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WHITE PAPER			
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SUMMARY

In May of 2019, Spaite et al published the [Excellence in Prehospital Injury Care \(EPIC\) study](#)¹ in the Journal of the American Medical Association (JAMA) Surgery. This publication summarized an eight year (2007-2015) state-wide effort (over 130 EMS agencies) across Arizona to implement a new Traumatic Brain Injury Protocol. The EMS physicians compared 15,228 traumatic brain injury (TBI) patients before the new protocol was activated to 6,624 post implementation TBI patients. Over the eight years of the study, a total of 21,852 patients were evaluated.

The researchers found their protocol *doubled*² the survival rate of severe TBI patients and *tripled*³ the survival rate of the most critically ill TBI patients (those requiring intubation). The MDPB aims to duplicate these impressive results by adopting Arizona’s protocol in the 2021 Maine EMS Protocols.

WHAT DID THEY DO DIFFERENTLY?

¹ Spaite DW, Bobrow BJ, Keim SM, et al. Association of statewide implementation of the prehospital traumatic brain injury treatment guidelines with patient survival following traumatic brain injury: The Excellence in Prehospital Injury Care (EPIC) study: The excellence in prehospital injury care (EPIC) study. JAMA Surg. 2019;154(7):e1911152

² Among the patients with severe TBI [70% (15,147/21,681) of the entire study population and 76% (4970/6581) of the post-implementation cohort], adjusted survival to hospital discharge *doubled* statewide after implementation [adjusted odds ratio = 2.03 (1.52-2.72; p<0.0001)]

³ Among the severe patients who were intubated, adjusted survival *tripled* [aOR = 3.14 (1.65-5.98; p=0.0005)]

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The EPIC protocol focuses on 3 simple interventions:

1. Prevention and treatment of hypoxia
2. Prevention and avoidance of hyperventilation
3. Addressing and treatment of hypotension.

Dr. Spaite refers to this care bundle as “avoiding the three H-Bombs.”

This is the first major prehospital study to evaluate the impact of prehospital TBI guidelines. Rarely do we find high quality studies targeted to our specialty of medicine that show such dramatic opportunity to increase survivability with such simple interventions.

WHAT DOES MY EMS SERVICE NEED TO DO TO ACHIEVE THESE SAME RESULTS?

Train. Then *re-train*. Although these interventions are technically simple, it is critical that each key step is accomplished. Attention to detail, and a commitment to maintaining consistent vigilance is key to mimicking Arizona’s success. The EPIC group found that re-training after initial introduction to this new protocol was key to success.

WHAT DO I NEED TO DO TO SAVE THE LIVES OF MY TBI PATIENTS?

Understand the new protocol and commit to adhering exactly to each step. *All* of the detailed actions must be achieved to match the success of the EPIC protocol. This is an all-or-nothing effort.

Dr. Dan Spaite: “In the last 40 years, essentially all of the treatments that have been studied in the emergency care of TBI have been negative: there’s a graveyard full of promising drugs and treatments that when finally tested led to no improvement (e.g., steroids, progesterone, cooling, etc.). EPIC’s implementation of the Guidelines has broken a really long losing streak-- it’s a major breakthrough after nearly half a century of attempting to find ways to improve TBI outcome”

WHAT PATIENTS FIT INTO THIS PROTOCOL?

Any trauma patient who has suffered a mechanism that could have induced a brain injury AND:

- Loss of consciousness, decreased level of consciousness, decreased responsiveness, or any deterioration of mental status
- OR
- Any multisystem trauma requiring BVM (or advanced airway/ventilation)
- OR
- Any post-traumatic seizures

HOW OFTEN SHOULD VITAL SIGNS BE RE-EVALUATED AND RE-CHECKED?

Every 3 to 5 minutes.

Why so often? It is important to find even subtle changes in vital signs (decreasing blood pressure or SPO2) as early as possible to intervene and avoid any hypotension or hypoxia before it occurs.

HOW IS AIRWAY/OXYGENATION BEST MANAGED?

Place continuous high-flow O2 via non-rebreather mask on *all* potential TBI cases. The key take away is preventing potential hypoxia in these patients. A *single* oxygen saturation less than 90% is independently associated with at least a *doubling* of mortality⁴.

WHAT IS THE TARGET VENTILATION RATE?

Age 0-2 years:	1 breath every 2-3 seconds
Age 2-14 years:	1 breath every 3 seconds
Age 15+:	1 breath every 6 seconds

WHY IS HYPERVENTILATION SO IMPORTANT TO AVOID?

Hyperventilation is independently associated with at least a doubling of mortality⁵. Some studies have shown that even moderate hyperventilation can increase the risk of dying by six times. Evidence has shown repeatedly that inadvertent hyperventilation occurs if not meticulously prevented by using adjuncts to assist deterrence, no matter the experience of the EMS Clinician.

WHY IS MDPB RECOMMENDING (BUT NOT REQUIRING) ADJUNCTS TO ASSIST WITH AVOIDING HYPERVENTILATION?

First, the MDPB believes it is very difficult to avoid hyperventilation when delivering breaths via a BVM to critically ill patients. Adjuncts serve as reminders of the target ventilation rate and help protect your patient from inadvertently giving too much volume of air and too many breaths in a minute. The two adjuncts used in the EPIC study were:

- Pressure-Controlled Bags (AKA Smart bags)
- Ventilation Rate Timers (AKA ventilation timing lights)

Second, although the MDPB strongly believes these adjuncts are necessary to guide best practice TBI care, the MDPB is sensitive to mandating equipment that may be cost prohibitive for some EMS agencies. If financially feasible, the MDPB strongly recommends use of these adjuncts.

⁴ <https://epic.arizona.edu/system/files/files/EPICEMSTBIGuidelineNProtocolsADULTFINAL.pdf>

⁵ <https://epic.arizona.edu/system/files/files/EPICEMSTBIGuidelineNProtocolsADULTFINAL.pdf>

WHY DID THE MDPB REVERSE THE RECOMMENDATION TO HYPERVENTILATE PATIENTS WITH SUSPECTED HERNIATION?

Given EPIC's remarkable results of significantly increasing survival, the MDPB felt this change in practice (avoid hyperventilation at all cost, in all patients) was important enough to reverse prior TBI protocol recommendation introduced in the 2019 protocol update. The MDPB continuously reviews current literature to ensure Maine's EMS practice is in line with the most up to date evidence; occasionally the MDPB pivots and changes course in response.

WHAT IS THE GOAL BLOOD PRESSURE IN TBI PATIENTS?

It is essential to avoid hypotension. In pediatrics, the BP should be maintained *above* the 5th percentile for age and in adults, the blood pressure should be maintained above a systolic BP of 90 mmHg.

Hypotension by age:

Age 0-10: 70 mmHg + (age x 2)

Age > 10: 90 mmHg

Rules of thumb to remember regarding hypotension by age:

Infant: 70 mmHg

5-year-old: 80 mmHg

10 years and older: 90 mmHg

It is important to remember that a single episode of SBP <90 mmHg is independently associated with at least a doubling of mortality. Repeated episodes of hypotension can increase the risk of dying by as much as *eight* times⁶. If a multisystem trauma patient also has head injury, do not allow for permissive hypotension below an SBP of 90 mmHg, and do not wait for the patient to become hypotensive. If the SBP is dropping, or if there are any other signs of compensated shock, such as increasing heart rate with decreasing SBP, begin aggressive treatment before the patient becomes hypotensive.

The MPDB is excited to bring this protocol to Maine and hopes that implementation of these steps will result in benefits to TBI patients equivalent to those found in Arizona. The MDPB thanks the Maine EMS Trauma Advisory Committee, the Maine EMS Education Committee, Maine EMS Staff, the EMS Clinicians in Maine and all others who help disseminate and implement Maine EMS Protocols.

⁶ <https://epic.arizona.edu/system/files/files/EPICEMSTBIGuidelineNProtocolsADULTFINAL.pdf>