

# ABSTRACTS

## NAEMSP 2005 ANNUAL MEETING

The following abstracts are the oral and poster presentations at the National Association of EMS Physicians 2005 Annual Meeting, January 13–15, Naples, Florida.

### Oral Presentations

**01 DOES IO EQUAL IV?** Larry J. Miller, John G. Kuhn, Daniel D. Von Hoff, *University of Texas Health Science Center, San Antonio, Texas*

**Objective:** Intraosseous (IO) administration of medications is increasingly used in prehospital emergency medicine, when conventional intravenous (IV) access to the circulation may be difficult or impossible. Despite the growing popularity of IO infusion, there has been no published research on the pharmacokinetics of intraosseously administered medications in humans. The current study compares the pharmacokinetics of IO versus IV administration of morphine sulfate (MS) in adults. **Methods:** The study was a randomized crossover design. Each patient served as his/her own control. Eligible patients had failed at least one previous attempt at IV access and had a confirmed diagnosis of cancer. Each patient was equipped with an indwelling IO access device and two IV lines. Patients were randomized to receive a 5-mg bolus of MS infused IO or IV, followed by the alternate administration route 24 hours later. Serial blood samples (5 mL) were taken at baseline (before infusion) and at 13 time points over an 8-hour period post-infusion. Blood samples were analyzed for MS concentration by radioimmunoassay. Pharmacokinetic parameters calculated included maximum plasma concentration ( $C_{max}$ ), time to maximum concentration ( $T_{max}$ ), area under the plasma concentration–time curve ( $AUC_{0-8}$ ), elimination half-life ( $T_{1/2}$ ) plasma clearance ( $CL_p$ ), and apparent volume of distribution ( $V_d$ ). Data were analyzed by analysis of variance. **Results:** Full pharmacokinetic data were available for 14 of 22 patients. No statistically significant differences were observed between IO and IV administration of MS in

adults for  $C_{max}$  ( $235 \pm 107$  ng/mL vs.  $289 \pm 197$  ng/mL, mean  $\pm$  SD, IO vs. IV, respectively),  $T_{max}$  ( $1.3 \pm 0.5$  min vs.  $1.4 \pm 0.5$  min),  $AUC_{0-8}$  ( $4,372 \pm 1,785$  ng-min/mL vs.  $4,410 \pm 1,930$  ng-min/mL),  $T_{1/2}$  ( $140 \pm 108$  min vs.  $118 \pm 56$  min), or  $CL_p$  ( $20.2 \pm 7.6$  mL/kg/min vs.  $20.6 \pm 9.4$  mL/kg/min). There was a difference in  $V_d$  ( $4.81 \pm 1.66$  L/kg vs.  $3.62 \pm 1.41$  L/kg, IO vs. IV,  $p = 0.025$ ), thought to be due to a minor depot effect of MS in the bone marrow. **Conclusion:** The results provide evidence in support of the bioequivalence of IO- to IV-administered morphine sulfate.

**02 THE NATURE OF ADULT AND PEDIATRIC ADVERSE EVENTS AND NEAR-MISSES IN EMS** Rollin J. Fairbanks, Crista N. Crittenden, Kevin G. O'Gara, Matthew A. Wilson, Elliot C. Pennington, Manish N. Shah, *University of Rochester School of Medicine, Rochester, New York*

**Objective:** This pilot study describes the nature of medical error in emergency medical services (EMS) and the types of adverse events and near-misses that occur. **Methods:** This study was conducted in a Northeastern U.S. EMS region that includes urban, suburban, and rural communities. Providers were asked to describe near-misses and adverse events that they had been directly involved with. Data were collected through a Web-based anonymous EMS event-reporting system, and with in-depth interviews in which purposive sampling was used to select EMS providers with varying levels of experience and training. All interviews and reports were compiled and reviewed by a 5-member team; analytic domains were created and assigned. All data were analyzed using descriptive statistics. **Results:** 15 in-depth interviews (involving 73% advanced life support 40% volunteer, and 87% male participants) were conducted and resulted in 50 event descriptions. 11 additional event reports were obtained from the anonymous reporting system. Of the 61 total events described, 27 (44%) were near-misses and

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34 (56%) were adverse events. 14 (23%) involved a child (<19 yo), and 34 (56%) involved an adult (13 did not report age). Types of error included: 33 clinical judgment (54%; 95% CI: 41–67%), 9 medication error (15%; 95% CI: 7%–26%), 13 skill performance (21%; 95% CI: 12–34%), 3 destination choice (5%; 95% CI: 1–14%), and 3 other (5%; 95% CI: 1–14%). For 21 cases in which the provider discussed reporting the event to an authority, 10 (48%) were reported to a physician, 9 (48%) to a supervisor, 4 (19%) were not reported at all, and none were reported to the patients themselves (two were reported to two authorities). **Conclusions:** EMS providers were willing to openly discuss medical error with researchers and provide anonymous event reports. Although most existing literature focuses on skill performance errors, four-fifths of events reported here involve other kinds of errors, and the majority involves errors in clinical judgment. Not all errors were reported to an authority, and none to the patients themselves. A more in-depth analysis is necessary to determine the root causes of these errors.

**03 THE CHANGING INCIDENCE OF VENTRICULAR FIBRILLATION AND CARDIAC ARREST IN MILWAUKEE COUNTY (1992–2002)** Mark S. Polentini, Ronald G. Pirralo, William McGill, *Medical College of Wisconsin Emergency Medicine Residency, Wauwatosa, Wisconsin*

**Objective:** To investigate the changes in incidence and survival of out-of-hospital cardiac etiology adult (>21 y/o) arrests of different initial rhythms, including ventricular fibrillation (VF) and ventricular tachycardia (VT), in Milwaukee County between 1992 and 2002 and determine correlations with patient- and emergency medical systems (EMS)-system-dependent factors. **Methods:** The study was a retrospective observational study of all adult (>21 y/o) out-of-hospital cardiac etiology arrests with identifiable rhythm and resuscitation attempted by EMS in Milwaukee County from 1992 to 2002. A total of 9,171 cases were enrolled. The main outcome measures were changes in annual incidence of initial cardiac arrest rhythm with a focus on VF/VT. Secondary outcome measures were changes in survival to hospital admission and hospital discharge for VF and VT. Patient and EMS system factors potentially affecting the outcome measures were identified and correlated using multivariate logistic regression. **Results:** The incidence of out-of-hospital VF/VT arrests decreased steadily from 37.1 per 100,000 in 1992 to 19.4 per 100,000 in 2002. While the incidence of pulseless electrical activity and overall cardiac arrest remained unchanged, the incidence of asystole during the study period increased from 27.3/100,000 to 44.9/100,000. Multivariate regression analyses revealed that age <80, male sex, white race, previous cardiac surgery, and cardiac history were patient-dependent factors predic-

tive of VF/VT. Witnessed arrest, public location, and shorter response time were EMS-dependent factors predictive of VF/VT. Based on observed trends, none of these correlated factors could explain the decrease in the incidence of VF/VT arrests. Rates of patient survival to hospital admission and discharge were not significantly changed over time. EMS factors predictive of survival were witnessed arrest, public location, and decreased number of defibrillations. Prior cardiac surgery and absence of chronic problems were the only patient factors predictive of survival to hospital admission but were not correlated to survival to hospital discharge. **Conclusion:** A decline in the incidence of adult, out-of-hospital VF/VT and an increase in asystole occurred. This was not explained by any patient- or EMS-dependent factor. VF/VT arrest survival was not significantly changed. Survival was primarily influenced by EMS factors and unrelated to patient-dependent factors.

**04 A RANDOMIZED CONTROLLED TRIAL COMPARING SAFETY AND EFFICACY OF RECTILINEAR BIPHASIC VERSUS MONOPHASIC DEFIBRILLATORS IN OUT-OF-HOSPITAL CARDIAC ARREST: "ORBIT"** Laurie J. Morrison, Paul Dorian, Jennifer Long, Marian J. Vermeulen, Brian Schwartz, Bruce Sawadsky, Jamie Frank, Bruce Cameron, Robert Burgess, Jennifer Shield, Paul Bagley, Vivien Mausz, James E. Brewer, Bruce Lerman, *Sunnybrook & Women's College Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada*

**Background:** Comparisons of defibrillation waveform efficacy in out-of-hospital cardiac arrest (OHCA) are confined to patients presenting in a shockable rhythm and resuscitated by first responders (basic life support). This study compared defibrillation waveforms using rectilinear biphasic (RLB) with monophasic damped sine (MDS) using step-up energy levels for conversion of ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT) in all OHCA patients treated with advance life support (ALS). **Methods:** This prospective randomized controlled trial enrolled OHCA patients requiring at least one shock, regardless of the initial presenting rhythm. Shock success was defined as conversion at 5 seconds to organized rhythm after 1 to 3 escalating shocks. **Results:** Shock success for RLB was superior to MDS for OHCA patients regardless of initial rhythm (55% vs. 42%,  $p = 0.01$ ) and for patients initially presenting in a shockable rhythm (53% vs. 32%,  $p < 0.01$ ). First-shock conversion was superior with RLB (24% vs. 11%,  $p = 0.03$ ), as were conversion rates for RLB, 120 J, vs. MDS, 200 J, and RLB 200 J, vs. MDS, 360 J, for initially shockable patients (29% vs. 16%,  $p = 0.03$ ) and (26% vs. 8%,  $p < 0.01$ ), respectively. There were no significant differences for

return of spontaneous circulation (48% vs. 47%), survival to 24 hours (30% vs. 27%), and survival to discharge (10% vs. 8%). **Conclusion:** Step-up protocol using RLB waveform was superior to MDS in ALS treatment of all OHCA patients. RLB waveform at 120 J and 200 J was superior to 200-J and 360-J MDS waveform for conversion to an organized rhythm.

**05 CLINICAL EVALUATION OF AN INSPIRATORY IMPEDANCE THRESHOLD DEVICE DURING STANDARD CARDIOPULMONARY RESUSCITATION** **Tom P. Aufderheide, Ronald G. Pirralo, Terry Arend Provo, Keith G. Lurie, Medical College of Wisconsin, Milwaukee, Wisconsin**

**Introduction:** Use of an inspiratory impedance threshold device (ITD) enhances venous return during chest wall recoil, thereby increasing circulation and survival in animal models of cardiopulmonary resuscitation (CPR). **Objective:** To test the hypothesis that an ITD would also improve short-term survival in patients with out-of-hospital cardiac arrest receiving standard manual CPR (sCPR). **Methods:** This prospective, randomized, double-blind trial was conducted in an urban emergency medical services system. Adults in cardiac arrest of presumed cardiac etiology were randomized to receive an active or sham ITD (Advanced Circulatory Systems Inc., Eden Prairie, MN). The primary endpoint was intensive care unit (ICU) admission rate. A chi-square test was used for statistical analyses. **Results:** One-hour survival, ICU admission, and 24-hour survival rates were 18%, 17%, and 12% with sham ( $n = 116$ ) versus 26%, 25%, and 17% with active ITDs ( $n = 114$ );  $p = \text{NS}$ , respectively. In patients presenting initially with pulseless electrical activity (PEA), 1-hour, ICU admission, and 24-hour survival rates were 20%, 20%, and 12% with sham ( $n = 25$ ) versus 56%, 52%, and 30% with active ITDs ( $n = 27$ );  $p = 0.009$ , 0.017, and NS, respectively. In patients with PEA at any time during cardiac arrest, 1-hour, ICU admission, and 24-hour survival rates were 21%, 20%, and 11% with sham ( $n = 56$ ) versus 43%, 41%, and 27% with active ITDs ( $n = 49$ );  $p = 0.018$ , 0.018, and 0.036, respectively. In patients presenting initially with ventricular fibrillation/tachycardia, 1-hour, ICU admission, and 24-hour survival rates were 29%, 26%, and 19% with sham ( $n = 31$ ) versus 32%, 32%, and 32% with active ITDs ( $n = 28$ );  $p = \text{NS}$ , respectively. Outcomes were also not significantly different for patients presenting with asystole. No significant adverse events were reported. **Conclusions:** Use of an ITD during sCPR in patients with out-of-hospital cardiac arrest more than doubled short-term survival for patients with PEA at any time during the resuscitation effort. These results represent the first effective treatment to increase acute

resuscitation rates for patients in PEA. A larger study is needed to determine the potential long-term benefits of the ITD with sCPR for the treatment of cardiac arrest.

**06 IMPROVEMENT IN FIELD RETURN OF SPONTANEOUS CIRCULATION USING CIRCUMFERENTIAL CHEST COMPRESSION CARDIOPULMONARY RESUSCITATION** **Joseph P. Ornato, Mary Ann Peberdy, David P. Edwards, Harinder Dhindsa, Jerry L. Overton, Richmond Ambulance Authority, Richmond, Virginia**

**Background:** There is evidence that circumferential chest compression (CCC) can improve arterial perfusion pressure compared to that which can be achieved with standard (STD) cardiopulmonary resuscitation (CPR) in animal models and critically ill patients undergoing CPR in the intensive care unit. It is unknown whether this hemodynamic difference will result in any improvement in the rate of return of spontaneous circulation (ROSC) from out-of-hospital cardiac arrest. **Objective:** To compare the rates of ROSC before and after an all-advanced life support (all-ALS) urban emergency medical services system converted from using STD-CPR to CCC-CPR as standard of care. **Methods:** CCC-CPR was performed using Autopulse devices (Revivant Corp., Sunnyvale, CA) which were placed into service on all ALS ambulances in Richmond, VA, on December 20, 2003. The percentages ROSC from all adult, out-of-hospital, non-traumatic cardiac arrest cases of presumed cardiac origin were compared from 5 years before, and for the first 6 months following, conversion from STD-CPR to CCC-CPR in the Richmond Ambulance Authority. No other significant operational or medical protocol changes were made in the EMS system during the changeover period. **Results:** ROSC for all patients rose dramatically from  $21.6 \pm 3.1\%$  (95% CI 17.7–25.4%) to 37.5% from the STD-CPR ( $n = 1,007$ ) to CCC-CPR ( $n = 79$ ) periods, representing a 74% relative increase in ROSC. The improvement occurred regardless of the patient's initial cardiac arrest rhythm: ventricular fibrillation or ventricular tachycardia [ $25.2 \pm 4.1\%$  (95% CI 20.1–30.3%) STD-CPR ( $n = 239$ ) to 47.4% with CCC-CPR ( $n = 19$ )]; asystole [ $12.3 \pm 4.7\%$  (95% CI 6.5–18.1%) STD-CPR ( $n = 536$ ) to 29.3% with CCC-CPR ( $n = 41$ )]; and pulseless electrical activity [ $33.2 \pm 10.1\%$  (95% CI 20.5–45.8%) STD-CPR ( $n = 232$ ) to 47.4% with CCC-CPR ( $n = 19$ )]. **Conclusions:** In this preliminary before-and-after case series comparison, the use of CCC-CPR resulted in a significant improvement in field ROSC that occurred independent of the initial presenting rhythm. This hypothesis-generating observation strongly supports the need for an adequately powered, prospective randomized clinical trial comparing the two CPR techniques.

**07 VALIDATION OF A PREDICTIVE MODEL FOR PLACEMENT OF AUTOMATED EXTERNAL DEFIBRILLATORS IN RURAL AMERICA** N. Clay Mann, Greg Mears, J. Michael Dean, Dagan Wright, Michael Schnyder, *University of Utah School of Medicine, Salt Lake City, Utah*

**Introduction:** In 2002, under contract with the Office of Rural Health Policy (ORHP), we devised a probability model to guide the placement of automated external defibrillators (AEDs) in rural regions of the U.S. through the Rural Access to Emergency Devices Act. Model implementation involved AED placement on emergency vehicles to increase geographic coverage. Promoting this model, in excess of 20 million dollars has been distributed to states for the purchase and placement of AEDs. To date, the efficacy of the placement model has not been investigated. **Objective:** To test the validity of the AED placement model by associating regions in the State of Utah predicted to benefit from AED coverage with the actual frequency of out-of-hospital cardiac arrests (OHCAs) attended by emergency medical services within those regions. **Methods:** Design: A statewide cross-sectional study. Analytic Plan: The national placement model was devised by mapping Centers for Disease Control and Prevention (CDC) heart disease mortality to all U.S. census tracts designated as "rural" by the ORHP. A risk coefficient was calculated for each census tract and an estimated likelihood of AED use was assigned to each tract. Using State of Utah data, the likelihood of AED use assigned to each census tract was associated with the actual number of OHCAs attended by EMS in each tract from 1999 through 2001. **Results:** A total of 14,586 rural census tracts in 50 U.S. states were included in the placement model. Nationally, the model identified 509 census tracts predicted to experience >4 OHCAs per year per AED placed. In Utah, the estimated likelihood of AED use assigned to census tracts was significantly correlated with 120 OHCAs attended by EMS personnel ( $\rho = 0.55$ ,  $p < 0.001$ ). **Conclusions:** Findings suggest that the AED placement model promoted by OHRP may determine the rural census tracts most likely to benefit from AED placement.

**08 DIFFERENTIAL EFFECTS OF PREHOSPITAL INTERVENTIONS ON SHORT- AND LONG-TERM SURVIVAL AFTER CARDIAC ARREST** Henry E. Wang, David Hostler, Alice Min, Clifton W. Callaway, *University of Pittsburgh, Pittsburgh, Pennsylvania*

**Objectives:** While Utstein guidelines recommend linking prehospital Advanced Cardiac Life Support (ACLS) interventions to long-term outcomes after out-of-hospital cardiac arrest (OOHCA), these actions may have different effects upon short- and long-term survival. We previously reported that this time-dependent relationship could not be adequately modeled using traditional survival analysis. **Objective:** To address this

limitation by using Cox regression with heavyside functions to account for different survival profiles on and after day 1. **Methods:** We studied adult ( $\geq 18$  years) cases from an OOHCA database in one city between 1998 and 2002. Time to death (days) after collapse was identified using the paramedic record or the Social Security Death Index. Clinical variables included age of patient, sex, witnessed collapse, bystander cardiopulmonary resuscitation (CPR), use of an automated external defibrillator (AED), initial electrocardiogram rhythm, medications, and response time intervals. For each covariate we defined two heavyside functions (time-varying coefficients) to separately model the effects of each predictor upon short-term (on day 1) and long-term (after day 1) survival. We used Cox regression with paired variable entry to identify independent predictors of the rate of death. The proportional hazards assumption was evaluated using Schoenfeld residuals and time-varying covariates. **Results:** Survival data were available for 1,416 patients. The majority (75%) of deaths occurred on day 1. Witnessed collapse (hazard ratio 0.85; 95% CI: 0.75–0.97) and the use of epinephrine (1.57; 1.20–2.07), lidocaine (0.78; 0.66–0.91), or dopamine (0.75; 0.56–1.00) were independently associated with rate of death on day 1. Epinephrine use (1.84; 1.23–2.78) and age (1.02; 1.01–1.03) were independently associated with rate of death after day 1. Initial rhythm, witnessed collapse, bystander CPR, the use of an AED, and response times were not associated with rate of survival on or after day 1. The proportional hazards assumption was satisfied (global test  $p = 0.99$ ; all time-varying covariates  $p > 0.05$ ). **Conclusions:** Short-term survival after OOHCA is associated with witnessed collapse and three resuscitative drugs, while long-term survival is primarily associated with epinephrine use and age. Many covariates have no effect upon short- or long-term survival. Prehospital ACLS interventions should be evaluated using primarily short-term outcomes.

**09 A RANDOMIZED CONTROLLED COMPARISON OF CARDIOPULMONARY RESUSCITATION PERFORMED ON THE FLOOR AND ON A MOVING AMBULANCE STRETCHER** Douglas C. Vogel, John Kim, Guy Guimond, David P. Hostler, Henry E. Wang, James J. Menegazzi, *University of Pittsburgh, Pittsburgh, Pennsylvania*

**Objectives:** The therapeutic importance of effective cardiopulmonary resuscitation (CPR) has recently gained renewed interest. We sought to compare the quality of CPR delivered on the floor (control) versus that performed on a moving stretcher. We hypothesized that CPR performed on the floor would be superior to that performed on a moving stretcher. **Methods:** We utilized a randomized cross-over experimental design. Subjects included emergency medical technician students, paramedic students, and emergency medicine

residents. All gave informed consent. Two-member teams were randomly assigned to perform two-rescuer CPR on a manikin either on the floor or on a moving stretcher. For three minutes, one member performed bag-valve-mask ventilations while the other performed chest compressions. They then switched roles and performed another three minutes of CPR. After a five-minute rest, the teams performed CPR in the same order but under the opposite condition. Compression and ventilation data were collected using a Resusci-Anne Modular System manikin connected to a computer. Dependent variables were compression depth (reported in mm), compression rate per minute, percentage of correctly performed chest compressions, and percentage of correctly performed ventilations. We compared data using two-tailed paired Student's *t*-test and chi-square, with  $\alpha = 0.05$ . **Results:** Sixty-two subjects, 68% male and average age of 25.2 years, completed the study. Total collected data consisted of 372 minutes of CPR and approximately 13,600 chest compressions. Compression depth performed on the floor ( $39.0 \pm 9.0$ ) was greater than that done on a moving stretcher ( $27.9 \pm 9.2$ ) with  $p < 0.001$ . The rates of chest compressions for the floor ( $110.1 \pm 17.2$ ) and on a moving stretcher ( $112.5 \pm 20.9$ ) were not different ( $p = 0.494$ ). The percentage of correct compressions performed on the floor ( $54.4 \pm 39.8$ ) exceeded that done on a moving stretcher ( $20.5 \pm 28.6$ ), with  $p < 0.001$ . The percentage of correct ventilations performed on the floor ( $42.7 \pm 26.3$ ) was greater than on a moving stretcher ( $24.4 \pm 21.2$ ), with  $p < 0.041$ . **Conclusions:** We found that CPR performed on the floor was superior to CPR performed on a moving stretcher in this manikin model. Both ventilation and compression performances were compromised while moving.

**10 DERIVATION OF A TERMINATION-OF-RESUSCITATION GUIDELINE FOR EMERGENCY MEDICAL TECHNICIAN-PARAMEDICS AND COMPARISON WITH A PUBLISHED EMERGENCY MEDICAL TECHNICIAN-DEFIBRILATOR GUIDELINE** **Laurie J. Morrison, Marian J. Vermeulen, Alexander Kiss, Lisa Nesbitt, Ian G. Steill, P. Richard Verbeek, Sunnybrook & Women's College Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada**

**Objectives:** We sought to identify characteristics associated with survival of out-of-hospital cardiac arrest attended by advanced paramedics (EMT-Ps) and compare them with a published out-of-hospital termination of resuscitation (TOR) guideline previously derived in cardiac arrests treated by emergency medical technician-defibrillation (EMT-D) attendants. **Methods:** Retrospective analysis of adult cardiac arrests treated by EMT-Ps in rural and urban emergency medical services (EMS) systems participating in the

Ontario Prehospital Advanced Life Support (OPALS) study. The EMT-D guideline proposed termination of resuscitation if the patient had no return of spontaneous circulation (ROSC), no shock administered, and EMS personnel did not witness the arrest. Multivariate logistic regression was used to examine the relationship between these variables, as well as bystander witness and bystander cardiopulmonary resuscitation (CPR), and survival to hospital discharge. Sensitivity and negative predictive value were calculated for the combination of predictive characteristics and the original rule. **Results:** 4,673 cardiac arrest patients were included; 3,098 (62%) were male, mean (SD) age was 66 (15), and 239 (5.1%; 95% CI 4.5–5.8) survived to hospital discharge. Among those with ROSC (3,841, 82%), only 3 survived (0.08%; 95% CI 0.02–0.23). Multivariate analysis showed that ROSC (OR 745; 95% CI 101.9–>999.9), bystander witness (OR 2.1; 95% CI 1.3–3.3), bystander CPR (OR 2.9; 95% CI 1.8–4.5), and shock prior to transport (OR 4.6; 95% CI 2.6–8.2) were associated with survival. A TOR guideline based on these variables was 100% sensitive (95% CI 98–100) for survival and had 100% negative predictive value (95% CI 100–100) for death. For the EMT-D rule, these values were 100% (95% CI 99.3–100) and 100% (95% CI 100–100), respectively. **Conclusion:** In the OPALS EMS systems, cardiac arrest patients may be considered for prehospital TOR after EMT-P resuscitation when there is no ROSC, no shock administered, no bystander CPR, and the arrest was unwitnessed by bystanders. The EMT-D TOR guideline appears equally sensitive. Both require prospective validation.

**11 PARAMEDIC STUDENT ENDOTRACHEAL INTUBATION SKILL IS ASSOCIATED WITH VOLUME OF PROCEDURAL EXPERIENCE** **Henry E. Wang, S. Robert Seitz, David Hostler, University of Pittsburgh, Pittsburgh, Pennsylvania**

**Introduction:** Proficiency in endotracheal intubation (ETI) is assumed to improve with accumulated experience on live patients. While the National Standard Paramedic Curriculum requires that paramedic students (PSs) perform at least 5 live ETIs, these novice intubators often have only limited live ETI opportunities. **Objective:** We evaluated whether PS ETI proficiency is affected by cumulative live ETI experience, elapsed duration of training, and clinical setting. **Methods:** We used longitudinal, multi-center data from 60 paramedic training programs over a two-year period. PSs reported outcomes (success/failure) for all live ETIs attempted in the operating room (OR), emergency department (ED), intensive care unit (ICU), and other in-hospital or prehospital (PH) settings. We used fixed-effects logistic regression to model up to 30 consecutive ETI efforts by each PS, accounting for per-PS clustering. For each patient we evaluated the association between

ETI success and the PS's cumulative number of ETI, adjusted for clinical setting, elapsed days of training, and the interaction (cumulative ETI  $\times$  elapsed days). We constructed predicted probability plots depicting the "learning curve" overall and for each clinical setting. **Results:** 802 students attempted between 1 and 74 ETIs (median 7; IQR 4–12). Only 547 (68%) achieved 5 or more successful ETIs. Of 7,635 ETIs included in the multivariate analysis, 6,464 (87.4%) were successful. 6,311 (82.7%) ETIs were performed in the OR, 271 (3.6%) in the ED, 64 (0.8%) in the ICU, 86 (1.1%) in other in-hospital settings, and 903 (11.8%) in the PH setting. Cumulative number of ETIs was associated with an increased adjusted odds of ETI success (odds ratio 1.07 per ETI; 95% CI: 1.04–1.09). Across all settings, predicted per-PS ETI success increased from 77.8% for the first ETI to 95.8% after 30 ETI (risk difference (RD) 18.0%). Improvement in predicted ETI success was largest for the PH (51.7% to 87.5%; RD 35.8%) and ICU (47.8% to 85.7%, RD 37.9%) settings. **Conclusions:** PS ETI success improves with accumulated live experience. PS ETI training should include a variety of live experience in both in-hospital and prehospital settings. PS ETI training in certain clinical settings (PH, ICU) may be more beneficial after baseline experience in controlled (OR) situations.

**12 ARE PARAMEDIC STUDENTS MEETING THE CLINICAL EXPERIENCE RECOMMENDATIONS FROM THE CURRENT NATIONAL STANDARD CURRICULUM?** **David I. Page, Nicole L. Stethem, Koren L. Kaye, James P. Manson, Inver Hills Community College, Inver Grove Heights, Minnesota**

**Introduction:** Clinical experiences are one of the most important learning opportunities for paramedic students. The current Paramedic National Standard Curriculum recommends that the paramedic student perform a specific number of goals. These goals consist of psychomotor skills, comprehensive patient assessments, and the formulation as well as implementation of treatment plans for patients of varying ages with different pathologies and complaints. There is also a recommendation to serve as a team leader in prehospital emergency situations. These goals were derived by an informal survey of accredited paramedic program directors. **Objective:** Hypothesis: most graduating paramedic students meet the recommended goals of the current Paramedic National Standard Curriculum. **Methods:** Between January 2001 and December 2003, paramedic students participating in FISDAP, a national computerized student tracking system, used a Web page to prospectively report their clinical experiences. The students' preceptors also completed a paper evaluation. Instructors at each of the participating training programs then verified the data by compar-

ing the computerized records to the paper evaluations. Inclusion criteria consisted of student consent, successful graduation, and instructor verification of student records. **Results:** Records from 812 paramedic graduates from 65 geographically distinct institutions met the inclusion criteria for the study. Only 49 (6%) completed all of the recommended goals. The most commonly completed skills were the 15 medication administrations (92%), 25 intravenous access completions (89%), five endotracheal intubations (64%), and 50 adult evaluations (64%). Less than half the graduating paramedic students completed the remaining goals of assessing 30 geriatric (47%), 40 trauma (32%), 20 psychiatric (33%), 10 obstetric (25%), and 30 pediatric (21%) patients, leading 50 patient encounters (40%), and ventilating 20 unintubated patients (13%). Additionally, less than half completed the goal of assessing, formulating, and implementing treatment plans in 20 patients with respiratory (47%) and 30 patients with chest pain (26%) complaints. **Conclusion:** The majority of paramedic students did not complete the goals recommended by the National Standard Curriculum. More research is needed to determine why the majority of graduating paramedic students fail to meet these recommended goals.

**13 CHARACTERISTICS OF AMBULANCE CRASHES COMPARED WITH MOTOR VEHICLE CRASHES INVOLVING SIMILAR-SIZED VEHICLES** **Adam M. Ray, Douglas E. Kupas, Geisinger Health System, Danville, Pennsylvania**

**Objective:** To better describe the characteristics and associated occupant injuries of motor vehicle collisions (MVCs) involving ambulances as compared with MVCs involving other similar-sized vehicles. **Methods:** The Crash Outcome Data Evaluation System database is a statewide, population-based computerized database related to MVCs, containing information collected by police at the scene of a crash and prehospital personnel. All crashes reported to the database for the year 2000 were included. Analysis compared the characteristics of crashes involving ambulances with those of crashes involving vehicles with similar body types. Crash demographics (e.g., location of crash, roadway conditions, intersection type) and associated injuries were examined to determine if any differences exist between ambulances and ambulance-sized motor vehicles. Comparisons between groups were made using chi-square tests and Fisher's exact test. **Results:** A total of 100,235 MVCs were identified, 288 of which involved ambulances and 99,937 involved other similar-sized vehicles. Most crash demographics, including day and time of crash, environmental light conditions, and road surface, were similar, but ambulances were more likely to be involved in 4-way intersection (43% vs. 25%,  $p = 0.001$ ) and angle collisions

(47% vs. 33%,  $p = 0.001$ ). Ambulances were more likely to be involved in multi-vehicle collisions (84% vs. 75%,  $p = 0.001$ ). More people were typically involved in ambulance MVCs ( $p = 0.001$ ), with 85% of ambulance MVCs involving 3+ people and 33% involving 5+ people. Pedestrian involvement in these MVCs was rare (3% in both groups). Injuries were reported in 29% of ambulance MVCs and 31% of others, with the police-reported injury severity rates being similar. Prehospital EMS data showed no difference in patient Glasgow Coma Score (GCS), injury site, type of injury, and patient condition on scene and at facility. **Conclusion:** The characteristics of MVCs involving ambulances are similar to those of other similar-sized vehicles. Ambulance MVCs occur more frequently at intersections and involve more people.

**14 MANAGING RISK AND REDUCING CRASHES: IMPLEMENTING A DRIVER PERFORMANCE-MEASURING DEVICE IN GROUND AMBULANCES** **Nadine R. Levick, Jon Swanson, Maimonides Medical Center, New York, New York**

**Objectives:** To determine if emergency vehicle driver behavior can be modified and improved through the installation of an on-board, computer-based, monitoring device. **Methods:** The on-board computer system used was installed at Metropolitan Emergency Services from March 2002 to February 2003. The system was operational for 12 months in a fleet of 28 ambulances, with more than 185 drivers and 1.2 million miles of recorded vehicle operations. The system monitors a number of parameters every second, and records penalty points or counts for exceeding these parameters, and stores the data on an on-board computer and downloads the data to a base station for analysis and generation of electronic real-time reports. The on-board system provides an audible feedback to the driver with warning tones. The parameters measured include vehicle speed, hard acceleration/braking and cornering g-forces, use of emergency lights and sirens, turn signals, and parking brake. **Results:** The implementation of the system using this approach was well received by the providers. Performance has improved from a March/April baseline of over 56 penalty points or counts for every mile driven to a performance peak in August of 15.8 miles between each penalty point or count. Seatbelt violations have dropped from 13,500 in April to 4 violations in August. There was one vehicle mishap with the system installed in more than 1.25 million miles of operations. **Conclusion:** There has been a dramatic, measurable improvement in driver performance in every measured area with the on-board system installed. A sustained improvement in safety proxies was demonstrated over a 12-month period, with no inservice or retraining after the initial introduction period. Implementation of a black box system for enhancing safety in the ambu-

lance transport environment has demonstrated to be an effective approach requiring minimal inservice training time and optimal safety outcome. Use of the black box should be encouraged for widespread implementation throughout the emergency medical services system to optimize safety.

**15 FEASIBILITY OF BRAIN ACOUSTIC MONITORING IN THE PREHOSPITAL SETTING FOR TRIAGE OF PATIENTS WITH POSSIBLE TRAUMATIC BRAIN INJURY** **Douglas J. Floccare, John M. Sewell, Colin F. Mackenzie, Carmen D. Embert, Robert R. Bass, Maryland Institute for EMS Systems, Baltimore, Maryland**

**Introduction:** Field evaluation of traumatic brain injury (TBI) is complicated by intoxication from alcohol or drugs in up to 45% of patients. Patients may not be triaged to trauma centers because intoxication may mask TBI, or those who are simply intoxicated may be driven or flown extended distances to have TBI ruled out. In hospitalized patients, a noninvasive acoustic sensor designed to measure and amplify brain sound waves originating from arterial pulsations can accurately predict traumatic computed tomography (CT) abnormalities with up to 93% sensitivity. Patients with normal acoustic waveforms had up to 100% uneventful recoveries. **Objective:** This pilot study utilized a newly downsized Brain Trauma Assessment System (BTAS) in the prehospital setting to perform brain acoustic monitoring in patients with impaired consciousness. **Methods:** The BTAS consisted of two acoustic sensors connected to a handheld pocket personal computer (PC) with a signal conditioning cradle. To obtain a reading, one sensor was placed on the patient's forehead and one was placed over the radial artery. A relatively motionless period of 10 seconds was required for data acquisition. One reading was taken at the scene of injury, one during transport, and one after hospital arrival. The pilot study focus was on whether accurate acoustic waveforms could be documented during ongoing patient care and immobilization, subject to the space, noise, lighting, and vibration challenges of the prehospital environment. **Results:** The BTAS was tested on fifteen Medevac subjects: two normal controls and thirteen patients with possible TBI. Interpretable waveforms were documented for all subjects. Noise and vibration in flight resulted in predictable frequency spikes which did not impair waveform interpretation after application of subtraction analysis/noise cancellation algorithms. Seven patients showed normal BTAS waveforms. CT scans were all normal in this group. Six patients showed abnormal BTAS waveforms. CT demonstrated traumatic abnormality in two of these six patients. **Conclusion:** It appears feasible to perform brain acoustic monitoring in the prehospital setting. Larger numbers of patients will be required to determine its

sensitivity, specificity, and predictive value as a triage tool for possible TBI in the field.

**16 STRESS TEST PERFORMANCE DOES NOT PREDICT MANIKIN RESCUE PERFORMANCE** **Jonnathan M. Busko, Tom H. Blackwell, Lawrence Raymond,** *Carolinas Medical Center, Charlotte, North Carolina*

**Objectives:** Various physiologic tests and measures, including Maximal Bruce Protocol Exercise Electrocardiography (GXT), are recommended to screen firefighters, Hazmat personnel, and rescue technicians who may experience heat stress while performing their duties. Their use in predicting job performance has not been validated. The purpose of this study was to determine if GXT performance, body mass index (BMI), or weight predicted individual performance during a simulated rescue evolution. **Methods:** Participants previously performed GXT to a maximum time ( $GXT_{max-t}$ ), and had a weight and BMI evaluation as part of their routine job screening. For this study, each participant donned level-B protective gear (hooded coveralls and self-contained breathing apparatus) and was subjected to physical stress through a simulated manikin rescue. Performance was terminated when (1) the subject achieved a 90% maximum heart rate determined from previous GTX, (2) a core temperature measurement of  $>102^{\circ}F$  was obtained, or (3) subjective fatigue was reached. Maximum heart rate during the scenario ( $HR_{max}$ ) and total flights of stairs ( $N_{fs}$ ) climbed were recorded. **Results:** Data were collected on 57 individuals. Correlation coefficients were determined for BMI v.  $HR_{max}$  ( $r = 0.02$ ), weight v.  $HR_{max}$  ( $r = 0.08$ ),  $GXT_{max-t}$  v.  $HR_{max}$  ( $r = 0.28$ ), BMI v.  $N_{fs}$  ( $r = -0.15$ ), weight v.  $N_{fs}$  ( $r = -0.06$ ), and  $GXT_{max-t}$  v.  $N_{fs}$  ( $r = 0.29$ ). There were no differences in correlation coefficients for those subjects who terminated the simulation for maximum heart rate, for maximum temperature, or for subjective fatigue. **Conclusions:** Although GXT, BMI, and weight are frequently used to screen public safety professionals for injury risk and ability to perform job tasks, in this study they did not predict performance during a simulated rescue. Since these tests may not be valid for predicting actual job performance, future research should focus on determining what physiologic tests accurately predict performance during simulated and actual job tasks.

## Poster Presentations

**17 PREHOSPITAL ANALGESIA USE IN ADULTS AND CHILDREN** **John L. Alexander, Dawn B. Kendrick,** *Maine Medical Center, Portland, Maine*

**Objective:** Describe the use of prehospital analgesia in adults and children with suspected extremity fractures or burns. **Methods:** Retrospective review of all patient encounters in a statewide emergency medical services (EMS) database from January 2001 through December 2002. The statewide database consists of rural and urban EMS systems with 200,000+ annual patient encounters. Records for all patients with fractures or burns, excluding multi-system trauma and head injuries, were included. Data collected included age, injury type, analgesic administration, and adjunctive therapies for fracture management. Interventions including oral suctioning, oral/nasal airway, bag-valve-mask ventilation, endotracheal intubation, cardiopulmonary resuscitation, and naloxone use were collected for patients receiving analgesia. The study was approved by the hospital institutional review board. **Results:** A total of 426,767 EMS runs were reviewed. Fractures or burns were identified in 25,647 patients. Of these, 21,393 patients were included in the study, with 4,254 meeting exclusion criteria. There were 2,120 (9.9%) patients less than 18 years of age, compared to 19,273 (90.1%) patients who were 18 years and over. Overall, 9.9% of patients received any type of analgesia. The rate of analgesia use in patients less than 18 years of age was 13.0% (95% confidence interval [CI]: 11.6%, 14.5%). For patients 18 years of age and older, 9.5% received analgesia (95% CI: 9.1%, 10%). Of the 20,584 patients with fractures, 49.7% (95% CI: 47.5%, 51.9%) of children and 23.2% (95% CI: 22.6%, 23.8%) of adults were splinted, cold application occurred in 38.0% (95% CI: 37.5%, 42.0%) of children and 14.8% (95% CI: 14.3%, 15.3%) of adults, and an intravenous line was placed in 21.9% of children and 22.3% of adults. Adults receiving analgesia were more likely to undergo an intervention for airway or vascular compromise compared with those receiving no analgesia (1.1% vs. 0.5%). Only 1 child (0.1%) who received analgesia required any airway or cardiovascular intervention. **Conclusions:** Children were more likely to receive analgesia for their injuries when compared to adults. In addition, children were more likely to receive adjunctive therapy for fracture management. The need for airway or cardiac interventions in patients receiving analgesia was limited. The overall rate of analgesia delivery remains low.

**18 EVALUATION OF A SYSTEM OF NON-TRANSPORT FOR PEDIATRIC PATIENTS REQUESTING EMS SERVICES** **Christopher J. Haines, Esther R. Lutes, Norman Christopher, Mark Blaser,** *Akron Children's Hospital, Akron, Ohio*

**Background:** In a time when emergency department overcrowding, ambulance diversion, and increased out-of-service times for highly skilled paramedics are increased, a highly functional prehospital system will

balance the needs of the individual patient with the more global needs of the community it serves. Our community addressed these issues through the development of a multi-tiered prehospital care system that incorporates unique protocol-driven operational procedures including emergency medical services (EMS)-initiated non-transport of pediatric patients (EINT). **Objective:** To evaluate a system of non-transport for pediatric patients requesting EMS services. Our main outcome measure was the determination of appropriate medical follow-up, hospitalization, and patient safety after designation as EINT. **Methods:** This was a prospective observational case series including consecutive pediatric patients designated EINT during a six-month period between August 2003 and January 2004. **Results:** There were 5,336 EMS requests during the six-month period. Seven hundred four were designated EINT, of which 74.8% completed phone follow-up. Category of EMS request included minor medical illness 43.4%, trauma 44.4%, motor vehicle collision 11.5%, and other 0.7%. The median age of the children was 8 years. Fifty-three percent of children were evaluated by a medical professional within 72 hours after initial EMS request, with a median time to evaluation of 2.5 hours. There were 13 admissions (2.4%, CI 1.3–4.3%) to the hospital after EINT designation. Admissions after EINT had trends toward younger age ( $p = 0.022$ ) as well as medical etiology ( $p = 0.006$ ). There were no pediatric intensive care unit admissions or deaths. Family satisfaction was measured using a five-point Likert scale with a mean of 4.43, SD 0.90, for all non-transports and a mean of 4.65, SD 0.45, for admitted non-transports. **Conclusion:** This system is an alternative to traditional EMS protocols, allowing effective resource utilization with a high level of patient safety and family satisfaction. Our system could be generalized to other systems; however, the level of risk is dependent on the community in which the system functions.

#### 19 PREHOSPITAL SEIZURE MANAGEMENT IN PEDIATRIC PATIENTS **John L. Alexander, Dawn B. Kendrick, Maine Medical Center, Portland, Maine**

**Objective:** To describe emergency medical services (EMS) management of pediatric patients with seizures. **Methods:** A retrospective review of more than 400,000 patient encounters in a statewide EMS database from 2001 to 2002 was performed. Data for all patients less than 18 years old with a chief complaint of seizure were collected, including age, gender, category of seizure (e.g., diabetic or trauma-related), initial Glasgow Coma Scale (GCS) score, use of cardiac monitor or pulse oximetry, intravenous (IV) attempts, oxygen administration, medications administered (including glucose, naloxone, and diazepam), and airway management procedures performed (including clearing/suctioning

the airway, oral/nasal airway placement, bag-valve-mask use (BVM) or endotracheal intubation). The data were analyzed for patients according to GCS using descriptive statistics. The study was approved by the hospital institutional review board. **Results:** 1,727 cases of seizures were reviewed: 877 (50.8%) were males. The age range for all GCS scores was 0–16 years, with a mean of 5.9 years ( $\pm 5.4$  years). Children 2 years old or less accounted for 43.4% of cases. 2% of cases were categorized as trauma-related. Of the 1,541 patients with a valid GCS score, 57.3% had a GCS of 15, 42.7% had a GCS of 3–14, and 16.7% had a GCS of 3–8. For all patients, 8.6% received any airway intervention, of which suctioning/clearing was most common (5.4%). For support interventions, 58.5% received oxygen, 50.8% had pulse oximetry, 35.8% were cardiac-monitored, and 25.9% had an IV attempted. The most common medication administered was diazepam (4.1%), followed by dextrose (0.5%) and naloxone (0.4%). For the 257 patients with a GCS of 3–8, 34.6% received any airway intervention, including suctioning/clearing (19.4%) and BVM (10.9%). For support interventions, 85.2% received oxygen, 69.3% had pulse oximetry, 54.5% were cardiac-monitored, and 42.0% had an IV attempted. The most common medication administered was diazepam (16.7%), followed by naloxone (1.9%) and dextrose (0.4%). **Conclusions:** The majority of pediatric patients transported by EMS have a normal GCS and require only occasional interventions. Patients with severe mental status changes receive frequent interventions. More studies are needed to further assess the appropriate therapies for pediatric seizures in EMS.

#### 20 ACCURACY OF THE LENGTH-BASED RESUSCITATION TAPE FOR DETERMINING PEDIATRIC WEIGHTS IN THE PREHOSPITAL SETTING **Sara R. Shimmin, Brian R. Moore, Daniel G. Hankins, Mayo Clinic, Rochester, Minnesota**

**Objectives:** The length-based resuscitation tape (LBT) has been shown to be an accurate tool for determining patient weight and endotracheal tube size during pediatric emergencies in the hospital, but there have been no studies published evaluating the LBT in the prehospital setting. The purpose of this pilot investigation was to evaluate the accuracy of paramedic LBT use in the field. **Methods:** The pediatric protocol of an advanced life support paramedic ambulance service based at an academic medical center is to obtain the patient's weight by LBT. All of the paramedics are Pediatric Advanced Life Support (PALS)-trained and have completed additional training on the proper use of the LBT. In a pilot study of 37 patients, EMS and hospital charts were retrospectively reviewed. The weights obtained by paramedics using the LBT were compared to those measured on the scale at the receiving institution.

**Results:** In 23 patients (62%), the weight matched within the defined color category for the patient. In 12 patients (33%), the LBT weight was one color category away from the color category containing the actual weight. Two (5%) were found to be two colors away, both of which the LBT underestimated the patient's weight. Of the 14 patients with misidentified weights by LBT, 10 patients (27%) were underestimated compared to the actual weight, and for 4 patients (11%) the weights were overestimated. **Conclusions:** When using the LBT, PALS-trained paramedics were able to accurately obtain the true weight color of a pediatric patient in 62% of the cases. 95% of the patients were accurately identified within one color above or below their category. Further studies would be helpful to delineate if the differences in weights are due to errors in LBT use or to inaccuracies in the tape for the study population, and a larger sample size is needed to achieve statistical significance.

**21 AN IMPEDANCE THRESHOLD DEVICE SIGNIFICANTLY INCREASES INVASIVELY MEASURED ARTERIAL PRESSURES DURING STANDARD CARDIOPULMONARY RESUSCITATION IN OUT-OF-HOSPITAL CARDIAC ARREST** **Ronald G. Pirralo, Tom P. Aufderheide, Terry Arend Provo, Keith G. Lurie,** *Medical College of Wisconsin, Milwaukee, Wisconsin*

**Introduction:** Use of an inspiratory impedance threshold device (ITD, Advanced Circulatory Systems, Inc.) enhances venous return to the heart during standard cardiopulmonary resuscitation (sCPR), improving hemodynamics in laboratory animals. **Objective:** Hypothesis: The ITD will significantly increase blood pressure (BP) in adult, out-of-hospital, cardiac arrest patients during sCPR. **Methods:** This prospective, randomized, double-blind, out-of-hospital study was conducted in an urban emergency medical services (EMS) system. EMS personnel used an active or sham (non-functional) ITD applied to an endotracheal tube during sCPR in subjects >21 years old in cardiac arrest of presumed cardiac etiology. Active and sham ITDs were indistinguishable. Care between groups was identical except for ITD type. Low-dose epinephrine (1 mg) was used per American Heart Association guidelines. An on-scene physician and paramedic acquired and measured invasive femoral arterial BP. BP measurements for the first 6 min of recorded data during sCPR were averaged and analyzed with an unpaired Student's t-test. At least 2 min of BP data during sCPR with the ITD defined a priori successful enrollment. **Results:** Of 39 possible subjects, >2 min of data were obtained in 21 (54%) subjects (10 active; 11 sham). Age, gender, height, weight, 911-response interval, frequency of witnessed arrest and bystander CPR, initial recorded rhythm, and average epinephrine dose were not significantly differ-

ent between groups. The mean  $\pm$  SEM interval (min) between 911 call and first invasive BP measured was  $34.0 \pm 3.5$  in the active and  $35.2 \pm 2.7$  in the sham group,  $p = \text{NS}$ . Mean  $\pm$  SEM systolic BP (mm Hg) was  $86.7 \pm 7.7$  in the active and  $51.8 \pm 5.4$  in the sham group,  $p < 0.001$ . Mean  $\pm$  SEM diastolic BP was  $22.2 \pm 4.4$  in the active and  $17.3 \pm 2.5$  in the sham group,  $p = \text{NS}$ . No significant adverse device or monitoring events occurred. **Conclusions:** Use of an active ITD during sCPR safely and significantly increased systolic BP in out-of-hospital cardiac arrest patients. We also demonstrated it was possible to effectively acquire invasive BP in this unique population. The >50% increase in blood pressure supports the use of an ITD as a circulatory adjunct during sCPR.

**22 EMS PROVIDERS' EXPERIENCE WITH FAMILY PRESENCE DURING OUT-OF-HOSPITAL RESUSCITATION** **Alexander Madgy, Mark Goldstein, Debra Seguin, Brian J. O'Neil, Scott Compton, Robert A. Swor,** *Wayne State University, William Beaumont Hospital, Royal Oak, Michigan*

**Introduction:** Allowing family presence during emergency department resuscitations is controversial. Emergency medical services (EMS) providers frequently have families present during resuscitations. **Objective:** To describe paramedics' attitudes toward, and experiences with family presence during EMS resuscitations. **Methods:** Setting: Suburban EMS system. We surveyed EMS providers in 4 communities regarding their experiences with patients' families during out-of-hospital resuscitations. Survey elements included: provider demographics and resuscitation experience; provider experience with, and preferences toward family presence at resuscitation; and perceived impact of family on the conduct of resuscitation. They were also queried regarding their roles in consoling families, and their level of comfort with this role. Questions were either yes/no or utilized a 5-point Likert scale. Descriptive statistics are reported. **Results:** We surveyed 97 EMS providers from 4 advanced life support suburban fire departments. We received 69 (71.0%) surveys; all respondents were male; all reported experience with families' presence; 48 (69.6%) were EMT-Ps. Their average age was 40 years, had an average of 14.3 years of EMS experience, and most (82.6%) had participated in >20 cardiac arrests. Of all respondents, 28 (40.6%) had been threatened or concerned about their well-being during resuscitation, and one reported being shown a gun. Many (25, 36.2%) reported that family presence negatively impacted their ability to perform resuscitative procedures, including 12 (17.4%) who reported physical interference with resuscitative efforts. A minority (19, 27.5%) felt that family presence affected their decisions, although few (11, 15.9%) felt that families often

interfered. A small proportion (10, 14.5%) preferred that family members witness resuscitations. On univariate analysis we found no difference in comfort with family presence by age, years of EMS experience, or level of training. When questioned regarding interactions with family, most (57, 82.6%) providers identified that they provided emotional support to family members, and a majority (54, 78.3%) felt comfortable with this role. Almost half (36, 52.2%) believe that family members benefit from witnessing resuscitation. **Conclusions:** EMS providers perceive that family presence at resuscitations impacts the provision of care. They often provide emotional support to family members of critically ill patients. EMS education should address psychosocial issues of resuscitation.

**23 POTENTIAL IMPACT OF A TARGETED CPR PROGRAM FOR OLDER ADULTS** **Robert A. Swor, Gail Fahoome, Scott Compton, William Beaumont Hospital, Royal Oak, Michigan**

**Introduction:** Traditional cardiopulmonary resuscitation (CPR) training programs do not target older adults who are most likely to witness private-residence cardiac arrests, nor reliably result in a bystander who is likely to perform CPR in the event of an arrest. **Objective:** To compare targeted CPR training programs for older adults (>50 yrs) that: (1) increase numbers of CPR trained bystanders or (2) increase the percent of trained bystanders who perform CPR. A simultaneous outcome was to estimate the minimal significant survival benefit associated with each of the training programs. **Methods:** A probabilistic simulation model was developed in Fortran95 that incorporated key out-of-hospital cardiac arrest elements, including witnessed arrests, CPR-trained witness, CPR provision, and impact of CPR on ventricular fibrillation. Input data were derived from published or publicly available data, including a large prospective cohort study of outcomes. Monte Carlo simulation ( $n = 10,000$ ) and sensitivity analyses ( $n = 40$ ) were used to assess median and 95% confidence intervals for incremental survival with either intervention. **Results:** The baseline model, calibrated to the input-data community's characteristics, established 40.8% of cardiac arrest bystanders were trained in CPR; however, only 25.7% performed CPR. This yielded 4.81% survival (95% CI 4.72–4.89). Modeling the impact on the baseline training level with increased CPR performance among trainees indicated that 75% of trained bystanders would need to perform CPR in order to reach a minimally significant improvement in survival (5.02%, 95% CI: 4.94–5.15). Similarly, targeted CPR training that would result in a significant survival benefit (to 5.01%, 95% CI 4.93–5.09) would require that 70.8% of bystanders be trained. **Conclusions:** CPR training programs that focus on yielding 75% of

trainees who perform CPR in the event of witnessing an arrest would have equivalent results to mass CPR training programs that result in 70% of arrest bystanders' being CPR-trained. However, the minimal survival benefit associated with these programs (~0.2%) may prove neither method to be cost-effective.

**24 A SIMPLE ADAPTIVE FILTER ALGORITHM TO REMOVE CPR ARTIFACTS FROM ECG SIGNALS** **Qing Tan, Frederick Geheb, James E. Brewer, ZOLL Medical, Chelmsford, Massachusetts**

**Introduction:** Resuscitation protocols for prehospital cardiac arrest often include defibrillation by automated external defibrillators (AEDs). As an essential part of these protocols, cardiopulmonary resuscitation (CPR) introduces electrocardiographic (ECG) artifacts due to compressions. To detect rhythms, ECG analysis in AEDs requires interrupting CPR. Methods to remove CPR-induced artifacts have been evaluated but are too complex for effective use. **Objective:** We developed an adaptive filtering method (AFM) to remove CPR-induced artifacts, and we hypothesized that AFM would significantly improve ECG analysis during CPR. **Methods:** AFM comprises an adaptive step (constructing CPR artifact "signals" using compression velocity) and an estimation step (subtracting artifact signals from ECG with zero-order adaptive filter) to create artifact-free ECG. Velocity was derived using accelerometer data from a device placed between hand and chest. **Results:** AFM was tested with 459 ECG episodes of shockable ( $n = 200$ ) and non-shockable ( $n = 259$ ) rhythms at compression cycle of 90 per minute and average compression depth of 2 inches. A 10-dB increase in signal-to-noise ratio was observed between filtered ECG and unfiltered ECG, with artifact attenuation  $\geq 35$  dB ( $\geq 98\%$  decrease in artifact amplitude). In a clinical pilot ( $n = 6$ ), AFM was evaluated using 98 non-shockable 9-second episodes of patient ECG rhythm with CPR artifact. AFM increased specificity from 82/98 to 91/98 ( $p = 0.046$ ) while maintaining high sensitivity. **Conclusions:** Artifact-free ECG signals were reconstructed with an adaptive filter that can be used in an AED. Preliminary findings indicate that the adaptive filter may assist an AED to "see through" compression artifacts to analyze ECG rhythms during CPR.

**25 MULTIVARIATE PREDICTORS OF PER-RESCUER PREHOSPITAL ENDOTRACHEAL INTUBATION VOLUME** **Henry E. Wang, David Hostler, Douglas F. Kupas, Robert Cooney, University of Pittsburgh, Pittsburgh, Pennsylvania**

**Introduction:** Proficiency in prehospital endotracheal intubation (ETI) may be difficult to maintain without regular clinical experience. American Heart

Association (AHA) guidelines recommend that rescuers perform 6–12 ETIs/year. **Objective:** In this study we calculated per-rescuer prehospital ETI volumes for a demographically diverse state. We also identified independent clinical and demographic predictors of the per-rescuer frequency of prehospital ETI. **Methods:** We used statewide prehospital patient care records for calendar year 2003. We included advanced life support rescuers with at least one patient contact. We calculated the number of ETIs performed by each rescuer. We calculated univariate relationships between ETI frequency, rescuer age, and per-rescuer clinical and demographic mix. We used multivariate negative binomial regression to identify independent predictors of per-rescuer ETI volume. **Results:** For 1,322,363 patient care records, 6,112 rescuers performed a total of 13,648 ETIs. Per-rescuer ETI volume ranged from 0 to 23 (median 1; IQR 0–3). 2,293 rescuers (37.5%; 95% CI: 36.3–38.7%) did not perform any ETIs during the study period. Only 764 rescuers (12.5%; 11.7–13.4%) attained the AHA guideline of 6 or more ETIs. The median per-rescuer ETI incidence was 5 ETIs/1,000 patient contacts/year (IQR 0–16). On multivariate regression, independent demographic predictors of per-rescuer ETI frequency included (all ordinal): rescuer age (rate ratio 0.87; 95% CI: 0.84–0.90), mean patient age (1.04; 1.01–1.08), fraction of male patients (1.04; 1.01–1.07), fraction of air medical cases (1.12; 1.10–1.13), mean response time (0.92; 0.88–0.96), and number of patient contacts (1.003; 1.001–1.004). Independent clinical predictors of per-rescuer ETI frequency included mean GCS (0.90; 0.88–0.93), and numbers of cardiac arrests (1.41; 1.37–1.46), major traumas (1.08; 1.06–1.10), respiratory patients (1.15; 1.12–1.17), and patients in life-threatening condition (1.14; 1.12–1.16). Rescuer practice population mix (urban/rural) was not significant. **Conclusions:** In this demographically diverse state, prehospital rescuers performed ETI at limited frequencies. Per-rescuer ETI volume is related to patient and rescuer demography, but is associated primarily with severity of patient mix. Prehospital rescuers, particularly those who do not care for large numbers of high-acuity patients, may not be able to rely upon clinical experience alone to maintain proficiency in ETI.

**26 ESOPHAGEAL INTUBATION IN AN EMS SYSTEM: A 6-YEAR EXPERIENCE** Colleen J. Buono, Daniel P. Davis, Gary M. Vilke, Barbara Stepanski, *University of California San Diego, San Diego, California*

**Background:** Proper confirmation of endotracheal (ET) tube position should eliminate unrecognized esophageal tube placement following prehospital intubation attempts; however, recent data document a high incidence of misplaced ET tubes upon emergency department (ED) arrival. **Objective:** To doc-

ument paramedic confirmation strategies in patients identified by ED personnel as having esophageally positioned ET tubes. **Methods:** The emergency medical services quality assurance (QA) program in our county includes mandatory reporting of all ET tubes that are determined to be esophageally positioned upon arrival in the ED; subsequent determination of esophageal intubation versus dislodgment is made by an audit committee using available documentation. Prehospital records were abstracted for all reported esophageally positioned ET tubes from July 1997 to February 2004. Demographic data, chief complaint, cardiac rhythm, indication for intubation, and ET tube confirmatory techniques were recorded for each patient. To identify potential cognitive errors by prehospital personnel, the initial and ongoing approach to ET tube confirmation was categorized in a stepwise fashion as: digital display capnometry (DDC), qualitative capnometry (QC), esophageal detection device (EDD), or clinical exam (CE). Descriptive statistics were used to describe results. **Results:** A total of 33 esophageally positioned ET tubes were reported; 23 were determined to be esophageal intubations and 10 were determined to have been dislodgments. This represents <1% of all paramedic intubations during the 6.5-year study period. Of the 23 esophageal intubations, DDC was used in 1 patient (4%), QC in an additional 5 patients (22%), EDD in another 2 patients (9%), and CE in 1 other patient (4%). Of the 10 dislodgments, DDC was used initially in 1 patient (10%), QC in an additional 1 patient (10%), EDD in another 2 patients (20%), and CE in 1 other patient (10%). None of the 33 patients had documentation reflecting ongoing assessment of ET tube position en route, including those with access to DDC. **Conclusions:** Paramedic esophageal intubations appear to be related to an improper approach to ET tube confirmation. In addition, dislodgments appear to result from a failure to appropriately reassess ET tube position en route.

**27 INCORPORATION OF THE LARYNGEAL MASK AIRWAY INTO A PREHOSPITAL AIRWAY MANAGEMENT PROTOCOL: THE KENTUCKY LMA PILOT PROJECT REPORT** Irvin E. Smith, Jamey Locke, Scot Harp, *Mercy Regional EMS, Paducah, Kentucky*

**Objective:** We evaluated the laryngeal mask airway (LMA) as a rescue airway device in the event of failed prehospital endotracheal intubation. **Methods:** Our emergency medical services (EMS) airway management protocol was revised with the addition of the LMA. Paramedics completed an airway management update that included didactic and clinical training in the use of the LMA. The airway course stressed oxygenation and ventilation by both basic and advanced airway techniques and endotracheal placement

confirmation by clinical exam, capnometry, and pulse oximetry. All patients requiring any invasive airway management over a one-year period were included in the study. **Results:** After retrospective EMS chart review, 110 patients were entered into the study. Endotracheal intubation was attempted in 96 patients and was successful in 77 (80%). There were no unrecognized esophageal intubations. In 9 (75%) of these patients with failed intubation, the LMA was successfully utilized. In 3 of the patients, the LMA was successfully placed but ventilation was inadequate because of LMA cuff leak because of decreased pulmonary compliance. In 7 patients, basic airway procedures were used to manage the airway after failed intubation. In 13 patients, the airway was managed with basic procedures rather than endotracheal intubation. Outcome studies showed the highest survival-to-discharge rates in the groups receiving primary basic airway management (92%) and rescue by basic airway management (71%) when compared to those receiving endotracheal intubation (18%) or LMA placement (25%). **Conclusions:** The LMA may be utilized as a rescue airway device for failed prehospital endotracheal intubation. Paramedics can easily learn the protocols and techniques for LMA placement. The LMA effectiveness is limited in patients requiring increased ventilating pressures with poor pulmonary compliance. Although advanced airway techniques are critically important skills and endotracheal intubation is the "gold standard" for airway management, good patient outcomes can be obtained by utilizing basic airway management techniques in the subset of patients with respiratory distress/arrest who maintain a perfusing rhythm.

**28 DOES NEUROMUSCULAR BLOCKADE OFFER AN ADVANTAGE OVER THE USE OF DEEP SEDATION ALONE WHEN PERFORMING ENDOTRACHEAL INTUBATION ON PATIENTS WITH A GCS < 8?** **Ross E. Megargel, Diane McGinnis-Hainsworth, Robert E. O'Connor,** *Christiana Care Health System, Newark, Delaware*

**Objective:** Pharmacologic adjuncts are frequently used in the prehospital setting to facilitate endotracheal intubation in uncooperative patients. This study was conducted to determine whether neuromuscular blockade (NMB) offered an advantage over the use of deep sedation alone when performing endotracheal intubation on patients with a Glasgow Coma Score (GCS) < 8. **Methods:** Trauma patients having endotracheal intubation attempted in the prehospital setting were eligible. Patients were required to have a GCS of 8 or less, to be uncooperative, and not to be in cardiac arrest. Depending on which type of agency they were employed by, paramedics were trained to use deep sedation alone, or deep sedation in combination with NMB. Treatment allocation was determined by whether the paramedic

agency was authorized to use deep sedation (etomidate and midazolam) with or without NMB (succinylcholine). Patients were eligible if laryngoscopy was performed. Success was determined using end-tidal CO<sub>2</sub> and clinical methods. Patients who could not be intubated were ventilated during transport using the bag-valve-mask. Statistical analysis was performed using the Yates-corrected chi-square test and by performing a post-hoc power analysis with a significance set at 0.05. **Results:** A total of 92 patients were enrolled; 45 in the sedation-only group and 47 in the sedation + NMB group. Clinical situations associated with a GCS < 8 included multiple trauma in 42, isolated head injury in 48, and burns in 2. The two groups were comparable in mean age, gender distribution, and proportion with isolated head injury. Intubation success rate was 82% (37/45) in the sedation-only group and 85% (40/47) in the sedation + NMB group ( $p = \text{NS}$ ). Post hoc power calculation was 94%. Reasons cited for failure to intubate included inability to visualize the vocal cords, and inability to properly pass the endotracheal tube. **Conclusions:** The overall success rate of 84% is comparable to other studies using a similar patient population. Intubation success rates in trauma patients with a GCS < 8 (who are not in cardiac arrest) is similar whether or not succinylcholine is added to deep sedation using midazolam and etomidate.

**29 THE EFFECT OF PARAMEDIC RAPID-SEQUENCE INTUBATION ON OUTCOME IN TRAUMA PATIENTS** **Robert M. Domeier, Shirley M. Frederiksen, Carl F. Chudnofsky, Pino Colone,** *Saint Joseph Mercy Hospital, Ann Arbor, Michigan*

**Objectives:** To evaluate the effect of paramedic rapid-sequence intubation (RSI) on trauma patient outcome. **Methods:** Consecutive major trauma patients were prospectively enrolled in two phases, the first prior to and the second after implementation of a paramedic RSI program. RSI training consisted of 6 hours of didactic and mannequin training. Operating room intubation experience is required for oral intubation clearance in the system, but not for RSI training. All trauma patients with a Glasgow Coma Score (GCS) between 3 and 8 for whom resuscitation was indicated were eligible for inclusion. Exclusion criteria included death in the field or Emergency department (ED) and inability to obtain outcome information. For both phases, intubation was indicated for trauma patients with a GCS of 3–8. For phase 2, oral intubation was attempted for all patients prior to RSI. Etomidate and succinylcholine were administered for RSI. RSI was not attempted for patients in whom the alternative airways, Combitube, cricothyrotomy, and bag-valve-mask ventilation were judged not feasible. Method of airway control, intubation success rates, and survival to hospital

discharge were determined. **Results:** There were 134 patients with outcomes in phase 1; 19 of 21 (90.5%) in arrest at presentation had a definitive airway established, and 19 had additional exclusion criteria, leaving 94 for analysis. There were 386 patients with outcomes in phase 2; 85 of 94 (90.4%) in arrest at presentation had a definitive airway established, and 65 had additional exclusion criteria, leaving 227 for analysis. The oral intubation success rate was improved for phase 2 study vs. phase 1 control patients (53.3% vs. 14.9%); total definitive airway rate was also greater (59.5% vs 40.4%). RSI was used in 112 patients; 11 were excluded. Oral intubation success for RSI patients was 87.5%; 91.1% had definitive airways established. Survival rates for patients with oral intubation without RSI were similar for the two phases (42.4% vs. 42.9%). Survival for study patients was improved during phase 2 (78.0% vs. 67.3%). Survival for study RSI patients was 85.1%. **Conclusion:** Emergency medical services protocols for paramedic RSI resulted in improved intubation success rates and improved survival to hospital discharge.

**30 EMS-BASED SCREENING, EDUCATION, AND REFERRAL FOR OLDER ADULTS IN A RURAL COMMUNITY** Susan Scarlato, Lindsay Clarkson, E. Brooke Lerner, Robert McCann, Manish N. Shah, *University of Rochester, Rochester, New York*

**Objectives:** To prevent injuries and diseases among older adults in a rural community, this study aimed to evaluate the feasibility of an emergency medical services (EMS)-based screening program that identifies patients at risk for pneumococcal disease, influenza, and falls during emergency medical responses. **Methods:** A prospective observational study was performed in a rural town, population 9,654. All community-dwelling older adults (age 65 and older) cared for by the volunteer EMS agency from February 2004 to August 2004 were screened for influenza and pneumococcal vaccination status and risk of falling. Screening included self-reported risk based on three standardized questions and EMS providers' visual evaluation of the home environment. Only a patient's first EMS encounter was included in the study. Screening results were faxed to each patient's physician for intervention. Feasibility was evaluated by determining the proportion of patients screened by EMS. Descriptive statistics were used to characterize the patient population and the extent of patient risk. **Results:** A total of 104 EMS patients were eligible and 100 (96%; 95% CI: 90%–99%) were successfully screened. Of the screened patients, the mean age was 79.5 (standard deviation 7.3). 52% were female. 82% of patients were white, 1% was American Indian, and 17% were not recorded. 21 (21%, 95% CI: 13%–30%) reported lacking the pneumococcal

vaccine. 10 (10%; 95% CI: 5%–18%) reported lacking the influenza vaccine for the 2003 influenza season. 41 (41%, 95% CI: 31%–51%) reported a history of falls during the past year. Emergency medical technicians evaluated the home environment for 70 patients and found risk factors for 22 patients (31%; 95% CI: 21%–44%). 13 of 22 patients (59%; 95% CI: 36%–79%) with identified risks in the home environment reported falling during the past year. **Conclusion:** EMS providers can successfully screen older adults during emergency responses. Older adult EMS patients have significant deficiencies in immunization rates and risks for falling. Referral of identified needs to a primary care physician may remedy deficiencies, but studies must be performed to evaluate the impact of the referral upon patient outcomes.

**31 BUCKLE UP! EMS USE OF SEAT BELTS** Laura L. Bultman, Jeffrey Ho, David I. Page, *Hennepin County Medical Center, Minneapolis, Minnesota*

**Introduction:** An ambulance can be a dangerous environment for emergency medical services (EMS) crews and patients, as has been demonstrated by publicized fatal ambulance crashes. Ambulances are exempt from vehicle crash testing, and lack of safety restraint was implicated in the majority of fatal accidents reviewed by the National Highway Traffic Safety Administration. Effective safety restraint in the rear cabin while attempting to deliver medical care can be difficult, particularly with uncooperative patients. **Objective:** We hypothesized that seat belt use would be dissimilar between front and rear cabins, and that lights and siren (L&S) operation would reduce compliance. **Methods:** Within a metropolitan area of 1.2 million people, two-paramedic crews in three different ambulance services were studied in an observational, prospective, blinded fashion. Research assistants and paramedic students gathered data during ride-along shifts sampled over a 68-day period. Data collected included use of seat belts by front and rear cabin occupants, patient behavior, equipment security, and use of L&S. The data were analyzed using descriptive statistics and chi-square testing. **Results:** A total of 346 runs were observed, in which 296 patients were transported. L&S were utilized on 96% of responses to the scene and 8% upon return. Overall seat belt compliance by the driver was 86%; rear bench seat compliance was 21%, neither was significantly affected by L&S operation ( $p > 0.48$  and  $p = 0.36$ , respectively). Patient belt use was 84% in adults and 82% in children. Thirty-six (12%) return runs were perceived to have dangerously unsecured or loose equipment, eight of which occurred during L&S. Of 250 patients whose behavior was recorded, 39% were observed to be agitated or intoxicated, and 3% required physical restraint (all face up). Difficult patients were more likely to be belted ( $p = 0.035$ ). **Conclusions:** Given the potentially

hazardous nature of ambulance transport and lack of traditional safety testing, seat belt use is a reasonable method to prevent injuries. Literature suggests that the rear cabin is most risky for injuries, and our study supports that this area has the lowest seat belt compliance rate. This was not significantly affected by L&S transport. Agitated or intoxicated patients are more likely to be belted.

**32 UTILIZATION OF EMS AND HOSPITAL RESOURCES BY SERIAL INEBRIATE PROGRAM (SIP) CLIENTS** James V. Dunford, Gary M. Vilke, Theodore C. Chan, *University of California at San Diego Medical Center, San Diego, California*

**Objective:** To determine the impact of a defined population of chronic public inebriates on emergency medical services (EMS), emergency department (ED), and hospital resources. **Methods:** In response to concerns regarding increasing EMS, hospital, and public safety contacts with chronic alcoholics, the San Diego Police Department initiated the Serial Inebriate Program (SIP) in 2000. SIP is a partnership linking law enforcement, EMS, hospitals, public defenders, the Superior Court, the City and County of San Diego, the business community, and recovery agencies. The goal of SIP is to promote sobriety and stop the "revolving door syndrome" between jail, EDs, and the Inebriate Reception Center (IRC). A SIP client is defined as an individual who is incarcerated and convicted for public intoxication after presenting to the IRC five or more times within thirty days. Judges offer clients the choice of successful completion of a 6-month recovery program or incarceration for up to 180 days. 548 individuals met this case definition from January 2000 to December 2003. Hospital billing records from two urban hospitals and the city paramedic provider were abstracted for numbers of transports and visits, charges, payments, and payer type. **Results:** During the study period, 319/548 (58.2%) SIP clients were transported by paramedics a total of 2,520 times. 426/548 (77.7%) clients accumulated 3,846 ED visits and 232/548 (42.3%) clients accrued 4,094 in-patient days. The mean numbers of transports, ED visits, and in-patient days were  $8 \pm 10$  (1–52),  $9 \pm 13$  (1–100), and  $3 \pm 4$  (1–23), respectively. Total charges for services were \$19,512,856, including \$1,365,635 for paramedic care, \$2,858,759, for ED care, and \$15,288,462 for in-patient care. Total collections were \$3,510,757 (18.0%), including \$184,081 (13.5%) for paramedic care, \$421,139 (14.7%) for ED care, and \$2,905,537 (19.0%) for in-patient care. Payer types were: MCAL/MCR (28.7%); no insurance (26.2%); private insurance (5.0%); and other government aid (40.1%). **Conclusions:** Chronic inebriates place disproportionately large, undercompensated service demands on EMS and hospital re-

sources. Comprehensive, community-based strategies such as SIP may offer an opportunity to reduce episodic care and excessive use of public safety resources by redirecting individuals toward recovery, social support, and primary medical care.

**33 OCCUPATIONAL INJURY AND HEALTH MAINTENANCE IN EMS** Damian MacDonald, David Cone, Sandy Bogucki, *Yale Emergency Medicine, New Haven, Connecticut*

**Objective:** To describe common line-of-duty injuries, infectious disease exposures, health maintenance, insurance coverage, and disability in emergency medical services (EMS) personnel. **Methods:** Survey was included with 2003 National Registry of Emergency Medical Technicians (NREMT) re-registration applications. Demographic variables examined included type of service, level of provider, and size of the provider's community. Injuries were categorized into seven mechanisms and ten types of injury. Health and safety markers examined included seat belt policies and usage, frequency of hearing tests, and occupational exposure to infectious disease. Use of private insurance for work-related injury and disability from work-related injury were examined. **Results:** 29,575 surveys were returned, partially answered (81%), demographic information only (18%), and completely blank (0.15%). Response rates to non-demographic questions ranged from 60% to 94%. One or more work-related injury was sustained by 18.6% (3,924/21,101) of respondents. The most common categories were lifting/carrying 43% (1,764/4,130); Motor vehicle collision 10% (417/4,130); and violence, chemical hazards, fire/technical, and roadside EMS operations at 5–6% each. The most common injury types were back and neck strain 37% (2,323/6,267) and joint/muscle injury 24% (1,526/6,267), followed by traumatic brain injury, lacerations, respiratory injury, and abdominal and chest trauma with 4% to 7% each. A written seat belt policy was present in 82% (14,421/17,664). Compliance with seat belt use was 82% (18,190/22,185). Exposure to HIV or hepatitis B with antibody conversion occurred in 1% (230/19,809). A yearly purified protein derivative (PPD) test was placed in 71% (13,992/19,740). Hearing tests were administered to 37% (7,084/19,045). Nonzero percent disability as the result of a work-related injury was assigned to 4% (681/18,068). After an injury, own insurance was used in 19% (530/3,924) of cases. **Conclusions:** The most common mechanism is lifting and carrying, resulting in musculoskeletal injury. Other common mechanisms and injury types towards which preventive efforts should be directed were identified. A significant percentage of health workers had to use their own insurance after a work-related injury. Work-related injury is a significant source of morbidity in the EMS

community, and the preventive measures surveyed are underutilized.

**34 DRINKING UNDERAGE, A PUBLIC HEALTH INITIATIVE STUDY** **Daniel L. Lemkin, Donald Alves, Morgen McCullough, Richard Bissell, Wade Gaasch,** *University of Maryland School of Medicine, Baltimore, Maryland*

**Introduction:** Alcohol consumption by minors remains a significant public health concern. It is a contributing factor in many motor vehicle crashes and incidents of sexual assault, and is considered a gateway substance to more extensive drug abuse. While much alcohol consumption takes place in private residences and parties, teens still gain access to bars and dance clubs where they are routinely served alcohol. **Objective:** To quantify underage alcohol consumption attributable to bars. **Methods:** An urban fire department's emergency medical services dispatch data and local hospital medical records were queried. Actual responses to bars were sorted by number of ambulance runs and proximity to our study hospital. Address searches were expanded by a one-block radius to allow greater capture of intoxicated patients. Ambulance run time and date information was correlated with medical record admission data to find matches. Matched medical records were reviewed and specific data elements were extracted. **Results:** Queries from fire department computer-aided dispatch (CAD) data revealed 36 address matches for 7 nearby bars. Expanding the search radius for these bars yielded 84 calls for hospital medical record correlation. 74 of 84 calls were matched to medical records. 56 of 74 records were alcohol-related. 50 of 56 had only one emergency department visit for acute intoxication; the remaining were habitual drinkers with frequent visits. 17 (34%) of patients were minors. Overall, 48% were women, 22% African American, 74% White, 2% other. Total hospital charges were \$28,405 (not including physician fees). 36% of patients were uninsured. **Conclusions:** The large number of underage drinkers who ended up in the hospital presumably represent a much larger number of underage bar clients who may not be hospitalized as a direct result of alcohol toxicity, but who may well represent other public health and safety hazards. 34% of intoxicated patients were minors. A small number of bars appear to be responsible for the majority of cases of alcohol poisoning or alcohol-related illness. This information identifies a problem and localizes it effectively. Local liquor boards, police, and the department of public health will be contacted, and aggregate information shared. We will repeat this analysis determining the initiative's effectiveness in reducing hospital admissions for acute alcohol intoxication, and excess alcohol ingestion by minors.

**35 ATV-RELATED INJURIES IN CHILDREN: DO HELMETS MAKE A DIFFERENCE?** **David J. Dula, John J. Skiendziewski, Andrew Skiendziewski,** *Geisinger Medical Center, Danville, Pennsylvania*

**Introduction:** Studies show that all-terrain vehicle (ATV) accidents result in a significant number of emergency department visits and deaths, with 40% of the victims being less than 16 years old. In response to these concerns, Pennsylvania has implemented regulations for safe ATV operation to include: mandatory ATV training courses, mandatory helmet use, and promoting parental supervision. This study reviewed data in the Pennsylvania Trauma Systems Foundation (PTSF) of children involved in ATV accidents. **Objective:** To determine if helmet use affects the incidence and severity of head injuries in children involved in ATV accidents. **Methods:** The PTSF database from 1999 to 2003 was used for this study. The patient population for this study included ATV trauma patients younger than 19 years of age. The following data were collected: age, sex, position of the patient on the vehicle (driver/passenger), whether or not a helmet was used, mechanism of the accident, and mortality. A statistical analysis using a chi-square test was performed. This study was approved by our hospital's institutional review board. **Results:** In this study there were 552 victims of ATV accidents who were younger than 19 years of age. Of this group, 49% of the ATV trauma victims wore helmets. Although helmet use was not found to be associated with a reduction of ISS or TRISS scores or mortality, helmet use was associated with 66% reduction in skull fracture and 37% reduction in intracranial injury. **Conclusion:** Helmets use is an effective measure to reduce the risk of serious head injury in children involved in ATV accidents.

**36 A ROLE FOR EMS IN PRIMARY PREVENTION** **Jennifer L. Bell, Darlene Bouwsema,** *City of Edmonton EMS, Edmonton, Alberta, Canada*

**Introduction:** Seniors (age 65+) will increasingly comprise a larger share of the Canadian population. Annually, one third of all seniors experience at least one fall, approximately 50% result in minor injury, and 25% result in serious injury. The personal, economic, and societal costs of falls among seniors are enormous. Unless the incidence of falls and fall-related injuries can be reduced through prevention initiatives, the economic costs will escalate in the face of a growing population of seniors. Accurate information is critical for health care providers in the planning of effective prevention programs. **Objectives:** To develop and use the STOP (Seniors' Training on Preventing) Falls data-collection tool utilized by emergency medical services (EMS) personnel to promote and support the

collection of injury data on community-dwelling seniors. **Methods:** With the assistance of partnership agencies, EMS Prevention and Public Education staff developed the STOP Falls data collection tool. This simple one-page tool was created to attain additional information regarding circumstances surrounding a fall. Frontline EMS staff completed this form for events dispatched as a "fall" in community-dwelling seniors (aged 65+). **Results:** The majority (85%) of community-dwelling seniors in the City of Edmonton experienced falls while indoors, and 81% of these falls occurred in the seniors' residence. The most common cause was "tripping" or "stumbling" (30%). Thirty-six percent of patients were not injured and not transported to a hospital. In all cases the EMS personnel felt the patient would benefit from follow-up outside of the hospital setting and made recommendations for prevention 75% of the time. **Conclusion:** EMS is the intersection of public safety, public health, and health care systems. EMS may be the patient's first or only contact with the health care system and can play a significant role in early detection, information sharing, and promoting continuity of care for patients. Direct referral by EMS to existing community programs and services is an effective means of improving continuity of care and enhancing the continuum of health services. Early recognition and timely action are critical to effective prevention efforts.

**37 WHICH DISPATCH PROTOCOLS ACCURATELY TRIAGE HIGH-ACUITY CALLS? A COMPARISON OF THE MEDICAL PRIORITY DISPATCH SYSTEM TO A VALIDATED PREHOSPITAL ACUITY SCORE** **Michael J. Feldman, David Lyons, P. Richard Verbeek, Sandra Chad, Alan Craig, Brian Schwartz, Sunnybrook Base Hospital Program, Toronto, Ontario, Canada**

**Introduction:** The Medical Priority Dispatch System (MPDS) consists of 33 protocols used by emergency medical services (EMS) dispatchers to interrogate callers, determine dispatch priority, and provide pre-arrival instructions. Although use of MPDS is widespread in many EMS systems, there is little evidence that dispatch priority correlates with patient acuity. The Canadian Triage and Acuity Scale (CTAS) is a validated tool used by Canadian emergency departments and many EMS systems to prioritize patient care requirements, and correlates with both hospital admission rate and need for investigations. **Objective:** To determine the relationship between MPDS dispatch priority and patient acuity according to prehospital CTAS. **Methods:** The Toronto EMS communications database was queried to obtain all calls from March 1, 2003, until February 29, 2004. All duplicate calls, non-emergency transfers, and cancelled calls were excluded. Only protocols accounting for >1% of call volumes were ana-

lyzed. A focus group consisting of paramedics, emergency medical dispatchers, EMS physicians, and EMS managers assigned a range of MPDS dispatch priorities considered appropriate to each CTAS level. Sensitivity, specificity, overtriage, rate and undertriage rate were calculated for all protocols collectively and individually. **Results:** Of 197,882 calls, 54,598 calls were excluded due to cancellations by caller or by patient, and 26,879 were excluded due to missing data fields. Nineteen protocols accounted for 96.2% of the remaining calls. The focus group defined 5% undertriage as a reasonable target for dispatch protocols. The overall sensitivity and specificity of MPDS were 56.8% and 56.8%, respectively. The overall overtriage and undertriage rates were 65.7% and 23.2%, respectively. Only protocols for patients with diabetic problems or shortness of breath, accounting for 17.4% of calls, undertriaged less than 5% of calls. **Conclusions:** The comparison of MPDS to CTAS represents a novel method of evaluating dispatch protocols. Although the MPDS exhibits a reasonable degree of sensitivity and specificity for detecting high acuity of illness or injury, seventeen of nineteen protocols that account for the majority of medical 9-1-1 calls undertriaged high-acuity cases in >5% of calls. These protocols may represent targets for revisions of the MPDS.

**38 EFFECTIVENESS OF DISPATCH PRIORITIZATION AS MEASURED BY RED LIGHTS AND SIRENS RETURN TO THE HOSPITAL** **Matthew C. Gratton, Alex G. Garza, James McElroy, Kansas City Health Department, Kansas City, Missouri**

**Objective:** Emergency medical services (EMS) systems must use some method to prioritize the response to calls received at their dispatch center. The Medical Priority Dispatch System (MPDS) prioritizes calls into A, B, C, D, and E determinants, in order of increasing acuity, based on the callers' answers to standardized questions. The purpose of this study was to determine the ability of the MPDS protocol to discriminate between low- and high-acuity patients. **Methods:** This was a retrospective review of dispatch computer records of all 911 calls received in calendar year 2003. The study was performed in an urban, midwest, single-tier, all-advanced life support, public utility model system. All dispatchers were paramedics and emergency medical dispatch (EMD) certified. Call prioritization was accomplished with the MPDS (v11). High-acuity patients were defined as those receiving red lights and sirens (RLS) transport to the hospital, based on the judgment of the on-scene paramedic. Chi-square analysis for linear trend and odds ratios were used to evaluate differences between determinants. **Results:** There were 61,881 total calls. Of these, 12,539 were cancelled and 10,304 refused transport. Of the 39,038 patients

transported, 14,194 did not receive a final determinant due to lack of information from the calling party, leaving 24,844 study patients. Of the study population, 1,332 (5.4%) were transported to the hospital with RLS. The breakdown by determinant and RLS transport was: A = 5,548, 42 (0.76%) RLS; B = 3,265, 89 (2.73%) RLS; C = 5,463, 175 (3.2%) RLS; D = 10,334, 875 (8.47%) RLS; and E = 234, 151 (64.53%) RLS. There was a significant difference between the five determinants for likelihood of a RLS return to the hospital (chi-square = 776.816,  $p < 0.001$ ). The odds ratio for a RLS return for each determinant was: A = 1; B = 3.67; C = 4.34; D = 12.13; and E = 238.5. **Conclusion:** The five MPDS categories of determinants do discriminate between patients who have a low likelihood of requiring a RLS return, and those who have a high likelihood of requiring a RLS return. This information can be used to help plan an appropriate response to each category of determinant.

**39 EMS DISPATCH TRIAGE CRITERIA CAN ACCURATELY IDENTIFY PATIENTS WITHOUT HIGH-ACUITY ILLNESS OR INJURY** J. Brent Myers, Paul Hinchey, Joseph Zalkin, Ryan Lewis, Donald Garner, Jr., *Wake EMS System, Raleigh, North Carolina*

**Objective:** This study evaluated the ability of the Medical Priority Dispatch System (MPDS) to appropriately assign the alpha response. Hypothesis: Use of the alpha level dispatch determinant can identify patients who do not demonstrate high-acuity illness or injury. **Methods:** This retrospective, descriptive study queried electronic patient care reports (ECRs) from January 7 to July 7, 2004, generated by paramedic crews dispatched from a metropolitan 9-1-1 center. This center utilized Pro-QA Emergency Medical Dispatch (EMD) software version 3.3.0.194 and met National Academy of Emergency Dispatch (NAED) quality assurance standards. The records of alpha dispatch in the ECR were then compared to the ProQA database to confirm that personnel had correctly recorded the dispatch determinant. Requests for interfacility transfer underwent a locally modified EMD procedure and were excluded. High-acuity patients were defined as those who received medications or procedures indicative of acute coronary syndrome, respiratory distress, altered mental status, or treatment for abnormal vital signs. Additionally, any patient for whom the paramedic documented suspected acute stroke, ST-segment elevation myocardial infarction, or who met trauma criteria were categorized as high-acuity. Patients not meeting these criteria but who received emergent transport to the hospital were categorized as potential high-acuity patients and reported separately. **Results:** There were 23,939 total dispatches; 2,703 were recorded as alpha dispatches in the ECR. A total of 582 alpha ECR calls were excluded:

224 were incorrectly recorded as alpha (based on ProQA database comparison), 185 were interfacility transfers, 101 were the result of events that did not involve caller interrogation (e.g., station walk-ins), and 72 were excluded because the EMD determinant was not recorded in ProQA. Nineteen of 2,121 calls (<1%) screened using standard MPDS protocols calls met high-acuity criteria. The secondary analysis for potential high-acuity patients identified 17 of 2,121 (<1%) who were transported emergently to the hospital. Three of these 17 (0.1% of all alpha calls) also met the high-acuity criteria. **Conclusion:** The use of standard MPDS protocols can successfully identify patients who do not demonstrate high-acuity illness or injury more than 99% of the time.

**41 PREHOSPITAL 12-LEAD ECG: EFFICACY OR EFFECTIVENESS** Robert A. Swor, Stacey Hegerberg, Mark Goldstein, Christine C. McEachin, *William Beaumont Hospital, Royal Oak, Michigan*

**Introduction:** Previous literature has documented that obtaining a prehospital 12-lead electrocardiogram (ECG) decreases the time to reperfusion in patients with ST-segment elevation acute myocardial infarction (STEMI). **Objective:** To compare times to ECG, angioplasty suite (lab), and reperfusion (reperfusion) in emergency medical services (EMS) STEMI patients who received care through three different processes. **Methods:** Setting: Large suburban community teaching hospital with emergency department (ED)-initiated single-page acute myocardial infarction (AMI) team activation for STEMI patients. Population: STEMI patients transported by EMS from 4/02 to 6/04. Not all EMS agencies had prehospital 12-lead capability. Paramedics interpret and verbally report clinical assessment and ECG findings via radio. The AMI team is activated either: 1) prior to patient arrival to the ED based on EMS assessment; 2) after ED evaluation with EMS ECG; or 3) after ED evaluation and ED ECG. Time intervals were calculated from ED arrival. To assess the impact of interventions on performance targets, we also report the proportion of patients who arrived in lab within 60 minutes and reperfusion within 90 minutes of arrival. Parametric and non-parametric statistics are used for analysis. **Results:** During the study period there were 116 STEMI patients transported by EMS, mean age 63.8, 61% male. Of these, 48 (41.3%) had an EMS ECG, and a minority (13/48, 27.1%) of these had AMI team activation prior to ED arrival. Mean time to lab for all patients was  $48.5 \pm 31.0$  minutes and time to reperfusion was  $96.9 \pm 33.3$  min. Patients with pre-arrival activation were transported to lab sooner (median 20 min vs 50 min,  $p < 0.001$ ) and received reperfusion sooner than all other patients (median 74 min vs 95 min,  $p = 0.007$ ). More pre-arrival activation patients

met performance targets to lab (100% vs 69.7%,  $p = 0.03$ ) and reperfusion (76.9% vs 42.7%,  $p = 0.02$ ). There was no difference in time to lab or to reperfusion for patients who received EMS ECG but no pre-arrival activation compared to those who received EMS transport alone. **Conclusion:** A minority of patients with EMS ECGs had pre-arrival AMI team activation. EMS ECGs combined with systems that activate hospital resources, but not EMS ECGs alone, decrease time to lab and reperfusion.

**42 THE EIGENVALUES OF THE DERIVED 12-LEAD ECG: A NEW CARDIAC ELECTRICAL MARKER FOR ACUTE MYOCARDIAL INFARCTION** David M. Schreck, Gevork Mosesi, Matthew S. Viscito, *Emergency Medical Associates of New Jersey, Summit, New Jersey*

**Background:** The 12-lead electrocardiogram (ECG) is described by 3 lead-vectors using factor analysis (FA). FA calculates the eigenvalues (EVs) of the ECG information space. It is advantageous for paramedics to derive the 12-lead ECG from 3 measured leads using a universal patient coefficient matrix (UPCM). Simplex optimization (SOP) may be used to derive the UPCM. **Objective:** To derive a 12-lead ECG from 3 measured leads using a SOP-derived UPCM and predict the presence of acute myocardial infarction (MI) from an EV index calculated from both the measured and derived ECGs. **Methods:** Thirty training ECGs of varying pathology were digitized resulting in  $300 \times 12$  voltage-time data arrays for each case. SOP was used to derive a  $12 \times 3$  UPCM from the ECG training set. A different set of 51 test cases, including 35 normal and 16 acute infarction ECGs, were similarly digitized, from which leads I, aVF, and V2 were chosen as the measured 3 lead-vector basis factor space. The UPCM was then multiplied by the  $\{I, aVF, V2\}$  measured lead-vector  $3 \times 300$  matrix yielding the derived 12-lead ECG  $300 \times 12$  matrix. The 51 measured and derived test case ECGs were graphically compared for diagnostic and morphologic correlation. **Results:** All 51 test case ECGs were predicted correctly. No significant morphologic or diagnostic changes were noted in the derived ECGs. Significant differences between normal and acute MI were detected at EV3% ( $p < 0.05$ ) for both measured and derived ECGs. The EV index predicted pathology correctly in all cases. The reduction of the measured 12-lead ECG data set to 3 leads allowed the display of a vector plot of the movement of the electrical forces resulting in a spatial ECG curve. **Conclusions:** A 12-lead ECG can be derived from 3 measured leads by paramedics using a SOP-derived UPCM. The comparison of the measured and derived ECGs is clinically and morphologically similar. This study also demonstrated that an EV index may differentiate normal from acute MI pathology. Using current computer technology, this calcula-

tion may occur instantaneously in real time to enhance patient observation capabilities and to allow for a more convenient and cost-efficient acquisition of the ECG by paramedics.

**43 A RANDOMIZED CONTROLLED FEASIBILITY TRIAL COMPARING SAFETY AND EFFECTIVENESS OF OUT-OF-HOSPITAL PACING VERSUS CONVENTIONAL TREATMENT: "PREPACE"** Laurie J. Morrison, Paul Dorian, Jennifer Long, Marian J. Vermeulen, Brian Schwartz, Bruce Sawadsky, Jamie Frank, Bruce Cameron, Robert Burgess, Jennifer Shield, Paul Bagley, Vivien Mausz, James E. Brewer, Bruce Lerman, *Sunnybrook & Women's College Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada*

**Objective:** Case series suggest out-of-hospital transcutaneous pacing (TCP) is a promising intervention for patients with hemodynamically unstable bradycardia; however, the evidence is limited by the lack of controlled trials. The study objective was to determine the feasibility and safety of a trial using TCP in out-of-hospital patients presenting with Heart rate  $<60$  and blood pressure (BP)  $<80$  or BP  $<100$  with Glasgow Coma Score (GCS)  $<15$  or chest pain or crackles on auscultation who fail to respond to 1–3 mg of atropine and/or 500-mL fluid bolus. The primary outcome measure was survival to hospital discharge. **Methods:** Patients were randomized 1:1 using concealed envelopes at point of care to titrating dopamine infusion 5 mg/kg/min as the control and TCP from 8 mA until capture. Paramedics crossed over to dopamine if there was no improvement in BP, deterioration, or failure to capture. A blinded validation committee adjudicated all end points. Blinded statistical intention-to-treat analysis was completed using chi-square and t-test with a p-value of 0.05. **Results:** There were 342 unstable bradycardic patients treated during the study period. Of these, 134 received fluid only; 82 received additional atropine; 16 received atropine only; with 110 remaining eligible for the study. 28 patients were not enrolled at paramedic discretion (i.e., time restraints). The data entry error rate was  $<1\%$  and there was no loss to follow up. Two patients were withdrawn post randomization and two received the incorrect treatment (5%). The patients in the dopamine and pacing groups, respectively, were similar for age, 72 (14.0) mean (SD) vs 77 (12); sex, 23 vs 21 male (58%:50%); and EMS response interval, 9.7 (6.3) vs 9.9 (7.1). Survival outcomes: at 24 hrs, 30 vs 34 (75%:81%); and at hospital discharge, 28 vs 29 (70%:69%). **Conclusion:** This study suggests that a randomized trial of TCP versus conventional therapy is feasible and safe in the out-of-hospital setting. The high response rate (68%) to atropine and/or fluid suggests a multicenter trial would be required.

**44 THE IMPACT OF MODE OF ARRIVAL TO THE HOSPITAL ON TIME INTERVAL FROM SYMPTOM ONSET TO TREATMENT FOR PATIENTS WITH ACUTE CORONARY SYNDROME** **Ross E. Megargel, Robert E. O'Connor,** *Christiana Care Health System, Newark, Delaware*

**Introduction:** Cardiac disease is the most common cause of death in the United States, and delays in symptom recognition and decision to seek care increase mortality. **Objective:** This study was conducted to determine the impact of mode of arrival to the hospital on time interval from symptom onset to treatment. Our hypothesis was that chest pain patients who call 911 are more decisive and seek treatment more rapidly than if they chose to drive themselves in, or if they chose to arrive by private vehicle. **Methods:** All patients with clinical symptoms, and/or an initial electrocardiogram, suggestive of acute coronary ischemia were eligible for enrollment in this observational study. Patients were stratified according to whether they arrived by ambulance, private vehicle, or drove themselves. Patients were excluded if mode of arrival was not available. Time interval from onset of symptoms to emergency department arrival was measured. Secondary outcome measures included survival to hospital discharge. Statistical analysis was performed using analysis of variance. **Results:** A total of 1,756 patients were studied. Mode of arrival was not available on 24 patients, leaving 1,732 available for analysis. Of these, mode of arrival was as follows: 1,246 (72%) arrived by ambulance, 397 (23%) arrived by private vehicle, and 91 (5%) drove themselves. The mean time from symptom onset to emergency department arrival was 208 minutes for ambulance arrivals, 281 minutes for arrival by private vehicle, and 230 minutes for those who drove themselves ( $p = 0.000$ ). The survival-to-hospital-discharge rate was 94% for those arriving by ambulance, 98% for those arriving by private vehicle, and 96% for those who drove themselves. These differences are not statistically significant. **Conclusions:** Patients who choose to call 911 for treatment and transportation to the hospital arrived significantly faster than patients transported by others, or who drove themselves. This time saving is in addition to the reduction in the interval from emergency department arrival to reperfusion intervention. These findings reaffirm the need for prompt recognition and action in the setting of symptoms suggestive of acute coronary syndrome.

**45 THE EFFICACY OF HELIUM-OXYGEN MIXTURE (65%–35%) IN ACUTE ASTHMA EXACERBATIONS** **Philippe Sattonnet, Patrick Plaisance, Frederic Adnet, Laurent Lecourt, Charlotte Chollet, Eric Vicaut, Roch Joly, Karim Tazarorte,** *CHR Metz-Thionville Hôpital, Bel-air, France*

**Objective:** To confirm the effectiveness of a helium-oxygen (He-O<sub>2</sub>) mixture of 65%–35% (Oxhel) as a driving gas for  $\beta_2$  mimetics during acute asthma exacerbation. **Methods:** Design: Randomized, double-blind, multicenter study approved by our institutional review board. Continuous administration by emergency mobile units during 1 hour of a gas which is in a bottle manufactured to be indistinguishable with preset manometer (8 L/min for O<sub>2</sub> and 12 L/min for Oxhel). Nebulization of terbutaline (10 mg) with pure O<sub>2</sub> or He-O<sub>2</sub> on three occasions at 20-minute intervals, evaluation of dyspnea, peak expiratory flow (PEF), and clinical score, after each nebulization. Setting: 15 mobile emergency units from teaching hospitals. Subjects: 203 adults with acute asthma exacerbation (PEF <120 L/min and/or Score >8) were included between May 1999 and September 2001. Main outcome measures: clinical score during the first hour, PEF, intubation rate, and outcome of patient in terms of hospitalization and duration of stay in the intensive care unit (ICU). **Results:** Despite the lack of difference in the score improvement, the patients in the Oxhel group had a better PEF value than in the O<sub>2</sub> group at each time of evaluation ( $p < 0.01$ ): T 20: 250 vs. 150; T 40: 290 vs. 190; T 60: 330 vs. 192. The most important results concern the intubation rate: 1.03% (Oxhel) vs. 7.37% (O<sub>2</sub>),  $p = 0.03$ , and the percentage of patients still in the ICU at day four: 8.42% (Oxhel) vs. 20.21% (O<sub>2</sub>),  $p = 0.02$ . **Conclusion:** The use of Oxhel in combination with standard treatment during the early stage of acute asthma exacerbation leads to a more significant improvement in spirometry, avoids intubation, and facilitates the fast recovery of the patient. The systematic use of Oxhel should be envisaged in prehospital settings.

**46 EVALUATION OF PREHOSPITAL USE OF FUROSEMIDE IN PATIENTS WITH RESPIRATORY DISTRESS** **Jason M. Jaronik, Paul Mikkelsen, William Fales,** *Michigan State University/Kalamazoo Center for Medical Studies, Kalamazoo, Michigan*

**Objective:** To evaluate the appropriate use of furosemide by paramedics in patients with respiratory distress. **Methods:** This was a retrospective study of patients receiving prehospital furosemide in a countywide emergency medical services system between 07/01/03 and 06/30/04. All patients over 18 years old receiving furosemide were identified from a computerized EMS information system. Cases were manually matched to hospital records, including the emergency department (ED), admission, discharge, and laboratory reports. Cases unable to be matched to the hospital record were excluded. Data were collected using a standardized form and included ED and hospital primary and secondary diagnoses, initial brain-type natriuretic peptide (BNP) when obtained, and final disposition.

Furosemide was considered appropriate when the primary or secondary ED or hospital diagnosis was congestive heart failure or pulmonary edema (CHF) or the BNP was >400. Furosemide was considered inappropriate when primary or secondary diagnosis did not include CHF, when the BNP was less than 200, or when the patient received an order for IV fluids. Furosemide was considered potentially harmful when the diagnosis included sepsis, dehydration, or pneumonia, without a diagnosis of CHF or BNP >400. **Results:** Two of the 146 patients identified were unable to be matched to hospital records and were excluded. Of the 144 patients included, the mean age was 74.9 years, and 53% were male. The primary and secondary diagnoses of CHF were reported in 60 (42%) and 24 (17%) patients, respectively. The initial BNP was >400 in 65 (44%) of the 120 patients in which this study was obtained. Sixty patients (42%) did not receive a diagnosis of CHF, 30 (25%) patients had a BNP <200, and 33 (23%) had an order for IV fluids. A diagnosis of sepsis, dehydration, or pneumonia without a diagnosis of CHF or BNP >400 occurred in 24 (17%) patients. Seven of 9 (78%) deaths did not have a CHF diagnosis. Furosemide was considered appropriate in 84 (58%), inappropriate in 60 (42%), and potentially harmful in 24 (17%) patients. **Conclusion:** In this EMS system, prehospital furosemide was frequently administered to patients not diagnosed with CHF and not uncommonly given to patients when clinically contraindicated. EMS systems should reconsider the appropriateness of prehospital diuretic use.

**47 EFFECTIVENESS AND SAFETY OF MORPHINE IN A DIVERSE EMS SYSTEM** Ed J. Cain, Saleema Karim, *Emergency Health Services Nova Scotia, Dartmouth, Nova Scotia, Canada*

**Introduction:** The importance of pain relief has only recently been emphasized in the emergency medicine and paramedicine disciplines. Relief of pain is one of the six "D"s described by the Emergency Medical Services Outcomes Project (EMSOP) as a measurable outcome (discomfort). That analgesics do not interfere with accuracy or timeliness of diagnosis has been shown in several studies—in both children and adults. Morphine is the opioid analgesic by which others are measured. It has an excellent safety and efficacy profile. **Objective:** To evaluate the effectiveness of morphine in a large EMS system covering urban, suburban, and rural areas and various levels of paramedics by studying the compliance with providing morphine and its effect when given. **Methods:** All patient care records (PCRs) from January 1 to June 9, 2004, with specific protocols that call for the administration of morphine were analyzed for compliance, contraindications (as detailed in the protocol for morphine), dosage, and de-

gree of pain relief as measured using a visual analog score (VAS). All PCRs documenting no morphine administration were reviewed by the second author for contraindications. **Results:** Two hundred thirty-seven PCRs were reviewed. Of these, 219 (94%) had documentation of morphine administration. Nineteen of these 219 had contraindications to morphine administration. Of the 18 PCRs not documenting morphine administration, two had contraindications and in one the patient refused. Compliance was 203/237, or 86%. The mean dosage was  $5.62 \pm 2.61$  mg. The mean change in pain was 31.9 mm. 54.6% of patients who received morphine had a change of >30 mm in their pain VAS. There was no adverse reaction documented. **Conclusion:** Morphine is a safe, relatively effective analgesia. Efficacy might be improved by dosing to effect. There was a concern regarding the number of cases given morphine when contraindicated (8.7%).

**48 DEGREE OF CLINICAL IMPROVEMENT FOLLOWING PREHOSPITAL TREATMENT OF SUSPECTED PULMONARY EDEMA** Andrew L. Aswegan, Ross E. Megargel, Diane McGinnis-Hainsworth, Robert E. O'Connor, *Christiana Care Health System, Newark, Delaware*

**Objective:** Difficulty breathing is a common patient complaint prompting emergency medical services (EMS) access. We conducted this study to determine the degree of clinical improvement achieved using oxygen, nitrates, and intravenous furosemide administered to patients with dyspnea and rales. Our secondary goal was to identify clinical factors predictive of clinical improvement. **Methods:** Paramedic run sheets were collected from consecutive, adult, advanced life support transports for a chief complaint of difficulty breathing. Patients with rales on physical examination were included. Patients requiring endotracheal intubation, or those with clinical evidence of shock (or a systolic blood pressure less than 100), were excluded. Demographic information, medical history, vital signs, clinical assessments, and prior use of furosemide by the patient were abstracted into a database by trained reviewers. The rales protocol involved treatment with oxygen, topical and sublingual nitrates, and furosemide. Clinical improvement was determined by the paramedics based on subjective assessment, improved work of breathing, and improvement in vital signs. The Mann-Whitney U test, chi-square, and linear regression were used to test for significant differences between those patients showing clinical improvement and those who did not. **Results:** A total of 437 patients were studied, with 315 (72%) showing clinical improvement and 122 (28%) remaining unchanged or worsening. Prior use of nitrates and/or furosemide, history of congestive heart failure (CHF), vital signs, mean furosemide dose, age, and gender

were similar between responders and non-responders. Jugular venous distention (JVD) was present in a significantly greater proportion (29% vs. 15%;  $p = 0.01$ ) and mean initial pulse oximetry reading was lower (90% vs 93%,  $p = 0.04$ ) when responders were compared with non-responders. During treatment, 21 patients (5%) were noted to worsen during the prehospital phase of care. **Conclusions:** The majority of prehospital patients with breathing difficulty who have rales on physical assessment improve with prehospital treatment using oxygen, nitrates, and furosemide. Patients showing improvement are more like to have JVD and a lower initial pulse oximetry reading. We recommend use of a rales protocol that specifies administration of oxygen, nitrates, and furosemide in the prehospital setting.

**49** INTERMITTENT BOLUS DOSING OF LIDOCAINE—AN ALTERNATIVE TO BOLUS FOLLOWED BY A DRIP  
**Michael G. Millin, Samuel H. Kim, Mohamud Daya, Terri Schmidt, Jonathan Jui, Brad Fujisaki, Jon Shields, Steve Dargan, Skip Freedman, Johns Hopkins University Hospital, Baltimore, Maryland**

**Objective:** To determine the efficacy and safety of intermittent bolus dosing of lidocaine versus the dosing strategy of a bolus followed by a drip. **Methods:** This was a pre- and post-change observational study, following a protocol change. Patients 18 or older treated with lidocaine for cardiac dysrhythmia were included in the study. Patients were excluded for: lidocaine for intubation, cardiac arrest without successful resuscitation, trauma, and incomplete charts. Patients were divided into two groups: Drip group (Jan–Dec 2002), treated with lidocaine 1.0–1.5-mg/kg intravenous (IV) bolus up to 3 mg/kg until the dysrhythmia resolves, then a 2–4-mg/min drip. Bolus group (Jan–Dec 2003), treated with lidocaine 1.5-mg/kg IV bolus, followed by 0.75-mg/kg IV bolus every 5 min up to 3 mg/kg until the dysrhythmia resolves; once the dysrhythmia resolves, intermittent boluses of 0.75 mg/kg every 10 min. Endpoints were resolution of arrhythmia, occurrence of complications, and adherence to written protocols. Complications considered were seizures, respiratory depression, and cardiac arrest. **Results:** The study included 150 patients in the drip group and 120 patients in the bolus group. Overall, 122/150 (81.3%) of the drip group patients and 112/120 (93.3%) of the bolus group patients had resolution of dysrhythmia ( $p = 0.004$ ). Odds ratio 3.21 [95% CI: 1.40, 7.34]. A post-hoc subgroup analysis of resolution of dysrhythmia in those patients who received lidocaine for indications other than ventricular fibrillation found no statistical difference between the two groups: 44 /54 (81%) of the drip group patients had a resolution of the dysrhythmia compared to 40/44 (90.9%) of the bolus group patients. There was

no statistical difference found between the two groups in complications or protocol violations: 1/150 (0.7%) of the drip group patients and 1/120 (0.8%) of the bolus group patients had a serious complication; 72/150 (48.0%) of the drip group and 55/120 (45.8%) of the bolus group patients had a protocol violation. **Conclusions:** Intermittent bolus dosing protocol was associated with an equivalent efficacy in treating ventricular dysrhythmias without an increase in complications. There was a high incidence of protocol violations in both groups.

**50** COMPARING THE EFFECTIVENESS OF TREATING HYPOTENSION IN THE PREHOSPITAL SETTING USING INTRAVENOUS SALINE BOLUSES VERSUS PLACING THE PATIENT IN A FLAT AND SUPINE POSITION  
**Ross E. Megargel, Diane McGinnis-Hainsworth, Robert E. O'Connor, Christiana Care Health System, Newark, Delaware**

**Objective:** Paramedics commonly use intravenous fluid therapy and/or patient positioning in the prehospital setting to treat symptomatic hypotension. We conducted this study to compare the effectiveness of treating hypotension using intravenous saline boluses with positioning the patient flat and supine. **Methods:** The study design was a retrospective cohort without randomized allocation to treatment arm. Patients with non-traumatic hypotension, defined as a systolic blood pressure (SBP) of less than 90 mm Hg, were studied. The initial SBP reading was used to qualify the patient for enrollment. Those receiving pressors, with pulse rates exceeding 140 beats per minute, or a history of recent injury, were excluded. Patients were allocated to one of two treatment arms at the discretion of the paramedics. Group 1 received intravenous saline in one or more 250-mL boluses, and group 2 were placed in a flat recumbent position on the stretcher. Repeat boluses of saline were given at the discretion of the paramedics. Statistical analysis was performed using the Mann-Whitney U test and post-hoc power calculation with a significance of 0.05. **Results:** A total of 314 subjects were identified, and 17 were excluded. Of the 297 remaining, 201 were treated with intravenous saline, and 96 were positioned flat. The mean initial SBP was 71.7 mm Hg in the saline group and 71.9 mm Hg in the flat group ( $p = \text{NS}$ ). Following treatment, SBP was 97.3 mm Hg in the saline group and 94.5 mm Hg in the flat group ( $p = \text{NS}$ ). The mean arterial pressure (MAP) increased 21 mm Hg in the saline group and 19 mm Hg in the flat group ( $p = \text{NS}$ ). Therapy caused the pulse rate to decrease by approximately 30 beats per minute in both groups ( $p = \text{NS}$ ). The mean volume of saline that was infused in the fluid group was 478 mL. Post-hoc power calculation was 80%. **Conclusions:** Intravenous saline and flat positioning appear to be equally effective in

raising the SBP and MAP during prehospital transport in patients with non-traumatic hypotension. Patients whose initial SBP is less than 90 mm Hg may improve with flat positioning alone, thus preempting the need for intravenous saline.

**51 THE PREDICTIVE VALUE OF FIELD AND ARRIVAL GLASGOW COMA SCALE SCORE IN MODERATE-TO-SEVERE TRAUMATIC BRAIN INJURY** Daniel P. Davis, Jennifer A. Serrano, Colleen J. Buono, Gary M. Vilke, Michael J. Sise, David B. Hoyt, *University of California San Diego, San Diego, California*

**Background:** The Glasgow Coma Scale (GCS) is widely used to quantify level of consciousness in the prehospital environment. The predictive value of field GCS (fGCS) vs. arrival GCS (aGCS) is not well defined but has tremendous implications with regard to triage and therapeutic decisions as well as the use of predictive scoring systems such as TRISS. **Objectives:** To explore the predictive value of fGCS and aGCS in patients with moderate-to-severe traumatic brain injury (TBI). **Methods:** Major trauma victims with Head Abbreviated Injury Score (AIS) 3+ were identified from our county trauma registry over a 16-year period. Values for fGCS and aGCS were compared using univariate statistics and linear regression. Their predictive value with regard to mortality, Head AIS, and Injury Severity Score (ISS) was determined using linear regression. The aGCS/fGCS difference was modeled against Head AIS, mortality, ISS, and fGCS to identify patients in whom fGCS might not accurately predict aGCS. Receiver-operating characteristic (ROC) curves were used to define an optimized fGCS/aGCS value for predicting severe TBI (Head AIS 4+ and Head AIS 4+ with death or intensive care unit >2 days) and mortality. **Results:** A total of 12,882 patients were included in this analysis. The mean values for fGCS and aGCS were similar (11.4 and 11.5, respectively,  $p = 0.336$ ), and a strong correlation ( $r^2 = 0.68$ ,  $p < 0.0001$ ) was observed between the two values. Mean values for fGCS and aGCS were identical in patients with Head AIS 4+ (10.1 for both,  $p = 0.769$ ); a strong correlation between the values was again observed ( $r^2 = 0.69$ ,  $p < 0.001$ ). A nonlinear relationship between fGCS/aGCS and both Head AIS and mortality was observed. Neither fGCS nor aGCS alone was highly correlated with Head/Neck AIS ( $r^2 = 0.01$ ), ISS ( $r^2 = 0.01$ ), or mortality ( $r^2 = 0.01$ ). The difference between fGCS and aGCS did not appear to be related to fGCS, Head AIS, ISS, or mortality. GCS values of 10–11 were most predictive of severe TBI or mortality based on ROC analysis. **Conclusions:** Values for sGCS are highly predictive of aGCS, supporting the use of fGCS for TRISS calculations. Neither is predictive of head-injury severity, overall injury severity, or mortality. This underscores the need for additional

prehospital variables to guide therapeutic and triage decisions.

**52 COMPUTER MODELING OF ESTIMATED TRAJECTORY: COMET** Eli Segal, Gisele Ouimet, David Beaumont, Eric Lareau, *Urgences-sante, Sir Mortimer B. Davis-Jewish General Hospital, McGill University, Montreal, Quebec, Canada*

**Introduction:** Arriving at the patient's side in the shortest time possible is one of the challenges facing every emergency medical services (EMS) system. In order to optimize our ambulance dispatch-to-arrival on-scene interval, ambulances have been outfitted with monitors that display computer-generated directions (CGD) for each ambulance run. However, the utility of the CGD has not been studied. **Objective:** This study modeled the use of the CGD by comparing the actual route taken (ROUTE\_A) to the CGD (ROUTE\_CGD). **Methods:** This was a descriptive, retrospective analysis of all priority one (urgent response) runs for a one-year period. For each run, the ROUTE\_A, ROUTE\_CGD, as well as the actual time (TIME\_A) and the estimated time (TIME\_CGD) were compared. Equivalency between the two routes was predefined as  $\geq 90\%$  match of all data points between the two routes. **Results:** There were 88,027 priority one runs during the one-year period. 42,630 (48.4%) of runs were excluded from analysis due to change of priority or errors in data acquisition. Of the 45,424 runs analyzed, 19.76% were equivalent.  $TIME\_CGD - TIME\_A$  was  $-2.13 \pm 2.31$  minutes in equivalent runs and  $-3.07 \pm 3.17$  minutes in non-equivalent runs. **Conclusions:** In this pilot study, we found that approximately 20% of runs were equivalent between the actual and CGD trajectories. In equivalent runs, the computer underestimated the actual time required. Further prospective study of this tool is required to better determine its effectiveness as well as how it may be improved.

**53 A RETROSPECTIVE CASE SERIES USING PREHOSPITAL PALPABLE PULSE CHARACTER TO PREDICT MORTALITY IN TRAUMA PATIENTS** John B. Holcolmb, John G. McManus, Jose Salinas, John A. Ward, James H. Duke, Fred A. Moore, *Army Institute of Surgical Research, Fort Sam Houston, Texas*

**Objectives:** Although some literature suggests that neither blood pressure nor other signs of shock are well correlated with tissue perfusion or outcome, no study has compared prehospital pulse character with mortality in trauma patients. The purpose of this study was to determine if the character of a pulse could be used as an early predictor of mortality in patients transported to a Level I trauma facility and be correlated with the systolic blood pressure (SBP). **Methods:** We performed

a retrospective chart review of 371 patients transported by Life Flight System helicopter to Memorial Hermann Hospital, an urban Level I trauma center in Houston, Texas, from August 2002 to January 2004. SBP and pulse characters of the radial, femoral, and carotid arteries were recorded by a flight nurse or paramedic at the scene. **Results:** Receiver operating characteristic (ROC) curve areas for the radial, femoral, and carotid pulses as predictors of patient mortality were found to be 0.722, 0.711, and 0.644, respectively. Analysis of the radial pulse character and SBP revealed that the radial pulse is as effective a predictor of patient survival as SBP (ROC area = 0.689). Based on graphical analysis, it was found that radial pulse character changed from normal to weak at a SBP of 110 mm Hg and from weak to absent at 70 mm Hg. Further analysis was done on a cohort of patients using a Glasgow Coma Score (GCS) of  $\geq 9$  to eliminate severe central nervous system (CNS) injuries. This GCS value was based on the point where the slope of the Reed-Muench fifty percent end point curve was minimal. In patients with a GCS  $\geq 9$ , a normal radial pulse at the scene resulted in an overall mortality of 1%, whereas a weak or absent pulse increased the mortality rate to 28.6%. **Conclusion:** The palpable radial pulse character may serve as a simple, early predictor for mortality in prehospital trauma patients. Controlling for severe CNS injury increases the positive predictive value for a palpated normal radial pulse. Furthermore, given a normal, weak, or absent radial pulse, a corresponding blood pressure range can be estimated.

**54 DESCRIPTION OF 33 PREHOSPITAL NEEDLE CHEST DECOMPRESSIONS FOR PRESUMED TENSION PNEUMOTHORAX** Jennifer Hannum, Jonnathan M. Busko, Stephanie Dix, Tom H. Blackwell, Gamal Mostafa, Ronald F. Sing, *Carolinas Medical Center, Charlotte, North Carolina*

**Objectives:** Prehospital needle decompression for presumed tension pneumothorax is considered a potentially lifesaving procedure, but the frequency, appropriateness, and outcomes of its use have been poorly described. The purpose of this study was to determine the effectiveness of this procedure by evaluating all trauma patients who received prehospital needle decompression and were transported to a Level 1 trauma center over a 5-year period. **Methods:** The emergency medical services system is an advanced life support provider with an annualized volume of 65,000. Trauma patients receiving prehospital needle decompression between 1998 and 2004 and transported to the Level 1 trauma center were included in the dataset. Prehospital patient care reports and hospital charts were reviewed and data were extracted. Prehospital data included hypotension (systolic blood pressure  $< 90$  mm Hg) and hypoxia when noted (pulse oximetry  $< 90\%$ ). Hospital

data included survival, hypotension, hypoxia, pneumothorax or effusion on chest x-ray, chest tube placement, and presence of air leak after chest tube insertion. **Results:** 33 patients were included in the dataset; 26 (79%) were male, 7 (21%) were female. 14 (42%) were in cardiac arrest throughout their care, and there were no survivors in this group. Of the 19 (58%) survivors, 4 (21%) patients were neither hypotensive nor hypoxic, and 15 (79%) were either hypotensive, hypoxic, or both. Of the 19 survivors, 2 (11%) had negative chest x-rays and 9 (47%) had either small pneumothoraces or effusions; none of these 11 patients underwent tube thoracostomy. The remaining 8 survivors (42%) had chest x-rays showing either large pneumothorax or large effusion and all had chest tubes inserted; 7 of these had air leaks after chest tube placement. **Conclusions:** In this sample of 33 patients undergoing prehospital needle decompression, the 14 who presented in cardiac arrest had no change in outcome. 4 survivors never had hemodynamic or respiratory instability, and only 7 patients ultimately had clinical evidence of a potentially significant pneumothorax. Needle decompression should be prospectively evaluated to further assess the appropriateness and effectiveness of its use in the prehospital environment.

**55 EVALUATION OF PARAMEDIC FIELD TRIAGE OF INJURED PATIENTS TO TRAUMA CENTERS AND EMERGENCY DEPARTMENTS** Gary M. Vilke, Edward M. Castillo, Leslie Upledger-Ray, Daniel P. Davis, Patricia A. Murrin, Frank Kennedy, Sue Cox, Raul Coimbra, *County of San Diego EMS, San Diego, California*

**Background:** A third-party assessment of our county's emergency medical services system implied that there might be an issue with overtriage to trauma centers. **Objective:** To assess our prehospital protocols of trauma triage for paramedic and base hospital compliance. **Methods:** This was a retrospective chart review of records from a prehospital computerized database of all adult emergency patients with an injury chief complaint who were transported to a receiving hospital during a representative two-week period. The decision for a patient to be designated as a trauma patient in the field is determined by the paramedic and medical intensive care nurse providing care utilizing a trauma decision tree algorithm based on criteria from the American College of Surgeons Gold Book. This algorithm uses three main categories for triage: physiologic, anatomic, and mechanistic. Patients who met trauma center triage criteria but were not transported to a trauma center were classified as undertriaged. Patients who were transported to a trauma center, but did not meet trauma center triage criteria were classified as overtriaged. Patients who were identified as trauma patients and transported to a trauma center or who were not identified as

trauma patients and were transported to an emergency department were classified as appropriately triaged. **Results:** Paramedics responded to 5,972 patients, of whom 5,242 were transported. Of the transported patients, 978 were adult, defined as age 14 years or older, had an injury chief complaint and a complete medical record, and were included in the analysis. There were 180 patients who met prehospital trauma triage criteria: 27 physiologic, 20 anatomic, and 133 mechanistic, with an additional 31 with comorbid conditions meeting criteria. Overtriage of patients transported to a trauma center who did not meet triage criteria compared with those who were actually transported to a trauma center:  $13/191 = 0.068 = 6.8\%$ . Undertriage of patients who met trauma triage criteria but were not transported to a trauma center compared with all who met trauma center triage criteria:  $33/211 = 0.156 = 15.6\%$ . The majority of the undertriage patients were classified based solely on mechanism. **Conclusions:** Paramedics in our system adhere closely to trauma triage protocols. The overtriage rate based on well-established protocols was 6.8%.

**56 COMPLIANCE WITH TRANSPORT PROTOCOLS FOR PATIENTS WITH MAJOR TRAUMA** **Bradley J. Kaufman, Neal Richmond, James Braun, John Freese, John J. Clair, New York City Fire Department, Brooklyn, New York**

**Introduction:** In the New York City 911 emergency medical services system, state and regional protocols require that prehospital patients be transported to the nearest appropriate hospital destination. Those patients meeting criteria for major trauma are therefore required to be transported to the nearest designated Level 1 trauma center. Lack of compliance with such protocols may result in major trauma patients' receiving less-than-optimal care, and may also reflect broader non-compliance with general system transport protocols. **Objective:** To determine 911 field-provider compliance with protocols for transport of patients meeting criteria for major trauma. **Methods:** The 911 computer-aided dispatch (CAD) database was queried for relevant call-types to identify those cases potentially meeting major trauma criteria during the two-week period from July 1 to 14, 2002. Those patients with an initial or final call type suggesting trauma, injury, amputation, burn, motor vehicle accident, pedestrian-struck, gunshot, or stab wound were eligible for inclusion into the study. Patients found to be in extremis due to an unmanageable airway, and who may therefore have been appropriately transported to the nearest 911 hospital destination, were excluded from further analysis. Ambulance call reports (ACRs) for each of the identified 911 calls were retrospectively reviewed to determine whether patients met criteria for major trauma, and whether they were subsequently transported to

the nearest designated Level 1 trauma center. **Results:** A total of 2,860 cases were identified by query of the CAD system, of which 2,424 ACRs (84.8%) were obtained for review. Of these, 477 (19.7%) met New York State-established criteria for major trauma, and 430 (90.1%) of those patients were transported to a designated Level 1 trauma center. Of the patients transported to a trauma center, 415 (96.5%) were transported to the nearest such institution, while this information was not documented in 5 (1.2%) cases. **Conclusion:** Patients meeting major trauma criteria may not always be transported to the nearest appropriate hospital destination. Lack of compliance with established protocol may result in less-than-optimal patient care, and may reflect inappropriate transport of other categories of patients as well.

**57 ONLINE MEDICAL CONTROL DOES NOT CHANGE ADHERENCE TO A CPAP FIELD PROTOCOL** **Larry R. DesRochers, MONOC Emergency Services, Brick, New Jersey**

**Objective:** To determine if online medical control alters adherence to protocol in the application of continuous positive airway pressure (CPAP) for acute pulmonary edema in the field. **Methods:** A retrospective chart review of patients receiving CPAP for pulmonary edema in the field during two time periods: the first requiring medical control and the second not requiring medical control. Excluding the primary investigator, the data collectors were blinded to the primary objective. Inter-rater reliability testing was done on the data collectors. Adherence to protocol was then analyzed using chi-square analysis. Factors associated with non-adherence, and group attributes were also analyzed for trends. **Results:** Data were collected for the time period 1/1/01 to 9/30/02 in the medical control (MC) group and 10/1/02 to 3/31/03 for the non-medical control (non-MC) group. A total of 172 patients received CPAP during these time periods. 55 charts were excluded for one of two reasons: either the record could not be found or the data required to determine adherence to protocol were missing. This left 117 patients with complete data; 82 in the MC group and 35 in the non-MC group. Both groups were closely matched for age, race, on-scene times, total field times, length of stay, and vital signs. The medical control group was adherent to the protocol in 37/82 (45%) cases and the non-MC group was adherent in 15/35 (43%) cases ( $p = 0.982$ ). There were also no significant differences in admission diagnosis, survival to discharge or transfer, complications from CPAP, or intubation rates. The only factor significantly associated with non-adherence to protocol between the two groups was the presence or absence of rales ( $p = 0.0479$ ). **Conclusions:** Online medical control does not make a difference in

adherence to protocol for the field treatment of pulmonary edema.

**58 COMPUTERIZED VERSUS HANDWRITTEN EMS ONLINE MEDICAL CONTROL LOG ACCURACY** **Mario Capuzzi, Mike Jorolomen, Heramba Prasad, Jay M. Scott, SUNY Upstate Medical University, Syracuse, New York**

**Background:** Emergency medical services (EMS) notifies our emergency department (ED) of patients who require advanced life support (ALS) in two ways: one is via text message sent by EMS dispatch through EM-System; the other is by digitally recorded radio or telephone conversations with a base-station physician. The physician records patient-specific information on a handwritten log sheet. Historically, the written log entry has been used to identify and locate the recording of the conversation with online medical control, when necessary, for quality improvement purposes as well as investigation and resolution of complaints. **Objective:** This exempt study was undertaken to determine the efficacy of computerized log entry, compared to manual log entry, for locating and retrieving recordings of radio/telephone call-ins for patients brought to the ED by EMS. **Methods:** One hundred manual log entries and one hundred computerized entries were randomly selected. One of the investigators reviewed date, time, and chief complaint information from the respective logs necessary to locate and retrieve the associated recordings. The frequencies (and 95% confidence intervals) with which the audio recordings could be successfully located and retrieved were compared for the two groups. **Results:** For the computerized log entries, 100% (95% CI: 97–100%) of the recordings could be located and retrieved. By comparison, only 47% (95% CI: 37–57%) of the recordings could be identified and retrieved based on the written physician log entries. **Conclusion:** Using automated computerized log entries significantly increases the frequency with which recordings of EMS conversations with base station physicians can be located and retrieved. When automated, computerized logging systems are in place, manual logs are a duplication of efforts that do not contribute to the ability to locate and retrieve such recordings.

**59 THE RELATIONSHIP BETWEEN PARAMEDIC INSTRUCTOR QUALIFICATIONS AND STUDENT PERFORMANCE ON THE NATIONAL CERTIFICATION WRITTEN EXAM** **Gregg S. Margolis, Philip D. Dickison, National Registry of EMTs, Columbus, Ohio**

**Introduction:** Emergency medical services (EMS) instructor qualifications are an important and often debated educational policy issue. While it may be intuitive that higher instructor qualifications result in increased

instructional quality and increased student performance, there is no empirical evidence demonstrating this relationship in EMS instruction. **Objective:** Hypothesis: There is a relationship between paramedic instructor clinical credentials and education and first-time pass rate of their students on the written portion of the national certification examination. **Methods:** Candidates taking the National Registry of EMTs paramedic exam in 2002 were asked to identify the clinical credential and highest educational degree attained by their lead instructor at the bottom of their exam answer sheet. The instructors' clinical credentials and education were correlated to the first-time pass rate. **Results:** The paramedic written exam was administered 12,849 times during the study period, with 7,890 taking the paramedic exam for the first time. Of these, 5,874 (74.4%) candidates completed the survey. 1,665 candidates identified the clinical credential of their lead instructor. The first-time pass rates by instructors' clinical credentials were as follows: paramedic = 54.4%, nurse = 72.9%, physician = 67.1% ( $p \leq 0.001$ ). 2,452 candidates identified the educational level of their lead instructor. The first-time pass rate by instructors' educational level were as follows: associate's degree = 62.7%, bachelor's degree = 69.4%, master's degree = 72.7%, and doctoral degree = 78.5% ( $p \leq 0.001$ ). **Conclusion:** There is a strong relationship between paramedic instructor clinical credential, educational background, and student first-time pass rate on the written portion of the national paramedic certification examination. More research is needed to determine if this relationship is causal or correlational.

**60 PARAMEDIC SELF-REPORTED MEDICATION ERRORS IN AN ANONYMOUS SURVEY** **Gary M. Vilke, Jim Harley, Marcy Metz, Barbara Stepanski, Dori Vroman, Marilyn Anderson, Holly Shipp, County of San Diego EMS, San Diego, California**

**Background:** Continuing quality improvement (CQI) reviews reflect that medication administration errors occur in the prehospital setting. These include wrong dose, wrong medication, wrong route, wrong concentration, or wrong indications. **Objective:** To anonymously survey paramedics to assess the magnitude of these types of medication errors. **Methods:** This study was a survey given to all paramedics in our county at the time of their annual protocol update training. The survey tool was established based on previous literature reviews and questions developed based on previous CQI data. Data were collected and analyzed and descriptive statistics were evaluated. **Results:** 298 surveys were returned, with the paramedics' having an average of  $8.46 \pm 6.7$  years of field experience. They work an average of 11.0 shifts/month with an average of 25.4 hours and 6.7 calls/shift. 11.9% of responding

paramedics reported having a medication error in the last twelve months. Types of errors included dose-related errors (63%), protocol errors (33%), wrong-route error (21%), and wrong-medication error (4%). Issues identified in contributing to the errors include failure to triple check, infrequent use of the medication, dosage-calculation error, and incorrect dosage given. Fatigue, training, and equipment setup of the drug box were not listed as any of the contributing factors. The majority of these errors were self-reported to the CQI representative (79.1%), with 8.3% being reported by the base hospital radio nurse, 8.3% found upon chart review, and 4.2% noted by paramedic during call, but never reported. **Conclusions:** Although many safeguards have been put into place, almost twelve percent of paramedics responding to an anonymous survey report medication errors in the last twelve months, with 4% of those having never been reported in the CQI process. Additional safeguards must continue to be implemented to decrease the incidence of medication errors.

**61 A NOVEL HOMEMADE INEXPENSIVE INTRAVENOUS CATHETERIZATION TRAINING MODEL FOR PARAMEDIC STUDENTS** Vivek Parwani, Susan Stroud, David Cone, *Yale University School of Medicine, New Haven, Connecticut*

**Introduction:** Teaching paramedic students venipuncture and intravenous (IV) catheterization has traditionally relied on bulky, expensive phlebotomy models (\$95–\$395). A recently described homemade gelatin intravenous model (GIM) costing less than 50 cents is currently being used in the training of medical students and interns. **Objective:** To evaluate paramedic students' perceptions of the GIM as a training tool. **Methods:** GIMs are created using gelatin, psyllium, Penrose drains, food coloring, salt, and water.  $1/4$ -inch and  $1/2$ -inch Penrose drains are filled with artificial blood composed of salt water and food coloring. After knotting both ends, the drains are placed in an aluminum pan with a base of hardening gelatin. The  $1/2$ -inch drains can be left toward the bottom of the pan with the  $1/4$ -inch drains higher to simulate deep and superficial veins, respectively. The psyllium and gelatin are mixed with boiling water and layered on the drains to create this effect. A convenience, volunteer sample of 14 paramedic students who have previously trained with traditional phlebotomy models each made 2–5 attempts at IV insertion using the GIM. Perceptions of the GIM were measured using a Likert scale questionnaire (1 = worst rating, 5 = best rating). Mean scores are reported. **Results:** Study subjects rated ease of use at 4.17, perception of realism at 4.07, and effectiveness at learning IV insertion at 4.28. GIM is a more effective tool in teaching IV insertion than the conventional rubber arm,

yielded a rating of 4.14. Median response in all data sets was 5.00. **Conclusions:** Further studies evaluating the GIM's construct and content validity are needed. The formula for the GIM appears to be a valuable one. Given the GIM's simplicity and value, paramedic instructors should consider implementation of this device in their curricula.

**62 ALS VS. BLS: IS THERE A DIFFERENCE IN EMS CARE DELIVERED TO PATIENTS IN MEDICALLY UNDERSERVED AREAS IN VIRGINIA?** Jeffrey D. Ferguson, Sabina Braithwaite, Eric Byrnes, Anthony Yoder, *University of Virginia, Charlottesville, Virginia*

**Objective:** Recent attention to rural prehospital health care has recognized disparities between urban and rural systems, including level of care and skill retention. Virginia designates medically underserved areas by criteria including population income level, age, primary care physician ratio, infant mortality rate, and unemployment rate. We compare provision of advanced life support (ALS) care and procedures by 911 emergency medical services (EMS) agencies in medically underserved and non-underserved areas in Virginia. **Methods:** Data collected by the Virginia Office of EMS from patient care reports between July 1, 2002, and March 31, 2003 were evaluated for calls designated ALS or basic life support (BLS), and number of ALS procedures performed. Data were analyzed to determine differences in proportion of ALS calls and number of ALS procedures performed between the 42 areas designated as medically underserved and the 92 remaining areas. **Results:** 390 of 402 career or volunteer 911 EMS agencies reported data on call type and ALS procedure utilization. 133 agencies were in 42 underserved areas (6 cities, 36 counties), and 257 agencies in non-underserved areas (33 cities, 59 counties). Data from 327,179 call reports were analyzed, including 70,041 ALS calls and 532,431 EMS procedures. Random sampling and pooled analysis of variance determined mean and p-values. No significant difference was found between the rate of ALS call designation between the two groups (18.50% CI  $\pm$  3.08% vs. 18.97% CI  $\pm$  4.35%,  $p = 0.095$ ), but significantly fewer ALS procedures (28.15% CI  $\pm$  3.24% vs. 30.59% CI  $\pm$  3.51%,  $p < 0.005$ ) performed by agencies in underserved areas compared to non-underserved areas. **Conclusions:** Performance of ALS skills in medically underserved areas is lower than in non-underserved areas despite similar ALS call percentages. Further research should assess whether patients have a lower severity of illness in medically underserved areas and should be receiving fewer ALS procedures, though this is unlikely, given medically underserved designation criteria. There may be other etiologies to this disparity such as provider training and transport time.

**63 PREHOSPITAL ASPIRIN ADMINISTRATION RATES: A TEN-YEAR PROSPECTIVE REVIEW** **Juan A. March, Mary J. Pollock**, *East Carolina University, Greenville, North Carolina*

**Introduction:** Research has shown that Prehospital aspirin (ASA) administration is associated with a 23% reduction in myocardial infarction mortality. Unfortunately, previously published studies show that prehospital ASA administration rates are usually less than 50%. **Objective:** To determine the effects of different interventions on the rate of prehospital aspirin administration during a 10-year period. **Methods:** This study was performed retrospectively using an advanced life support database for two months in each study year. The setting was Pitt County, North Carolina, with a population of 130,000 and approximately 15,000 emergency medical services calls annually. The interventions were divided into 6 stages as follows. Phase 0—control, 1991. Phase 1—new chest pain protocol ASA added, 1992. Phase 2—30-minute educational session, 1993. Phase 3—five-year follow-up (no interventions), 1998. Phase 4—repeat educational session, 1999. Phase 5—Root cause analysis with education, 2000. **Results:** The percentages of chest pain patients administered ASA were as follows: Phase 0—0%, Phase 1—30%, Phase 2—80%, Phase 3—51%, Phase 4—68%, Phase 5—76%. Root cause analysis noted documented causes for not giving ASA as follows: patient refused (upset stomach), allergy, already took ASA (enteric-coated). **Conclusion:** Over a 10-year period, the rate of ASA administration has waxed and waned from 0% to 80%. This study suggests that root cause analysis can significantly increase the rate of ASA administration by identifying the causes for non-administration. The decreased rates associated during non-education periods suggest the need for continuous evaluation and education.

**64 NON-TRANSPORT OF EMS PATIENTS: IDENTIFICATION OF INDIVIDUAL PARAMEDIC CREW BEHAVIORS THROUGH SYSTEM-WIDE AUTOMATED AUDIT MECHANISMS** **Raymond L. Fowler, Paul E. Pepe, David M. Melville, Alexander L. Eastman, Gregory L. Larkin**, *University of Texas Southwestern Medical Center, Dallas, Texas*

**Introduction:** Many emergency medical services (EMS) systems use non-transport policies to optimize resource utilization. While well-intended, such policies may increase the risk of mistriage and potential for bad outcomes. Therefore, in any system allowing non-transports, effective monitoring methods are strongly recommended. **Objective:** To demonstrate the utility of a system-wide audit of automated EMS records to identify varying rates of non-transport among individual paramedic crews, thus allowing identification of po-

tential areas for focused investigation and intervention. **Methods:** A retrospective analysis of 906,011 EMS incidents from 1998 to 2003 in a large, urban EMS system was performed. Data from computerized EMS patient records were reviewed and entered into a proprietary Microsoft FoxPro (Microsoft Corporation, Redmond, WA) database. Generated reports were then exported into Microsoft Excel for compilation and analysis. These data were analyzed with specific regard to variation in the rate of non-transport across individual crews, shifts, and stations. **Results:** During the 6-year study, no patient was transported to a hospital in 541,920 incidents (59.8%). Great variability was found in both the rate and the reason for non-transport. The highest overall rate of non-transport by an individual crew, "Shift 1," was found to be 73.8%, and this individual crew maintained the highest non-transport rate in the system for five of the six study years. A second crew at the same station, "Shift 2," had an overall non-transport rate of only 58.0% (OR: 1.9 [1.8, 2.1]  $p < 0.00001$ ). The EMS-initiated (versus patient-initiated) non-transport rate for shift 1 was 21.4%, as compared to shift 2, whose EMS-initiated non-transport rate was 14.9% (OR: 1.9 [1.7, 2.1]  $p < 0.00001$ ). System-wide, the overall EMS-initiated non-transport rate was 8.4% (range: 2.8%–21.4%). **Conclusion:** In a large urban EMS system, considerable variability exists between individual crews regarding both the rate of non-transports and the reasons for non-transport. While multiple geographic and sociologic variables may explain this variation across the system, this analysis still provides strong data to justify targets for review (e.g., large differences at the same station on different shifts). Further study should determine whether this focus allows medical directors to more efficiently direct corrective interventions and alter patient outcomes.

**65 ARE PARAMEDIC ESTIMATED TIMES OF ARRIVAL FOR TRAUMA PATIENTS ACCURATE?** **Robert L. Norton, Christopher Bangs**, *Oregon Health & Science University, Portland, Oregon*

**Introduction:** Paramedic estimated times of arrival (ETAs) for trauma patients allow for trauma team and emergency department (ED) resource preparation to receive trauma patients. Accurate estimates permit efficient use of personnel time, whereas inaccurate estimates may result in undue waiting and inefficient resource use. **Methods:** This study retrospectively reviewed all trauma system patients transported by ground ambulance to a Level 1 trauma center. The study site emergency medical services system is an all-advanced life support transport, multi-county region with designated trauma system and defined patient entry criteria. Air-transported patients, delayed extrications, prolonged transports ( $\geq 1$  hour) and interhospital

transfers were excluded. Data sources included trauma communication center and trauma registry databases. ETAs were given at the time of system entry. Time interval from trauma system entry to emergency department arrival (transport time) was calculated from the documented times. Time differences (time diff) between the ETA and transport time were calculated. **Results:** During 5 years, there were 6,139 trauma system patients with a mean difference between the ETA and transport time of 7.8 minutes ( $\pm 7.1$ , range 0–49). 45% of patients arrived within 5 minutes of the ETA and 72% within 10 minutes. There were no significant differences in mean time diff for the following comparisons; full vs. modified trauma team activation, survivors vs. non-survivors, day of week, initial Glasgow Coma Scale Score. There were statistically significant, but probably clinically insignificant, differences in mean time diff for rush hour compared to non-rush hour transports (8.5 vs 7.7 min,  $p < 0.002$ ) and hour of day of transport (ANOVA). **Conclusions:** In this system, 28% of paramedic ETAs for trauma patients were inaccurate by more than 10 minutes. Time of the day for the transport accounts for some of the inaccuracy. There is opportunity to develop more accurate methods, perhaps using geographic information systems, to better estimate time of arrival.

**66 THE IMPACT OF EMERGENCY MEDICAL TECHNICIAN GLUCOMETRY ON PATIENT TRIAGE** **Jared Strote, Donald Cloyd, Thomas Rea, Mickey Eisenberg, University of Washington, Seattle, Washington**

**Objectives:** Rapid glucose testing is a valuable tool for emergency medical services (EMS) patient evaluation and treatment. Currently, in most EMS systems, paramedics, but not emergency medical technicians (EMTs), are authorized to use glucometry. We attempted to measure the utility of EMT glucometry on patient assessment and triage in a two-tiered EMS response system. **Methods:** King County, Washington, EMTs underwent training to check blood sugar levels for specific patient presentations. We present a case series of the first 500 of such encounters from October 2003 through March 2004, during which time EMTs recorded their subjective assessment of this additional information on patient evaluation. **Results:** For 22 patients (4.4%), glucometry prompted EMTs to upgrade the triage level and request advanced life support transport; in 23 patients (4.6%), glucometry caused EMTs to downgrade the triage level, canceling already dispatched paramedics; for 52 patients (10.4%), glucometry allowed EMTs to function without paramedics when they otherwise would have called for assistance. **Conclusion:** Use of glucometry by EMTs may allow patients to be triaged more appropriately and make better use of paramedic evaluations and transports.

**67 UNDESIGNATED PATIENTS: WHERE DO THEY GO AND WHY?** **Laura L. Bultman, Jeffrey Ho, David I. Page, Hennepin County Medical Center, Minneapolis, Minnesota**

**Introduction:** Typical emergency medical services (EMS) transport of patients is dictated by patient hospital request; however, many patients do not have a designated hospital. These undesignated patients (UPs) are not well-characterized in the literature. UPs may represent uncaptured revenue for competing local facilities. **Objective:** We hypothesized that many factors might influence their transportation to destination hospitals. **Methods:** We utilized a prospective, observation model where research assistants and paramedic students gathered data during scheduled EMS ride-along shifts. The shifts were sampled over a 68-day period and included all shift types. Multiple two-paramedic crews in three different ambulance services were observed. Each service is a hospital-based provider, and these EMS systems serve a population of over 1.2 million people, including urban and suburban locations. One urban, public hospital and numerous private hospitals were available as destinations. Data points collected included: status of patient (designated vs. undesignated), type of destination hospital (public vs. private, affiliated vs. nonaffiliated hospital), call location (urban vs. suburban), patient appearance and behavior (desirable vs. undesirable), and presenting problem (medical vs. trauma). Data were collected in a blinded fashion and were analyzed using descriptive statistics and chi-square testing for significance. **Results:** A total of 346 runs were observed, of which 207 were UP encounters (60%). Of the UP encounters, 98 occurred within an urban environment and 99 occurred within a suburban environment; 125 involved a medical presentation and 79 a trauma presentation. Fifty-six percent were transported to the EMS system's own affiliated hospital(s). Paramedics suggested a hospital in 27% of UPs, and were significantly influential ( $p < 0.001$ ). In 206 UP encounters where behavior was recorded, 47% had undesirable behavior, including poor hygiene or dress, agitation, or intoxication. A significant difference was found in transporting suburban undesirable patients to the urban public hospital ( $p = 0.022$ ). **Conclusions:** Sixty percent of patients encountered in this EMS system are UPs. This represents potential revenue for capture by area hospitals, and it appears that paramedics can significantly influence patient choice of hospital destination. Undesirable behavior is a significant predictor for UPs to be transported to the public hospital.

**68 HOSPITAL INTERVAL PILOT PROJECT** **Eli Segal, Antoinette Colacone, Vedat Verter, Marc Afilalo, Urgences-sante, Sir Mortimer B. Davis—Jewish General Hospital, McGill University, Montreal, Quebec, Canada**

**Introduction:** Concurrent with increasing congestion in emergency departments (EDs), the amount of time emergency medical technicians (EMTs) spend in the hospital per call has increased. We conducted a time-motion study of EMT flow in an urban, academic ED. **Objective:** To describe the activity of the EMTs during their time in the ED. Secondary objectives included the association of time of day, age, and triage code with the various time intervals. **Methods:** In this descriptive study, we combined information from two databases: 1. Prospectively collected time-motion data of a convenience sample of EMTs presenting to one ED; 2. A prehospital call database of time data collected electronically. Data from the two databases were merged together using key identifiers. The time intervals calculated were: pretriage interval, triage interval, and posttriage interval. Total time spent in ED, as a proportion of total call time, was also calculated. Mean times with 95% confidence intervals (95% CIs) were reported. Analysis of variance was performed for associations of time of day, age, and triage code with time intervals. **Results:** Of 159 calls in database 1, matched data in database 2 were found for 152 calls. Of the seven calls not matched, 5 did not appear in database 2 at all, while 2 had no time data available. For the 152 calls with complete data, the mean times for the pretriage, triage, and posttriage intervals were 8.97 [95% CI 7.70–10.23], 5.14 [95% CI 4.49–5.79], and 31.10 [95% CI 28.91–33.30] minutes, respectively. Average time spent in the ED as a proportion of total call time was 47.43%. Subgroup analysis showed significant differences only between total time spent in the ED in the 7:30–10:00 time period (57.25 [95% CI 47.15–58.36] minutes) as compared with the 14:00–16:00 time period (42.03 [95% CI 37.21–46.84] minutes). **Conclusion:** More time was spent in the pretriage and posttriage intervals as compared with the triage interval. Total time spent in the ED represents almost half the total call time. Further study of time-motion in the ED will be necessary to provide more detailed information of the pre- and posttriage intervals in order to plan interventions to decrease the time spent in hospital by EMTs.

**69 PATIENT TRANSPORT REFUSALS: A COMPARISON OF REFUSAL RATES FOR VOLUNTEER AND CAREER EMS AGENCIES IN VIRGINIA** **Korin B. Hudson, Sabina Braithwaite, Eric Byrnes, Anthony Yoder, University of Virginia, Charlottesville, Virginia**

**Objective:** Emergency medical services (EMS) refusals are a potential source of liability for the EMS provider, the agency, and the medical director. Multiple previous studies have evaluated refusal rates in urban settings, staffed by career providers. However, there is scant literature evaluating refusal rates for volunteer EMS agencies. In the Commonwealth of Virginia, a sig-

nificant proportion of 911 responses are provided by volunteer agencies. We felt it was important to assure that all agencies are comparable in this regard; our hypothesis was that volunteer and career EMS agencies have similar refusal rates. **Methods:** Data were obtained from EMS patient care records submitted to the Virginia Office of EMS. 360,350 EMS call reports from July 1, 2002, through March 31, 2003, were incorporated into a database. Patient care reports submitted by routine transport agencies and other agencies not responding to 911 calls were excluded from further analysis, as our focus was solely on 911 based services. Patient care reports from agencies with combined volunteer and career staffing as well as reports from agencies whose staffing status was unspecified were excluded from further review. Random sampling of data sets was used to prevent unequal weighting of results due to the wide range of reported call volume between agencies and to allow for a pooled analysis of variance. **Results:** 328,088 calls were reviewed, with 145,311 reports submitted by 353 volunteer agencies and 182,777 submitted by 46 career agencies. Pooled refusal rates for volunteer agencies (9.51%, 95% CI  $\pm$  1.15%, range 8.35–10.67%) and for career agencies (9.48%, 95% CI  $\pm$  1.59%, range 7.88–11.08%) were not significantly different. **Conclusion:** Refusal rates for 911 responses vary widely among agencies, yet the rate of patient refusals for volunteer agencies and career agencies are similar, with both consistent with previously published refusal rates. In a state where nearly half of all reported 911 responses for the study period were provided by volunteers, it is important to establish that there is no difference in refusal rates, and both types of agency are providing comparable care.

**70 ASSOCIATION BETWEEN CHANGE IN PATIENT CONDITION AND PARAMEDIC RESPONSE INTERVAL IN A TWO-TIERED EMS SYSTEM** **Ross E. Megargel, Robert E. O'Connor, Christiana Care Health System, Newark, Delaware**

**Introduction:** Paramedic response intervals are used in emergency medical services (EMS) quality improvement measurements. However, there is little evidence that a threshold of 8 minutes translate into improved outcome. In fact, for treatment of cardiac arrest, this interval is too long. **Objective:** To determine whether paramedic response times were associated with clinical changes. **Methods:** The EMS system is a three-tiered service with first responders, EMT-Bs, and paramedics. Emergency medical dispatch assigns basic or paramedic response. Consecutive paramedic trip sheets from 2004 (January to August) were abstracted. The entire response interval was determined based on the interval from 911 call receipt to paramedic arrival at the patient side. Clinical condition was

assessed initially and then while en route to the hospital by the paramedics. Change in clinical condition was assessed based on interval change between the two assessments, and was classified as improved, unchanged, or worsened. Response intervals were stratified as less than 4 minutes, 4–8 minutes, 8–12 minutes, 12–16 minutes, and greater than 17 minutes. The 95% confidence intervals were determined for the proportion of patients improved, unchanged, or worsened for each response interval. Post-hoc power analysis was performed. **Results:** A total of 12,983 records were abstracted, with 4,521 (35%) improved, 7,329 (56%) unchanged, and 1,133 (9%) worsened. The breakdown by response intervals was as follows: 2,593 (20%) less than 4 minutes, 5,794 (45%) 4–8 minutes, 3,185 (25%) 8–12 minutes, 1,077 (8%) 12–16 minutes, and 334 (2%) greater than 17 minutes. The 95% confidence intervals were overlapping for patients classified as improved, unchanged, or worsened, when stratified by response time. Power was calculated at 98%. **Conclusions:** In a system where most paramedic response intervals are less than 8 minutes, there is no significant difference in the proportions of patients determined to be clinically improved, unchanged, or worsened during the prehospital phase of care. The response interval may be less important than previously thought for most patients receiving care by paramedics. Exceptions requiring a rapid response may include cardiac arrest and other specific emergent conditions.

**71 KOSOVO'S POST-WAR DEVELOPMENT OF EMERGENCY MEDICAL SERVICES** Katherine P. O'Hanlon, E. Brooke Lerner, *University of Rochester, Rochester, New York*

**Objectives:** To assess 4-year post-war development of Kosovo's emergency medical services and determine future expectations. **Methods:** A qualitative study was conducted using an institutional review board-approved survey designed for in-person interviews (preferred) or written responses. The survey was translated by a native Albanian speaker and administered in Kosovo in October 2003. Respondents were selected to sample a spectrum of clinicians and policy makers. All responses were analyzed using descriptive statistics. **Results:** A total of 13 surveys were completed (10 in person and 3 written). Respondents were health care professionals (5 emergency medicine residents, 1 physician emergency department director, 1 emergency nurse, 2 consulting residents, 2 consulting specialists, and 2 public health officials). Most respondents (85%) felt that emergency medical services had not begun to develop until the end of the North Atlantic Treaty Organization (NATO) bombing campaign in 1999. Two respondents (15%) felt the advances since the war's end had been cosmetic and not functional; one (8%) felt emergency

medical services had been more effective during the 1980s, when Yugoslavia was intact. International assistance was credited with providing infrastructure (69%), supplies (69%), and training (62%). Most respondents (77%) thought no aspects of international assistance had been harmful; some noted specific instances of inappropriate investment (31%) (e.g., surgical suite in urgent care facility). Kosovo's leading emergencies were identified as trauma (77%), cardiac (54%), and ingestions/suicidality (46%). 10 of 11 respondents responsible for providing emergency care identified trauma as a primary concern. Needs for emergency medical services are training (85%) and equipping of departments and prehospital vehicles (62%). Respondents felt current needs should be addressed by improved hospital management (62%), improved political administration (54%), and increased international assistance (54%). Specific assistance desired from the international community includes training (62%), exchange opportunities (38%), and equipment (31%). 5 of the 6 non-emergency personnel felt their specialties weren't appropriately consulted for emergency medical services development. **Conclusions:** Survey respondents credit the international community with the 4-year post-war development of emergency medical services but feel future development requires improved Kosovar management. Continued international assistance should focus on training, including international exchange programs. Enhanced involvement of consulting specialists should be considered.

**72 IMPACT OF A LARGE ICE STORM ON EMS OPERATIONS** Jonnathan M. Busko, Tom H. Blackwell, Monroe Hicks, *Carolinas Medical Center, Charlotte, North Carolina*

**Objective:** The impact of severe weather on emergency medical services (EMS) operations has not been previously analyzed. Our community was affected by an ice storm for a period of 7 days. We examined EMS operations during this period to assess the effectiveness of routine system status plans and to identify changes that may be needed during inclement weather conditions. **Methods:** The urban advanced life support (ALS) system has an annualized call volume of 65,000. Data were collected for all emergency responses for the six days prior to and the six days following an ice storm. Time-utilization data, which included total effective unit hours (aggregate time of all in-service units performing any task), task times (aggregate time that all in-service units accrued responding to calls, on scene, transporting, and at hospital), and out-of-service time, were obtained for each hour of the study period. Due to system status scheduling, total effective unit hours are different for each hour; therefore, task times were expressed as a percent of total effective unit hours for

each hour analyzed. **Results:** 1,092 calls occurred prior to and 1,375 after the ice storm. Response times (405 v. 445 sec,  $p < 0.001$ ) and transport times (914 v. 1,008 sec,  $p = 0.0002$ ) were longer post-storm. There were a total of 288 time-utilization samples (144 hourly samples from each six-day period). Percentages of each hour pre- and post-storm spent on calls (35% v. 47%), responding (5% v. 8%), on scene (10% v. 14%), and transporting (8% v. 10%) were higher ( $p < 0.0001$ ), as was time spent at the hospital (12% v. 14%,  $p = 0.0019$ ). There was no difference in time spent out of service (5% v. 6%,  $p = 0.3884$ ). **Conclusions:** As expected, the ice storm increased the percent of time EMS spent responding to and transporting patients; however, the percent of time spent on scene and at the hospital also increased. The causes for scene and hospital delays and their impact to the system are unclear. Future research and planning should focus on target areas for improving time management and maximizing unit availability for responses when severe weather conditions are expected or present.

**73 THE EFFECT OF AN EIGHTEEN-HOUR BLACKOUT ON AN URBAN EMS SYSTEM** **David A. Rand, David J. Mener, E. Brooke Lerner, Nicholas DeRobertis,** *University of Rochester, Rochester, New York*

**Objectives:** To describe the experience of an urban, commercial ambulance provider during the multi-state August 2003 blackout and to identify how a power outage can affect an emergency medical services (EMS) system. **Methods:** Data were abstracted from all dispatch and prehospital medical records generated during the 18-hour blackout period. An hour-by-hour comparison was made between the median number of hourly dispatches during the month of August 2003 and the total number of EMS dispatches during the blackout. Chief complaints were categorized and all calls related to the blackout were identified. **Results:** During the first 10 hours of the blackout, hourly call volume increased an average of 250% and a maximum of 500% (range 50%–500%) as compared with all of August 2003. The greatest increase in call volume occurred during the first 7 hours of the blackout. During the blackout period, 10% ( $n = 12$ ) of all patients presented with heat-related complaints precipitated by the failure of air conditioning. During the same period, 23% ( $n = 25$ ) of all patients presented with a respiratory-related complaint, 55% ( $n = 15$ ) of which were precipitated by the failure of home respiratory equipment such as ventilators, nebulizers, and oxygen concentrators. During the blackout, the average time spent on scene with patients increased 63% from 11 to 18 minutes when compared with the 16 hours immediately prior and 14 hours immediately after the blackout. Average response and transport times did not change. **Conclusion:** Loss of

power can cause a dramatic but short-term increase in call volume and lead to a disaster-like situation. EMS resources may be conserved during such an event by proactively assisting patients with home medical devices before they develop emergent conditions. This patient population might benefit, for example, from home deliveries of portable oxygen tanks or from the creation of temporary facilities that provide a climate-controlled environment and electrically powered medical devices.

**74 A PROSPECTIVE, CROSS-SECTIONAL ANALYSIS OF HOSPITAL BED SURGE CAPACITY** **Daniel P. Davis, Jennifer C. Poste, Colleen J. Buono, Toni Hicks, Deanna Polk, Therese E. Rymer, Irving Jacoby,** *University of California San Diego, San Diego, California*

**Background:** Prehospital disaster triage relies on accurate data regarding the ability of the hospital to receive patients. Traditional strategies to determine hospital surge capacity have relied on cross-sectional hospital census data, which underestimates the true surge capacity in the event of a mass casualty incident. **Objective:** To more accurately determine hospital surge capacity using physician and nurse manager assessments for the disposition of all inpatients at multiple facilities. **Methods:** Overnight and day-shift nurse managers from each inpatient unit at four different hospitals made assessments on all patients under their care. Physicians at two academic institutions were also approached for comparison. Age, gender, and admission diagnosis were recorded. In addition, assessments were made for each patient as to his or her predicted disposition at 2, 24, and 72 hours in the event of a mass casualty incident. Transfers to a lower level of care, including a hypothetical “on-site nursing facility,” or discharge to home were included. A physical assessment of each hospital was also made to determine whether enough space was available for patients dispositioned to an “on-site nursing facility.” Data regarding hospital surge capacity for all facilities were reported descriptively. In addition, comparisons were made with regard to overnight and day-shift nurse assessments, physician and nurse manager assessments, and across facilities. **Results:** A total of 1,741 assessments on 788 patients by 82 nurse managers and 25 physicians from the four institutions were included. Nurse managers assessed approximately one-third of all patients as dischargeable at 24 hours and approximately one-half at 72 hours; a quarter of patients were assessed as being transferable to an “on-site nursing facility” at both time points. Physicians were more likely than nurse managers to send patients to such a facility or discharge them home but less likely to transfer patients out of the intensive care unit. **Conclusions:** A large proportion of inpatients can be discharged within 24 and 72 hours. Additional beds can be made available if an “on-site

nursing facility" is made available. Both physicians and nurse managers should be included on the team that makes patient dispositions in the event of a mass casualty incident.

**75 "CANNOT VENTILATE/CANNOT INTUBATE" EVENTS IN SUBURBAN-RURAL AMBULANCE RSI PROGRAMS: A FOUR-YEAR OBSERVATION** **Brian P. McGlinch, Eric A. Weller**, *Mayo Clinic College of Medicine, Rochester, Minnesota*

**Introduction:** Perhaps one of the greatest concerns in allowing paramedics to perform rapid-sequence intubation (RSI) is fear of the "cannot ventilate-cannot intubate" ("CV-CI") scenario. **Objective:** To review a prehospital RSI database involving five suburban-rural ambulance services where intubation attempts failed after administering RSI medications. **Methods:** Retrospective, observational review of a prehospital RSI database collected from five suburban-rural communities (populations 35,000-85,000) over a 48-month period. Standardized RSI criteria, protocols, and report forms were utilized throughout the period. All RSI ambulance report data are entered into a single corporate database. Data from all patients receiving RSI are available for review. RSI is indicated for Glasgow Coma Scores <8, rapidly declining respiratory and/or hemodynamic status, or persistent hypoxia or unresponsiveness in the presence of assisted ventilation and oxygen therapy. Two RSI-trained paramedics were required on-scene. Etomidate and succinylcholine are used for sedation and paralysis. Laryngoscopy is limited to 30 seconds. No more than 3 intubation attempts are permitted. **Results:** In the 48-month period, 252 patients met RSI criteria (<0.1% of all emergency contacts). 161 of 252 (64%) had RSI attempted (113 medical emergency and 48 trauma patients). In the 113 medical emergency patients, 8 (7%) required three intubation attempts or could not be intubated. Four had Combitube placement. Four had mask ventilation following failed intubation. "CV-CI" did not occur in medical emergencies. Of the 48 trauma patients, ten (21%) required three intubation attempts or could not be intubated. Five patients (10%) had Combitube placed following the third failed intubation. Two patients met criteria for "CV-CI" but only one received emergency tracheostomy. **Conclusion:** Concerns that "CV-CI" events will occur at a high rate when prehospital RSI is performed by paramedics appear unfounded based upon our four-year observation; even in suburban-rural communities.

**76 HIGH COMPETENCY OF PARAMEDIC AIRWAY SKILLS IN A HOSPITAL-BASED EMERGENCY MEDICAL SERVICES SYSTEM** **Stacy N. Weisberg, Marc Restuccia**, *University of Massachusetts Memorial Health Center, Worcester, Massachusetts*

**Introduction:** Several published studies advocate conservative airway management, rather than intubation, by paramedics in the out-of-hospital setting. However, we and others propose that, with adequate training and supervision, paramedics can intubate with a high degree of competency and can even use medication-enhanced intubation (MEI) without an increased incidence of adverse outcomes. **Objectives:** The primary goal of this study was to quantify intubation success rates by paramedics in our hospital-based, closely supervised emergency medical services (EMS) system, with emphasis on experience (i.e., number of intubations per year) and employment status (full-time vs. per-diem) on % success rate. We also compared intubation success rates before vs. after initiating MEI protocols in our EMS agency. **Methods:** This study, conducted as a retrospective chart review, assessed all intubations performed by paramedics employed by Worcester EMS in 1999 (1 year before MEI protocols) and 2000 (after training and permission to use fentanyl, midazolam, and succinylcholine during intubations). For each paramedic, the numbers of attempted and successful intubations were tabulated, and employment status was verified. **Results:** This study included 53 paramedics, 42 full-time and 11 per-diem. They performed between 1 and 12 intubations per year. Median success rates ranged from 94% to 100% with no difference in % success as a function of attempts ( $p = 0.67$ ), and no correlation between the number of attempts and success ( $r^2 = 0.01$ ). There was no difference in success rates between full-time vs. per-diem employees, with a median of 100% for both cohorts ( $p = 0.40$ ). Lastly, success rates were comparable (median of 100%) before and after introduction of MEI protocols ( $p = 1.0$ ). **Conclusion:** This study demonstrates that paramedics (regardless of employment status) in our closely supervised, hospital-based EMS system were skilled in airway management, without increase in adverse outcomes using medication-enhanced intubation.

**77 PREHOSPITAL RAPID-SEQUENCE INTUBATION IN HAWAII: DATA FROM THE FIRST TWO YEARS** **James H. E. Ireland, Edward Kalinowski, Barbara Brennan, Donald Fancher, Donna Maiava**, *Mayo Clinic, Rochester, Minnesota*

**Introduction:** Rapid-sequence intubation (RSI) refers to the use of sedating and paralytic agents to facilitate the intubation of a conscious or semi-conscious patient. These traditionally have included a benzodiazepene such as Versed with a paralytic agent, often succinylcholine. While some regions have used these types of medications for over a decade, many systems have only recently adopted their use in the prehospital setting. **Objective:** To initiate a protocol in the State of Hawaii to introduce this procedure to

practicing paramedics statewide, and incorporate this into the paramedic curriculum for the paramedic students. **Methods:** All charts where RSI was completed or attempted were automatically audited as part of ongoing State of Hawaii emergency medical services quality assurance. The data from those charts were reviewed for indications and complications, including failure to intubate. The results of this retrospective chart review for the first two years are presented here. **Results:** In the first year, there were a total of 123 patients, with 63% having medical indications and 37% having traumatic indications. Among the medical patients, cerebrovascular accident and acute respiratory failure were the most common indications. In the trauma group, closed head injury was the most common. In the second year, 205 patients were reported, which was increased 67% over the first year. The island of Oahu accounted for nearly the entire increase in patients, as the numbers for the Outer Islands of Hawaii, Maui, and Kauai remained essentially the same. Forty-three patients (13%) were not intubated after paralytics were administered. These patients were managed by a Combitube in 26 (60%), bag-valve-mask (BVM) in 16 (37%), and nasotracheal intubation in one. No patients required a surgical airway. Taken together, 16 of 328 patients (5%) were without an airway and managed by BVM after paralytics were administered. Complications were rare, but there was one case of unrecognized esophageal intubation. **Conclusions:** The introduction of RSI in our system was considered successful and continues today. Medical directors have taken steps to stress contingency plans in the event intubation is not successful, such as the use of the Combitube, BVM alone, or surgical airway when needed.

**78 UTILIZATION OF PREHOSPITAL TRAUMA RSI IN A RURAL COMMUNITY WITHOUT AEROMEDICAL SUPPORT**  
**Brian P. McGlinch, Eric A. Weller, Mayo Clinic College of Medicine, Rochester, Minnesota**

**Introduction:** Prehospital rapid-sequence intubation (RSI) is a well-described prehospital intervention, but its use in rural communities is not frequently reported. **Objective:** To report our four-year experience with prehospital RSI in a rural community of 37,000 without aeromedical support. **Methods:** Retrospective, observational review of an RSI database from a 48-month RSI experience in a rural community serviced by a single advanced life support (ALS) ambulance company (1,300 ALS runs annually) without immediate availability to aeromedical support. RSI is indicated for Glasgow Coma Scores <8, rapidly declining respiratory and/or hemodynamic status, or persistent hypoxia or unresponsiveness in the presence of assisted ventilation and oxygen therapy. Two RSI-trained paramedics were required on scene. Etomidate and

succinylcholine are the agents used for sedation and paralysis. Laryngoscopy is limited to 30 seconds. No more than 3 intubation attempts are permitted. Patients were categorized as indicated-not performed (I-NP) or indicated-performed (I-P). Hospital medical records were reviewed for all patients meeting prehospital RSI criteria. **Results:** In the study period, nineteen trauma patients met RSI criteria; 5 (I-NP) and 14 (I-P). Of the 14 I-P patients, six required either three intubation attempts or could not be intubated. Two patient met criteria for surgical airways but only one received the intervention. In the same period of time, eight patients received RSI for medical emergencies, six of whom were intubated on the first attempt. Six months can pass between RSI utilizations. **Conclusions:** Trauma RSI is infrequently indicated and is associated with high failure rates in smaller communities with low ALS run volumes. Alternatives to RSI for airway management in critical trauma patients warrant consideration.

**79 HYPERVENTILATION AMONG AEROMEDICAL CREWS MAY BE A DELIBERATE RESPONSE TO HYPOXIA RATHER THAN INADEQUATE TRAINING**  
**Daniel P. Davis, Danielle Douglas, Colleen J. Buono, University of California San Diego, San Diego, California**

**Background:** Recent studies document a high incidence of hyperventilation (HV) among prehospital providers, with a potentially detrimental effect on outcome in traumatic brain injury (TBI). It is unclear whether HV is deliberate or reflects inadequate ventilation training. **Objective:** To document the incidence of HV among aeromedical providers and explore a possible relationship between HV episodes and hypoxia. **Methods:** This was a prospective, descriptive study using TBI patients undergoing prehospital RSI by aeromedical crews. Continuous data regarding end-tidal carbon dioxide (ETCO<sub>2</sub>), ventilatory rate (VR), and oxygen saturation (SaO<sub>2</sub>) were downloaded from hand-held oximeter-capnometer devices. The incidence of desaturations (decrease in SaO<sub>2</sub> by  $\geq 2\%$  to SaO<sub>2</sub>  $\leq 95\%$ ) and HV episodes (decrease in ETCO<sub>2</sub> by  $\geq 5$  mm Hg to ETCO<sub>2</sub> < 30 mm Hg) was determined. Episodes of HV were classified independently by two investigators as: associated with a desaturation (D) or absent SaO<sub>2</sub> data (A), occurring immediately after intubation with (ID) or without (IN) a desaturation during RSI, or none of these (N). Desaturations not associated with a HV episode were evaluated for an association with an ETCO<sub>2</sub> decrease by  $\leq 5$  mm Hg. Descriptive statistics were used to report results. **Results:** A total of 24 patients were enrolled with a mean duration of ventilation monitoring of 16.3 min. A strong correlation between respiratory rate and ETCO<sub>2</sub> was observed. A total of 24 HV episodes were identified in 12 patients. High classification agreement

between investigators was observed ( $\kappa = 0.96$ ). Of the 24 HV episodes, 22 (92%) were associated with either desaturations or absent SaO<sub>2</sub> data (12 D, 4 ID, 6A). Both of the remaining patients were classified as IN; no patients were classified as N. A total of 20 post-intubation desaturations were identified; 12 were associated with HV episodes, and another 4 were associated with an ETCO<sub>2</sub> decrease. **Conclusions:** A high incidence of HV was observed among aeromedical crews. These appear to reflect a response to desaturations rather than inadequate training. This suggests the need for alternative strategies to improve oxygenation, such as the use of positive end-expiratory pressure valves.

**80 HELICOPTER TRANSPORT FOR TRAUMA PATIENTS: A META-ANALYSIS** **Bryan E. Bledsoe, Keith Wesley, Marc Eckstein, Thomas Dunn,** *George Washington University Medical Center, Washington, D.C.*

**Background:** Helicopters have become a major part of the modern trauma care system and are frequently used to transport patients from the scene of their injury to a trauma center. Early studies reported decreased mortality for trauma patients transported by helicopters when compared to those transported by ground ambulances. More recent research has questioned the benefit of helicopter transport of trauma patients. **Objective:** To determine whether existing literature shows a benefit for trauma patients transported by helicopter. **Methods:** A meta-analysis was performed on peer-review research on helicopter utilization. The inclusion criteria were all studies that evaluated trauma patients transported by helicopter from the scene of their injury to a trauma center with baseline parameters defined by Injury Severity Score (ISS), Trauma Score (TS), Revised Trauma Score (RTS), and the likelihood of survival as determined via Trauma Score–Injury Severity Score (TRISS) methodology. **Results:** 22 studies comprising 37,350 patients met the inclusion criteria. According to the ISS, 60.0% (99% CI: 54.5 to 64.8) of patients had minor injuries. According to the TS, 61.4% (99% CI: 60.8 to 62.0) of patients had minor injuries. According to TRISS methodology, 69.3% (99% CI: 58.5 to 80.2) of patients had a greater than 90% chance of survival and thus minor injuries. 25.8% (99% CI: –1.0 to 52.6) of patients were discharged within 24 hours after arrival at the trauma center. **Conclusions:** The majority of trauma patients transported by helicopter have minor injuries. Efforts to more accurately identify those patients who would benefit most from helicopter transport from the accident scene to the trauma center are needed to reduce helicopter overutilization.

**81 EVALUATION OF BISPECTRAL INDEX AS A MEASURE OF ADEQUATE SEDATION DURING AEROMEDICAL TRANSPORT** **Ryan C. Fringer, William Heegaard,**

**R. J. Frascone, David Dries, Gregory Pippert, David Ladmer, James Miner,** *William Beaumont Hospital, Royal Oak, Michigan*

**Introduction:** Many critically ill patients are given sedatives and paralytics to facilitate aeromedical transport. Bispectral Index (BIS) monitoring is a computer derived electroencephalogram analog currently used to monitor the level of awareness of sedated patients. It gives a score of 1–100, with 1 representing no brain function and 100 representing a completely alert patient. We have previously presented data supporting the feasibility and validity of BIS monitoring of healthy volunteers during a simulated aeromedical transport. **Objective:** To determine the feasibility and validity of BIS monitoring of critically ill patients in an aeromedical setting. **Methods:** This was a prospective, observational study of a convenience sample of critically ill patients transported by helicopter. This study was conducted in association with LifeLinkIII, an aeromedical transport service based in St. Paul, MN. All patients who received sedatives and/or paralytics to facilitate transport were eligible for enrollment by the attending clinician. Prior to lift-off, a BIS sensor was applied to the patients' forehead. Minimum, maximum, and mean BIS index was recorded every minute during transport. The flight clinicians were blinded to the monitor. The data were analyzed using descriptive statistics. **Results:** 13 adult patients were enrolled (mean age 62 years, 40% female). The mean maximum BIS was 64.5 (95% CI 61.9 to 67.1), and the mean minimum BIS was 56.6 (95% CI 54.5 to 58.7). There was adequate signal quality to report a BIS score 96% of the time that patients were monitored. The average SQI was 80.1% (95% CI 74.5 to 84.6). **Conclusion:** The mean and maximum BIS scores of patient in this study suggest that patients are adequately sedated. Also, the signal quality was infrequently affected by the vibration and overall harsh environment of the helicopter.

**82 EFFECTIVENESS OF VENTILATION UTILIZING THE BAG-VALVE DEVICE (BVD) VERSUS THE OXYLATOR FR-300 IN INTUBATED PATIENTS DURING AIR MEDICAL TRANSPORT** **Kurt R. Horst, Marc Restuccia, Alexander Matolcsy, Robert J. Goldberg, Jorge Yarzebski,** *University of Massachusetts Memorial Health Center, Shrewsbury, Massachusetts*

**Objective:** The bag–valve device (BVD) is utilized by many air medical services during the transport of intubated patients. The goal of this study was to compare the BVD with the Oxylator FR-300; a small, hand-held, oxygen-powered device. The Oxylator is a pressure-regulated resuscitator that delivers oxygen to a pre-set peak airway pressure of 20 cm H<sub>2</sub>O, followed by passive exhalation until the flow level has reached 2–4 cm H<sub>2</sub>O. The next breath is then delivered. This

report presents descriptive data from the pilot phase of the study. **Methods:** Intubated patients being transported by UMass Memorial Life Flight were randomized to either the BVD or Oxylator. A Novamatrix Tidal wave monitor captured data on end-tidal carbon dioxide (ETCO<sub>2</sub>), respiratory rate, pulse rate, and oxygen saturation. The primary outcome measure was the effectiveness of ventilation (targeted oxygen saturation >95% and ETCO<sub>2</sub> of 30–45 mm Hg) at 5 minutes of ventilation with either respiratory device. Variability of these values between study groups was also determined. **Results:** Eleven patients (males = 8) were randomized during the pilot phase of the study to either the Oxylator FR-300 ( $n = 7$ ) or the BVD ( $n = 4$ ); their mean ages were 60 (range = 18–88) and 49 years (range = 35–77), respectively. Baseline (upon entering the helicopter) and 5-minute (en route) capnographic and pulse oximetry measurements were examined. The corresponding ETCO<sub>2</sub> mm Hg baseline (median/SD) values for the Oxylator and BVD were 28/6 and 39/5, respectively; and at 5 minutes, 35/1 and 38/9, respectively. The baseline (median/SD) respiratory rate/minute with the Oxylator was 12/6 and 29/15 with the BVD; and at 5 minutes, 12/5 and 17/5, respectively. Among patients ventilated with either the Oxylator and/or BVD, the O<sub>2</sub> saturation (median/SD) values were identical at baseline (98/1) and similar at 5 minutes, 98/6 and 99/1, respectively. **Conclusions:** Data from the pilot phase of the study suggest that the effectiveness of ventilation is similar with either device. At the same time, the findings of the study's pilot phase highlight the need for further studies (e.g., a randomized clinical trial).

**83 COMPARISON OF ANALGESIA USE BY PHYSICIANS AND NURSE/MEDICS ON AIR-TRANSPORTED TRAUMA PATIENTS** **David J. Dula, David P. Sole, David Schoenwetter, Geisinger Medical Center, Danville, Pennsylvania**

**Introduction:** Previous studies have identified pre-hospital pain management as an important part of emergency medical services (EMS) care. The air medical program at Geisinger uses both physicians and nurse/medics as crewmembers. This provides a unique opportunity to analyze differences in prehospital pain management between physician and nurse/medic crews. **Objective:** To compare prehospital analgesic (PA) use by physician and nurse/medic crews on air-transported patients with extremity injuries. **Methods:** This was a retrospective analysis of 100 air medical records of both physician and nurse/medic directed air-transported trauma retrievals. Inclusion criteria were adult trauma patients with an extremity injury and complaints of pain, Glasgow Coma Score (GCS) > 14, Flight time > 10 minutes and a blood pressure > 105/70. Each group was analyzed regarding the amount and

type of analgesia used. This study was approved by our institutional review board. **Results:** A total of 100 records were reviewed, 50 records in the physician group and 50 records in the nurse/medic group. In the physician group, fentanyl was used in 16 cases, with an average dose of 119 ug. Morphine was used in 7 cases, with an average dose of 6.3 mg. The percentage of patients receiving analgesia in the physician group was 46%. The nurse/medics used fentanyl in 14 cases at an average dose of 107  $\mu$ g. Morphine was used in 8 cases at an average dose of 6.3 mg. Percentage of patients receiving analgesia in the nurse medic group was 44%. **Conclusion:** In this study, 45% of air-medical-transported trauma patients received prehospital analgesics. There was no significant difference in PA use between physician and nurse/medic crews.

**84 DOES TRANSFERRING ROTOR-WING FLIGHT SERVICES FROM A HOSPITAL TO AN AIRPORT-BASED SYSTEM IMPROVE RESPONSE TIMES?** **Daniel L Pierce, Darren Braude, University of New Mexico, Albuquerque, New Mexico**

**Objective:** Flight programs are continuously looking for new ways to decrease response times. Lifeguard is a busy university trauma center-based rotor- and fixed-wing flight program servicing an extensive suburban and rural population in New Mexico. In May of 2003, Lifeguard transferred rotor-wing operations at our Albuquerque base from a hospital rooftop helipad with on-site fueling to the nearby airport. It was hypothesized that lift-off times would be reduced due to crew proximity to the aircraft and lack of extra in-hospital duties. **Methods:** Retrospective review of the flight database was performed comparing lift-off times from 6 months before to 6 months after the transfer. Lift-off times were defined as time from crew notification to actual lift-off. Only scene flights originating from the base of operations were included. **Results:** Number of flights included were 137 hospital and 222 airport-based. Average and median response times calculated were 5:41, 6:00 and 6:31, 5:55, respectively. Using the Wilcoxon random sum test to accommodate for outliers, there was no significant difference with a p-value of 0.54. **Conclusion:** Relocating rotor-wing emergency medical services operations from a hospital helipad to an airport had no significant change on response times. This lack of difference is most likely due to air traffic control delays at the busy commercial and military airport. Flight programs planning on relocating to a busy airport should anticipate no change in response times.

**85 FENTANYL TRAUMA ANALGESIA USE IN AIR MEDICAL SCENE TRANSPORTS** **Oscar Rago, Stephen Thomas, Tim Harrison, Paul Biddinger,**

**Suzanne Wedel**, *Massachusetts General Hospital, Boston, Massachusetts*

**Objective:** This study assessed frequency, safety, and efficacy of prehospital fentanyl analgesia during 6 months' adult and pediatric helicopter trauma scene transports (213 doses in 177 patients). **Methods:** We reviewed flight records for pain assessment and analgesia provision, effect, and complications. **Results:** Analgesia was administered to 46 of 49 (93.9%) intubated patients. In nonintubated patients, pain assessment was documented in 112 of 128 (87.5%), and analgesia was offered, or there was no pain, in 97 of 128 (75.8%). Of the 67 nonintubated patients to whom analgesia was administered, post-analgesia pain assessment was documented in 62 (92.5%) and pain improved in 53 (79.1% of 67). Post-analgesia pulse oximetry blood pressure dropped below 90 in 2 of 177 cases (1.1%, 95% confidence interval {CI} 0.1–4.0%). Post-analgesia pulse oximetry (SpO<sub>2</sub>) did not drop below 90% in any patients (95% CI 0–2.3%). **Conclusions:** In this study, prehospital providers performed well with respect to pain assessment and treatment. Fentanyl was provided frequently, with good effect and minimal cardiorespiratory consequence.

**86 DETERMINANTS OF CARDIAC ARREST SURVIVAL IN A SINGLE URBAN/RURAL EMS SYSTEM** **Saleema Karim, Ed J. Cain**, *Emergency Health Services, Halifax, Nova Scotia, Canada*

**Introduction:** Several studies of urban emergency medical services (EMS) systems have identified bystander cardiopulmonary resuscitation and early defibrillation as the major determinants of survival from out-of-hospital cardiac arrest. **Objective:** To validate these findings in a large EMS system which uses a single set of medical protocols and responds to cardiac arrests in urban, suburban, and rural areas. **Methods:** Demographic, clinical, and response characteristics for patients who survived to hospital discharge were compared to those of nonsurvivors by means of chi<sup>2</sup> and t-test statistics. Multivariate stepwise logistic regression analysis were performed to assess the predictors of survival. Variables were considered if they were found to have significance at the univariate level. Odds ratios and 95% confidence intervals were calculated for factors independently that were associated with survival to hospital discharge. Significance of association was determined. **Results:** Over the study period there were 5,582 confirmed cardiac arrests with resuscitation attempted in 3,536 (63%). Cardiac etiology was determined to be the cause in 2,970. Of the 2,675 non-EMS-witnessed cardiac arrests, 56.7% were witnessed by bystanders, 37.5% had bystander CPR, 27.9% had initial rhythm of ventricular fibrillation (VF) and ventricular tachycardia (VT) and 60.8% had a call response interval

less than 9 minutes. Survival for all non-EMS-witnessed arrests was 3.8%. For all cardiac arrests, survival was 5.12%. Witnessed arrest, call response interval, cardiac arrest location, and initial rhythm of VF/VT all had increased odds of survival which were statistically significant. Bystander CPR had an increased odds of survival but did not reach clinical significance. **Conclusion:** In a system that includes urban, suburban, and rural areas, the major determinants of survival were witnessed arrest, call response interval, arrest location, and initial rhythm of VF/VT.

**87 A RETROSPECTIVE, CASE-MATCHED REVIEW OF THE EFFECT OF A CPR ASSIST DEVICE ON SURVIVAL FROM OUT-OF-HOSPITAL CARDIAC ARREST** **Michael J. Casner, David W. Andersen, Marshal Isaacs**, *San Francisco Fire Department, San Francisco, California*

**Objective:** In 2003, San Francisco Fire Department participated in a customer acceptance trial to evaluate the ease of use of the AutoPulse, a cardiopulmonary resuscitation (CPR) assist device produced by the Revivant Corporation of Sunvale, CA. **Methods:** The Fire Department deployed the AutoPulse with its paramedic supervisors. The AutoPulse was used in the place of manual CPR whenever a paramedic supervisor arrived on the scene of a cardiac arrest in progress. Data were collected as part of a standard cardiac arrest review process. Data Analysis: Cases in which the AutoPulse were used were matched to cases in which manual CPR was used based on age, gender, and length of resuscitation effort. The primary endpoint was defined as transported to hospital with spontaneous circulation. **Results:** Overall, use of the AutoPulse was associated with an increased rate of return of spontaneous circulation when compared with manual CPR (39% vs. 29%,  $p = 0.003$ ). This increased rate of ROSC is most pronounced with initial presenting rhythm of asystole (37% vs. 22%,  $p = 0.008$ ) or pulseless electrical activity (PEA) (38% vs. 23%,  $p = 0.08$ ) but was not evidenced in patients with a presenting rhythm of ventricular fibrillation or pulseless ventricular tachycardia (44% vs. 50%,  $p = 0.34$ ). **Conclusions:** These results suggest the AutoPulse confers a greater chance of return of spontaneous circulation in patients with presenting rhythms of asystole or PEA. A more rigorous study is required to verify these results.

**88 GEOGRAPHICAL INFORMATION SCIENCE (GIS) ANALYSIS OF A FIRE DEPARTMENT CARDIAC ARREST REGISTRY** **Craig R. Warden, Mohamud Daya, Lara LeGrady**, *Oregon Health & Science University, Portland, Oregon*

**Objective:** Cardiac arrest is an extremely time-sensitive emergency medical services (EMS) activity.

Geographical Information Science (GIS) is an emerging methodology to assist EMS systems in optimizing service delivery. **Methods:** A single large fire district Utstein-style cardiac arrest registry was queried from January 1, 2000, to December 31, 2002, for all patients >18 years of age for whom resuscitation was attempted. Survival to emergency department (ED) admission was primary outcome measure to have sufficient event rate to analyze. Descriptive statistics were performed. All incidents and fire station locations were geocoded (ArcView 9.0, ESRI, Inc., Redland City, CA). Spatial cluster analysis was performed for incidents responded to by first-due vs. secondary-due fire apparatus. **Results:** 527 patient incidents were eligible with age  $67 \pm 17$  years, 63% male, 53% witnessed, bystander CPR in 38%, bystander automated external defibrillation in 0.01%, presenting rhythm: ventricular fibrillation 43%, ventricular tachycardia 1%, pulseless electrical activity 14%, asystole/agonal 35%, and other 7%, average response time  $5.5 \pm 2.1$  minutes, survival to ED 17%, and survival to hospital discharge 5.7%. There was no difference in response time between survivors and non-survivors. Number of cardiac arrest calls varied from 11 to 56 for each station, and the rate of second-due response varied from 0% to 19%, but rates became unstable with less busy stations. Spatial cluster analysis did not detect a survival difference for stations with >20 responses (binomial  $p = 0.40$ ). A map demonstrating analysis will be presented. **Conclusion:** GIS is a new methodology for analyzing EMS incident data. It adds a spatial component of analysis to traditional statistical techniques. No spatial difference was found on patient survival in this initial analysis. Further GIS techniques are available, including controlling for potential confounding variables that will be attempted on this dataset.

**89 COMPLIANCE WITH THE CURRENT AHA GUIDELINES WITH REGARD TO THE USE OF EPINEPHRINE IN OUT-OF-HOSPITAL CARDIAC ARREST** Lou Durkin, Timothy J. Mader, EMSCQI.com, Springfield, Massachusetts

**Background:** Recent evidence from several small clinical trials has led to an American Heart Association (AHA) recommendation that vasopressin, 40 units intravenous (IV) as a one-time dose, be considered as an alternative to epinephrine 1 mg IV every 3–5 minutes for patients in cardiac arrest. This recommendation has yet to be widely adopted despite the potential for improved compliance. **Objective:** To determine the rate of non-compliance with the current AHA guidelines with regard to the use of epinephrine in out-of-hospital cardiac arrest. **Methods:** This was a structured explicit retrospective review of all cardiac arrests currently logged in the EMSCQI.com database cover-

ing the first 6 months of 2004. EMSCQI.com (emergency medical services continuous quality improvement) is a national Web-based system of prospectively recording prehospital data for the purpose of tracking and improving quality of care. All patients suffering cardiac arrest were included in the current search. Patients achieving return of spontaneous circulation in the field were excluded. Compliance was defined as epinephrine administration less than every 3 minutes or greater than every 5 minutes. Time from first dose of epinephrine to hospital arrival and total epinephrine administered during the resuscitation along with contextual information were extracted. Descriptive statistics were used to analyze the data. **Results:** There were 43 cardiac arrests included in the analysis. Rhythms included asystole, pulseless electrical activity, ventricular tachycardia without pulse, and ventricular fibrillation. All patients received at least one dose of epinephrine. The rate of non-compliance was 65% (95% CI = 49–76%). Four of 43 patients were given epinephrine more frequent than every 3 minutes, and 24 of 43 patients had epinephrine less often than every 5 minutes. There were no identifiable predictors of non-compliance. **Conclusions:** Compliance with the current recommendations regarding the use of epinephrine in cardiac arrest is poor. Adopting the use of a one-time dose of vasopressin could significantly improve compliance in out-of-hospital cardiac arrest. Whether or not this change will affect outcome is not addressed in this study.

**90 KNOWLEDGE RETENTION OF PREHOSPITAL PERSONNEL ON STROKE: RE-TESTING IN THE ST. LOUIS EMERGENCY STROKE EDUCATION PROJECT (SLESEP)** Orlando Heredia, David Tan, Henry Lloyd, Fiju Job, Abdullah Nassief, Washington University School of Medicine, St. Louis, Missouri

**Introduction:** The biggest barrier to timely acute stroke evaluation is prehospital identification and transport. Medical dispatchers and prehospital personnel (PP) have insufficient knowledge of the management of acute stroke. Education of prehospital personnel on stroke and its change over time has been poorly researched in the US. **Objective:** To determine if SLESEP training of PP on stroke knowledge is retained over a 6-month period. **Methods:** Before–after study of written test results. In late 2003, all PP for one of the main emergency medical services (EMS) providers that serve the city of St. Louis attended a mandatory one-hour multimedia presentation discussing the basic concepts of the prehospital management of acute stroke. A 10-point multiple-choice exam was administered 3 hours before and immediately after the presentation. PP were retested 6 months later for knowledge retention. They received no additional stroke education in this 6-month

period. Numbers of correct answers were compared with the paired-sample t-test. **Results:** All PP for the EMS provider participated; 363 participated in the initial education and testing, 264 in the retest. Due to high employee turnover, only 118 (44.7%) of the retested PP had participated in the initial intervention. Of the included 118 PP, 44 were paramedics and 74 were emergency medical technicians. Mean number of years of experience in prehospital care was 5.1 (range 0–23). In the pre-training test 2.4 (mean; SD 1.4) answers were incorrect; in the post-training test they decreased to 0.7 (mean; SD 1.0); in the 6-month retest they increased to 2.0 (mean; SD 1.6). **Conclusions:** Educational research has clearly shown the importance of repetition and reinforcement for knowledge retention. A one-hour multimedia presentation administered to PP improves knowledge of the diagnosis and prehospital management of patients with acute stroke, but only on a short-term basis. Many EMS providers attend educational courses only once a year, usually in an intensive full-day format (thus limiting their overall retention). Though multimedia presentations are more effective than traditional lectures, isolated interventions have limited utility. This study reinforces the need for more frequent PP education to improve knowledge and retention.

**91 PREDICTORS OF STROKE DURING 911 CALLS: OPPORTUNITIES FOR IMPROVING PREHOSPITAL RESPONSE**  
**Reginald Reginella, Todd Crocco, Allison Tadros, April Shackelford, Stephen M. Davis, West Virginia University, Morgantown, West Virginia**

**Background:** Only 31–52% of stroke calls are accurately identified by 911 dispatchers according to prior studies. Recognizing the time-dependent nature of acute stroke, better identification of stroke patients at the time of their 911 call may allow an improved prehospital response. **Objective:** To identify any words/phrases that 911 dispatchers could use to identify more stroke calls. **Methods:** Potential stroke calls were identified from emergency medical services (EMS) run sheets by searching for the following chief complaints: numbness, drooling, abnormal vision, inability to stand/walk, weakness, impaired communication, or (if age > 50) headache, nausea/vomiting, fall, or decreased level of consciousness. We obtained the discharge diagnosis on each patient to determine the presence of a stroke. EMS tapes for identified runs were independently reviewed by two listeners who were blinded to the final diagnosis. They recorded whether the callers said the following: numbness, drooling, headache, nausea/vomiting, fall, weakness, abnormal vision, cardiac problems, decreased level of consciousness, decreased ability to stand/walk, or impaired communication. Other pertinent words/phrases were also recorded. Using the final diagnosis of stroke as the gold standard, the sensitivity,

specificity, and positive likelihood ratio (LR+) of each word and phrase were calculated. Cohen's kappa was calculated to assess interrater agreement. Data will be collected for runs from October 2003–July 2004. **Results:** As of May 2004, 122 tapes were reviewed (24 strokes, 98 non-strokes). The presence of at least one of four criteria predicted 75% of all stroke calls: the word "stroke," facial droop, weakness/fall, impaired communication. Each criterion element had very good interrater agreement (stroke kappa = 0.883; facial droop kappa = 0.658; fall kappa = 0.796; weakness kappa = 0.631; impaired communication kappa = 0.602). The word "stroke" was highly predictive of actual stroke (LR+ 2.8). **Conclusions:** The majority of stroke patients can be identified by 911 dispatchers if the caller reports any one of the following four complaints: stroke, facial droop, weakness/fall, or impaired communication. Additionally, use of the word "stroke" was highly predictive of an actual stroke.

**92 EMS EDUCATION, PROTOCOLS, AND COMMUNITY OUTREACH FOR STROKE**  
**Jane H. Brice, Julie Lellis, Kelly Evenson, Wayne D. Rosamond, Jennifer B. Christian, Dexter L. Morris, University of North Carolina, Chapel Hill, North Carolina**

**Objective:** Emergency medical services (EMS) response to stroke and chest pain is dependent on adequate education, protocols, and policies. We sought to compare the amount of education offered, protocol use, and community outreach programs established for stroke and chest pain among North Carolina EMS provider agencies. **Methods:** A survey was mailed to every primary EMS agency in the state of North Carolina during the fall of 2001. Of the 83 agencies surveyed, 72 (87%) responded. **Results:** Forty-four percent of the agencies provided advanced life support (ALS) services exclusively, 1% provided basic life support (BLS) only, and 54% provided both BLS and ALS. Forty-four percent of agencies utilized a diagnostic scale to identify stroke patients: 19% of these used the Los Angeles Prehospital Stroke Screen, 36% the Cincinnati Prehospital Stroke Scale, and 45% a locally developed scale. Eighty-three percent of the EMS agencies had protocols for managing stroke and 99% for managing chest pain. While 89% of the EMS agencies provided stroke education and 96% provided education about chest pain in the last two years, the median number of hours devoted to stroke was one-third as long as those devoted to chest pain (4.0 vs. 11.4 hours). Thrombolytic checklists were used to identify eligible stroke patients at 37% of the EMS agencies compared to 28% for eligible chest pain patients. In the past 6 months, 14% of EMS agencies had conducted community outreach programs about the medical urgency of stroke compared to 17% for the medical urgency of chest

pain. **Conclusions:** In North Carolina, primary EMS agencies appear to have stroke and chest pain protocols in approximately the same frequency, but their personnel receive only one-third as much education about stroke as they do about chest pain. The results of this survey will serve as the foundation for developing stroke education tools for EMS providers in North Carolina.

**93 "HIGH-PERFORMANCE HEART CARE"—COMBINING IN-HOSPITAL AND EMERGENCY MEDICAL SERVICES PATIENT MANAGEMENT IMPROVES POSITIVE OUTCOMES FOR PATIENTS WITH COMPLAINT OF CHEST PAIN AND ST-ELEVATION ACUTE MYOCARDIAL INFARCTION** John J. Paulowski, Troy D. Heavelyn, Mark Resanovich, Mark L. Marchetta, *Cardiovascular Consultants, Canton, Ohio*

**Objective:** To integrate the patient management of emergency medical services (EMS), emergency department (ED), and the heart center to expedite treatment and improve positive outcomes when delivering care to patients presenting with chest pain (CP) and ST-elevation acute myocardial infarction (AMI). Three specific goals were: (1) streamline and decrease in-hospital door-to-electrocardiogram (ECG) turnaround time to less than 10 minutes for patients presenting to the ED with complaint of CP, (2) streamline the in-hospital process of door-to-perfusion turnaround time for patients presenting to the ED with ST-elevation AMI to less than 90 minutes, and (3) utilize EMS in obtaining and transmitting a digital, diagnostic-quality twelve-lead ECG prior to the patient's arrival at the hospital to support goals (1) and (2). **Methods:** Six Sigma methodologies were utilized. Sigma for door-to-ECG turnaround time was established through before-and-after sampling of data with  $n = 52$  and  $n = 70$ , respectively. Baseline Sigma for door-to-perfusion turnaround time was established by chart review for calendar year 2003 ( $N = 117$ ). Post-implementation chart review is ongoing. **Results:** Door-to-ECG mean turnaround time decreased from 21.7 minutes to 5.0 minutes, while Sigma increased from 0.62 to 2.87. Door-to-perfusion mean turnaround time decreased from 119.0 minutes to 89.9 minutes, while Sigma increased from 1.10 to 1.67. Furthermore, the integration of EMS and data transmission technology decreased door-to-perfusion times to an average of 82.4 minutes, with individual door-to-perfusion times of 17 minutes and 26 minutes. **Conclusion:** Integration of EMS, ED, and heart center patient management strategies and utilization of technology improve positive outcomes for patients presenting with CP and ST-elevation AMI. While streamlining in-hospital processes improves delivery of care for this patient category, the inclusion of EMS and technology

shows promising results by addressing the prehospital patient care process.

**94 FEASIBILITY OF FACILITATED PCI FOR ST-ELEVATION MYOCARDIAL INFARCTION IN ONTARIO—RESULTS OF THE TRANSFER-AMI PILOT STUDY** Laurie J. Morrison, Warren J. Cantor, Richard Choi, Michael Heffernan, Vladimir Dzavik, Charles Lazzam, Marko Duic, David Fitchett, Janet Wawrzyniak, Saleem A. Kassam, Shaun G. Goodman, Anatoly Langer, *Sunnybrook & Women's College Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada*

**Background:** Facilitated percutaneous coronary intervention (PCI) for ST-elevation myocardial infarction (STEMI) may offer some of the benefits of primary PCI without treatment delay when patients require transfer. **Objective:** To conduct a multicenter nonrandomized pilot study to determine the feasibility of transferring patients for facilitated PCI within 6 hours of fibrinolysis. **Methods:** Eligible patients presenting to non-PCI centers within 12 hours of symptom onset with  $\geq 2$ -mm anterior ST elevation or inferior ST elevation with high-risk features (tachycardia, hypotension, Killip class 2–3, anterior ST depression, right ventricular involvement) were transferred for facilitated PCI within 6 hours of full-dose tenecteplase (TNK). Feasibility was assessed as the ability to arrange transportation and catheterization within 6 hours of fibrinolysis. Bleeding was classified using GUSTO criteria. **Results:** 20 patients were enrolled at 4 referring centers and transferred for PCI. No complications occurred during transport. Two patients were withdrawn prior to catheterization. Persistent infarct-related artery (IRA) occlusion was observed in 5 of 18 patients who underwent cardiac catheterization. PCI with stenting was performed in 17 (85%) cases. GP IIb/IIIa inhibitors were started at PCI centers (median 3.8 hrs after TNK) in 18 (90%) patients. Median time from TNK to first balloon inflation was 3.9 hours (2.7–6.4 hours). One death occurred in a patient with persistently occluded IRA despite attempted PCI and emergency bypass surgery. One patient had transient hypotension requiring inotropes for 24 hours after successful PCI. One patient with multivessel disease underwent bypass surgery one week after successful stenting of the IRA. There were no severe bleeds, 2 moderate bleeds, and 3 mild bleeds. **Conclusions:** The strategy of transferring STEMI patients to PCI centers for facilitated PCI within 6 hours of fibrinolysis is feasible. Complications during transport are rare and severe bleeding is infrequent despite potent antiplatelet therapy after TNK. The TRANSFER-AMI randomized trial will compare facilitated PCI with thrombolysis and provisional rescue PCI in over 500 patients.

**95 USE OF THE 5-ELECTRODE EASI ECG IN A PREHOSPITAL SETTING** Charles L. Feldman, Shoshana Z. Milstein, Diana Neubecker, Kevin Underhill, Eric Moyer, Steve Glumm, Matthew Womble, Jan Auer, Charles Maynard, Richard K. Serra, Galen Wagner, *Brigham & Women's Hospital, Boston, Massachusetts*

**Background:** For patients experiencing the onset of acute ST-elevation myocardial infarction, the longer the delay in restoring coronary blood flow, the greater the amount of myocardium that will be lost. In many communities, prehospital acquisition and interpretation of 12-lead electrocardiograms (ECGs) are used to shorten time to treatment. Barriers to more widespread use of prehospital 12-lead ECGs include the need for additional paramedic training, the perceived difficulty of applying precordial leads accurately, and the amount of ECG artifact found in the mobile emergency medical services (EMS) environment. An alternative is the derived 12-lead, five electrode EASI lead system. **Objective:** To compare the EASI lead system with the Mason Likar lead system in the prehospital setting. **Methods:** Paramedics in two large EMS agencies each recorded EASI 12-lead ECGs on 100 sequential patients. Upon arrival in the emergency department, nearly simultaneous EASI and Mason Likar 12-lead ECGs (standard 12-lead ECGs with limb leads placed on the patient's torso) were recorded and key ECG parameters from the two systems were compared. Paramedic response to the use of EASI was surveyed at the end of the study. **Results:** The EASI 12-lead ECG yielded results that were indistinguishable from those of the Mason Likar 12-lead ECG. The EASI system received an average score of 3.4/4 on the final study questionnaire, indicating a very high level of acceptability. **Conclusion:** The EASI ECG offers an accurate and acceptable alternative to the Mason Likar ECG in the prehospital setting. It requires only five electrodes, all located on easy-to-identify bony anatomic landmarks, yields results similar to those of the Mason Likar system, and is well accepted by paramedics.

**96 SHOULD TRANSCUTANEOUS CARDIAC PACING (TCP) BE PERFORMED IN AN URBAN EMERGENCY MEDICAL SERVICES SYSTEM?** William R. Smith, Jonathan M. Rubin, *St. John's Hospital, Medical College of Wisconsin, Jackson, Wyoming*

**Introduction:** Transcutaneous cardiac pacing (TCP) is the standard of care for symptomatic bradycardia refractory to atropine. Recent advances in cardiac care equipment have made TCP feasible for use in the prehospital setting, although TCP's use in some urban emergency medical services (EMS) settings is still questioned due to short transport times. **Objective:** It was hypothesized that adequate time exists for TCP use

in patients with symptomatic bradycardia in an urban prehospital environment. **Methods:** A 10-year (1994–2003) retrospective analysis of urban EMS data was conducted to identify the number of cases of symptomatic bradycardia in patients 18 years of age or older. Symptomatic bradycardia was defined as a heart rate of less than 60 beats per minute, with any of the following: systolic blood pressure less than 90 mm Hg, ischemic chest pain, dyspnea, syncope, or altered mental status. The use of atropine was then analyzed in these patients using descriptive statistics. It was postulated that patients requiring multiple doses of atropine would be candidates for TCP, per Advanced Cardiac Life Support protocols. **Results:** Of 201,332 advanced life support calls, 5,929 (2.94%) cases of symptomatic bradycardia occurred during the 10-year study period. Of these 5,929 cases, atropine was administered to 772 (13%). Forty-four percent of those given atropine (336 of 772) required two or more doses. Patients receiving multiple doses of atropine had a mean scene time of 31.3 minutes and a mean transport time of 7.2 minutes. An additional 4% of patients with symptomatic bradycardia (227 of 5,929) could not be given atropine due to unsuccessful IV attempts, thus these patients could also be candidates for TCP. **Conclusion:** Time does not appear to be a barrier to the implementation of TCP in an urban EMS system.

**40 DOES PROVIDING REAL-TIME FEEDBACK TO EMS DISPATCHERS IMPROVE PERFORMANCE?** Renee Chow, Brian Schwartz, Sandra Chad, Michael West, *Sunnybrook & Women's College Health Sciences Center, Toronto, Canada*

**Background:** Initiatives to improve Emergency Medical Services (EMS) response have not historically focused on dispatchers. Advanced computer-aided dispatch tools provide data on individual patients and ambulances but not real-time feedback on dispatcher performance in terms of response times, coverage, and resource utilization. Ecological Interface Design (EID) is a theoretical approach for designing human-computer interfaces. It has been tested in complex, high-risk environments such as nuclear power generation, aviation, and intensive care medicine. **Objective:** to evaluate the feasibility, effectiveness and acceptance of an EID-based display system for EMS dispatchers. **Methods:** Displays were designed using EID principles, with ongoing input from dispatchers, management and EMS physicians. Two scenarios (comprising 25 EMS calls) were tested by eight dispatchers trained on the new displays, and comparison was made between performance on the current displays (CD) and the new displays (ND). Half utilized ND on the first test, and half on the second. Outcomes were defined as on-time assignments (OTA) (number of times a call was assigned

within 75 seconds) and priority post coverage (PPC) (number of minutes in which EMS units were at predetermined locations). Participants were surveyed on usefulness of the displays. **Results:** Four new displays were designed: a) Current Utilization (units in service, out of service, and in-hospital); b) Historic Utilization (time spent in each mode of service over current shift); c) Current Response Times ("on time" versus "delayed" according to dispatch priority); and d) Historic Response Times (categorized by dispatch priority for a given period). In 25 EMS calls no difference was found in dis-

patcher OTA performance [CD mean 23.4 calls (95% CI 22.9, 23.9) versus ND 22.6 (21.9, 23.9)], or PPC [CD mean 68.3 minutes (38.9, 70.7) versus ND 74.0 (38.9, 76.3)]. Three of the four displays were rated favorably by the participants. **Conclusions:** In this small experiment, EID was feasible but not effective in improving performance. Dispatcher background experience or unfamiliarity with EID may have limited performance. Further study is required to evaluate usefulness of EID. Favorable ratings suggest that EID may be helpful with complex scenarios or with inexperienced dispatchers.