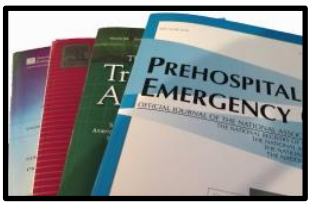
International Prehospital Medicine Institute



IPHMI EMS Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

Vol. 5.3

1. **Weighty Matters: A Real-World Comparison of the Handtevy and Broselow Methods of Prehospital Weight Estimation.** Knudsen-Robbins C, Pham PK, Zaky K, et al. *Prehosp Disaster Med.* 2022;37(5):616–624.
2. **Impact of Ambient Temperature on 5 Emergency Drugs Aboard an Emergency Medical Car Over a 1-Year Period.** Welter C, Roschel K, Schneider S, Marson C, Stammet P. *Ann Emerg Med* 2022;80:358-363.
3. **Predictive accuracy of adding shock index to the American College of Surgeons' minimum criteria for full trauma team activation**. McCormick T, Haukoos J, Hopkins E, et al. *Acad Emerg Med.* 2022;29:561-571.
4. **Prehospital Airway Management: A Systematic Review.** Carney N, Totten AM, Cheney T, et al. *Prehosp Emerg Care* 2022;26:716-727. Full text available at: https://doi.org/10.1080/10903127.2021.1940400

1. **Weighty Matters: A Real-World Comparison of the Handtevy and Broselow Methods of Prehospital Weight Estimation.** Knudsen-Robbins C, Pham PK, Zaky K, et al. *Prehosp Disaster Med.* 2022;37(5):616–624.

Critical pediatric encounters in the prehospital environment are not frequent and often promote a heightened level of stress among the responders. Medications administered to pediatric patients, while usually the same as those given to adults, most often require weight-based dosing, thus requiring prehospital providers to obtain or estimate the child's weight. Currently there is no reliable and readily available scale for use in the prehospital environment. This has led to the use of alternative methods for estimating the weight of the child. The best known, given the length of time it has been available, is the Broselow tape method. Recently the Handtevy method has gained popularity. The Broselow system uses a length-based formula, while the Handtevy uses an age-based system with a length-based backup.

The authors of this study compared the weight estimation of these two methods to the actual weight of children. This was a retrospective chart review that looked at pediatric patients under the age of thirteen (13) years that were transported by EMS to the emergency department (ED) of a designated children's hospital between January 2021 and June 2021. Exclusion criteria included patients with cerebral palsy and contractures, interfacility transports, patients for whom ED weights were not obtained, and patients whose charts contained incomplete study data. The estimated weight of the patient documented by the prehospital care providers was compared to the actual weight obtained on a scale in the ED. The authors used a plus/or minus ten percent (10%) range for the prehospital estimate as within acceptable criteria.

During the six-month study period 509 patients were included. The prehospital providers using the Broselow method obtained the 10% criteria in 51.3% of the patients. Providers using the Handtevy method obtained the 10% criteria 43.7% of the time. Both systems demonstrated an overall under

estimation of the child's weight in the 6-7% range. There was no statistical difference between the two systems in regard to weight estimation within the study group.

An important limitation of this study is that it is unclear if either system was applied correctly by the EMS providers, only that the system was used, and a weight estimation was recorded.

Calculating the dose and administering weight-based medication to children is always difficult. This is especially challenging in the prehospital environment where accurate weight determination by use of a scale is unavailable in most cases. While the study concluded that both systems were statistically the same in their determination of weight, what is concerning is that both systems accurately predicted the patient's weight only forty to fifty percent of the time and usually underestimated it. This study does not address how either system could be improved to better estimate the pediatric patient's weight. It would have been interesting if the study had included asking the parent what the child's weight was (since parents often know their child's actual or approximate weight) and comparing that to both estimated weights as well as the actual weight as determined by the ED.

2. **Impact of Ambient Temperature on 5 Emergency Drugs Aboard an Emergency Medical Car Over a 1-Year Period.** Welter C, Roschel K, Schneider S, Marson C, Stammet P. *Ann Emerg Med* 2022;80:358-363.

Emergency medications used by EMS personnel are typically stored within EMS vehicles that are exposed to extremes of temperature. Additionally, those medications are often taken out of the vehicle for extended periods of time and potentially left outside as providers care for patients where they find them. As a result, emergency medications are exposed to wide temperature variations that often exceed the drug manufacturers' recommendations.

The authors of this paper tracked the temperature range of medications in a specific emergency vehicle and over its active time intervals. One EMS vehicle from the National Fire and Rescue Corps of Luxembourg was chosen for this study. The medications chosen for the study were amiodarone, rocuronium, fentanyl, succinylcholine, and epinephrine, all "emergency" medications associated with resuscitation and airway control. The vials or ampoules of medications all came from the same manufacturing lot. Luxembourg has a moderate climate with average temperature ranges from 1 to 21.2 degrees Celsius (33.8 to 70.2 degrees Fahrenheit).

Two control batches of medications were assembled. Control group 1 was stored for 12 months on the shelf of the pharmacy with an ambient temperature of 20 degrees Celsius (68 degrees Fahrenheit), plus or minus 5 degrees. Control group 2 was stored for the same time in a central pharmacy refrigerator at 5 degrees Celsius (41 degrees Fahrenheit), plus or minus 3 degrees. Four test groups of medications were also assembled and stored within a standard EMS bag in the EMS vehicle; these medications were not used for patient care. That EMS vehicle was in service for 365 days between 06:00 and 22:00 each day. It responded to 1,900 calls for medical assistance. The stability of the study medications was then compared to the control specimens, stored in a temperature regulated environment in compliance with the pharmaceutical company's temperature guidelines.

The temperatures of both control groups and the study groups were monitored via temperature loggers. An additional batch of the same medications were analyzed for efficacy on day zero of the study via high-pressure liquid chromatography coupled with ultraviolet detection. One batch of the study group medications were removed every three months and analyzed via the same process and equipment used on the day zero control batch.

The exposed temperature range within the EMS vehicle medication bag was 13.9 degrees Celsius (57 degrees Fahrenheit) to 33.9 degrees Celsius (93 degrees Fahrenheit). The succinylcholine (a manufacturer recommended refrigerated medication) degraded to 89% efficacy after 12 months in the EMS vehicle. The remaining four medications-maintained greater than 90% efficacy (the minimum

acceptable potency for clinical efficacy) over the same time interval with most having > 95% efficacy. As might be anticipated, degradation was less in the two control groups compared to medications in the EMS vehicle.

The authors concluded that these five medications remained clinically effective for 12 months while being stored in an EMS response vehicle. There are a number of limitations to this study. Luxembourg is described as having a moderate climate which is not the case for many EMS agencies that are exposed to greater extremes of temperature. They only looked at a select five emergency medications, not all the medications frequently carried by EMS agencies. In addition, medications from different pharmaceutical companies may respond differently to fluctuations in temperature. Lastly, there was no mention of the study medications leaving the EMS vehicle. It is possible that exposure to temperatures outside of the vehicle could yield different results.

For these five medications, efficacy remained stable after one year out of the controlled environment of a pharmacy. While EMS agencies should attempt to store medications within manufacturer recommended guidelines, they can be reassured that most medications will retain adequate efficacy while being stored in the EMS vehicle. Temperature loggers within medication storage areas in EMS entry bags may also help to identify extremes of temperatures and medications at risk.

3. **Predictive accuracy of adding shock index to the American College of Surgeons' minimum criteria for full trauma team activation**. McCormick T, Haukoos J, Hopkins E, et al. *Acad Emerg Med.* 2022;29:561-571.

Predicting which trauma patients will benefit from preferential transport to a trauma center and trauma team activation remains a challenge for physicians and medics. The American College of Surgeons Committee on Trauma (ACS-COT) field triage guidelines establish criteria based on anatomic and physiologic criteria, as well as mechanism of injury and special patient populations such as geriatric, pediatric, and burn patients. The criteria for full trauma team activation (rapid trauma surgeon response) include six criteria based on the anatomic and physiologic parameters (ACS-6). The ACS-6 criteria for full trauma team activation include: hypotension (SBP ≤ 90 mm Hg), intubation or respirator compromise, penetrating trauma to the torso, Glasgow Coma Scale (GCS) < 9, interhospital transfer requiring blood transfusion, and physician discretion.

The goal of the ACS-COT guidelines is to optimize overtriage and undertriage to the trauma center. Overtriage is defined as patients who are transported to the trauma center who do not meet criteria and could be managed at a non-trauma center. Overtriage burdens the trauma center with unnecessary patients. The ACS-COT accepts a 35% overtriage rate, so they clearly prefer that patients be transported to a trauma center if there is any doubt. Undertriage is the opposite. Undertriage is defined as transport of a trauma patient to a non-trauma center when their injuries dictate that they should be at a trauma center. Undertriage risks the life of the patient as severely injured patients may not be properly treated in a rapid manner, especially those with severe hemorrhage requiring urgent operative intervention. The ACS-COT accepts an undertriage rate of only 5%.

Shock index (SI) is defined as heart rate (HR) divided by systolic blood pressure (SBP). A SI ≤ 1 is predictive of hemorrhagic shock (i.e., any time the HR is greater than SBP one should have an increased index of suspicion for severe hemorrhage). Researchers have suggested SI could be a predictor of necessity for transport to a trauma center. The goal of this study was to use prehospital SI with the ACS-6 criteria to identify severely injured patients and the need for surgical intervention in adult trauma patients. The authors hypothesized that the addition of SI to the ACS-6 increased the accuracy of the predictive value of the triage criteria. This is a retrospective study conducted at Denver Health, a regional Level 1 trauma center. All patients entered into the trauma registry over the age of 15 were

included. The study period was 1993-2006. Various thresholds of SI were calculated, including ≥ 0.8, ≥ 0.85, ≥ 0.9, and ≥ 1. The primary outcome of the study was emergency operative or procedural intervention (EOPI). Early operative intervention (EOI) was defined as the patient undergoing emergency surgery by the trauma surgeon within 1 hour of arrival to the trauma center. Emergency procedural intervention (EPI) included cricothyroidotomy, thoracotomy, or cesarean section in the emergency department. Secondary outcomes measured were Injury Severity Score (ISS) > 15, a combination of ISS > 15 and EOPI, and urgent operative intervention within 4 hours of arrival.

A total of 20,872 patients met inclusion criteria. Of these, 27% had an ISS > 15 (a marker of moderate injury) and 23% met at least one of the six ACS criteria. Of all patients, 5% underwent EOPI, 4% underwent EOI, 2% EPI, and 0.8% both. The vast majority of patients undergoing EPI received a thoracotomy in the emergency department, while 15% underwent cricothyrotomy and 0.2% a cesarean section. There was a significant difference in SI between those who underwent EOPI and those who did not (0.74 vs 1.0), patients with an ISS > 15 vs ≤ 15 (0.74 vs 0.78) and patients with an ISS > 24 vs those ≤ 24 (0.74 vs 0.83). Sensitivity and specificity of the ACS-6 alone for EOPI was 86% and 81% respectively. Adding SI thresholds of 0.8 to 1.0 increased this accuracy for prediction of EOPI to over 90%.

Limitations of this study include its retrospective nature, as well as the inherent weakness associated with utilization of a large database. If prehospital vital signs weren't documented, then the authors used the first set of vital signs measured in the emergency department as a proxy (this occurred in ~ 30% of patients). The authors used cricothyrotomy as an emergency procedure, yet performance of this procedure is not related to hemorrhagic shock and is not relevant in this situation.

This is an interesting study recognizing the predictive value of prehospital SI for trauma team activation and future EOPI after arrival to the trauma center. The new ACS-COT guidelines recognize this and utilize the basic SI of ≤ 1 (HR > SBP) as a possible indicator of trauma team activation.

4. **Prehospital Airway Management: A Systematic Review.** Carney N, Totten AM, Cheney T, et al. *Prehosp Emerg Care* 2022;26:716-727. Full text available at: https://doi.org/10.1080/10903127.2021.1940400

Airway management has long been an important intervention when treating critically ill or injured patients in the prehospital setting. Several techniques are commonly utilized in the field including the Bag-Masks (BM) device, supraglottic airways (SGA) and endotracheal intubation (ETI). The reported benefits and risks of each of these methods vary widely in the medical literature.

The authors conducted a systematic review of the literature comparing the three interventions in patients with cardiac arrest, medical emergencies, and trauma. To identify published papers, Ovid, MEDLINE, CINAHL, the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews and Scopus online databases were searched for papers published from 1990 to September 2020.

The authors reviewed 9,284 abstracts and 772 full-text articles. They included 99 studies involving 630,397 patients. which appeared in 101 publications. Twenty-two of these studies were randomized controlled studies, 20 were prospective, and 50 were retrospective studies. Most of the included studies were from the United States and Canada followed by Europe and then Asia. Most of these studies consisted of adults and patients in cardiac arrest with care most often provided by ETI-capable or mixed EMS personnel levels.

There were few differences in primary outcomes between BVM, SGA and ETI. Findings included:

- There was no difference in survival in hospital or at 1 month between the three approaches in adult/mixed age and pediatric cardiac arrest patients and no difference in comparing BVM and ETI in trauma patients.

- There was no difference in ROSC overall when they compared BVM with SGA or ETI. When SGA was compared to ETI in cardiac arrest patients the results favored SGA. They found no difference between the three approaches in pediatric cardiac arrest patients.
- When they compared successful placement between SGA and ETI, they found that first pass success favored SGA in adult cardiac arrest patients with no difference in pediatric cardiac arrest patients. Overall, there was no difference in airway insertion success in cardiac arrest, medical emergencies or mixed emergency types.
- In looking at neurological function, they found that outcomes favored BVM vs SGA in cardiac arrest patients. When BVM was compared to ETI in cardiac arrest victims, there was no difference in neurologic outcomes. When ETI was compared with BVM or SGA in pediatric cardiac arrest patients, there was no difference in outcomes.

This study has a number of limitations. Resuscitation time bias, referring to interventions that are applied at varying time points with those applied later being less effective, could affect the reported results. More than one airway is often used in a progression through different approaches which also may affect outcomes. The authors noted that the available data was weak with most of it coming from observational studies.

The authors concluded that in their analysis, "the available evidence does not indicate benefits of more invasive airway approaches based on survival, neurological function, ROSC, or successful airway insertion." This review supports other studies that have shown that ETI is not superior to other less invasive methods of airway management and that patient outcome appears similar regardless of method of airway intervention.