs determination, completed the same survey immediately following their initial history and physical examination of the patient. Patient-level data, including chief complaint, age, sex, and vital signs, were recorded. Data were collected on consecutive patients encounters on five weekdays during typical urgent care operating hours. **Results:** Data were collected on 235 consecutive patient encounters, 233 of which were analyzed. Diversion was deemed appropriate by EMTs in 45 cases (19.3%, 95% CI 14.6-24.8). Thirty five (15%, 95% CI 10.9-20) instances of discordance between EMT and attending physician determination were recorded, with 27 encounters (11.6%, 95% CI 7.9-16.3) deemed appropriate for urgent care diversion by the treating EMT and inappropriate by the attending physician. **Conclusions:** Emergency Medical Technicians could not reliably determine suitability for diversion to urgent care centers in this cohort. Identification of trends in discordant cases may serve as the foundation for future educational efforts.

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KETAMINE FOR ACUTE PAIN: ONE EMS SYSTEMS FIVE-YEAR EXPERIENCE

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Background: Treating patient's pain within the prehospital setting ought to be a medical priority for Emergency Medical Services (EMS). First responders must quickly identify, treat and manage the pain symptom with adequate analgesics to lessen the suffering and reduce the patient's potential of harmful short/long term effects. At present, literature regarding multi-year use of ketamine for analgesia in the out-of-hospital (OOH) setting are limited. Our objective was to determine the change in the patient's medical response after subdissociative dose ketamine administration by paramedics treating under a pain management protocol. **Methods:** A retrospective analysis was conducted on all patients receiving prehospital Ketamine by paramedics for pain in a countywide EMS system from August 2010 to March 2016. Ketamine administration indications were for analgesia of the trauma or medical patient requiring pain management, with dosing of 0.1 - 0.5 mg/kg intramuscular (IM), intravenous (IV) and intraosseous (IO) over 60 seconds. Contraindications include hypertensive crisis, seizures, elevated intracranial pressure, inability to control airway and psychotic illness. Those cases where the ketamine intervention was used for pain management were queried within the ZOLL ePCR system and abstracted. National EMS information System response to medication, route, dosing, and general demographics were recorded. Descriptive statistics were utilized to describe study characteristics and a 95% confidence interval was calculated for patient's medical response. **Results:** A total of 115 patients met the study inclusion criteria. Among this group, a clinical outcome improvement of medical response was observed after the first dose in 86% (95%CI 79% - 91%) of patients, with 14% unchanged, and 0% cases had a

worsening response. The first ketamine, mean dose was 74mg (range 4 - 475 mg), administration routes were 99(86%) IV, 25(22%) IM, and 2(2%) IO. The mean age was 49 years (range 12 - 92 years), 67(58%) patients were male with a mean weight of 87kg. Moreover, no patient adverse events were reported.

Conclusions: In this system's population ketamine analgesia used by EMS was effective and safe for pain management in the prehospital care setting. Prospective OOH patient studies utilizing ketamine are needed to identify and define a comprehensive pain treatment continuum.

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TELECOMMUNICATOR BREATHING ASSESSMENT TECHNIQUES IN OUT-OF-HOSPITAL CARDIAC ARREST

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Background: Telephone CPR (TCPR) increases survival from out-of-hospital cardiac arrest (OHCA). AHA recommends a two question approach for telecommunicators to identify OHCA: Is the patient (1) conscious and (2) breathing normally? Telecommunicators use breathing assessment techniques (BATs) to identify or confirm breathing status. BATs may delay the TCPR process. We sought to determine durations of BATs and frequency of unneeded BATs. **Methods:** Retrospective, observational study of telecommunicator breathing inquiries using defined BATs. BATs were categorized as either initial (IA) or secondary (SA) assessments in OHCA audio recordings received at a regional 911 center in Arizona between 2/1/2011 and 3/15/2012. The center had not adopted the two-question approach. SAs were defined as any assessment after IA. Unneeded BATs were defined as any occurring after the call evaluator recognized the patient was not breathing normally. BAT type and duration were collected in a structured format. Duration of unique BATs within cases were estimated using Kaplan-Meier method.

Results: After exclusions, 591 recordings were evaluated. Telecommunicators made IAs in 443 (75.0%). Of these cases, 239 (54.0%) had at least one SA. The following are median elapsed times in seconds for six BATs telecommunicators asked or instructed callers to perform: (1) is patient breathing? = 5 [n=399, 92 censored, 95% CI=(4,6)], (2) watch for rise and fall of chest = 10 [n=102, 18 censored, 95% CI=(8, 11)], (3) listen and feel for signs of breathing = 15 [n=61, 9 censored, 95% CI=(12, 20)], (4) head-tilt-chin-lift = 21 [n=57, 7 censored, 95% CI=(17, 25)], (5) count patient's breathing rate = 21 [n=53, 10 censored, 95% CI=(14,26)], (6) is there agonal breathing? = 7 [n=19, 3 censored, 95% CI=(4, 9)]. Among all 358 SAs employed by telecommunicators, 72.6% (260) were employed after the call evaluator recognized the patient was not breathing normally. BATs ranged from a median of 5 s to 21 s in duration. **Conclusions:** During OHCA, breathing assessments can cause significant time delays in recognition of cardiac arrest and initiation of chest compressions.

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A COMPARISON OF NALOXONE UTILIZATION AND OPIATE OVERDOSES IN A LARGE EMS SYSTEM

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Background: Reports of opiate abuse and overdose are growing in the United States. Emergency Medical Systems (EMS) and Public Health agencies have used EMS naloxone utilization as a proxy for measuring the opioid crisis. Our objective was to evaluate whether naloxone administration by EMS accurately represents EMS calls for opiate overdose. We hypothesize that naloxone administration underestimates opiate overdose. **Methods:** We conducted a chart review of suspected overdose patients and any patients administered naloxone in our urban EMS system (pop. 1 million) from January 2013 - December 2015. Patient care report narratives and other relevant data were extracted via charting software, and the resultant database was analyzed by two EMS Physicians. After reading each narrative, cases were classified into categories, including known or presumed opiate use, cardiac arrest, and whether naloxone was administered. The primary outcome was the proportion of naloxone administration for known/presumed opiate use compared with the proportion of EMS patients with known/presumed opiate use during the study period. Data were analyzed using descriptive statistics and confidence intervals. **Results:** After removing duplicates, calls unrelated to substance abuse, and

uncomplicated alcohol overdose calls, there were 4758 cases included for analysis. Patients were 57% male, 65% white, and mean age 38. Naloxone was administered in 28% of cases (n = 1,351), for indications ranging from unspecified altered mental status to known opiate use to cardiac arrest without known/presumed opiate use. Of the total 4,758 cases, 30% (95% CI: 29% to 31%, n = 1,431), were known/presumed opiate use, while only 17% (95% CI: 16% to 18%, n = 810) of these received naloxone. Of the 1,351 naloxone administration cases, naloxone was given for reasons other than known/presumed opiate use 40% of the time (n = 541 cases). Annual comparison showed a 20% increase in overdose/substance use patients during the study period, while only a 12% increase in overall EMS system calls. Limitations include the chart review methodology. **Conclusions:** In this chart review, naloxone administration was not a suitable marker for EMS opiate overdose patients. Future research should evaluate reasons for paramedic administration of naloxone outside of known/presumed opiate use.

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MEDICATION SAFETY IN EMS: APPROACHING A VALIDATED & RELIABLE METHOD OF VERIFICATION TO REDUCE ERRORS

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Background: Lack of verification is often cited as a root cause of medication errors. The "five rights" are commonly taught and performed as a one-person mental process, but as a safety strategy, this is brittle - relying on the mind that produced the error, to also prevent it. It is possible however, that medication errors occur in spite of verification and that human factors science can inform the design of a more effective method. This study seeks to evaluate the effectiveness of a novel, team-based method of medication verification to prevent errors in the prehospital setting. **Methods:** The Medication Administration Cross-Check (MACC) was designed through an iterative process to achieve the goals of safe medication administration as a communication protocol, and was implemented in an urban, Midwestern EMS agency. Medication error data was collected over a 54 month period, 27 months before and after MACC implementation, to evaluate its effectiveness. Errors were also categorized across four taxonomies to lend the greatest breadth of error data to the literature: 1) by medication, 2) by type of error, 3) Generic Error Modeling System (GEMS), and 4) NCC MERP. **Results:** One sided independent samples t tests were used to identify error rate changes after the MACC intervention. Monthly error rates (errors per medication administration) were calculated to control for changes in frequency of administration. Overall, a substantial and reliable decrease in the average monthly error rate (pre/post-MACC) was realized for all medications administered (49.0%, p = .01) during the post-intervention time period. The average monthly error rate for fentanyl was of interest due to its frequency of administration, and a 71.1% decrease (p = .004) was demonstrated. **Conclusions:** This study is the first to test the effectiveness of a medication verification process. The MACC demonstrated a reliable decrease in the number of medication errors. The MACC is likely to improve the safety of EMS patients and enhance resilience in EMS systems. These findings may also extend into other less technologically sophisticated healthcare environments or as a modification in those that solely rely on the mental process of solitary providers to prevent medication errors.

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A FRAILITY INDEX DERIVED FROM A PARAMEDIC RISK ASSESSMENT: THE PARAMEDICS ASSESSING ELDERLY AT RISK FOR INDEPENDENCE LOSS (PERIL-FI)

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Background: Older adults often require paramedic services. Frailty is common within this population and can place patients at risk for adverse outcomes following such encounters. There is currently no widely accepted method for frailty screening or assessment by paramedics. A frailty index (FI) or count of problems may be a feasible option given the introduction of electronic health records. Frailty, as defined by the accumulation of health deficits, is predictive of adverse outcomes in multiple patient populations. Our objective was to evaluate the validity of a paramedic derived FI from the Paramedics

Assessing Elders at Risk for Independence Loss (PERIL-FI) study. **Methods:** A secondary analysis of the PERIL checklist was performed. Eligible patients (age ≥ 65 years) who called 911 for paramedic services and were assessed within their own home using the PERIL checklist between January 2005 and March 2008 were included. A FI was constructed using 30 variables. The properties of the PERIL-FI were described including its relationship with age, sex, and maximum value. **Results:** The mean age was 80.8, IQR 75.5 – 86.4 years ($n = 2,323$) and 60.2% were women ($n = 1,480$). We enrolled 2,458 subjects at 4 centers. Complete data was available for all 30 variables allowing construction of the FI in 71.4% of the cohort ($n = 1,756$). The mean PERIL- FI was 0.23 (IQR 0.17 – 0.33), and 99% limit was 0.57, with a maximum of 0.70. The mean PERIL-FI was not higher in women and older participants in this cohort. **Conclusions:** It is possible to evaluate frailty using a FI in the EMS setting. The PERIL-FI displayed many similar properties as other published FIs from clinical settings. Future studies should validate the predictive accuracy of the PERIL-FI.

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PEDIATRIC AMBULANCE PATIENT TRANSFER RATES: A RETROSPECTIVE OBSERVATIONAL STUDY

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Background: Current evidence shows that certain conditions, such as ST-elevation myocardial infarctions, stroke and trauma, have better outcomes if transported directly to a regional specialty centre, bypassing a closer facility if necessary. The majority of this evidence addresses adult conditions and there is currently little evidence to help create guidelines that would allow prehospital identification of pediatric patients who would benefit from direct transport to a pediatric centre. This study sought to describe the characteristics of children brought by ambulance to community emergency departments (ED) who subsequently require transfer to specialty care. **Methods:** A retrospective observational cohort study was performed in a metropolitan area with a population of 414,000. It is serviced by a single EMS provider, has one tertiary pediatric specialty centre and four community EDs. The electronic patient care record database was queried for patients under 16 years old transported to a community ED during a 5-year period (Jan 1, 2010 – Dec 31, 2015). Transfer to the pediatric specialty centre within 24 hours was identified. The primary outcome was percentage of transfers to specialty care. Secondary outcomes were the age, chief complaint and triage acuity score of pediatric patients. Descriptive statistics were used to describe the whole group as well as transfer rates for each age category, chief complaint and triage acuity level. **Results:** 872 pediatric patients were transported to community EDs with 95 (10.9%) requiring transfer to the pediatric centre. Increasing acuity was associated with increased transfer rates (CTAS 1 $n=9$, 77.7% vs. CTAS 5 $n=67$, 2.9%). The chief complaints of “Major Trauma”, “Altered Mental Status” and “Overdose/Poisoning” were associated with above-average transfer rates ($n=8$, 50%, $n=12$, 41.7% and $n=41$, 24.4% respectively). There was no association between age and transfer rates. **Conclusions:** The study may have missed pediatric patients that died prior to transfer or those who were transferred by means other than an ambulance. Despite these limitations, this retrospective study shows high acuity and three chief complaints (major trauma, altered mental status and overdose/poisoning) are associated with higher rates of transfer to pediatric specialty care and may benefit from further research.

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MASS GATHERING MEDICAL CARE: A STATE BY STATE COMPARISON

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Background: This study examines state protocols and legislation to determine if states have regulations regarding mass gathering medical care and if they are standardized. Additionally, this study seeks to understand barriers to the development of standardized laws and protocols. **Methods:** State EMS medical directors were contacted to determine if their state had protocols or legislation governing mass gathering medical care. If the state did not have either, they were asked a short questionnaire about barriers to creation. All 50 states and the District of Columbia were searched in a legal database to determine if they had legislation, and their websites were reviewed to determine if they had protocols

For states with regulations, copies were reviewed for key information and results were analyzed qualitatively. **Results:** Fourteen (27%) medical directors responded. Identified barriers to regulation creation include: disparate local jurisdictions, lack of large scale events, and economic concerns. On review of the legal database and state websites, eighteen states and the District of Columbia (37%) have written documents regarding mass gathering medical care, fifteen laws, one protocol, two both. One state uses NAEMSP definition of mass gathering. Others range from as small as 20 people to as large as 10,000, with length from 4 hours to 24. Nine require physician oversight (only 4, EMS supervisory experience). Two require EMT/paramedic staffing, 5 nurse/physician, 1 either. Staffing scales with expected crowd size in ten, and with additional variables in two. Fourteen require on-site medical facility. Ten require ambulances. While fifteen have specific equipment requirements, none require an AED. **Conclusions:** This study highlights the variability of mass gathering medical care at the state level. Key changes that should be made include ensuring that staffing and equipment must scale with expected patient presentation rates, and the understanding that needed changes are based on more complex variables than event size. It is concerning that statutes outnumber protocols, EMS officials and not legislators, should be determining appropriate staffing equipment and planning for events. This study did not examine local jurisdictions. Due to small sample size, information regarding challenges of statewide rules may be missing.

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IMPLEMENTATION OF A MEDICAL AMNESTY POLICY AT AN URBAN UNIVERSITY WITH A COLLEGIATE-BASED EMERGENCY MEDICAL SERVICES AGENCY

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Background: Excessive alcohol use by students on college campuses can result in serious illness, injuries, and death. Students, however, may be reluctant to seek medical attention, fearing disciplinary consequences. An urban university with a collegiate-based basic life support (BLS) transporting emergency medical services (EMS) agency implemented a medical amnesty program immunizing students seeking medical assistance from disciplinary action for violations of the university's alcohol policy. This study analyzed how implementation of this program affected alcohol-related requests for EMS service. **Methods:** All calls to the on-campus EMS agency in which suspected or known alcohol intoxication was documented by prehospital providers were included for analysis in this study. The pre-intervention study period was defined as the 3 Fall semesters prior to implementation of the amnesty program. The post-intervention period was the subsequent 2 Fall semesters. For the purposes of this study, requests for advanced life support (ALS) assistance were used as a surrogate marker for the acuity of illness. The studied collegiate BLS EMS agency by protocol must request ALS for unstable vital signs, a Glasgow Coma Scale score (GCS) of 8 or less, and other predefined conditions. **Results:** Following the introduction of the amnesty program, there was a statistically significant increase in the average volume of alcohol-related calls per day, 0.85 pre-implementation vs. 0.91 post-implementation (mean difference=0.06, $p<0.02$, 95% CI [0.01 to 0.11]). There was no significant difference in the number of daily transports to the emergency department, 0.50 pre-implementation vs. 0.55 post-implementation (mean difference=0.05, $p=0.346$, 95% CI [-0.09 to 0.20]). The timing of calls for service changed, with the median time occurring earlier in evening (1:26AM pre-implementation vs. 12:58AM post-implementation). Finally, there was a significant reduction in the percentage of calls which required ALS resources after amnesty, 10.2% pre-implementation vs. 2.3% post-implementation (OR 0.21, $p<0.03$). **Conclusions:** The implementation of a medical amnesty program at a university with a collegiate-based EMS agency is associated with a higher call volume for alcohol-related medical emergencies, requests for service that occur earlier in the evening, and a reduction in acuity of illness (as suggested by a reduction in the requests for ALS assistance).

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ADEQUACY OF EMS SYSTEMS OF CARE PROTOCOLS FOR ADULTS WITH OHCA, STEMI & STROKE IN RURAL AND NON-RURAL COUNTIES IN OREGON: A STRUCTURED REVIEW

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Background: EMS protocols for prehospital care vary greatly in the US. For Out-of-Hospital Cardiac Arrest (OHCA), STEMI and stroke systems of care, well-developed evidence-based consensus statements and guidelines exist regarding prehospital care. Our objective was to examine rural and non-rural Oregon licensed ambulance protocols for OHCA, STEMI & stroke elements of care. **Methods:** NASEMSO evidence-based guideline and AHA consensus statement recommended care elements were selected for abstraction. For OHCA there were 27 elements abstracted, 20 for STEMI, and 10 for stroke. Oregon licensed ambulance treatment protocols received for OHCA, STEMI and stroke were reviewed in a structured fashion using a piloted data collection tool. Rural EMS agencies were defined as those in counties classified by the State of Oregon as Rural or Frontier. Descriptive statistics and chi-square were used to summarize the findings. **Results:** Protocols were received from 95 Oregon ambulance agencies from 34 of Oregon's 36 counties. There were 31 different protocols used in the 60 rural agencies and 9 different protocols used in the 35 non-rural agencies. At least 75% of the protocols were dated within the prior 4 years, more so in protocols from non-rural agencies compared to rural agencies. Recommended care elements were mentioned or followed variably ranging from 0-100% of the time. Data elements present in all OHCA protocols included initial vasopressor and advanced airway, in all STEMI protocols 12 lead ECG, IV access, nitroglycerin and analgesic administration, and in stroke protocols time of symptom onset. The most common elements lacking from the protocols were specific event times and tidal volumes for ventilations. EMS protocol data element compliance or presence was higher in non-rural agencies compared to rural agencies for OHCA and stroke ($p < 0.05$), but not different for STEMI ($p = 0.053$). **Conclusions:** In Oregon, ambulance protocols for OHCA, STEMI and stroke systems of care were quite varied. Protocols from rural agencies tended to lack elements compared to those from non-rural agencies. Further studies may be of benefit to determine the optimal EMS treatment protocols and how to best implement them throughout the state, to cover both rural and non-rural EMS agencies.

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USE OF THE LUCAS-2 DEVICE IN HELICOPTER EMS: IS IT SAFE?

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Background: Performing CPR in EMS helicopters is difficult. Manual CPR presents a safety hazard because of the necessity to remove safety belts. Lack of a sterile cockpit (everyone and everything secured) during takeoff and landing, violates FAA regulations (FAR 135.100). The purpose of this trial was to evaluate survival before, and following, deployment of the LUCAS device in a helicopter EMS agency to assess its acceptability as a substitute for manual compressions. **Methods:** Patient care records from June 2009 – September 2013 (pre-LUCAS) and October 2012 – January 2016 (post-LUCAS) were identified. Demographics (age, sex), initial cardiac rhythm, patient outcome (survival to ED admission) and duration of in-flight CPR were abstracted. Basic comparisons of continuous variables were completed using unadjusted t-tests and unadjusted Chi-squared for categorical variables. Stratified ANOVAs were calculated to analyze the group differences in CPR time based on patient survival status prior to HEMS leaving the emergency department. **Results:** 109 runs (43 pre-LUCAS and 65 post-LUCAS) were abstracted. Gender (pre, 32% male vs. post, 68% male, $p = 0.015$) and initial rhythm (pre, 24% asystole vs. post, 76% asystole, $p = 0.009$) were significantly different between the study periods. There were no overall differences in age or survival (pre = 77% vs. post = 67%, $p=0.34$) between the study periods. CPR was performed for a significantly longer period of time with the LUCAS compared to standard CPR (pre mean, 8.08 min (SD 7.58) vs. post mean, 14.66 min (SD 11.84), $p = 0.0012$). Despite the fact that CPR was performed for a longer period of time with the LUCAS device, the percent of patients reported alive when HEMS left the ED was not different between the study periods (pre: $F(2,44) = 2.01$, $p=0.15$, post: $F(2,59) = 0.84$, $p=0.44$). **Conclusions:** There was no difference in survival to ED

admission between the two compression methodologies. It appears the LUCAS device is clinically safe, and safer for the crew. In addition, the device allows the agency to be compliant with FAA regulations in the event of inflight cardiac arrests. This study is limited by its small sample size.

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PEDIATRIC DESTINATION DECISION MAKING AMONG PREHOSPITAL PERSONNEL IN MARYLAND: A QUALITATIVE STUDY

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Background: Prehospital triage algorithms have been adopted by EMS agencies to enhance decision making with evidence-based guidelines, improving patient outcomes and reducing overuse/underuse of resources. However, existing prehospital guidelines (CDC Trauma Triage Tree, TTT) lacks details to differentiate many common pediatric injuries. Little is known about how EMS providers utilize the TTT for children or how providers feel about destination guidance tools. Our objective was to understand how prehospital providers utilize current triage tools and make destination decisions in clinical situations not addressed by current tools. To gather provider experiences and opinions to guide revision of current tools and creation of novel pediatric triage tools. **Methods:** We administered an electronic survey to a random sample of current Maryland EMS providers. 217 providers completed the survey, 67 volunteered to participate in in-depth interviews (IDI), and 36 participants were randomly selected from defined demographic groups. IDIs were conducted by phone using a semi-structured interview guide exploring experiences with pediatric destination decisions, attitudes about current and hypothetical pediatric triage tools, and decision-making on four hypothetical clinical scenarios. Interviews were transcribed verbatim. Focused coding of transcripts by line organized responses to identify pertinent themes. **Results:** 36 IDI were completed (average 40 minutes). Providers were split between ALS/BLS (19/17), Urban/Rural (22/14) and career/volunteer (21/15). Providers indicated that when a pediatric center was within 30 minutes, they would opt to transport children with severe conditions (require surgery, multi-system trauma or neonates), prior medical problems or parent request directly to the pediatric center. Providers indicated that they want more guidance on capabilities of destination hospitals. Providers had mixed feelings about the existing TTT, finding it useful but lacking specific details about pediatric conditions. Providers felt a pediatric triage tool would be very useful, suggested content included chronic conditions (congenital heart disease, seizures, asthma), normal pediatric vital signs, capabilities of different facilities to handle pediatric cases, and that the tool be provided as an “app” or other easily accessible format. **Conclusions:** EMS providers are dissatisfied with using current triage tools for pediatric patients. A pediatric triage tool with specific evidence-based guidance on destination would be welcomed by providers.

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THE BURDEN OF EMERGENCY MEDICAL SERVICES CARE FOR DIALYSIS PATIENTS

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Background: Patients receiving chronic dialysis often require inpatient and emergent care, however little is known about their prehospital/inter-hospital use of Emergency Medical Services (EMS). The purpose of this study was to describe the utilization of EMS in a cohort of dialysis patients. **Methods:** A retrospective cohort study was conducted of adult (≥ 18 years), chronic dialysis patients within the Nova Scotia Health Authority renal program from January 1, 2009-December 31, 2013 (last follow up 01 July 2015). Dialysis patient data was linked to provincial Emergency Health Services (EHS) data. Requests for EMS, including encounter type, day of the week, frequency, severity and type of presenting complaints were described. **Results:** The cohort consisted of 468 patients of whom 80% (N=375) had an EMS encounter. Between 2009-2015 there were a total of 10823 EMS encounters. Transfers (including those between facilities for dialysis treatments) accounted for 91% of all encounters (N=9833), followed by treated and transported (N=782, 7%). Only a minority of the cohort (<2%) did not require transportation

to hospital. Among patients that were treated and transported the most frequent complaints were respiratory distress (13%), chest pain (12%) and general malaise (10%). Median time at scene was 23 minutes (interquartile range, 17-30). Of the treated and transported cohort, 9% required code 1 (emergent transport) to the nearest appropriate facility. Most emergent EHS transports occurred on Monday (17%) and Tuesday (18%) both of which typically occur two days after the patient's last dialysis treatment. **Conclusions:** Utilization of EMS services by dialysis patients is considerable, particularly for facility transfers. This highlights a potential area to be targeted for reducing resource utilization. Calls requiring treatment and transport occurred more often after the long-dialysis break, and call for a potential reevaluation of EMS system status plans.

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PEDIATRIC PALLIATIVE CARE IN NOVA SCOTIA: USE OF AN OUT-OF-HOSPITAL SPECIAL PATIENT PROGRAM ADMINISTERED BY PARAMEDICS

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Background: Children with life-limiting illnesses are increasingly dying at home. Challenges to enrolling children in palliative home care programs include the fear that pain and distressing symptoms at end of life cannot be adequately managed outside hospital. In Nova Scotia, Canada, paramedics follow individualized care plans through the Emergency Health Services (EHS) provincial Special Patient Program (SPP) to avoid unnecessary treatment or transport and to reassure caregivers. The objective of this project was to describe EMS utilization, location of care and death to improve understanding of paramedics' role in this population's care. **Methods:** Retrospective hospital and EHS chart review of pediatric patients enrolled in the EHS SPP and the palliative care program at the children's hospital (n=21) from 2009 to 2015. Data were extracted on reason for EMS call, use of SPP care plans, location of death, pediatric palliative team phone calls, home visits and demographic data. **Results:** Twenty-one patients (17 males, 4 females) were enrolled in both programs in the study. Median age at time of receiving a DNAR was 11 years (IQR 3.5-14). Primary diagnoses included disorders of the nervous system (43%), malignancies (38%) and perinatal conditions or congenital anomalies (19%). Total EMS encounters were 49 (median of 1, IQR 0-3.5) with 35 (71%) calls qualifying for care plan use. Paramedics attempted/followed care plans 94% of the time. Seizures (active and postictal) were the most common reason for calling 911 (47%). The majority of patients were transported to hospital (80%). Reasons for interacting with the pediatric palliative team included check ups and pain management but were few in numbers (median of 0, IQR 0- 2). The majority of patients died in hospital (60%), with 80% of patients who wished to die at home dying in that location. **Conclusions:** There is little research concerning EMS agencies with palliative care protocols, particularly concerning pediatric patients. Our data demonstrates that prehospital emergency treatment is rare in this population and often results in transport to hospital. With an increasing number of pediatric patients wishing to die at home, more research is required to determine if existing prehospital services meet this populations' needs.

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A RETROSPECTIVE COMPARISON OF THE KING LARYNGEAL TUBE AND IGEL AIRWAYS IN OUT-OF-HOSPITAL CARDIAC ARREST: INITIAL EXPERIENCE IN A SINGLE EMS SYSTEM

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Background: Supraglottic airways have been used for first-line airway management in out-of-hospital cardiac arrest (OHCA), offering possible advantages of high success rates and potential for insertion without chest compression interruption. Few studies have compared effectiveness of supraglottic airways in OHCA. The study objective was to compare the King-LTS-D and I-gel airways in OHCA. **Methods:** This retrospective analysis of data obtained from a countywide EMS system (population ~250,000) compared the King-LTS-D and I-gel airways, used first-line in OHCA. This system changed from the King-LTS-D to the I-gel on 10/1/2015. Data for the I-gel were analyzed for a 6-month period beginning 10/1/2015 and compared to the King-LTS-D for the same 6-month period beginning

10/1/2014. Data were obtained through the state EMS information system. Individual records were manually reviewed. Cases were included when either device was used as the first-line airway for OHCA, and excluded if used in non-OHCA. The primary outcome was first-pass success rate. Secondary outcomes were final success, return of spontaneous circulation (ROSC), and neurologically favorable discharge (cerebral performance categories 1 or 2) rates. Waveform capnography (ETCO₂) was primarily used to confirm success. A non-inferiority chi-square analysis was performed with a significance of 0.05. **Results:** There were 88 King-LTS-D and 113 I-gel uses during the respective study periods. King-LTS-D and I-gel patients were similar in age (65.4 vs. 62.7 years, $p=0.146$) and gender (53.4% vs. 60.2% male, $p=0.926$). First-pass success rate was 81.8% for the King-LTS-D vs. 92.0% for the I-gel ($p=0.018$). Success confirmed by ETCO₂ was comparable between both groups (90.9% vs. 93.8%, $p=0.438$). The first-pass and final success rates with the I-gel were respectively estimated to be 10.2% (95% CI: 0.6, 19.7) and 11.0% (1.7%, 20.4%) higher than the King-LTS-D. Non-inferiority was not demonstrated between the King-LTS-D and the I-gel for ROSC (38.6% vs. 37.3%, $p=0.441$) and neurologically favorable hospital discharge rate (7.0% vs. 12.0%, $p=0.838$). **Conclusions:** In OHCA, the I-gel airway was found to be non-inferior to the King-LT airway for first-pass and final success rates. Non-inferiority was not demonstrated for ROSC or neurologically favorable hospital discharge rates. Our results support continued study of the I-gel airway in OHCA.

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PREHOSPITAL RECURRENT VENTRICULAR FIBRILLATION CARDIAC ARRESTS TREATED WITH BETA-ADRENERGIC BLOCKERS

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Background: Many methods exist in ACLS guidelines for prehospital providers treating VF. VF is best treated with early defibrillation. Recurrent VF can be treated with anti-arrhythmic medications, additional defibrillations and/or double sequential defibrillation. The current evidence in prehospital cardiac arrests regarding the use of metoprolol is not as robust as the research for in-hospital episodes of VF arrests. **Methods:** All cardiac arrests in a major urban EMS system from January 2014 to December 2015 were retrospectively analyzed. The data was prospectively collected in a comprehensive cardiac arrest database by the Office of the Medical Director. The data was evaluated for independent variables in the prehospital setting of recurrent ventricular fibrillation, as well as compared with basic demographic measurements. **Results:** A total of 2362 cardiac arrests were identified in the selected time period. A total of 117 cases of recurrent VF were identified by review of Patient Care Reports. 11 of these were treated with metoprolol. All of those had previously received amiodarone, calcium chloride, vasopressin, and sodium bicarbonate during the course of resuscitation. Patients treated with metoprolol had uniformly fatal results, compared to the other group that had 17 out of 106 (16.03%) survive to hospital admission. Age ($p=0.29$ [-4.0—13.1]), initial end tidal CO₂ ($p=0.27$ [0.20—5.7]), and total EMS epinephrine 1mg doses ($p=0.087$ [-2.2—0.15]) were not statistically significant variables with respective P values and 95% CI shown. Total EMS shocks delivered did reach statistical significance with $p=0.02$, but with 95% CI of [-2.91—0.27]. **Conclusions:** Data suggest less survival to hospital admission when metoprolol is administered for this subset of OHCA patients. Anti-arrhythmic therapy for recurrent ventricular fibrillation in prehospital cardiac arrests could benefit from larger, multi-center studies in order to examine the benefit, if any, of using this class of drugs in the prehospital setting.

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SAFETY AND CLINICALLY IMPORTANT EVENTS IN PCP-INITIATED STEMI BYPASS IN OTTAWA: A HEALTH RECORD REVIEW

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Background: In Ottawa, STEMI patients are transported directly to percutaneous coronary intervention (PCI) by advanced care paramedics (ACPs), primary care paramedics (PCPs), or transferred from PCP to ACP crew (ACP-intercept). PCPs have a limited skill set to address complications during transport. Our

objective was to determine what clinically important events (CIEs) occurred in STEMI patients transported for primary PCI via a PCP crew, and what proportion of such events could only be treated by ACP protocols. **Methods:** We conducted a health record review of STEMI patients transported for primary PCI from Jan 1, 2011 – Dec 21, 2015. Ottawa has a single PCI center and its EMS system employs both PCP and ACP paramedics. We identified consecutive STEMI bypass patients transported by PCP-only and ACP-intercept using the dispatch database. A data extraction form was piloted and used to extract patient demographics, transport times, and primary outcomes: CIEs and interventions performed during transport, and secondary outcomes: hospital diagnosis, and mortality. CIEs were reviewed by two investigators to determine if they would be treated differently by ACP protocols. We present descriptive statistics. **Results:** We identified 967 STEMI bypass cases among which 214 (118 PCP-only and 96 ACP-intercept) met all inclusion criteria. Characteristics were: mean age 61.4 years, 78% male, 31.8% anterior and 44.4% inferior infarcts, mean response time 6 min, total paramedic contact time 29 min, and in cases of ACP-intercept 7 min of PCP-only contact time. A CIE occurred in 127 (59%) of cases: SBP100 20.6%, malignant arrhythmias 7.5%, altered mental status 6.5%, airway intervention 2.3%, 2 patients (0.9%) arrested, both survived. Of the CIE identified, 54 (42.5%) could be addressed differently by ACP vs. PCP protocols (25.2% of total cases). The majority related to fluid boluses for hypotension (44 cases, 35% of CIE). There were 6 in-hospital deaths (2.8%) with no difference in transport crew type. **Conclusions:** CIEs are common in STEMI bypass patients however a smaller proportion of such CIE would be addressed differently by ACP protocols compared to PCP protocols. The vast majority of CIE appeared to be of limited clinical significance.

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DOES THE REASON FOR CALLING 911 AFFECT PATIENTS' CONFIDENCE IN PARAMEDIC RECOMMENDATIONS?

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Background: In 2015, the Orange County Fire Chiefs Association launched the Alternate Destinations Pilot Project, allowing experienced and trained paramedics to offer selected low-acuity patients transport to Urgent Care Centers (UCC) instead of Emergency Departments (ED). Program opponents have asserted that redirection of low-acuity patients to UCC may result in dissatisfaction with prehospital and general care. The study objective was to determine whether patient-stated reasons for calling 911 affected patient satisfaction with paramedic care or confidence in paramedic recommendations. **Methods:** Alternate Destination Paramedics (ADP) received 4 hours of continuing education on evaluating low acuity patients for UCC disposition and on the consent process. Eligible patients were defined as those with isolated extremity injury, soft tissue infection, laceration with controlled bleeding, cough, and/or fever who were deemed appropriate for UCC by an ADP. Eligible patients contacted during UCC operating hours were offered enrollment in the OCFCA pilot study and after enrollment were offered transport to UCC. Outcomes for enrolled patients were determined regardless of chosen destination (UCC, ED, or transport refusal). Scripted phone follow-up surveys were performed 96 hours after enrollment to assess patient satisfaction, reason for 911 call, and treatment outcomes. **Results:** We report interim results of the 24-month pilot project. In the first seven months of operation, ADPs offered enrollment to 39 patients of whom 69.2% were enrolled. Phone follow-up was completed in 81.5% of enrolled patients. Most patients endorsed more than one reason for calling 911, with the most common reasons for calling 911 being fear of possible life threatening condition and desire to be evaluated by a paramedic. All patients reported satisfaction with ADP care and 86.4% (CI 73.5% - 99.3%) reported confidence in the ADP UCC recommendation. **Conclusions:** Preliminary data demonstrate patient trust in paramedics as medical providers and post-event satisfaction with care, regardless of reason for 911 call or disposition outcome. If these results are borne out in larger cohorts, the findings may mitigate provider concerns that redirection of calls will decrease public satisfaction and confidence in prehospital care.

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SAFETY AND COMPLIANCE WITH AN EMS DIRECT TRANSPORT PROTOCOL TO A WITHDRAWAL MANAGEMENT FACILITY VS. EMERGENCY DEPARTMENT

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Background: Transportation to alternative destinations (diversion) has been proposed as part of a resolution to overcrowding in hospital emergency departments (ED). We aimed to evaluate compliance and safety of an EMS protocol allowing paramedics to transport medically stable intoxicated patients to an alternate facility, Withdrawal Management Services (WMS). Patients were eligible for diversion if they were ≥ 18 years old, scored <4 on the modified Prehospital Early Warning (PHEW) score, and did not have any vital sign parameters in the red zone (as per PHEW score criteria). We hypothesize this protocol is safe for the prehospital diversion of intoxicated patients. **Methods:** A retrospective analysis was conducted on patients presenting to EMS with alcohol intoxication from June 1, 2015 - May 31, 2016. Study outcomes were: missed protocol opportunities, protocol noncompliance, protocol failure (presentation to ED within 48 hours of appropriate diversion), and patient morbidity (hospital admission or adverse event within 48 hours of diversion). Data was abstracted from EMS reports, hospital records, and WMS discharge forms. Data was analyzed using proportions and 95% confidence intervals. **Results:** EMS responded to 681 calls for intoxication, 568 were taken to the ED and 113 were diverted. Of the 568 transported to ED, 65 (11%) could have been diverted to WMS, these are cases of missed protocol opportunity. Of the 113 diversions, there was protocol noncompliance in 41 cases (36%), but 35 were due to incomplete sets of vital signs. Another 5 (12%) diversions involved vital signs documented outside allowed limits. 8 patients (20%) from the protocol noncompliance group presented to ED within 48 hours of diversion, none were admitted. Protocol failure occurred in 16 patients (22%), of which 1 was admitted. Overall, 24 patients (21%) presented to the ED after diversion, and 1 (1%) was admitted. **Conclusions:** EMS providers had high protocol compliance when transporting patients directly to the ED. There was some protocol non-compliance in diverting patients to WMS, largely attributed to incomplete recording of vital signs. The protocol causes low levels of morbidity in diverted patients. Broader implementation of the protocol could reduce the volume of intoxicated patients in the ED.

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SAFETY AND COMPLIANCE WITH AN EMS DIRECT TRANSPORT PROTOCOL TO A MENTAL HEALTH FACILITY VS. EMERGENCY DEPARTMENT

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Background: Transportation to alternative destinations (diversion) has been proposed as part of a resolution to overcrowding in hospital emergency departments (ED). We aimed to evaluate compliance and safety of an EMS protocol allowing paramedics to transport medically stable mental health patients to an alternate facility, Crisis Intervention (CI). Patients were eligible for diversion if they were ≥ 18 years old, scored <4 on the modified Prehospital Early Warning (PHEW) score, and did not have any vital sign parameters in the red zone (as per PHEW score criteria). We hypothesize this protocol is safe for the prehospital diversion of mental health patients. **Methods:** A retrospective analysis was conducted on patients presenting to EMS with psychiatric complaints. Study outcomes were: missed protocol opportunities, protocol noncompliance, protocol failure (presentation to ED within 48 hours of appropriate diversion), and patient morbidity (hospital admission or adverse event within 48 hours of diversion). Data was abstracted from EMS reports, hospital records, and CI discharge forms. Data was analyzed using proportions and 95% confidence intervals. **Results:** EMS responded to 695 calls with psychiatric complaints, 650 were taken to the ED and 45 were diverted. Of the 650 patients taken to ED, 18 (3%) could have been diverted to CI, these are missed protocol opportunities. Of the 45 diversions, there was protocol noncompliance in 36 cases (80%), but 34 were due to incomplete sets of vital signs. Only 1 (3%) diversion involved vital signs documented outside allowed limits. 13 patients (36%) from the protocol noncompliance group presented to ED within 48 hours of diversion, 6 were admitted. Protocol failure occurred in 3 patients (33%) who met diversion criteria but presented to ED within 48 hours, 2 of

which were admitted. Overall, 16 patients (36%) presented to the ED after diversion, and 8 (18%) were admitted. **Conclusions:** EMS providers had high levels of compliance with the protocol when taking patients straight to the ED. There was poor protocol compliance in diverting patients to an alternate destination, though this is largely attributed to incomplete recording of vital signs. The protocol provides moderate levels of safety in diverted patients.

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A FOUNDATION FOR DEVELOPING NEW NON-TRAUMA PEDIATRIC DIRECT TRANSPORT PROTOCOLS

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Background: Emergency medical services (EMS) typically transports patients to the nearest emergency department (ED). After initial presentation, children needing specialized care must undergo secondary transport, exposing them to additional risks and delaying definitive care. EMS direct transport protocols exist for trauma and certain adult medical conditions, however the same cannot be said for non-trauma pediatric patients. To build such protocols, the non-trauma pediatric secondary transport population must first be analyzed, and criteria for direct transport candidates must be identified. **Methods:** Pediatric secondary transport patients aged 0-18 years were identified by deterministic linkage. Patients meeting state EMS trauma protocol criteria or who were clinically unstable were excluded. Data were abstracted by chart review of EMS, community hospital ED, and specialty hospital records. Patients were compared with condition-matched controls who did not require secondary transport. **Results:** Deterministic linkage identified 211 non-trauma pediatric secondary transport patients between 2013 and 2014. Over half (60%) had one or more pre-existing medical conditions. Patients traveled a median of 7.6 km by EMS to the receiving community hospital, a median of 27.0 km from the community hospital to the specialty hospital, and would have traveled a median of 27.2 km by EMS directly to the specialty hospital. The three most prevalent conditions were seizures (n=52), isolated orthopedic injuries (n=49), and asthma/respiratory distress (n=27). For seizure patients, online medical direction (OR=11.5), glucose measurement (OR=2.9), tracheostomy care (OR=17.8) and administration of either midazolam (OR=2.3) or supplemental oxygen (OR=150.8) were significant for secondary transport. For orthopedic injury patients, splinting was significant (OR=3.3). For patients with asthma/respiratory distress, online medical direction (OR=4.1), tracheostomy care (OR=36.2) and administration of supplemental oxygen (OR=22.7) were significant. **Conclusions:** Children with seizures, isolated orthopedic injuries, and asthma/respiratory distress comprised the majority of the non-trauma pediatric secondary transport population. Each of those three conditions had one or more significant predictors of secondary transport identified during the initial EMS assessment. This study provides an essential foundation for building new pediatric direct transport protocols.

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PARAMEDICS' PERSPECTIVES ON INTRAMUSCULAR KETAMINE PROTOCOL FOR EXCITED DELIRIUM

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Background: Patients with excited delirium pose a safety hazard for EMS providers due to their severe agitation and combative behavior. While both patient and provider safety have been shown to be priorities when discussing choice of sedative medications in the prehospital setting, none have assessed the opinions of paramedics. Our EMS agency implemented a protocol for intramuscular ketamine administration for excited delirium in July 2013. Prior to this, paramedics were required to complete video and protocol review in addition to passing a written exam. After 3 years of the protocol in place, we surveyed paramedic providers to understand their perspective on education, provider and patient safety, and satisfaction of usage of this protocol. **Methods:** A 17-question survey was developed and distributed to paramedic providers in large, urban EMS system. The anonymous and optional survey was distributed by email and completed in Survey Monkey. **Results:** The survey was completed by 145 paramedics, with a response rate of 71%. 61% of paramedics reported over 5 years prior experience. 78% of paramedics reported administering ketamine at least once in the past, while 21% reported giving

the medication over 3 times. The medication was given 248 times over the 3 years since inception of the protocol. 89% of survey respondents believed their training was sufficient prior to using the medication, and 74% felt comfortable identifying patients with excited delirium. Overall, 89% indicated they were satisfied with ketamine as a treatment for excited delirium, with 91% of providers stating that it is superior in creating a safe environment for patients, and 92% stating that it is superior in creating a safe environment for EMS providers when compared to other sedative medications. **Conclusions:** After adequate training, paramedics in our system believe that ketamine is superior in creating a safer prehospital environment for both patients and EMS providers when compared to other sedatives for the treatment of excited delirium. Future studies will examine if the perceived increase in safety is related to an actual decrease in harm to patients and providers.

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THE USE OF NORTH CAROLINA TRAUMA TRIAGE DESTINATION PLANS IN THE PREHOSPITAL CARE OF GERIATRIC TRAUMA PATIENTS

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Background: As the number of geriatric trauma cases rises with a growing population, EMS must increasingly make complex decisions regarding who needs trauma center care. As a result, North Carolina (NC) implemented statewide Trauma Triage Destination Plans (TTDPs) to objectify EMS decision-making. Little research exists describing their effectiveness, especially in relation to geriatric trauma patients. We investigate the impact of the NC TTDP on EMS triage of geriatric trauma patients. **Methods:** This was a retrospective cohort study of geriatric trauma patients transported by EMS between 03-01-2009 to 09-30-2009 (pre-TTDP) and 03-01-2010 to 09-30-2010 (post-TTDP). Patient criteria included: 1. Age 50 years or older, 2. Transported to a hospital by NC EMS, 3. Experienced an injury, and 4. Met NC TTDP physiologic criteria for trauma. Data were collected from the Prehospital Medical Information System (PreMIS). Data collected included transport, destination, patient, and injury characteristics. **Results:** Pre-TTDP, 31.3% of patients were transported to trauma centers compared to 28.8% ($p < 0.05$) post-TTDP. Pre-TTDP, 39.5% of 50-59 year olds and 26.3% of those ≥ 80 were transported to trauma centers compared to 37.2% of 50-59 year olds and 23.1% of those ≥ 80 post-TTDP. When looking at physiologic triage criteria, patients with a systolic blood pressure < 90 mmHg were transported to trauma centers 44.8% of the time pre-TTDP and 41.8% of the time post-TTDP ($p < 0.05$). Patients with a respiratory rate < 10 or > 29 were transported to trauma centers 45.8% of the time pre-TTDP and 42.7% of the time post-TTDP ($p < 0.05$). Patients with a Glasgow Coma Score < 13 were transported to trauma centers 32.9% of the time pre-TTDP and post-TTDP 29.9% of the time ($p < 0.05$). **Conclusions:** Despite published guidelines, undertriage of geriatric trauma patients is prevalent and corroborates a national trend. Evidence suggests geriatric trauma patients who meet field triage physiologic criteria are inappropriately transported to non-trauma centers. Research to understand the uptake of guidelines and protocols into EMS practice is critical to improving care in the prehospital environment.

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A NOVEL EMERGENCY MEDICINE RESIDENT TRAINING PROGRAM FOR ON-LINE MEDICAL CONTROL

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Background: On-line medical command (OLMC) occurs when Emergency Medicine (EM) physicians aid emergency medical services (EMS) providers by giving guidance in difficult cases when field protocols either mandate direct physician contact or protocols are insufficient to guide patient care. While training in OLMC is required for EM residencies, there is no literature describing standardized training for this process. The purpose of this educational study was to design, deliver, and evaluate an innovative OLMC curriculum for the purpose of training residents to better handle calls from providers in the field and to improve resident comfort and confidence with answering OLMC calls. **Methods:** Participating PGY2 EM

residents (N=11) were given a local OLMC handbook to review one week prior to the educational session. At the start of the session they listened to two simulated OLMC calls of patient transport refusals and rated the critical actions of each on a checklist which served as the pretest. During the session, residents individually took simulated OLMC refusal calls on speakerphone with a paramedic. Faculty observers rated each call using the checklist from the pretest. After all simulated calls were completed, participants took a post-test, which consisted of rating 2 additional recorded calls. The tests were analyzed and resident confidence and comfort with handling OLMC calls were described before and after based on questionnaire responses using Wilcoxon Signed Rank test. **Results:** Data analysis demonstrated improvement in learner knowledge from pre- and post-intervention questionnaire data as scored on a 5-point Likert scale, with increased comfort and confidence in their ability to handle OLMC refusal calls (2.9 to 4.55, $p < 0.05$), and in determining a patient's capacity over the phone (2.82 to 4.55, $p < 0.05$). All learners strongly agreed that the session was relevant to their needs. **Conclusions:** Improvements in resident knowledge, confidence and comfort in handling OLMC calls after completing this training course illustrate the success of our curriculum. Though limited by a small sample size and testing at a single center, we believe that this program addresses the gap in resident training for OLMC by providing a standardized curriculum.

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FACTORS ASSOCIATED WITH EMERGENCY MEDICAL SERVICES UTILIZATION AMONG ROAD TRAFFIC INJURIES DURING THAI LONG HOLIDAY PERIODS: A NATIONWIDE REGISTRY

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Background: Road traffic injuries (RTI), which cause fatality and serious morbidities, usually have higher incident rates during long Thai holiday periods such as the New Year and Songkran holidays. Emergency Medical Services (EMS) plays a major role in resuscitating and transporting patients to definite care. However, there was little data describing factors of EMS utilization among RTI during these holiday events. We sought to determine factors associated with EMS utilization among RTI during Thai long holiday periods. **Methods:** We conducted a cross-sectional study by using a pre-existing database called Information Technology Emergency Medical Services (ITEMS) from the National Institute for Emergency Medicine (NIEM) Thailand. The database collected RTI data from all hospitals in Thailand during New Year holidays in 2008 – 2015 and Songkran holidays in 2008 – 2014. We excluded patients who died on the scene, were not transported to an emergency department (ED), or had missing data from analysis. Seventy-six provincial codes were grouped into 13 Thai Areas Health (AH). Factors associated with EMS utilization were identified by using multiple logistic regressions. **Results:** In total, 363,453 patients were in the final analysis, of which 88,578 patients (24.37%, 95%CI 24.23% - 24.51%) used EMS transportation to hospitals. Patients who had accidents on highways had 48% greater odds of EMS utilization relative to accidents on city roads (OR 1.48, 95%CI 1.45 – 1.51). When compared with AH 13, which is Bangkok, other areas had greater odds of EMS utilization which ranged from OR 1.42 (95%CI 1.29 – 1.55) in Area 4 to OR 5.88 (95%CI 5.38 - 6.45) in Area 10. There were gradual increasing odds of EMS utilization from holidays in 2009 (OR 1.26, 95%CI 1.21 – 1.30) to holidays in 2015 (OR 2.53, 95%CI 2.44 – 2.63). **Conclusions:** Accidents on highways was a factor that lead to the increase of EMS utilization during long Thai holiday periods. There were a variety of EMS utilization among AHs in Thailand. EMS utilization has been gradually increasing every year since 2008. These results might be used to manage EMS resources effectively to prevent fatality and serious morbidity in the future.

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DOES METRONOME-GUIDED CARDIOPULMONARY RESUSCITATION IMPROVE THE QUALITY OF BYSTANDER CHEST COMPRESSION

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Background: Cardiopulmonary resuscitation is an important lifesaving procedure that can be effectively taught to anyone. Evidence has shown us that bystander CPR and performing high quality chest compression serves as predictors of survival. The 2010 & 2015 American Heart Association guidelines emphasized on the importance high quality CPR for survival, describing it as the corner stones for the system of cares that can optimize outcome beyond ROSC. In this study we are trying to see if bystander use of metronome guided defibrillators and AEDs will help them perform higher quality CPR and thus improve patient outcome. **Methods:** This is a prospective observational study in which we are trying to compare chest compression quality data (rate, depth, and fraction) with and without feedback from metronome guided CPR. Data were collected during CPR teaching classes for first year college students (preparatory program). The Data was used to calculate the in-target chest compression percentage which for the purposes of this study defined as the percentage of chest compressions reaching the 2015 AHA guidelines for rate (100 -120/min), depth (2 – 2.4 inches) and fraction (60-80%). **Results:** We included data from 516 manikins simulated CPR. All chest compression were recorded through metronome guided devices looking at appropriate depth, rate and fraction then calculating the in-target chest compression percentage. Each candidate were asked to preform one cycle of CPR without receiving any feedback for the quality of their chest compression's followed by one cycle of CPR with feedback from the metronome guided device. 30 percent of chest compression were in-target of 2015 AHA guided CPR when preformed without feedback .The in-target chest compression reached 71 percent when preformed with assisted feedback. **Conclusions:** Feedback for quality of chest compression improved CPR performance. In this, study metronome guided CPR device improved the percentage of in-target chest compression's for bystander CPR. These simulated sessions have shown that providing feedback to bystander CPR through these metronome guided Devices gave higher quality chest compression's and thus potential for improvement of survival.

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MOBILE INTEGRATED HEALTHCARE IN AN ACUTELY ILL MEDICARE COHORT: A DESCRIPTIVE STUDY

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Background: A variety of models around the Country deploy mobile integrated healthcare (MIH) in an attempt to reduce EMS frequent user transports, prevent readmissions and reduce ED visits. This unfunded MIH program sought to evaluate the effectiveness of such a program amongst an acutely ill Medicare cohort. **Methods:** Patients belonging to a single practice management services organization (MSO) were followed over a 12-month period. This Medicare cohort had multiple comorbidities resulting in acute episodic visits by an unfunded MIH program utilizing critical care paramedics with physician oversight. The MIH field provider functioned at the discretion of the MSO physician and had the ability to perform POC blood and urine tests, EKGs, and was able to administer oral and/or parenteral medications. **Results:** A total of 506 acute episodic MIH encounters occurred in a 12-month period from June 2015 through May 2016. Mean age of the overall cohort was 74.5 years (Range 29-105 years) and 61% were female. Mean response time (dispatched to arrival on scene) was 33.1 min (Range 4-125 min) and mean time on scene was 69.7 min (Range 5-541 min). The top 4 diagnostic groupings were gastrointestinal (n=73), cardiac (n=64), labs/vitals request (n=69), and medication administration (n=49). Medications were administered to 212 patients (41.9%), EKG performed in 168 patients (33.2%), IV placed in 53 patients (10.5%), and POC labs were performed in 73 patients (14.4%). A total of 426 patients (84.2%) remained at home and avoided an acute ED visit. Sixteen patients (3.1%) were transported to the PCP office and 64 patients (12.6%) required transportation to the emergency department. Of the 64 ED transports, 10 patients (15.6%) were transported by municipal 911 services. The most common category of ED transports was cardiac (25%) followed by gastrointestinal (17%) and neurologic (12.5%). Patients and field providers reported no adverse events. With the average ED visit of \$3000, cost savings is estimated at \$1.4 million. **Conclusions:** This study describes a highly successful, unfunded MIH program geared towards acutely ill Medicare patients with multiple comorbidities. An overwhelming majority of these patients were successfully managed at home, avoiding costly ED visits and hospital admissions.

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PARAMEDIC 12-LEAD ECG AND THE FREQUENCY OF STEMI IN PATIENTS WITH AND WITHOUT CHEST PAIN

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Background: The American Heart Association recommends paramedics perform a prehospital 12-lead ECG (PHTL) for patients exhibiting symptoms consistent with acute myocardial infarction (AMI) as it has been shown to reduce mortality in STEMI patients. Symptoms of AMI may include chest pain, dyspnea, nausea, general fatigue, or others. Although many patients have chest pain, this is not required for the diagnosis of an AMI. The purpose of this study is to determine the frequency of STEMI for patients with chest pain compared to those without chest pain. **Methods:** We performed a retrospective review of paramedic calls where a PHTL was performed in one Canadian EMS agency during an 18-month period between October 2013 and March 2015 – the first four months are included in this initial analysis. Data was abstracted from the paramedic medical records (PMR) including the paramedic-reported presenting concern. Final diagnosis of STEMI or other cardiac/medical was determined by in-hospital chart review. The frequency of STEMI was determined for the most common presenting concerns where the paramedic performed a PHTL. **Results:** A total of 219 cases were included, with 80 (37%) being performed for chest pain. The four most common presenting concerns were chest pain, other medical, general weakness and dyspnea. The number of patients and the frequency of STEMI for each category (number, frequency) were: chest pain (80, 15%), other medical (54, 5%), general weakness (45, 0%) and dyspnea (40, 5%). 75% of all STEMIs presented with chest pain. There was a significant difference (chi-squared $p=0.0078$) between the frequency of STEMI in chest pain patients compared to the other presenting concerns. **Conclusions:** This initial analysis suggests despite 63% of the PHTLs being performed for patients without chest pain, fewer than 25% of STEMIs presented in these patients. The very low frequency of STEMI in patients without chest pain in this interim data needs to be confirmed with the full dataset; however, the frequency in some presenting concerns may be so low that the benefit of a PHTL may be limited.

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INFLUENCE OF MECHANISMS OF INJURY AND SIGNS OF HEAD INJURY ON FIELD TRIAGE OF INJURED OLDER ADULTS

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Background: Older adults are more likely to be transported to a non-trauma center by prehospital emergency medical services (EMS) compared to younger adults with similar injuries. Little is known regarding EMS provider decision-making processes for triaging older adults, especially those at high-risk for head injury. Our objective was to determine whether mechanisms of injury and signs of head injury influence EMS providers' decision to transport patients to a trauma center. **Methods:** We conducted a prospective multi-center study, encompassing all four hospital within the community, one of which was a designated level I trauma center. All injured older adults (age 55 or older) transported by EMS were eligible regardless of injury severity. Trained research assistants interviewed each patient's EMS provider using a standardized survey to assess mechanism of injury and signs of injury to the head. **Results:** Descriptive statistics were used to characterize the study sample and chi-square tests, using Fishers Exact tests where appropriate, were used to assess for differences according to destination hospital. Data from 2,943 subjects were analyzed, median age was 77 years and 61% were female. Transport to a trauma center vs. non-trauma center differed significantly by mechanism of injury ($p<0.0001$). Patients with the following mechanisms of injury were most frequently transported to a trauma center: motorcycle crash (90%), bicyclist/pedestrian struck (73%), and motor vehicle crash (53%), whereas falls were less frequently transported to a trauma center (29%). Nearly one-third (30%) of patients had at least one sign of a head injury. Patients with open skull fracture (80% vs. 20%, $p<0.05$),

depressed skull fracture (75% vs. 25%, $p=0.001$), deep laceration (53% vs. 47%, $p<0.0001$), and behavioral changes (53% vs. 47%, $p<0.0001$) were more frequently transported to a trauma center compared to patients without these injuries. **Conclusions:** Despite growing evidence that older adults have poor outcomes with minor injuries and low-energy mechanisms of injury, such as falls, we found that older adults having high-energy mechanisms and obvious anatomic injuries were more likely to be transported to a trauma center.

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PREHOSPITAL KETAMINE FOR CHEMICAL RESTRAINT OF ACUTE VIOLENT / COMBATIVE PATIENTS: "TREATING THE UNTREATABLE FOR 5 YEARS"

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Background: Emergency Medical Services (EMS) encounters severely violent/combatative patients suspected of Excited Delirium Syndrome (ExDS). ExDS represents a true life threatening medical emergency with high potential of respiratory depression, declining consciousness and cardiac arrest. Urgent and critical prehospital care cannot be provided to this subset of patient's until the aggressive behavior is controlled. At present, there are scarce EMS studies of Ketamine practice and effects in a large population. The purpose of this study is to measure the number of violent/combatative patients who were medically managed (pharmacologically sedated) by paramedics using a Ketamine patient restraint protocol (PRP). **Methods:** This retrospective study included all PRP patients receiving prehospital Ketamine by paramedics in a countywide EMS system from August 2010 to March 2016. Ketamine administration indications were for rapid control of violent/agitated patients requiring medical intervention, with dosing of 4 mg/kg intramuscular and 2 mg/kg intravenous. Medically managed was defined by the National Association of EMS Physicians position paper on patient restraint in EMS systems, as adequate chemical restraint to decrease agitation and increase the cooperation of patients who require care and transportation. Extracted ePCR data included response to medication, route, dosing, advanced life support (ALS) assessment performed and transport. Descriptive statistics were utilized to describe study characteristics and a 95% confidence interval was calculated for patients who were medically managed. **Results:** All 431 patients were included, of these 100% (95%CI 99%-100%) were medically managed. The mean age was 36 years (range 13-81 years), 287(67%) patients were male with a mean weight of 81kg. The first ketamine, mean dose was 270 mg (range 40- 550 mg), administration routes were 339(79%) intermuscular and 92(21%) intravenous. We observed improvement after the first dose in 389(90.3%) of patients, 36 cases (8.3%) were unchanged and 6 cases (1.4 %) had worsening of the clinical condition. There were 77(23%) of patients who received multiple doses. **Conclusions:** In this population the Ketamine PRP used by EMS for violent and severely agitated patents was effective for facilitating restraint to allow for care. Prospective prehospital studies utilizing ketamine for ExDS are needed to fully characterize the patient clinical outcomes.

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PRESENCE OF UNDERTRIAGE AND OVERTRIAGE IN SIMPLE TRIAGE AND RAPID TREATMENT

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Background: During a disaster in which the need for medical care exceeds available resources, a quick and effective disaster triage process can help allocate these resources to more critically ill or injured patients. We evaluated the use of the Simple Triage and Rapid Treatment (START) method, a commonly used disaster triage algorithm, by Emergency Medical Services (EMS) and hypothesized that EMS can categorize patients using the START colors accurately. **Methods:** Cross-sectional. Setting: Inner-city emergency department (ED). Participants: Patients ≥ 18 years transported by Emergency Medical Services (EMS) with a START color of Red, Yellow, or Green during the state triage tag exercise, October 9-15, 2011. Interventions: EMS assigned each patient a START triage tag. ED staff recorded tag number and color. Chart review of the electronic EMS run sheets was performed by investigators to determine a START color. Institutional review board approval was obtained. Main Outcome Measures: START triage

colors were re-categorized as Red = 1, Yellow = 2, and Green = 3. The difference between the investigator's color and EMS color signify the following: 0 for agreement in triage, -1 for undertriage by one category, -2 for undertriage by two categories, 1 for overtriage by one category, 2 for overtriage by two categories. **Results:** EMS providers were blinded to the study, and investigators were blinded to the EMS triage categories. 95% confidence intervals were presented for statistical significance. Of 224 participants, START triage colors were: Red=7.1%, Yellow=19.2%, Green=73.7%. The mean difference in triage categories was 0.228 (0.114-0.311). 71.0% of patients were triaged to the same category, 5.8% undertriaged by one category, 0% undertriaged by two categories, 17.9% overtriaged by one category, and 5.4% overtriaged by two categories. Chart review of the cases overtriaged by two categories revealed that all patients were able to ambulate. **Conclusions:** The majority of patients were triaged in the same category by the investigators and EMS, with no undertriaging by two categories. EMS was more likely to overtriage using START. All patients who were overtriaged by two categories were ambulatory, which implies other findings not in START may affect triage.

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PREHOSPITAL QUALITY IMPROVEMENT AND EDUCATION IN CARE FOR PARCA PATIENTS

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Background: High quality, timely protocol-based care is the primary goal for prehospital ALS systems, especially when it comes to critically-ill and injured patients. Quality improvement (QI) aims to continuously improve performance and ultimately, outcomes. PARCA, (prehospital post-arrival respiratory/cardiac arrest), is a novel patient subclassification that allows very focused QI interventions for the treatment of the most ill and injured patients. The objective of this study was to assess outcomes following PARCA-directed education. **Methods:** Based on the patterns identified in analyzing suboptimal care, unannounced field-based, real-time, high-fidelity simulations were designed and conducted in an urban EMS system (over 60,000 patient call volume per year) beginning in 2011. These simulations were individually tailored without disciplinary ramifications. In addition, PARCA patterns lead to the development of guidelines and algorithms that were incorporated into education and simulations. These guidelines were aimed at minimizing delayed critical interventions and thus, reducing witnessed arrests. **Results:** Overall trends ($P<0.05$) showed that EMS crews accomplished an average of 3.65 critical interventions and patient monitoring tools per PARCA patient in 2011 prior to implementation of the simulations and guidelines, compared to an average of 5.8 in 2014 (95% confidence interval [CI], 0.34-3.96). In those cases, the average time for significant interventions decreased. This data correlated with a decrease in cardiac arrest after EMS arrival translating to a decrease in PARCA patients from 5.7% in 2011 to 4.0% in 2014. **Conclusions:** From this study, PARCA-directed QI can be an effective means to improve patient outcome. This study was limited by a single EMS system and small sample size. Furthermore, detailed analysis in tailoring educational goals to patterns of error in PARCA patients warrant further investigation in a wide variety of systems. This potentially useful new tool needs to be further explored, used, and standardized in different EMS systems to become validated.

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PREHOSPITAL PROCEDURES AND MEDICATIONS DELIVERED TO PEDIATRIC EMERGENCY PATIENTS THROUGHOUT NORTH CAROLINA IN 2015

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Background: Literature is limited in describing care provided to prehospital pediatric patients in rural and urban environments. The study objective was to describe procedures performed and medications administered to children by emergency medical services (EMS) in North Carolina (NC). **Methods:** This retrospective study assessed all pediatric (age ≤ 15) emergency calls included in the NC State EMS Data System from 1/1/2015 to 12/31/2015. Data were collected in the National EMS Information System (NEMSIS) version 2 standard. NEMSIS elements describing procedures performed (E19_03) and

medications administered (E18_03) were assessed. Comparisons were made based on incident county (E08_13) urban/rural status according to the US Department of Agriculture/Office of Management and Budget urban influence codes. Descriptive statistics were calculated. **Results:** There were 64,186 pediatric emergency calls (74.4% urban) out of 1,386,028 total 911 calls in 2015. During this study period, 56,187 procedures and 24,524 medications were reported. The average number of procedures and medications reported were 2.3 (± 2.1) and 2.0 ($+1.8$), respectively. Statewide, the most common procedures performed were: Intravenous (IV) lines (11,061 [19.7%]), ECGs (6,327 [11.3%]), spinal immobilizations (3,777 [6.7%]), pulse oximetry (3,229 [5.8%]), and nebulizations (2,890 [5.1%]). Among these procedures, proportional differences were noted based on rural/urban status. IV lines comprised 25.3% of procedures in rural counties and 17.9% in urban. ECGs represented 12.8% in rural and 10.8% in urban. Spinal immobilizations were 9.1% in rural and 6.0% in urban. Pulse oximetry represented 3.6% in rural and 6.4% in urban. Nebulizations were 6.5% in rural and 4.6% in urban. Statewide, the most common medications administered were Oxygen (5,103 [20.8%], rural 20.2%, urban 21.2%), Albuterol (4,390 [18%], rural 15%, urban 18.8%), IV fluids (2,537 [10.3%], rural 15.2%, urban 8.9%), and Narcotics (2,019 [8.2%], rural 8.4%, urban 8.0%). **Conclusions:** Differences in prehospital care provided to pediatric patients were noted in rural and urban areas throughout NC based on the assessment of procedures performed and medications administered. Future research should determine if differences positively impact patient outcome or if they are solely influenced by proximity to transport destinations.

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IMPLEMENTATION OF A NURSE PRACTITIONER RESPONSE UNIT IN AN URBAN EMS SYSTEM

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Background: The Los Angeles Fire Department (LAFD) in recent years has experienced a disproportionate increase in 911 use for low acuity medical complaints. In January 2016, LAFD launched a Nurse Practitioner Response Unit (NPRU) - a specialized ambulance run by a licensed nurse practitioner and a firefighter/paramedic with the mission of treating and releasing patients on scene, and providing linkage to further care. **Methods:** This was a retrospective review of LAFD electronic health records and prospectively collected patient survey results from NPRU incidents from January - March 2016 in South Los Angeles area. Enrolled patients were either low-acuity 911 callers, identified through monitoring 911 radio traffic or housed (i.e. non-homeless) 911 frequent users identified from prior LAFD health records for scheduled visits. Summary descriptive statistics were collected and linkage to primary care was assessed through a standardized telephone survey at 1, 7 and 30 days after each incident. **Results:** The NPRU unit was linked to 256 incidents over 46 days (mean 5.6 per day, IQR 4-7, Range 1-12). Of the 256 incidents, 41 were cancellations, in 26 no patient was found, in 4 the patient refused EMS care outright, and in 3 the patient was otherwise ineligible for NPRU care, leaving 182 incidents for evaluation (71.1%). Of these, 172 (94.5%) were low-acuity 911 callers and 89 (51.7%) were treated and released on scene, of which none reported having used a 911 ambulance in the follow-up period. Two individuals visited an emergency department for refill of pain medications, and no low-acuity patients reported requiring hospitalization. In the 32 patients surveyed, 100% agreed that NPRU personnel treated them with courtesy, and rated their overall quality of care as very good or excellent. Ten (5.5%) 911-frequent users were evaluated and referred for further resources, of which 50% showed decreased EMS utilization over the next 30 days. **Conclusions:** The LAFD NPRU offers low-acuity 911-callers an alternative to costly EMS transport and ED care, and preliminary results support its feasibility, efficacy and patient satisfaction. Further studies are needed to confirm these findings and assess cost effectiveness of this new model of care delivery.

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SAFETY EVENTS IN HIGH RISK PREHOSPITAL NEONATAL CALLS: A RETROSPECTIVE CHART REVIEW

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Background: To quantify and characterize patient safety events during high-risk neonatal transports in the prehospital setting. **Methods:** We conducted a retrospective chart review of all code 3 or “lights and sirens” ambulance transports of neonates ≤ 30 days old over a four-year period in a metropolitan area. Each case was independently reviewed for potential patient safety events that may have occurred in clinical assessment and decision-making, resuscitation, airway management, fluid or medication administration, procedures performed, and/or equipment used. **Results:** Twenty-six patients ≤ 30 days old transported over a four-year period were transported code 3 during the study period. Overall, safety events occurred in 19 patients and severe safety events (potentially causing permanent injury or harm, including death) occurred in ten. The incidence of safety events related to medication administrations was 90% (70% severe), resuscitation 64.7% (47.1% severe), procedures 64.7% (35.3% severe), fluid administration 50% (25% severe), clinical assessment and decision-making 50% (30.8% severe), airway management 47.6% (28.6% severe), equipment use 25.5% (10.0% severe), and systems processes 19.2% (7.7% severe). **Conclusions:** High-risk neonatal calls are infrequent and prone to a high incidence of serious patient safety events. More focus should be given to provide education and resources for emergency medical services (EMS) providers caring for neonates.

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ASSOCIATION OF NUMBER OF PREHOSPITAL CPR TEAM AND SURVIVAL AFTER OUT-OF-HOSPITAL CARDIAC ARREST IN KOREA: A NATIONWIDE OBSERVATIONAL STUDY

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Background: We aimed to evaluate the association of number of prehospital CPR team and survival after out-of-hospital cardiac arrest (OHCA). **Methods:** Study design was nationwide retrospective observational study and source of data were emergency medical service (EMS) run sheet and medical chart review. EMS-accessed OHCAs in Korea between 2006 and 2012 were analyzed. Exposure variables were number of prehospital CPR (PCPR) team. Number of PCPR team was varies 1 to 3 persons and also differ from province level. Primary outcome was number of PCPR team and survival to discharge. Secondary outcome was number of PCPR team and neurological good come. We figured out demographic findings and compared the survival rates between the groups regarding number of PCPR team. And also, calculated adjusted odds ratio (AORs) per number of PCPR team using multivariable logistic regression models, adjusting for potential confounders at individual levels. **Results:** Of 153,078 patients with EMS-accessed OHCAs, 123,837(80.9%) patients with EMS-treated OHCAs were included. Of these, OHCA cases received with 1 to 3 person PCPR team were 18,578(15.0%), 866,654(70.0%), 18,605(15.0%), respectively. AORs for survival to discharge were 1.06(0.97-1.17) for 2 persons PCPR, 1.20(1.07-1.36) for 3 persons PCPR. AORs for neurological good outcomes were 1.26(1.07-1.48) for 2 persons PCPR, 1.63(1.33-2.00) for 3 persons PCPR. **Conclusions:** Number of PCPR team was associated with survival to discharge rates and neurological good outcomes after OHCA. This result will be conjugate emergency dispatching system emergency patient such out-of-hospital cardiac arrest, severe trauma, etc.

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DEFIBRILLATION AT 200 JOULES: A SECOND LOOK

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Background: Patients in ventricular fibrillation (VF) or pulseless ventricular tachycardia (PVT) require early and effective conversion to a perfusing rhythm to offer the best chance at survival. Since the 1995 updates to the Advanced Cardiac Life Support (ACLS) guidelines, patients with VF or PVT have been defibrillated at an initial energy of 200 Joules (J). A review of the literature did not identify any superiority of 200J as an initial energy level when compared to 300J or 360J. We chose to evaluate rates of return of spontaneous circulation (ROSC) in our EMS system for patients in VF or PVT managed with an initial defibrillation of 200J. **Methods:** A retrospective chart review of all patients with VF or PVT over

a 1-year period managed with an initial energy dose of 200J. Our EMS system, MONOC (Neptune, NJ) is the largest provider of advanced life support (ALS) services in the State of New Jersey. Utilizing our electronic medical record (RescueNet, Zoll) and information from our defibrillator (LifePak 15), we extracted demographic and biometric data, interventions including defibrillation doses and medications, and outcomes. **Results:** From January 1, 2014 – December 31, 2014, MONOC EMS provided ALS care to 34,545 patients. 1,192 (3.45%) of calls were for confirmed cases of cardiac arrest. 146 of these patients (12%) were found to have VF or PVT at the time of ALS response. 83 patients underwent defibrillation at an initial energy of 200J. Of these patients, only 4 (4.8%) cases resulted in successful ROSC. Notably, three of the four were witnessed cardiac arrest with early CPR. 63 of the 146 patients with VF/PVT were treated defibrillated initially with 300J or 360J, and had a notably higher rate of ROSC, at 40.4%. **Conclusions:** Of eighty-three patients with VF or PVT who underwent initial defibrillation at 200J, only 4.8% of cases resulted in ROSC. We found that the use of 200J is ineffective for most patients and as such our institution has chosen to abandon the use of 200J in the management of VF and PVT. Further research is needed to identify the most appropriate initial energy level.

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GLASS INTACT ASSURES SAFE CERVICAL SPINE PROTOCOL

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Background: Evaluation of the motor-vehicle collision (MVC) victim's cervical spine is of critical importance. Despite the implementation of validated clinical decision-making rules (such as the NEXUS criteria), many MVC victims undergo unnecessary c-spine evaluations, which involve significant cost, discomfort, and radiation exposure. A single field test known as the GLASS criteria has previously been evaluated through a retrospective cohort study. We assessed the feasibility of performing a prospective cohort study to examine the ability of a single field test to exclude c-spine injury. We hypothesized that if the forces involved in an MVC are not sufficient to damage any of the automobile's windows—or greenhouse—then these forces would not cause significant c-spine injury, prospectively defined as an Abbreviated Injury Score of 2 or greater. **Methods:** Using a prospective pilot study format, local EMS personnel were asked to fill out a simple questionnaire between February 2013 and May 2014. EMS personnel collected data evaluating patients who were belted front seat occupants, aged 16-60 years, who did not have an airbag deploy, and who were in cars with raised windows. Patients were contacted by phone or their EMR reviewed for follow-up. We then compared the incidence of c-spine injuries in subjects with intact and non-intact greenhouses. **Results:** We examined a total of 99 occupant cases. Of that total, 32 met the GLASS criteria and were studied. Of those, 28 had intact greenhouses, and all of these occupants had no significant c-spine injuries. Of the remaining 4 occupants in MVC's with non-intact greenhouses, only 1 sustained a c-spine injury. **Conclusions:** The GLASS criteria continue to be a promising novel and objective approach to c-spine clearance of patients involved in low-speed motor vehicle crashes. The results of our pilot study confirmed the feasibility of conducting a prospective study to validate the characteristics of the criteria with regards to sensitivity and specificity. We also found that a number of logistical aspects of a prospective study could be optimized to increase the strength and ease of conducting such a study.

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AN EXPLORATION OF FACTORS USED BY EMS MEDICAL DIRECTORS IN THE UNITED STATES IN DETERMINING HYPERTONIC GLUCOSE CONCENTRATION FOR TREATMENT OF HYPOGLYCEMIA

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Background: Hypoglycemia is a common prehospital condition for which EMS treatment protocols in the United States (U.S.) vary greatly, particularly the concentration of hypertonic glucose. Treatment protocols are established by EMS medical directors, but little is known about the factors used to develop EMS protocols. We sought to qualitatively examine the factors that U.S. EMS medical directors use to determine hypertonic glucose concentration in hypoglycemia protocols. **Methods:** EMS medical

directors from 2 sources: the website www.emsprotocols.org and the 50 largest populated cities in the US were surveyed to explore the factors they use to choose the concentration of hypertonic glucose in their hypoglycemia treatment protocols. A software tool was used to send, track and collect responses from a previously piloted survey. Survey text responses were then reviewed, categorized into themes independently by 4 separate groups of the authors. These 4 sets of themes were then combined into one through consensus. **Results:** Survey invitations were sent to 160 unique EMS medical directors of whom 85 opened the email invitation (53%). Of these 85, 72 (85%) completed the survey. Of the survey respondents, 93% were male, 90% were MDs, and 94% reported board-certification in Emergency Medicine. Subspecialty-certification in EMS was reported by 60% with 20% having completed an EMS fellowship. The mean age was 52 years. Responders were from 27 of the 50 U.S. states. Of respondents, 15% were involved with statewide protocols, 34% regional protocols, 31% county protocols, and 20% city protocols. D50 use only was reported by 24% of the respondents, D10 use only by 18% and either D50 or D10 by 58%. In decreasing frequency, extravasation risk, formulation availability, effectiveness, post-treatment hyperglycemia, cost, ease of use, dosing errors, prior practice and published scientific research were the major elements that emerged as themes that EMS medical directors considered in determining their concentration of hypertonic glucose. **Conclusions:** In the U.S., EMS medical directors use a variety of factors to establish their choice of hypertonic glucose concentration in hypoglycemia treatment protocols. Further studies are warranted to understand these factors and their effect on variability in published EMS protocols.

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INTUBATION OF PREHOSPITAL PATIENTS WITH CURVED LARYNGOSCOPE BLADE IS MORE SUCCESSFUL THAN WITH STRAIGHT BLADE

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Background: Direct laryngoscopy can be performed using curved or straight blades, and providers usually choose the blade with which they are most comfortable. Anecdotally, curved blades are often thought of as easier to use than straight blades. We seek to compare intubation success rates of paramedics using curved versus straight blades. **Methods:** This retrospective chart review was performed in a hospital-based suburban ALS service with 20,000 calls per year. Patients with any direct laryngoscopy intubation attempt over an 8.5-year period were selected as subjects. Paramedics were allowed to use the blade of their choice and were told to maximize first attempt success. Prehospital medical records were reviewed. First attempt success rate and overall success rate were calculated for attempts with curved and straight blades. Differences between the two groups were calculated, along with 95% confidence intervals. **Results:** 2299 patients were intubated by direct laryngoscopy. Of these, 1865 had attempts with a curved blade, 367 had attempts with a straight blade, and 67 had attempts with both. Baseline characteristics were similar between groups. For curved blade intubations, average age was 69.1 years (SD 19.2), weight was 83.8 kg (SD 28.6), and 52.8% (SD 0.50) were male. For straight blade intubations, average age was 68.7 years (SD 20.3), weight was 84.3 kg (SD 28.9), and 57.4% (SD 0.50) were male. First attempt success was 86% with a curved blade and 73% with a straight blade: a difference of 13% (95% CI: 9-17). Overall success was 96% with a curved blade and 81% with a straight blade: a difference of 15% (95% CI: 12-18). There were an average of 1.11 intubation attempts per patient with a curved blade and 1.13 attempts per patient with a straight blade (2% difference, 95% CI: -3-7). **Conclusions:** Our study found a significant difference in orotracheal intubation success rates between laryngoscope blade types. Direct laryngoscopy using a curved blade had a higher first attempt success rate as well as overall success rate of endotracheal intubation when compared to using a straight blade. Paramedics should consider selecting a curved blade as their tool of choice to maximize intubation success.

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DETERMINING A NEED FOR POINT OF CARE ULTRASOUND (POCUS) IN HELICOPTER EMS

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Background: The use of point of care ultrasound (PoCUS) has become a helpful tool to aid in diagnosis of acute life threatening conditions in unstable patients in the emergency department (ED). The decrease in size of portable ultrasound machines allows for the use of this modality in the prehospital setting particularly Helicopter EMS (HEMS) programs. Identifying which exams would be most utilized in HEMS may contribute information important to the development of a helicopter PoCUS program that develops the sonography skills of providers on exams they will commonly use. Our objective was to determine the percentage of the HEMS patient population that would potentially benefit from PoCUS and how commonly the EFAST protocol for trauma patients or RUSH protocol for medical patients could be used on patients. **Methods:** This was a retrospective chart review of one year's worth (2015) of patient data from flights of adult patients in a mid-sized midwestern helicopter EMS system. Vital signs, information on the nature of the call and, if known, what the patient's diagnosis was were extracted from the chart by a trained reviewer. Hypotensive patients were deemed potential ultrasound candidates. Presence of diagnosis was based off of HEMS provider charting. Hypotension was defined as systolic blood pressure less than 90. Patients that died prior to transport and cancelled calls were excluded. IRB approval was obtained from the Medical College of Wisconsin. **Results:** There were 216 adult runs. Three were excluded. Of the 213 cases 100 (47%) were trauma, 51 (51%) of those had an episode of hypotension. 39 (39%) of trauma patients had hypotension with an unclear cause. 113 (53%) patients were medical, 73 (65%) of which had an episode of hypotension. 4 (3%) of medical patients had hypotension with an unknown cause. 124 (58%) patients were hypotensive and could have benefited from PoCUS. **Conclusions:** This study found that over 1 in 2 HEMS patients may benefit from PoCUS, with 51% of trauma patients receiving an EFAST exam and 65% of medical patients receiving a RUSH exam. PoCUS may be particularly useful in 39% of trauma and 3% of medical patients without a diagnosis.

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A DESCRIPTIVE ANALYSIS OF PEDIATRIC PREHOSPITAL REFUSAL OF MEDICAL ASSISTANCE (RMA) WITHIN A SINGLE SERVICE PROVIDER SYSTEM

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Background: Pediatric RMA is a potentially high-risk event with implications for both individual patient outcomes and greater EMS system efficiency. The purpose of this study was to describe characteristics of pediatric RMA calls and outcomes. **Methods:** Single EMS agency retrospective study of calls between January 1, 2011 – December 31, 2015 for patients < 18 years of age resulting in RMA. Dispatch complaint-matched case-control group was generated from transported patients during the same time period. **Results:** A total of 241 pediatric calls (12.7%) resulted in RMA, compared with 2425 adult calls (5%, $p < 0.0001$). 139 (57.7%) refusals involved male patients, average patient age was 9.4 ± 6.0 years. The three most common RMA dispatch complaints were seizures, difficulty breathing, and traffic/transportation accidents. 157 (65.1%) pediatric RMA calls were dispatched Priority 1 (emergency), compared with 938 (56.4%) of transported pediatric patients ($p = 0.01$). The average scene time for pediatric RMA calls was 21 ± 1.7 minutes, compared with 43 ± 1.6 minutes for pediatric transported patients ($p < 0.0001$). Medical control was contacted for 11 (4.6%) RMA calls. Retrospective review indicated that medical control consultation was warranted in a minimum of 34 (14.1%) RMA calls, and occurred in 7 of these calls. The average word-count for patient care report (PCR) narratives for RMA patients was 179 ± 99 words, compared with 164 ± 139 words for controls ($p = 0.11$). Documentation of risk-benefit discussion occurred in 69 (28.6%) RMA narratives. Outcome data was available for 202 patients. Of these, 87 (54.7%) of 159 RMA patients with documented alternative plans completed the alternative plan. Within 72 hours of RMA, 10 (5.0%) calls with known outcome resulted in unexpected emergency department visit. No unexpected ED visits resulted in admission. Ten (5.0%) RMA patients were admitted, 1 patient was admitted to the ICU. No emergent surgeries or deaths during the study period. **Conclusions:** Pediatric RMA is common within our study population, and two thirds involve emergent dispatch. Although outcomes are generally good, refusal documentation is sparse and medical control is seldom contacted. Multiple opportunities for systems improvement exist.

REPEAT NALOXONE DOSING IN PATIENTS WITH SUSPECTED OPIOID OVERDOSE

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Background: Advanced Life Support (ALS) providers are routinely called upon to care for patients with suspected opioid overdose (OD). Naloxone, an opioid-antagonist deliverable by an intra-nasal route, historically a drug administered by ALS providers, has now become widely available and utilized by responding law enforcement officers as well as basic life support (BLS) providers. As ALS is often requested or simultaneously dispatched to these suspected opioid overdoses, our aim was to describe the characteristics of patients requiring repeat dosing of naloxone and thus warranting ALS assessment and transport to the hospital for further management. **Methods:** A retrospective chart review of patients greater than 17 years old with suspected opioid overdose already treated with an initial intranasal dose of naloxone, and subsequently managed by paramedics from the largest ALS provider in the state of New Jersey from April 2014 to June 2016. We describe demographic and biometric data using descriptive statistics to identify those aspects of the history, physical exam findings and interventions associated with repeated naloxone utilization. **Results:** 2,166 patients with suspected opioid OD received naloxone from ALS providers. 195 (9%) were managed after an initial dose of naloxone was provided by first responders. Of these 195 patients, Police Officers administered the first dose in 66.7% of all cases. Patients were primarily male (74.4%), Caucasian (88.2%), with a mean age of 36.4 years. 76.7% of patients were found in the home, 23.1% had a suspected mixed ingestion, and 27.2% had a previous OD. The mean Glasgow Coma Scale (GCS) was 5, and 96.9% of patients had altered mental status. 20% of patients required a 3rd dose. These patients had relatively lower GCS scores, oxygen saturations and a higher degree of tachycardia. Overall, thirteen patients were intubated, and one patient died. **Conclusions:** Acute opioid toxicity can be life threatening and may require repetitive dosing to reduce morbidity and mortality. Twenty percent of patients required greater than 2 doses of naloxone. Features associated with repeat dosing of naloxone include male gender, lower GCS, tachycardia and relative hypoxia. First responders should continue to activate an ALS response after an initial dose of naloxone.

PEDIATRIC REFUSAL OF MEDICAL ASSISTANCE: ASSOCIATION WITH SUSPECTED ABUSE OR NEGLECT

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Background: Unlike adult refusal of medical assistance (RMA), pediatric refusal is not initiated by the patient. This lack of autonomy may permit neglect by the guardian through denial of necessary treatment. The purpose of the current study was to determine whether pediatric RMA was associated with suspected abuse or neglect (SAN). **Methods:** Single EMS agency case-control study of calls between January 1, 2011 – December 31, 2015 for patients < 18 years of age resulting in RMA. Age- and complaint-matched control groups were generated from transported patients during the same time period. Recidivism was defined as 2 or more episodes of RMA involving a single patient during the study period. **Results:** A total of 241 calls for service resulted in RMA during the study period, representing 12.7% of all pediatric calls. Information regarding SAN was available for 202 calls. Recidivism was noted in 8 patients (17 calls for service), resulting in 185 unique patients. Twenty-one RMA patients (11.4%) were identified as SAN. No difference in SAN status was noted between RMA patients and age-matched controls (21 vs. 25, $p = 0.88$) and complaint-matched controls (21 vs. 31, $p = 0.34$). No SAN was identified in the 8 recidivist patients when compared with the 177 non-recidivist patients (0 vs. 21, $p = 0.60$). **Conclusions:** Pediatric SAN patients are not uncommon users of EMS in our service area. Neither RMA nor recidivist RMA predicts the presence of SAN within our patient population.

SUCCESS RATE OF PREHOSPITAL LMA PLACEMENT AFTER FAILED INTUBATION ATTEMPTS

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Background: Prehospital intubation continues to remain a controversial topic, with previous research indicating worse patient outcomes with any paramedic intubation attempt, let alone failed and multiple airway attempts. Studies also suggest overall prehospital intubation success rates are significantly lower compared to those performed in the emergency department. Supraglottic airway device placement is the standard fallback for failed EMS intubations and tends to be inserted successfully even after failed intubation, yet is not commonly used as the initial airway device. We sought to determine the overall and first attempt success rates of laryngeal mask airway (LMA) placement by paramedics after failed intubation attempts. **Methods:** Design: retrospective chart review. Setting: a hospital-based suburban ALS service with volume of 20,000 calls per year. Subjects: All patients requiring LMA placement after failed intubation attempt over an 8.5-year period. Protocol: Prehospital medical records of patients requiring advanced airway management were reviewed. Patients with failed orotracheal intubation and subsequent LMA placement were analyzed. Overall and first attempt success rates were calculated, with 95% confidence intervals. **Results:** Of 4,126 prehospital patients requiring advanced airway management, 96 had LMA placement after failed intubation. The average age of this group was 66.4 years (SD 16.6) and weight was 101 kg (SD 43). Prior to LMA insertion, 62 patients had failed direct laryngoscopy (DL), 18 had failed video laryngoscopy (VL), and 16 had failed both DL and VL. The overall success rate of LMA placement was 93% (95% CI: 87-98), with first attempt success 92% (95% CI: 86-97). There was no significant difference in overall LMA insertion success rate (92% vs. 94%) or first attempt success rate (91% vs. 91%) for DL versus VL. The average failed intubation attempts prior to LMA insertion was 1.7 (95% CI: 1.5-1.8) for DL and 1.4 (95% CI: 1.2-1.7) for VL. **Conclusions:** The LMA is a successful alternative to prehospital intubation for patients with prior failed intubation attempts, whether direct or video. Given the high success rate of LMA placement on these difficult to intubate patients, EMS providers and medical directors should consider LMA as a first line option for achieving prehospital airway stabilization.

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AN ASSESSMENT OF COMMUNICATION & TRANSFERRING DATA VERBALLY BETWEEN THE PARAMEDICS & RECEIVING FACILITY (PHYSICIANS AND NURSES) IN TRAUMA PATIENTS AT A LEVEL I TRAUMA CENTER

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Background: Healthcare provider handover communication is important in ensuring key information is passed on for patient safety. Many institutions use standardized handover communication to ensure important information is not lost. This study was conducted to determine the need for and to develop a standardized communication tool (handover) between paramedics and trauma receiving facility staff. **Methods:** This is a prospective descriptive study using both interviews and an online survey tool to collect data. The survey was distributed electronically to all trauma team staff, paramedics, from a single level-one trauma center from March 1st, 2015 to June 30th, 2015. The survey consisted of 7 questions seeking the opinions on trauma handover between paramedics and receiving staff. **Results:** A total of 92 participants completed the study: 6 trauma physicians, 5 trauma fellows, 5 ED physicians, 13 ED nurses, 63 paramedics. Over 60% responded that a standardized handover is needed. Only 7.0% were aware of standardized handover protocols/tools. When given 3 examples of standardized handover tools, 27.4% preferred ISBAR, 29.8% preferred IMIST-AMBO, 29.8% prefer EMSTO, and 8.3% preferred another protocol/tool. **Conclusions:** Most members on the trauma team were unaware of standardized handover protocols/tools although a majority were in favour of using a standardized handover process. Preference for any single tool was varied and thus the specific tool may be less important than the use of any common tool to standardize the communication of key information in a succinct manner.

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EMS DESTINATION DECISION MAKING FOR PEDIATRIC PATIENTS

Background: Although all emergency departments (ED) can accept children, the recent Pediatric Readiness survey demonstrated that many are not properly equipped to treat children. To better understand how these findings might impact destination decision-making, we must first understand the current practice of EMS destination decision-making for pediatric patients. Our objective was to determine how frequently pediatric patients are transported to pediatric specialty hospital EDs and to evaluate distribution patterns based on illness/injury severity. **Methods:** We conducted a retrospective analysis of all pediatric EMS transports within a single county's EMS system between October 2011 and September 2013. This county has a single pediatric specialty hospital with relatively short transport times from any location in the county. EMS transported children (18 years and younger) were identified through EMS medical records. The percent of pediatric patients transported to the only pediatric ED (PED) was calculated. Patients were stratified by type of chief complaint (injury versus illness) as well as severity. Severe injury and illness were defined as those that met the physiologic criteria of the field triage guidelines. Destination decisions were determined for those with abnormal vital signs for age. Data analysis was conducted using descriptive statistics. **Results:** A total of 4,891 patients were transported by EMS to an ED by the participating agencies and had complete data. Overall, 60% were transported to a PED. 75% of children younger than 15 years were transported to a PED, while 34% of those ages 15-18 years were transported to a PED. 63% of the injured children and 80% of the severe injury subset were transported to a PED. 59% of the ill children and 71% of the severe illness subset were transported to a PED. Patients with abnormal vital signs for age including systolic blood pressure, GCS, and respiratory rate were transported to a PED 72%, 73% and 75% respectively. **Conclusions:** Our study demonstrates that EMS providers commonly transport children to PED. However, approximately a quarter of children with severe injuries and illness and/or abnormal vital signs are transported to general EDs. Children may not always be reaching the right ED resources for their condition.

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METRONOME-ASSISTED LAYPERSON-CALLER CPR: A PRELIMINARY STUDY

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Background: Compression rate and depth are key metrics in determining the quality of cardiopulmonary resuscitation (CPR). As of 2005, the automated (software) version of the Medical Priority Dispatch System (MPDS®) has included a Metronome Tool to help emergency medical dispatchers (EMDs) instruct layperson-callers in providing effective CPR. Our objective was to assess the effectiveness of the Metronome Tool by measuring compression rate (and, secondarily, compression depth) of CPR compressions provided by layperson-callers assisted with the MPDS metronome instructions (experimental group), as compared with compressions provided by layperson-callers not assisted with those instructions (control group). **Methods:** The prospective randomized study involved laypersons at two locations: High school, and Assisted-Living Residential in Salt Lake City, Utah, USA. The study took one day at each location. Two emergency medical dispatchers (EMDs) and two manikins were used. Upon receipt of a voluntary written informed consent, participants (age 15 years or older) were assigned to a study group based on a pre-designed randomization list for each EMD. Gender, age, CPR training (Yes/No), compression per minute, and compression depth (millimeters [mm]) data were collected from participants. Outcome measures included: compression rate, and compression depth. **Results:** 69 laypersons, mean age 22 years, 64% female participated in the study: 37 were assigned to experimental group and 32 to the control group. Overall, 36 (52%) laypersons had previous CPR training (19 in the experimental group). The experimental group had a higher compression rate than the control group (93% and 77%, respectively). Conversely, the control group had a slightly higher compression depth than the experimental group (42 mm and 48 mm, respectively). Overall, the compression rate was inversely proportional to the compression depth—more pronounced in the control than in the experimental groups. **Conclusions:** A built-in software CPR tool that provides a metronome for dispatchers to use to

direct layperson-callers giving CPR is effective in helping callers achieve the correct compressions rate. It is also correlated (slightly) with more effective depth and strongly with overall more effective CPR. Improvements to the instruction sequence are recommended to simplify communication with the caller, and further studies are planned.

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THE ROLE OF BYSTANDERS IN PROMPT CPR AND RELATED OUTCOMES AFTER OUT-OF-HOSPITAL CARDIAC ARREST

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Background: Without cardiopulmonary resuscitation (CPR), cardiac arrest survival declines 5-10% for every minutes. But, there is a limit to reduce the time from collapse to Emergency medical service (EMS) arrival. This study aimed to examine the association between the time interval from collapse to CPR by EMS providers and related outcomes in patients who received bystander CPR. **Methods:** A population-based observational study was conducted with out-of-hospital cardiac arrests (OHCA) of cardiac etiology who were witnessed by laypersons in Korea between 2012 and 2014. Exposure variable was the proportion of the time interval from collapse to CPR by EMS providers categorized into quartile groups: the fastest group (group 1) (time < 4 min), fast group (group 2) ($4 \leq \text{time} < 8$), late group (group 3) ($8 \leq \text{time} < 15$), the latest group (group 4) ($15 \leq \text{time} < 30$). Primary endpoint was time interval from collapse to CPR by EMS providers and secondary endpoint were survival to discharge and survival with favorable neurological outcome (Cerebral Performance Category (CPC) 1-2). Multivariable logistic regression analysis was performed. The final model was performed to evaluate interactive effect between bystander CPR and the time interval from collapse to CPR by EMS providers. **Results:** A total of 15,354 OHCA were analyzed. Bystander CPR was performed in 8,591 (55.95%). The survival to discharge rate was 10.6% (1632) and favorable neurological outcome was 6.5% (996). In an interaction model of bystander CPR patients, AORs (95% CIs) for survival to discharge rate were 0.89 (0.66-1.20) in fast group, 0.76 (0.57-1.02) in late group, 0.52 (0.37-0.73) in the latest group compared with the fastest group. For favorable neurological outcome, AORs were 1.12 (0.77-1.62) in fast group, 0.90 (0.62-1.30) in late group, 0.59 (0.38-0.91) in the latest group. **Conclusions:** Despite poor ambulance response time, patients who received bystander CPR would show favorable outcomes. Prompt delivered bystander CPR was strongly associated with increased survival.

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DEFINING THE VALUE OF PULSE CHARACTER ASSESSMENT AFTER INJURY BY PREHOSPITAL PROVIDERS

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Background: Systolic blood pressure (SBP) is a standard physiologic measure to assess and triage trauma patients in the prehospital environment and a SBP < 110 mmHg is associated with shock. However, the equipment and time to measure SBP is not always available, particularly in austere or hostile environments and mass casualty incidents. Emergency medical service (EMS) providers, both civilian and military, are trained to assess radial pulse character as a marker of hemodynamic status. The purpose of this analysis was to assess the utility of the radial pulse character to identify prehospital hypotension after trauma. **Methods:** The electronic field data collection registry of a large regional trauma system was utilized to identify 135,971 transported by EMS for injury. Data collected included patient demographics, injury mechanism, SBP, and pulse character classified as normal or abnormal (weak / absent). In addition, EMS providers were identified as basic life support (BLS), advanced life support (ALS), and air medical transport (AMT). Associations were developed between radial pulse character relative to SBP and mortality. **Results:** The mean SBP found associated with the subjective qualification of abnormal pulse character was 95 ± 53 mmHg. Injured patients with abnormal pulse character had a mortality of 6.0% compared to 1.2% in those with normal pulse character ($P < 0.05$). The ability to discern pulse character differences was associated with the level of training of the prehospital provider.

The sensitivity of AMT providers to recognize abnormal pulse character at 60 mmHg was 93%, 75 mmHg was 82%, and 90 mmHg was 66%. In contrast, the sensitivity at the same levels of SBP were 76%, 53% and 31% for ALS and 36%, 30% and 14% for BLS respectively ($p < 0.05$). **Conclusions:** These data suggest that abnormal pulse character is a useful clinical tool to rapidly assess hemodynamic status and predict mortality risk. Prehospital provider experience level played a significant role in the value of this physical assessment tool. These results highlight the value of rudimentary physical exam skills and prehospital provider training in order to optimize prehospital trauma triage and patient management decisions.

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RECOGNITION AND TREATMENT OF SEPSIS IN A SINGLE PROVIDER, 2-TIERED EMS SYSTEM

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Background: Sepsis remains a leading cause of morbidity and mortality. Earlier research has shown that it is possible to identify sepsis in the prehospital setting. Our goal was to identify whether paramedics can reliably identify potentially septic patients and initiate prehospital fluid resuscitation. **Methods:** All EMS runs from Glendale Fire Department (GFD), a single-provider 2-tiered EMS system, from November 2015 to May 2016 were collected in a longitudinal fashion. Through the GFD electronic medical record, patients that met our case definition for sepsis were abstracted. This included any of the following chief complaints: agitated delirium, cough, dizzy, fever, nausea or vomiting, weakness, shortness of breath and altered mental status along with vital sign abnormalities of tachycardia greater than 100 beats per minute and tachypnea greater than 20 breaths per min. Paramedics were provided with infrared thermometers for recognition of fever. Narratives from these cases were reviewed by a single study member for cases that were likely sepsis based on identification of an infectious source (e.g. pneumonia, meningitis, UTI, etc...) The proportion receiving an IV and IV fluids were measured. Confidence intervals were calculated for the proportions. **Results:** There were 497 cases that met study criteria of which 142 or 28.6% [CI 24.6 – 32.6] met our case definition for potential sepsis. An IV was placed in 34.5% [CI 26.7 – 42.3] of potential septic patients and IV fluids were started in 13.4% [CI 7.8 – 19] cases. **Conclusions:** EMS providers are not reliably recognizing and starting prehospital treatment of potential sepsis within the study period. Among our study limitations are the reliance on the completeness of paramedic records and lack of a gold standard for recognizing sepsis in the prehospital setting. In future studies, emergency department admission diagnosis could be used to compare against paramedic initial impressions and training programs can be initiated to educate prehospital providers on sepsis identification and treatment.

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AGGRESSIVE COOLING PRIOR TO TRANSPORT FROM A LARGE MASS GATHERING EVENT RESULTS IN FAVORABLE NEUROLOGIC OUTCOMES FOR DRUG-INDUCED HYPERTHERMIA

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Background: Drug-induced hyperthermia is associated with a high mortality and management relies on rapid cooling to prevent multi-system organ failure and death. Available data supports the use of cold or ice water immersion for rapid cooling of these patients, but no published cases exist regarding safety or efficacy of cooling prior to transport. **Methods:** A retrospective chart review was performed of patients presenting to the medical tent at a large electronic dance music festival over a single weekend with suspected drug-induced hyperthermia with a primary endpoint of neurologically intact survival. Inclusion criteria were suspicion for drug use and initial rectal temperature greater than 106 F. These patients were managed by a team of physicians, nurses, and paramedics using a pre-determined cooling protocol including cold IV fluids, IV dantrolene, ice water immersion, and rapid sequence intubation. Prehospital and hospital records were abstracted by a single physician reviewer and entered into an excel spreadsheet and descriptive statistics were calculated. **Results:** Over the three day event, the festival recorded approximately 140,000 attendees per night, and 1,475 participants were treated in the medical tent, of which eight patients met our inclusion criteria. The median age was 23 (IQR=2), of

which 4 (50% [95% CI 21.5-78.5%]) were female. The median initial rectal temperature was 42.1°C (IQR = 0.5°C). Seven out of the eight patients (87.5% [95% CI=52.9-97.8%]) were discharged from the hospital neurologically intact and one patient developed multi-system organ failure and died. **Conclusions:** A protocol of aggressive cooling with cold IV fluids, IV dantrolin, ice water immersion, and rapid sequence intubation for patients with severe drug-induced hyperthermia prior to transport from a large mass gathering event resulted in favorable neurologic outcomes in this cohort. The study is limited by retrospective data collection, lack of physician reviewer blinding, small study cohort, and lack of a control group. Our data suggest that a larger, prospective controlled study is indicated to objectively assess the efficacy and safety of this protocol.

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AN EVALUATION OF ADULT/PEDIATRIC AND INFANT/NEONATE END-TIDAL CO₂ SAMPLING LINE UTILIZATION IN EMERGENCY MEDICAL SERVICES

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Background: Waveform capnography (EtCO₂) has become a standard of care in the prehospital setting due to its ability to rapidly identify correct endotracheal (ET) tube placement and predict return of spontaneous circulation (ROSC). According to the manufacturer an infant/neonate EtCO₂ sampling line is recommended for ET tube sizes ≤ 4.5 mm versus an adult/pediatric sampling line for ET tube sizes ≥ 5.0 mm. Given the importance of capnography data, it is crucial that the correct sizes are being utilized in order to ensure accurate measurements. Our objective was to determine if EMS agencies are following the manufacturer recommendations for use of the infant/neonate EtCO₂ sampling line for ET tube sizes ≤ 4.5 mm. **Methods:** EMS agencies in each of the 100 counties in North Carolina were contacted by phone to complete the survey. Survey questions focused on capnography use, type of equipment used, resuscitation protocol in pediatric patients, and whether the EMS agency carries one or both EtCO₂ sampling lines. Agencies that carry both adult/pediatric and infant/neonate EtCO₂ sampling lines were also asked which ET tube sizes each device is used for. **Results:** The response rate for the survey was 76% (76 of 100). All 76 EMS agencies (100%) use EtCO₂ yet only 12 agencies (15.8%) currently use both adult/pediatric and infant/neonate EtCO₂ sampling lines. Many agencies carrying both sampling lines expressed uncertainty about when one device was indicated over the other. Twenty-five agencies (32.9%) also stated that an EtCO₂ reading of ≤10 mmHg influenced the length of their pediatric resuscitations. **Conclusions:** A majority of EMS agencies in North Carolina use EtCO₂ yet only a small percent carry both adult/pediatric and infant/neonate EtCO₂ sampling lines. Using the wrong sampling line may give inaccurate measurements, which could potentially affect patient treatment and outcome. This study only represents the current practice of EtCO₂ sampling line usage in the prehospital setting. Further research is needed to determine whether it is safe to use adult/pediatric EtCO₂ sampling lines to monitor intubated infants/neonates, or whether EMS agencies should use the infant/neonate sampling line.

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DISPATCH CHIEF COMPLAINT MAY IDENTIFY PREHOSPITAL PATIENTS MOST IN NEED OF EMS

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Background: EMS systems are experiencing growing demand with increased focus on resource utilization. One area yet to achieve attention is patient chief complaint. This is routinely identified by 911 call takers, but dispatch chief complaint is not consistently used in determining patient severity. Our goal is to identify types of patients most sick and which patients improve most during EMS care. To determine patient acuity, we utilize the rapid emergency medicine score (REMS) – a 26-point predictor of emergency department patient mortality derived from patient age, heart rate, blood pressure, respiratory rate, and Glasgow Coma Score, with higher score indicating greater chance of mortality. **Methods:** All non-cardiac arrest emergency transports from April 1, 2013 to March 31, 2014 were selected from a single ALS municipal EMS agency. For each patient, initial and final REMS were

calculated using first and last paramedic-documented vital signs. Change in REMS, defined as initial minus final scores, were calculated with 95% confidence intervals. Results were stratified by dispatch chief complaint – the protocol used by telecommunicators from 911 caller information. **Results:** 61,346 patients were enrolled. Average initial REMS was 4.3 (95% CI: 4.2-4.3) and average change in REMS was 0.37 (95% CI: 0.36-0.38). The dispatch problem cardiac/respiratory arrest had the highest initial REMS at 6.3 (95% CI: 5.7-6.8), followed by stroke, falls, breathing problems, and heart problems. Pregnancy/childbirth had the lowest initial REMS at 0.8 (95% CI: 0.7-0.9), followed by electrocution, animal bites/attacks, assault, and stab wound. Drowning/diving accident had the greatest change in REMS with a decrease of 1.60 (95% CI: 0.01-3.19), followed by cardiac/respiratory arrest, inaccessible/entrapment, choking, and heat/cold exposure. Change in REMS was significant for all dispatch problems except animal bites/attacks, electrocution, and fire/police support. **Conclusions:** Applying REMS as a surrogate for severity of medical condition can suggest which problems require higher EMS response. Patients with low initial REMS and low change in REMS likely do not need significant EMS presence. Conversely, patients with high REMS and high change in REMS are more likely to be sick and benefit from EMS care.

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EVALUATION OF PHYSICIAN AND PARAMEDIC PERSPECTIVES ON THE MOUNT SINAI COMMUNITY PARAMEDICINE PROGRAM

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Background: Community Paramedicine (CP) is a new and evolving model of health care that allows paramedics to function outside of their customary emergency response and transport roles. CP targets delivery problems including overuse of the 911 system, readmission of high-risk patients, and preventable transports. Our hospital recently launched a CP initiative that supports acute medical complaints for primarily homebound, elderly patients. When patients call their primary care physician (PCP) with an urgent need, the provider may request a CP assessment. A paramedic arrives at the patient's home, communicates the patient's status and provides treatment as directed by the PCP, who has obtained regional certification to provide orders to the medics. A shared decision-making conversation is then had between the physician and the patient or their proxy as to whether or not to transport to the ED. Our objective was to evaluate physician and paramedic perspectives on the CP program. **Methods:** Between September 2015 and February 2016, the CP program performed 36 urgent assessments. To assess satisfaction with the intervention, CP physicians and paramedics were sent an electronic survey after each encounter. Data was analyzed in SPSS. **Results:** Physicians spent an average of 20 minutes communicating with paramedics during each encounter. 89% of physicians (n=32) rated the intervention as "very helpful," or "helpful," to their practice. 94% (n=34) said that having the paramedic on scene strengthened confidence in the clinical assessment. 87% (n=23) of paramedics felt comfortable leaving the patient at home after the assessment. In the absence of CP, 64% (n=23) of physicians attested that they would have directed the patient to the emergency department, however, of the 36 patient encounters, only 5 patients (22%) were transported. **Conclusions:** This study demonstrates a high degree of satisfaction among physicians and paramedics with the newly implemented CP intervention, with most finding it a helpful addition to their practice. Furthermore, CP interventions may be useful in preventing transport to the ED by addressing urgent symptoms in the patient home. Further research will include a robust chart review to determine 30-day utilization and clinical outcomes for patients who receive a CP intervention.

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INTERACTIVE EFFECT OF HYPOXIA ACROSS SHOCK AT THE SCENE ON HOSPITAL MORTALITY AND DISABILITY IN SEVERE TRAUMA

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Background: Trauma is one of the biggest public health issues in several countries. Hypoxia in trauma is the key risk factor for outcome. It is unclear whether effect size of hypoxia is different according to shock status at the field for hospital mortality and disability. **Methods:** Emergency medical services (EMS)-treated severe trauma (ST) patients who had abnormal revised trauma score at the field or positive criteria by the prehospital trauma triage scheme for transport to trauma center were analyzed among patients injured by five mechanisms (traffic accident, fall, collision, penetrating, and machinery injury) and transported by EMS in 2012 and 2013 in 10 provinces in Korea. Exposure variable was hypoxia (<94%) measured by EMS at the field. Primary and secondary end points were hospital mortality and disability measured by Glasgow outcome scale. Multivariable logistic regression was used for hospital outcomes adjusting for confounders (age, sex, Charlson co-morbidity, mechanism, elapsed time interval, mental status at the field, shock, injury severity score (ISS), and etc.) to calculate the adjusted odds ratios (AOR) with 95% confidence intervals (95% CIs). To compare the effect size of the hypoxia by shock (SBP<90 mmHg) and non-shock status, interaction term (hypoxia*shock) was added. **Results:** Total 17,406 EMS-ST patients were analyzed. 43.2% of patient had higher ISS than 9. Total 2598 (14.9%) died and 3292 (18.9%) were disabled at discharge. 16.8% showed hypoxia at the field. 35.7% in hypoxia patient died while 10.7% in non-hypoxia patients were dead ($p<0.0001$). 38.3% in hypoxia patient were disabled while 15.0% in non-hypoxia patients were disabled at discharge ($p<0.0001$). AOR of hypoxia was 1.96 (1.74-2.21) for hospital mortality and 1.42 (1.27-1.58) for disability. In interaction model, AORs for hospital mortality in shock group and non-shock was 2.71 (2.35-3.12) and 1.70 (1.56-1.84), respectively. AORs for disability in shock group and non-shock was 1.59 (1.39-1.81) and 1.31 (1.21-1.41), respectively. **Conclusions:** Hypoxia in the field was the significant risk factor for hospital mortality and disability in EMS-ST patients. The effect of hypoxia was significantly different according to shock status for hospital mortality and disability. In shock patients, the hypoxia was associate with much higher mortality and disability.

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IS THE PRESENCE OF HYPOGLYCEMIA IN PREHOSPITAL SEIZURE PATIENTS A MYTH?

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Background: Conventional wisdom states that hypoglycemia is frequently present during a seizure or is a 'cause' of seizures. Recent literature disputes this. The purpose of this study was to determine the frequency of hypoglycemia in patients identified as having "seizure" listed as the primary or final problem code in Ambulance Call Reports from a large regional paramedic base hospital program. **Methods:** Retrospective analysis of a database of ambulance call reports (ACRs) for 2 years (January 1, 2014 to December 31, 2015). All 5,854 ACRs with paramedic determined primary or final problem codes of "seizure" were identified from a database of all calls performed by 8 municipal paramedic services covering a total urban and rural population of 1.4 million. Municipal paramedic services used iMedic electronic ACRs. A 10% sample from each year was generated using a random number table. ACRs were manually searched and data extracted onto spreadsheets. Results were analyzed and described using frequencies and summary statistics. **Results:** A total of 582 calls were analyzed. 430 (73.9%) patients were adults and 152 (26.1%) were paediatric (age <18). A blood sugar was determined in 501/582 (86.1%) of all calls, adults 388/430 (90.2%), paediatric 113/152 (74.3%). The GCS, when measured, was 15 in 280/575 (48.7%) cases. Seizures were witnessed by paramedics in 47/582 (8.1%) calls, adults 33/430 (7.7%), paediatric 14/152 (9.2%). In calls where paramedics witnessed a seizure a blood sugar was determined 36/47 (76.6%) of the time, adults 25/33 (75.8%), paediatric 11/14 (78.6%) Hypoglycemia (BS < 4.0 mm/L) was found in 3 cases when BS was checked – overall 3/501 (0.6%), adults 1/388 (0.3%), paediatric 2/113 (1.3%). Case 1 – age 12mon, GCS 13, BS 3.9mm/L. Case 2 – age 22 mon, GCS 15, BS 3.9mm/L, Case 3 – age 70yr, GCS 12, BS 3.8mm/L. **Conclusions:** Hypoglycemia was rarely found in patients who had a prehospital seizure. When present, hypoglycemia was unlikely to be the cause of the seizure. The routine determination of blood sugars in all patients who have had a seizure prior to paramedic arrival should be reconsidered.

COMMUNICATION BETWEEN EMERGENCY MEDICAL SERVICES (EMS) AND HOSPITALS FOR MEDICAL SURGE IN PEDIATRIC MASS CASUALTY INCIDENTS: AN EVALUATION OF CONNECTICUT HOSPITALS

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Background: Efficient interdisciplinary communication and medical surge generation are crucial for Mass Casualty Incident (MCI) response. A pediatric disaster preparedness plan from two Connecticut pediatric facilities was shared amongst community/regional hospitals. We aimed to assess integration of the pediatric disaster plan in Connecticut hospitals and detect gaps between ideal and actual pediatric MCI readiness. **Methods:** A tabletop exercise qualitatively assessed MCI preparedness at a hospital in each of Connecticut's EMS regions, with a standardized after-action report generated post-exercise. Participants included nurses, physicians, EMS providers, and emergency department leadership, each receiving a survey to assess post-exercise comprehension. We evaluated EMS-hospital communication, surge capacity and capability, disaster policies, and transfer agreements/memoranda of understanding (MOUs) with alternate facilities using medical surge standards from US Department of Health and Human Services resources. Metrics obtained from after-action reports and post-exercise surveys were analyzed for significant differences among prehospital coordination/leadership and hospital response personnel. **Results:** There were five after-action reports 20 survey responses (100% response) included. Public-EMS and EMS-hospital communications showed minimal occupational response differences. 66.7% of responses reported patient number/status as the principal MCI descriptor. Significantly more prehospital disaster response coordination/leadership personnel (85%) suggested recruiting additional EMS resources from adjacent cities than did hospital response personnel (33%) and the after-action responses (0%) [$p < 0.0021$]. 66.7% of survey and after-action responses detailed intra-hospital sources for surge capacity with 80% of hospitals referencing specific pediatric capacity procedures. Among surveys, more respondents provided relevant/specific means of generating surge capacity (93.3%) than surge capability (60%) [$p < 0.031$]. Although more action report responses (100%) provided specific MOU knowledge than survey respondents (54%), $p=0.063$. **Conclusions:** There is comprehension deficiency of medical surge capability compared to surge capacity in individual respondents. MOU awareness can be reinforced among staff for successful cohesive MCI response among multiple hospitals. These findings can be emphasized in future MCI educational interventions.

ASSAULT ON EMS: IS A STATEWIDE REGISTRY IN NORTH CAROLINA'S FUTURE?

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Background: EMS personnel are routinely called to violent scenes and aggressive patients. Recent deadly violence targeting police officers has brought attention to the vulnerability of uniformed public officials. Without a standardized reporting system the true incidence of violence directed towards EMS personnel is unknown and strategies to prevent and react to violence are currently based on anecdotal information. We sought to obtain North Carolina (NC) EMS agency representatives' perceptions of violence against EMS personnel and inform whether a standardized violence reporting system is needed. **Methods:** A survey was distributed to 256 members of NC-NAEMSP, NC EMS Administrator and EMS Directors via the Office of EMS electronic mailing list. The survey included 22 questions, 5 used a 5 point Likert scale, 13 were multiple choice, and 4 yes/no. Questions fell into four themes, a. frequency of violence, b. policies regarding violence, c. arming EMS providers and d. general agency descriptors. Descriptive statistics were performed. **Results:** Between July 22 and August 6, 2015, 79 surveys were completed (31% response rate) from across the state. Respondents were mostly from urban settings (53% - 42/79) and 911-EMS type (99% - 78/79) organizations. Violence occurring on a call within their organization was a concern for 94% (74/79). A policy that required injury reporting was present in 98% (77/79) of responders, but 32% (25/79) felt more than 25% of incidents were not actually reported. Drugs/alcohol (95% - 75/79) and psychiatric disorders (82% - 65/79) were the top two factors thought to be involved in violent incidents. Five or more incidents in the past year were reported by 69% (44/64) of

respondents and 38% (30/79) of reporting agencies report lost work days due to an assault. Most respondents (69% - 47/79) were strongly opposed to arming EMS providers with hand guns.

Conclusions: This data shows that there is a strong perception that violence against EMS in NC is a significant problem. Underreporting is thought to be very common. Both of these findings suggest a need for a standardized, collaborative state-wide registry to gather information, which can be used to help prevent or decrease injuries from violence directed at EMS personnel.

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FACTORS CONTRIBUTING TO EARLY DISCHARGE OF AIR MEDICAL SCENE TRANSPORTS FROM A LEVEL I TRAUMA CENTER

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Background: Air medical transport of trauma patients from the scene of injury plays a critical role in the delivery of critically ill patients to trauma centers. Overtriage of less severely injured patients to trauma centers reduces the system efficiency and jeopardizes safety of air medical crews. Our objective was to determine which triage factors utilized by EMS providers are strong predictors of early discharge for trauma patients transported by helicopter to a trauma center. **Methods:** A retrospective chart review over a two year period was performed for trauma patients flown from the injury site into a Level I trauma center by helicopter. Demographic and clinical data was collected on each patient. Prehospital factors such as GCS, revised trauma score (RTS), intubation status, mechanism of injury, anatomic injuries, physiologic parameters and combinations of these factors were investigated to determine which triage criteria accurately predicted overtriage. ISS, length of stay, survival, and Emergency Department disposition were also collected. Early discharged was defined as a hospital stay of less of than 24 hours in a patient who survives their injuries. A more stringent definition of overtriage defined as in-hospital death, ISS > 15, patients taken to the OR or ICU or receipt of blood products was also considered to determine overtriage rates. **Results:** An overall early discharge rate of 34.8% was found among the study population. Furthermore, when the more stringent definition was applied, overtriage rates were as high as 85%. Positive predictive values indicated that patients who met at least one anatomic and physiologic criteria were appropriately transported by helicopter as 94% of these patients had stays longer than 24 hours. No other criteria or combination of criteria had a high predictive value for early discharge. **Conclusions:** No individual triage criteria or combination of criteria examined demonstrated the ability to reliably reduce the early discharge rate. Although helicopter transport and subsequent hospital care is costly and resource consuming, it appears that a significant number of patients will be discharged within 24 hours of their transport to a trauma center.

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PRELIMINARY AND POTENTIAL IMPACTS OF A PARTNERSHIP BETWEEN EMS AND HEALTH AND HUMAN SERVICES ON CALL VOLUMES GENERATED BY EMS "SUPER-USERS"

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Background: For years, rising EMS call volumes have taxed resources in EMS jurisdictions. A significant problem of utilization by frequent 911 callers has contributed to transports and ED utilization, some of which may be unnecessary. Solutions to this have been limited for field providers. We wished to both pilot a new EMS partnership with our County's Health and Human Services Agency (HHS) that could intervene with services for these "super-users", and study the scope of the problem, with the goal being appropriate alternate dispositions besides EMS activation. We hypothesized that intervention through referrals from multiple sources to a new EMS-HHS Partnership will have an impact on EMS utilization by super-users. **Methods:** We identified the most frequent 911 users by medical and dispatch records, and referred them for intervention by our partnership with HHS. We retrospectively reviewed the call volumes before and after HHS intervention. We then used a new ePCR system to conduct a retrospective 14 month study of the scope of the problem that may be impacted by an ongoing

partnership. **Results:** The highest users (N=14) generating 128 calls in the quarter ending in March 2015 were referred to HHS, which enhanced services available to them. They were primarily vulnerable adults. In the quarter after intervention, their call volume decreased to 47 (64%). In a second phase, we developed field referral and e-PCR search programs to identify super-users over a 14 month period from April 2015 to July 2016. There were 265 patients accounting for 4,393 e-PCRs. Of those, the top super-users (N=20) accounted for 797 responses. **Conclusions:** We showed that super users in our large system are often vulnerable adults. A partnership with HHS had preliminary impacts on call volumes generated by the highest users, and a second phase identified the magnitude of EMS patients this partnership might reach. This preliminary multi-phase partnership and its interventions show potential to stem growing EMS over-utilization. More studies are needed to prospectively prove the value and best practices of these programs.

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COMPARING THE CRITERIA OUTCOMES TOOL TO VARIOUS MASS CASUALTY INCIDENT TRIAGE ALGORITHMS IN CHILDREN < 15 YEARS OF AGE USING THE NATIONAL TRAUMA DATABASE

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Background: Several mass casualty incident (MCI) algorithms are currently in use, yet, there is no consensus regarding which algorithm is superior in the pediatric population. **Methods:** In this study, we compare Criteria Outcomes Tool (COT) performance to triage outcomes of Simple Triage and Rapid Treatment (START), modified START (FDNY), and CareFlight in patients 48 hours, apnea, cardiac arrest, and death in the ED. The COT outcomes were considered the criterion standard. Based upon prior definitions, the sensitivity, specificity, over- and under-triage of START, FDNY, and the CareFlight MCI algorithms were compared to each of the COT outcomes (Black, Red, Yellow, and Green). **Results:** 31,093 patients < 15 years of age were reviewed and had the following outcomes using the COT: 17,333 (55.7%) Green, 11,587 (37.3%) Yellow, 1,572 (5.1%) Red, 601 (1.9%) Black. Performance in the Red COT category was similar between MCI algorithms with sensitivity 54-56%, specificity 80-89%, over-triage 0%, and under-triage 46-56%. The Yellow COT category had the lowest sensitivity (20-22%), highest under-triage (60-65%), and an over-triage of 16-19%. The Green category performance was 69-79% sensitivity, 43-47% specificity, and 21-31% over-triage. CareFlight had the highest sensitivity (83%) and the lowest under-triage (17%) in the Black category. START and FDNY had sensitivity 39%, specificity 100% and under-triage 61%. Other than CareFlight's performance for the Black category, none of the tools demonstrated both high specificity and sensitivity for any triage category. **Conclusions:** Using the COT outcomes as the criterion standard, the algorithms tested showed poor sensitivity in predicting Red and Yellow outcomes and poor specificity predicting Green outcomes. These results cast doubt regarding the utility of these tools in accurately predicting outcomes.

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ASSOCIATION OF HOSPITAL CHARACTERISTICS WITH OUTCOMES OF PATIENTS RESUSCITATED AFTER OUT-OF-HOSPITAL CARDIAC ARREST

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Background: Substantial variation exists on the clinical approach to out-of-hospital cardiac arrest (OHCA) patients after return of spontaneous circulation (ROSC). Current AHA guidelines state that regional specialty centers for cardiac arrest care may be beneficial. Our objective is to explore the association of hospital characteristics with outcome in patients resuscitated from OHCA in a large and diverse US state. **Methods:** We performed a retrospective study of adult patients admitted to Michigan hospitals with an ICD-9 admission diagnosis of cardiac arrest (427.5) or VF (427.41) between July 1, 2010 and June 30, 2013. We queried the Michigan Inpatient Database (MIDB), which collects data on admissions to all Michigan acute care hospitals, to obtain data including demographics, clinical characteristics, and outcome (survival to discharge). This data was combined with hospital characteristics including ED volume (stratified by quartiles), PCI capability, nursing Magnet designation,

and verified trauma center status obtained from state regulatory and national certifying bodies. Records with missing data were excluded and the combined dataset was analyzed using multivariate logistic regression. **Results:** During the study period 4,173 patient records met criteria, of which 39.4% survived to hospital discharge. VF arrest (OR=3.01, 95% CI 2.56-3.54) was associated with increased odds of survival while cardiogenic shock (OR=0.42, 95% CI 0.33-0.52) and increasing age (per year OR=0.98, 95% CI 0.98-0.99) were associated with decreased odds of survival. Most hospital characteristics including: level 1 or 2 trauma center status, nursing Magnet designation, cardiac surgery capability, and PCI capability were not associated with improved outcome. However, compared to the busiest quartile, hospitals with ED volumes in the 2nd busiest (OR=1.27, 95% CI 1.01-1.60) and 3rd busiest (OR=2.74, 95% CI 1.63-4.59) quartiles were associated with improved outcomes. **Conclusions:** Though limited by lack of prehospital data, using this large statewide dataset we did not demonstrate improved outcome for post arrest patients based on advanced hospital medical, surgical, or nursing characteristics. Further work is needed to assess whether advanced hospital care provided rather than hospital characteristics improves post arrest outcomes.

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HIGH FIDELITY HYBRID SIMULATION MODEL ADAPTED FROM MILITARY EXPERIENCE SUPPORTS INTEGRATED TRAINING OF CIVILIAN CRITICAL CARE TRANSPORT PROVIDERS

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Background: Hemorrhage control and airway management represent core skills of critical care prehospital providers. It is difficult to assess the potential field competency in these skills because they are typically trained independent of each other independently and on non-interactive models in a low stress environment. We wished to develop a high fidelity hybrid simulation model (HFHSM) to train providers to provide integrated care in evaluation, stabilization, and management during initial care and transport from the field. **Methods:** We used an adaptation of a previously developed HFHSM used in training of combat medics to test and train 95 critical care transport providers. To evaluate the level of stress during performance, providers were fitted with a physiologic band for collection of physiologic data. They were administered a pre- and post-assessment on confidence level of skills on a 5-point Likert scale including: tourniquet placement and effectiveness, wound packing, airway management and tension pneumothorax skills. A patient scenario that included hemorrhage control and airway management during field care and transport was utilized (grain elevator explosion), providers were, and briefed on the patient scenario, safety considerations, physical and surroundings, available equipment, medic gear check and the flow of the exercise. Providers were allowed one hour to complete the scenario. Paired t-test was used to analyze the comparisons. **Results:** Providers demonstrated significant physiologic stress throughout the scenario, evidenced by significantly higher heart rates at all time points when compared to baseline (Baseline HR 107,±33 , Peak HR 135,±30). Participants self-reported as being more confident in their skill level after completion of the scenario, even if they reported weak confidence on the pre-assessment. The percent of participants self-reported as weak in a specific area decreased by 5% (endotracheal intubation) to 20% (wound packing, needle chest decompression), p<0.05 for all comparisons. **Conclusions:** A high-fidelity hybrid simulation model adapted from military experience resulted in improved confidence in prehospital skills in civilian critical care transport providers. This integrated training provided physiologic stress demonstrated by increased heart rate.

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A COMPARISON OF VIDEO LARYNGOSCOPY TO STANDARD LARYNGOSCOPY IN EXPERIENCED PARAMEDICS

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Background: Endotracheal intubation has always been an essential paramedic skill. With the advent of video laryngoscopy paramedics now have an additional tool to facilitate endotracheal intubation.

Numerous video laryngoscopy devices are available. The VividTrac (Vivid Medical, Palo Alto, CA) is a novel disposable video laryngoscope that provides real-time images on a computer or smartphone. Our objective was to determine whether the VividTrac video laryngoscope is an effective device for endotracheal intubation by paramedics. **Methods:** The study was declared exempt by the University of Nevada, Reno Institutional Review Board. Paramedics attending a mandatory educational session were asked to voluntarily participate in the study. Two intubation manikins (Laerdal Airway Management Trainer, Wappingers Falls, NY) were used for the protocol. Subjects first attempted standard endotracheal intubation on one manikin followed by endotracheal intubation with the VividTrac. The subject then moved to the second manikin and repeated the protocol. The subject was monitored by an independent observer and time intervals recorded on the research datasheet. **Results:** 15 subjects made 32 intubation attempts using standard endotracheal information and 32 intubation attempts using the VividTrac. The cohort consisted of experienced paramedics with 13.4 (Range: 1-23) years of experience. The overall intubation success rate for standard endotracheal intubation was 100% versus 91% for the VividTrac. The difference in the time to the first visualization of the vocal cords was faster for standard intubation (2.6 versus 3.7 seconds, $p=0.01$). The difference in the time to attempted endotracheal tube placement was faster for standard intubation (6.2 vs. 9.7 seconds, $p=0.01$). The difference in time to first ventilation following endotracheal tube placement was similar (12.3 vs. 15.2, $p=0.32$). The quality of cord visualization was similar between the two techniques with an average Mallampati score (1.4 vs. 1.4, $p=0.41$) and percentage of glottic opening (POGO) score (93.4% vs. 91.7%, $p=0.27$). **Conclusions:** The VividTrac video laryngoscope system demonstrated similar, but not superior, performance to standard endotracheal intubation in a cohort of experienced paramedics.

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A DESCRIPTIVE ANALYSIS OF PREHOSPITAL REFRACTORY VENTRICULAR FIBRILLATION

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Background: When ventricular fibrillation (VF) is unable to be terminated with conventional external defibrillation, it is classified as refractory VF (RVF). Currently, there is little evidence for the treatment of RVF, with double sequential external defibrillation (DSED) being a potential novel treatment. The goal of this investigation is to provide a descriptive analysis of patients in an urban EMS system with RVF as well as to determine how often DSED may have been utilized as a potential treatment option in these patients. **Methods:** Ambulance Call Records (ACRs) of all patients with out-of-hospital cardiac arrest (OHCA) between March 1, 2012 and April 1, 2016 were reviewed. All cases in which one or more defibrillations occurred were examined and cases of RVF (≥ 5 consecutive defibrillations) were determined by manual review. Descriptive characteristics and clinical variables were compared for RVF versus non-RVF patients using chi-square or t-test analyses where appropriate. **Results:** 645 OOHCA occurred during the study period. 193 (29.9%) arrests involved at least one analysis of VF. Ninety (13.9%) cases of OOHCA were identified as RVF. Thirty-four (37.8%) of the RVF arrests had two or more manual defibrillators on scene. There was no difference between the non-RVF and RVF groups in age (65.02 vs. 67.28, $p=0.313$) or gender ($p=0.132$). There was no difference between time from EMS activation to arrival at patient (9.00 min vs. 8.73 min, $p=0.610$) and time from EMS activation to time at first defibrillation (11.31 min vs. 12.63 min, $p=0.122$) between the two groups. There was no difference in the incidence of bystander CPR between groups ($p=0.840$). **Conclusions:** In the study group the incidence of RVF was 14% and nearly half of all OOHCA involving VF were refractory in nature. Just under half of the RVF cases had the potential to have DSED utilized in the prehospital setting. Although there were no identified variables associated with prehospital RVF, next steps will include a review of the hospital charts to determine the incidence of sustained RVF in transported patients, survival to admission, survival to hospital discharge and potential co-morbidities that may increase the likelihood of RVF.

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“SAY AGAIN...I DON’T UNDERSTAND YOU” - PROBLEMS IN PARAMEDIC-PHYSICIAN TELECOMMUNICATION

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Background: Clear paramedic-physician telecommunications (patches) are critical in systems utilizing on-line medical control. Investigation of specific problem calls indicated communication problems were more common than believed. Existing literature on paramedic telecommunication is sparse. This project was undertaken to understand the extent and nature of problems in paramedic-physician telecommunication. **Methods:** Retrospective analysis of all patch calls between physicians, providing on-line-medical-control, and paramedics from 4 municipal paramedic services from January 1, 2014 - December 31, 2014. MP3 audio files recorded during normal operating procedures by the Central Ambulance Communication Centre were anonymized and transcribed. Transcripts were read multiple times by 2 authors and analyzed using mixed methods - qualitative thematic framework analysis and quantitative descriptive statistics. **Results:** 155/161 cases identified were usable for analysis. 127 (81.9%) patches were for termination of resuscitation orders, 28 (19.1%) were for advice or orders not covered by medical directives. 567 pages of transcription comprised the data set. Communication problems were identified in 138 (89.0%) patches. Most had multiple problems. These included disconnections (13.5%), difficulty hearing one another (56.8%) - indicated by phrases such as “sorry?”, “what?”, “I can’t hear you” - individuals interrupting each other (34.2%), and talking simultaneously (54.8%). Incorrect information was identified in 17 (11%) patches, e.g. “asystole with a PEA of 40”. Medical directives were not understood by physicians in 12 (7.7%) patches e.g. Physician: “...use Morphine instead.” Paramedic: “I don’t have Morphine, we only have Toradol.” Signaling the end of “talk turns” – using terms such as “10-4” or “over” - was never done. Instead, terms like “yah” and “OK” were used. When communication went awry, time was spent repairing mis/poor communication. This required repeating information or attempting to ‘sell’ the case by providing information unnecessary for decision making – e.g. during a request for termination of resuscitation, “there is vomit on the floor”. **Conclusions:** Paramedic-physician telecommunication problems are extremely common. They involve equipment problems and human factors (disorganized radio ‘technique’). The high incidence of telecommunication problems is concerning when critical clinical decisions (e.g. ceasing resuscitation) depend on clear communication. Further study of these issues is warranted.

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MERGER OF 2 DISPATCH CENTRES: BEYOND ECONOMIES OF SCALE, DOES IT IMPROVE QUALITY AND PATIENT SAFETY?

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Background: Dispatch centres (DCs) are considered as an essential but expensive component of highly developed health-care systems. The number of DCs in a country are usually based on local history and often related to highly decentralized health-care systems. Today, current technology (global positioning system, internet access) abolishes the need for closeness between DCs and the population. Our country went from 22 DCs in 2006 to 17 today. We describe hereunder from a quality and patient safety point of view, the merger of 2 DCs. **Methods:** We analyzed the performance of 2 medical dispatch centers for 12 months prior merging and for 12 months again after the merger. Dispatch A has a catchment population of 768,000, dispatchers are paramedics or nurses and use a criteria-based system. Dispatch B has a catchment population of 178,000, dispatchers are police officers taking care of police and medical calls, with only basic training in medical activity. Merger took place in January 2015, when dispatch A took over dispatch B’s medical activity. **Results:** Prior merging, dispatch A had a sensitivity/specificity regarding the use of lights and sirens and severity of cases of 86% / 48% with over and under triage rates of 78% respectively 5%. Dispatch B had sensitivity and specificity of 92% / 20% and over and under triage rates of 84% and 7% respectively. After they merged, global sensitivity/specificity reached 87% / 67% and over and under triage rates were 71% and 3% respectively. **Conclusion:** Although evidence is

lacking regarding the most appropriate catchment population per DC, reducing their number may contribute to improvements in recruiting, training and retaining qualified personnel, and to controlling the high costs of these structures (salaries, computer-aided dispatch systems). A lower number of DCs may, in particular, allow the number of dispatchers covering the same geographical region to be reduced, especially during night-time. Our experience also shows it may improve performance in terms of quality of services and patient safety (decrease of under triage without increasing overtriage).

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A COMPARATIVE ANALYSIS OF QSOFA, SIRS AND EARLY WARNING SCORES CRITERIA TO IDENTIFY SEPSIS IN THE PREHOSPITAL SETTING

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Background: Early recognition of sepsis is key in delivering timely life-saving interventions. The role of paramedics in recognition of these patients is understudied. It is not known if the usual prehospital information gathered is sufficient for severe sepsis recognition. We sought to: 1) evaluate the paramedic medical records (PMRs) of severe sepsis patients to describe epidemiologic characteristics, 2) determine which severe sepsis recognition and prediction scores are routinely captured by paramedics, and 3) determine how these scores perform in the prehospital setting. **Methods:** We performed a retrospective review of patients ≥ 18 years who met the definition of severe sepsis in one of two urban Emergency Departments (ED) and had arrived by ambulance over an eighteen-month period. PMRs were evaluated for demographic, physiologic and clinical variables. The information was entered into a database, which auto-filled a tool that determined SIRS criteria, shock index, prehospital critical illness score, NEWS, MEWS, HEWS, MEDS and qSOFA. Descriptive statistics were calculated. **Results:** We enrolled 298 eligible sepsis patients: male 50.3%, mean age 73 years, and mean prehospital transportation time 30 minutes. Hospital mortality was 37.5%. PMRs captured initial: respiratory rate 88.6%, heart rate 90%, systolic blood pressure 83.2%, oxygen saturation 59%, temperature 18.7%, and Glasgow Coma Scale 89%. Although complete MEWS and HEWS data capture rate was <17%, 98% and 47% patients met the cut-point defining “critically-unwell” (MEWS ≥ 3) and “trigger score” (HEWS ≥ 5), respectively. The qSOFA criteria were completely captured in 82% of patients, however, it was positive in only 36%. It performed similarly to SIRS, which was positive in only 34% of patients. The other scores were interim in having complete data captured and performance for sepsis recognition. **Conclusion:** Patients transported by ambulance with severe sepsis have high mortality. Despite the variable rate of data capture, PMRs include sufficient data points to recognize prehospital severe sepsis. A validated screening tool that can be applied by paramedics is still lacking. qSOFA does not appear to be sensitive enough to be used as a prehospital screening tool for deadly sepsis, however, MEWS or HEWS may be appropriate to evaluate in a large prospective study.

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PREHOSPITAL RAPID SEQUENCE AIRWAY: A SERIES OF 57 CASES

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Background: Rapid Sequence Airway (RSA) is an airway management technique that combines the pharmacology and preparation of Rapid Sequence Intubation (RSI) with the immediate planned placement of an extraglottic device. Publications on this technique have been limited. The purpose of this study was to determine the overall success rate of RSA in the prehospital setting. A secondary goal was to determine the aspiration rate associated with RSA. **Methods:** This is an IRB-approved retrospective cases series of prehospital adult and pediatric RSA cases between 2007-2016 from one ground EMS system and one air transport system in New Mexico. Overall success of RSA was determined by the ability to oxygenate and ventilate the patient effectively. Aspiration data was obtained via hospital chart review and was determined to be present if radiologic evidence (CXR, Chest CT) of aspiration was present within 48 hours of hospital presentation. **Results:** During the study period 57 patients from 1 to 73 years of age and 10 to 125 kg underwent prehospital RSA. The LMA-Supreme

was used on first attempt in 30 cases, the King LT in 18 cases, the LMA-Unique in 8 cases and a Combitube in 1 case. RSA was successful on first attempt in 46 of 57 cases (81%) and overall successful in 52 of 57 cases (91%). Five cases required intubation due to inability to achieve adequate ventilation or oxygenation. Aspiration data was available on 42 patients of whom 3 (7%) were found to have evidence of aspiration within 48 hours. **Conclusions:** Overall success rate for RSA was high and aspiration rates were low considering this was a high risk population followed for 48 hours and all underwent secondary RSI procedures in the Emergency Department. RSA may be a viable option for emergency airway management in the prehospital setting and warrants further study.

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UTILITY AND EFFICACY OF A STATE MANDATED NALOXONE PROGRAM FOR MFR/EMR AND BLS UNITS IN AN ALL ALS SYSTEM INCLUDING A COST-BENEFIT ANALYSIS

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Background: The Macomb County Medical Control Authority (MCMCA) consists of 27 EMS agencies. Agencies by type: 17 Advanced Life Support (ALS), 7 Basic Life Support (BLS), 3 are Medical First Responder (MFR). In October 2015, the State of Michigan passed legislation requiring all MFR and BLS units to carry naloxone, regardless of “type of system”, e.g. all ALS. Analysis is underway to determine the utility of a state mandated MFR-BLS naloxone program in an all ALS system with an average ALS unit response time of 5:08 (90% fractile time of 8:00). The legislation has a “sundown date” of October 2017, after which each MCA may choose to continue a MFR-BLS naloxone program. Our objective was to determine the utility and efficacy of a state legislated MFR-BLS naloxone program in an all ALS system. **Methods:** Perform a comparative retrospective analysis of patient care records (PCR’s) for the 12 months prior to MFR-BLS naloxone program implementation in October 2015 with the 12 months since implementation. Data to be analyzed includes frequency of MFR-BLS use, frequency of ALS use, time interval from MFR-BLS naloxone administration to ALS arrival, and the financial burden of the program on the EMS system and member-owner hospitals. **Results:** There have been 7 MFR-BLS administrations of naloxone since October 2015. The average time interval from MFR-BLS naloxone administration to ALS arrival is 3:25. The financial burden on the system includes the initial cost to supply 186 naloxone kits at \$35 each (\$6,510) plus the costs to provide 2 hours of paid training for the 45 paid MFR’s and the 633 paid EMT’s working in the system. The cost burden does not include annual re-training of the MFR’s and EMT’s nor does it include naloxone replacement for use or expiration. **Conclusions:** Based upon the infrequent occurrences of MFR-BLS naloxone administration, the minimal time interval from MFR-BLS naloxone administration to ALS arrival, initial and on-going naloxone kit supply and replacement costs, and the MFR-EMT training costs as referenced above, it is concluded that each EMS system should be allowed the option to adopt an MFR-BLS naloxone program.

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REDUCED-DOSE KETAMINE FOR EMERGENT CHEMICAL RESTRAINT

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Background: Ketamine is an effective medication used for chemical restraint in emergent settings. For managing patients with severe agitation, time is critical in order to prevent injury. Ketamine can be administered intramuscularly with a rapid onset and excellent sedation, allowing for safe provision of care. The optimal dose for emergent chemical restraint has not been studied. Based on our experience, we hypothesize that a standard dose of 250mg IM will reduce the need for intubation without increasing the need for additional sedation in order to prevent injury. **Methods:** As a retrospective chart review, data was obtained by querying EMS patient care records for two EMS agencies. Included were adult patients who received intramuscular ketamine and transported to one of two affiliated hospitals. Excluded were those who received ketamine for reasons other than chemical restraint. Hospital charts were then reviewed to determine dose administered, the need for a repeat dose, the need for additional sedation by EMS or within 30 minutes of hospital arrival, and whether the patient required intubation. **Results:** 145 patients were included in final analysis. 11 patients received a single 500mg

dose of ketamine. The remainder received 150 to 300mg (mean 265mg). 22 patients required a second dose (overall mean 300mg). Of the 29 patients receiving > 300mg, 7 required intubation, whereas 23 of 116 patients receiving ≤ 300mg required intubation, for an overall intubation rate of 20.7% (similar research at higher doses resulted in a 30% intubation rate). Of the 134 patients who received ≤ 300mg initially, 73 (54.5%) required additional sedation either by EMS providers or within 30 minutes of hospital arrival. When compared with prior similar research at higher doses, this demonstrated a statistically significant increase in the need for additional sedation ($p < 0.0001$). There were no significant injuries documented to responders or bystanders. There was one death noted due to methamphetamine toxicity. **Conclusions:** Although there was an increased need for additional sedation, a trend toward less frequent intubation suggests improved patient safety. With an educational focus on appropriate medication titration, we believe 250mg is a reasonable initial dose for time-sensitive chemical restraint.

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A SURVEY OF THE PERCEPTIONS OF VIOLENCE AND SAFETY AMONG EMS PREHOSPITAL PROVIDERS

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Background: Violence towards EMS providers has been a growing problem for many years, so we looked to gather provider perceptions. We defined “violence” as any altercation between bystanders/ patients towards providers involving physical altercations or verbal threats. We wanted perceptions on how services handled reporting incidents, patient restraint systems, training in verbal de-escalation and self-defense. Lastly, we asked how providers viewed their profession and their job performance. **Methods:** Utilized an online survey directed at EMS providers that was anonymous, covered multiple areas related to provider safety, and produced nearly 700 responses. **Results:** The majority of respondents were EMT-P level from urban 911 systems. Of note, 75% of respondents reported being physically or verbally assaulted in their career, personal safety training was not offered by their services, and 72% of providers felt their training had not been appropriate to deal with violent patients. For restraints, 80% of the time providers felt they couldn’t apply their restraint system alone, and 40% of providers reported having patients escape their restraint systems. In provider safety, 64% of responses reported an association between violent encounters and patient demand for narcotics. Some 74% of respondents felt their work environment has become more unsafe since the start of their career, 30% felt they didn’t have resources available to support reporting violent encounters, 64% see violence towards EMS providers as “part of their job”, and 11% reported their service asking them to not report an incident with a patient. When on duty, 10% carried unauthorized restraint devices, 15% wore tactical protection devices, and 15% carried unauthorized offensive weapons. **Conclusions:** We recognize that these results may be biased by providers that believe they have had issues during their careers, so this does not represent all EMS prehospital providers. Overall the survey showed that incident reporting results and personal safety training was felt to be low, the perception of violence towards EMS providers was high, and that providers felt there was a strong association between patient desire for narcotics and violence. Lastly, many providers feel that violence is now a “part of their job”, and that this affects their performance.

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qSOFA SCORE IN THE PREHOSPITAL SETTING

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Background: Sepsis/septic shock is a life-threatening condition. The quick SOFA score (qSOFA) intends to better identify patients with the worse prognosis. We measured the performance of the qSOFA score vs. the sepsis/septic shock definition to identify the most severe patients (ICU admission, mortality <48 hours, mortality < 29 days) within a population transported by EMS. **Methods:** We performed a retrospective study of all patients transported to a University Hospital, from January 1, 2012 to December 31, 2012. Population Prehospital qSOFA scores and sepsis/septic shock definition were retrospectively determined from prehospital charts for all patients transported by EMS and having a

final diagnosis of infection following the ED workout. **Results:** In 2012, 36,129 were admitted in the ED. 893 patients had a final diagnosis of infection. Among those, 267 patients had criteria of sepsis/septic shock in the prehospital setting whose 106 with a qSOFA score ≥ 2 . 626 patients did not meet sepsis/septic shock criteria in the prehospital setting but 33 among those did present a qSOFA ≥ 2 . Sensitivity of sepsis/septic shock definition versus qSOFA score regarding prediction of ICU admission was 65% vs. 40%, regarding mortality <48 hours was 63% vs. 71% and regarding mortality < 29 days was 53% vs. 16%. Specificity of sepsis/septic shock definition versus qSOFA score regarding prediction of ICU admission was 11% vs. 35%, regarding mortality <48 hours was 4% vs. 7% and regarding mortality < 29 days was 9% vs. 29%. **Conclusions:** For the first time, qSOFA score's performance has been compared to the sepsis/septic shock definition to identify the most severe cases in the prehospital setting. qSOFA score's sensitivity seems superior to predict mortality at 48 hours but inferior to predict ICU stay and mortality < 29 days. qSOFA score's specificity performed better than sepsis/septic shock definition for all three outcomes.

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CREATIVE SIGNALS ANALYSIS OF MEDIA TECHNOLOGY FOR RECOGNIZING CARDIAC ARREST

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Background: Recognition of cardiac arrest with checking carotid pulse is less than a half correct by the public. Poor recognition of cardiac arrest or patient of agonizing situation delays early bystander cardiopulmonary resuscitation (BCPR) that should be critically provided in the first five minutes before emergency ambulance arrival. Globally we still lack of effective technology to assist better recognition of cardiac arrest to facilitate early BCPR and public access defibrillation (PAD). In this study, we aim to innovate a video signals analysis tool to assist recognition of cardiac arrest. **Methods:** We designed an innovative skill algorithm for transforming and analyzing the signals of the video recordings filmed with mobile smartphone for part of human body. Fast Fourier Transform (FFT) signals were evaluated in our skill algorithm. The time length for each video recording was fifteen seconds, which was filmed within the first five minutes after cardiac arrest witnessed in the intensive care unit. This signal analysis skill algorithm was applied on the video recordings of cardiac arrest patients and compared with that of normal volunteers. **Results:** We applied our skill algorithm analysis on video segments from twenty cardiac arrest patients (asystole for 18 cases, ventricular fibrillation for 2 cases) and twenty non-arrest volunteers (median heart rate 74/min, IQR: 65- 88/min), matched in age and sex. We innovated a mathematic formula to calculate a value (we called it Slope Alfa) mainly from the cluster of FFT signals evaluated by the skill algorithm. The Slope Alfa value (Mean, [SD]) of cardiac arrest patients was significantly different from the value of non-arrest volunteers (0.14, [0.09] vs. 1.96, [0.37], $p < 0.01$). The results also indicated a tendency that for cardiac arrest patient the Slope Alfa would be less than 1.0. **Conclusions:** The skill algorithm we innovated for smartphone video signals analysis may successfully recognize patient after cardiac arrest. Further integration of this technology with mobile devices would provide the general public an easily accessible tool for cardiac arrest recognition and early chest compressions.

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A NOVEL PREHOSPITAL CARDIAC ARREST TEXT-MESSAGE ALERT SYSTEM FOR EMERGENCY MEDICINE RESIDENTS

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Background: To improve emergency medicine (EM) resident education regarding EMS care and prehospital cardiac arrest management, we initiated an opt-in system for the delivery of text-message alerts for all 911 calls coded as not breathing or breathing uncertain within the local urban EMS system's response area. Residents could respond to the incident location at their discretion in personal vehicles and integrate with EMS personnel in resuscitations. We used a structured survey to assess program

participation, educational value and opportunities for improvement. **Methods:** Nine months after initiation of the program, a web-based survey was sent to all PGY-2 and PGY-3 EM residents at our training program. PGY-1 residents were excluded, as they had not been enrolled in the paging system yet. **Results:** Nineteen residents (100%) completed the survey and nine (47%) opted to receive alerts. Rates of opting-in and responding to alerts did not differ significantly between individuals with and without prior EMS experience. Four residents responded to at least 14 alerts, but only one where active resuscitation was ongoing. All residents who responded to alerts believed the experience was educational, regardless of whether resuscitation was ongoing (mean=75.8 on a 100-point scale, std dev=8.2). Number of alerts responded to ranged from 1 to 12 (median=1). The most common reason not to opt-in was that residents already receive ,“too many text-messages and emails.” Factors identified as increasing the likelihood of enrolling or responding included: knowing whether the alert was an active code vs. obvious death (89% of residents), responding with an EMS fellow/faculty (72%), having a dedicated response vehicle (67%), and greater familiarity with EMS personnel (61%). **Conclusions:** While participation varied greatly, all residents that responded to a text-message alert found the experience educational. Improvements that may increase involvement and educational value include: narrowing alerts to true cardiac arrests through radio monitoring, combined resident/EMS personnel training, responding with EMS faculty, and availability of a dedicated response vehicle. This text-message alert system has potential to provide a unique educational avenue for EMS education to EM residents.

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AN ANALYSIS OF DISASTER MEDICINE TRAINING FOR MEDICAL STUDENTS

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Background: Every hospital is required to have a disaster plan in place with many physicians being a part of the process but the majority lack formal training in the subject. In 2003, the AAMC and the CDC constructed recommendations for medical school training in Disaster Medicine, but this has been instituted in very few programs nationwide. Addressing this deficit, a pilot curriculum of Disaster Medicine was instituted within the University of Rochester School of Medicine. The objective of our study is to analyze the difference between pre and post course confidence and exam scores of those students who completed the curriculum. Our hypothesis is that students will both be more confident in their knowledge of Disaster Medicine and will score higher on the knowledge exam after completing the course. **Methods:** Survey data was collected as part of a quality improvement project associated with the curriculum in Disaster Medicine. The curriculum involved a flipped classroom concept with pre-coursework and a 2-hour session with tabletop scenarios. Pre and post course surveys were completed in courses from August 1, 2015 to January 31, 2016. The data gathered by the surveys were analyzed retrospectively using Wilcoxon Sum Rank and Wilcoxon Test of the Median. **Results:** 61 medical students completed both the Disaster Medicine training and both pre and post course surveys. Overall confidence, measured as the difference between Pre and Post-course confidence scores, was statistically significant ($p < 0.0001$), indicating that participants had more confidence after the completion of the course. Participants scored significantly higher on the Post-Course test than on the Pre-Course test ($p < 0.0001$). Overall Pre and Post median test scores were 5 and 8, respectively. Surprisingly, students with prior Disaster Medicine and EMS experience had lower Pre-test median scores (4 vs. 5). Students going into Emergency Medicine had higher median Pre-test scores (6 vs. 5). **Conclusions:** Students had significantly increased confidence scores and knowledge based exam scores after completing the curriculum. It is our hope that these findings may ultimately translate into these students feeling more prepared to assist in a meaningful way during disasters throughout their careers as physicians.

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SALT TRIAGE TRAINING FOR SCHOOL PERSONNEL

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Background: To determine if non-medical schoolteachers and other school personnel can be trained to understand and apply SALT (Sort, Assess, Lifesaving Interventions, Treat/Transport) triage methods and lifesaving interventions after brief training. The investigators predicted that subjects can learn to triage with accuracy similar to medical professionals, and that subjects can pass an objective structured clinical exam (OSCE) evaluating hemorrhage control. **Methods:** Local public and private school personnel were eligible to participate in this prospective observational study. Investigators recorded subject demographic information and prior medical experience. All subjects received a 30-minute lecture on SALT triage and a brief lecture and demonstration of hemorrhage control and tourniquet application. A slide show-based test with descriptions of mass casualty victims was administered immediately after training. Subjects independently categorized the victims as dead, expectant, immediate, delayed, or minimal. Subjects also completed an OSCE to evaluate hemorrhage control and tourniquet application using a mannequin arm. **Results:** Personnel from two schools completed the study. Fifty-nine subjects were from a private school that enrolls early childhood through grade 8, and 45 were from a public middle school (n=104). The average subject age was 45 years and 69% were female. Approximately 81% were teachers and 87% had prior cardiopulmonary resuscitation training. Subjects correctly triaged an average (\pm standard deviation) of 19.9 ± 2.6 of the 25 victims (79.5%). Ninety-six of the subjects passed the tourniquet application OSCE (92.3%). **Conclusions:** After two brief lectures and a short demonstration, school personnel were able to triage descriptions of mass casualty victims with an overall accuracy similar to medically trained professionals, and most were able to apply a tourniquet correctly. Opportunities for future study include integrating high-fidelity simulation and mock disasters, evaluating for knowledge retention, and exploring the study population's baseline knowledge of medical care, among others.

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EXPERIENCE OF A STADIUM MEDICAL RESPONSE FOR AN NFL FOOTBALL TEAM

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Background: Mass gathering events require a great deal of health resources given a high population density and limited access points. Previous studies indicate a patient presentation rate (PPR) from 5.0 to 32 per 10,000 and a transport to hospital rate (TTHR) of 0.49 to 0.88 per 10,000. One of the most popular mass gathering events in the United States is an American football game. We sought to examine mass gathering medical care during the home games over one season of a professional football team. **Methods:** From August 2014 to December 2014, data was collected for 10 home games from seven medical aid stations at a stadium with a capacity to hold approximately 70,000 spectators. First aid and emergent care was provided to spectators and employees for a minimum of seven hours per game. Two emergency medicine attendings oversaw care with one serving as medical director. Each station was staffed with a one nurse and two paramedics. Emergency medicine residents assisted with staffing when available. Patient encounters were recorded for any medical intervention except for minor care (i.e., request for a Band-Aid, tampon, or ice pack.) Staff recorded patient encounters on paper charts and this information was transferred to a prehospital electronic patient care record. **Results:** Over the 10 games, there were 683,527 spectators and 40,000 employees, totaling 723,527 attendees. A total of 434 patient presentations were recorded, yielding a PPR of 5.97 per 10,000 attendees. A total of 41 patients were transported, yielding a TTHR of 0.57 per 10,000 attendees. The most common presenting illness was atraumatic headache, accounting for 35.7% (155) of the presentations. No medical problem was the second most common recorded presentation with 18.4% (80). The third most common presentation was syncope 7.4% (32). 16.4% (71) of the presentations were not recorded. **Conclusions:** This study found a PPR and TTHR for one season of a professional football team consistent with, but on the lower end of, previously established ranges. Further research should evaluate factors that would possibly affect these rates, such as alcohol use and the score of the game at the time of presentation.

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ADMINISTRATION OF PREHOSPITAL PAIN MEDICATION COMPARED TO EVENTUAL NEED AMONG SUBJECTS OF A RANDOMIZED CONTROLLED TRIAL

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Background: Prehospital pain management continues to be a controversial factor in overall treatment of pain, especially in the pediatric population. The primary aim of this prospective, double-blinded, randomized control trial was to determine whether a single, sub-dissociative dose of ketamine would decrease the total narcotic requirements of pediatric emergency department (ED) patients compared to a group of patients who received morphine alone. Here, we present the frequency of prehospital opioid administration as compared to eventual need for treatment upon arrival at the ED. **Methods:** Patients aged 3-17 presenting to the ED with a condition requiring opioid pain management per standard of care were randomized to the study. After administration of either a single bolus of ketamine (0.3 mg/kg) or a single bolus of morphine (0.05 mg/kg), they were followed to determine if additional doses of morphine were needed. Retrospectively, we determined whether each subject was given prehospital pain medication by the emergency medical service (EMS). **Results:** Forty pediatric patients (mean age 13.0 ± 3.7 , 35% female) were enrolled, all of whom were deemed to require opioid pain management per standard of care upon arrival at the ED. Twenty patients were randomized to each study arm and administered the assigned drug. EMS providers had previously administered an opioid (morphine, dilaudid, or fentanyl) to 23 (57.5%) of the study subjects. Seven of the ten subjects (70%) who went on to need additional doses of morphine in the first hour after study drug administration received prehospital pain medication. Twelve of the 19 subjects (63%) who received any post study drug morphine received prehospital treatment. **Conclusions:** Although all subjects in our study required intravenous pain management upon arrival at the ED, only 57.5% of the children received medication in the field. Medics may be apprehensive to administer narcotics to pediatric patients due to potential adverse event. Perhaps they would be willing to administer low-dose ketamine, an agent with intrinsic analgesic properties that has been shown to prevent opioid tolerance and opioid induced hyperalgesia. A larger trial is warranted that includes low dose ketamine as an option to prehospital providers.

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POOR NEIGHBORHOODS HAVE SLOWER EMS RESPONSE AND TRANSPORT TIMES

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Background: Reduced ambulance and emergency medical services (EMS) have disproportionately affected poor neighborhoods, potentially affecting timely access to medical care. The effect of socioeconomic status (SES) on EMS response and transport times has not been widely examined. We sought to determine whether EMS response and transport times were longer in low income zip codes. Additionally, response times were compared to the frequently cited standard benchmarks of 4, 8 and 15 minutes for all patients and for cardiac arrest patients. **Methods:** We used data from the 2013 National EMS Information System (NEMSIS) database. This retrospective study included regression analyses of EMS times, including response, on-scene and transport intervals, for adults using EMS to get to a hospital. Income quartile, based on median zip code income was the primary independent variable. EMS-related variables included time, day, distance and urban setting. A subgroup analysis of cardiac arrest patients was also performed. **Results:** There were 5,996,013 patient encounters. The average total EMS time from dispatch to hospital was 36.8 minutes and 43.8 minutes in the highest and lowest income quartile, respectively ($+7.0$ $p < 0.01$). With patient and EMS-related variables controlled, EMS total time was 5.84 ($p < 0.01$) minutes longer for poorer zip codes compared with wealthier zip codes. Cardiac arrest patients from poorer zip codes took 2.05 minutes longer than wealthier zip codes. The majority of these patients were not reached in 4 minutes by EMS, with only 6.1% of patients from wealthier zip codes and 7.8% of patients from poorer zip codes. At the 8-minute and 15-minute mark, EMS responded to 48.8% of patients and 91.5% in wealthier zip codes compared to only 41.3% and 79.7% of patients from poorer zip codes, respectively. **Conclusions:** Patients from the poorest zip codes had overall longer EMS times compared to those from the wealthiest zip codes, even when controlling

for observable factors like distance and time of day. Despite overall low rates of meeting the standard benchmarks, the same pattern tended to persist for response times in low income patients in cardiac arrest.

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PREHOSPITAL HYPOGLYCEMIA TREATMENT: AN NEMESIS DATABASE REVIEW

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Background: To quantify current national use of different treatments for hypoglycemia in the prehospital setting. Oral replacement of saccharides and IV dextrose are the accepted first and second line interventions for symptomatic hypoglycemia; however, there is ongoing debate regarding the most appropriate and cost effective third line treatment. The purpose of this paper is to quantify the national use of different hypoglycemia treatments in order to advance further discussion. **Methods:** The National Emergency Medical Services Information System (NEMESIS) is an EMS data set that accepts data submission from across the United States. Data was reviewed for 2 calendar years 2013 and 2014. The filters included all sugar containing medications, glucagon, and related diagnosis codes for hypoglycemia. These results were summed and categorized by year, diagnosis code, and treatment. Proportion confidence intervals for percentages were calculated using online calculator. **Results:** The NEMESIS database revealed 56,866 EMS incidents with condition codes “Blood Glucose” or “AMS/Syn/Diz” treated with a hypoglycemic medication (45,845 and 11,021 respectively). IV/IO Dextrose was the most commonly used agent for both condition codes (75.1% + 0.48 and 70.1% + 1.02). Glucagon was the least used agent, and there were 5,548 and 1,024 respective administrations (12.1% + 0.86 and 13.2% + 1.74). **Conclusions:** IV/IO dextrose continues to be the primary treatment patients receive for hypoglycemia in prehospital setting. There are also a significant number of patients receiving glucagon nationally. This study has many limitations common with large database reviews based on the filters and the data available, including, but not limited to: inability to exclude agencies that do not carry glucagon, inability to screen for agencies with similar hypoglycemia treatment guidelines/protocol, and this study did not distinguish between IV and IO administration of dextrose. Due to these limitations, additional investigation is needed to determine the reasons for first and second line treatment failure. Further investigation is warranted to discover the reasons for treatment failures, and the frequent use of glucagon.

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RESPIRATORY DISTRESS: CURRENT EVIDENCE-BASED RECOMMENDATIONS FOR PREHOSPITAL CARE

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Background: Because emergency medical services (EMS) protocols vary widely across the United States, national organizations have collaborated to create evidence-based guidelines to guide standardization and quality improvement. However, these guidelines either do not explain the level of evidence behind their recommendations, or only apply to a limited number of conditions. Our objective was to develop evidence-based guidelines for the prehospital treatment of adult respiratory distress by advanced life support providers with explanations of the level of evidence currently available, and compare to the protocols in each of the 33 local EMS agencies (LEMSA) in California for quality improvement. **Methods:** Two review authors independently performed a literature review of research evaluating prehospital treatment of respiratory distress and extracted data from studies meeting the inclusion criteria. We rated the quality of evidence using GRADE, which was then used to form our guidelines for 9 PICO questions. **Results:** The following protocol components that we analyzed, and their impacts and usage (by percent of total LEMSAs) in protocols are as follows: Oxygen titration in COPD (3%), corticosteroids (0%)/albuterol (100%) in suspected bronchospasm, and non-invasive positive pressure ventilation in undifferentiated respiratory distress or suspected CHF (97%) have been shown to improve outcomes. Ipratropium in bronchospasm (45%) did not affect outcomes. There is insufficient evidence around the use of non-invasive positive pressure ventilation in suspected bronchospasm (97%) or nitrates in suspected congestive heart failure (100%). Furosemide is likely harmful in suspected congestive heart

failure (12%). **Conclusions:** There is a paucity of prehospital research about the proper management of respiratory distress. When the interventions in our evidence-based guidelines are compared to the 33 CA LEMSA protocols for respiratory distress, there is wide variation.