mixed career/volunteer, number of advanced life support personnel, median response and transport times, urban vs. rural, and population median income and poverty rate). **Results:** Of 1,953 ETIs performed over an 18-month period, an ETI error occurred in 444 patients (22.7%; 95% confidence interval [CI]: 20.9–24.6%), including tube misplacement or dislodgment in 61 (3.1%; 2.4–3.9%), multiple attempts in 62 (3.2%; 2.4–4.0%), and failed ETI in 359 (18.5%; 16.7–20.2%). Per-service ETI error rates ranged from 0% to 40%. ETI errors were more likely in age <6 years (odds ratio [OR] 2.8; 95% CI: 1.4–5.7), trauma (OR 1.3; 1.0–1.8), and nonarrest (OR 1.6; 2.1–3.2) patients, as well as those receiving sedation-facilitated (OR 4.9; 2.0–12.0) or conventional (OR 3.1; 1.4–6.7) ETI. Adjusted odds of ETI error were higher for services with more than 5,000 annual patient contacts (OR 2.5; 1.3–5.0) and those with less than 50 annual ETIs (OR 2.9; 1.7–4.9). ETI errors were not associated with other system characteristics. **Conclusions:** Almost one-fourth of patients in this series were exposed to an ETI error. The frequency of prehospital ETI errors is substantial and varies among EMS services. ETI errors are associated with selected patient subsets, but are less frequently reported by smaller services performing high numbers of ETIs.

03 VIRTUAL REALITY FOR PAIN MANAGEMENT: DEMONSTRATION OF EMS FEASIBILITY **Ernest Wheeler, James R. Williams, Michael Richards, Dale Alverson, Hunter Hoffman,** *City of Hobbs Fire and EMS, Hobbs, New Mexico*

Objectives: Recent research suggests that entering an immersive virtual reality (VR) environment can serve as an adjunct for management of painful conditions. Advances in the portability of VR equipment now make this technology accessible to austere clinical environments such as emergency medical services (EMS). We sought to demonstrate that VR could be utilized in an EMS environment. **Methods:** Sixty healthy volunteer subjects, serving as simulated patients, were randomized for evaluation under three conditions for 20 minutes each: A) No VR, in moving ambulance (baseline); B) VR in stationary ambulance; and C) VR in moving ambulance. The VR system included a head-mounted video display unit, audio headphones, and the SnowWorld VR software. After each condition, subjects evaluated their nausea with a 10-cm visual analog scale (VAS). After each VR condition, subjects evaluated their nausea using the Kennedy Simulator Sickness Questionnaire (KSSQ) with a score range of 0 to 300. They also rated their sense of presence in the VR world, the ease of use, and comfort of the VR equipment on a 10-cm VAS. Statistical analysis was performed with nonparametric tests for paired groups and repeated measures. **Results:** VAS ratings for nausea were low under all conditions and slightly increased under VR conditions: A (0.08 cm, 95% confidence interval [CI]: 0, 0.16), B (0.17 cm, CI: 0.02, 0.33), and C (0.59 cm, CI: 0.25, 0.94), $p = 0.002$. The KSSQ scores were not statistically different between the VR conditions: B (12.6, CI: 7.1, 18.1), and C (24.5, CI: 12.6, 36.4), $p = 0.26$. There was a moderately strong sense of presence in the VR world that remained unchanged between the VR conditions: B (6.7 cm, CI: 5.9, 7.3), and C (6.4 cm, CI: 5.7, 7.1), $p = 0.79$. The VR equipment was rated as very easy to use (9.2 cm, CI: 9.0, 9.4) and comfortable (8.3 cm, CI: 7.9, 8.6). **Conclusion:** VR was proven feasible in an EMS environment in a group of simulated patients. There was a low rate of nausea, use in a moving ambulance did not appear to increase simulator sickness, and the equipment was rated as comfortable and easy to use.

04 PHYSIOLOGIC EFFECTS OF SIMULATED FIREFIGHTING TASKS COMPARED WITH CONTINUOUS EXERCISE, IN HEAT AND PPE **Carin M. Van Gelder, L. Alex Pranger, Kevin J. Burns, Lawrence Armstrong, William P. Wiesmann, Sandy Bogucki,** *Yale University, New Haven, Connecticut*

Objectives: This study compared the physiologic responses of firefighters (FFs) performing simulated fireground tasks with those of FFs performing continuous exercise to volitional fatigue. Previous studies by our group established the validity of both experimental models of uncompensable heat stress in FFs, but did not directly compare them. **Methods:** 13 FFs (12 male, 1 female) wearing standard firefighting personal protective ensemble (PPE) and Self-contained breathing apparatus (SCBA) in a heated environment (40°C) completed both protocols. In the first phase, subjects completed tasks simulating fire suppression, including treadmill walking while carrying a hose, ladder climbing, simulated search and rescue, and a pike pole breach-and-pull exercise. The second phase consisted of walking on a treadmill while wearing a weighted vest at a 4-mph rate and a 2% grade. In both phases, subjects exercised to volitional fatigue. Physiologic markers measured or calculated included hemoglobin, hematocrit, glucose, lactate, urine and plasma osmolality, plasma volume, body weight, body mass index (BMI), core temperature, heat storage, and maximum volume of oxygen consumption (VO_2max). Duration of exercise was recorded and FFs gave serial ratings of perceived exertion. **Results:** Durations of exercise ranged from 4 to 22 minutes, were not significantly different between the two phases, and positively correlated with heat storage and lactate levels. Simulated fire tasks caused greater increases in lactate (mean 8.8 m mol/L), plasma osmolality levels (mean 296 mOsm/kg), plasma

volume loss (mean 12%), core temperature (>39°C), and higher heat storage levels (mean 339 kJ) than did weighted treadmill testing. Subjects in phase two did not have significant changes in these variables, despite working to volitional fatigue. Those with a lower BMI tended to have a higher VO_2max, but BMI had no correlation with duration of exercise. **Conclusions:** We have demonstrated that firefighters in a hot environment and wearing PPE are significantly more physiologically stressed by simulated fireground tasks than by continuous aerobic exercise, despite similar durations of exercise and ratings of perceived exertion. This physiologic stress and its lack of correlation with volitional fatigue may contribute to line-of-duty illness and injury to FFs, and may have implications for management of fireground illness and injuries.

05 Paramedics Independently Triage Patients for Primary Percutaneous Angioplasty **Michel LeMay, Richard Dionne, Justin Maloney, John Trickett,** *Ottawa Base Hospital, Ottawa, Ontario, Canada*

Background: Most trials reporting prehospital management of ST-segment elevation myocardial infarction (STEMI) had a physician accompanying the mobile unit or the electrocardiogram (ECG) performed in the field and transmitted to a control physician at a base hospital. **Objective:** To show that paramedics can effectively and independently establish the presence of STEMI in the field, and independently decide to transfer patients with STEMI to a designated center for primary percutaneous coronary intervention (PCI). **Method:** During phase I, paramedics assigned within a mid-size metropolitan city were trained in the diagnosis of STEMI on the prehospital ECG. Once the training was judged satisfactory, phase II was implemented, which allowed paramedics to triage patients with chest pain, and transport those with STEMI directly to a designated PCI center for primary PCI, bypassing the city's four hospital emergency departments. **Results:** During phase I, paramedics evaluated 411 patients with chest pain. A diagnosis of STEMI on the prehospital ECGs was confirmed in 63 patients. The paramedics identified STEMI with a positive predictive accuracy of 82% and a negative predictive accuracy of 99%. During phase II, paramedics assessed 1,379 patients with chest pain. Among these, 74 were transported directly to the PCI center with a presumptive diagnosis of STEMI. During transport, no patient experienced a serious adverse event. The diagnosis was confirmed in 58 of these patients, of whom primary PCI was attempted and performed successfully in 54 patients (93%). The median time delay from the paramedic's prehospital ECG to balloon inflation was 88 minutes (interquartile range: 63–110), and the median time from hospital door to first balloon inflation was 63 minutes (interquartile range: 35–83). In-hospital, one patient died (1.8%), one patient had a nonhemorrhagic stroke (1.8%), and no patient experienced abrupt vessel closure. **Conclusion:** Paramedics can be trained to independently triage patients with chest pain and transport those with STEMI to a designated PCI center. In our study, this approach led to short delays to mechanical reperfusion and, consequently, favorable clinical outcomes.

06 Prospective Validation of a Termination-of-Resuscitation Guideline for Defibrillation-trained Emergency Medical Technicians **Laurie Morrison, Laura Visentin, P. Richard Verbeek,** *Sunnybrook & Women's College Health Sciences Centre and University of Toronto, Toronto, Ontario, Canada*

Objective: To prospectively validate a previously derived basic life support termination-of-resuscitation (BLS TOR) guideline for out-of-hospital cardiac arrest managed by defibrillation-trained emergency medical technicians (EMT-Ds). The guideline supports termination of resuscitation in the out-of-hospital setting subsequent to failed BLS resuscitation by EMT-Ds if all of the following are true: 1) no return of spontaneous circulation prior to transport; 2) no shock given prior to transport; and 3) arrest not witnessed by emergency medical services (EMS) personnel (firefighter or EMT-D). **Methods:** This prospective validation study was conducted in 12 rural and urban communities in Ontario, Canada, involving 24 EMS systems. Patient care was unchanged during the study. Survival was measured as hospital discharge or in-hospital status at 6 months. A t-test statistic compared the survival rate when the guideline suggested termination with the 1.0% rate of survivability reflective of medical futility. Diagnostic test characteristics of the guideline to predict survival were calculated. **Results:** A total of 1,240 cardiac arrest patients were enrolled over the 25-month study period, with 100% follow-up. The survival rate when the guideline indicated termination was 4 out of 776, or 0.5% (95% Confidence interval [CI]: 0.1%, 0.9%), significantly less than the medical futility rate of 1.0% ($p = 0.04$). The BLS TOR guideline was 90% (95% CI: 88%, 92%) sensitive in identifying survivors; and had a specificity of 64% (95% CI: 62%, 67%), a positive predictive value of 8% (95% CI: 7%, 10%), and a negative predictive value of 99% (95% CI: 99%, 100%). **Conclusions:** The BLS TOR guideline suggested termination with a survival rate below that considered to be medically futile and had a strong negative predictive value for survival. The guideline is a valid means to identify patients who could be considered for out-of-hospital termination of resuscitation following failed BLS resuscitation by EMT-Ds.

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ABSTRACTS

NAEMSP 2006 ANNUAL MEETING

The following abstracts are the oral and poster presentations at the National Association of EMS Physicians 2006 Annual Meeting, January 19–21, Tucson, Arizona.

Oral Presentations

01 NATIONAL LIMITATIONS IN OPERATING ROOM TRAINING FOR PARAMEDIC STUDENT ENDOTRACHEAL INTUBATION **Bradford Johnston, S. Robert Seitz, Henry Wang,** *University of Pittsburgh, Pittsburgh, Pennsylvania*

Objectives: Operating room (OR) training is a fundamental experience for learning endotracheal intubation (ETI). We sought to determine the quantity and nature of OR training currently available to paramedic students nationally. **Methods:** We surveyed the directors of all paramedic training programs accredited by the Commission on Accreditation of Allied Health Education Programs. We used an anonymous 12-question, structured, closed-response survey instrument. We administered the survey by mail with two follow-ups to nonrespondents. We requested information regarding the duration, nature, and quality of OR training provided to students. We analyzed the results using descriptive statistics. **Results:** Of 192 surveys, we received 152 (response rate 79%). Programs graduated a median of 20 (interquartile range: 14–40) students annually. OR training was used at 147 programs (97%). More than 25% of programs used three or more hospitals to provide OR training. OR training was limited at most programs (median 17–32 hours per student). Half of the programs provided less than 16 OR hours per student. The number of OR ETIs attempted by students was limited (median 6–10 ETIs). Students at 40 (27%) programs attempted five or fewer OR ETIs, and students at 118 (80%) programs attempted 10 or fewer OR ETIs. At 22 (14%) programs, more than 25% of students did not fulfill the national curriculum recommendation of five total ETIs in any setting, and at 11 (8%) programs, more than 50% of students did not fulfill the recommendation. Most respondents (60%) reported competition from other health care students for OR ETI. Other identified hindering factors included the widespread OR use of laryngeal mask airways and anesthesiologists' medicolegal concerns. Respondents from 48 (33%) programs reported a recent reduction in OR access, and 52 (35%) programs expected future OR opportunities to decrease. **Conclusions:** Despite its fundamental role in ETI training, the quantity and nature of OR training available to paramedic students are limited. Many paramedic students do not satisfy national curriculum ETI procedural standards. These observations highlight barriers to paramedic student ETI training nationally.

02 ERRORS IN PREHOSPITAL ENDOTRACHEAL INTUBATION **Henry Wang, Judith Lave, Carl Sirio, Donald Yealy,** *University of Pittsburgh, Pittsburgh, Pennsylvania*

Objective: Prior efforts have described individual prehospital endotracheal intubation (ETI) errors occurring in single emergency medical services (EMS) systems. We sought to describe the aggregate prevalence of ETI errors committed by multiple EMS systems. **Methods:** In this prospective multicenter study of 42 EMS systems, prehospital rescuers (paramedics, prehospital nurses, and physicians) completed structured, closed-response data forms describing patient demographics, clinical course, complications, and outcomes for all ETIs. We defined ETI error as 1) ET tube misplacement or dislodgment, 2) multiple ($\geq$4) ETI attempts, or 3) failed ETI on hospital arrival. We calculated total and per-service ETI error rates. Using univariate and multivariate regression, we identified associations between ETI errors and clinical factors (patient age, gender, arrest vs. nonarrest, trauma vs. medical, ETI method) and EMS system characteristics (annual ETIs, annual patient contacts, ground vs. air medical, all career vs.

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