8:30 San Francisco Room A
Section 1: EMS Systems and Technology
Moderator: Ron Krome

1) EMS Resources in the United States: A Survey of 183 Major Providers

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We constructed a pilot database on EMS systems based on a survey of EMS agencies and providers in the 150 most populous cities (mean 559,983; min 100,000; max 7,262,700). Using telephone followup, 183 responded (100%). The mean annual number of transports per provider was 21,619 (34.9% "ALS" and 65.1% "BLS"); the mean number of ambulances was 15.1 (2.74 per 100,000 population; 6.5 per 10,000 transports/yr). Crew compositions were as follows: paramedic-paramedic, 41.7%; paramedic-EMT, 30.7%; EMT-EMT, 25.4%; and other, 2.4%. The mean reported service time intervals for emergency calls were: response time, 5.8 min; trauma scene time, 10.6 min; medical scene time, 24.1 min; transport time, 9.6 min. A moderate positive correlation was seen between response times and the number of transports per ambulance per year. On-line medical control models were: decentralized, 57.8%; centralized, 25.6%; and multicentric, 16.1%, and provided by: physician, 56.6%; nurses with physician backup, 32.4%; nurses, 6.6%; and paramedics, 1.1%. Other features examined were: the usage and the method of on-line control for 24 ALS procedures, the type of quality assurance method employed, and the type and duration of training for on-line medical control providers. Construction of an ongoing national EMS resource and performance database may be of value in establishing normative standards for system planning and evaluation purposes.

2) Implementation Statistics Including Transport Fre quency as Categorized by a Medical Priority Dispatch System's Call Types in a Large Urban Area

Clawson JJ
Salt Lake City Fire Department, Salt Lake County Fire Department
Salt Lake City, Ut.

In November of 1988, the City of Los Angeles implemented a medical priority dispatch system after training all fire department dispatch personnel to Emergency Medical Dispatcher (EMD) level. Statistics were collected based on the 32 chief complaint categories and four response/determinant level codes contained in the Salt Lake City medical priority dispatch system. Data collection ran 60 days from the program start date and generated 102 separate categories including the number and percentages of each percentage of transports after arrival.

Incidents for the period totaled 38,733. The four response determinants orignally were formulated to represent A: Closest BLS unit—cold; B: Closest BLS Unit—Hot; C: Closest ALS Unit—Hot; and D: Closest BLS and ALS Units—Hot. By tier, percentages of occurrance and transport respectively were: A) 28% (41.3% Transported); B. 25.6% (38.3% Transported); C, 22.8% (67.4% Transported); and D, 21.8% (62.2% Transported). These data correspond closely to other systems studied using medical priority dispatch. At this point, medical priority dispatch systems transport statistics are unique in North America.

In individual code categories, transport rates ranged from 3.3% for dead bodies (9B) and 5.8% for animal bites (3A) to unconscious diabetics (13D) 81% and pregnancy 79.8% (24A), 79.6% (24C), 80.2% (24D), and chest pain (1OD) 79.3% (for categories over 0.1% of incidents).

These data are useful in establishing unit impact of tiered response or first responder activity in an "all ALS" system. Such data may serve as a comparison base for other systems contemplating implementation of a medical priority dispatch system. The author advises use of the standard medical priority dispatch system to provide direct comparison during system implementation and evaluation.

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3) The Effect of Standing Orders on Medication and Skill Selection, Paramedic Assessment, and Hospital Out come: A Follow-up Report

Pointer JE
San Francisco Emergency Medical Services Agency
San Francisco, Calif.

A California EMS District studied the effect of standing orders on field times, comparison of paramedic assessment with emergency department diagnosis, use of medications and procedures, and hospital outcome. The District investigated 3 discrete, 6 week intervals, each including approximately 1600 paramedic cases:

1) Control—Paramedics were required to attempt base contact for the administration of any medication;
2) Standing Order (SO)—Paramedics administered essentially all procedures and drugs under standing orders;
3) Limited Standing Order (LSO)—Paramedics administered only cardiac arrest drugs (epinephrine, atropine, and lidocaine) and altered level of consciousness drugs (ALOC) (dextrose 50% and naloxone) and intravenous line (IV) starts without an attempt at Base contact.

The purpose of the study was to show the effect of standing orders and limited standing orders on the measured variables. In a previous report, there was a 5 minute decrement in field time in the SO and LSO groups as compared to the control group.

The differences between intervals for endotrachael intubation, defibrillation, use of the 3 cardiac arrest drugs, assessment comparison and hospital outcome were not significant. Differences among intervals for 50% naloxone, dextrose use, IV starts, and no procedure were significant ($p < .05$). There are several potential methodologic flaws: 1) patients in the cardiac arrest, ALOC, and IV groups were studied independently of other patients in the 3 intervals; 2) selection of the LSO drugs and procedure was made arbitrarily but intuitively as those which would least likely result in patient morbidity.

RESULTS

DRUGS		PERCENT UTILIZATION			
INTERVAL	EPI	ATR	LIDO	D50	NAR
CONTROL	3.6	2.2	1.7	10.6	7.4
SO	2.0	1.8	0.5	3.3	3.2
LSO	1.0	0.9	0.9	7.0	6.0
PROCEDURES					
INTERVAL	NONE	IV	ET	DEFIB	NONE
CONTROL	71.0	60.9	2.5	1.2	38.5
SO	87.8	26.6	1.8	0.7	72.9
LSO	85.6	41.0	1.2	0.4	58.4

HOSPITAL OUTCOME		FIELDED ASSESSMENT COMPARISON
PERCENTAGE DIED		PERCENTAGE AGREEMENT
CONTROL	5.4	87.9
SO	5.5	89.3

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The data suggest standing orders result in decreased use of drugs and IV starts in non-critical situations without affecting paramedic assessment or hospital outcome.

4) Patients Who Refuse Prehospital Evaluation and/or Therapy

Hedges JR, Neely K, Stark G, Norton R
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Prehospital patients (or parents/guardians of patients) who refuse clinical evaluation and/or treatment have been discussed largely without the benefit of EMS research. A retrospective cohort analysis of prehospital refusals (PRs) was performed to characterize the type of patient encounter, support personnel on the scene, and disposition outcome. Multivariable analysis using logistic regression analysis ($p < 0.05$) was used.

During a six month period in an urban EMS system, 169 of 1715 (9.9%) base station calls were for documentation of a PR. The mean patient age was 47.9 ± 22.4 years (range 1–102). Confounding features included alcohol intoxication (24%), trauma (22%), seizures (12%), narcotic use (7%), and hypoglycemia (7%). Disposition outcome was as follows: left at scene against medical advice (53%); taken by EMS to the hospital (28%); left with a friend (13%); or other (5%). While police were called to the scene 41 times (2.3%), they placed a hold on only 10 patients (24.4%). Leaving the patient at the scene against medical advice was associated with the absence of: family, disorientation, a police hold, and abnormal speech (slurred or inappropriate); and with the presence of hypoglycemia and alcohol. Transportation by EMS was associated with: increasing age; the presence of disorientation, abnormal speech, and a police hold; and the absence of alcohol ingestion.

PRs represent a significant proportion of base station calls. Improved medical-legal guidelines for police officers to facilitate police hold placement will be needed to improve timely EMS transportation.

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5) Saliva Alcohol Reagent Strips in Altered Response Protocols

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Center for Emergency Medicine of Western Pennsylvania
Pittsburgh, Pa.

The detection of ethanol intoxication as a contibuting factor in patients with altered level of consciousness (LOC) in the field has been unreliable, usually based on clinical impression. We performed a prospective trial to investigate the utility of a rapid colorimetric saliva reagent strip designed to quantify serum ethanol levels (Alco-Screen, Chem-Elec, Inc.) in patients with an altered LOC in a busy, urban ALS system over a one-month period. Patients were enrolled after insertion of an intravenous line and glucose estimation, and only in the absence of significant arrhythmias. Blood was drawn simultaneously and refrigerated prior to analysis. Serum ethanol levels were measured by a central lab using gas chromatography. After receiving training in the use of these strips, paramedics filled out a data sheet on each subject enrolled. The clinical impression of the level of impairment (mild-moderate-severe, based on well-defined criteria) and the estimation of the serum ethanol level using the reagent strip were recorded.

A total of 29 adult subjects have been enrolled, with four subjects excluded from analysis due to missing blood samples. Of the 25 remaining in the study population, 12 (48%) were considered mildly impaired, four (16%) were moderately impaired, and nine (36%) were severely impaired. Serum ethanol levels ranged from 0–461 mg/dl, with a mean of 193.8 mg/dl. Of the study population of 25, seven (28%) had field estimations of 0 mg/dl, five (20%) 20–99 mg/dl, eight (32%) 100–299 mg/dl, and five (20%) had 300 mg/dl or greater. The saliva strips displayed a sensitivity of 41.2% and a specificity of 87.5% in diagnosing moderate or severe ethanol intoxication (field estimation of 100 mg/dl or greater with a similar serum level).

We conclude that these semi-quantitative saliva strips are useful in excluding significant intoxication in patients with altered LOC, but cannot predict the serum ethanol level in intoxicated subjects. Further prospective research is warranted in order to more accurately define the limitations to the use of these strips in the prehospital setting.

6) Prehospital Glucose Estimation Using Reagent Strips

Yealy DM, Hogya PT, Paris PM, Stewart R
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Center for Emergency Medicine of Western Pennsylvania
Pittsburgh, Pa.

Altered level of consciousness (LOC) protocols call for proper airway management, insertion of intravenous lines, and administration of dextrose solutions. Although the empiric administration of glucose solutions is safe in most patients, the cost of this treatment when applied to large populations is significant. The ability to tailor treatment to patient need is preferable in most clinical situations; additionally intravenous 50% dextrose solutions may have theoretical disadvantages when given to non-hypoglycemic patients with decreased LOC. Blood for glucose estimation using a reagent strip (Chemstrips, Indianapolis, Ind.) was obtained after insertion of an intravenous line; a simultaneous sample was obtained and saved in a flourinated tube, and measured for serum glucose by colorimetry within three hours by a central laboratory. Euglycemia was defined as a glucose level of 61-179 mg/dl; hypo- and hyperglycemia were defined as estimations and serum levels below and above this range respectively. Sensitivity, specificity, and 95% lower limits of confidence (LLC) were calculated for all data.

A total of 62 patients with complete data were enrolled . Field estimates suggested hypoglycemia in 16 (25.8%), euglycemia in 28 (45.1%), and hyperglycemia in 18 (29.1%). Of the 16 subjects with field hypoglycemia by reagent strip, 9 (56.3%) were confirmed by serum glucose analysis. Of the 46 patients with field estimations of euglycemia or hyperglycemia, none were found to have laboratory hypoglycemia. The sensitivity of detecting true hypoglycemia field reagent strips was 100% (LLC=81.3%) and the specificity was 88.3 % (LLC=83.3%). The specificity of field detection of the absence of hypoglycemia was 100% (LLC=81.3%), and the sensitivity was 86.6% (LLC=80.9%). In detecting hyperglycemia, the reagent strips had a sensitivity of 66.7% (LLC=50%) and specificity of 100% (LLC=81.3%).

We conclude that field glucose estimation can reliably predict the presence or absence of true hypoglycemia. However, given the small sample size, the theoretic potential for unrecognized hypoglycemia based on 95% confidence intervals could be as high as one in five. These strips do not accurately assess the presence of hyperglycemia in the field.

7) Utility and Accuracy of Glucose Reagent Strips in an Active, Physician-Supervised EMS System

Susler S, Dougherty J
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Northeastern Ohio University College of Medicine
Akron, Ohio

Traditional EMS teaching enphasizes the rapid empiric administration of glucose (usually 50–100 cc of 5O% dextrose) in any patient with possible hypoglycemia. Recent work by investigators in the area of cerebral resuscitation have presented evidence that recovery from cerebral ischemia depends, in part, upon pre-ischemic blood glucose concentration. Therefore, it appears desirable to avoid the use of dextrose in patients experiencing brain ischemia who are not hypoglycemic. The recent advent and availability on chemical reagent strips to approximate blood glucose levels offers the potential for rapid differentiation of hypoglycemic from non-hypoglycemic states. These are attractive particularily in the prehospital setting where quantitative blood glucose values are not available.

We designed a prospective clinical study to examine the accuracy of glucose reagent strips in an active, physician-supervised EMS system. Pre-treatment field glucose levels as well as a rapid field glucose determination utilizing a Visidex (Miles Lab) reagent strip were examined in 50 adult patients meeting pre-determined criteria for field glucose administration. Using a definition of hypoglycemia as glucose <70 mg/dl, we found significant inaccuracies in the Visidex rapid glucose test, In patients with a known history of diabetes, there was a high predictive value (.926) concerning the presence of hypoglycemia. Conversely, we were not able to accurately diagnose field hypoglycemia in the group of patients not known to have a history of diabetes (negative predictive value = .696)

Care should be utilized in relying on field glucose reagent strips reporting apparent hypoglycemia, particularly in patients who have no history of diabetes mellitus.

8) Chemstrip Reliability Declines with Ambulance Storage

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Division of Emergency Medicine, University of Utah Hospital
Salt Lake City, Utah

We removed and tested Chemstrip bG strips (the most widely used glucose reagent strip) from paramedic rigs in Salt Lake City to determine how age of storage might alter accuracy and consistency of glucose reading compared to newly manufactured Chemstrips. Four Chemstrips from each of the 10 rigs were exposed to plasma glucose solutions (corrected to whole blood values) of 35, 68, 223, and 761 mg/dl. Each strip was read by the three authors with readings averaged to yield one datum. Sets of fresh Chemstrips were similarly tested and read as controls. Results showed that all Chemstrips bG were stored in metal containers and comprised four different lot numbers and three different expiration dates (time on rigs 5, 9, and 11 months). All differed significantly from the laboratory value, but were closer than were controls.

	Laboratory Glucose (whole blood,mg/dl)			
	35	68	223	761
Chemstrip bG	41.3*	66.2	150*	463*
(5 controls, same lot number (±SEM)	(±3.0)	(±1.8)	(±4.1)	(±45)
Chemstrip bG	46.0* **	73.9* **	173* **	480*
(10 rigs)	(±3.8)	(±6.4)	(±23.4)	(±105)
Breakdown by age				
4 of age 11 months	44.2* **	79.8* **	282	390*
(2 lot numbers)	(±3.2)	(±5.3)	(±145)	(±134)
5 of age 9 months	48.0* **	69.4	175*	517*
(same lot number)	(±3.8)	(±3.3)	(±27.5)	(±91.0)
1 of age 5 months	43.3	73.0* **	160	600*

** indicates p <.05 from laboratory reading*
*** indicates p <.05 from Chemstrip bG controls*

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Compared to fresh Chemstrips, ambulance-stored Chemstrips read significantly higher at the three lowest glucose levels ($p < .05$). Breakdown by time of storage showed overestimation increasing with age at the 68 and 223 mg/dl value and decreasing at the 761 mg/dl value. The standard error of the mean (SEM) was much higher than controls at the normo- and hyperglycemic values (6.4 vs. 1.8, 23.4 vs. 4.1, 105 vs. 45.0). This variability persisted even when comparing the SEM of all five chemstrips of identical lot number and age of 9 months.

We conclude that Chemstrips bG stored on rigs significantly overestimate glucose values compared with fresh controls with much higher variability. This variability increases with storage time aboard rigs. Uniform storage, replacement, or periodic testing of Chemstrips may be indicated to maximize confidence in field glucose.

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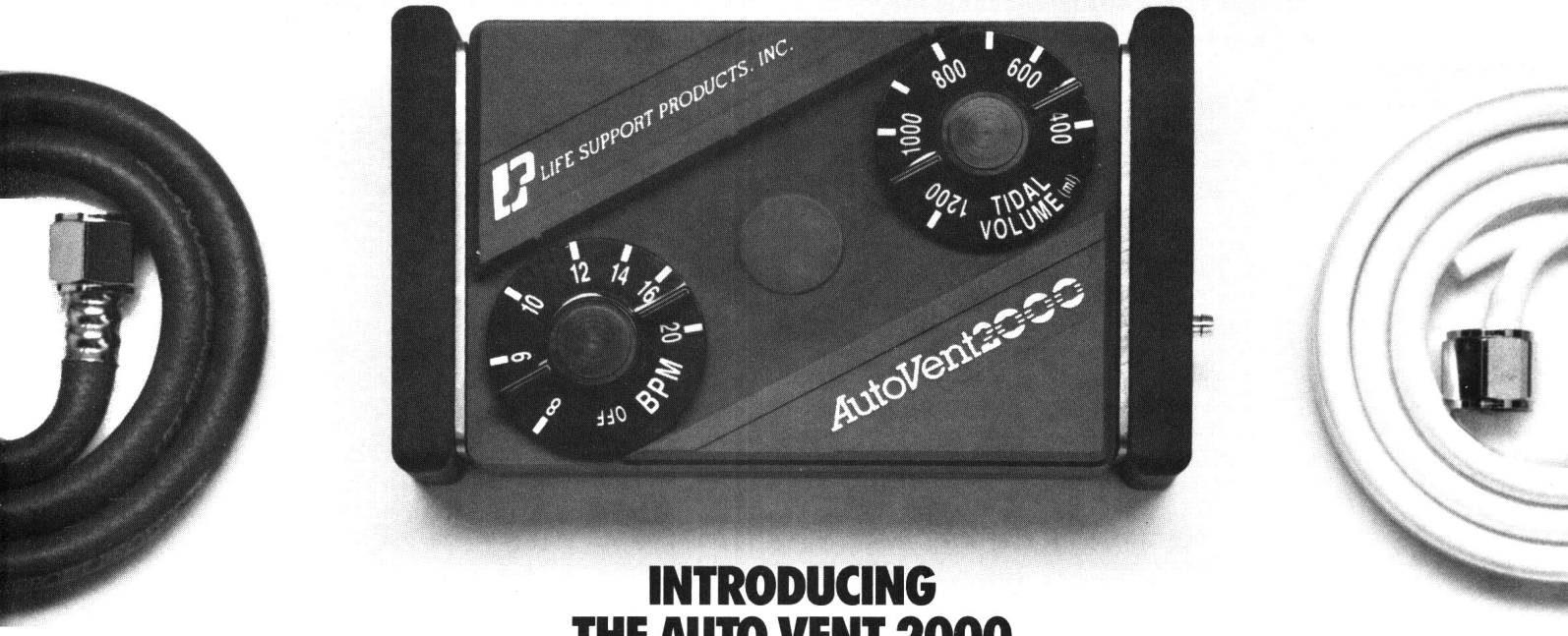

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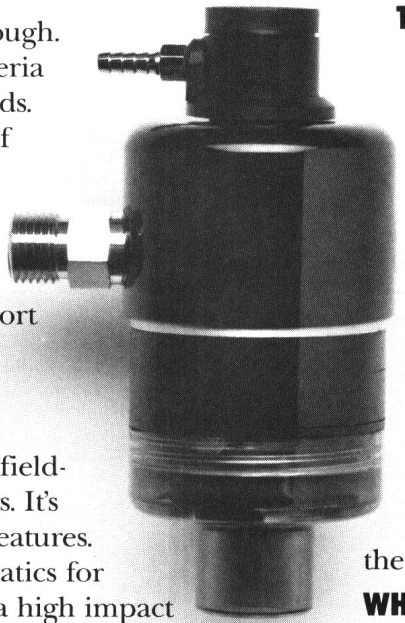

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8:30 San Francisco Room B
Section II: Advanced Cardiopulmonary Life Support
Moderator: E. Jackson Allison

9) Evaluation of a New Device for Simultaneous Compressions and Ventilations

Thomson DP, Yealy DM, Heller MB, Stoy WA
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Pittsburgh, Pa.

The resuscitator bag has long been considered the standard apparatus for prehospital management of ventilation. Recently, the Berg Resuscitation Apparatus (BRA) has been proposed as an alternative to the resuscitator bag. The BRA consists of a plastic housing into which a 40 liter per minute demand valve is fitted. The demand valve is triggered by a cable which attaches to this plastic housing. Oxygen is delivered via a section of tubing which is attached to a one-way valve; this valve connects to the mask or endotracheal tube.

The study was conducted in two phases. In the first phase, 20 experienced emergency care providers (18 paramedics, 2 emergency physicians) ventilated a test lung using a resuscitator bag, BRA, and demand valve. Using a randomized crossover design, we compared these two devices for their ability to deliver adequate tidal volumes and their efficacy during simulated single-rescuer CPR. Subjects were instructed to deliver a tidal volume of one liter at 10 to 20 breaths per minute for two minutes with each device. During the second phase of the study 19 subjects (16 paramedics, 3 emergency physicians) performed single-rescuer CPR on a recording Resusci-Anne. for two minutes, using the bag-valve-mask and the BRA with a mask. Tidal volumes were recorded in each instance

	MEAN VOLUME (LITERS)	STD DEV	
PHASE I			
Resuscitator bag	1.13	0.21	
BRA	1.10	0.22	p=0.54 (NS)
demand valve	1.18	0.26	
PHASEII			
Resuscitator bag	0.35	0.19	p<0.0001
BRA	0.81	0.26	

Data were analyzed using the two-tailed t-test and ANOVA. The per-experimental error was set at 0.05. Results from the first phase demonstrated no significant difference between the devices (p=0.54). During the single-rescuer CPR phase, the BRA delivered a volume of 0.81 liters compared to the resuscitator bag volume of 0.35 liters (p<O.OOOl).

We conclude that, in the hands of experienced personnel, the BRA allows ventilation to be performed as accurately as traditional equipment. When used in single rescuer CPR, it appears to augment the tidal volumes delivered. These results may have particular relevance in EMS systems with limited field personnel.

10) Performance Evaluation of Transport Ventilators

Mahoney JF, Kaplan RM, Yealy DM, Klein KA
Center for Emergency Medicine of Western Pennsylvania
Division of Emergency Medicine
University of Pittsburgh

Demand for sophisticated, reliable ventilators in prehospital care and aeromedical transport has swelled recently . Since there are little objective data about these new, lightweight, oxygen-powered ventilators, selection is difficult. We designed an experimental study to evaluate ventilator parametric accuracy, gas consumption, and transportability. The models tested were AutoVent 2000, HARV PneuPac 2-R, Logic 7, and Oxylog. Laboratory, ambulance, and helicopter tests were conducted under various operating conditions and simulated patient parameters using a test lung. Oxygen efficiency was calculated based on measured gas delivery to the test lung divided by measured oxygen source depletion. Data were analyzed using descriptive methods.

All models adequately ventilated the test lung, but the volumes delivered ranged from 67% to 129% of the control settings. The HARV and AutoVent were extremely portable and simple to operate, but wasteful (86%–87% oxygen efficiency). The Logic 7 was bulky and complex but permitted more sophisticated ventilation control and was 97% oxygen efficient. The Oxylog was intermediately sized, equally complex to Logic 7, and 91% oxygen efficient. The air-mix feature of the Logic 7 and Oxylog reduced oxygen consumption from 12.5 min ro 4.5 min, tripling the working time for a given oxygen supply.

We conclude that the AutoVent and HARV are best suited for brief, emergent applications where simplicity is virtuous and the oxygen supply is not limiting. The Logic 7 and Oxylog are larger and more complicated to use, but their oxygen economy makes them well-suited for longer transports of ventilated patients, particularly if the weight of a large oxygen supply would be prohibitive. Oxygen-powered transport ventilators are an important adjunct for patient transport and should be chosen based on system needs and ventilator design and performance.

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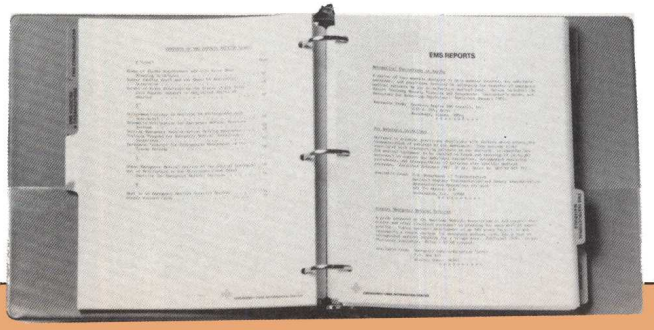

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11) Prehospital Cardiac Arrest: The Impact of Witnessed Collapse and Bystander CPR in an EMS System with Short Response Times

Spaite DW, Hanlon T, Criss EA, Valenzuela TD, Wright AL, Keely K, Meislin HW
Section of Emergency Medicine, College of Medicine, University of Arizona
Tucson Fire Department Department of Mathematics, University of Arizona

Computerized prehospital data (6/87–9/88) were analyzed from a medium-size metropolitan area to determine the effect of various parameters on the outcome of adult, non-traumatic cardiac arrest (CA). The Fire Department (FD) responds to all medical calls in the city via an enhanced 911 dispatch system. Mean Basic (BLS) and Advanced Life Support (ALS) response times in this system are 3.0 and 5.0 minutes respectively. Two hundred ninety-eight patients met study criteria. One hundred ninety-five (65.4%) were witnessed while 103 events (34.6%) were unwitnessed. Twenty-five witnessed cases (12.8%) were discharged alive while no unwitnessed victims survived ($p < 0.001$). Patients suffering witnessed episode of ventricular fibrillation/tachycardia VF/VT) were more likely to survive (21 of 96, 21.9%) than other patients (4 of 202, 2.0%; $p < O.OOOl$). Among witnessed patients, initiation of bystander CPR (BCPR) was associated with a significant improvement in survival (13 of 65, 20.0%) when compared to the no-BCPR group (12 of 130, 9.2%; $p<0.05$). Also, CPR was associated with improved outcome when witnessed patients with successful prehospital resuscitation (56) were evaluated as a group. Eighteen had BCPR of which 13 (72.2%) survived, while only 12 of the 38 patients with no BCPR 31.6%) survived ($p < O.Ol$). The subset of patients most likely to survive were witnessed victims of VF/VT in whom BCPR was initiated (30.6%). This group had a much higher survival rate than other patients (5.3%, $p < O.OOO1$).

Numerous studies have shown initiation of BCPR to significantly improve survival from prehospital cardiac arrest. However, in systems with very short response times BLS $\leq$ 3.0 min, ALS $\leq$ 5.0 min), BCPR has not previously been known to impact outcome.

Our data reveal improved survival rates when BCPR is initiated on victims of witnessed CA in such a system.

12) Improved Survival Rates with Automatic Defibrillators

Atkins JM, Streigler H, Burstain T, Foster G,
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Dallas Fire Department
Dallas, Tx.

In order to evaluate whether improvements in survival could be made with earlier defibrillation in an urban paramedic system, a study was begun in 1985 using automated defibrillators which detect ventricular fibrillation and advise or provide defibrillation. The design was to place these devices on fire engines in districts where there were no paramedics and arrival of an ambulance was later thanthat of a fire engine arrival.

The automated devices were used in 169 patients and compared to 200 patients in the same districts that did not have an automated defibrillator used. The average response time in the system for the fire engine and ambulance were 4.0 and 5.0 minutes, respectively. However in the districts, studied the fire engine was on the scene for more than two minutes 62.7% of the time. Of the 169 patients, 74 had ventricular fibrillation on analysis of the tape, 89 patients had asystole, and 42 patients had EMD. Of the 74 patients with ventricular fibrillation, 72 were shocked by the device. The two patients not shocked had fine ventricular fibrillation. No patient with asystole, EMD, or a perfusing rhythm was shocked. When individual analyses were examined, the machine correctly shocked or advised shock in 104 of 115 episodes of ventricular fibrillation. Thus, the sensitivity of the device was 90% for all episodes of ventricular fibrillation, and 97% for patients with ventricular fibrillation. The specificity of the device was 100% for asystole, EMD, and perfusing rhythms. Twenty one patients initially were admitted to the hospital with perfusing rhythms and 19 were long-term survivors. By comparing the year prior to the use of the automated defibrillators and two six month periods in between studies with different devices, the initial resuscitation rate for all arrests was 5% with a long-term survival of 2.6% for periods without automated defibrillators. The initial resuscitation rate was 12.4% with a long-term survival of 11.2% with the automated defibrillators. This difference is statistically significant.

Therefore, the judicious use of automated defibrillators can increase the short and long-term survival from cardiac arrest even in an urban system with rapid delivery of paramedic care. Automated defibrillators are effective and safe in the hands of firefighters who are trained only as first responders. Careful planning and the use of these devices can improve short and long-term patient survival from cardiac arrest.

13) Prehospital Transcutaneous Pacing of Significant Bradycardias by Paramedics: Clinical and System Effectiveness

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PURPOSE

Success with prehospital transcutaneous (external) pacing for clinically significant bradycardia has been reported. To date, these reports have been largely anecdotal. This project had three aims: 1) to implement transcutaneous pacing in a through a mixed urban-suburban, EMS system; 2) to determine the need for pacing for bradycardic patients in such a system (pacing uses per 100 cardiac arrests per year); and 3) to establish the clinical necessity of prehospital pacing by observing the need for subsequent temporary and permanent transvenous pacemakers.

METHODS

This tiered, EMT-D/paramedic-based system serves a population of 900,000 people, living on 460 square miles. A total of 71 paramedics in 8 paramedic units were trained in the use of a stand-alone, transcutaneous pacemaker/monitor. Protocols instructed the paramedics to initiate transcutaneous pacing for patients with clinically significant bradycardias (HR<60/mm, with hypotension, decreased level of consciousness, or dyspnea), unresponsive to two intravenous injections of atropine. Base-station permission was required.

RESULTS

In one year, a total of 28 patients were paced. Causes of the bradycardias included ischemic heart disease/acute myocardial infarction (22), respiratory failure (3), drug overdose (2), and toxic plant ingestion (1). Prepacing heart rates averaged 45 beats per minute; prepacing systolic blood pressure averaged 61 mm Hg. Average systolic BP during pacing was 104 mm Hg. Duration of pacing averaged 29 minutes. Four patients did not respond to prehospital pacing; they deteriorated and died at the scene; 24 patients responded with increased blood pressure and heart rate and were paced to the emergency department. Nineteen of these 24 patients (80%) were admitted to the hospital; 15 (63%) received temporary transvenous pacemakers. Five patients died in the ED, and 5 died in the hospital. Of the 14 patients discharged alive (50% of the 28 paced patients), 9 had temporary transvenous pacers placed, and 2 had permanent pacemakers. No adverse effects from prehospital pacing of these bradycardic patients were detected. In the year covered by this study, 561 cardiac arrests of cardiac etiology occurred. This suggests that similar urban-suburban systems can expect to encounter 5 bradycardic patients who need prehospital pacing per 100 cardiac arrests per year.

CONCLUSIONS

We conclude that transcutaneous pacing can be implemented effectively in a large EMS system. Early pacing was unquestionably a life-sustaining intervention for some patients with bradycardia as shown by the initial clinical response, and the frequent need for subsequent transvenous pacing. Nevertheless, transcutaneous pacing for significant bradycardias was used infrequently in prehospital care. Purchase of a rarely used, stand-alone device, may not be justified in all EMS systems. We highly recommend a moderately-priced, prehospital device that combines a monitor/defibrillator with a transcutaneous pacemaker.

14) Prehospital Trial of Tissue Plasminogen Activator (t-PA): Development of a Protocol for IRB Approval and Municipality Support

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Prehospital research protocols in emergency medicine typically involve patients unable to give informed consent. In this study, two institutional review boards (IRB) at a university and community hospital were consulted to establish an ethical approach for paramedics to deliver t-PA (Genentech, Inc.) in the field to competent patients with acute myocardial infarction (AMI). While a protocol with 150 patients was first proposed, the university IRB mandated an initial safety and feasibility study of 20 consecutive patients. These patients with AMI established by 12-lead electrocardiography and cellular telephone technology would receive t-PA by constant infusion pump. Successful delivery of t-PA to these 20 patients after receiving informed consent, would develop into a 150 patient study to compare t-PA given in the field versus the emergency department.

After approval by the hospital IRB, the Nashville Academy of Medicine was approached with the protocol. Serving as medical control for the emergency service in this city, support by this medical organization was necessary to approach the political structure of metropolitan Nashville/Davidson County. Simultaneous approval by the mayor and the leadership of the fire department ambulance division led to the development of a paramedic training program for the successful delivery of t-PA in the pre-hospital setting.

While the emergency department is established as the appropriate site for delivery of thrombolytic therapy, medical control for this decision may actually be extended to the prehospital arena. Preliminary data from this study demonstrates that only a small percentage of chest pain patients will likely be candidates for prehospital thrombolytic therapy. Of 44 patients with chest pain considered as candidates, 27 (61%) were potentially elegible for t-PA therapy in the ambulance. Of these 27 patients, 9 (33%) were found to have AMI by ECG criteria: 1 millimeter ST elevation in two contiguous leads. Three of the patients with AMI were excluded from the prehospital t-PA therapy after ECG transmission on discovery of previously undetected exclusion criteria. Three patients with AMI did not have their ECG's transmitted because of equipment malfunction, subsequently received thrombolytic therapy on ED presentation. Finally, 3 of the patients with AMI successfully received t-PA in the field with reperfusion.

Therefore, only 6 of 44 (14%) chest pain patients were candidates for pre-hospital thrombolytic therapy.

15) The Effect of Tiered System Implementation on Sudden Death Survival Rates

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Emergency Medical Services (EMS) systems often are gauged by how rapidly they can provide defibrillation and advanced life support (ALS) in the community. As a result, many EMS system planners promote the concept of all-paramedic (PARA) staffing using the rationale that this would better guarantee the fastest arrival of ALS. However, in most systems, no more than 1% of EMS emergency response incidents actually involve ventricular fibrillation/tachycardia (VF/VT), and usually less than 15% even require ALS care or precautions. As a result, in all-PARA systems, ALS providers are, for the most part, actually preoccupied with cases that readily could be managed by a basic emergency medical technician (EMT). Also, as PARA numbers increase, not only do payroll and training costs rise, but individual skill, performance, and the depth of individual medical supervision and attention are diluted further .

The primary purpose of this eighteen month study was to identify any detrimental effect on VF/VT survival rates that would occur following conversion of an all-PARA response system to a tiered-priority dispatch system that uses basic life support (BLS) units (staffed with two EMTs) for non-ALS transports as well as for those initial responses unlikely to need ALS. During a six-month transition period, a fleet of 32 one-PARA/one-EMT ("dual-purpose" ALS/BLS) response/transport units and 3 BLS transport (only) units was converted to a modified tiered system in which 16 BLS response/transport units and 12 two-PARA response/transport units (dedicated to ALS) were assigned primarily to the busy inner city zone where 70% of all responses occur. The less busy (but very large) peripheral area of the city remained covered by 13 dual-purpose (one-PARA/one-EMT) response/transport units. In addition, the EMS system also uses BLS first-responder support (firetrucks) from 78 neighborhood fire stations. At the end of the six-month transition period, a locally-designed, computerized priority dispatch system was placed into effect to complete the implementation of the new, tiered ALS/BLS system.

The results indicate that the VF/VT save rate (successful hospital discharge) of 11.3% (27/188) documented for the six-months immediately prior to the transition period rose to 17.4% (36/206) durinq the six months of transition and remained at 17.0% (35/206) during the first six months following final implementation. At the same time, among other benefits, staffing shortages and PARA morale improved remarkably following the system change.

Although a historical control was used, we concluded that sudden death survival rates were not adversely affected by conversion from an all-PARA response to a modified tiered ALS/BLS response system. Instead, many operational benefits were realized immediately.The long-term benefits have yet to be determined.

16) Clinical Predictors of Survival in Paramedic-Witnessed Cardiac Arrest

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Generally, only a certain proportion of out-of-hospital cardiac arrest patients resuscitated by emergency medical services (EMS) teams survive to successful hospital discharge. However, previous reports discussing paramedic witnessed arrest have shown a very high chance of survival if the paramedics are able to achieve successful prehospital cardiovascular resuscitation (restoration of spontaneous circulation) following witnessed cardiac arrest associated with ventricular fibrillation or tachycardia (VFT). The purpose of this study was to further validate these reports and to identify any factors predictive of successful resuscitation (and eventual hospital discharge) in this unique subset of cardiac arrest victims.

Over a six-month study period, all patients with paramedic-witnessed arrest were prospectively evaluated in terms of: age; sex; prior medical history; initial arrest rhythm; time to restoration of pulses; hospital admission; and survival (successful hospital discharge). For purposes of this study, those less than 18 years of age and those with arrest associated with injury, drugs, or a primary respiratory problem were excluded.

During the half-year study period, there were 478 primary cardiac arrests, 45 (9.4%) which were witnessed by paramedics. Of 200 VFT cases, 13 (6.5%) were paramedic-witnessed. In the other 32 cases of arrest witnessed by paramedics, 8 patients immediately lost EKG complexes (asystole) while another 24 arrested with either a pulseless, idioventricular rhythm (PIVR) or a sinus or bradycardic rhythm with normal-appearing complexes (EMD). Of the 13 VFT cases, 8 (62%) were successfully resuscitated in the prehospital setting and all 8 went on to survive. Only 3 of 7 PIVR/EMD patients, and 1 of 2 asystole patients, in whom spontaneous circulation was restored, eventually survived. While the number of study patients involved was too small to demonstrate statistical significance, there appeared to be a trend for non-survivors in the VFT group to have hypotension (systolic blood pressure less than 90 mm Hg) while VFT survivors tended to have relatively normal vital signs at the time of initial presentation to paramedics. The VFT patients also tended to be younger (mean age 54.4 ± 14.3 years) than PIVR/EMD patients (mean age 64.5 ± 11.9 years) and pulses were returned within 5.0 ± 3.6 minutes after VFT versus 21.0 ± 6.6 minutes after PIVR/EMD.

In conclusion, the chance of survival following paramedic-witnessed VFT is extremely high as long as successful prehospital resuscitated. In turn, successful resuscitation may be predicted by the patient's initial presenting vital signs prior to arrest.

10:30 San Francisco Room A
Section II: Airway Management, EMS Research, and Quality Assurance
Moderator: Terry Valenzuela

17) Determining the Need for Prehospital Intubation of the Trauma Patient

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The design of protocols to ensure appropriate prehospital (PH) endotracheal intubation (ETI) of trauma victims requires definition of indications and risks associated with the procedure. The ambulance runsheets and trauma registry records of 426 trauma victims (mean ISS 16; blunt:penetrating 369:57; mean age 33) admitted over 6 months were analyzed to determine which factors available on-scene best predict the need for PHETI. Immediate ETI on arrival to the trauma center was taken as indicative of the need for PHETI. No trauma victims underwent actual PHETI during the time course of this study. Patients requiring ETI for control of agitation or for a procedure were not considered as needing PHETI. Stepwise discriminant analysis using 10 physiologic measures, age, and 36 anatomic injuries easily discerned in the field (open fractures, facial lacerations, etc) revealed 6 variables: GCS; systolic blood pressure; pupil size/reactivity; respiratory rate; and age which correctly classified 87% of victims as needing or not needing PHETI.

Sensitivity=93%. Specificity=60%

		PREDICTED GROUPS	
Groups on arriva	# Cases	PHETI not needed	PHETI needed
Not intubated	343	321	22
Intubated	83	33	50

Cervical spine and anterior basilar skull fractures, conditions which make endo/nasotracheal intubation risky, were seen in 4% and 3.8% of the 426 victims, respectively.

Factors available on-scene can be utilized to correctly predict the need for ETI. The incidence of injuries that place a victim at risk of additional injury from a poorly performed intubation is low.

Future work will test this classification methodology against a larger population and translate the results in to a protocol that can be applied simply in the field.

18) Comparison of Intubation Routes in the Pre-Hospital Setting by Non-Physician Providers

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Endotrachael intubation is the optimum procedure for maintaining a patient's airway in the presence of real or threatened compromise. The current DOT paramedic curriculum includes both oral and nasotracheal intubation. While pre-hospital orotracheal intubation has been studied, there is little available information on pre-hospital nasotracheal intubation. This study examines the use of oral and nasotracheal intubation by paramedics and advanced life support nurse-EMTs on ground and aeromedical crews. Ground care was provided to a primary population of 144,000 over 454 square miles and aeromedical coverage was to a population of 1,639,000 over 6,734 square miles.

During the one-year study, there were 162 patients on whom intubation was attempted with 145 (90%) successfully intubated. The area receiving coverage by both aeromedical and ground ALS units had one intubation attempted for every 1,071 persons in the population base. Oral intubation was attempted on 87% and nasal intubation was attempted on 18%, with 8 patients (5%) having both routes attempted. The success rate for oral intubation was 91% (120/141) and for nasal intubation was 55% (16/29). Of the 8 patients on whom both routes were attempted, all 4 successes were by oral route. Of the 74% (120/162) of the patients intubated successfully on the first attempt, 106 were by oral route and 14 were by nasal route. Of patients successfully intubated, 83% were intubated on the first attempt. Reasons for intubation were tabulated and varied among medical and trauma patients as well as between ground crew and air crew patients. Outcome and complication data were solicited on all patients. Reports were received from the receiving institution on 152 patients, 94%. Only 3 complications were noted, none of which contraindicated the procedure.

During the study period, ground providers attempted to intubate 144 patients with 127 (88%), successfully intubated. For ground providers, oral intubation was attempted on 92% and nasal intubation was attempted on 12% with 6 patients (4%) having both routes attempted. Ground providers were successful in 92% (22/133) of oral intubations and 29% (5/17) of nasotracheal intubations. There were 20 patients on whom aeromedical providers, attempted intubation and 18 (90%) were intubated successfully. For aeromedical providers, oral intubation was attempted on 40% and nasal intubation was attempted on 70% with 2 patients having both routes attempted. For aeromedical providers there was an 88% (7/8) success rate for oral intubation and a 79% (11/14) success rate for nasotracheal intubation.

Nasotracheal intubation was shown to be a useful route for intubation by both air and ground ALS providers. Indications for intubation differed among medical and trauma patients, and may account for variations in success rates and routes among ground and air providers.

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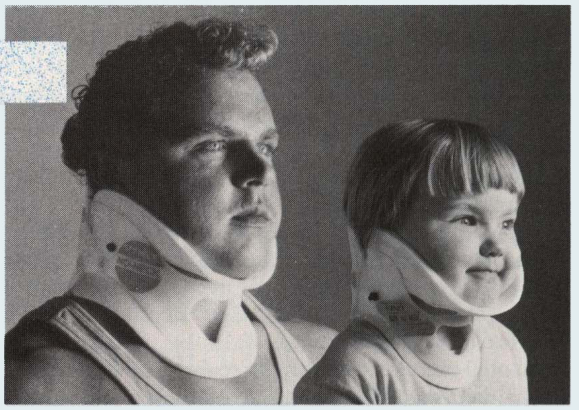

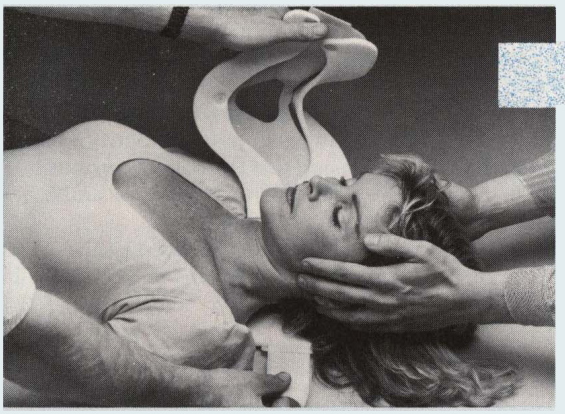

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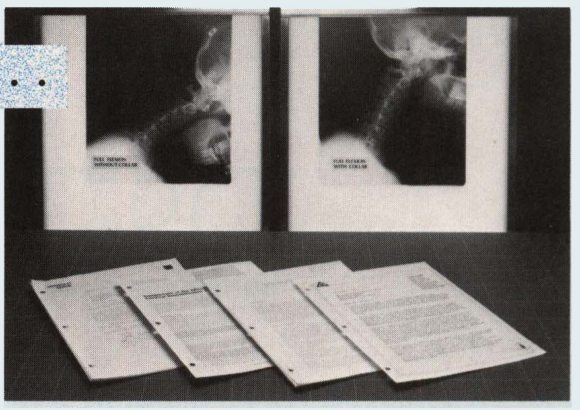

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19) Verification of Endotrachael Intubation Using a Dis posable End-Tidal CO_2 Detector

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The commonly employed clinical techniques for confirmation of endotracheal tube (ET) placement have been shown to be unreliable, particularly in the prehospital setting. End-tidal $C0_2$ monitoring of expired gas does allow for accurate detection of endotracheal tube placement, but the size, fragility, and expense of such units prohibit their use in the emergency setting. In an ongoing, prospective investigation, we studied a disposable colorimetric $C0_2$ detector (FEF™ End-Tidal $C0_2$ Detector, Fenem, Inc.) for the verification of ET tube placement in emergently intubated patients. The detector changes color in the presence of elevated $C0_2$ concentrations, such as would be expected in the tracheal, but not esophageal environment. Tube position was confirmed by auscultation, direct visualization, pulse oximetry, and radiography.

Analysis of the first 50 cases revealed that the detector was utilized 23 times (46%) in the prehospital setting (14 ground and 9 helicopter transports) and 27 times (54%) in the emergency department. 15 cases (30%) were in cardiopulmonary arrest. There were 48 (96%) endotracheal and 2 (4%) esophageal intubations. The device was 100% specific in the 39 cases in which intratracheal tube placement was indicated by the detector. The overall sensitivity for detecting intratracheal tube placement was 81% (39/48), but all 9 incorrect readings occurred in cases of cardiac arrest. The sensitivity was 100% in non-arrest patients. Both cases of esophageal intubations were correctly identified. Of the 15 cardiac arrests (all endotracheally intubated), the device failed to confirm placement in 9/15 (60%).

We conclude that this $C0_2$ detector is highly sensitive and specific for confirming intratracheal tube placement in the non-arrested patient. Also it is specific for detecting intratracheal placement in the arrest setting; however its limited sensitivity during cardiac arrest merits further study.

20) Prehospital and Emergency Department Verification of Endotrachael Tube Position Using a Portable, Non-Directable, Fiberoptic Bronchoscope

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Verification of endotrachael tube (ETT) location in the emergency department (ED) and prehospital settings is a challenging task and unrecognized esophageal intubations may occur more frequently in these environments. Various methods and devices for verification have been developed, but no single method has proven completely reliable for use in emergency patients. To evaluate the verification capabilities of an inexpensive, portable, non-directable fiberoptic bronchoscope (Visacath; Microvasive; Milford, Mass.), a prospective series of 22 emergently intubated prehospital, aeromedical, and ED patients (mean age of 62 years (range 17-90), underwent fiberoptic verification (FOV) of a newly placed ETT. No other verification methods were employed prior to the FOV, but auscultation, chest movement, pulse oximetry, and chest x-ray were used after the FOV to confirm the diagnosed position. Time required for FOV, ETT location, difficulty of intubation, and any changes in management as a result of FOV were recorded. Twenty-four FOVs were performed: 17 prehospital/aeromedical (71%), and seven ED (29%). Eleven patients were intubated for cardiac arrest and six for respiratory arrest; five were intubated for airway protection and/or hyperventilation therapy. Twenty-one tracheal (88%) and two esophageal (8%) intubations were identified; there was one non-visualization. The esophageal identifications were re-intubated, accounting for the two additional FOVs. Non-visualization occurred because of massive aspiration of blood from the esophagus. FOV confirmed placement in 23 intubations (96%). FOV was completed in all cases in less than 25 seconds. Seven intubations (29%) were considered difficult, requiring multiple attempts. FOV resulted in minor changes in management (adjustment of ETTdepth) in 5/23 (22%), and was the sole confirmation method in five intubations where the patients injuries or ambient noise precluded standard verification methods.

We conclude that fiberoptic verification shows promise as a reliable adjunct for confirmation of ETT position in prehospital and ED intubations.

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21) Prehospital Complications of Esophageal Obturator Airway (EOA) and Endotracheal Tube (ET) Placement

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A prospective study of 509 adult respiratory arrests was done to evaluate prehospital complications of esophageal obturator airway (EOA) and endotracheal tube (ET) placement. The final airway was the, EOA in 208 patients (40.09 %) and the ET in 232 patients(45.6 %). Forty-seven patients (9.2 %) had only oral or nasal pharyngeal airways, 22 patients (4.3 %) had both the EOA and ET at the time of examination. Patients were examined in the field, hospital, funeral home, or medical examiner's quarters for complications of the airways.

EOA complications include tracheal malplacement in 8 patients (3.8%), 1 posterior pharyngeal laceration (0.48%), 4 patients with posterior pharyngeal swelling or hematoma (1.9%) and 10 patients (4.8%) had plugging, kinking, or curling of the tube. ET complications include 5 patients (2.1%) with esophageal malplacement, 6 patients (2.5%) with signs of pharyngeal trauma, 2 patients (0.8%) with subcutaneous emphysema, 1 patient (0.43%) with a kinked tube, 1 patient (0.43%) with the tube balloon at the level of the cords and 3 patients (1.3%) with right mainstem intubation. The adverse complications of the EOA which prevented resuscitation (malplacement, plugging, kinking, curling) were seen in 18 patients (8.7%) and were nearly 3 times higher than the adverse complications of the ET tube (malplacement and kinking which prevented resuscitation (6 patients—2.6%) ($p < .05$).

We conclude that this study should lead to the strong consideration that an oral/nasopharyngeal airway with bag-valve-mask or endotracheal intubation should be used to the exclusion of the EOA.

22) Comparison of the Pharyngeal Tracheal Lumen Airway to the Endotracheal Tube: An EMS Field Trial

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Emergency Medical Residency Program, Charlotte Memorial Hospital, Charlotte, S.C.
Division of Emergency Medicine, Jacksonville University Hospital, Jacksonville, Fla.

A prospective, randomized field trial was conducted to compare intubation using the Endotrachael Tube (ETT) with intubation using the tracheal lumen (PtL) airway. Paramedic units from four separate county EMS systems, in three states, taught by faculty and residents from three Emergency Medicine Residency Programs participated. Randomization was achieved by alternating use of the ETT and the PtL on a PER UNIT basis. All adult patients that were intubated were included in the study. A total of 276 intubations occurred during the study period. Arterial blood gas (ABG) data was collected on 146 patients. The ABG data indicate that the PtL appears to perform as well as the ETT in the field. PtL: pH 7.14, $pC0_2$ 60.2, $p0_2$ 152, $HC0_3$ 17; ETT pH 7.15, $pC0_2$ 62., $p0_2$ 14,$HC0_3$ 17 (p values 0.73—0.91). In addition, the PtL was easier to place than the ETT ($p < 0.05$) and was placed slightly faster (16.8 sec vs 25.2 sec). We found the PtL to be an effective, safe, dependable, and easy to use airway adjunct (subjective comments and data) that could be used: (1) as a backup airway when ETT intubation cannot be accomplished; (2) as a primary airway when oral intubation with an ETT is contraindicated; (3) as a primary airway for EMT-D and "well trained" basic personnel; and (4) as a primary airway on nursing units in hospitals and nursing homes.

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23) Pre-Trial Peer Review in EMS Research

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Pittsburgh, Pa.

The Department of Health and Human Services requires pre-trial peer review for all research involving human subjects. We sought to evaluate the frequency of pre-trial peer review in prehospital research, and to analyze the form of such review. Four years (1985 through 1988) of three prominent refereed emergency medicine journals were reviewed. All three journals require that the peer review mechanism be stated in the methods section of each manuscript. Additionally, the primary author of each prospective trial was contacted by phone.

Seventy-nine manuscripts were identified as original contributions in prehospital care utilizing human subjects. The study design was retrospective in 40 (51%), prospective in 33 (42%), and cross sectional in 6 (7.5%). Nine of the 79 published trials (11.4%) had obtained pre-trial peer review, 6 from a university or hospital-based IRB. All of the peer reviewed trials were prospective in nature (9/33, 27.2%). An open-end survey of the authors of each prospective trial without pre-trial peer review indicate that review was not obtained because of the following reasons: perceived lack of need (96%); anticipated difficulty with in-hospital IRB understanding the nuances of prehospital research (16.7%); and feared interference with the research protocol (12.5%). Each author who had obtained IRB approval commented on the difficulty encountered as a result of the poor understanding of prehospital care by hospital-based committees.

We conclude that pre-trial peer review is lacking in the majority of prehospital research trials. Although many cross-sectional and retrospective trials do not require pre-trial peer review, prospective studies on human subjects should be reviewed prior to data collection. Guidelines need to be developed in order to facilitate the process using current hospital-based IRBs. Creation of regional EMS IRBs also may assist prehospital care researchers.

24) Use of Initial Resuscitation Rates for Quality Assurance

Atkins JA, Streigler H, Burstain T
University of Texas Southwestern Medical Center
Dallas Fire Department
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Long-term survival is achieved primarily in cardiac patients who have witnessed ventricular fibrillation. Since this number of cases is too small to allow adequate quality control, we developed a computer model of cardiac arrest using regression analysis of initial resuscitation data (return of rhythm and pulse to allow moving the patient from the emergency department to intensive care). The model was proved by comparing one year to the next and by comparing random and non-random groups.

Records of 4031 CPRs were analyzed. The average response time of the system for all cardiac arrests was 4 minutes and 55 seconds. The patient was declared dead in the emergency department 86.1% of the time. For all arrests, asystole was seen 50.0%, ventricular fibrillation (VF) 35.3%, and electromechanical dissociation (EMD) 14.7%. Only 36.6% were witnessed. The average age was 56, and 65.7% were men. Initial success was seen in 19.3% of witnessed and 9.2% of unwitnessed arrests. Initial success was seen in 16.7% of VF, 7.8% of asystole, and 17.2% of EMD; most of the initial success in EMD was of traumatic etiology and most subsequently died as did most of the asystole patients. Success was seen in 27.2% of the witnessed VF with this group providing 85% of the long-term survival. Statistically significant ($p<O.Ol$) better rates of resuscitation were seen in women, witnessed arrest, ventricular fibrillation, bradycardias, and patients given lidocaine. More shocks and higher doses of epinephrine had a negative impact on survival. Response time was not a factor as 83% of cases had a response time of 2–6 minutes. By comparing protocols before and after removal of calcium chloride, the administration of calcium chloridet was shown to be harmful and to decrease the likelihood of success. The computer correctly found that seven units had significantly worse results than the system as a whole. One of these units had a faulty defibrillator that would meet all manufacturer's specs but failed in field use. Five units had only one paramedic and an EMT-basic (all other units had two or more paramedics). The remaining unit had morale problems.

Therefore, initial resuscitation data can be used to build a model of the EMS system. This model then can be used to compare protocols and provide quality assurance for an individual unit as well as the system. This information could not be determined from only final outcome data.

10:30 San Francisco Room B
Section IV: Trauma
Moderator: Kimball Maull

25) Dual Reponse Runs for Prehospital Trauma

Cayten CG, Stahl W, Murphy J, Agarwal N
Institute for Trauma and Emergency Care
New York Medical College
Valhalla, N.Y.

Dual response runs (BLS & ALS) for trauma patients were compared to BLS and ALS runs respectively. Data were collected for nine months from eight hospitals for consecutive adult patients cared for by BLS, ALS, and both BLS and ALS units. Only patients who stayed for >48 hours and/or died were included. The following data were collected: cause of injury; type of percentage times; age; revised trauma score (RTS); injury severity score (ISS); and hospital mortality. Using the TRISS method, Z and M statistics were used to compare mortality among the groups and to the Major Trauma Outcome Study (MTOS) patients. Negative Z scores = more deaths than predicted by MTOS; an absolute value of Z which exceeds 1.96 is required for a significance level of 0.05. M scores of greater than 0.88 reflect a similar severity case mix to the MTOS.

Scene

	n	Time	Age	RTS	I SS	Z	M
Penetrating							
BLS	87	16.5	31.8	7.0	14.5	-1.12	.90
ALS	130	11.8	29.0	6.8	14.8	-0.88	.92
BLS/ALS	22	11.4	25.6	6.1	15.5	-0.39	.83
MVC							
BLS	185	19.7	40.6	7.4	10.3	-0.63	.93
ALS	150	17.7	40.5	7.3	14.9	1.12	.94
BLS/ALS	69	16.2	37.0	6.6	19.2	-0.41	.86
Other Blunt							
BLS	107	19.4	42.8	7.6	10.2	-0.84	.91
ALS	54	17.9	38.6	7.1	15.0	-0.32	.91
BLS/ALS	17	12.9	41.8	6.5	19.1	-1.17	.83

With each cause of injury, dual response runs had the shortest scene times and the most severely injured patients. For each cause of injury, BLS units had the longest scene times and the least severely injured patients. These trends showed greatest statistical significance ($p < .05$) for the MVC patients. The survival of the dual response patients was not better than the BLS or ALS units using the Z and M statistics to control for severity of injury. The survival of all of the patient groups studied were not significantly different from the patients in the MTOS. Further study of the use and value of dual response for prehospital trauma care is warranted.

26) Severity Index/Outcome Assessment of Prehospital Trauma

Cayten CG, Stahl W, Murphy J
Institute for Trauma and Emergency Care
New York Medical College
Valhalla, N.Y

Severity index and outcome data (trauma registry data) were used to study time at scene. Data were collected for nine months from eight hospitals on consecutive adult patients who stayed greater than 48 hours and/or died; and were brought in by BLS or ALS units beginning April 1988. The following data were collected: cause of injury; type of prehospital care; age; scene time; revised trauma score (RTS); injury severity score (ISS); days in ICU; length of stay (LOS); complications; and mortality. Mean scene times of ALS and BLS units were compared utilizing mean severity and outcome measures for penetrating and motor vehicle crash (MVC) patients. Using the TRISS method, Z and M statistics were used to compare mortality rates among groups. Negative Z scores indicate more deaths than predicted by Major Trauma Outcome Study (MTOS); an absolute value of Z which exceeds 1.96 is required for a significance level of 0.05. M scores of greater than 0.88 reflect a similar severity case mix to the MTOS.

			Scene			LOS		ICU		
	n	Age	Time	RTS	ISS	(days)	Compl	(days)	Z	M
Penetrating										
BLS	87	31.8	16.5	7.0	14.5	8.2	0.2	3.9	-1.12	.90
ALS	130	29.0	11.8	6.8	14.8	8.2	0.3	3.4	-0.88	.92
MVC										
BLS	185	40.6	19.7	7.4	10.3	10.3	0.3	4.2	-0.63	.93
ALS	150	40.5	17.7	7.3	14.9	15.2	0.5	5.7	1.12	.94

Using these data, a medical director can conclude the following: 1) BLS and ALS units took care of similar severity penetrating injury patients and yet BLS unit took 4.7 min longer at the scene ($p < .05$); 2) ALS units took care of more seriously injured MVC patients yet spent 2 minutes less time at the scene ($p < .05$); and 3) the survival of all patient groups was comparable to the MTOS according to Z and M scores. The implications of these results regarding medical control and quality assurance will be discussed. Trauma registry data add an important dimension to protocol compliance monitoring in prehospital trauma care quality assurance.

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27) Intraosseous Infusion in the Prehospital Setting

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City of Pittsburgh Department of Public Safety
Bureau of Emergency Medical Services
Center for Emergency Medicine of Western Pennsylvania
Pittsburgh, Pa.

The establishment of intravascular access in critically ill pediatric patients is a difficult and time-consuming problem. Intraosseous (IO) infusion is an established means of obtaining vascular access and administering fluids and medications in hospitalized patients. Therefore, prior to the implementation of an IO infusion protocol by the city paramedics, a study was undertaken to compare the establishment of IO infusion in various prehospital settings. The aim was to determine time to establishing an IO infusion and the success rate on first attempt at the scene and en route to the hospital.

The study participants (paramedics [8] and Emergency Medicine (EM) residents [4]), received a lecture on IO infusion, followed by a "hands-on" clinical session. Jamshidi (modified Illinois) IO needles (15G) and turkey legs were used throughout the study. The three prehospital "scenarios" were: 1) classroom ("scene"); 2) a moving medic unit at 25 mph making slow, steady turns; and 3) a moving medic unit at 30–35 mph with sudden stops and starts (to simulate traffic at intersections). Participants were timed from skin entry to establishment of infusion.

All participants were successful in establishing IO infusion with >80% of access achieved in <1 minute in all settings. The "scene" had somewhat shorter mean time and higher first attempt success rate, compared to the en route scenarios, but the differences were not statistically significant (Table).

group	1st attempt success (%)	mean time to successful IO insertion (seconds)	median time to success (sec)	time range to success (sec)
scene	81.8	36.7	27.6	19.09–93.40
25 mph	54.5	48.1	30.0	13.75–158.45
30 mph	63.6	39.9	30.3	13.62–133.08

Prehospital and Disaster Medicine © 1989; Fuchs et al.

This study demonstrates that, using a simulated model, IO access can be established successfully in the prehospital setting. The minimal time delay in establishing IO infusion makes it an ideal technique for use in the pediatric population both at the scene (or in the medic unit prior to leaving the scene) or en route to the hospital.

28) An Evaluation of a New IV Warmer Suitable for Field Use

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SJW: Armstrong County Memorial Hospital
Kittaning, Pa.

INTRODUCTION

No method of warming intravenous (IV) fluids has thus far proven practical for routine prehospital use. We have developed and tested an IV warmer (IVWARMER) that may fill this critical void.

METHOD

The IVWARMER consists of an insulated wrap housing two 4"xlO" reusable sodium acetate heat packs which reversibly liberate heat of crystallization at a maximum temperature of 54°C. Two IVWARMERS in series can enclose an IV bag and infusion set. The IVWARMER was tested on 1-liter IV bags against microwave insulated wrap, and against non-heated/non-insulated controls in five groups as follows:

Group 1: IVWARMER (Bag+ tubing)
Group 2: Microwave-heated fluid
Group 3: Control, room temperature fluid
Group 4: IVWARMER (Bag + tubing), initial fluid tempera ture= 9–13°C
Group 5: Cold Control, initial fluid temperature= 9–13°C

Ambient temperature was maintained at (minus) -18°C. Infusion rates were either slow (5 ml/min) or rapid (225-250 ml/min). For groups 1 and 4, fluid flow was initiated 15 minutes after heat pack activation, to simulate prehospital response and IV start times. Temperature was measured both in the IV bags and at the distal tubing injection bulb.

RESULTS

At slow infusion rates, IV fluid was delivered significantly warmer (p<.001) in the IVWARMER groups than in either the unheated controls or the microwave-warmed groups. At rapid infusion rates, the IVWARMER groups delivered significantly warmer fluids (p<.OOl) than their respective controls, but significantly cooler than the microwave-warmed group.

	Group 1	Group 2	Control	Group 4	Cold Control
Flow=5ml/min					
Bag Temp.(°C)	35.1±0.6	39.9±1.0	21.0±1.0	29.3±1.3	7.1±1.0
Distal Temp (°C)	27.3±1.0	5.5±1.2	2.3±0.7	27.3±1.2	-6.8±1.2
Flow=250ml/min					
Bag Temp.(°C)	33.5	45.5	25.5	25	14.5
Distal Temp (°C)	30.0±0.3	40.1±2.1	22.7±0.7	21.7±1.1	12.6±1.1

Prehospital and Disaster Medicine © 1989; White et al.

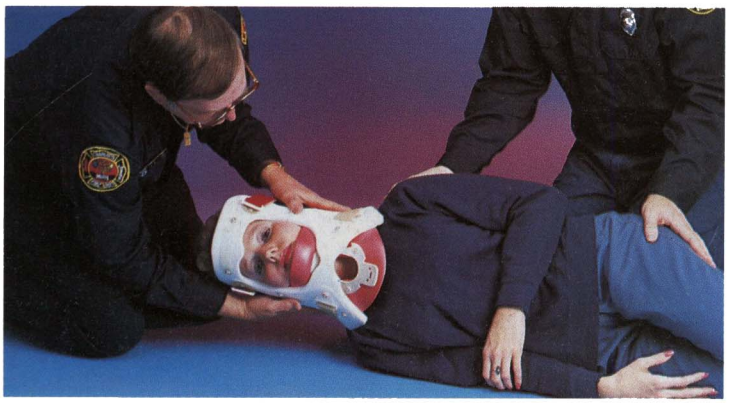
The IVWARMER is able to prevent freezing of IV fluids at low flow rates, while delivering warmed fluids at high flow rates. We believe that it has potential value in prehospital medicine, especially in cold environments.

PHILADELPHIA™ E.M. HALO

In cases where the Head Immobilizer is not necessary, the Philadelphia™ Halo may be more appropriate to use at the scene of an accident before the spineboard. Remove necklaces, earrings and look for glass in patient's hair. First, snap the Halo attachment to the back portion of the collar. Be certain to keep the patient's hair away from forehead when applying the Halo. Always center Vel-Stretch® on Halo strap. Keep the head in neutral position while holding head stable and pull both sides of the Halo strap to secure patient with even pressure.

HALO/STABILIZER

As a precaution, this should be applied even if no cervical injury is suspected. It is easier for the surgeon to have either the Halo or Stabilizer removed as he sees the patient's cervical spine is improving. The Philadelphia™ Halo provides much more comfort to the patient and can be quickly applied.



LOG ROLL WITH HEAD IMMOBILIZER AND E.M. COLLAR

The Log Roll maneuver becomes less dangerous when the head and neck are stabilized. You must move the head, neck and torso as a unit to reduce the chance of aggravation to spine injuries. Application of the Head Immobilizer and E.M. Collar will help secure some points at the cervical region needed to work together while performing this delicate maneuver of placing the patient on the spineboard. Add Stabilizer if possible.

HEAD IMMOBILIZER

The red E.M. Philadelphia™ Cervical Collar® is effective by attaching the Philadelphia™ Head Immobilizer. Extra protection is provided from head tilt and it helps avoid cervical spine injury from becoming cord damage until the extrication device can be applied.

HEAD IMMOBILIZER/ STABILIZER

Immediate aid to help stabilize the cervical spine becomes a reality. The combined effect of the Head Immobilizer, Stabilizer and E.M. Collar gives the critical support needed to the cervical spine, head and neck at the accident scene before using extrication devices or spineboard.

Demand Philadelphia.™

THE CHOICE OF TRAUMA & E.M. FIELD PROFESSIONALS WHO PUT THEIR PATIENT'S SAFETY & COMFORT FIRST.

From and automobile accident to the Emergency Room, the PHILADELPHIA™ CERVICAL COLLAR® Company will now be providing new state-of-the-art E.M. Collars and products for emergency and medical professionals providing their patient with care and comfort.

THE ADVANTAGES OF USING PHILADELPHIA™ CERVICAL COLLAR® PRODUCTS ARE:

- *All new PHILADELPHIA™ CERVICAL COLLAR® products attach to the E.M. Collar.*
- *Stabilizer is designed to help immobilize the cervical region when applied to the PHILADELPHIA™ CERVICAL COLLAR.®*
- *No tools necessary to apply. Brace is comfortable for a variety of people.*
- *Stabilizer comes in one size; fits almost all average adults.*
- *Apply PHILADELPHIA™ CERVICAL COLLAR® first to help secure immobilization of cervical region, then apply the necessary PHILADELPHIA™ attachments.*
- *Wrist-cuff, located on stabilizer, is designed to keep patient's arms out of the way while moving.*
- *Attaching the Stabilizer to the PHILADELPHIA™ CERVICAL COLLAR® provides more stability to the cervical spine from flexion and extension than the collar alone.*
- *Adding Head Immobilizer to unit eliminates most rotation and head tilt, more than the collar alone.*
- *An additional feature about the PHILADELPHIA™ complete unit is that the brace does not have to be removed from the patient for X-rays. There are no metal parts to deter the X-ray evaluations.*
- *As the patient improves, the physician could remove the Halo and/or the Stabilizer as the physician sees the cervical spine improving.*
- *As a precaution the E.M. Halo should be applied even if no cervical injury is suspected. Snap on Halo before applying to patient.*
- *Color coded for easy application and use with attachments. Beige is the front and yellow is the back.*

The next time when ordering remember:

—the PHILADELPHIA™ CERVICAL COLLAR® Company.

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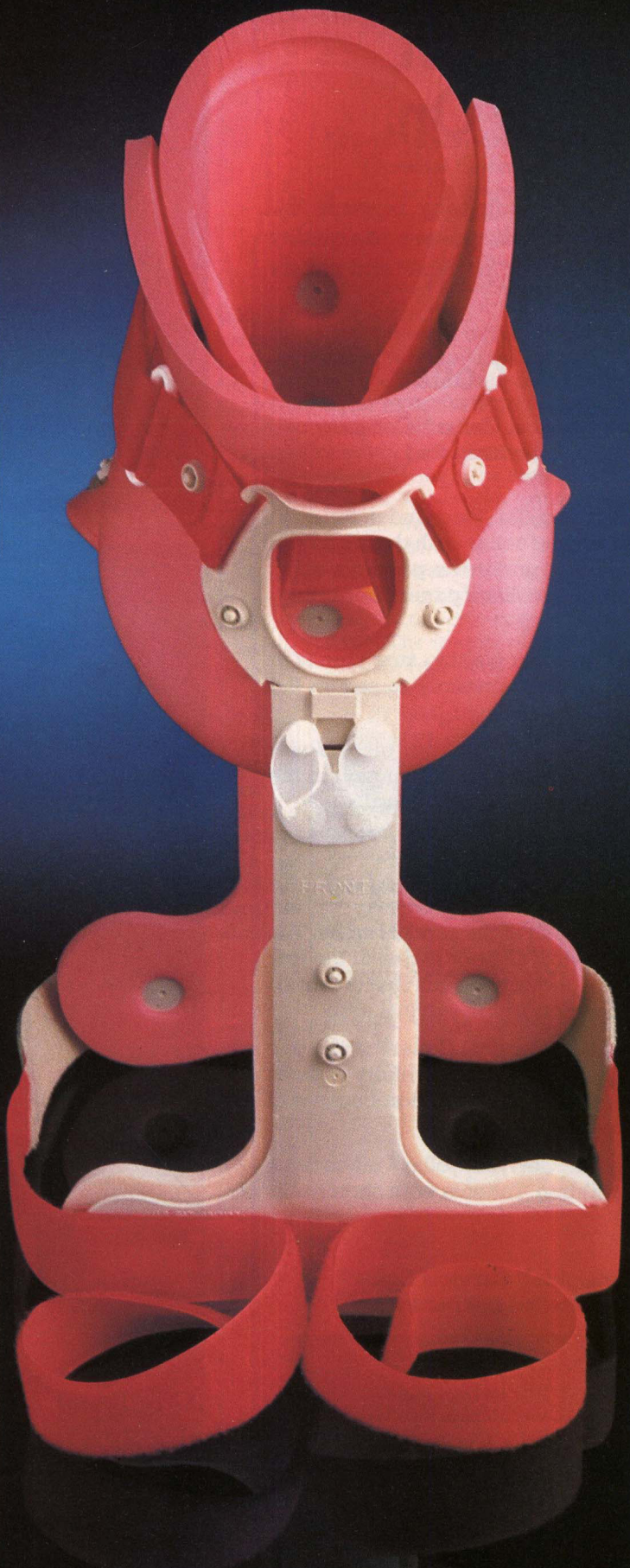
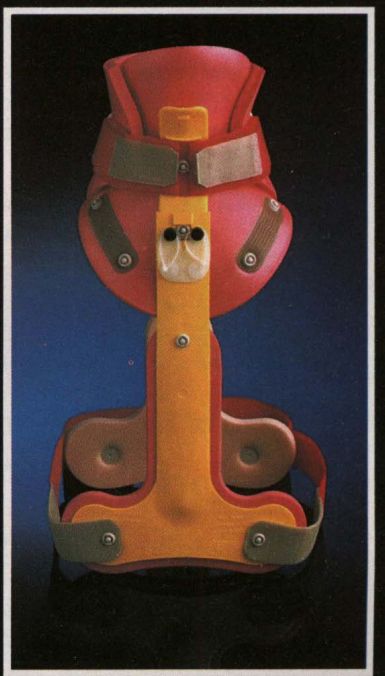
STATE OF THE ART RESCUE EQUIPMENT





All Philadelphia™ Cervical Collar® products are color coded for easy assembly and attachment to the stabilizer. The front is beige colored. The back is yellow and fits into the back portion of the stabilizer.

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Philadelphia™ Cervical Collar® Head Immobilizer/Stabilizers and Halos are packed flat and are Adult Universal.

Immediate Medical Support You Can Rely On.

Philadelphia™ Cervical Collar® Company rewards the Trauma and E.M. FIELD Professionals by putting new quality tools in their hands to comfort their patients and satisfy themselves.

The E.M. Adult Collar

The use of the Philadelphia™ Cervical Collar® Company new red E.M. Collar's easy application is demonstrated in the following test and photographs.

Figure 1. Flatten back portion of collar. Place index finger in "looped" part of bow and hold edge of collar with thumb as you *simultaneously slide bow and collar* under the patient's neck. Just apply and center back portion of collar if patient is in sitting position.

Figure 2. Place front portion of collar making sure chin is in proper position. Pull with just enough pressure to secure the head.

Figure 3. If patient is nauseous, just pull chin piece down enough to allow vomit to escape to avoid an obstruction in the airway. If patient is strapped in spineboard, tilt board.

Several additional items of importance to note are:

Most collars do not support the arch of the cervical spine. The new red E.M. Philadelphia™ Cervical Collar® is one of the few collars in the E.M. field that has a preformed back that conforms to the spine to accommodate support to the cervical arch.

The new red E.M. Philadelphia™ Cervical Collar® is the one collar in the E.M. field that supports the head carefully without tilting it from side to side and it eliminates rotation because of the Head Immobilizer attachment.

The new red E.M. Philadelphia™ Cervical Collar® offers three sizes that fit most adults and children. Patients with short necks will be accommodated soon.

All new red E.M. Philadelphia™ Cervical Collar® products come with detailed instructions.

CAUTION: ALL Philadelphia™ Cervical Collar® Products should be applied by a physician or certified medical authority

For more information, call or write the

Philadelphia™ Collar® Company

P.O. Box 185 • Westville, NJ 08993

1 (215) 923-9760

Patents: U.S. 3,756,226; 4,677,969; 4,502,471; 4,515,153; Canadian (Brevete) 1976, 1986; U.K. 2,126,485; DBP 3534191C2

Patents Pending: U.S./Foreign

Printed in U.S.A. 5/88

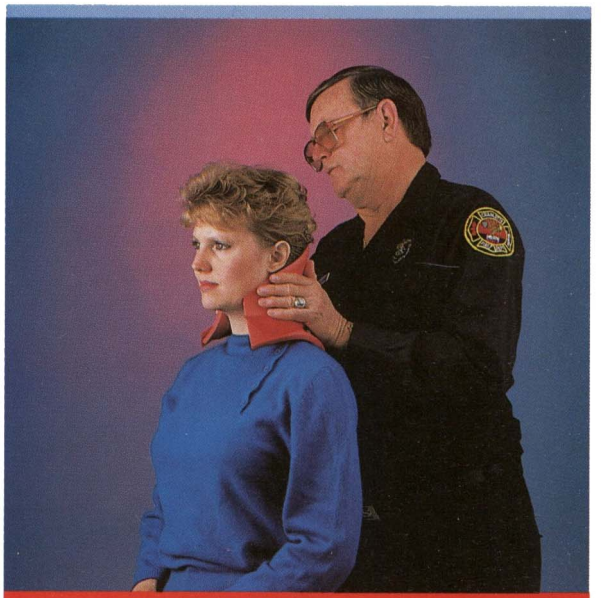

FIGURE 1.

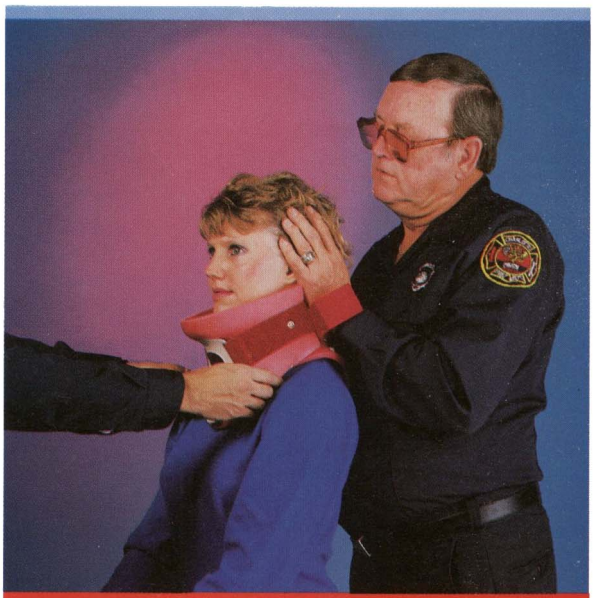

FIGURE 2.

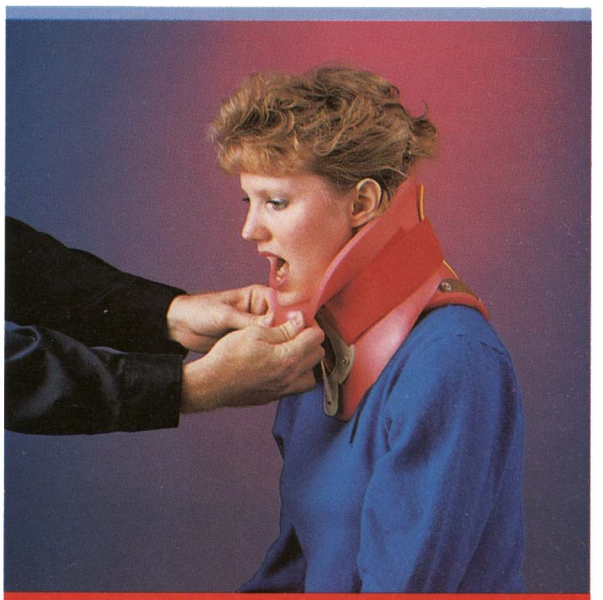

FIGURE 3.

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29) Evaluation of a New Cervical Immobilization/Extrication Device

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Salt Lake City, Ut.

A new cervical immobilization device, the Philadelphia Red E. M. Collar with Head Immobilizer/Stablizer (Red E. M.), has been introduced as an adjunct in extricating potentially neck-injured patients. This study compared efficacy of immobilization of the Red E. M. to that of the short spine board. In addition, experienced EMS personnel rated the Red E. M. in simulated field situations. The Red E. M. and a short spine board were applied to 25 adult volunteers in a sitting position, using standard methods. Each subject then exerted maximal force in flexion, extension, rotation, and laterally. Degrees of head motion from neutral position were measured in each direction. Results were compared using a Student's t-test. Then 10 EMS personnel were asked to apply the Red E. M. to volunteers. Each rated the performance of the Red E. M. on a scale of 1 (poor) to 4 (excellent) regarding: ease of application (sitting and supine); ease of extrication (lifting, logrolling, transfer); access to patient (chest auscultation, CPR, airway management); storage; and overall utility.

Results indicate that the Red E. M. was significantly better than the short spine board in both lateral and rotational immobilization ($p<0.001$). There was no significant difference for flexion and extension ($p>0.05$). Ratings for the device (mean ± standard error) were: ease of application (sitting) 3.5 ± 0.2 (supine) 2.7 ± 0.2; ease of extrication 3.1 ± 0.2; access to patient 3.4 ± 0.2; storage 3.1 ± 0.3; and overall utility 3.1 ± 0.2.

We conclude that the Philadelphia Red E. M. Collar with Head Immobilizer/Stabilizer is an efficacious and practical adjunct to stabilization and extrication of potentially neck-injured patients.

30) Air vs. Ground Transport From a Trauma Scene: Optimal Criteria for Helicopter Utilization

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Although civilian medical helicopters have been used to respond to trauma victims since 1972, optimal criteria for use has not been well-established. Butterworth AeroMed is a physician and nurse staffed helicopter service capable of transporting one or two patients at a time.

We retrospectively reviewed all air and ground scene transports arriving at the Butterworth Regional Trauma Center in Grand Rapids, MI between January 1, 1988 and December 31, 1988. Of the 605 air transports during this period, 86 (14.2%) were from the trauma scene.

Comparison of ground ambulance forms, AeroMed flight records, and hospital records revealed no significant difference in age, sex, or percentage of blunt and penetrating type injuries ($p < 0.05$). The severity of injury was compared using (Ground transport, Air transport): Abbreviated Trauma Score (7.2, 5.5), Prehospital Index (3.9, 7.0) and Injury Severity Score (12.8, 15.8).

By using linear regression, the distance from scene to trauma center (air miles) was plotted against prehospital time. The ground transport prehospital time was defined as time of arrival at scene to arrival at trauma center. The air transport prehospital time was defined as time of helicopter activation until arrival at trauma center. This gave two independent lines that intersect at 17.4 miles. Prehospital time of either ground or air transport from that distance was equal.

Previous studies have shown that morbidity and mortality of major trauma patients is improved by rapid transport to trauma centers. Based on this study, prehospital personnel should consider activating aeromedical systems early in transporting trauma patients from locations greater than 17.4 miles from a trauma center, or those with prolonged extrications or poor surface road conditions.

31) Urban Trauma Scene Flights: Paramedic's Estimation of Transport Time

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Multonomah County Emergency Medical Services
Portland, Ore.

Guidelines for the use of aeromedical services (AMS) in urban trauma scene responses are not well-established. Potential disadvantages of urban Trauma Scene Flights (TSF) include delay in transport, increased cost, risk of injury, and unavailability for the service for trauma transfers. Protocols for our urban area allow for helicopter transport of injured patients whenever estimated ground transport time (GTT) exceeds estimated helicopter transport time (HTT) by 10 minutes. The AMS is staffed by a nurse/paramedic team with standing orders similar to those of ground personnel.

To assess this protocol, 52 consecutive TSF over a four month period were reviewed. The paramedic's upper and lower estimates of GTT were compared to the actual HTT calculated from helicopter dispatch to arrival at the trauma center. Additional variables assessed included Trauma Score (TS), Glasgow Coma Score (GCS), and extrication difficulties.

The mean HTT for all 52 patients was 24.2 ± 10 minutes. The HTT exceeded the lower estimate for GTT in 44 cases (85%) by a mean of 7.1 ± 9,6 minutes. Using the higher estimates, HTT exceeded GTT in 35 cases (67%) by a mean of 5.0 ± 9,8 minutes. Using either estimate, only two patients had their estimated travel time shortened 10 or more minutes by the AMS.

If the 36 (69%) patients with difficult extrication, GCS <13 and TS <13, are excluded, the remaining 16 patients (31%) had a mean HTT of 24.7 ± 6.1 minutes. None of these had their estimated travel time shortened by 10 or more minutes. Since paramedics appear to overestimate the travel time saved, more objective criteria based on patient need should be used to guide urban TSF.

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32) Retention of Basic Life Support Skills

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Riverside Methodist Hospital
Emergency Medical Services Technology, Department of Allied Health, Columbus State Community College
SKYMED Hospital Helicopter Consortium
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Expeditious prehospital care has been identified as one factor which can lead to reduced trauma morbidlty and mortality. The Basic Trauma Life Support (BTLS) Course is a 16 hour didactic and practical skills course that has been developed to improve prehospital care of the trauma victim. The current recommendation for BTLS provider recertification is three years, although there have been no studies documenting retention of the course material. Similar studies for retention of Advanced Cardiac Life Support skills have shown that didactic and practical skills decline within six months of initial training. The purpose of the current study was to measure retention of the BTLS skills.

In October and November of 1987, 124 paramedics were trained ln BTLS. Fourteen to 18 months later, thirteen individuals were selected for retesting in both the written and practical skills without prior notification. Paramedics were tested using the identical written course post-test. Practical skills were examined using the same moulaged trauma scenario with which the paramedics were tested originally and graded using a standard instrument. In 10 of the 13 paramedics tested, the same examiners were used. The difference in the means (results after course and 14–16 months later) were evaluated using a paired Student t-test with significance considered at $p < 0.05$.

The mean value on the written test immediately after the BTLS course for the 13 paramedics tested was 93.0±6.6 percent (mean ± standard deviation}. This compares to a mean score of 94.0 ± 4.8 for all 124 paramedics. For the practical test, their mean was 71.6 ± 10.4 percent. For the entire group of paramedics, the mean practical score was 89.9 ± 15.8 ($p > O.O5$). Fourteen to 18 months later, the mean for these subjects on the written test was 64.9 ± 11.8 percent ($p < .001$). Their mean for the practical test was 81.8 ± 18.2 ($p < .08$}.

The results of this study suggest that within 18 months of presentation of the BTLS course, there is significant loss of the course content. The didactic material appears to be less well retained than the practical skills. More frequent trauma education and skills practice for paramedics may be necessary to retain the BTLS course material.

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