

# ABSTRACTS

## ABSTRACTS FOR THE 2007 NAEMSP SCIENTIFIC ASSEMBLY

**1. THE TORONTO PREHOSPITAL HYPERTONIC RESUSCITATION HEAD INJURY AND MULTI-ORGAN DYSFUNCTION TRIAL (TOPHR HIT)** Laurie J. Morrison, MSc, Sandro Rizoli, Brian Schwartz, Shawn Rhind, Sandra Black, Donald T. Stuss, Andrew Baker, Merita Simitci, Tyrone Ferreira, Russell D. MacDonald, Jennifer Shield, Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada

**Goal:** To evaluate the feasibility of a prehospital randomized controlled trial (RCT) comparing 250 mL of hypertonic saline and dextran (HSD) to normal saline (NS) for head-injured adult trauma patients GCS < 9. Specific objectives were to evaluate the protocol-related logistical issues; randomization, HSD safety, follow-up rates, and to define the best primary outcome. **Methods:** Double-blind randomized trial with paramedic administration of a 250-mL solution within 4 hours of the incident. The primary outcome was survival to 30 days; secondary outcomes were Disability Rating Scale (DRS) and Glasgow Outcome Score Extended (GOSE) at 4 months. The study was conducted with waiver of consent for the primary outcome. Patients consented for telephone follow-up of neurofunctional outcomes. **Results:** Of 132 eligible patients, 113 were randomized. Nineteen eligible patients were missed: lack of time (9 [22%]); paramedic discretion (3 [7%]); forgot (6 [15%]); refused (1 [2%]). Randomization compliance was 96% (109/113). Four randomized cases met exclusion criteria: one penetrating trauma, cardiac arrests, and one fall from standing. Three randomized patients were excluded from the final analysis; two patients received <50 mL of study solution because of an interstitial intravenous line and one lost randomization identification. Fifty patients (47%) were randomized to HSD and 56 (53%) to NS. Mean ISS was 32.7 for HSD and 32.6 for NS. Initial head scans scored  $\geq 3$  by Marshall Classification for 12 HSD and 11 NS patients. Zero adverse events occurred, and follow-up for the primary outcome was 100%. Alive at 30 days for HSD

and NS was 70% (35/50) and 75% (42/56) and at discharge was 34/50 (68%) and 41/56 (73%), respectively. Only 49.3% (37/77) of surviving patients consented to follow up at 4 months and 89% (33/37) completed the assessment; DRS (median, interquartile range) for HSD; 3 (0,6) and NS 0 (0,6); GOSE > 4 for HSD 12/12 (100%) and NS 15/21 (72%). **Conclusions:** It is feasible to conduct a prehospital RCT with HSD for treatment of blunt trauma patients with head injuries. Acquiring consent for neurofunctional outcomes in this cohort is problematic and threatens the feasibility of definitive trials using these potentially meaningful endpoints.

**2. PAMPPER: A NOVEL PEDIATRIC PAIN MANAGEMENT EDUCATIONAL PROGRAM FOR EMS PROVIDERS** Halim Hennes, Deborah Simpson, Ronald Pirrallo, Judith Rehm, Kenneth Sternig, Del Szewczuga, Michael K. Kim, Medical College of Wisconsin, Wauwatosa, Wisconsin

**Purpose:** Evaluate the effect of PAMPPER (Pain Assessment & Management for Prehospital Pediatric Emergencies), a two-part educational intervention on EMS providers' knowledge of pediatric pain management and determine its impact on prehospital pain management of children with extremity fracture or burn. **Hypothesis:** The intervention will improve EMS providers' knowledge of pediatric pain management and increase the proportion of eligible children receiving prehospital analgesia. **Methods:** The setting was an urban EMS system with 234 paramedics serving a population of 1 million. Part one consisted of a 1-hour online PowerPoint presentation with accompanying audio narration on pediatric pain physiology, assessment, and management. Part two, presented 9 months after part one, involved 1-hour small group facilitator led discussion centered around six short video triggers scripted to portray real-life prehospital pain assessment and management scenarios. EMS providers completed a 26-item validated multiple-choice test before (pre) and after (post) participating in each part. Prehospital patient care records of children aged 5–17 years transported during the study period with extremity injury or burn were reviewed and data on demographics and

field management were abstracted. Data analysis included  $\chi^2$  for categorical variables and the Student's t-test for continuous variables. **Results:** There was a total of 145 providers who completed both parts of the education and completed corresponding pre and posttests. Part one mean pretest score was 68.6% (95% CI: 66.6–70.4) and posttest score was 84.5% (95% CI: 82.9–86.1) with difference of 16% ( $p = 0.001$ ). Part two mean pretest score was 80.1% (95% CI: 78.1–82.0) and posttest score was 87.9% (95% CI: 86.4–89.3) with difference of 7.8% ( $p = 0.001$ ). Proportion of patients with pain score documentation before part 1 was 14.5% ( $n = 145$ ) and improved to 53.3% ( $n = 30$ ) after part 2 ( $p = 0.0001$ ). Proportion of patients who received analgesia before part 1 was 7.2% ( $n = 145$ ) and improved to 33.3% ( $n = 30$ ) after part 2 ( $p = 0.0001$ ). **Conclusion:** Preliminary results indicate that our two-part educational intervention is effective in improving EMS providers' knowledge of pediatric pain assessment and management. Knowledge retention at 9 months was excellent and further enhanced after second intervention. The proportion of patients with documented pain score and those who received prehospital analgesia increased significantly.

### 3. RATES OF ON THE JOB ILLNESS AND INJURY AMONG A NATIONAL COHORT OF EMS PROVIDERS **Jon R. Studnek, Amy Ferketich, National Registry of EMTs, Columbus, Ohio**

**Introduction:** EMS professionals are at risk for numerous occupational injuries. The objective of this study was to estimate the prevalence and incidence rates of job-related illness or injury and determine what characteristics predict the occurrence of illnesses or injury among a national cohort of EMS professionals. **Methods:** The Longitudinal EMT Attributes and Demographics Study (LEADS), a prospective study of EMS personnel, has been conducted since 1999. Each year participants are asked to report if they have been absent from their EMS job because of an EMS work-related illness or injury; this is the outcome variable of interest. Prevalence was estimated as the number of respondents who reported work-related illness or injury at baseline per 100 EMS workers. The incidence rate was estimated by using data from respondents who completed a follow-up survey. To identify predictors of illness or injury, multivariable logistic regression analyses were performed on the longitudinal data, and the variables under consideration included call volume, community size, self-reported back problems, and other demographics. The measure of effect for this analysis is the odds ratio (OR). **Results:** There were 5,096 baseline observations used in this analysis. The prevalence of job-related illness or injury was estimated at 9.4%. There were 1,862 participants who were injury free at baseline and who subsequently completed a follow-up

survey. The 1-year incidence of illness or injury was estimated at 8.1 per 100 EMS providers. The results from the logistic regression model fit to the follow-up data indicate that increasing call volume (OR = 3.0 for very high vs. very low, 95% CI: 0.97–9.26), an urban work environment (OR = 2.79, 95% CI: 1.65–4.72), and a history of back problems (OR = 1.72, 95% CI: 1.63–1.06) are associated with reporting a new job-related illness or injury. **Conclusions:** The results from this analysis are among the first to estimate national rates of on the job illness and injury among EMS providers. It is important to note that these rates may be underestimated because the outcome variable captured only those injuries requiring time off from work. Comparative analysis to other related fields should be conducted.

### 4. EFFECTIVENESS OF SINGLE-RESCUER DELIVERED CHEST COMPRESSIONS USING 15:2 VERSUS 30:2 IN BOTH STATIC AND MOBILE ENVIRONMENTS COMPARED WITH AN ACTIVE COMPRESSION DECOMPRESSION DEVICE. **John Glasheen, David Hennelly, Cathal O'Donnell, Ambulance Service HSE Mid-West, Limerick, Ireland**

**Introduction:** Recent changes in resuscitation guidelines have emphasized the importance of delivering effective chest compressions in cardiac arrest. It is postulated that a 30:2 compression:ventilation ratio results in more effective CPR. However, in a single-rescuer EMS setting, 30:2 may result in rescuer fatigue with consequent drop in the quality of CPR delivered. The objective of this study was to compare the effectiveness of chest compressions performed by experienced paramedics on the floor and on a stretcher in a moving ambulance using compression:ventilation ratios of both 15:2 and 30:2. We also compared these with chest compressions delivered by an active compression decompression device (LUCAS). **Methods:** Twenty paramedics (mean experience 6.7 years) performed single-rescuer cardiopulmonary resuscitation on a resuscitation manikin (Laerdal Resusci Anne Skilmeter). Compressions were delivered for 10-minute periods as follows: 15:2 static, 15:2 mobile; 30:2 static, and 30:2 mobile. Subjects rested for 5 minutes between each period of CPR, and the order in which the subjects performed the different compression:ventilation ratios was randomised. **Results:** By using a ratio of 15:2 the effective chest compression rate was 81% static versus 60.8% mobile ( $p = 0.04$ ), whereas with a ratio of 30:2, the effective chest compression rate was 70.9% static versus 51.7% mobile ( $p = 0.008$ ). Observed differences between static 15:2/static 30:2 and mobile 15:2/mobile 30:2 were not statistically significant ( $p = 0.139$  and  $p = 0.61$  respectively). The LUCAS delivered effective chest compressions 99.2% of the time both mobile and static. **Conclusions:** Effective delivery of chest compressions by human rescuers is significantly better in a static

environment than in a mobile environment. Changing to a compression:ventilation ratio of 30:2 does not significantly impair effective delivery of chest compressions. An active compression decompression device is highly effective at delivering chest compressions and is not affected by change from a static to mobile environment.

**5. A SYSTEMATIC REVIEW OF PREHOSPITAL TRIAGE FOR PATIENTS WITH ST - ELEVATION MYOCARDIAL INFARCTION DIRECTLY TO PERCUTANEOUS CORONARY INTERVENTION CENTERS: SHOULD THE GUIDELINES STILL SAY "INDETERMINATE"?** **Steven Charles Brooks, Michelle Welsford, Cathal O'Donnell, Richard Verbeek, Katie Allan, Laurie J. Morrison, Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada**

**Purpose:** The 2005 American Heart Association Guidelines found that there was insufficient evidence to recommend prehospital triage and direct transportation of STEMI patients for PCI. To determine effectiveness, we undertook an updated systematic review of all studies comparing this prehospital strategy to others for patients with STEMI. **Methods:** Medline, EMBase, Current Contents, Dissertation Abstracts, Cochrane Library, and the Index of Scientific and Technical Proceedings databases were searched. Bibliographies and grant agency websites were reviewed, and primary investigators and industry were contacted to find unpublished studies. Two authors independently reviewed citations for inclusion. Original studies were included if they involved prehospital identification of STEMI patients with direct ambulance transport to a PCI-capable center for primary PCI, used a control group, and reported outcomes of treatment time intervals, all-cause mortality, reinfarction rate, stroke rate, or the frequency of cardiogenic shock. Studies were classified according to the American Heart Association levels of evidence (LOE). Results: Five studies meeting the inclusion criteria were identified. There were two RCTs (LOE 2), one prospective cohort (LOE 4), and two retrospective cohort studies (LOE 3, 4). The randomized studies were negative, underpowered, and methodologically weak. The pooled OR for mortality was 1.07 (95% CI: 0.54–2.137,  $p = 0.841$ ) from two studies comparing direct transport for PCI versus prehospital fibrinolysis and 0.26 (95% CI: 0.07–1.06,  $p = 0.06$ ) from two studies comparing direct transport for PCI versus transfer from a community hospital for PCI. Median symptom-onset-to-reperfusion intervals were longer with direct transport for PCI compared with prehospital fibrinolysis (176 vs. 113 minutes,  $p$ -value not provided [Armstrong 06] and 190 vs 130 minutes,  $p$ -value not provided [Bonney 02]) and shorter compared with transfer for primary PCI from community hospitals (177 vs. 208,  $p \leq 0.001$  [van't Hof 2005] and 129 vs. 250,  $p \leq 0.001$

[Terkelsen 2005]). **Conclusion:** Although the current data support a hypothesis that prehospital triage and direct transportation to PCI-capable centers for primary PCI may be effective for patients with STEMI, there is still insufficient data to make a definitive conclusion. A large randomized trial comparing this strategy to alternative prehospital protocols is urgently needed.

**6. TORT CLAIMS FROM ADVERSE EVENTS IN EMERGENCY MEDICAL SERVICES** **Henry E. Wang, Rollin J. Fairbanks, Manish N. Shah, Donald M. Yealy, University of Pittsburgh, Pittsburgh, Pennsylvania**

**Objective:** Although voiced as a concern by providers and system leaders, emergency medical services (EMS) malpractice litigation and the links to adverse events are not well understood. We sought to describe the types, frequencies, and outcomes of adverse events resulting in tort claims against EMS. **Methods:** We analyzed and categorized 2003–2004 liability claim records from a large, national EMS insurer, including both open and closed cases. We included cases involving EMS response, transport, or provision of care that resulted in injury to patients or other individuals. We excluded cases involving property damage only and emergency vehicle collisions with less than \$10,000 incurred costs. Using structured chart review, we identified the types, circumstances, and outcomes of each adverse event. We analyzed the data using descriptive statistics, including binomial proportions with exact confidence intervals. Results: We reviewed 275 cases, with emergency response in 46% and nonemergency response in 39%. The most commonly involved units were ground ambulances (67%) and wheelchair vans (19%). Adverse event categories included patient handling (40%; 95% CI: 34%–46%), emergency vehicle movement or collision (31%; 26%–37%), medical management (11%; 7%–15%), EMS response or transport (8%; 5%–12%), lack or failure of equipment (4%; 2%–7%), and other errors (9%; 6%–13%). Patient handling errors included stretcher or wheelchair "tips" (28%; 19%–37%), patient drops (31%; 23%–41%), injury during patient movement (19%; 12%–28%) and patient falls (13%; 7%–21%). Occupants of other vehicles were injured in 61% of emergency vehicle collisions. Improper patient restraint complicated 9% of emergency vehicle movement/collision and patient handling cases. Associated injuries included non-life-threatening injuries (65%; 59%–71%), death (18%; 14%–23%), disability or life-threatening injury (8%; 5%–11%) and other (9%; 6%–13%). The median incurred liability cost was \$17,000 (IQR \$5,000–\$45,000). The highest median costs involved lack or failure of equipment (\$71,000; IQR \$2,000–\$175,000) and medical management (\$34,000; \$10,000–\$90,000). Conclusions: Patient handling errors and emergency vehicle movement/collisions are the most common adverse events resulting in tort claims against EMS. Other incidents

are less frequent but incur higher individual costs. These findings highlight key areas for improving EMS patient safety.

**7. TREATED AND RELEASED AT THE SCENE: OUTCOMES OF EMS PATIENTS TREATED WITH ALBUTEROL** John P. Freese, Robert A. Silverman, Doug A. Isaacs, David Ben-Eli, David J. Prezant, *New York City Fire Department, Brooklyn, New York*

**Introduction:** Emergency medical services (EMS) (5%–25%) calls may result in a refusal of medical aid (RMA). We describe 1-week outcomes among asthmatics treated at the scene with albuterol who subsequently refused hospital transport within a large, urban EMS system. **Methods:** Retrospective review of prehospital records of patients treated with by BLS or ALS providers at the scene with albuterol but not transported to the hospital during a 4-week summer period. Telephone interviews were performed with their patients and/or caretakers regarding medical events in the week following the RMA. Certified letters were sent to patients for whom telephone contact was unable to be established. All patients over the age of 18 and with a recorded history of COPD or asthma were included. **Results:** Ninety-nine patients met inclusion criteria. Seventy-nine patients had provided valid contact information, with 77.2% (61/79) completing a telephone interview or identical written survey and providing outcome data for analysis. The primary reason given for RMA was patient belief that transport was unnecessary (74.1%); improvement after initial treatment (15.7%); and suggestion by the prehospital providers that transport was unnecessary (10.2%); 29.5% of patients (18/61) experienced a similar or more severe exacerbation in the week following their refusal, of which 55.6% (10/61) were admitted to hospital. Admitted patients were more likely to be over the age 60 (LR = 3.36), to be taking inhaled or oral steroids (LR = 4.79), to have a history of prior ICU admissions (LR = 6.4), and less likely to have a home nebulized (LR = 0.19). One patient died within 5 days of EMS treatment and refusal of transport. **Conclusions:** One week recidivism is high among asthmatics who refuse medical aid, with outcomes including hospital admission and even one death. Although albuterol administered by EMS may provide rescue relief, this does not provide control therapy. Our data suggest that asthma patients who receive prehospital albuterol should be transported by EMS or provided with appropriate follow-up to ensure the receipt of control therapy.

**8. IMPROVING THE SPECIFICITY OF URBAN FIREFIGHTER "FIRST RESPONSE" BY MODELING THE PROBABILITY OF CRITICAL INTERVENTION BEFORE EMS ARRIVAL** Alan M. Craig, Rick Verbeek, Brian Schwartz. *Toronto EMS, Toronto, Ontario, Canada*

**Objective:** To derive a method to test the specificity of urban firefighter "first response" by modeling the probability of firefighter critical intervention before EMS paramedic arrival in an EMS system using the Medical Priority Dispatch System (MPDS). **Background:** Many fire departments dispatch defibrillator-equipped non-paramedic resources to selected EMS calls intending to deliver time-sensitive interventions prior to EMS paramedic arrival. Truly critical cases are rare (<1%), and "hot" responses by Firefighter First Responders (FFRs) are associated with risk to responders and the public. Furthermore, EMS paramedics often arrive before FFRs. **Methods:** Patient records 182,635 from an urban EMS system over 16 months were reviewed to establish the cumulative rate of defibrillation, CPR, or critically ill/injured patients for each MPDS determinant. A generalized multiplier model was developed, which predicts the probability of FFR critical intervention for various rates of firefighter arrival before EMS. MPDS determinants with more than 1% probability of FFR intervention before EMS arrival were designated as warranting "hot" response. Determinants with a probability of intervention between 0.4% and 1% were redesignated as nonemergency ("cold") responses to provide on-scene assistance to paramedics. Where the probability of intervention was less than 0.4%, firefighter response was considered futile. **Results:** In the study community, firefighters are "first-on-scene" in 50% of calls. This model would have reduced annual FFR "hot" responses by 76% (from 62,900 to 15,300) by restricting "lights-and-siren" response to MPDS determinants with a probability of critical intervention before EMS arrival of greater than 1%. 36,500 responses were downgraded to safer nonemergency runs, and 11,100 responses were eliminated as medically futile. The specificity of FFR response was improved from 75.2% (95% CI: 75.0%–75.4%) to 94.3% (95% CI: 94.3%–94.4%). The model produced a three-fold improvement in positive predictive value from 3.2% to 9.5%, with the negative predictive value increasing from 99.7% to 99.9%. Modeling higher rates of FFR "First-on-Scene" increased calls designated as "hot" responses but rapidly degraded specificity (if 1% cutoff for "hot" response is maintained). **Conclusions:** This model improves the specificity of firefighter response to EMS calls and should be validated prospectively.

**9. PREHOSPITAL ENDOTRACHEAL INTUBATION ERRORS AND PATIENT OUTCOME** Henry E. Wang, Lawrence J. Cook, Chung-Chou H. Chang, Judith R. Lave, Donald M. Yealy, *University of Pittsburgh, Pittsburgh, Pennsylvania*

**Objective:** Prior efforts have identified the frequent occurrence of prehospital endotracheal intubation (ETI) errors. The effect of these events on patient outcome

is unknown. We sought to identify the association between ETI errors and patient mortality. **Methods:** In this prospective multicenter study of 42 EMS services, prehospital rescuers (paramedics, prehospital nurses, and physicians) completed structured, closed-response data forms describing patient demographics, clinical course, complications, and preliminary outcomes for all ETI. We defined ETI errors as (1) ET tube misplacement or dislodgment (MOD), (2) multiple ( $\geq 4$ ) ETI attempts, or (3) failed ETI. Using clinical, demographic and geographic information, we used probabilistic methods to link ETI data with statewide ambulance, hospital admission, and death records. We modeled the relationship between patient death and ETI errors using Cox Regression with shared frailties to account for clustering. Using heavyside functions, we separately modeled the effects of ETI errors on early (prior to hospital admission) and late (after hospital admission) death. We used censoring to account for cases not successfully linked to outcome. We adjusted estimates using patient-level (age, sex, cardiac arrest vs. non-arrest, trauma vs. medical, systolic blood pressure, intubation method, hospital admission severity) and system-level (rural vs. urban, ground vs. air, career vs. mixed career/volunteer, number of ALS personnel, mean response time) covariates. Results: Of 1,954 patients undergoing an ETI attempt over an 18-month period, ETI errors included tube MOD in 61 (3.1%), multiple attempts in 62 (3.2%), and failed ETI in 359 (18.5%). We successfully linked 61.2% of records to outcomes. ETI errors were not associated with early death (adjusted hazard ratio; 95% CI); tube MOD (0.98; 0.65–1.47), multiple ETI attempts (1.23; 0.81–1.88), ETI failure (1.11; 0.88–1.39). ETI errors were not associated with late death; tube MOD (0.41; 0.10–1.66), multiple ETI attempts (1.68; 0.23–12.61), ETI failure (0.82; 0.51–1.32). Cardiac arrest status (1.55; 1.16–2.06) and systolic blood pressure (0.76; 0.68–0.85) influenced early death, whereas hospital admission severity (3.50; 2.64–4.63) influenced late death. **Conclusions:** Selected ETI errors (tube MOD, multiple ETI attempts, failed ETI) are not associated with patient mortality. Other clinical events may have stronger relationships with outcome.

**10. USE OF THE COMBITUBE AS AN ALTERNATE AIRWAY DEVICE FOR RAPID SEQUENCE INTUBATION IN AN AIR MEDICAL PROGRAM** **Jeremy T. Cushman, Douglas J. Floccare, Morgen J. Bernius,** *Department of Emergency Medicine, University of Rochester, Rochester, New York*

**Introduction:** The combitube is used by many jurisdictions as an alternate primary airway or rescue device for failed rapid sequence intubation (RSI). The objective of this study was to determine the efficacy and prognostic indicators for combitube use in an air medical RSI program. **Methods:** A structured, retrospective review

of medical records and prospectively obtained quality assurance data was performed of all RSI attempts from November 1, 1998, to December 31, 2005. Data fields included the following: patient age, sex, mechanism of injury, initial GCS, initial SpO<sub>2</sub>, lowest SpO<sub>2</sub> during RSI, blood pressure and heart rate prior to RSI, and the end-tidal CO<sub>2</sub>, blood pressure, heart rate, and SpO<sub>2</sub> on emergency department (ED) arrival. Descriptive and comparison statistics were calculated as appropriate. Results: There were 435 tracheal intubations and 36 combitube placements available for analysis. Principle component analysis of continuous variables and logistic regression of binary variables identified those associated with endotracheal and combitube insertion, however, subsequent comparison found no difference in the two groups ( $p > 0.05$  for all analyses). Pulse, blood pressure, pulse oximetry, and end-tidal CO<sub>2</sub> on ED arrival for patients having combitube placement was comparable with patients who received tracheal intubation and are reported as aggregate data. Average age was 32.9 years (95% CI: 30.6, 35.3), 87.7% were male, 97% suffered blunt trauma, and initial GCS was 5.5 (5.2, 5.7). Prior to RSI, average SpO<sub>2</sub> was 85.7% (84.5, 86.9), systolic BP 143.4 mmHg (140.3, 146.5), diastolic BP 86.6 mmHg (84.4, 88.7), and heart rate 103.8 (101.2, 106.3). Lowest SpO<sub>2</sub> during treatment was 83.9% (82.5, 85.3) and initial EtCO<sub>2</sub> after tube placement was 34.3 mmHg (33.2, 35.4). Upon ED arrival, EtCO<sub>2</sub> was 30.5 mmHg (29.7, 31.3), SpO<sub>2</sub> 95.3% (94.1, 96.5), systolic BP 137.5 mmHg (133.9, 141.1), diastolic BP 83.7 mmHg (81.2, 86.2), and heart rate 101.1 (98.1, 104.1). **Conclusions:** The use of the combitube was associated with achieving similar treatment goals as tracheal intubation in measures of pulse oximetry, end-tidal CO<sub>2</sub>, blood pressure, and heart rate upon ED arrival. Our data provide no predictors of patients who were more likely to require combitube as a rescue airway device.

**11. PREHOSPITAL INTUBATION IN TRAUMATIC BRAIN INJURY: A TRISS ANALYSIS** **Daniel P. Davis, Michael Sise, Fred Simon, Gail Tominaga, Frank Kennedy, Tom Velky, Raul Coimbra,** *UCSD Emergency Medicine, San Diego, California*

**Background:** Emergent endotracheal intubation (ETI) is considered standard of care for patients with severe traumatic brain injury (TBI). However, recent evidence suggests that the procedure may be associated with increased mortality, possibly reflecting inadequate training, suboptimal patient selection, or inappropriate ventilation. **Objective:** To explore prehospital ETI in patients with severe TBI using a novel application of TRISS methodology. **Methods:** Patients with moderate-to-severe TBI (head AIS 3+) were identified from our county trauma registry. Demographic information, pre-resuscitation vital signs, and injury severity scores were

used to calculate the probability of survival for each patient. This methodology was previously validated by using the identical data base. The relationship between outcome and prehospital ETI, provider type (air vs. ground), and ventilation status as defined by arrival pCO<sub>2</sub> value were explored by using (1) observed survival (Os)-predicted survival (Ps) and (2) the ratio of unexpected survivors/deaths using various threshold values. **Results:** A total of 12,882 patients were identified with complete data for this analysis. Os and Ps were similar for both intubated and nonintubated patients. The ratio of unexpected survivors/deaths increased and Os exceeded Ps for intubated patients with lower Ps values. Both intubated and nonintubated patients transported by air medical crews had better outcomes than those transported by ground. Both hypo- and hypercapnia were associated with worse outcomes in intubated but not in nonintubated patients. **Conclusions:** Prehospital intubation appears to improve outcomes in more critically injured TBI patients. Air medical outcomes are better than predicted for both intubated and non-intubated TBI patients. Iatrogenic hyper- and hypoventilation are associated with worse outcomes.

**12. HOW WOULD MINIMUM EXPERIENCE STANDARDS AFFECT PREHOSPITAL ENDOTRACHEAL INTUBATION?**  
**Henry E. Wang, Benjamin N. Abo, Judith R. Lave, Donald M. Yealy, University of Pittsburgh, Pittsburgh, Pennsylvania**

**Objective:** Experts suggest limiting prehospital endotracheal intubation (ETI) to rescuers, agencies or regions with adequate procedural experience. However, the potential influence of these limits on the distribution of ETI is unknown. We sought to determine how minimum ETI experience standards would influence the number, allocation, and availability of prehospital ETI. **Methods:** We used 2003 Pennsylvania statewide EMS and census data. We calculated the total number of ETI performed across the state. We considered minimum ETI standards ranging from 0 to 50 ETI per minor civil division (MCD). We calculated the change in total, cardiac arrest, non-arrest, pediatric and trauma ETI when the procedure was limited to MCD meeting the minimum standard. We similarly calculated the change in ETI availability to minority, rural, and impoverished populations. We evaluated the same relationships by using agency- and rescuer-based minimum ETI standards. We evaluated these relationships using scatter plots and Geographical Information System (GIS) maps. **Results:** Among 2,851 MCD, there were 11,898 ETI (7,903 cardiac arrest, 3,995 non-arrest, 584 pediatric and 1,361 trauma ETI). Limiting ETI to MCD with at least 5, 10, 25 and 50 procedures reduced total ETI by 19.7%, 38.8%, 63.1%, and 75.3%, respectively. The number of arrest, non-arrest,

and pediatric ETI exhibited similar trends. Changes in trauma ETI were larger (32.1%, 57.2%, 79.6%, and 90.2% ETI reduction). Procedural limits strongly curtailed ETI availability to rural populations (89.9% reduction at 10 procedure minimum) but had less effect on minorities (14.5% reduction at 10 procedure minimum). Agency- and rescuer-based minimum ETI standards reduced total and subgroup ETI to a similar degree. **Conclusions:** Modest minimum experience standards would result in sizable reductions in total and subgroup ETI. Rural populations could be most affected by ETI limits, whereas minority populations may be less affected. These findings should be used to plan any potential systemic changes in prehospital ETI.

**13. THE PROGNOSTIC VALUE OF EARLY EEG IN PATIENTS RECEIVING THERAPEUTIC HYPOTHERMIA POST CARDIAC ARREST**  
**Patrick B. Medado, Raymond Jackson, Brian J. O'Neil, Robert Swor, William Beaumont Hospital, Royal Oak, Michigan**

**Introduction:** A neurologist's evaluation along with an EEG has been considered the gold standard for assessing prognosis in post out-of-hospital cardiac arrest (OOHCA) patients; however, little is known about its utility in those receiving therapeutic hypothermia. **Objective:** The objective of this study is to determine the prognostic accuracy of the EEG and neurologist assessment early after therapeutic hypothermia. **Methods:** In this observational study, we enrolled comatose OOHCA patients who received therapeutic hypothermia and had a neurologist examination with EEG performed for prognostic purposes within 48 hours of hypothermia completion. The EEG interpretations and neurologist's clinical interpretation for neurological recovery were grouped into four primary categories ranging from brain death to good prognosis. Patients were clinically evaluated by investigators and assigned a Glasgow-Pittsburgh Cerebral Performance Category (CPC) at hospital discharge. For purposes of analysis, we retrospectively dichotomized CPC, neurologist evaluation, and EEG data as either good or poor neurological recovery. We analyzed the data by using McNemar's  $\chi^2$  and descriptive statistics. **Results:** To date, we have enrolled 19 patients (12 males, average age 66 years) into the study. Eight different neurologists performed evaluations. The outcomes at hospital discharge were 9 (47%) deaths, 1 (5%) vegetative, 9 (47%) with good neurological recovery. Overall, the neurologist and EEG predicted the correct neurological outcome 63% and 71% respectively. The EEG weakly predicted the correct neurological outcome (McNemar's  $\chi^2 = 3.0$  p = 0.08). We observed a significant difference between the Neurologist prediction and observed neurological outcome (McNemar's = 7.0 p = 0.008) with seven patients given

a poor prognosis resulting in good patient neurological outcome. **Conclusion:** The prognostic accuracy of the neurologist's evaluation and EEG are poor when performed early after therapeutic hypothermia in resuscitated OOHCA patients. These evaluations should be used with caution when used to make end-of-life decisions after therapeutic hypothermia.

**14. MILD HYPOTHERMIA IS ASSOCIATED WITH IMPROVED LACTATE CLEARANCE AFTER RESUSCITATION FROM PROLONGED CARDIAC ARREST** **Brian P. Suffoletto, Jon C. Rittenberger, James J. Menegazzi, Eric Logue, Clifton Callaway,** *Department of Emergency Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania*

**Introduction:** Elevated blood lactate is associated with poor neurological outcomes and increased mortality in postcardiac arrest patients. Mild hypothermia has been shown to improve survival and neurological outcomes. **Hypothesis:** We hypothesized that mild hypothermia (35°C) would decrease postarrest lactate levels and improve lactate clearance in a swine model of prolonged ventricular fibrillation (VF) arrest. **Methods:** Twenty-four mixed-breed domestic swine were block randomized to receive a 30 mL/kg IV infusion of normal saline solution (NSS) under one of the following conditions: body temperature, 40°C infused prior to cardiac arrest, or 40°C infused 10 minutes after cardiac arrest. Core temperature was measured by esophageal probe. Animals were shocked into ventricular fibrillation (VF) and untreated for 8 minutes. Mechanical external chest compressions and ventilation with 100% oxygen at a ratio of 15:1 then began. After 2 minutes of CPR, an IV drug cocktail of 0.1 mg/kg epinephrine, 40 U vasopressin, 1.0 mg propranolol, 1 mEq/kg sodium bicarbonate was given. The first rescue shock (150 J biphasic) was given 3 minutes later (minute 13 of VF). Normothermic animals had temperature maintained within a 1.0°C range, and hypothermia was maintained at 35°C. During the postarrest phase, blood lactates were measured from a central venous catheter at 5-minute intervals. A subset of 10 animals survived to 1 hour post-ROSC. A generalized estimating equation analysis was used to determine the difference between time epochs and temperature groups. **Results:** Baseline and early postarrest levels of serum lactate were not significantly different between groups. Both groups increased from a prearrest mean lactate of 1.47 mmol/L to a mean peak of 8.39 mmol/l at 35 minutes postarrest. There was a significantly ( $p < 0.05$ ) lower serum lactate at 50, 55, 60, and 75 minutes after cardiac arrest in swine with hypothermia compared with those that were normothermic. **Conclusions:** Mild hypothermia did not affect early lactate levels but did improve clearance of serum lactate in a swine model of prolonged VF.

**15. PERFORMANCE OF RESCUERS PROVIDING CARDIOPULMONARY RESUSCITATION IN PUBLIC ACCESS DEFIBRILLATION** **Ronald E. Stickney, Alidene Doherty, Paula Lank, Thomas D. Rea,** *Medtronic Emergency Response Systems, Redmond, Washington*

Performance of lay rescuers using an automated external defibrillator (AED) and providing cardiopulmonary resuscitation (CPR) in clinical cases has rarely been reported. **Purpose:** Retrospectively analyze rescuer performance in Public Access Defibrillation (PAD) Trial cases recorded by one model of AED using the ECG and thoracic impedance waveforms. **Methods:** All LIFEPAK® 500 AED (Medtronic) cases from the PAD Trial were analyzed by using CODE-STAT™Beta 6.0 V2 software (Medtronic), which includes a CPR report. Using the software's automated chest compression detection algorithm, two reviewers independently edited compressions, classified the initial rhythm, and identified periods of probable spontaneous circulation. The reviewers then jointly reviewed differences and reached a consensus for all cases. The CPR report software calculated compressions ratio (% of time providing chest compressions while the patient did not have spontaneous circulation) and average compression rate. **Results:** Thirty-six cases were received from the PAD Trial. The initial rhythm was ventricular fibrillation in 15 cases, asystole in 5, apparent pulseless electrical activity in 8, and apparent pulsatile rhythm (including evidence of cardiac output in the impedance signal) in 8. For the eight cases that were apparently not cardiac arrest, no shocks were advised by the AED and only two had CPR. Rescuers pushed the shock button 39 of the 40 times that the AED advised a shock. Median compressions ratio was 36% [interquartile (IQ) range 19%–48%, range 4%–64%]. Median compressions ratio during AED-prompted CPR periods was 49% [IQ range 31%–66%, range 2%–83%]. Median compression rate was 96/minute [IQ range 92–111, range 69–130]. **Conclusions:** In this case series, PAD rescuers performed well at defibrillating but spent a low percentage of time delivering CPR. About half of the rescuers had a compression rate outside the desired range of 90–110/minute. PAD Trial rescuers were rigorously trained; fewer trained rescuers may have a lower level of CPR performance. Lay rescuers could benefit from methods to deliver more CPR, at the recommended compression rate, during AED use.

**16. EFFECTS OF AN IMPEDANCE THRESHOLD DEVICE ON HEMODYNAMICS AND RESTORATION OF SPONTANEOUS CIRCULATION IN PROLONGED PORCINE VENTRICULAR FIBRILLATION** **James J. Menegazzi, David Salcido, Michael Menegazzi, Jon Rittenberger, Brian Suffoletto, Eric Logue, Timothy Mader,** *University of Pittsburgh, Pittsburgh, Pennsylvania*

**Background:** An impedance threshold device (ITD) has been designed to enhance circulation during CPR by creating a negative intrathoracic pressure during the relaxation phase of chest compression. **Hypothesis:** We sought to determine the effects of the ITD on coronary perfusion pressure (CPP), return of spontaneous circulation (ROSC), and short-term survival (maintained for 20 minutes after ROSC) using an established porcine model of prolonged ventricular fibrillation (VF). We hypothesized that the ITD would improve all three variables compared with standard CPR. **Methods:** Using a factorial experimental design as a component of the primary study, we compared CPR with the ITD (ITD-CPR) to regular CPR without the device (designated hereafter as CPR). We systematically assigned 36 domestic swine, weighing 23–29 kg (18 per group) to resuscitation with either ITD-CPR or CPR after 8 minutes of untreated VF. Animals were anesthetized and instrumented with micromanometer-tipped catheters for intravascular pressure measurement. At minute 8, mechanical chest compression and ventilation began, and drugs (0.1 mg/kg epinephrine, 40 U vasopressin, 1.0 mg propranolol, 1 mEq/kg sodium bicarbonate) were given. The first rescue shock (150 J biphasic) was delivered at minute 11 of VF. We recorded CPP continuously (calculated as end-relaxation aortic pressure minus end-relaxation right atrial pressure), ROSC (systolic arterial pressure >80 mmHg sustained for 60 seconds continuously), and survival. Data were analyzed with two-tailed Fisher's exact test and generalized estimating equations (GEE), with  $\alpha = 0.05$ . **Results:** We analyzed 3,150 compressions. CPP for the ITD-CPR group (mean 28.1 mmHg [95% CI: 27–29.3 mmHg]) did not differ from the CPR group (mean 32.3 mmHg [95% CI: 31.2–33.4 mmHg]). ROSC occurred in 6/18 (33%) animals in the ITD-CPR group and 14/18 (78%) in the CPR group ( $p = 0.02$ ). Survival occurred in 3/18 (17%) in the ITD-CPR group and 13/18 (72%) CPR group ( $p = 0.003$ ). **Conclusions:** ITD-CPR did not improve CPP compared with CPR. ROSC and survival were significantly lower with ITD-CPR.

CPP by group and time

Group	30s	60s	90s	120s	150s	180s
ITD-CPR	4.2	24.2	35.8	36.5	35.4	32.6
CPR	4.6	24.1	44.8	44.8	38.9	36.8

**17. PREVENTION OF PEDIATRIC DRUG CALCULATION ERRORS BY PREHOSPITAL PROVIDERS** **Morgen J. Bernius**, *University of Maryland Medical System, Baltimore, Maryland*

**Purpose:** Calculation of weight-based drug dosages for pediatric patients is a difficult process with significant potential for human error, and in the prehospital setting

there are few safeguards in place to prevent these inevitable pediatric drug administration errors. Although certain pediatric aids exist, as the scope of practice of prehospital providers expands to include rapid sequence intubation, and other skills requiring use of a variety of new medications, these aids are becoming obsolete, and the potential for error increases. **Methods:** The subjects included pre-hospital providers from multiple jurisdictions in Maryland and the District of Columbia. Questionnaires were administered with sample calculations of drug dosages and volumes, as well as endotracheal tube (ETT) size calculations. Half of the participants performed the calculations with the pediatric "code card" as an aid, and half without. The calculations were considered typical of those required of pre-hospital providers. Responses to the questionnaires were evaluated for calculation errors, and rates and degrees of error compared between those performed with and without the pediatric "code card." **Results:** There have been a total of 183 surveys collected thus far (89 without the "code card" and 94 with) and data collection is ongoing. The total error rate for those questioned without the card was 25.4% and 6.6% for those with ( $p < 0.01$ ). Clinically significant error rates were 14.5% and 3.6%, respectively ( $p < 0.01$ ). Mean time for completion of the questionnaires was 12.67 minutes for those without the card and 6.63 minutes for those with ( $p < 0.01$ ). Fifty-three percent of all providers surveyed did not know the formula to determine ETT size. Of those who knew the formula but did not have the "code card," 31.5% still calculated the incorrect ETT size for a 6-year old child. Of those who did not know the formula, but did have the "code card" as an aid, there were no errors in determining proper ETT size. **Conclusions:** With the use of the pediatric "code card" prehospital providers are better able to calculate consistently accurate weight-based drug dosages, volumes of administration, and ETT sizes, although errors are not completely eliminated.

**18. DO ALL PEDIATRIC FEBRILE SEIZURE PATIENTS NEED TO BE TRANSPORTED BY ALS?** **Mark Merlin, Robert S. Levy, Ernest Leva, Richard Brodsky**, *Robert Wood Johnson Medical School-UMDNJ, New Brunswick, New Jersey*

**Introduction:** A literature search found no previous articles addressing prehospital triage of pediatric febrile seizure patients. Currently, in the state of New Jersey, all pediatric febrile seizure have simultaneous basic life support (BLS) and advanced life support dispatch. We sought to determine the rate of adverse outcomes during transport of pediatric febrile seizure patients. If the rate of adverse outcomes during prehospital transport is low, cost and resource savings may be obtained by

triaging these patients to BLS, leaving advanced life support (paramedics) available for other emergencies. **Methods:** A retrospective case study of all pediatric febrile seizures transported to our University Hospital in New Jersey from January 2003 to April 2006 by the hospital's paramedics. The Hospital employs approximately 90 paramedics. Inclusion criteria were all patients, aged 2 months to 7 years, transported to the emergency department by ambulance with a chief complaint of seizure activity who also had a fever noted by parents, Paramedics or ED staff. All of the patients studied had documented temperature equal to or greater than 100.3. Patients were classified into one of three categories: simple febrile seizure (single generalized tonic-clonic seizure in 24 hour period that lasted less than 15 minutes), patients whose seizure pattern did not fit criteria of simple febrile seizure and patients with underlying medical conditions which may contribute to seizure activity. The rate of adverse outcomes was then determined for each of the three groups. Adverse outcomes were defined as the need for prehospital benzodiazepines, any hospital admission, or medical intervention such as intubation, either in the field or in the emergency department. **Results:** Seventy-one patients met the inclusion criteria, and 47 (66%) met criteria for simple febrile seizure. None of the 47 had an adverse outcome; 13 of the remaining 24 (54%) who did not meet criteria for simple febrile seizure had an adverse outcome. **Conclusion:** Patients who meet criteria for simple febrile seizure can be transported to the emergency department by BLS personnel without any resulting adverse outcome to the patient. We hope to further this investigation by instituting BLS triage criteria which will be studied prospectively to determine outcomes.

**19. WELCOME TO THE WORLD: FINDINGS FROM AN EMS PEDIATRIC INJURY PREVENTION PROGRAM. Eric Hawkins, Jane H. Brice, Barbara A. Overby, UNC Chapel Hill, Durham, North Carolina**

**Background:** Unintentional injuries are the most common cause of morbidity and mortality in young children and most injuries occur in the home. **OBJECTIVES:** To report findings from a primary prevention program that trained paramedics to conduct home safety surveys, provide family safety education, and identify common pediatric injury risks in the home. **Methods:** We retrospectively reviewed standardized records from each survey, abstracting information on family demographics, safety devices and practices, and provision of educational materials and safety equipment. We descriptively analyzed and reported statistics as means and percent frequencies. **Results:** Two-hundred sixty-two families participated and had children averaging 21 months of age. Most had a smoke detector (250/255) and a fire extinguisher (140/215), with 77% (192/250)

and 76% (107/140) of these respective devices functional. Twenty-seven percent (55/202) had a fire evacuation plan, and 33% (18/55) reported ever practicing their plan. For bathwater sites, 56% had temperatures measured <120° F. Eighty-five percent (218/257) had medications and 53% (134/249) had household chemicals out of reach of children, but most reported storage in an unlocked location. Eighty-five percent (42/49) reported storing guns unloaded, and 45% (22/49) stored all guns in locked locations. Paramedics distributed 63 smoke detectors, 46 fire extinguisher vouchers, 234 first-aid kits, and 225 educational packets. **Conclusions:** Participating families had high rates of fire/burn hazards and unsafe storage practices. Paramedics can recognize common hazards in the home, can provide education and mitigation to reduce risks of pediatric injury, and can distribute home safety devices in a community injury prevention program.

**20. A PROSPECTIVE EVALUATION OF THE ABILITY OF PARAMEDIC RAPID SEQUENCE INTUBATION (RSI) TO CORRECT PEDIATRIC HYPOXIA AND HYPOVENTILATION Morgen J. Bernius, Doug J. Floccare, Jeremy T. Cushman, University of Maryland Medial System, Baltimore, Maryland**

**Introduction:** The purpose of this study is to evaluate the effectiveness of paramedic RSI as a tool for treatment of respiratory insufficiency in children. There have been a number of studies performed to evaluate the effect of paramedic RSI on mortality. The immeasurable confounding factors in these outcome studies make it difficult to clearly assess the role of RSI in prehospital care. Our study evaluates protocol-driven RSI as a tool to facilitate both placement of an artificial airway and to ensure adequate oxygenation and ventilation in the hypoxic or hypoventilated pediatric patient. **Methods:** This prospective study was initiated November 1, 1998, and is reported through December 31, 2005. Maryland State Police flight paramedics were trained to perform RSI by using medications including midazolam, etomidate, succinylcholine, and vecuronium. Patients less than 8 years of age or with uncuffed ETTs were pretreated with atropine. Airway rescue methods included the Combitube (>4 feet tall), surgical cricothyroidotomy (>9 years old), and needle cricothyroidotomy. Continuous pulse oximetry and End Tidal CO<sub>2</sub> (ETCO<sub>2</sub>) monitoring were used during transport. **Results:** Thirty-two patients aged 0–14, and 58 patients aged 15–17 underwent RSI. The youngest patient was 18 months old. Of these 90 patients, 86 (96%) received ETTs and 4 (4%) received Combitubes, with no unrecognized esophageal intubations. As a group, the mean GCS was 5.2 (±2.4 SD); 88% required BVM assistance prior to RSI, and 66% had blood in their airways prior to intervention. The mean pre-RSI O<sub>2</sub> saturation was 85.7% (±11.8), with

a mean post-RSI O<sub>2</sub> saturation of 97.4% ( $\pm$ 4.2). Mean ETCO<sub>2</sub> on hospital arrival was 31.9 ( $\pm$ 9.2). **Conclusions:** In this group of hypoxic and hypoventilating pediatric trauma patients, prehospital RSI appears to have been an effective treatment option to facilitate artificial airway placement and to correct respiratory insufficiency.

**21. A COMPREHENSIVE EVALUATION OF 9-1-1 CALLS FOR CHILDREN LOCKED IN CARS** Shirin Badrtalei, Amish Shah, Dawn Brown, Estrella Evangelista-Hoffman, Sandy Young, David Edward Slattery. *University of Nevada School of Medicine, Las Vegas, Nevada*

**Introduction:** In 2002, the CDC reported heat-related causes as the most common fatality in unattended children in or around vehicles. In our community, it is estimated that firefighters respond to an average of two calls per day for children locked in vehicles. To our knowledge, no study has evaluated the EMS and event characteristics of children locked in cars (CLIC). The aim of this study is to provide a comprehensive descriptive analysis of the 9-1-1 calls responded to by our EMS system, and to assess whether temperature played a role in the EMS decision to gain access into the vehicle. **Methods:** Setting: Urban fire-based EMS agency. Design: Retrospective descriptive study. All EMS calls for CLIC were included. (June 2003–June 2006). Patient care reports were reviewed by trained abstractors using a predefined data collection tool. Accuracy was confirmed by systematic monitoring by the principal investigator. We used univariate analysis (MS Excel) for descriptive statistics. Multivariate analysis (EpiInfo) was performed to assess the association between temperature and extrication predictors. **Results:** During the 3-year study period, there were 715 EMS fire responses for CLIC; 46% were female, the average age was 19.5 months, and >98% of children were under the age of 5. In obtaining vehicle entry, 24.7% were opened urgently by the fire department, and in 34.6% of cases, FD stayed on scene until they could be opened by a locksmith. Of those accessed by the FD, 46% of windows were broken, 17.8% locks were forced. 4.6% of patients were documented as “in distress.” 12 cases were transported to the hospital. The firefighters were more likely to access the vehicle emergently (OR = 2.16, CI: 1.45–2.30) in warmer temperatures (>72°F). **Conclusions:** We conclude that the vast majority of CLIC events occur in victims < 5 years of age, and these rarely require hospital transport. Our results also suggest that higher ambient temperatures appear to drive a more aggressive and timely extrication by firefighters. These results may have important educational and performance

improvement implications for similar EMS systems nationwide.

**22. EFFECTIVENESS OF SUPRAGLOTTIC AIRWAY DEVICES IN PREHOSPITAL BASIC LIFE SUPPORT AIRWAY MANAGEMENT** Mark Dixon, Noel Carmody, Cathal O'Donnell, Marcella Daly, Linda O'Rourke, Ralph O'Neill, Frank Donnellan, Cathy McCormack, *Health Promotion Unit, HSE Mid-West, Clare, Ireland*

**Introduction:** Basic life support (BLS) paramedics resuscitate patients in moving ambulances using postural airway management and bag valve mask (BVM) ventilation. This study is designed to evaluate whether mobile BVM ventilation is effective, whether supraglottic airway devices aid improved ventilation and if so, which supraglottic device is most suitable for patient ventilation in a prehospital setting. **Methods:** Nineteen BLS certified full-time emergency medical technicians (EMT-B) were trained in the use of the Ambu Spur BVM, the Portex laryngeal mask airway (LMA), and the VBM laryngeal tube airway (LT). Each candidate was allowed a 2 minute resuscitation practice in a classroom environment on each device. Candidates were then asked to ventilate a manikin with an attached skill meter (Ambu Cardiac Care Trainer) for three 2-minute cycles using BVM, LMA, and LT, respectively, in a moving vehicle on a predetermined urban route. Correct ventilations were defined as 400–600 mL of tidal air movement without gastric distension. **Results:** A total of 266 ventilations were delivered by BVM, 328 by LMA, and 319 by LT. The proportion of correct ventilations delivered were 15% (BVM), 19.2% (LMA), and 23.5% (LT). The difference between BVM and LT was statistically significant ( $p = 0.048$ ). Incorrect BVM ventilations were largely due to hypoventilation (80%), incorrect LMA ventilations were equally split between hypoventilation (41%) and hyperventilation (40%) and incorrect LT ventilations were predominantly hyperventilation (72%). Gastric ventilation rates were 9.7% (BVM), 15.8% (LMA) and 0.31% (LT). The differences between BVM and LT and between LMA and LT were both statistically significant ( $p = 0.018$  and  $p = 0.023$ , respectively). **Conclusion:** Effective ventilation rates using all three methods were low. The laryngeal tube is significantly better than bag valve mask ventilation at delivering effective ventilation and significantly better than both bag valve mask ventilation and laryngeal mask airway ventilation at preventing gastric inflation (and subsequent aspiration). The laryngeal tube is the most effective BLS prehospital airway adjunct and is superior to bag valve mask ventilation.

**23. DO DIFFERENT TUBE SECURING METHODS AFFECT ENDOTRACHEAL TUBE DISLODGE­MENT IN A PREHOSPITAL SETTING** Karl F. Kauffman, Douglas F. Kupas, Henry E. Wang, *Geisinger Health System, Danville, Pennsylvania*

**Purpose:** The optimal technique for securing an endotracheal tube (ETT) in the prehospital setting is unknown. We compared the effectiveness of common tube-securing techniques at preventing ETT dislodgement. **Methods:** This was a prospective, observational, multicenter study conducted with 42 emergency medical services (EMS) agencies. EMS providers completed structured, closed-response data forms for all attempts at endotracheal intubation (ETI). Data were collected over 18 months. We included all successful intubations as well as failed ETI where ETT securing was performed. EMS providers indicated methods used to secure the ETT, including the use of adhesive tape to face (face tape), tape wrapped around neck (neck tape), umbilical tape (twill), intravenous or oxygen tubing (tubing), commercial tube holders, and manual stabilization/none. Providers also indicated the concurrent use of a cervical collar and/or cervical immobilization device with backboard (CID). ETT dislodgement was reported by providers. We evaluated the rates and odds of ETT dislodgement for each tube-securing technique using binomial proportions with exact confidence intervals as well as multivariate logistic regression. **Results:** Of 1,668 patients, ETT dislodgement occurred in 45 (2.7%). ETT dislodgement rates were face tape 15/354 (4.2%; 95% CI: 2.4–6.9%), neck tape 9/205 (4.4%; 2.0–8.2%), twill 0/67 (0%; 0–5.3%), tubing 1/30 (3.3%; 0.1–17.2%), commercial tube holders 25/1111 (2.3%; 1.5–3.3%), cervical collar 2/121 (1.7%; 0.2–5.8%), CID 12/377 (3.2%; 1.7–5.5%). On multivariate regression, there were no differences in the odds of ETT dislodgement between different securing techniques; face tape OR 1.6 (95% CI: 0.6–4.0), neck tape 1.5 (0.5–4.0), twill (odds ratio not applicable), tubing 1.1 (0.1–10.5), commercial tube holder 0.8 (0.3–2.4), cervical collar 0.5 (0.1–2.4), CID 1.4 (0.7–2.9). **Conclusions:** ETT dislodgement did not occur when umbilical twill tape was used to secure the tube. Other common tube-securing methods exhibit comparable odds of ETT dislodgement.

**24. COMPARISON OF DIFFERENT SECURED AIRWAYS IN A SIMULATED COMBAT SCENARIO** Robert Norris, Gregory Gilbert, Peter D'Souza, James Quinn, Emma Bakes, Carmie Chan, Jessica Ngo, Bao Duong, Dave Ghilarducci, *Stanford University, Palo Alto, California*

**Objective:** Tactical emergency medicine is a developing field focusing on scenarios where standard prehospital techniques may be impractical or dangerous. The tactical medic, when faced with an apneic pa-

tient in a hostile setting, may have to secure an airway quickly and with minimal exposure to a potential threat. We compared three different airway techniques that might be chosen in such a setting. **Methods:** Paramedics were videotaped while establishing an airway using the King LT-D supraglottic airway, the Combitube esophageal/tracheal double-lumen airway, and oral tracheal intubation (OTI) in a mannequin representing an apneic, wounded victim. Order of attempts was determined randomly for each participant, and participants were instructed to establish the airway as quickly as possible while staying as close to the ground as possible (limiting exposure). Each participant completed three successful uses of each technique. The videos were analyzed, and mean time to airway establishment and average maximal head height of the operator were measured. Results were compared with paired t-tests with 95% confidence intervals for the three techniques. Results: Twenty full-time paramedics participated. They were able to establish an airway more quickly using the King airway (7.92 seconds; 95% CI: 7.06–8.78) compared to the Combitube (13.00 seconds; 95% CI: 11.39–14.61) or OTI (18.01 seconds; 95% CI: 15.6–20.42). This saved 5.08 seconds (95% CI: 3.74–6.42) versus the Combitube and 10.09 seconds (95% CI: 7.99–12.20) versus OTI. There was no difference in maximal head height using the King device (54.5 cm; 95% CI: 50.7–58.3) compared to the Combitube (55.8 cm; 95% CI: 52.7–58.9); however, both were significantly lower than OTI (64.4 cm; 95% CI: 62.5–66.3). **Conclusions:** Paramedics were able to secure the airway most quickly and with least exposure using the King LT-D device. In an actual combat setting, the time saved and reduced exposure using the King airway could result in a better outcome for both the victim and the at risk medic.

**25. THE REACH\* STUDY: IS ADVANCED AIRWAY MANAGEMENT UNDERUTILIZED IN COMBAT? \*REGISTRY OF EMERGENCY AIRWAYS ARRIVING AT COMBAT HOSPITALS** Andrew E. Muck, Peter Cuniowski, Robert De Lorenzo, Bruce Adams, *San Antonio Uniformed Services Health Education Consortium, Fort Sam Houston, Texas*

**Purpose:** Skillful and timely management of the trauma airway is a critical task. Previous experience demonstrated limited use of definitive prehospital airways in combat despite a high success rate. We investigated whether patients received appropriate definitive airway management prior to arrival to the combat support hospital (CSH) in Operation Iraqi Freedom (OIF). **Methods:** This was a prospective, observational, study approved by the IRB. All combat traumas during a 12-month period received by a single CSH were evaluated. Patients requiring an emergent airway within 30 minutes of arrival were analyzed by using six criteria to identify those who might have benefited from

definitive prehospital airway management: CPR in progress, GCS <8, O<sub>2</sub>sat <80%, base deficit >20, systolic blood pressure <80, pH <7.0. The criteria were face validated established a priori to data analysis. **Results:** The CSH received 1,622 major trauma patients during the study period. A total of 247 (15.2%) ultimately required emergent intubation. Prehospital endotracheal intubations were established prehospital for 85 (34.4%). Emergent intubation was delayed on 162 trauma patients until arrival to the CSH emergency department (65.6%). By our criteria, 76 of these (46.9%) could have benefited from definitive prehospital airway management. Of this latter cohort; 12 presented with CPR in progress, 56 with GCS <8, 8 with O<sub>2</sub> sat <80%, 15 with base deficit >20, 22 with systolic blood pressure <80, and 19 with pH <7.0. This cohort had average 5.9 GCS, 93.4% O<sub>2</sub> sat, -12 base deficit, 93 systolic blood pressure, and 7.12 pH. Furthermore, 86% came directly from the battlefield and 6% from battalion aid stations. Mode of arrival was 46% ground ambulance, 13% air and 30% by nonmedical combat vehicle. Mechanism of injury was 53% gunshot, 25% blast, 4% motor vehicle accident. **Conclusions:** Over 15% of combat traumas require emergent airways. A preponderance of patients do not receive definitive airway management until they arrive in critical status to the hospital. We propose that battlefield airways are underutilized. We encourage improvement of training, field equipment, and forward positioning of medical personnel to ensure that early airway management occurs within the limits of battlefield safety.

**26. PROCEDURAL EXPERIENCE OF EMTs WHO ATTEMPT ENDOTRACHEAL INTUBATION** **Todd Brown, Shannon W. Stephens, Stacey S. Cofield,** *Department of Emergency Medicine/University of Alabama @ Birmingham, Birmingham, Alabama*

**Objectives:** Prehospital endotracheal intubation has come under recent scrutiny. This report examines the prior intubation experience of EMTs who attempted endotracheal intubation in Alabama in 2005. **Methods:** We analyzed the Emergency Medical Services Information System (EMSIS) database maintained by the Alabama Department of Public Health. EMSIS is a statewide EMS patient care report database containing 190 variables. Computer data entry is performed by EMS providers during each shift, and the data is uploaded to EMSIS. Quality control occurs at the local level, and is enhanced by standardized data fields and definitions, as well as predetermined treatment protocols. Alabama licenses EMTs trained to the standards of the National Registry of Emergency Medical Technicians EMT-intermediate or EMT-paramedic to perform endotracheal intubation. For this analysis, we selected a two year period of data from EMSIS, Jan 1 2004 through December 31

2005. EMTs were included only if they had attempted endotracheal intubation in 2005. EMTs who attempted intubation in 2005 but not in 2004 were included (with zero attempts in 2004) only if they had an active EMT license during 2004. **Results:** The final 2005 dataset contained 632 operators who intubated in 2005, on 1283 incidents. 57.9% (366/632) of rescuers who intubated in 2005 performed the procedure only once during 2005. 23.4% (148/632) of rescuers intubated three or more times in 2005. Amongst rescuers who intubated in 2005, the mean and median number of attempts per rescuer was 2.03 and 1, respectively. When the combined data for years 2004 and 2005 was considered, there were 514 rescuers with data for both years. 46.7% (240/514) of rescuers who attempted intubation in 2005 had not attempted any intubations at all in 2004, and 20.6% (106/514) had intubated three or more times. Amongst rescuers with data available for both years, the mean and median number of attempts per rescuer in 2004 was 1.36 and 1, respectively. In nearly half (41.7%) of incidents in 2005 where intubation was attempted, the operator had not attempted intubation in 2004. **Conclusions:** Nearly half of EMTs in Alabama who attempt endotracheal intubation in 2005 had not done so the previous year. Nearly half of patients who need intubation in 2005 were under the care of an EMT who had not intubated in the previous year.

**27. RATE OF DECLINE IN OXYGEN SATURATION VALUES FOR PATIENTS UNDERGOING PREHOSPITAL RAPID SEQUENCE INTUBATION** **Daniel P. Davis, James Hwang, James V. Dunford,** *UCSD Emergency Medicine, San Diego, California*

**Background:** A high incidence of desaturations has been observed during prehospital rapid sequence intubation (RSI). The rate of SpO<sub>2</sub> decline with various SpO<sub>2</sub> values has not been defined with emergency RSI. Furthermore, it is unclear when active bag-valve-mask (BVM) ventilation should be performed to optimize preoxygenation and avoid subsequent desaturations. **Objective:** To define the rate of SpO<sub>2</sub> decline for various SpO<sub>2</sub> values and identify a threshold below which active BVM should be performed during prehospital RSI. **Methods:** Trauma patients undergoing prehospital RSI by paramedics and air medical crews were included in this analysis. Prehospital providers were instructed to monitor SpO<sub>2</sub> by using a handheld oximeter-capnometer during all RSI procedures; SpO<sub>2</sub> values are recorded every 8 seconds and can be exported for analysis. The time period from the highest to the lowest preintubation SpO<sub>2</sub> value was selected for review. The mean rate of SpO<sub>2</sub> decline was calculated for each SpO<sub>2</sub> value and then used to define a theoretical SpO<sub>2</sub> desaturation curve. An inflection point was identified, and the success of intubation attempts

initiated above and below this threshold compared. Finally, the interim SpO<sub>2</sub> value following BVM was compared with the initial SpO<sub>2</sub> value at the time of the first intubation attempt in patients undergoing multiple attempts. **Results:** A total of 684 SpO<sub>2</sub> values from 87 patients were included in this analysis. Lower SpO<sub>2</sub> values were associated with a faster rate of SpO<sub>2</sub> decline, with an inflection point occurring below 94%. The desaturation rate (SpO<sub>2</sub> < 90%) for patients in whom intubation was attempted with SpO<sub>2</sub> < 94% was much higher than with SpO<sub>2</sub> = 94% or greater (100% vs. 6%,  $p < 0.01$ ). In patients undergoing multiple intubation attempts, the SpO<sub>2</sub> value achieved with interim BVM was consistently higher than the preintubation value, suggesting that BVM would have been an effective preoxygenation strategy. **Conclusions:** The rate of SpO<sub>2</sub> decline increases as SpO<sub>2</sub> decreases, with an inflection point occurring below 94%. Intubation attempts below this value are almost always associated with subsequent desaturation, whereas attempts above this value are rarely associated with desaturation. Active preoxygenation with BVM should be used with prehospital RSI for SpO<sub>2</sub> < 94% despite passive preoxygenation.

**28. EMERGENCY MEDICAL TECHNICIAN PRACTICE PATTERNS IN ADULT CARDIAC ARREST RESUSCITATION**  
**Jeff Owens, Sara R. Shimmin, Bentley J. Bobrow, Peter Richman, Vadeboncoeur F. Tyler, Mayo Clinic Hospital, AZ; Arizona Department of Health Services, Bureau of EMS, Arizona**

**Background:** The American Heart Association 2005 Guidelines emphasize the importance of high-quality chest compressions with minimized interruptions during cardiac resuscitation. These guidelines stress basic life support skills as opposed to advanced airway techniques and medications. This represents a paradigm shift for prehospital advanced life support providers. **Objective:** To evaluate emergency medical technicians' (EMTs) practice patterns in adult cardiac arrest and the influence of focused cardiocerebral resuscitation (CCR) training emphasizing quality chest compressions in cardiac arrest. **Methods:** A voluntary, Internet-based, survey composed of 15 closed-answer questions, was sent to 823 licensed EMTs from 24 different EMS agencies in Arizona. The survey questions were designed to assess EMT knowledge, experience, and attitude with regard to adult cardiac arrest resuscitation. **Results:** A total of 476 of the 823 (57.8%) EMTs responded. Responses were received from 16 of 24 (66.7%) different EMS agencies in the Phoenix metropolitan region. Level of certification was as follows: 310 EMT-Paramedics (EMT-P), 7 EMT-Intermediates (EMT-I), and 159 EMT-Basics (EMT-B). Sixty-three of 159 (39.7%) EMTs who had undergone CCR training responded that adminis-

tration of 10 or fewer ventilations per minute should be attempted versus 72 of 317 (22.7%,  $p = 0.001$ ) of those without CCR training. One-hundred two of 159 (64.2%) providers with CCR training and 157 of 317 (49.5%) of providers without CCR training responded that high-quality CPR was most important for cardiac arrest survival ( $p = 0.004$ ; OR = 0.55; 0.37–0.81). A total of 112/159 (70.4%) of CCR trained EMTs reported that endotracheal intubation was important whereas, 256 of 317 (80.1%) without CCR training reported similarly ( $p = 0.015$ ; OR = 1.8; 1.1–2.7). **Conclusion:** EMT practice patterns for adult cardiac resuscitation are not standardized. Additional training focused on updated resuscitation guidelines and specifically the importance and optimal technique for CPR would assist in promoting a standardized response consistent with the 2005 AHA guidelines.

**29. FEMALE SEX IS ASSOCIATED WITH IMPROVED SHORT-TERM OUTCOME FOLLOWING PROLONGED VENTRICULAR FIBRILLATION**  
**Jon C. Rittenberger, Eric Logue, James J. Menegazzi, Brian Suffoletto, Timothy Mader, University of Pittsburgh, Pittsburgh, Pennsylvania**

**Introduction:** Recent studies have demonstrated a possible survival benefit in female patients experiencing cardiac arrest. This finding potentially affects the interpretation of all in vivo animal studies. **Hypothesis:** We hypothesized that sex is not an independent predictor of return of spontaneous circulation (ROSC) or short-term survival in porcine studies of prolonged ventricular fibrillation (VF). **Methods:** Retrospective analysis of the last five experiments performed in our lab using mixed-breed domestic swine of either sex (weighing 23–30 kg). All experiments include prolonged untreated VF, CPR, defibrillation, and IV medications. We defined ROSC as a systolic blood pressure of 80 mmHg or greater, sustained for 1 minute. Short-term survival varied between 20 and 60 minutes. Multiple logistic regressions determined predictors of ROSC and short-term survival. Candidate variables included sex, duration of VF, duration of anesthesia, weight, and resuscitation protocol. **Results:** We included 221 swine in the analysis (104 females, 117 males). The rate of ROSC was 75% for females and 64% for males. The rate of short-term survival was 68% for females and 53% for males. Duration of VF alone was a predictor of ROSC (odds ratio 0.87; 95% CI: 0.78, 0.97). Duration of VF and sex were predictors of short-term survival (odds ratio 0.80; 95% CI: 0.71, 0.90 for VF and odds ratio 0.43; 95% CI: 0.22, 0.84 for sex). Both models had acceptable fit with Hosmer-Lemeshow values of 0.05 in the ROSC model and 0.20 in the survival model. **Conclusions:** Sex predicts short-term survival but not ROSC in a swine model of prolonged ventricular fibrillation.

**30. RACIAL DISPARITIES IN THE RATE OF BYSTANDER CPR.** Robert E. O'Connor, Diane McGinnis-Hainsworth, David Zamara, Melissa Bollinger, Ross E. Megargel, *Christiana Care Health Systems, Newark, Delaware*

**Purpose:** Disparities in health care are widely documented. We conducted this study to test the hypothesis that there were no differences in the frequency of bystander CPR when the victim of out-of-hospital cardiac arrest (OOHCA) is classified by race. **Methods:** The EMS system uses a two-tiered response of first responders/basic life support followed by paramedics. The service responds to approximately 50,000 calls annually. All calls are handled by an emergency call center, which provides prearrival instructions, including CPR prompts to the lay person. All out-of-hospital cardiac arrests (OOH-CA) that were treated by paramedics in our system during 2005 were included. Patients were excluded if the paramedics stopped resuscitative efforts on their arrival. (obvious death, DNR orders, etc.). Demographic information was collected on all patients, as was the time of day and location of arrest. Time intervals from emergency call receipt to BLS and paramedic arrival were recorded. EMS noted the race of the patient, and whether bystander CPR was being performed on their arrival. Statistical testing included  $\chi^2$ , Mann-Whitney, and regression analysis. **Results:** A total of 770 patients in cardiac arrest were studied, with 563 patients classified as "white," 185 classified as "black," and 22 unclassified and excluded from further analysis. The proportion of patients receiving bystander CPR was 45% for white, 34% for black, and 35% for other ( $p < 0.001$ ). The rate of return of spontaneous circulation (ROSC) was significantly higher in whites than blacks (30% vs. 17%;  $p < 0.0001$ ). The proportion of OOH-CA occurring in the home was similar for whites (73%) and blacks (70%), however, the rate of bystander CPR for OOH-CA occurring in the home was significantly lower (33% vs. 20%;  $p < 0.0001$ ). **Conclusions:** Significant racial disparities in the frequency of bystander CPR exist. Although both groups had lower rates of bystander CPR when OOH-CA occurred in the home, significant disparities existed here as well. These findings have important implications for focusing on CPR training for all, with emphasis on increased training of the black population.

**31. FUTILITY OF RESUSCITATION FOR UNWITNESSED PEA AND ASYSTOLE OUT-OF-HOSPITAL CARDIAC ARREST** James J. Menegazzi, Maragret Hsieh, James Niemann, Robert Swor, *University of Pittsburgh, Pittsburgh, Pennsylvania*

**Introduction:** Emergency medical services (EMS) treat approximately 240,000 out-of-hospital cardiac arrests

(OOHCA) per year. Approximately 70% of these cases present with pulseless electrical activity (PEA) or asystole as the first ECG rhythm. A large percentage of these cases are also not witnessed by a bystander. Early termination of these cases may spare EMS resources and reduce risk of injury during transport. **Objective:** We sought to determine the rates of return of spontaneous circulation (ROSC) and survival to hospital discharge for unwitnessed OOHCA with PEA and asystole as the first ECG rhythm. **Methods:** In this NIH-sponsored study, we merged data from Los Angeles, CA, Pittsburgh, PA, and Royal Oak, MI, into a new OOHCA database. Data were categorized by witness status, ECG, ROSC, survival to hospital admission, and survival to hospital discharge. **Results:** The database contains 5,046 cases. There were 269 cases of unwitnessed PEA, with 100 having ROSC (37%), 59 surviving to admission (22%), and 4 surviving to discharge (1%). There were 975 unwitnessed asystole cases, with 156 having ROSC (16%), with 133 surviving to admission (13%), and 8 discharged alive (0.8%). **Conclusion:** There were 12 of 1,244 survivors to hospital discharge (0.9%). Survival for unwitnessed PEA and asystole are the equivalent. Although the incidence of survival for unwitnessed PEA and asystolic OOHCA is less than 1%, it is not zero. Still, these cases are often futile, and early termination of resuscitation and non-transport are often warranted.

**32. METRONOME IMPROVES CARDIOPULMONARY RESUSCITATION BY NONTRADITIONAL RESCUERS** Ali-dene Doherty, Ronald E. Stickney, Robert E. Smith, Jon A. Meads, *Medtronic Emergency Response Systems, Redmond, Washington*

There is an increasing demand for methods to improve the quality of cardiopulmonary resuscitation (CPR). Current CPR guidelines recommend a chest compression rate of 100/minute, a 30:2 compression:ventilation ratio for nontraditional rescuers, and a  $\leq 10$ -second pause in compressions for ventilations. We developed two CPR metronomes aimed at improving the quality of chest compressions and ventilations. A verbal metronome uses the word "ventilate" and a nonverbal metronome uses a tone instead. Both use a tock sound for compressions. **Hypothesis:** Single nontraditional rescuers using a CPR metronome are more likely to perform CPR on a manikin with a compression rate of  $100 \pm 10$  per minute and a  $\leq 10$ -second pause for ventilations compared to CPR without a metronome. **Methods:** Twenty-nine nontraditional rescuers (police officers and casino security officers previously trained in automated external defibrillator use) were randomized to perform 2 minutes of one-rescuer CPR on a recording manikin either without (control group) or with (metronome group) a CPR metronome. Metronome

subjects were further randomized to either the verbal or nonverbal metronome. Average compression rate was calculated by manikin software for each compression series and the median value for each subject was used. The median pause for ventilations was measured from the recorded manikin waveforms. **Results:** one of 15 control subjects and 11 of 14 metronome subjects met the target criteria for both compression rate and pause for ventilations ( $p = 0.00012$ ). For control subjects, the median compression rate was 96/minute [interquartile (IQ) range 79–108, range 65–123] and for metronome subjects it was 100/minute [IQ range 100–101, range 95–103]. For control subjects the median pause for ventilations was 11.2 seconds [IQ range 9.1–12.4, range 6.2–16.4] and for metronome subjects it was 8.8 seconds [IQ range 8.3–9.4, range 6.8–11.0] ( $p = 0.018$ ). **Conclusions:** Both the verbal and nonverbal 30:2 CPR metronomes are highly effective at guiding nontraditional rescuers to the recommended compression rate and at preventing an excessive pause for ventilations during CPR on a manikin. Including the CPR metronomes in a defibrillator would likely improve the quality of CPR during resuscitations.

**33. HOSPITAL VARIABILITY OF OUT-OF-HOSPITAL CARDIAC ARREST SURVIVAL** J. Marc Liu, Ronald G. Pirrallo, John P. Klein, Tom P. Aufderheide, *Medical College of Wisconsin, Milwaukee, Wisconsin*

**Objective:** Previous studies have described patient and EMS system factors that are associated with improved out-of-hospital cardiac arrest outcomes. The purpose of this study was to determine whether rates of survival to discharge of resuscitated adult out-of-hospital cardiac arrest patients vary among different receiving hospitals in a single EMS system. **Methods:** This retrospective observational study included all adult (21 years or older) Utstein criteria cardiac-etiologic arrest patients from 1993 to 2004 who survived to inpatient admission. Primary outcome measure was survival to hospital discharge. Descriptive statistics and multivariate logistic analysis were performed to compare survival rates of the hospitals. Additional post hoc analysis stratified receiving hospitals into quartiles based on the annual number of study patient admissions. **Results:** The 2,649 patients survived to in-hospital admission at nine receiving hospitals. The mean annual total number of arrest patients received via EMS ranged from 1.7 to 81.8; mean annual number of survivors to inpatient admission ranged from 1.0 to 53.5. Survival to hospital discharge ranged from 15.3% (SE 12.7%) to 41.8% (SE 7.2%). In the lowest volume quartile (1–7 patients received per year) hospitals, mean survival was 22.7% (SE 7.5%). 32.7% (SE 3.1%) patients survived in the second quartile (8–28 patients); 37.4% (SE 1.9%) in the third quartile (29–46 patients);

and 31.4% (SE 1.3%) in the highest quartile (>46 patients). Compared to the first quartile, the odds of survival were higher in the second (OR 1.7, 95% CI: 1.1–2.6,  $p = 0.017$ ) and third (OR 2.0, 95% CI: 1.3–3.2,  $p = 0.002$ ) quartiles. The highest volume quartile also had a higher survival rate but was not significant (OR 1.6, 95% CI: 1.0–2.4,  $p = 0.052$ ). **Conclusion:** In one EMS system, adult out-of-hospital cardiac-etiologic arrest survival rates vary by the hospital receiving the patient. The annual hospital survival rate of out-of-hospital cardiac arrest patients appears to correlate positively with the number of EMS-resuscitated arrest patients admitted each year to that hospital. Such findings may have national implications for EMS transport policy and research design. Further research is needed to investigate this observed variability and to determine the specific in-hospital characteristics that may improve outcome.

**34. EMS STROKE CARE IN VIRGINIA: A RETROSPECTIVE REVIEW 2002–2005** Sabina A. Braithwaite, Nina J. Solenski, *University of Virginia Health System, Charlottesville, Virginia*

**Objectives:** To describe current status of EMS stroke care in Virginia, identify areas for improvement, and develop targeted interventions consistent with the 2005 American Stroke Association recommendations. **Methods:** Design: A 2-year retrospective review of the statewide Virginia Emergency Medical Services (EMS) Prehospital Patient Care Record (PPCR) database. Subjects: All EMS patients from July 1, 2002, to March 31, 2005, identified with CVA as the primary complaint, transported by 911 EMS agencies in Virginia for whom a PPCR was filed. Observations: Data analysis included prevalence of suspected stroke patients, total transport time, level of prehospital care and specific interventions, and differences in care based on location or agency type. **Results:** A total of 1,473,498 PPCR were reviewed and 24,749 subjects (1.7%) were identified; 34% were cared for by volunteer, 55% by career, and 11% by combined EMS agencies; 73% were cared for by advanced providers, 18% by basic providers, 9% by other, 61.5% of patients received treatment, with 17,228 total interventions documented including vascular access (39%), medication (2%), oxygen (32%), and ECG monitoring (24%). Stroke Assessment Tool use is currently not being collected on the PPCR. For the 94% stroke patients transported to a hospital, median call time (time of 911 call to arrival at destination) and response time (time of 911 call to arrival at scene) were evaluated, 15% patients in underserved areas (UA) had average transport times by jurisdiction (ATT) ranging from 21.8 to 379 minutes, and 85% patients from nonunderserved areas (NUA) had ATT from 26.2 to 226.6 minutes. ATT by patient in UA was 62.5 minutes, with 48%

of patients transported in less than 60 minutes. By contrast, ATT was 52.1 minutes in NUA, with 66% of patients transported in less than 60 minutes. Call times by county and city jurisdiction (FIPS) show ATT under 30 minutes in 3%, 30–60 minutes in 76%, and 60–90 minutes in 20%. **Conclusions:** There is considerable variability in EMS level of care and time to hospital for stroke patients in Virginia. Targeted areas of intervention should include improved data collection, EMS education on early stroke identification, and improved call time.

**35. UTILIZATION OF A PREHOSPITAL STROKE SCALE IN AN URBAN MATRIX OF PRIMARY STROKE CENTERS** **Bentley J. Bobrow, Bart Demaerschalk, Sara R. Shimmin, Lani Clark, Geoff McKinzie, Scott Silvers,** *Mayo Clinic Hospital, AZ; Arizona Department of Health Services, Bureau of EMS, Arizona*

**Background:** Time is of the essence for all acute stroke (AS) treatments. Primary Stroke Center (PSC) criteria were established in 2000 as a way of identifying those hospitals able to deliver specialized AS care in a timely manner. The Cincinnati Prehospital Stroke Scale (CPSS) is a rapid means of prehospital AS assessment. How the CPSS is used by prehospital providers and its effect on the entire Emergency Medical Services (EMS) system are not completely known. **Objective:** To determine baseline EMS use of the CPSS and the effect of CPSS score on PSC destination and transport decision making in our urban EMS system of PSCs. We hypothesize that the CPSS score correlates with PSC versus non-PSC destination. **Methods:** The Arizona Stroke Prehospital Identification Registry and Education (ASPIRE) program began in 2005. EMS first care reports were prospectively collected from 10 EMS agencies that transport to 8 PSCs and 18 non-PSCs in metropolitan Phoenix. The recorded components of the CPSS, triage decision making, and use of bypass protocols were extracted from the reports and entered into the ASPIRE database. **Results:** ASPIRE received 914 prehospital AS first care reports from January 2005 to August 2006. A lack of recorded CPSS information caused 187 (20%) reports to be excluded. There were 285/727 (39%) patients with CPSS score of 0, 193/727 (27%) with score of 1, 152/727 (21%) with score of 2, and 97/152 (13%) with score of 3. The proportion of patients transported to a PSC with a CPSS score of 0 was 158/285 (55%), 1 was 118/193 (61%), 2 was 99/152 (65%), and 3 was 66/97 (68%). (Correlation coefficient 0.996,  $p < 0.01$ .) **Conclusion:** In a large urban community with multiple, independent EMS agencies, prehospital CPSS scores correlate with transport destination to a PSC. There is evidence of overtriage of patients to PSC with a 0 score and undertriage of patients to PSC with a 3 score. The

effects of diverting AS patients to predesignated PSCs on a metropolitan EMS system and its hospitals and patient care warrant further investigation.

**36. ASSESSMENT OF THE ONTARIO PREHOSPITAL ACUTE STROKE SCREENING TOOL** **Jordan Chenkin, Laurie Morrison, David J. Gladstone, Patrice Lindsay, Richard Verbeek, Jiming Fang, Monique Kerr-Taylor.** *Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada*

**Background:** Improved prehospital identification and rapid triage of acute stroke patients by EMS is necessary for effective delivery of tissue plasminogen activator (tPA). In 2005, a three-item prehospital stroke screening tool (unilateral limb weakness, facial weakness, speech deficit) was implemented in Toronto, Ontario. Patients identified in the field using this tool are transported to a regional stroke center under a stroke redirect protocol, bypassing local hospitals that do not provide stroke thrombolysis. **Objective:** To determine the positive predictive value (PPV) of the Ontario Prehospital Acute Stroke Screening Tool for identification of acute stroke or TIA. Secondary outcomes include tPA treatment rates before and after this protocol, patient outcomes, and repatriation rates. **Methods:** We conducted a retrospective analysis of consecutive patients transported to Sunnybrook Health Sciences Centre under the EMS acute stroke protocol over a 12-month period (March 2005 to February 2006). All patients received consultation by a neurologist in the ED. Data were collected prospectively as part of the Registry of the Canadian Stroke Network. **Results:** Three hundred fifty-one patients were triaged under the EMS acute stroke protocol; 72% were transported from outside the hospital catchment area and 89% arrived within 2.5 hours of stroke onset. Final diagnoses were 56% ischemic stroke, 21% hemorrhagic stroke, 11% TIA; and 9% non-stroke (most commonly seizure, 3%). The PPV of the screening tool was 90% for acute stroke or TIA. PPV with 1, 2, or 3 positive criteria was 75%, 86%, and 98%, respectively. Total tPA use increased fourfold compared to the year prior to implementation of the triage protocol; 37% of ischemic stroke patients (18% of all patients) arriving within 2.5 hours received tPA. Of the tPA-treated patients, 20% of survivors recovered functional independence at discharge (Rankin 0–2); the symptomatic intracranial hemorrhage rate was 8%. 28% of the hospital bypass patients were repatriated to their local hospitals. **Conclusions:** This Prehospital Stroke Screening Tool is effective at identifying patients who require triage to a regional stroke center. Following implementation, we observed a dramatic increase in the number of patients who were eligible for and received tPA within the critical 3-hour time window.

**37. AN EMS-BASED PROTOCOL FOR THE PREVENTION AND TREATMENT OF STROKE CAN INCREASE THE PUBLIC'S KNOWLEDGE OF STROKE SIGNS AND SYMPTOMS**

**Todd Crocco, Allison Tadros, Ronnie Best, Jr., Jeffrey Mullen, Stephen M. Davis, Anthony Teets, Charles Maxwell,** *West Virginia University, Morgantown, West Virginia*

**Background:** Previous studies have demonstrated that increasing the public's awareness of stroke can result in increased frequency of patient presentations within the therapeutic window for thrombolytics. However, these public awareness campaigns were resource intensive, which may be prohibitive for smaller communities. **Objectives:** To increase public awareness of stroke prevention and treatment using a unique emergency medical services (EMS)-based community education campaign. **Methods:** Personnel from a local hospital-based EMS program were educated and trained on stroke prevention and care. Methods and tools for public stroke education were then developed by the EMS squad, and strategic community dissemination points were identified. The media materials were disseminated by EMS personnel over a 2-month intervention phase in the spring of 2006 in a rural, Mid-Atlantic county with a population of 84,000. A random-digit telephone survey was administered to community residents before and after the intervention. Differences in the proportion of respondents who correctly said they would call 9-1-1 and named at least one sign, symptom, or risk-factor of stroke between the baseline and postintervention periods were tested by using the statistic. An a priori power analysis indicated a sample size of 268 (134 per survey period) to detect a 15% increase from baseline with 80% power at an alpha of 0.05. **Results:** We surveyed 284 individuals (142 per period). The number of individuals able to name at least one warning sign or symptom of stroke significantly increased from 75% to 88% ( $p < 0.05$ ). There was no change in the number of individuals able to mention at least one risk factor (87% vs. 88%;  $p = 0.72$ ) or the need to call 911 (66% vs. 58%;  $p = 0.18$ ). **Conclusions:** This pilot study indicates that the public's knowledge of stroke signs and symptoms can be increased by using a program developed and implemented by a community EMS system. Further studies using a control group are needed to confirm these findings in other locales. The impact that this program has on reducing presentation times for treatment should also be assessed.

**38. ACCURACY OF FUROSEMIDE USE IN THE APPLICATION OF A PREHOSPITAL DYSPNEA PROTOCOL: A PRELIMINARY REPORT**

**Joel A. Caldon, Jason Kubert, Salvatore Silvestri, George A. Ralls,** *Orlando Regional Medical Center, Orlando, Florida*

**Objective:** Acute dyspnea is a common complaint prompting evaluation by EMS personnel. Determin-

ing the etiology of dyspnea in the prehospital setting is difficult. We sought to determine the accuracy of the prehospital administration of furosemide by EMS personnel by applying a dyspnea protocol. **Methods:** We performed a retrospective review of run reports and hospital records of patients treated with prehospital intravenous furosemide from October 2004 through September 2005. The setting included an urban, fire-based, advanced life support provider who performs approximately 50,000 EMS responses per year. During the study period, a dyspnea protocol was in place that authorized standing use of furosemide in patients in whom paramedics suspected acute pulmonary edema. A convenience sample of only those patients who received furosemide and were transported to the regional teaching hospital or its affiliated community hospital were included. We compared the accuracy of prehospital furosemide use for suspected pulmonary edema with hospital discharge diagnosis and brain natriuretic peptide (BNP) level. **Results:** Fifty patients met inclusion criteria, and 48 had complete records available for analysis. The mean age was 76.5 ( $\pm 16$ ). Of the 48 patients, 19 (40%) were male and 3 (6%) arrived at the ED in cardiopulmonary arrest. A primary or secondary final hospital discharge diagnosis of CHF was made in 29 (60%) patients. BNP levels were available for 41 of the 48 patient study group. Of the 41 patients, 22 (54%) had levels greater than 400 pg/mL. Nineteen patients were found to have hospital discharge diagnoses other than CHF. These diagnoses included pneumonia ( $n = 10$ ), COPD ( $n = 5$ ), and other ( $n = 4$ ). **Conclusion:** This study shows the difficulty of field assessment of dyspnea by paramedics in identifying which patients have an indication for furosemide.

**39. IMPROVED TIME TO PERUTANEOUS CORONARY INTERVENTION FOLLOWING IMPLEMENTATION OF A PREHOSPITAL "CODE STEMI" PROTOCOL.**

**Thomas H. Blackwell, J. Lee. Garvey, Hadley Wilson, Kevin Collier,** *Department of Emergency Medicine-Carolinas Medical Center, Charlotte, North Carolina*

**Purpose:** Many hospitals have developed strategies to address acute ST-elevation myocardial infarction (STEMI) specifically targeted to improve the time to reperfusion using percutaneous coronary intervention (PCI), or door-to-reperfusion time. We test the hypothesis that similar strategies may be extended to the prehospital environment to improve PCI reperfusion times. **Methods:** This retrospective review was conducted in a metropolitan county with a population of 750,000 from January 2004 through December 2005. The EMS system is a single-tier, advanced life support paramedic service incorporating 12-lead electrocardiographic (ECG) capability. The receiving facility is an urban teaching hospital with an annualized emergency department (ED) census of 108,000. In October 2004, a

Code STEMI protocol (based on prehospital ECG and clinical confirmation of acute myocardial infarction by paramedics) was implemented. This protocol includes ED activation of an interdepartmental team and mobilization of the cardiac catheterization lab team 24 hours a day. Cases were defined as patients transported by EMS and categorized as Code STEMI from October 2004 to December 2005. The control group included patients transported by EMS prior to protocol implementation from January 2004 to September 2004. Cases and controls all received PCI following ED evaluation. Hospital records were reviewed to compare PCI times pre- and post-Code STEMI protocol adoption. **Results:** In the control group ( $n = 41$ ), the mean time from ED arrival to reperfusion was 72 minutes. Following Code STEMI implementation ( $n = 62$ ), the mean time to reperfusion was reduced to 54 minutes ( $p = 0.0025$ ). The 90-minute time from ED arrival to reperfusion, as recommended by national guidelines, was achieved 90.3% of the time in cases compared with 70.7% in controls ( $p = 0.016$ ). Following Code STEMI implementation, not only were 25.5% more cases (69.4% vs. 43.9%) reperfused within 60 minutes of ED arrival compared to controls, but 67.2% of cases were reperfused within 90 minutes of the initial paramedic contact. **Conclusions:** In this sample, implementation of a protocol incorporating STEMI identification in the field and prehospital activation of emergency cardiac care resources results in a decreased time to reperfusion following ED arrival for acute myocardial infarction patients.

**40. ASSESSING PREHOSPITAL 12-LEAD INTERPRETATION** William A. Porcaro, James Fitch, Denise Daudelin, Assaad Sayah, Marc Restuccia, Harry Selker, *UMass/Memorial Healthcare—University of Massachusetts Medical School, Worcester, Massachusetts*

**Introduction:** Acute coronary syndromes (ACS) are among the most serious and prevalent complaints faced by prehospital providers. Early identification and treatment of ACS is critical to optimizing patient outcomes; therefore, accurate interpretation of prehospital 12-lead electrocardiograms may aid in prehospital identification of ACS and shorten the time to treatment through early notification of and delivery to an appropriate receiving facility. Timely review and feedback of prehospital provider 12-lead ECG accuracy of interpretation is an important first step in achieving a long-term goal of ACS quality improvement. **Objective:** To establish a process to review prehospital provider 12-lead ECG interpretations and begin to evaluate the current accuracy of paramedics in identifying ACS compared an with emergency physician. **Methods:** This Quality Improvement/error-reduction study is being conducted in an urban paramedic system with an annual call volume of approximately 25,000 responses. Emer-

gency department (ED) physician review of paramedic 12-lead ECG interpretations is conducted on an ongoing basis using an interactive, web-based data management program. Using the ED physician's ECG interpretation as the reference, the accuracy of paramedics in identifying ACS was evaluated. The results are summarized to focus paramedic educational efforts on a group and individual level for quality improvement. **Results:** In our initial analysis of 146 patients in whom prehospital 12-lead ECGs were obtained, 24 were identified by ED physicians as positive for ACS, and 119 were negative. The specificity for paramedic interpretation of ACS was 96%; however, the sensitivity was 71% (i.e., a false-negative interpretation was made in 7/24 [29%] of the patients with physician impression for ACS). **Conclusions:** We have successfully implemented a web-based system to evaluate prehospital interpretation of 12-lead ECG, and established that, at present, paramedics display a high specificity but relatively low sensitivity for the presumptive identification of ACS compared with emergency physicians. These initial data will be used for feedback, education, and quality improvement in the prehospital diagnosis of ACS. Limitations of this study include small sample size and current paramedic comfort in reporting ECG impression.

**41. PREHOSPITAL CORONARY CARE PROTOCOLS IN U.S. EMS SYSTEMS** Susanna Sellin, Damian MacDonald, Siggy Baretta, David Cone, *Free University of Berlin, Berlin, Germany*

**Background:** The American Heart Association (AHA) recently published updated guidelines for treatment of acute coronary syndromes (ACS). For prehospital use, 12-lead ECG, aspirin, morphine, and nitroglycerin are recommended. Advance hospital notification for time-to-treatment reduction is also recommended. Other options include field thrombolysis, catheterization lab activation, beta-blockers, intravenous nitroglycerin, and antiemetics. It is unknown whether these guidelines can be implemented in U.S. EMS systems. The aim of this study was to assess current ACS protocols and the availability of diagnostic tools and therapeutic options in large U.S. ALS systems. **Methods:** This IRB-approved study was a telephone survey of 205 ALS first response and transport agencies of the most populous U.S. cities, conducted between February and June 2006. Two investigators used a scripted questionnaire to determine the availability of diagnostic and therapeutic options for ACS. Calls targeted an EMS supervisor and were repeated as often as possible until the end of the study period to maximize the response rate. Descriptive statistics were used. **Results:** The overall response rate was 90% (184/205). The population served by systems covered in this study equals 24% of the U.S. population. In 84% of systems (155/184), 12-lead ECGs are performed,

with interpretation by paramedics in 97% (150/155) and transmission to a physician in 48% (74/155). In 33% (61/184) activation of and in 14% (26/184) direct transport to the catheterization lab is possible. Prehospital thrombolysis is possible in 3% (6/184). Available drugs are sublingual nitroglycerin and aspirin in 100% of systems, morphine in 92%, antiemetics in 46%, beta-blockers in 21%, and heparin in 5%. Some systems use additional nitroglycerin as paste (17%) or intravenously (5%). **Conclusions:** Prehospital 12-lead ECGs are available in most of the surveyed large ALS systems. Fewer than half allow prehospital triage to causal therapy based on ECG findings (field thrombolysis or direct disposition to cardiac catheterization). Medications, such as heparin and beta-blockers included in the AHA guidelines are not available in most of the surveyed systems under current protocols. At present, most prehospital care protocols in the United States do not allow for direct disposition to a reperfusion strategy.

**42. REDUCING TIME TO DECISION IN NON ST SEGMENT ELEVATED MYOCARDIAL INFARCTION (NSTEMI) BY USING PRE-HOSPITAL POINT OF CARE CARDIAC BIOMARKERS** Jay Kovar, Kevin Mifflin, Marie Torzewski-Craig, Lee Gillum, Sharla Shumaker, Montgomery County Hospital District EMS, The Woodlands, Texas

**Purpose:** Non-ST-Segment-Elevated-Myocardial-Infarction (NSTEMI) care relies on rapid detection and intervention but is delayed by a nondiagnostic ECG. Bedside point of care (POC) markers reduces time from test to result over standard hospital lab-based results. This study investigates the feasibility, implementation, accuracy, and further time-saving by performing these tasks by EMS personnel. Time saving analysis from ED presentation to resulted test between EMS and ED initiated cardiac biomarkers is a primary end point. **Methods:** Prospective Interventional Trial of Biosite, Inc. product cardiac biomarker in the prehospital setting by EMS was compared with standard ED testing. Pretrial study was performed to verify reproducibility and correlation with hospital lab-based results. Setting: Suburban community hospital ED and county's 911 EMS provider. Subjects: Adult patients with chest pain/chest pain equivalents requesting 911 and transport to ED or presenting as "walk-in" patients to the ED. Interventions: Standard ED and EMS protocols, which include Iv access and blood draw for patient presenting with above symptoms. Biosite, Inc. biomarker card was inoculated within 15 minutes of EMS arrival to ED. Biomarker card was read on correlated Biosite instrument in ED. EMS times were corrected according to "official" hospital ED times. Times were recorded for EMS transport with card inoculation prior to arrival, EMS transport with

blood drawn but card not inoculated, EMS transport only, and ED "walk-in" chest pain/chest pain equivalent patients. Statistical analysis: The t-test with a two-tailed distribution and unequal sample variances. **Results:** Two hundred ninety-three patient met criteria for study; 112 patients were ED walk-ins (38.2%), 112 patients arrived via EMS with biomarker inoculated pre-hospital (38.2%), 26 patients were transported with blood drawn only (8.9%), and 43 had transport only (14.7%). EMS biomarker group had an average result time of 15 minutes versus ED walk-in cohort of 69 minutes ( $2.45E-20$ ,  $p < 0.001$ ). EMS transport with blood draw only averaged 41 minutes to result ( $p < 0.01$ ). EMS transport only was not significantly different from walk-in results (68 minutes average). **Conclusions:** EMS initiated POC biomarkers are feasible, accurate, and result in a significant reduction in time to results and allows for quicker decision making and earlier intervention for this at-risk population.

**43. INTENSIVE TRAINING PROGRAM INCREASES PARAMEDICS AND PHYSICIANS KNOWLEDGE AND SKILL IN TREATING PATIENTS TRAPPED IN CONFINED SPACE DISASTERS** Carolyn Synovitz, Elizabeth Ablah, Kurt Konda, University of Kansas School of Medicine, Wichita, Kansas

**Introduction:** Community integrated disaster response exercises allowing first response organizations to train together is important in building a community's response capacity. A 3-day confined space medicine training program for paramedics and physicians provided vital training for prehospital treatment of patients trapped in collapsed structures after natural or man-made disasters. **Methods:** Qualitative and quantitative (pre- and posttest) data gathered from paramedics and emergency physicians are presented, including participant's understanding of Health Resources and Services Administration (HRSA) Objectives and FEMA Disaster Medicine Competencies, demographic information, assessment of classroom training and simulation drill activities. Pretest and posttest data were matched to participants, and compared with a two-tailed t-test to compare self-reported improvements in knowledge and skills used in operating in a confined space rescue. **Results:** Consensus findings from the classroom training, simulation, and drill indicated participants gained new skills and knowledge about confined space medical treatment. The evaluation packages ( $n = 25$ ) were distributed with 24 being returned with the pretest and 18 being returned by post class participants. The comparison of the disaster medicine objectives showed a statistically significant increase in knowledge with the matched two-tailed t-test at the ( $p < .05$ ) level for all objectives except performing a tabletop exercise. This increase in

knowledge reflects a transfer of skills and methodology by the use of lecture, skills stations, and the confined space simulator. The second comparison examined the relationship between the postclass and postdrill participant surveys, which examined the educational value of the drill environment coupled with previous learning environments. These data showed significant increased knowledge in a two-tailed test at the ( $p < 0.05$ ) level in the following learning objective: the ability to provide advanced treatment to a victim in a collapsed structure. **Conclusions:** Disaster medicine with an emphasis on confined space treatment can be successfully taught to prehospital emergency care providers. Skills stations combined with a culminating drill provide significant improvement in prehospital providers' attainment of skills and knowledge to safely provide care to patients in a confined space environment.

**44. IDENTIFYING EDUCATIONAL STRATEGIES OF SUCCESSFUL EMT-BASIC PROGRAMS** Jon R. Studnek, Gregg S. Margolis, Joe Mistovich, Antonio R. Fernandez, *National Registry of EMTs, Columbus, Ohio*

**Introduction:** First time pass rates on the EMT-Basic national certification examination is used by many as a benchmark for success of EMS education programs. Some EMS education programs consistently achieve high success rates, whereas others struggle. This project develops a list of specific educational strategies used by those who attain consistent success. **Methods:** A seven-step nominal group technique (NGT) was used to determine if strategies that lead to a successful EMT-Basic education program could be identified. For the purposes of this study, educational success is defined as the graduates first time pass rate on EMT-Basic national certification examination. Therefore, NREMT data from 2002 to 2005 was analyzed to identify consistently high performing EMT-Basic educational programs. Focus group participants were the program directors of educational institutions where at least 40 students took the national certification exam each of the last 4 years and at least 80% of their graduates passed the exam in 3 of the 4 years. Participants were convened and using the NGT asked to answer the following question: "What are specific strategies that lead to a successful EMT-Basic education program?" **Results:** Ten of the 12 EMS education programs meeting the eligibility requirements participated. After completing the seven-step NGT process, 12 strategies were identified as leading to a successful EMT-Basic education program: (1) accept students who are highly motivated to succeed; (2) assure institutional support; (3) administer multiple assessments; (4) develop standardized lesson plans; (5) have a passing standard that is above the minimum competency level; (6) hire qualified/certified instructors; (7) maintain effective communication between didactic, practical and field instructors; (8) maintain instructional consistency;

(9) provide clearly defined objectives; (10) provide immediate feedback for written and practical evaluations to students; (11) require prerequisites; (12) teach test-taking skills. **Conclusions:** A group of EMS educators selected based on past educational success were able to generate a list of strategies that may help other EMT-Basic education programs achieve similar success. This list represents ideas that other educators may use to increase their success. Future studies should be conducted to determine the impact these strategies have on program success.

**45. AN EDUCATIONAL PRESENTATION DOES NOT IMPROVE VISUAL ESTIMATION OF BLOOD LOSS BY PARAMEDICS** Bao Duong, Gregory Gilbert, Robert Norris, Carmie Chan, Jessica Ngo, Peter D'Souza, Emma Bakes, Dave Ghilarducci, *Stanford University, Palo Alto, California*

**Objective:** Visual estimation of quantity of blood loss by patients in the prehospital setting is difficult for emergency medical personnel. Some have advocated educating personnel in the art of estimating blood loss. The purpose of our study was to determine if an educational session combining a lecture and a demonstration would improve the precision and accuracy of blood loss estimation by paramedics. **Methods:** Four scenes were created with different known quantities of simulated blood. Paramedics were asked to estimate the amount of spilled blood at each scene both before and after a 20-minute slide presentation and visual demonstration by a second year emergency medicine resident. Percent errors of estimated blood volume were calculated and compared pre- and postintervention. **Results:** A total of 19 paramedics participated in the study, most were males with a median age of 35 years and with 10 years of experience. Total median percent error changed from 63% to 31% with teaching ( $p \leq 0.01$ ). Only 3 of 76 estimates were within 20% of the actual volume before teaching, and 26 out of 76 estimates afterward ( $p = 1.0$ ). **Conclusions:** Paramedics are inaccurate at estimating blood loss in the field. Although accuracy tended to improve with teaching, the precision of post intervention estimates was still poor. A brief educational session does not significantly improve the ability of paramedics to visually judge volumes of blood loss and should not be added to the paramedic curriculum.

**46. EVALUATION OF AN INNOVATIVE EDUCATION PROGRAM FOR EMS PROVIDERS** Michael K. Kim, Judith Rehm, Deborah Simpson, Kenneth Sternig, Del Szewczuga, Ronald Pirrallo, Halim Hennes, *Medical College of Wisconsin, Wauwatosa, Wisconsin*

**Purpose:** To describe EMS provider evaluation of an innovative, interactive educational module using short scripted video clips to trigger small group discussion.

**Methods:** A one-hour face-to-face educational module on prehospital pain assessment and management in children was presented to providers in our county EMS system, consisting of 234 paramedics from 8 departments serving nearly 1 million people. Needs assessment data revealed that providers had strong knowledge of the topic but "hands-on" application of knowledge was needed. In response, six short videoclips (30–40 seconds) were produced by depicting important EMS prehospital pain assessment and management skills. Instruction was provided by using a small group format with one facilitator per 10 EMS providers. Each facilitator showed a videoclip and then followed a structured teaching protocol for discussion. This process was repeated until all six clips were discussed. Immediately following the session, a 22-question anonymous evaluation form was completed by EMS attendees. The questions focused in the effectiveness of the module in knowledge attainment, intention to change practice, and it also asked the effectiveness of videoclips and facilitators using a six-point Likert scale. **Results:** A total of 237 evaluation forms were completed. Overall, the small group session was effective (92.1%). Results reveal that 77.8% of providers will increase use of faces pain scale; 87.2% will increase use of pain medications and 91.9% indicated that the instruction will have "a positive impact on my practice." Overall the interactive use of videoclips was rated highly, with 89.3% reporting that it was an effective method of instruction, 89.9% reporting that the format allowed for a productive group discussion, and 86.3% that it connected discussions to "real life" (86.3%). Overall, 93.9% rates facilitators as effective, and 93.4% rated facilitators as receptive to questions and providing sufficient answers to my questions. **Conclusion:** Our innovative educational model of facilitated small group discussion and videoclips design to portray "reallife" situations were deemed effective by over 92% of EMS providers. The impact of EMS performance associated with this innovative, yet resource-intensive educational method should be studied further (Supported by a grant from HRSA/EMSC #H34-MC02548-01).

**47. UTILIZATION OF DISTRIBUTIVE EDUCATION TO FULFILL NATIONAL REGISTRY REREGISTRATION REQUIREMENTS** **Jon R. Studnek, Antonio R. Fernandez,** *National Registry of EMTs, Columbus, Ohio*

**Introduction:** To maintain national registration, EMS providers are required to obtain a total of 72 hours of continuing medical education in a 2-year period. This training is broken up into two sections. Section one; refresher training, requires 24 hours for EMT-Basics and 48 hours for Paramedics. Section two, EMS-related continuing education (CE), requires 48 hours for EMT-Basics and 24 hours for Paramedics. The NREMT will

accept up to 50% of section two CE as distributive education (DE). This project was conducted to determine what proportion of nationally registered EMTs and Paramedics report using DE to fulfill their section two re-registration requirements. **Methods:** The NREMT accepts between 45,000 and 55,000 applications for reregistration annually. A sample of approximately 1%–2% of all nonmilitary EMT-Basics and Paramedics reregistering in 2004 and 2006 were reviewed. Any application received between the months of December and May 2004 and 2006 was eligible for review. Processed forms were pulled at random to facilitate data collection. Data gathered included registration level, state of residence, use of DE, hours of DE reported, and total hours of CE reported. The following key words were used to determine utilization of DE: online, computer, Internet, web, distributive, video, CBT or DE. **Results:** Data were collected from 348 applications from 2004 and 649 from 2006. DE was used by 19.3% (67/348) of applicants in 2004 and 20.5% (133/649) in 2006. In both years EMT-Basics were significantly more likely than Paramedics to report using DE (26.4% vs. 12.1%,  $p \leq 0.001$  and 23.4% vs. 16.8%,  $p \leq 0.038$ , respectively). Although DE can account for 50% of yearly section two CE, among those who used DE in 2004 and 2006, on average only 20.4% and 27.4% of CE were accounted for through DE. **Conclusions:** In this review of NREMT reregistration applications from 2004 and 2006, approximately 20% of EMT-Basics and Paramedics reported using any DE to fulfill their section two requirements. Of specific interest, of DE has not changed over use that 2-year time period. Of those who did use DE, on average, it was not used to its maximum allowable amounts.

**48. COMPETENCY ASSESSMENT OF EMS PRACTITIONERS IN CANADA: A CONSTRUCTIVIST PERSPECTIVE** **Steve Donaldson,** *City of Calgary Emergency Medical Services, Calgary, Alberta, Canada*

**Introduction:** Considerable diversity and inconsistency exists among agencies conducting assessments aimed at determining the competency of emergency medical services (EMS) practitioners in Canada. **PURPOSE:** The purpose of this study was to explore the competency measurement processes in use for EMS practitioners, particularly in Canada, and to determine the level of consistency and identification of best practice models support by evidence. **Methods:** A constructivist/interpretivist paradigm formed the framework for this qualitative investigation. Fifteen telephone surveys were conducted pertaining to performance measurement of EMS practitioners in Canada, the United States, Australia, and the United Kingdom. Data from the surveys were coded and categorized into themes that were used to develop in-depth interview questions. Ten in-depth interviews were conducted of

educational and administrative experts from EMS and allied health professions in Canada. A grounded theory approach was used to analyze and interpret the data. **Results:** Five common themes relating to competency assessment within EMS emerged from analysis of the in-depth interviews: (1) language and definitions, (2) governance and scope of practice, (3) education and training, (4) measurement processes, (5) constructivism and the qualitative domain. Two primary domains were defined from the themes. The first is a quantitative domain whereby professional and political forces exist in an objective, quantitative sphere that defines standards of practice, controls resources, and attempts to quantify practitioner competency. The second domain is qualitative whereby an individual's personal level of competence is conceived. Within this domain exists the perception of reality and the level of response to that reality. **Conclusions:** The assessment of competence is a complex process based on EMS service heterogeneity and the variability and unpredictability of practice in the context of the prehospital environment. Acknowledgment and incorporation of the qualitative domain in the design of a competency assessment process is important in achieving a more comprehensive, holistic, and valid process for EMS practitioners. The best method is one using multiple tools and most suitable to the needs of the specific service within the context of the governance model for that service.

**49. LACK OF ASSOCIATION BETWEEN PREHOSPITAL RESPONSE TIMES AND PATIENT OUTCOMES.** **Thomas H. Blackwell, Jeff Kline, Jeff Willis, Monroe Hicks, Mecklenburg EMS Agency, Charlotte, NC, Charlotte, North Carolina**

**Purpose:** Limited data exist that examines the relationship between prehospital response times (RT) and improved patient outcomes. We test the hypothesis that patient outcomes do not differ substantially based on an explicitly chosen advanced life support (ALS) RT upper limit of 10:59 minutes. **Methods:** This case-controlled retrospective study was conducted in a metropolitan county with a population of 750,000 for the calendar year 2004. The EMS system is a single-tier, ALS paramedic service that includes basic life support first responders. The 90% fractile RT specification required by contractual agreement is 10:59 minutes or less for emergency, life-threatening (priority 1) calls. Cases, defined as priority 1 transports with RTs exceeding 10:59 minutes were compared with controls, which comprised a random sample of priority 1 calls with RTs less than 10:59 minutes. Prehospital run reports and hospital outcomes were evaluated by using explicit criteria by one observer for primary outcome of in-hospital death and secondary outcomes of critical interventions performed in the field. We tested the hypothesis of

equivalence using the 95% CI for difference in proportions with  $\alpha = 0.05$  and  $\beta = 0.2$  to show  $\Delta = \pm 5\%$ . **Results:** Of the 3270 emergency transports in 2004, we identified 373 cases (RT > 10:59 minutes) and a random sample of 373 controls (RT 10:59 minutes). Survival to hospital discharge was 80% (76%–84%) for cases versus 82% (77%–85%) for controls, yielding a 95% CI for the difference = -6 to +4%. ALS procedures were performed in 47.7% (95% CI: 43%–53%) in cases versus 45.4% (40%–51%) in controls (95% difference in proportions -10 to +5%). The most frequent procedures performed were administration of nitroglycerine and endotracheal intubation. **Conclusions:** Compared with patients who wait less than 10:59 minutes for ALS response, priority 1 patients who wait longer than 10:59 minutes could experience between a 6% increase to a 5% decrease in mortality and do not have an increase in critical procedures performed in the field. Our data are most consistent with the inference that neither the mortality nor frequency of critical procedural interventions performed in the field vary substantially based on this prespecified ALS RT.

**50. IMPACT OF MANDATORY NON-TRANSPORT REPORTING ON PARAMEDIC NON-TRANSPORTATION RATES IN A LARGE URBAN EMS SYSTEM: A PATIENT SAFETY INITIATIVE** **Andrew R. Anton, Ian Blanchard, Tyler Williamson, Dwayne Clayden, Heather Klein-Swornink, City of Calgary EMS, Calgary, Alberta, Canada**

**Background:** Non-transport of patients by EMS providers is a relatively common occurrence. A sizeable number of these non-transports are not sanctioned by medical control and have the potential to compromise patient safety. Adverse events in this patient subset in a large urban EMS system prompted clinical investigation into the nature of non-transport. Continuing education based on these investigations failed to reduce clinical concerns in non-transported patients. As a result, non-transport reporting, in addition to routine patient documentation, was developed and made mandatory in all events where a patient was assessed but not transported to hospital. Mandatory non-transport reporting consists of documentation that explicitly identifies patients in high-risk clinical scenarios, provides a scripted set of verbal and written instructions for patients, and requires a medical release signature upon completion. **Purpose:** To determine if mandatory non-transport reporting decreases the overall rate of non-transport in a large urban EMS system, especially in high-risk clinical scenarios. **Methods:** We conducted a single group, retrospective, postimplementation analysis using a historical comparison group in a large urban center with a single-tiered advanced life support (ALS) ambulance service. Mandatory non-transport reporting

was implemented on January 15, 2006. All 9-1-1 calls requiring ambulance response between January 15, 2006, and June 30, 2006, that met study inclusion criteria were compared with the same time period in 2005. The rate of non-transport (defined as the ratio of non-transport to total unit responses) was modeled by using multivariable binomial regression, controlling for potential covariates. **Results:** A total of 54,919 patients met study criteria (28,205 and 26,714 for 2006 and 2005, respectively). The rate of non-transport was significantly lower in 2006 than to 2005 (16.3% vs. 18.3%,  $p < 0.001$ ). This effect was also observed with patients in high-risk clinical scenarios (12.1% vs. 13.7%,  $p = 0.001$ ). **Conclusions:** The implementation of mandatory non-transport reporting decreases the overall rate of non-transport and the rate of non-transport in high-risk clinical scenarios. These data are important for EMS systems attempting to ensure patient safety through the reduction of non-transport.

**51. ONE VERSUS TWO PARAMEDICS: DOES AMBULANCE CREW CONFIGURATION AFFECT SCENE TIME OR PERFORMANCE OF CERTAIN CLINICAL SKILLS?**  
**Eric Hawkins, Jonathan Brent Myers, UNC Chapel Hill, Durham, North Carolina**

**Background:** There is little evidence regarding the relative clinical benefit of single versus dual paramedic response. **Objective:** This hypothesis-generating study compared scene times and performance of specific clinical skills for two-paramedic and one-paramedic crews for a variety of high-acuity response scenarios. **Methods:** We conducted a retrospective cohort study examining electronic records from a large urban/suburban EMS system from 6/1/2003 to 6/1/2006. We selected patients treated for cardiac arrest and those transported emergently to hospital with traumatic injuries, cardiac emergencies, and respiratory distress. For each scenario, we defined our cohort as patients who received response from ambulances with a two paramedic crew (TPC) versus those with a single paramedic crew (SPC). We abstracted information on patient demographics, scene times, IV placement, and endotracheal intubation. For analysis, we compared continuous variables with t-tests for all means and categorical data using  $\chi^2$  or Fisher's exact test. **Results:** A total of 5,770 patients met inclusion criteria. For all patients, no significant difference between TPC versus SPC groups was noted in scene time (17.8 versus 17.6 minutes,  $p = 0.35$ ). When stratified by clinical scenario, TPC groups had a non-significant shorter scene time for trauma and cardiac arrest patients, and SPC groups had a shorter scene time for respiratory distress. No difference was seen between groups for cardiac emergencies. For all intubations, TPC groups had a higher rate of success for both eventual success (0.89 versus

0.86,  $p = 0.23$ ) and first attempt success (0.63 versus 0.59,  $p = 0.12$ ) compared to SPC groups. For IV placement, TPC groups had a higher rate of eventual success (0.89 versus 0.87,  $p = 0.04$ ), but not for success on the first attempt (0.71 versus 0.69,  $p = 0.24$ ). When stratified by clinical scenario, TPC and SPC groups did not differ significantly on performance of either intubation or IV placement. **Conclusions:** TPC ambulances had similar scene times and slightly improved rates of intubation and IV placement success compared with SPC ambulances. These differences were small and of uncertain clinical significance. Additional research is needed to determine if clinical outcomes are impacted by the response of a TPC versus a SPC ambulance crew.

**52. ASSESSING THE IMPACT OF MULTI-AGENCY CONSOLIDATION ON CALL COVERAGE USING A PREVIOUSLY CONSTRUCTED M/G INFINITY QUEUING MODEL**  
**James I. Syrett, Harry Groenevelt, Steven D. Lefebvre.**  
*University of Rochester, Rochester, New York*

**Hypothesis:** Consolidating smaller geographically adjacent EMS agencies into a single agency will allow improvements in call coverage, reduction of staffing demands and a decrease in overall costs. **Methods:** Three geographically adjacent EMS agencies provided 2004 call data that included time call received, call duration, and whether that call was covered by their own agency or another. A previously constructed queuing model using a nonstationary Poisson arrival, a general service time distribution, ample number of servers and hourly changing arrival rates was used to predict the optimum staffing level for each agency to maintain 90% and 95% call coverage. Results were expressed in hours of ambulance coverage per week. Data from each agency was then consolidated and the analysis rerun. A simple cost analysis was then done assuming a cost of \$30/hour to staff an ambulance within our EMS system. **Results:** Data from 10241 EMS calls were analyzed. For each agency to maintain 90% call coverage the model predicted 220, 227, and 230 (total 677) hours of ambulance coverage would be needed per week for agencies 1, 2, and 3. To maintain 95% call coverage 297, 279, and 284 (total 860) hours would be needed. In a consolidated system, 401 hours of ambulance coverage would be needed to maintain 90% call coverage and 481 hours to maintain 95%. Consolidation of individual agencies could reduce ambulance staffing hours by 40% saving \$8,280 per week in wage expenses if it chose to maintain a 90% call coverage rate and 44% or \$11,370 per week to maintain 95% (assuming those levels had been provided preconsolidation). Alternatively, if agencies chose to consolidate services and not reduce staff, staffing that had previously led to 90% call coverage would now allow 99% coverage

and staffing that had previously led to 95% call coverage would now allow 99.5%. **Conclusions:** Consolidation of smaller EMS agencies into a single larger agency will lead to improved call coverage without changing current staffing levels. Alternatively, maintaining previously attained call coverage levels will lead to considerable cost savings by a reduction in required staffing levels.

**53. SELECTION AND CONSTRUCTION OF AN APPROPRIATE QUEUING MODEL FOR EMS CALLS TO PREDICT THE IMPACT OF STAFFING CHANGES USING ONLY COMMONLY AVAILABLE EMS DATA** **Harry Groenewelt, James I. Syrett, Steven D. Lefebvre** *University of Rochester, Rochester, New York*

**Hypothesis:** The time an EMS call is received and the time it takes an EMS agency to complete that call can be used to create an accurate queuing model that can then be used to predict the impact of ambulance staffing levels on call coverage rates. **Methods:** Each of three geographically adjacent EMS agencies provided 2004 call data that included time call received, call duration and whether the EMS call was covered by their own agency (Normal) or by another (Mutual Aid). Analysis of data using t-tests were done to determine if differences existed between normal and mutual aid calls with  $p < 0.05$  considered significant. Call arrivals to the dispatch center for each agency follow a distinct weekly pattern that was estimated by using hourly time intervals. **Results:** A total of 10,241 calls were analyzed. Call arrivals follow a nonstationary Poisson process. Analysis of data shows that the difference in average duration between mutual aid and normal calls is statistically insignificant (all p-values  $> 0.28$ ) and can be ignored. These findings suggest the M/G/infinity model is the most appropriate model to use to accurately take account of changing call volumes by time of day and day of the week. This model permits calculation of a probability distribution for the number of calls in process in any time block of the day or week. By selecting one distribution for every 15-minute interval during the week and varying staffing levels this model will allow the evaluation of various staffing policies yielding the normal (nonmutual aid) call coverage and ambulance utilization rates. **Conclusions:** Our model will allow EMS administrators to routinely assess the impact on call coverage of varying the number of ambulances they staff. Other potential uses include assessing the impact of merging EMS agencies to realize economies of scale. Prospective validation of this model is now in progress.

**54. INITIAL CHARACTERIZATION OF PREDICTORS OF EXTENDED AMBULANCE INCIDENT SCENE TIMES** **Thomas M. Jarrett, Candi Van Vleet, Ricardo Pietrobon, David E. Marcozzi,** *UNC-Chapel Hill, Park-*

*wood Fire Department, Duke University, Durham, North Carolina*

**Background:** Few studies of prehospital health care have identified reasons for extended scene times other than for incidents involving critical traumatic injuries or cardiovascular emergencies. **OBJECTIVES:** This study attempted to assess reasons for extended scene times (defined as greater than 15 minutes) in all types of incidents where ambulance-based Emergency Medical Services (EMS) responded and transported to a hospital facility. **Methods:** One hundred fifty EMS care reports were reviewed prospectively by two trained raters for a variety of demographic variables such as incident type and variables expected to be predictive of extended scene times. We used multiple regression models calculated with 95% confidence intervals to measure the association between scene time and all predictors, adjusted for confounding factors. **Results:** The type of incident was not predictive of a scene time of greater than 15 minutes (95% CI: 2.2–35.0 minutes,  $p = 0.18$ ). However, certain variables if present on any type of incident were found to be predictors of extended scene time. These significant extended scene time predictors (95% CI: 18.4–44.3 minutes,  $p \leq 0.001$ ) included patient induced scene security risks, an obese patient, non-critical advanced life support skills being initiated prior to transport, full patient spinal immobilization needed, patient perceived to be low acuity, inaccurate perception of elapsed scene time, patient initial refusal of transport, prolonged patient assessment, and significant distance between ambulance staging and patient contact. **Conclusions:** Statistically significant predictors of extended scene time by EMS personnel are identified. Addressing the causes that are modifiable will assist in expediting patient delivery to the hospital.

**55. EMERGENCY MEDICAL SERVICES USE BY OLDER ADULTS: AN ANALYSIS OF THE NATIONAL HOSPITAL AMBULATORY MEDICAL CARE SURVEY** **Manish N. Shah, Rollin J. Fairbanks, Jeffrey J. Bazarian, E. Brooke Lerner, Bruce Friedman,** *University of Rochester, Rochester, New York*

Older adults (age  $\geq 65$ ) are the fastest growing segment of the population. No national studies have characterized older adult EMS patients and identified factors associated with their EMS use. This limits EMS leaders' ability to make operational and policy decisions. **Objectives:** To characterize older adults cared for by EMS nationally and to identify factors associated with their EMS use. **Methods:** A secondary analysis of the 1997–2000 National Hospital Ambulatory Medical Care Survey was performed. Descriptive statistics were used to characterize older adults using EMS services. Logistic

regression analyses were conducted to identify factors associated with EMS use. **Results:** A total of 62.2 million older adults received ED care during 1997–2000; 38% arrived via EMS, compared with 12% of younger patients ( $p < 0.001$ ); 38% of EMS patients were age 65 and older. Older adults used EMS at a rate of 167 uses per 1,000 population per year, exceeding the rate of 39 per 1,000 for younger patients ( $p < 0.001$ ). Logistic regression found the following characteristics to be significantly associated with EMS use: demographic factors such as age greater than 85 (OR 3.7, 99% CI: 3.1–4.4), urban residence (OR 1.3, 99% CI: 1.1–1.7), and residence in the Northeast (OR 1.5, 99% CI: 1.2–2.0) or South (OR 1.3, 99% CI: 1.1–1.6). Significant clinical factors included need for care in 15–60 minutes compared to less than 15 minutes (OR 0.6, 99% CI: 0.5–0.7) and having mental health (OR 2.1, 99% CI: 1.1–3.8), circulatory system (OR 1.9, 99% CI: 1.3–2.7), or respiratory system illnesses (OR 1.8, 99% CI: 1.2–2.5). Significant system factors included lack of health insurance (OR 1.5, 99% CI: 1.1–2.0) and arrival in the ED at night (OR 1.4, 99% CI: 1.2–1.6). Significant service characteristics included need for screening tests (OR 1.4, 99% CI: 1.0–2.0) and procedures (OR 1.7, 99% CI: 1.5–1.9). **Conclusion:** Older adults comprise a large proportion of the EMS patient population and use EMS at a disproportionately high rate. This suggests that as the population ages, EMS leaders must prepare for the increased volume of older adults through training, operational, and equipment changes. Managing demand for EMS services may be possible by modifying system resources based on factors associated with EMS use.

**56. EFFECT OF DEVICE FEATURES ON ABILITY OF UNTRAINED LAYPERSONS TO USE AEDS** **Vince N. Mosesso, Alan Shapiro, Karen Stein, Kelley Burkett, Henry Wang, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania**

**Purpose:** A variety of automated external defibrillators (AEDs) are available for use by laypersons. The device features that facilitate correct operation by these individuals are not known. We sought to identify the models and ergonomic features that facilitate successful and efficient AED use by untrained laypersons. **Methods:** This was a randomized trial of volunteer laypersons without AED or advanced medical training. Subjects were assigned to use one of six different models of AEDs on a mannequin in simulated cardiac arrest. No instructions were provided. Primary end points were successful shock delivery and elapsed time from start to shock. Secondary end points included time to power-on and time from shock to CPR. We identified key ergonomic features such as power-on mechanism and extent of instruction for CPR. We compared performance differences between models and ergonomic features us-

ing survival analysis. Subjects rated ease of use on a five-point Likert scale (1 = very easy, 5 = very difficult). **Results:** 109/120 (91%; per model range 80%–100%) subjects were able to deliver shock within 3 minutes. Overall median time from start to shock was 103 seconds but varied by device model (per model medians 89–147,  $p = 0.000$ ). Only 75/109 (69%) subjects began CPR after shock when indicated; overall median time from shock to CPR was 47 seconds (per model medians 42–59). With devices that provided step by step CPR instruction, 49/58 (84%) began CPR compared to 26/51 (51%) with devices that only prompted to start CPR ( $p=0.01$ ). Feature analysis found that time to power-on was shorter in devices with open lid (median 12 seconds) and pull handle (14 seconds) mechanism than with button to push (44 seconds,  $p = 0.000$ ). Subjects rated all the models easy to use (overall mean 1.48; per model means 1.28–1.71). **Conclusions:** Untrained laypersons were highly successful in delivering shock within 3 minutes, but significant differences in time to shock exist between models of AEDs. Specific ergonomic features that may affect efficient AED operation and initiation of CPR were identified.

**57. COMMUNITY CONSULTATION AND PUBLIC DISCLOSURE: THE RESQ TRIAL EXPERIENCE** **Joshua G. Salzman, Tom P. Aufderheide, Robert Swor, Marvin Wayne, Brian Mahoney, Kim Stahl, Patrick Medado, Janice Lapsansky, George Vasquez, Ralph J. Frascione, Regions Hospital EMS, St. Paul, Minnesota**

**Introduction:** The ResQ Trial, a multicenter, NIH-funded clinical study of two investigational devices designed to improve hemodynamics during cardiopulmonary resuscitation, is being conducted under the regulations for exception from informed consent (21CFR50.24) in five communities in the United States. This abstract describes the community consultation and public disclosure activities conducted to meet federal requirements. **Methods:** A structured review of the community consultation and public disclosure activities was performed. Descriptive data regarding study site characteristics, the number of open public meetings held (used by all sites to complete the community consultation process), and the number of attendees at these meetings were documented. The methods by which sites completed the public notification process, the number of institutional review boards (IRBs) reviewing the study, mean number of revisions to the study protocol prior to final approval, and descriptive statistics regarding length of IRB review were analyzed. **Results:** The total population among the five study sites is approximately 1.2 million covering 2346 square miles. A total of 289 people attended the 10 community consultation meetings (mean = 29). No objections to enrolling patients using exception from informed consent

were raised. Public disclosure was accomplished by using television interviews (11), radio interviews (6), paid public notices (22), feature newspaper and TV stories (9), direct mailings to community organizations (495), website announcements (5), presentations to local officials (7), and a variety of internal publications. A total of 18 IRBs reviewed this study, all of which provided final approval. The median interval from submission to approval was 106.5 days (interquartile range = 65–127), with a mean number of 1.2 revisions required per IRB (range = 0–7). **Conclusion:** Community consultation and public disclosure were completed successfully at all sites, despite wide variability among IRB standards. Defining community, identifying the true purpose of these requirements, and the lack of specific methodology for determining successful completion of the requirements are issues that need to be addressed. Because of wide variability among IRB standards, researchers should proactively develop plans with all reviewing IRBs to optimize the likelihood of meeting IRB expectations and meeting community standards

**58. TWENTY-FIVE YEARS OF VIOLENCE: THE EPIDEMIOLOGY OF TERRORISM IN SOUTH AMERICA** Amado Alejandro Baez, Matthew D. Sztajnkrycer, Raul Ruiz, Brigham and Women's Hospital/Harvard Medical School, Boston, Massachusetts

**Background:** Terrorism, defined as violence, or the threat thereof, calculated to create an atmosphere of fear and alarm and designed to coerce the actions of others, is a global public health burden. The factors motivating a terrorist incident are numerous and include social, religious, political, and economic concerns. South Americans have been victims of terrorism for many decades. Although the causes vary, the results are the same: death, disability and suffering. To the best of our knowledge, no previous epidemiological study has focused on terrorism in South America (SA). Our objective was to perform a comprehensive epidemiological descriptive study of South American terrorist incidents. **Methods:** A cross-sectional descriptive study was undertaken. Data from January 1971 to July 2006 were selected by using the RAND Terrorism Chronology 1968–1997 and RAND®-MIPT Terrorism Incident database (1998–present). For categorical variables,  $\chi^2$  testing and Fisher's exact testing were used to assess associations. Odds ratio (OR) was used as the measure of strength of association. For all tests statistical significance was set at the 0.05 level. **Results:** A total of 2883 incidents were reported during the study period, resulting in 3509 injuries (1.2 per incident) and 1973 fatalities (0.68 per incident). The overall case fatality ratio (CFR) was 36.0%. Country-specific analysis shows that Colombia had the majority of incidents (60.1%), followed by Peru (12.5%) and Chile (7.8%). Colombia had the highest CFR

(38.6%), whereas Chile had the lowest (4.8%). Incidents in Colombia accounted for the majority of total deaths (72.9%) and injuries (65.2%); comparing the Colombian death rate to all other SA countries, statistically significant differences were found [ $p < 0.001$ ] odds ratio of 1.44 [1.27 to 1.63]. The predominant method of choice for terrorist incidents was conventional explosive attacks with 2,543 of 2,883 incidents (88.2%). **Conclusions:** Terrorist incidents in South America have accounted for nearly 2,000 deaths. Conventional explosive devices are the method of choice of terrorists. Understanding the nature of terrorist attacks and the medical consequences of terrorism can assist emergency preparedness and disaster management officials in allocating resources and preparing for potential future events.

**59. CROSS-SECTIONAL INVESTIGATION OF INFLUENZA VACCINATION AMONG PREHOSPITAL AND EMERGENCY DEPARTMENT HEALTH CARE PROVIDERS** Erik A. Rueckmann, Manish Shah, Sharon Humiston, University of Rochester, Rochester, New York

**Background:** Influenza vaccination has been proven to be a prudent preventative health care measure to limit morbidity and mortality on an individual and community scale. National studies have shown low vaccination rates among health care providers (approximately 40%). However, to our knowledge, data on prehospital providers' influenza vaccination status has not been published. **Objective:** To compare the proportion of EMS providers receiving influenza vaccination to emergency department (ED) providers. We hypothesize that EMS providers will have a lower vaccination rate due to various barriers not present in the ED setting even though both groups take care of the same patient population. **Methods:** We conducted a cross-sectional survey investigation of all full-time EMS providers in an urban agency located in Rochester, NY, and a convenience sample of ED providers in an academic medical center located in the same city. Surveys were completed during July and August 2006. The survey gathered data on influenza vaccination status for the 2005–2006 season and opinions regarding the vaccination. A comparison of influenza vaccination status between EMS and ED provider was tested by using a  $\chi^2$  calculation. **Results:** Surveys were completed by 128 EMS providers (100%) and 128 ED providers (100% of those approached). Twenty-seven (21%; 95% CI: 14%–29%) of EMS providers and 83 (65%; 95% CI: 56%–73%) of ED providers stated they received an influenza vaccination ( $p < 0.001$ ) EMS providers gave the following top three barriers preventing vaccination: inability to obtain vaccination at work (70%; 95% CI: 62%–78%), cost to provider (58%; 95% CI: 62%–78%), and "taking a vaccine from someone who may need it more" (28%; 95% CI: 20%–36%). **Conclusion:** EMS providers

in urban Rochester, NY infrequently received the influenza vaccine in 2005, particularly compared with published national standards and other emergency personnel. This failure to vaccinate poses potential risk to providers and patients and has major implications in the event of a pandemic influenza event. Moreover, further investigation of reported barriers could lead to interventions to increase vaccination rates.

**60. A REMOTE TRIAGE CENTER FOR HURRICANE KATRINA VICTIMS: THE ARIZONA OPERATION GOOD NEIGHBOR EXPERIENCE** Sara R. Shimmin, Roland Petri, Bentley J. Bobrow, Steven Shem. Rode, *Mayo Clinic Hospital, AZ; Arizona Department of Health Services, Bureau of EMS, Arizona*

**Background:** Because of its magnitude, Hurricane Katrina heralded a call to action by states far removed from the primary disaster areas of the Gulf Coast. The state of Arizona responded to the surge of health care needs accompanying this disaster by equipping and staffing a mass shelter with an on-site medical/behavioral health triage and acute treatment clinic. This undertaking termed Operation Good Neighbor (OGN) was a new kind of response—one that had not previously been practiced in Arizona or clearly defined in the literature. **Objective:** Describe and evaluate the experience of OGN during the multistate disaster and relief effort for Hurricane Katrina. Issues regarding emergency preparedness, operating procedures, patient care, medical record keeping, patient tracking, communication, and key lessons learned are described with the intention of providing a template for others tasked with providing medical care for victims of a remote disaster. **Methods:** Case Study of the Arizona Department of Health Services (ADHS), Bureau of EMS (BEMS) patient database, policies, and procedures, and the OGN "After Action Report. Individual interviews were also conducted by telephone and in person. All potential patient information was de-identified. **Results:** A total of 1,396 patient encounters were documented for 819 evacuees. Nine percent of the evacuees treated were 16 years of age or younger. Of the 819 evacuees, 427 (52%) were male. Chronic medical conditions were commonly present in those seeking treatment; hypertension (207), diabetes mellitus (84), congestive heart failure (17), and HIV (9). The most common diagnosis made was hypertension (136), psychiatric disorder (116), orthopedic injury (114), respiratory infection (79), and diabetic complication (45). Medications were frequently prescribed for the following conditions; cardiovascular (362), antibiotics (321), and analgesics (301). Vaccinations were deemed to be up to date in 89% of evacuees and offered to those in need. **Conclusions:** We report the first activation of a remote triage medical clinic during a multistate evacuation. OGN illuminated numerous lessons

on how to overcome the significant challenges encountered in carrying out a large-scale remote disaster medical operation.

**61. ARE TERMINATION-OF-RESUSCITATION PROTOCOLS BEING USED AS INTENDED?** Elizabeth O'Brien, David Hendricks, David C. Cone, *Yale University School of Medicine, New Haven, Connecticut*

**Introduction:** Earlier work has demonstrated the safety of termination-of-resuscitation (TOR) protocols for traumatic (TOOHCA) and nontraumatic (NTOOHCA) out-of-hospital cardiac arrest, based on NAEMSP position papers. This study examined the actual implementation of these protocols in one midsize urban/suburban EMS system. The objective was to determine how often patients are transported to the ED despite meeting TOR criteria. **Methods:** All adult OOHCA patients transported to two EDs during a 3.5-year interval were retrospectively identified through dispatch and hospital records. Study inclusion criteria were patients older than 18 years sustaining NTOOHCA or TOOHCA. Exclusion criteria were arrest witnessed by EMS; arrest secondary to hypothermia or drowning; and unavailability of key data points. EMS and ED records were evaluated to assess for the presence of TOR protocol criteria, to determine whether the patients should have been transported or pronounced dead on scene. Records were also examined for documentation of mitigating circumstances that might have prompted transport despite meeting TOR criteria. The Utstein template was used, and IRB approval was obtained. **Results:** A total of 865 OOHCA patients were identified; 235 met study criteria. Of the 43 TOOHCA patients, 27 (63%) met TOR criteria, yet were transported. The other 16 patients had presenting rhythms other than asystole, warranting transport. No TOOHCA patient survived to admission. Of the 192 NTOOHCA patients, 104 (54%) met TOR criteria, yet were transported. Of the remaining 87, there were 23 patients with ROSC in the field, 22 with unsuccessful IV placement, 34 with unsuccessful definitive airway management, and 23 who were in a rhythm other than PEA or asystole at the time of transport, warranting transport. Twenty-two NTOOHCA patients survived to admission, and 17 survived to discharge; none of the discharged survivors met TOR criteria. In no case was a mitigating circumstance documented to justify transporting a patient meeting TOR criteria. **Conclusions:** This study confirms the safety of the TOR protocols, with no patient surviving to discharge after meeting TOR criteria. However, the protocols are not being implemented as intended in this EMS system, resulting in emergency transport to the ED for a substantial number of patients for whom continued resuscitative efforts are futile.

**62. EMERGENCY DEPARTMENT DIVERSION AND ITS EFFECT ON PREHOSPITAL TIME INTERVALS** **Jeremy T. Cushman, Richard Bissell**, *Department of Emergency Medicine, University of Rochester, Rochester, New York*

**Introduction:** Emergency department crowding has led to the frequent practice of ambulance diversion—whether diversion increases the response time of the agency due to greater numbers of ambulances being placed out of service when transporting to more distant facilities. This study analyzed the relationship of one or more hospitals on diversion and their effect on prehospital time intervals in a suburban/rural, county fire department-based EMS system that uses a fixed deployment strategy. **Methods:** The activation, response, scene, transfer, recovery, and total prehospital time intervals were calculated from computer aided dispatch logs. The system uses three classifications of diversion, and the type and time on and off diversion for the four primary receiving hospitals serving the EMS system were recorded. Data were placed into a standardized database and incidents were matched to the hospital(s) on diversion at the time of the call. Comparative statistics were calculated for each interval when hospitals were on and off each type of diversion. **Results:** Data for two years and 29,773 unique incidents were available for analysis. Fifty-three percent of EMS calls occurred when one or more hospitals were on some type of diversion. Both activation and response intervals did not increase when hospitals were on diversion. Average scene, transfer, recovery, and total prehospital intervals increased when hospitals were on diversion. There was significant variation in these intervals based on the number of hospitals on diversion, with general trends toward longer intervals when more facilities were on diversion. The primary receiving hospital for the service area accounted for 86.7% of all transports. Depending on the type of diversion, the scene interval increased up to 1 minute 28 second, transfer interval increased up to 4 minute 1 second, recovery interval increased up to 6 minute 2 second, and total prehospital interval increased up to 8 minute 31 second ( $p < 0.01$  for all analyses). **Conclusions:** Diversion appears to increase the total prehospital interval and delays the time to arrive at definitive care. It does not appear, however, that in this system diversion results in ambulances consistently being delayed in their ability to respond to subsequent calls.

**63. DO AMBULANCE CREWS HAVE A CONSISTENT RECOVERY INTERVAL WHEN A HOSPITAL IS ON DIVERSION?** **Jeremy T. Cushman, Richard Bissell**, *Department of Emergency Medicine, University of Rochester, Rochester, New York*

**Introduction:** Emergency department (ED) crowding increases the time an ambulance is held in the ED wait-

ing to transfer a patient. Local trends suggest some variability in this recovery interval regardless of the hospital's diversion status. This study examined the number of ambulances arriving at an ED and the recovery interval relative to the hospital being pre-, on-, and post-diversion. **Methods:** Time of ED arrival and departure for each ambulance transport to a single facility was recorded and the recovery interval calculated. Three classifications of diversion were used in this system, and the type and time on and off diversion was recorded. Data were placed into a standardized database, and each ambulance arrival was coded to the type of diversion and whether the hospital was on diversion, or 1, 2, or 3 hours prior to, or after diversion. Transport frequency and recovery intervals were calculated for each type of diversion and comparative statistics used. **Results:** Data from 19,651 consecutive transports over 2 years were available for analysis. When diverting stable patients (the most frequent type used in this system), ambulance frequency decreased 28.6%, and recovery intervals increased 2 hours prior to the hospital going on diversion. When diverting patients requiring ECG monitoring (but not unstable patients), ambulance frequency decreased 38.9%, but no pattern of increasing recovery interval was observed. When the EMS agency was rerouting ambulances because another ambulance was waiting >20 minutes to transfer a patient, ambulance frequency decreased 58.8%, and recovery intervals increased 3 hours prior to the hospital being placed on diversion. In all cases, the recovery interval returned to normal after the ED went off diversion. **Conclusions:** In this system, diversion decreased the frequency of ambulance arrivals at a single facility by as much as 58%. EMS recovery intervals, however, were affected hours before the hospital is placed on certain types of diversion. One type of diversion used in this system did not result in a significant increase in recovery times, suggesting that the ED is still capable of accepting patients quickly. This may be a result of an inconsistent and unnecessary use of diversion.

**64. THE HEAT IS ON: URBAN EMS OPERATIONS IN THE MIDST OF A HEAT WAVE** **John P. Freese, James D. Braun, Doug A. Isaacs, David Ben-Eli, David J. Prezant**, *New York City Fire Department, Brooklyn, New York*

**Introduction:** The heat wave in the summer of 2006 led to near record demands on healthcare systems across the country. Because August 2 and 3 produced the 6th and 7th busiest days in the history of this system, we sought to describe the changes in system demand and operations during this period in this large, urban EMS system. **Methods:** We performed a retrospective review of computer-aided dispatch (CAD) data, electronic prehospital medical records, and historical weather data for the period of August 1–4, 2006. Data

from this period were compared with historical control data established through an identical analysis of 155 days during July and August of 2004–2006. Data were analyzed by using SPSS 11.0 and extracted to Microsoft Excel 2003. **Results:** Compared with daily average of 3,177 (SD = 180.3) assignments during the control period, EMS volume increased by 509 to 942 assignments during the 4 days of the heat wave. ( $p < 0.001$ ). Although history shows an increase heat-related illnesses on any day for which the ambient temperature exceeds 89°F, these four days showed even more increase. There were no significant increases in the number of traumatic emergencies during this time; however, the increase was due to a significant ( $p < 0.05$ ) rise in 11 categories of medical emergencies among both adult and pediatric patients, including cardiac arrests. Daily system response times to cardiac, respiratory, and other potentially life-threatening events witnessed a statistically insignificant ( $p = 0.235$ ) mean increase of 30.8 seconds (5.8 minutes versus 5.3 minutes); however, the 15.2 seconds attributed to dispatch processing (63.4 versus 48.2 seconds) was statistically significant ( $p < 0.001$ ). Hourly analysis of dispatch processing times showed significant increases, particularly during the hours of 1:00 pm to 5:00 pm, where hourly means exceeded 8.3 minutes ( $p < 0.001$ ). **Conclusions:** Response times to the most critical of patients were maintained despite significant increases in EMS volume. In analyzing delays for all patients, the limited surge capacity of the EMS dispatching center is a rate limiting that deserves further attention, including the possibility of streamlined algorithms and increases in manpower.

**65. COMPARISON OF VARIOUS ENDOTRACHEAL TUBE CONFIRMATION DEVICES IN THEIR ABILITY TO DETECT MISPLACED ENDOTRACHEAL TUBES IN THE PREHOSPITAL ENVIRONMENT** **Karl F. Kauffman, Douglas F. Kupas, Henry E. Wang, Geisinger Health System, Danville, Pennsylvania**

**Purpose:** Prehospital endotracheal tube (ETT) misplacement can have devastating consequences. Although ETT misplacement is usually immediately recognized, it is sometimes delayed. We sought to determine if selected tube confirmation techniques reduce the delay in recognizing ETT misplacement. **Methods:** This was a prospective, observational, multi-center study conducted with 42 emergency medical service (EMS) agencies from urban, suburban, and rural settings. EMS providers completed standardized data forms describing patient demographics, clinical course, and preliminary outcomes for all endotracheal intubation (ETI) attempts. Providers indicated the methods used to confirm ETT placement, including waveform end-tidal carbon dioxide (ETCO<sub>2</sub>), colorimetric

ETCO<sub>2</sub>, esophageal detector device (EDD), auscultation alone, or other unlisted device. Detection of ETT misplacement was defined as immediate recognition (detected immediately after tube placement) or delayed recognition (unrecognized or detected after tube secured). We evaluated the association between the use of each tube confirmation technique and the recognition of ETT misplacement using Fisher's exact test. **Results:** In this study, 324 patients (14%) had at least one misplaced ETI attempt, including 549 attempts that were immediately recognized and 15 with delayed recognition. The number of immediate recognitions for each ETT confirmation technique was 13/13 for waveform ETCO<sub>2</sub>, 60/64 for colorimetric ETCO<sub>2</sub>, 47/49 for EDD, 14/14 for combined colorimetric ETCO<sub>2</sub> and EDD, and 386/395 for auscultation only or other. The number of delayed recognitions for each ETT confirmation technique was 0/13 for waveform ETCO<sub>2</sub>, 4/64 for colorimetric ETCO<sub>2</sub>, 2/49 for EDD, 0/14 for combined colorimetric ETCO<sub>2</sub> and EDD, and 9/395 for auscultation only or other. There were no differences among detection methods ( $p = 0.47$ ). No delayed recognitions occurred with the use of waveform ETCO<sub>2</sub> or the combination of EDD and colorimetric ETCO<sub>2</sub>. **Conclusions:** Although not statistically significant, there were no cases of delayed recognition of prehospital ETT misplacement when using either waveform ETCO<sub>2</sub> or combined colorimetric ETCO<sub>2</sub> and EDD.

**66. OUT-OF-HOSPITAL RAPID-SEQUENCE INTUBATION BY RESIDENT FLIGHT PHYSICIANS: HOW ARE WE DOING?** **Ricky C. Kue, Marc Restuccia, University of Massachusetts Medical Center, Worcester, Massachusetts**

**Introduction:** Out-of-hospital rapid-sequence intubation (RSI) by paramedics has been previously reported. Although data exist on in-hospital RSI by physicians and residents, few data exist on their performance in an out-of-hospital environment. **Objective:** To assess the out-of-hospital RSI success rate performed by emergency medicine residents (postgraduate year, or PGY-2/PGY-3) in a nurse/physician helicopter EMS service. **Methods:** A retrospective analysis of flight records from January 1, 2004, through December 31, 2005, for in-hospital and scene endotracheal intubation (ETI) was performed. RSI success was defined as establishing any type of airway (endotracheal, laryngeal mask or CombiTube<sup>®</sup>) after paralysis. Fisher's exact test was used for analysis and significance defined at  $p < 0.05$ . **Results:** Physicians intubated 114 patients, performing RSI in 94.7% (108/114, 66.7% males) with an overall success of 94% (101/108, 95% CI: 87%–97%). Mean age and initial GCS of patients were  $37 \pm 19$  years old and  $8.6 \pm 4.2$ , respectively. PGY-3 performed 87.7% (100/114) of intubations with 84% (79/94, 95% CI: 75%–91%)

success after RSI. PGY-2 performed 7.9% (9/114) of intubations with 89% (8/9, 95% CI: 52%–99%) success after RSI. Of all RSI performed by residents, 64% (67/104) occurred on scene, 82% (85/104) were on trauma patients and overall success was 93% (97/104, 95% CI: 87%–97%). Cricothyrotomy rate was 0.96% (1/104, 95% CI: 0.02%–5.2%), occurring in one patient during a scene RSI attempt. Two patients were managed with bag-mask ventilation, whereas another operator (ED physician or flight nurse) intubated four other patients after a resident attempt. No cases of unrecognized esophageal intubation occurred. RSI success for residents in-hospital versus scene were 95% (35/37, 95% CI: 82%–99%) and 93% (62/67, 95% CI: 83%–98%), respectively without statistical difference ( $p = 0.99$ ). There was no difference in RSI success between trauma and medical patients ( $p = 0.35$ ). **Conclusions:** RSI by physicians can be performed safely and effectively in an out-of-hospital environment. Residents were able to perform scene RSI as well as in-hospital RSI in both trauma and medical patients. Limitations of this study include the small sample size and retrospective methodology. Prospective studies should be performed to assess outcomes with out-of-hospital physician RSI.

**67. VALUE OF MULTIPLE PREHOSPITAL INTUBATION ATTEMPTS** **Shannon W. Stephens, Todd Brown, Stacey S. Cofield,** *Department of Emergency Medicine/University of Alabama @ Birmingham, Birmingham, Alabama*

**Objective:** Prehospital endotracheal intubation can be challenging to perform, due to the uncontrolled nature of the prehospital environment. Moreover, other resuscitative efforts frequently slow or stop during intubation attempts. This report describes the value of multiple attempts at endotracheal intubation in the prehospital setting. **Methods:** We analyzed the Emergency Medical Services Information System (EMSIS) database maintained by the Alabama Department of Public Health. EMSIS is a statewide EMS patient care report database containing 190 variables. Computer data entry is performed by EMS providers during each shift, and the data is uploaded to EMSIS. Quality control occurs at the local level, and is enhanced by standardized data fields and definitions, as well as predetermined treatment protocols. Alabama licenses EMTs trained to the standards of the National Registry of Emergency Medical Technicians EMT-intermediate or EMT-paramedic to perform endotracheal intubation. For this analysis, we selected a two year period, Jan 1 2004 through December 31 2005. EMTs were included only if they had attempted endotracheal intubation in 2005. EMTs who attempted intubation in 2005 but not in 2004 were included (with zero attempts in 2004) only if they had an active EMT license during 2004. We de-

scribe the success proportion overall and for each intubation attempt. We describe the incremental value of each intubation attempt. **Results:** Overall success rate was 81.5%. First attempts were most likely to succeed (67.8%). Probability of success on subsequent attempts declined (2nd = 40.8%, 3rd = 31.4%, >3rd = 30.4%). Of successfully intubated patients, 83.1% were intubated on the first attempt, 95.8% by the second attempt, and 99.3% by the third attempt. **Conclusions:** Probability of successful intubation in a given incident declines with each successive attempt during that incident. Amongst patients who were successfully intubated, little benefit was gained by >2 attempts at intubation, and virtually no benefit by >3 attempts.

**68. PARAMEDIC ATTITUDES FOLLOWING AN AIRWAY MANAGEMENT PARADIGM SHIFT** **Jennifer Janisewski, Ariane Reister, Robert Farrell, William Fales,** *Michigan State University/Kalamazoo Center for Medical Studies, Kalamazoo, Michigan*

**Introduction:** Endotracheal tube (ET) intubation has been the primary advanced airway for paramedics for cardiac arrest (CA) and other critical patients since its introduction in the 1970s. Recent studies have challenged the safety and efficacy of this intervention. The Combitube (CT) is an alternative advanced airway to the ET tube and is potentially better suited for out-of-hospital care. **Objective:** The objective of this study is to evaluate paramedic response to a paradigm shift in advanced airway management from ET to CT intubation in the out-of-hospital setting. **Methods:** The study design was a voluntary, audio-recorded, structured interview of paramedics in a single-county EMS system. The interviews took place within 5 months of a systemwide change to the CT from ET for CA patients. A brief questionnaire was developed, which included questions regarding the paramedics' airway experience, opinions and preferences for CT versus ET in various clinical scenarios, and the attitude toward the recent system change to the CT from ET for CA patients. Data were obtained during a confidential interview with a single investigator unknown to paramedics. Responses were documented and categorized for analysis. **Results:** Fifty of 52 (96%) paramedics invited, consented to participate (80 were eligible). The mean number of attempted ET and CT intubations per paramedic in the previous 12 months was 2.2 and 1.6, respectively, with self-reported estimated success rates of 89.6% and 92%, respectively. Eleven paramedics (22%) reported previous unrecognized esophageal ET intubations. Support, opposition and neutral opinion regarding the policy change to the CT for CA were 56%, 16%, and 28%, respectively. CT was preferred over ET for CA patients (52% versus 38%) and entrapped trauma patients (86% versus 5%). ET was preferred over CT for respiratory

arrest from a stab wound to the chest (52% versus 33%) and from an asthma exacerbation (86% versus 12%). **Conclusions:** In this EMS system, a paradigm shift in advanced airway management from ET to CT was accepted by most paramedics for out-of-hospital CA. Paramedics prefer the CT for some conditions and the ET for others. Expanded use of the CT in this and other EMS systems warrants further investigation.

**69. ASSESSING THE NEED FOR CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) IN AN URBAN EMS SYSTEM**  
**John P. Freese, David J. Prezant, David Ben-Eli, Doug A. Isaacs,** *New York City Fire Department, Brooklyn, New York*

**Objective:** Under local EMS protocols, advanced life support (ALS) providers may use continuous positive airway pressure (CPAP) in the management of patients presenting in acute pulmonary edema. We describe a needs-based assessment of this technology for a large, urban EMS system. **Methods:** For the 3-month period from September 15 through December 15, 2006, performed a retrospective review of electronic medical records for patients who may have qualified for CPAP use. Inclusion criteria included a history of coronary artery disease, asthma, hypertension, or COPD; a chief complaint of dyspnea, respiratory distress, or cardiac symptoms subsequently considered to be acute pulmonary edema; requirement of either bag-valve-mask (BVM) ventilation or endotracheal intubation. Exclusion criteria included an age <18, systolic blood pressure <100 mmHg, ventilator dependence, or the provision of CPR. **Results:** A total of 143 records met inclusion criteria. Analysis of these records found that CPAP would not have been appropriate due to a combative or altered mental status (85/162), noncardiogenic respiratory distress due to COPD or asthma (4/162) or pneumonia (12/162), or immediate progression to respiratory arrest on EMS arrival (18/162). The remaining 24 patients (~0.01% of the system's annual volume) were felt to be possible candidates for CPAP use by ALS providers. The mean transport time for these patients was 7.2 minutes. With 855 paramedics in the system, this means that each paramedic could be expected to encounter a patient for whom CPAP may be beneficial once every 8.9 years. With minimum initial training costs and stocking fees estimated at \$123,889.50 and \$104,400, respectively, this brings the per-patient cost to \$2,378.02. **Conclusions:** The frequency with which ALS crews within this EMS service encounter patients who may both qualify for and potentially benefit from CPAP is quite low, particularly given the short transport times in this urban EMS system. This raises concern for skill and knowledge degradation, resulting retraining requirements, and substantial costs for a technology likely to benefit very few patients within this EMS system.

**70. PREHOSPITAL USE OF CPAP: A STUDY OF INTUBATION RATES UP TO 12 HOURS AFTER HOSPITALIZATION**  
**Mark Marchetta, Richard L. Sheldon, Mark Resanovich,** *Aultman Health Foundation, Redlands, California*

**Introduction:** Previous literature has documented that prehospital use of continuous positive airway pressure (CPAP) reduces intubation rates in patients with congestive heart failure (CHF). There is little evidence that prehospital use of CPAP reduces intubation rates in dyspnea other than CHF. This study recorded intubation rates up to 12 hours after hospitalization for patients who received prehospital CPAP versus conventional oxygen therapy in CHF, asthma, chronic obstructive pulmonary disease (COPD), pneumonia and pulmonary edema. **Methods:** Paramedics from seven suburban EMS agencies were educated in the use of CPAP. CPAP was applied to dyspneic patients experiencing CHF, asthma, COPD, pneumonia and pulmonary edema who were awake and able to follow commands, were over 17 years old, had the ability to maintain an open and protected airway, and exhibited two or more of the following: (1) A respiratory rate greater than 24 breaths per minute; (2) pulse oximetry less than 94% SaO<sub>2</sub> at any time; (3) use of accessory respiratory muscles (study group n = 148). The control group (n = 161) was determined by dyspneic patients matching for the same inclusion criteria, who were transported by paramedics from 13 EMS agencies not outfitted with a CPAP device. **Results:** The study group had 13 intubations, and the control group had 56, for a period of time 12 hours after arrival in hospital. Percent of intubation reduction from the control to study group = 26.0% with 95% CI (16.7, 35.3), and p-value < 0.001. Of equal importance was a reduction of length of stay of 3 days for the study group (p-value ≤ 0.001). **Conclusions:** Patients who received CPAP for the prehospital treatment of CHF, COPD, pneumonia and pulmonary edema had a lower incidence of intubation for up to 12 hours after hospitalization.

**71. QUANTITATIVE EVALUATION OF CPAP USAGE BY EMS PROVIDERS FROM INTRODUCTION OF ADJUNCT INTO PRACTICE UNTIL PRESENT**  
**Maaya R. Marri, Diane McGinis-Hainsworth, Ross Megargel, Andria Cleary, Robert O'Connor,** *Christiana Care Health System, Wilmington, Delaware*

**Objective:** This study was conducted to test the hypothesis of whether usage of continuous positive airway pressure (CPAP) by EMS providers has declined after initial introduction of the adjunct as a result of provider disinterest after mastery of device usage. **Methods:** This retrospective study evaluated a three-county EMS system's prehospital data on the number of incidents of

CPAP usage by EMTPs. The EMS incident electronic database was searched for applications of CPAP during January 2001 until December 2005. Study population included any patient receiving CPAP by EMTPs since initial entry of CPAP into prehospital practice. The yearly call volume for ALS providers within these counties is approximately 58,000. EMS standing orders permit CPAP for an alert patient able to maintain a patent airway in moderate to severe respiratory distress or who is hypoxemic. CPAP use was broken down by year following implementation of the program in 2001. Trend analysis was performed by using  $\chi^2$ . **Results:** During the study period, 2,904 patients received CPAP. When grouped by year there were 558 cases in year 1, 708 in year 2, 759 in year 3, and 879 in year 4. The proportion of EMS cases where CPAP was used showed a linear trend of increased use during the 4 years of the study ( $p < 0.001$ ). **Conclusion:** In conclusion, there was an increase in usage of CPAP after initial introduction of device. The lack of novelty factor and linear increase in prehospital CPAP use confirms it is being used appropriately and is a useful adjunct for prehospital care of patients in severe respiratory distress. The upward trend may indicate a learning period for providers to become comfortable with device and routinely integrate it into practice.

**72. FURTHER ANALYSIS OF PUBLIC-ACCESS DEFIBRILLATION IN OUT-OF-HOSPITAL CARDIAC ARREST: PLACEMENT AND USAGE** **Duane M. Robinson, Robert Swor,** *William Beaumont Hospital-Emergency Medicine Research, Royal Oak, Michigan*

**Introduction:** The Public Access Defibrillation (PAD) Trial (NEJM 351:637-646) has demonstrated that trained laypeople are able to use automated external defibrillations (AED) to increase cardiac arrest survival. **Objectives:** To describe PAD placement and use at public locations with known cardiac arrest. **Methods:** A retrospective examination was conducted for all public location cardiac arrests in 10 suburban communities. The study period was from 9/04 to 8/06. Public location arrests, excluding physician's offices, health care facilities, and highways were reviewed for patient demographics, arrest location, PAD availability, PAD usage, and survival to discharge. PAD availability, usage, and staff training were confirmed by phone calls. Descriptive statistics are reported. **Results:** Of 328 documented cardiac arrests, 222 occurred in private residences, 15 on highways, 45 in nursing homes and medical offices, and 4 at other nonpublic locations, leaving a study population of 42 (12.8%). The subjects were 62.6% male and 37.4% female with a mean age of 63. AEDs for public use were available at 15 (35.7%) of the public location arrests, but were applied only eight times (53.3%) when available. Of the eight arrests when the PAD was applied,

six (75.0%) were applied by trained staff responders and two (25.0%) were applied by bystanders. Seven (87.5%) of the cardiac arrests with PAD application received a shock and four (50.0%) survived to discharge. The locations where a PAD was applied were four fitness clubs, three malls and one manufacturing plant. **Conclusions:** PADs were more likely to be used when staff was trained and assigned to respond to cardiac arrests. PAD usage in this group resulted in a high rate of survival to discharge. Further work needs to be done to improve PAD availability and use in public locations.

**73. EARLY AUTOPULSE DEPLOYMENT SIGNIFICANTLY IMPROVES ROSC BUT NOT SURVIVAL FOLLOWING OUT-OF-HOSPITAL CARDIAC ARREST** **Amy Gutman, Derrel Graham, Jr., Donna Carden, Robert Pringle, Jr.,** *LSU-HSC, Shreveport, Louisiana*

**Introduction/Hypothesis:** Recent American Heart Association guideline updates emphasize the need for effective chest compressions during cardiopulmonary resuscitation (CPR) to enhance survival following cardiac arrest. The AutoPulse resuscitation device (Revivant Corporation) provides effective chest compressions during CPR by disseminating force over the anterior chest with a load distributing band. The purpose of this study was to test the hypothesis that use of the AutoPulse in out-of-hospital cardiac arrest (OOHCA) improves ROSC and survival in victims of cardiac arrest. **Methods:** Retrospective, IRB-approved case-review conducted at a university, tertiary care referral center. Consecutive adults with nontraumatic OOHCA were divided into before AutoPulse (BAP) (March 2004–March 2005) and after AutoPulse (AAP) (June 2005–June 2006) groups. Data collected from EMS and hospital records were analyzed by using a Mann-Whitney nonparametric Student's  $t$ -test or  $\chi^2$  and compared gender, age, presenting rhythm, ALS response time, ROSC, 24-hour survival, and survival-to-discharge between groups. Time to device application was analyzed in survivors and non-survivors in the AAP group. **Results:** There were 224 patients in the BAP group and 166 in the AAP group. There were no differences in baseline characteristics between groups. Mean time to AutoPulse application was 7.3 minutes in patients with ROSC and 8.2 minutes in those without ROSC ( $p > 0.05$ ). BAP was 51/224 (23%) and 57/166 (34%) in the AAP group ( $p = 0.04$ ). Twenty-four hour survival and survival-to-discharge were 12 and 6% respectively in the BAP group (both  $p > 0.05$ ) and 14% and 10%, respectively, in the AAP group (both  $p > 0.05$ ). Presenting rhythm did not affect outcome in patients who survived cardiac arrest. **Conclusions:** Use of the AutoPulse resuscitation device significantly improves ROSC but not survival in out-of-hospital cardiac arrest.

**74. DIGITAL VIDEOGRAPHY OF OPEN-CHEST PORCINE VENTRICULAR FIBRILLATION CORRELATES WITH CHANGES IN THE SURFACE ECG WAVEFORM MORPHOLOGY** James J. Menegazzi, David Salcido, Jon Rittenberger, University of Pittsburgh, Pittsburgh, Pennsylvania

**Background:** There are a variety of models explaining the evolution of ventricular fibrillation (VF) over time. These include the concept of early "mother rotors" and "wandering wavelets." A variety of mathematical methods have been used to quantify the change in shape of the VF surface electrocardiogram (ECG) as VF deteriorates over time. **Hypothesis:** We sought to demonstrate the correlation between the overt visual change in the vigor and organization of VF with changes in the surface ECG. We hypothesized that this change would decay over time and would be reversible after open-chest CPR and drugs were administered. **Methods:** A 25.7-kg female mixed-breed domestic swine was anesthetized and instrumented with ECG corresponding to lead II. After femoral cutdown, micromanometer-tipped catheters were advanced into the aorta and right atrium for vascular pressure measurement (and calculation of coronary perfusion pressure [CPP]). Thoracotomy was performed, the myocardium delivered, and the pericardium excised. Digital video recording began and ECG and pressure data were recorded continuously. Video was recorded with a Panasonic DVX-100A Mini DV in standard mode at 30 interlaced frames per second per the National Television Systems Committee (NTSC). The camera has three CCDs at 410,000 pixels per chip. VF was induced with a transthoracic shock. Recordings continued during 8 minutes of untreated VF, and then open-chest cardiac massage began. After 90 seconds of open-chest massage, drugs (epinephrine 0.1 mg/kg, vasopressin 40 U, propranolol 1.0 mg, and sodium bicarbonate 1.0 mEq/kg) were given. Rescue shocks (150 J biphasic) were administered transthoracically beginning at 11 minutes of VF. Video of the fibrillating myocardium is presented split-screen with the ECG and pressure channels. **Results:** There were demonstrative and clearly correlated changes in the visual appearance of the VF and the ECG waveform. Early, there are very few large wavefronts, which correspond to the undulating (Torsades-like) appearance of the ECG. As these weakened, the ECG decreased in amplitude. Open-chest resuscitation with drugs clearly restored the quality of the VF. Pulses were restored permanently on the fourth rescue shock. **Conclusion:** Visual appearance of VF clearly correlates with changes in the ECG. These changes are reversible with therapy.

**75. MILD HYPOTHERMIA DECREASES VASOPRESSOR REQUIREMENTS AFTER RESUSCITATION FROM PROLONGED CARDIAC ARREST** Jon C. Rittenberger, James J. Menegazzi, Eric Logue, David Salcido, Brian Suffoletto, Clifton Callaway, University of Pittsburgh, Pittsburgh, Pennsylvania

**Introduction:** Mild hypothermia has been shown to improve outcome following cardiac arrest. Two mechanisms of hypothermia's effect are an increase in systemic vascular resistance and myocardial contractility. **Hypothesis:** We hypothesized that mild hypothermia would decrease postarrest vasopressor requirements in a swine model of prolonged ventricular fibrillation (VF) arrest. **Methods:** Forty-two swine were block randomized to a 30 mL/kg IV infusion of normal saline solution (NSS) either body temperature NSS during the resuscitation, ice-cold (4°C) NSS during the resuscitation, or ice-cold NSS prior to resuscitation. Swine experienced 8 minutes of untreated VF. Thereafter, CPR began for 2 minutes, followed by an IV drug cocktail of 0.1 mg/kg epinephrine, 40 U vasopressin, 1.0 mg propranolol, 1 mEq/kg sodium bicarbonate and 3 more minutes of CPR. The first rescue shock (150 J biphasic) was delivered at minute 13. All animals attaining return of spontaneous circulation (ROSC) were survived for 20 minutes. A subset of the animals with ROSC were survived to 1 hour post-ROSC. During the post-arrest phase, norepinephrine was administered to maintain a systolic pressure > 80 mmHg. The total norepinephrine dose, by kilogram of weight, was compared between the hypothermic and normothermic swine by the Kruskal-Wallis test. **Results:** Ten swine were survived to 1 hour. The total dose of norepinephrine per swine was less in the hypothermic group (13.5 μg/kg) than in the normothermic group (68.1 μg/kg; (p = 0.03). Five of the six swine that did not require any norepinephrine were in the hypothermia group. There was no difference in the total norepinephrine dose in the 20-min survival group. **Conclusions:** Mild hypothermia decreases postarrest vasopressor requirements in a swine model of prolonged VF.

**76. EFFECT OF ADENOSINE A1 RECEPTOR ANTAGONISM ON RETURN OF SPONTANEOUS CIRCULATION AND SURVIVAL IN PROLONGED PORCINE VENTRICULAR FIBRILLATION** Timothy J. Mader, Jon C. Rittenberger, Brian S. Suffoletto, Clifton W. Callaway, David D. Salcido, Eric S. Logue, James J. Menegazzi, Baystate Medical Center/Tufts University School of Medicine, Springfield, Massachusetts

**Background:** Endogenous adenosine (ADO) is cardioprotective during ischemia and its concentration in

the myocardium increases during untreated ventricular fibrillation (VF). We have previously shown that ADO A1 receptor antagonism (ADOA1R) hastens the time-dependent decay in VF waveform morphology. BG9719 (BG) is a potent and specific ADOA1R antagonist. Hypothesis: In a swine model of prolonged VF, pretreatment with BG would block the beneficial effects of ADO, lower the rate of return of spontaneous circulation (ROSC) and worsen short-term survival. Methods: A randomized controlled study using 36 domestic mixed-breed swine of either sex assigned to one of three groups: pretreatment with vehicle and vehicle during resuscitation (Control), BG 0.5 mg/kg pretreatment and vehicle during resuscitation (PRE) or vehicle pretreatment and BG 0.5 mg/kg during resuscitation (During). Animals were instrumented under anesthesia and BG or vehicle infused 5 minutes prior to VF induction. At minute 8 of untreated VF, mechanical chest compression with ventilation and drug therapy was initiated. The first rescue shock (150J biphasic) was delivered at minute 11. ROSC was defined as systolic pressure >80 mmHg sustained for greater than 1 minute. Survival was defined as ROSC for greater than 20 minutes. Data were analyzed by using Fisher's exact test. **Results:** ROSC occurred 7/12 in the Control group, 6/12 in the PRE group ( $p = \text{NS}$ ) and 7/12 in the DURING group ( $p = \text{NS}$ ). Survival occurred 4/12 in the Control group, 5/12 in the PRE group ( $p = \text{NS}$ ) and 7/12 in the During group ( $p = \text{NS}$ ). **Conclusions:** BG had no effect on ROSC or survival in this study. Although adenosine may play a role in VF of brief to moderate duration, its role in prolonged VF remains unclear.

**77. INITIAL OXIMETRY AS PREDICTOR OF NEUROLOGICAL OUTCOME IN OOHCA WITH ROSC.** **Patrick B. Medado, Duane Robinson, Brian J. O'Neil, William Beaumont Hospital, Royal Oak, Michigan**

**Introduction:** There are few objective early predictors of neurological outcome in OOHCA. Cerebral oximetry is a non-invasive technology that measures the oxygen content of the brain. **Objective:** To study the utility of cerebral oximetry in predicting neurological outcome in patients with ROSC after OOHCA. **Methods:** Patient who had a OOHCA and had ROSC upon ED presentation were prospectively consented and enrolled into this trial. Patients all had oximetry placed and recorded. Other data fields included were initial rhythm, age, witnessed arrest, and bystander CPR. The outcome measure was the cerebral performance category (CPC) upon hospital discharge. Descriptive statistics were used. **Results:** Forty-three patients have been enrolled to date. 14 patients were discharged with a CPC of 1 or 2. The mean age was 70 years old. The initial rhythm was V-fib in 24 patients, 13 (54%) of which had a CPC

of 1 or 2; 31 patients had bystander CPR performed with 13 having a CPC of 1 or 2. Bystander CPR was performed on 18 patients with 6 having a CPC of 1 or 2. All patients with abnormal oximetry, (<45% or >80%) on admission to the ED had poor neurological outcome independent of other measures. **Conclusion:** V-fib was the best predictor of good neurological outcome. Abnormal oximetry on admission to the ED was associated with a 100% mortality regardless of initial rhythm.

**78. THREATS TO LIFE IN RESIDENTIAL STRUCTURE FIRES** **David C. Cone, Donald MacMillan, Vivek Parwani, Carin Van Gelder, Yale University School of Medicine, New Haven, Connecticut**

**Introduction:** Firefighters are traditionally taught that heat, oxygen deprivation, and carbon monoxide (CO) toxicity are the primary threats to life in structure fires. When searching for victims, firefighters are taught to first search the floor of a building where the fire is, then the floor above, presuming that environmental conditions are the poorest on the fire floor. The objective of this study was to examine the validity of these teachings and to examine the degree of protection against CO provided by self-contained breathing apparatus (SCBA). **Methods:** During a series of six live-burn training evolutions on the first floor of a standard two-story wood-frame residential structure, metering of various parts of the building for oxygen and CO levels and temperature was conducted. Except where noted, all readings were taken 24 inches off the floor, to simulate the location of a crawling victim or firefighter. Readings were hand-recorded on a convenience basis by firefighters stationed outside the building, near the meters. Sixteen firefighters participating in interior firefighting operations wearing SCBA were tested immediately after completing operations using handheld breath CO analyzers. **Results:** Of the 35 oxygen levels recorded, the lowest was 18.2%, with only 12 levels below 20%. However, only 3 of 16 first-floor readings were below 20%, whereas 9 of 19 second-floor readings were below 20%. Of the 34 CO levels recorded, 29 exceeded the OSHA permissible exposure limit of 50 ppm. However, none of the 20 CO levels recorded on the first floor exceeded the NRC 30-minute exposure limit of 800 ppm, whereas 7 of 14 second-floor readings exceeded this limit. Although ceiling temperatures frequently exceeded the 1000°F limit of the meters, none of 16 readings taken 24 inches off the floor exceeded 137°F. First- and second-floor temperatures were comparable. No firefighter developed a COHb level of >2%. **Conclusions:** In residential structure fires, CO poses a greater threat to victims and firefighters than do oxygen deprivation or heat. Regarding search priorities, conditions on the floor above a fire are at least as adverse as those on the fire floor.

SCBA provides firefighters with excellent protection from CO.

**79. EFFECTIVENESS OF TACTICAL EMERGENCY MEDICAL SUPPORT (TEMS): A SYSTEMATIC REVIEW**

**Michael J. Feldman, Laurie J. Morrison, Brian Schwartz, Sunnybrook-Osler Centre for Prehospital Care, Toronto, Ontario**

**Introduction:** Tactical law enforcement operations pose an increased risk of injury or death to civilians and officers. As many as one third of missions result in injuries. There are no current systematic reviews of the effectiveness of TEMS. **Objective:** To systematically review the evidence for the effectiveness of TEMS on patient outcomes. **Methods:** Medline (1966–2005) and EMBASE (1980–2005) were searched for citations indexed using one of the subject headings “emergency medical services,” “police,” “law enforcement,” or the keyword “tactical.” Three blinded authors independently conducted a hierarchical selection based on title and then abstract. Agreement between reviewers was calculated at each level of the review. In addition, a hand search of *The Tactical Edge*, the official publication of the National Tactical Officers Association, was conducted for 1989–2005 for all articles on TEMS. Articles were selected for inclusion if they pertained to outcomes, effectiveness, best practices, or guidelines in civilian TEMS. **Results:** The literature search yielded Medline 184 citations and 135 from EMBASE. Of these, 15 articles were selected for full review. An additional 18 articles were identified in the hand search. The kappa statistic between the authors was  $0.51 \pm 0.03$  for titles and  $0.63 \pm 0.04$  for abstracts selected. Study quality was limited. Only four studies examined outcomes, and none were randomized or blinded. One evaluated tactical awareness training for emergency physicians, and three reported outcomes in psychiatric patients to which police responded. There were three position statements by major U.S. or international organizations. The remaining articles reported on standard practices in specific areas of TEMS, team configurations, and training. No articles specifically addressed tactical considerations for disasters, and only one discussed issues pertaining to terrorism or hazardous materials events. **DISCUSSION:** A large body of TEMS literature exists, which describes team configuration, training, planning, preventative and emergency care, communication, weapons safety, specialized equipment, hazardous materials, terrorism, evidence preservation, considerations for austere environments, medicine across the barricade, medical intelligence, response to psychiatric emergencies, and postmission support. Despite this, there is little evidence on effectiveness of TEMS.

**80. AIR VERSUS GROUND TRANSPORT OF THE TRAUMA PATIENT: A NATURAL EXPERIMENT** **Jennifer J. McVey, Dave A. Petrie, John M. Tallon, Sharon N. Malay, Kevin A. Colpitts, Dalhousie University Department of Emergency Medicine, Halifax, Nova Scotia**

**Introduction:** The use of helicopter emergency medical services for transport of trauma victims in the civilian setting has provoked significant debate in the literature over the past 20 years. Most studies have shown benefit; however, there have also been negative or conflicting results, and uncertainty therefore persists. Either way, TRISS outcome studies have always been limited by the potential for bias in the air versus ground cohorts. The purpose of this study is to eliminate potential bias using a unique “natural experiment” design to compare outcomes in these two groups. **Methods:** Outcomes in adult trauma patients transported to a level I trauma hospital by air will be compared with outcomes in a group that were accepted by the online Medical Control Physician to come by air, but whose missions were aborted due to aviation reasons (weather, maintenance, out on a mission). Data were collected by retrospective database review of trauma patients transferred between July 1, 1997, and June 30, 2003. Outcomes were measured by TRISS analysis. Z and W scores were calculated. **Results:** A total of 397 missions were flown by LifeFlight during this time versus 57 in the accepted then nonclinical abort (ground) group. The mean age, gender, mechanism of injury, and ISS were similar in the two groups. 5.61 more lives/100 patients transported were saved in the air group versus the accepted then aborted (ground) group ( $z = 3.37$ ). As per TRISS analysis, this is relative to the expected mortality seen with a similar group in the major trauma outcomes study (MTOS). The z-score for the accepted then aborted (ground) group was 0.4. A separate control group of “ground only” patients had a higher mean age, lower mean ISS, and worse outcomes according to TRISS analysis ( $W = -2.02$ ). **Conclusions:** This unique natural experiment leads to well-matched air versus ground cohorts. Outcomes were better in the air group than in the accepted then aborted (ground) group.

**81. COMPARISON OF WIRELESS INTERNET INFORMATION SYSTEM FOR MEDICAL RESPONSE TO DISASTERS (WIISARD) VERSUS TRADITIONAL PAPER TRACKING OF PATIENTS DURING A DISASTER DRILL** **Colleen J. Buono, Jake Jacoby, Steven Brown, Ricky Huang, James Killeen, Theodore C. Chan, Leslie Lenert, University of California, San Diego, San Diego, California**

**Purpose:** To compare the effectiveness of wireless electronic tracking devices versus traditional paper systems to track victims in a large-scale disaster drill.

**Background:** Current systems for disaster response, patient tracking, and field medical care rely on paper triage tags, paper forms, and radio or direct communications to relay information. The Wireless Internet Information System for Medical Response in Disasters (WIISARD) project uses sophisticated 802.11 wireless technology to coordinate and enhance patient tracking and care of mass casualties. WIISARD provides emergency personnel with medical data and tracking of victims by instantaneous information transfer among devices. **Methods:** We conducted an unblinded experimental comparative trial during a disaster drill involving multiple Disaster Medical Assistance Teams (DMATs) comparing the WIISARD system to traditional paper tracking of casualties. We shadowed the paper-work flow of patient triage, destination, and transport by using the WIISARD electronic triage tag (iTag), provider device, and the mid-tier supervisor device to triage and track victims at this drill. We collected data on the numbers of victims tracked by both including the initial patient capture, START triage status and transporting unit/destination determination of patients by WIISARD to that of the traditional paper method. Statistical analysis was performed (STATA) by using analysis. **Results:** There were 40 victims for the disaster drill. There were no differences in initial patient capture (87.5%, CI: 73.2–95.8%) captured with WIISARD compared to 92.5%; CI: 79.6–98.4% with the paper system;  $p = 0.712$ ). There was also no difference in capture of triage status; (97.1%; CI: 85.1–99.9%) for WIISARD versus 90.0%; CI: 76.3–97.2% for paper;  $p = 0.364$ ). However, WIISARD was significantly better in reporting transport units for patients (82.4% CI: 66.4–93.4%) compared with the traditional paper tracking system (32.5%; [CI: 18.6–49.1%];  $p=0.001$ ). **Conclusion:** WIISARD captured disaster patients as well as the traditional paper system, with significant superiority in the ability to track patient destinations and transporting units for these victims. **LIMITATIONS:** The ability to track patients may be over- or underestimated in this study because of interactions between the DMAT and WIISARD providers, which could have interfered or enhanced the ability to track patients due to artificial interactions during the drill.

**82. "ACCIDENT; UNKNOWN INJURIES"—THE INCIDENCE OF SERIOUS TRAUMA IN ONE URBAN EMS AGENCY.** David Hostler, Ronald N. Roth, *University of Pittsburgh, Pittsburgh, Pennsylvania*

**Background:** Ambulance crashes represent the highest occupational mortality for prehospital providers and carry inevitable risks and liability for the EMS agency. Despite this, calls to 9-1-1 reporting an "accident with unknown injuries" (AUI) are often handled with a

lights and sirens response. If serious injury is a low frequency event for AUI calls, then ubiquitous use of lights and sirens places EMS providers and the community at greater danger. We sought to describe the incidence of serious trauma in the population of 9-1-1 calls reported as AUI in an EMS system answering 55,000 calls per year. **Methods:** A quality improvement project was initiated to determine the frequency of seriously injured patients treated in response to AUI calls. All AUI reports within a 10-month period were queried from the computer aided dispatch system. For those calls categorized by the paramedics as highest priority transports, the patient care report (PCR) was obtained and abstracted. These were classified as basic life support (BLS), advanced life support (ALS), and critical injury transports based on vital signs and prehospital treatments rendered. **Results:** A total of 4,702 incidents were dispatched as AUI. Of these, 4,684 (99.6%) had at least one unit from either the fire or EMS bureau arrive on the scene. In the remaining incidents, the response was cancelled prior to arrival. Of the total AUI responses, only 11.4% resulted in a patient being transported to the hospital. The dispatch log classified 77 (1.6%) of incidents as highest priority transports. Of these, 10 (0.2%) actually met the criteria for critically injured patient. Of the remaining transported patients, 223 (4.8%) were BLS and 233 (5.0%) were ALS. Thirty-seven patients did not have an external injury or altered level of consciousness documented and were classified as highest priority based solely on mechanism of injury. **Conclusions:** The AUI dispatch rarely results in seriously injured patients. Based on these data, this agency has changed AUI responses to nonemergency resulting in over 5,500 fewer lights and sirens responses per year.

**83. QUANTIFYING AND DESCRIBING ACTIVELY PRACTICING NATIONALLY REGISTERED EMT-BASICS** Antonio Fernandez, Jon Studnek, *National Registry of EMTs, Columbus, OH*

**Introduction:** The perceived shortage of EMS professionals is ever present. However, there is a paucity of research discussing reasons for this perception at the EMT-Basic level. This study was conducted to quantify the number of Nationally Registered EMT-Basics actively practicing in the EMS workforce. Differences between those who are actively practicing and those who are not also are described. **Methods:** A random sample of Nationally Registered EMT-Basics were asked to complete a questionnaire. Completed questionnaires were analyzed to determine the number of "actively practicing" EMT-Basics, defined as an EMT-Basic who performed EMS work for at least one organization and had responded to at least one EMS call in the last month. Actively practicing EMT-Basics were then compared with those not actively practicing with respect to

their volunteer status and whether they report EMS as their primary career. Results of the 600 EMS providers who received surveys 338 (56.3%) responses were obtained. There were 237 (77.5%) Nationally Registered EMT-Basics who met the a priori criteria for "actively practicing." By comparing the two groups, those who are actively practicing were more likely to report EMS as their primary career (27.1% versus 14.3%,  $p = 0.03$ ) and were just as likely to report being a volunteer EMT (46.0% versus 48.4%  $p = 0.73$ ). **Conclusions:** It appears that almost one quarter of Nationally Registered EMT-Basics are not actively practicing, as defined in this study. Even more conspicuous is the fact that almost three quarters of those who are actively practicing report that EMS is not their primary career. These findings may contribute to a perceived workforce shortage at the EMT-Basic level. Further studies should be conducted to determine why EMT-Basics are not choosing EMS as a primary career and if EMT-Basics who are not actively practicing are contributing to the EMS workforce.

**84. TRENDS IN THE USAGE OF INTRAOSSEOUS ACCESS IN THE PREHOSPITAL SETTING** **Nisha Mathew, Diane McGinnis-Hainsworth, Ross Megargel, Andria Cleary, Robert O'Connor,** *Christiana Care Health System, Newark, Delaware*

**Objectives:** Intraosseous (IO) infusion is a feasible and effective alternative in administering fluids and medications when IV access is difficult to obtain or time-consuming. The objective of this study was to compare the success rate of conventional IO access with the EZ-IO<sup>®</sup> in the prehospital setting. **Methods:** This is a retrospective before and after study analyzing data on intraosseous access attempts in the state of Delaware's EMS system following personnel training. The subject population includes all patients in whom intraosseous access was attempted by EMS personnel in a single EMS system between January 3, 2001, and August 1, 2006. ALS responds to approximately 58,000 calls per year. Paramedics are trained to use IO on adults and children in cases where intravenous access is difficult or delayed. Conventional IO was used from 2001 to 2004, and EZ-IO was used for 2005 and 2006. The data set was collected from an electronic run sheets, which includes the incident number, date, whether the access attempt was successful, and the EMS agency. Agencies not formally trained in IO insertion were excluded from this study. Statistical analysis was performed by using the  $\chi^2$  test. **Results:** A total of 245 cases were reviewed with 52 using conventional IO before EZ-IO introduction and 193 using EZ-IO after. There were 31 successful attempts of IO access prior to the introduction of EZ-IO compared to 164 successful attempts after EZ-IO. The IO success rate was 60% before EZ-IO and 85% after. ( $p < 0.0001$ ). In addition, the proportion of pa-

tients receiving vascular access by IO significantly increased between the before and after phases of the study. ( $p < 0.0001$ ). **Conclusions:** The use of an EZ-IO device to gain IO access is associated with an increased proportion of IO use to gain vascular access and results in a significant improvement in IO success rate.

**85. FAST-1 STERNAL INTRAOSSEOUS ACCESS IN PRIMARY AND SECONDARY AEROMEDICAL TRANSPORT: EXPERIENCE FROM THE BRITISH COLUMBIA AIR AMBULANCE SERVICE (BCAS).** **Erik N. Vu, Robert Schlamp, Robert T. Wand,** *Division of Emergency Medicine, Vancouver Hospital, Vancouver, British Columbia*

**Background:** Intraosseous (IO) access devices have been described for decades for vascular access in resuscitation of adult and pediatric patients after failed attempts at conventional percutaneous approaches. Emergency medical service (EMS) experience with the FAST-1 sternal intraosseous infusion system (FAST-1) is limited, and its use in the aeromedical setting has not been previously reported. **Methods:** The Vancouver-based flight paramedic (CCP) team of the BCAS consists of approximately 20 members trained in the use of the FAST-1. The team has an annual call volume of >3,000 missions, of which approximately 1,000 are via rotary-wing and 2,000 via fixed-wing aircraft. We performed a Web-based survey of all CCP trained in the use of the FAST-1 as well as a retrospective chart review from 07/2004 to 07/2006, noting frequency of use, indications, and complications encountered. **Results:** Over the 24-month time period, the CCP team used the FAST-1 17 times. The FAST-1 was placed successfully 15 times (88.2%). On two occasions, the FAST-1 was deployed but not used. Indications for use included need for vascular access in trauma patients (76.5%), cardiac arrest (5.9%), and need for central access for delivery of vasoactive agent in shock states (17.6%). In cases where the FAST-1 was not used, the paramedics felt the catheter was interstitial. In these situations the difficulty in placement was attributable to the patients' obesity. In one situation the FAST-1 was used for the administration of blood and had to be flushed multiple times to maintain patency of the line. In a single case, a conscious patient tolerated the placement of the FAST-1 without consequence following local anesthetic infiltration. The survey of the CCP showed that, in general, significantly more force was required to deploy the FAST-1 than anticipated. **Conclusion:** We report the use of the FAST-1 in the aeromedical setting for primary and secondary aeromedical transport. The BCAS CCP team used the FAST-1 17 times over a 24-month period, with an overall success rate of 88.2%. Our success rate with this device is in keeping with previous studies and validates the use of the FAST-1 in the aeromedical setting.

**86. FACTORS INFLUENCING PREHOSPITAL PLACEMENT AND USE OF PERIPHERAL INTRAVENOUS CATHETERS**  
**Kristin C. Kuzma, Karl A. Sporer, Glen E. Michael, Glen M. Youngblood.** *Case School of Medicine, Cleveland, Ohio*

**Objective:** Previous studies found high rates of unused prehospital IV catheters. This study examined the association between IV initiation and use with primary impression, vital signs, skin signs, and Glasgow Coma Score (GCS). **Methods:** Prehospital records for 34,585 patients transported by ambulance were evaluated for the placement and use of an IV. Use was defined as a fluid bolus greater than 250 mL or administration of an IV medication. Paramedic primary impressions were grouped into 38 categories. Data analysis was conducted by using basic statistical methods followed by logistic regression analysis to control for age, race, and gender, paramedic primary impression, systolic blood pressure (SBP), heart rate (HR), respiratory rate (RR), GCS, skin sign color, and capillary refill. **Results:** IV catheters were initiated in 20,732 patients (60%). Seventy percent of the IVs were not used for treatment. Some primary impressions commonly had IVs placed but were infrequently used ( $n =$  number in group, % with IV placed, % unused): post seizure ( $n = 989$ , 72%, 91%); weakness/dizzy/nausea ( $n = 3092$ , 69%, 80%), syncope/near-syncope ( $n = 2,034$ , 81%, 74%), and abdominal pain ( $n = 1554$ , 70%, 86%). Independent statistically significant differences for IV initiation rates were found for paramedic primary impression, abnormal BP, HR, RR, GCS, and skin sign color. Fifty-eight percent of patients with normal vital signs received IV with 28%–30% utilized for treatment; hypotension 80% received IV (OR = 1.211,  $p = 0.012$ ) with 70% used; hypertension 61% received IV (OR = 1.060,  $p = 0.027$ ) with 28% used; bradycardia 82% received IV (OR = 1.588,  $p < 0.0001$ ) 51% used; tachycardia 66% received IV (OR = 1.152,  $p = 0.001$ ) 33% used; bradypnea 93% received IV (OR = 1.638,  $p = 0.051$ ) 86% used; tachypnea 70% (OR = 1.120,  $p = 0.024$ ) 33% used. Seventy-six percent of patients with a GCS less than 15 received IV (OR = 1.672,  $p < 0.0001$ ) with 32% used for treatment. The IV initiation rate for abnormal skin color was 79% (OR = 1.691,  $p < .0001$ ) with 42% used for treatment. **Conclusions:** Many primary impression categories are associated with high IV initiation rates but infrequent use. High use rates were associated with hypotension, bradycardia, bradypnea, and abnormal skin signs. Increased insight into the prehospital patients least likely to require IV use could reduce the number of unnecessary IV placements.

**87. A RETROSPECTIVE CHART REVIEW OF THE PERFORMANCE OF A HANDHELD, BLOOD ANALYZER IN THE PREHOSPITAL SETTING**  
**Carolyn C. Rosenczweig, Russell D. MacDonald,** *University of Toronto, Etobicoke, Ontario*

**Introduction:** There is only one other small study examining the reliability of a handheld blood analyzer in a prehospital setting. Ontario Air Ambulance (OAA) currently uses the iSTAT at four prehospital bases. Anecdotal reports suggest that the device might be failing while in transit. **Objective:** The principal objective was to determine the proportion of failures based on the setting in which the device was used. **Methods:** This retrospective chart review used prospectively collected data on iSTAT use in a provincial air transport system for patients transported between January 1, 2005, and June 30, 2006. Patient transports in which the device was used were identified by using the existing quality assurance (QA) database. Information on patient care completed by flight paramedics and pediatric transport nurses was abstracted. Patient care reports for identified cases were reviewed to determine location of device use (in hospital, in transit) and results of use (success, failure). A success was defined as providing results to the user. Location of use and success or failure were considered in binomial fashion. Data were analyzed by using  $\chi^2$  analysis or Fisher's exact test where appropriate. **Results:** The device was used 95 times during the study period. Data from one base ( $n = 17$ ) was excluded from the analysis because it routinely omitted recording failures. Of the remaining 78 uses, the device failed in 13 of the 30 uses (43.3%) when in flight and in 6 of the 48 uses (12.5%) when used at the sending facility ( $p < 0.005$ , OR = 5.3). A sensitivity analysis of the results, including data from the omitted base, revealed the device failed in 13 of the 38 uses (34.2%) when in flight and in 9 of the 57 uses (15.8%) when used at the sending facility ( $p < 0.05$ , OR = 2.8). **Conclusion:** The hand-held blood analyzer used in this transport setting fails significantly more in transit than in a hospital setting.

**88. EVALUATION OF RESPIRATORY FUNCTION DURING REEVES STRETCHER USE**  
**Adam Yates, Carrie Strauss Dunn, Dave Hostler,** *University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania*

**Objective:** We were aware of a small number of cases in our EMS system where patients had a worsening of their respiratory status after extrication from the home in a Reeves® Stretcher (RS). The RS is a semi-flexible stretcher used by providers to move patients through tight spaces. We sought to determine if this prehospital lifting device causes additional respiratory effort used in normal subjects. Secondarily, we described changes in several physiological parameters. **Methods:** Forty-nine subjects provided informed consent and entered into this study. Subjects were healthy paramedic students and resident emergency medicine physicians. Data were collected for each subject at two different points: once while lying supine on the ground and once while suspended over the ground in the RS. Each subject had non-invasive pulse oximetry recorded and

breathed through a Dager Volumeter 3000® spirometer. Data points were recorded in the final minute of a 3 minute exposure. Three minutes were chosen to simulate a prehospital transport time from the scene to the ambulance. Tidal volume, minute ventilation, heart rate, pulse oximetry, and respiratory rate were documented. Subjects were asked to rate the difficulty of breathing during each phase using the modified Borg scale. Data were compared by using the paired t-test with significance set at  $p < 0.05$ . **Results:** Complete data were available for 39 subjects with 10 subjects lost because of equipment failure. Subjects were aged  $26 \pm 4.4$  years and weighed  $78 \pm 15$  kilograms. The mean respiratory rate while suspended was  $9.9 \pm 3.0$  breaths per minute compared to  $9.1 \pm 2.5$  breaths per minute supine on the floor ( $p = 0.007$ ). The mean minute ventilation while suspended in a RS was  $8.17 \pm 3.25$  L/min versus  $7.37 \pm 2.37$  L/min supine on the floor ( $p = 0.03$ ). There was no difference in tidal volume, heart rate, pulse oximetry, or subjective modified Borg scale ratings. **Conclusions:** Subjects suspended in a RS for 3 minutes had statistically higher respiratory rates and minute volumes than the same subjects lying flat. Although these modest changes are clinically insignificant in normal subjects, the compensation seen in healthy subjects to the circumferential binding of the RS could present a significant challenge to subjects in respiratory distress.

**89. OUT-OF-HOSPITAL INTRAVENOUS ONDANSETRON USE: A PRELIMINARY REPORT** Christian C. Zuver, Salvatore Silvestri, George Ralls, David Hawley, Todd Stalbaum, *Orlando Regional Medical Center, Orlando, Florida*

**Objective:** The use of ondansetron in the out-of-hospital setting has not yet been reported in the literature. We evaluate the out-of-hospital use of intravenous ondansetron within a regional emergency medical services (EMS) system. **Methods:** This study is an observational cohort study of consecutive patients who were administered intravenous ondansetron. The study took place in an urban, regional EMS system from November 2005 to March 2006. The regional EMS system consists of several different ALS agencies that collectively transport over 70,000 patients per year. The EMS system operates under unified medical direction and, prior to November 2005, established standing orders for the administration of intravenous ondansetron for severe nausea and vomiting. The main outcomes measured were paramedic reported improvement in symptoms and reported adverse effects. **Results:** During the study period, 30,000 patients were transported and 91 (0.003%) patients received intravenous ondansetron; 32% of the patients were male and the mean age was 41.3 (SD  $\pm 17.2$ ). Of the 91 patients, 12 were not included in the preliminary analysis because of incom-

plete data, resulting in 79 patients for analysis. 77 (97%) patients received a 4-mg dose and 2 (3%) received a 2-mg dose; 71 (90%) had improvement reported in their symptoms, and 8 (10%) did not. There were no documented adverse effects. In the study group, 75 (95%) patients were administered ondansetron under standing orders, whereas medical control was contacted for 4 patients. **Conclusion:** In our system, paramedics demonstrated effective use of intravenous ondansetron in the out-of-hospital setting.

**90. PREHOSPITAL USE OF ODANSETRON REDUCES NAUSEA AND EPISODES OF VOMITING IN ADULTS AND CHILDREN OVER 12 YEARS OLD** Craig Warden, *OHSU, Portland, Oregon*

**Objective:** To evaluate the efficacy of ondansetron in the prehospital setting using 10-point and qualitative nausea scales and episodes of vomiting after treatment. **Methods:** Data were collected prospectively from all patients over 11 years old who received ondansetron in the Multnomah County EMS system between January 1 and June 30, 2005. Paramedics were to administer an extra data collection instrument including nausea scales and episodes of vomiting pre- and post-ondansetron administration. Patients and responses to medication were compared by using Student's t-test,  $\chi^2$ , and linear regression. **Results:** A total of 953 patients received ondansetron during the study period with 472 (50%) receiving the extra collection of nausea data of which 454 had pretreatment 10-point scale done, 215 had a posttreatment reassessment, 201 of these with a post-treatment scale, and 198 with a paired pre- and post-treatment 10-point scale. The average age was  $55 \pm 21$  years, 34% were male, with diagnoses spread throughout the major categories with preponderance in the gastrointestinal, urinary, and neurological categories. There was no difference in the patients receiving full-data collection versus not, except the former had a slight preponderance of normal findings on abdominal and neurological exams. Of the patients with paired assessments, the nausea score changed from  $6.5 \pm 3.2$  points to  $5.7 \pm 2.9$  ( $\Delta = 0.8$ , 95% CI: 0.2–1.4). Twenty-eight percent felt "much better," 35% "little better," 28% "unchanged," 1% "little worse," and 1% "lot worse," but there was no correlation with the nausea change score (linear regression  $p = 0.34$ ). Reports of vomiting pre- and posttreatment vomiting went from 43% to 24% ( $p = 0.23$ ). There was no change in vital signs or reports of adverse events. **Conclusion:** Ondansetron appears to decrease nausea and vomiting and to be safe in the prehospital setting in patients over 11 years old. Only half of eligible patients received study data collection. Ondansetron should be considered for prehospital treatment of nausea and vomiting.

**91. EMS ANALGESIA: A COMPARISON OF THE PARAMEDIC'S TREATMENT FOR PAINFUL TRAUMATIC CONDITIONS VERSUS PAINFUL MEDICAL CONDITIONS**

**Mark K. Goldstein, Robert A. Swor, Adam D. DeZure, William Beaumont Hospital, Royal Oaks, Michigan**

**Introduction:** A Wealth of EMS literature has documented low rates of analgesia for injured EMS patients. EMS systems have focused education and policy changes to increase analgesic use. **Objective:** We wished to describe the frequency of EMS and emergency department (ED) analgesia administration for a painful traumatic injury (hip fracture) and a painful medical condition (renal colic) and describe factors associated with the administration of analgesia by EMS. **Method:** A retrospective study of adults ( $>$  age 16) transported by EMS to a single suburban community hospital with an ED diagnosis of hip fracture or kidney stone. The study period was 6 months (7/04–12/04). Data elements collected included ED and EMS pain severity, EMS response and treatment characteristics, and EMS and ED pain Rx treatment. Analgesia is defined as administration of any parenteral narcotic. Time intervals to analgesia from EMS and ED arrival were calculated. Patients with multiple trauma or in whom EMS runsheets could not be identified were excluded. **Results:** A total of 110 patients met inclusion criteria, with 21 excluded because of no runsheets. They were predominantly female (61%) and elderly (mean age 80 [range 16–99]) years. Of these, 73 (90.1 %) sustained a hip fractures and 9 (9.9%) had kidney stones. Overall, 81.0% received ED analgesia and 11.4% received prehospital analgesia. Kidney stone patients had a greater pain severity than hip fracture patients (mean pain score  $8.7 \pm 3.4$  vs  $6.5 \pm 2.1$ ,  $p = 0.049$ ). Few patients (16.1%) with hip fracture and no patients with kidney stone received prehospital analgesia. A majority of patients with hip fracture (57.1%) and kidney stone (66.7%) had severe pain ( $>7/10$ ) on ED arrival. Patients' age or pain severity was not significantly associated with receipt of EMS analgesia. Hip fx patients that received prehospital analgesia received it 115 minutes sooner (range 22–280 minutes) than patients who waited for ED analgesia. **Conclusion:** Despite substantial educational and policy efforts focused on EMS providers, few patients received EMS analgesia, suggesting that low rates of analgesia may be due to patient as well as provider factors.

**92. ARE CHANGES IN PHYSIOLOGICAL PARAMETERS AFTER FENTANYL DOSING PREDICTABLE?** **Sachita Shah, William Krauss, Stephen Thomas, Massachusetts General Hospital, Boston, Massachusetts**

**Objectives:** Given concerns about hypotension, hypoxia, and decline in mental status following EMS Fentanyl use, this study was conducted to assess whether

vital sign abnormalities/GCS change was predictable based on patient age, gender, initial vital signs, dose, or patient diagnosis. **Methods:** This was a retrospective review of 100 consecutive scene and interfacility helicopter EMS transports (7/06), where fentanyl analgesia was administered by a nurse/paramedic crew operating under standing orders, including fentanyl at 1–5  $\mu\text{g}/\text{kg}$ . A total of 199 separate doses of Fentanyl in this group were analyzed. A multivariate linear regression model with dependent variable initial fentanyl dose ( $\mu\text{g}/\text{kg}$ ) assessed the independent variables of: age (the primary end point, group as pediatric {age  $<$  18}, adult {age 18–65}, geriatric {age  $>$  65}), sex, initial vital signs, GCS, and intubation status. The overall (entire transport period) fentanyl dose was also assessed ascertain whether any adverse events were associated with larger total Fentanyl doses. Statistical methods also included descriptive techniques (medians, 95% confidence intervals {CI}),  $\chi^2$  testing for categorical variables, and Kruskal-Wallis testing for nonparametric continuous variables. Statistical significance was defined at the  $p = 0.05$  level. **Results:** Percentage blood pressure drop was not predictable based on gender, ( $p > 0.289$ )), age ( $p > 0.541$ ), dose per kilogram ( $p > 0.945$ ), intubation status ( $p > 0.918$ ), initial systolic blood pressure ( $p > 0.07$ ), or patient diagnosis (cardiac, medical/surgical, trauma, neurological). No clinically significant drop in SPO2 or GCS occurred in any non-intubated patients. **Conclusions:** (1) This study fails to confirm that factors sometimes mentioned as predisposing patients to fentanyl-associated vital signs depression such as age, gender, dose/kg, or initial vital signs would predict vital signs depression or GCS decline after fentanyl dosing. (2) No differences were found in vital signs parameters after Fentanyl between cardiac, medical/surgical, trauma, and neurological patient groups.

**93. ADVANCING AGE IS ASSOCIATED WITH LESS ANALGESIA EVEN AFTER ADJUSTMENT FOR ACUITY AND PHYSIOLOGICAL PARAMETERS** **William C. Krauss, Sachita Shah, Stephen H. Thomas, Massachusetts General Hospital, Boston, Massachusetts**

**Objectives:** Given concerns about oligoanalgesia in elderly patients, this study was conducted to assess whether advancing age was associated with less analgesia provision, even after adjustment for physiological parameters such as vital signs. **Methods:** This was a retrospective review of 100 consecutive scene and interfacility helicopter EMS transports (7/06), where fentanyl analgesia was administered by a nurse/paramedic crew operating under standing orders, including fentanyl at 1–5  $\mu\text{g}/\text{kg}$ . A multivariate linear regression model with dependent variable initial fentanyl dose ( $\mu\text{g}/\text{kg}$ ) assessed the independent variables of age (the primary end point, group as pediatric {age  $<$  18}, adult

{age 18–65}, geriatric {age > 65}), sex, blood pressure, heart rate, respiratory rate, and intubation status. The overall (entire transport period) fentanyl dose was also assessed to ascertain whether any age-related differences were from conservative initial dosing. Statistical methods also included descriptive techniques (medians, 95% confidence intervals {CI}),  $\chi^2$  testing for categorical variables, and Kruskal-Wallis testing for nonparametric continuous variables. Statistical significance was defined at the  $p = 0.05$  level. **Results:** Increasing age was associated with decreasing initial fentanyl dose, with age accounting for 20% of the total variation in fentanyl dosing ( $p < 0.001$ ). Compared to adult patients, geriatric patients received  $0.3 \mu\text{g}/\text{kg}$  less fentanyl (95% CI: 0.15–0.47). Age was the only factor identified as associated with fentanyl dose: there was no association between analgesia and sex ( $p = 0.15$ ), Glasgow Coma Scale ( $p = 0.37$ ), respiratory rate ( $p = 0.30$ ), heart rate ( $p = 0.49$ ), or intubation status ( $p = 0.75$ ). Incorporation of various physiological variables in the model failed to change the point estimate of age-fentanyl association and no effect modification or confounding was identified. The results did not change when total fentanyl dose was assessed. **Conclusions:** (1) Advancing age is associated with less analgesia provision, even when physiological and acuity parameters are accounted for. (2) The tendency of prehospital and other health care providers to administer lower analgesia doses to older patients should be subjected to scientific scrutiny, to determine whether age alone is a valid reason for decreasing analgesia dosing.

**94. PREHOSPITAL PAIN MANAGEMENT IS NOT ADEQUATE** Rollin J. Fairbanks, Karen E. Kolstee, Heather A. Martin, Karen H. Dewar, Erik A. Rueckmann, Manish N. Shah, *University of Rochester, Rochester, New York*

**Background:** Adequate pain management is an important quality indicator. Recent studies suggest that EMS systems do not adequately treat pain. Delays in pain treatment after ED arrival magnify the need for prehospital treatment. **Objective:** This study aims to characterize the prehospital and ED pain management of EMS patients who report significant pain upon ED arrival. **Methods:** Setting: Academic medical center ED/trauma center (volume 90,000) that receives EMS patients from a mix of commercial and volunteer EMS agencies which cover urban, suburban, and rural communities. A retrospective analysis of an existing database which prospectively enrolled a random sample of pediatric (<19 years), geriatric (> 64 years), and critically ill patients (all ages) presenting to the ED between August 2005 and June 2006 was performed. ED and EMS charts were abstracted for demographic information, mode and time of arrival, EMS medications,

pain scores, ED medications and time of administration. Significant pain was defined as documented pain scores of 6/10 or higher. **Results:** A total of 8,118 patients were enrolled, 48% pediatric, 28% geriatric, and 34% critically ill (not exclusive); 3615 (45%) patients arrived via EMS, 726 (20%) of whom reported significant pain upon ED arrival. Of these, 24 (3.3%; 95% CI: 2.1 to 4.9%) received prehospital pain medication, and 479 (66%; 95% CI: 62%–69% received pain medication in the ED. In contrast, 50% (95% CI: 47%–52%) of non-EMS patients arrived with significant pain at triage received pain medication in the ED. For those receiving pain medication in the ED, the median time interval from ED arrival to first pain medication was 35 minutes (mean 68) for EMS patients versus 50 minutes (mean 87) for others ( $p = 0.0035$ ). Only 36 (1.2%; 95% CI: 0.9%–1.7%) other EMS patients (those with pain scores less than 6/10) received pain prehospital medications. **Conclusions:** In this random sample of pediatric, geriatric, and critically ill ED patients, significant pain on arrival in the ED was common, but EMS pain management was rare. Arrival by EMS was associated with an increased rate of and more timely ED pain management, but notable time elapsed prior to therapy. The effects of ED pain treatment delays can likely be moderated by more aggressive pain treatment by EMS.

**95. SAFETY AND EFFICACY OF INTRAMUSCULAR EPINEPHRINE IN ACUTE ASTHMA EXACERBATIONS** Doug A. Isaacs, John P. Freese, David Ben-Eli, David J. Prezant, *New York City Fire Department, Brooklyn, New York*

**Objective:** To describe the cardiovascular response to epinephrine given intramuscularly (IM) for patients with acute asthma exacerbations not responding to other interventions as well as the clinical response to epinephrine. **Methods:** A retrospective review of electronic prehospital call reports during a 1-year period, August 2005 to July 2006, was performed. Inclusion criteria included a documented history of asthma, a chief complaint of dyspnea or asthma or respiratory failure, and the administration of intramuscular epinephrine. Exclusion criteria included cardiopulmonary arrest or respiratory arrest. **Results:** Two hundred forty-three patients met inclusion criteria. Eight cases were excluded: three cardiac arrest prior to any intervention, four anaphylaxis cases, and one documentation error. The average age was 25.7 years (range = 0.75–79). The mean systolic blood pressure (SBP) change was  $-0.13 \text{ mmHg}$ , with a statistically significant change ( $>18 \text{ mmHg}$ ,  $p < 0.05$ ) among only five patients (2.1%). No significant change was noted in mean arterial pressure following epinephrine administration. Eleven patients (4.7%) had significant heart-rate change

( $\geq 20$  bpm,  $p$ -value  $< 0.05$ ). None of the available EKGs demonstrated signs of ischemic changes. Following epinephrine administration, paramedics documented improved clinical status for 183 patients (77.9%), no change in 21 patients (8.9%), and clinical deterioration in only 1 patient (0.4%) who had a documented use of cocaine prior to their exacerbation. The severity of patients asthma was gauged by the use of outpatient steroids in 33.2% (78/183) (both inhaled and oral) and past intubations in 19.1% (35/183). No reassessment of clinical status was noted for 30 patients (12.8%) Additional medication use among those with documented improvement included multiple albuterol treatments (176/183), and intravenous steroids (90/183), intravenous magnesium sulfate (63/183). Assisted ventilation was required for 27 patients given epinephrine at time it was initiated or shortly thereafter, 8 had shown clinical improvement. Among ALS medications administered, epinephrine alone had significant correlation with improvement (LR = 6.78). **Conclusions:** Following intramuscular epinephrine administration, most patients experience no significant cardiovascular compromise. Clinical improvement is frequently noted, including those patients for whom ventilatory assistance is required. These findings suggest that epinephrine administration is both safe and efficacious in this population.

**96. FACILITATED DELIVERY OF ANTIDOTES BY THE BRITISH COLUMBIA AIR AMBULANCE SERVICE (BCAAS) DURING SECONDARY AEROMEDICAL TRANSPORT IN POISONED OR TOXIC PATIENTS** **Erik N. Vu, Robert T. Wand, Robert Schlamp**, *Division of Emergency Medicine, Vancouver Hospital, Vancouver, British Columbia*

**Introduction:** Each year over 26,000 poisonings are reported in British Columbia (BC). The BC Drug and Poison Information Center (DPIC) provides 24-hour, toll-free, provincewide telephone consultation for health care professionals. The BCAAS has three air ambulance teams that provide 24-hour, provincewide secondary and tertiary aeromedical services. However, in the interfacility transfer of poisoned or toxic patients, significant delay can occur allowing for time aircraft preparation, flight time, transfer to and from the airport, and then flight time and transport to the accepting facility—several hours can elapse before the potentially life saving antidote is delivered. More recently, the DPIC and the Vancouver-based BCAAS have established mechanisms to allow the release of specific antidotes to the air ambulance team so that they can safely administer the antidotes in a more timely fashion. We report two such cases in which the Vancouver-based BCAAS team successfully facilitated the early delivery of the appropriate antidotes to toxic or poisoned patients in

BC. In a case of ethylene glycol poisoning, fomepizole was flown to the patient and administered prior to interfacility transport by the flight paramedics, cutting 5–6 hours off the time to antidote delivery. In a second case of acute digoxin toxicity, a flight paramedic team was able to administer the appropriate dose of digibind 2–3 hours earlier than if waiting until reaching the final destination. **Conclusion:** These two case studies illustrate an innovative and collaborative approach to secondary aeromedical transport of toxic patients by using aeromedical transport teams to both execute the transfer of critically ill patients as well as facilitating timely and optimal patient care. They also highlight the wonderful resource we have in BC with 24-hour free access to the experience and information at the BC DPIC.

**97. VARIATION IN THE PREHOSPITAL ADMINISTRATION OF NARCAN BY DAY OF THE WEEK** **Justi Morgan, Diane McGinnis-Hainsworth, Ross Megargel, Craig Durie, Robert O'Connor**, *Christiana Care Health Systems, Newark, Delaware*

**Objectives:** We conducted this study to determine the use patterns of Naloxone (Narcan) in the prehospital setting by the day of the week to test our hypothesis that there are days with increased use of Narcan. **Methods:** EMS records from a three county paramedic service were retrospectively reviewed from August 21, 2005, through August 19, 2006. The EMS service covers an area of 2,489 square miles with a population of 843,524. Paramedics respond to approximately 57,743 calls per year. Data were extracted for all cases of prehospital administration of naloxone from an electronic prehospital care report. The administration of Narcan was based on EMS standing orders for altered mental status patients that either had a serum glucose level  $> 80$  mg/dL, or in those patients who did not respond to administration of 25 grams of dextrose 50% (D50) IV. These data were compared on the basis of which day of the week naloxone was given. A data set with day of the week (Sunday to Saturday) versus number of weeks was constructed, and ANOVA was used to determine the significance of differences based on day of the week. **Results:** There was total of 681 instances of Narcan administration during the 365 days of the data set. There were 93 instances on Sundays, 98 on Mondays, 104 on Tuesdays, 91 on Wednesdays, 86 on Thursdays, 92 on Fridays, and 117 on Saturdays. The average number of Narcan administrations for each day of the week (Sunday–Saturday) were the following: 1.79, 1.88, 2.00, 1.75, 1.65, 1.77, and 2.25. The  $p$ -value obtained by using ANOVA was 0.727. **Conclusions:** There were no statistically significant differences in the number of Narcan administrations on any day of the week.

98. A DIAGNOSTIC ALGORITHM TO FACILITATE RECOGNITION OF SMOKE INHALATION CYANIDE POISONING F. J. Baud, P. Barriot, M. Imbert, C. Bismuth, *Assistance Publique-Hôpitaux de Paris, Lariboisière Hospital, Paris, France*

**Background:** Cyanide (CN) poisoning is diagnosed on the basis of signs and symptoms and index of suspicion given the lack of a widely available diagnostic test that returns results in time to initiate intervention. Previous research suggests the presence of a CN toxidrome that in smoke inhalation patients includes soot in the mouth and/or nose, neurological disturbance, abnormal respiration, hypotension, and lactic acidosis. In this investigation, the usefulness of toxidrome elements that are easily and rapidly assessable at the fire scene for predicting the presence of CN poisoning was evaluated. **Methods:** Data were obtained from a database of records of fire victims ( $n = 440$ ) administered care at the fire scene by the Paris Fire Brigade. The database comprised measures prospectively collected at the time of presentation. Mean (SD) pretreatment blood CN and carbon monoxide (CO) concentrations were summarized as a function of presence of soot deposits in the nose or mouth, neurological disturbance (loss of consciousness or altered mental status) among those with soot deposits, and systolic blood pressure (SBP  $\leq 100$  mmHg,  $> 100$  mmHg) among those with soot deposits and neurological disturbance. Blood CN and CO were measured by using microdiffusion and infrared methods, respectively. CN poisoning was defined as a blood concentration of  $\geq 39 \mu\text{mol/L}$ . CO poisoning was defined as a blood concentration of  $\geq 1$  mmol/L. **Results:** Soot deposits and neurological disturbance strongly predicted cyanide poisoning. Mean CN concentration ( $\mu\text{mol/L}$ ) was 39.8 in those with soot deposits ( $n = 144$ ) and 4.4 in those without soot deposits ( $n = 121$ ). Among those with soot deposits, mean CN concentration ( $\mu\text{mol/L}$ ) was 58.5 in those with neurological disturbance ( $n = 86$ ) and 9.1 in those without neurological disturbance ( $n = 57$ ). These findings less strongly predicted carbon monoxide poisoning. Among those with soot deposits and neurological disturbance, hypotension (SBP  $\leq 100$  mmHg) was a marker of severity of cyanide poisoning. **Conclusions:** CN poisoning should be strongly suspected in fire victims with soot deposits in the nose and/or mouth and neurological disturbance. Severe poisoning is likely in the presence of SBP  $\leq 100$  mmHg. These signs are easily identifiable at the fire scene and can be used to facilitate rapid recognition of smoke inhalation CN poisoning.

99. PLASMA LACTATE CONCENTRATIONS AS A MARKER OF CYANIDE POISONING IN SMOKE-INHALATION VICTIMS F. J. Baud, S. W. Borron, P. Barriot, C. Bismuth, *Assistance Publique-Hôpitaux de Paris, Lariboisière Hospital, Paris, France*

**Background:** In the context of smoke inhalation, plasma lactate  $\geq 10$  mmol/L has been suggested as a marker of cyanide (CN) poisoning, defined as a blood concentration of CN  $\geq 39 \mu\text{mol/L}$ . Carbon monoxide (CO) also causes lactic acidosis, but CO-associated elevations in plasma lactate are typically much less marked than those associated with CN poisoning. Measurement of plasma lactate is now easily accomplished in the emergency setting and could facilitate early recognition and treatment of CN poisoning. In this investigation, the correlations between plasma lactate and CN and between plasma lactate and CO were assessed in smoke inhalation victims not treated with antidotal therapy, which can confound assessment of the relationship between plasma lactate and blood CN. **Methods:** The sample included 15 victims of residential fires in Paris who had suspected smoke inhalation cyanide poisoning and had burns covering  $< 20\%$  of their body. CN and CO concentrations were measured from blood samples obtained at the scene before treatment was given. Plasma lactate concentrations were measured at the time of admission to the hospital, immediately after transport of victims from the fire scene. Correlations were assessed with non-parametric tests. According to Pace's approximation, 1 mmol/L CO corresponds to 11% HbCO in those with normal hemoglobin. **Results:** Of the 15 patients, 4 had a blood CN concentration  $\geq 39 \mu\text{mol/L}$ , reflecting CN poisoning. All 4 had a plasma lactate concentration  $\geq 10$  mmol/L (range 11.3–40.0 mmol/L). The remaining 11 patients had a blood CN concentration  $< 39 \mu\text{mol/L}$ . None of these 11 patients had a plasma lactate concentration  $\geq 10$  mmol/L (range 1.3–8.3 mmol/L). Thus, in this small sample, the sensitivity and specificity of plasma lactate  $\geq 10$  mmol/L for CN poisoning were 100%. Plasma lactate concentrations were strongly correlated with blood CN concentrations ( $r = 0.7388$ ;  $p = 0.0017$ ). Plasma lactate concentrations were less strongly correlated with blood CO concentrations ( $r = 0.5964$ ;  $p = 0.0189$ ). **Conclusions:** These data suggest that plasma lactate  $\geq 10$  mmol/L is a relatively sensitive and specific marker of CN poisoning in patients with smoke inhalation. Because plasma lactate can be easily obtained in the prehospital setting, use of this measure to facilitate the rapid diagnosis of cyanide poisoning should be considered.