# Prehospital $ETCO_2$ is Predictive of Death in Intubated and Non-Intubated Patients

Courtney Wham, MS, NRP[1]; Theresa Morin, MA[2]; Angela Sauaia, MD, PhD[3]; Robert McIntyre, MD[4]; Shane Urban, BSN, CCRC[4]; Kevin McVaney, MD[1]; Mitchell Cohen, MD, FACS[4]; Alexis Cralley, MD[2]; Ernest E. Moore, MD[2]; Eric M. Campion, MD, FACS[2]*

[1]*Denver Health Medical Center, Department of Emergency Medicine, Denver Paramedics, United States*
[2]*Ernest E. Moore Shock Trauma Center at Denver Health, Department of Surgery, United States*
[3]*University of Colorado, School of Public Health (AS), United States*
[4]*University of Colorado Anschutz, Department of Surgery, United States*

**COMIRB #20-2688**

## Background

- Prehospital trauma triage is limited to basic vital signs and a physical assessment.
- Other advanced diagnostics are expensive and not common place on ambulances, such as ultrasound and point-of-care testing.
- $ETCO_2$ devices are universal on ambulances and routinely used.

## Methods

- Prospective, observational study with a large EMS system and two level one trauma centers
- Paramedics placed patients at risk for severe injury on either a nasal capnography cannula (NCC) or an $ETCO_2$ in-line ventilator circuit monitoring device (ILVC).
- Included any adult patient (≥15 years old) who sustained a primary injury with at least one prehospital $ETCO_2$ value.
- AUROCs were calculated for lowest prehospital $ETCO_2$ values, minimum prehospital systolic blood pressure (SBP), and highest prehospital shock index (SI).

## Hypothesis

Prehospital $ETCO_2$ values are predictive of mortality and massive transfusion in intubated (via ILVC) and non-intubated (via NCC) patients.

## Demographics

| ***Age*** | **Total (n=549)** |
|---|---|
| Nmiss | 4 (0.7) |
| Median (IQR) | 36.0 (27.0–52.0) |
| ***Gender*** | |
| Female | 130 (23.7) |
| Male | 419 (76.3) |
| ***ISS*** | |
| Nmiss | 197 (35.9) |
| Median (IQR) | 12.0 (5.0–22.0) |
| ***Massive Transfusion*** | |
| Yes | 30 (5.5) |
| No | 519 (94.5) |
| ***Mortality*** | |
| Yes | 54 (9.8) |
| No | 495 (90.2) |
| ***Mechanism*** | |
| Blunt | 412 (76.7) |
| Penetrating | 128 (23.3) |
| ***$ETCO_2$ Device*** | |
| ILVC | 61 (11.1) |
| NCC | 488 (88.9) |

## Results

### *Overall Cohort*

**Mortality**

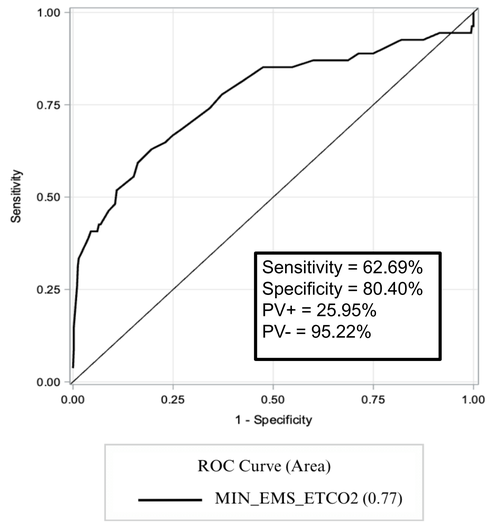


Figure 1 – $ETCO_2$ is a significant predictor of mortality (AUROC of 0.77; CI 0.53-0.78).

**Massive Transfusion**

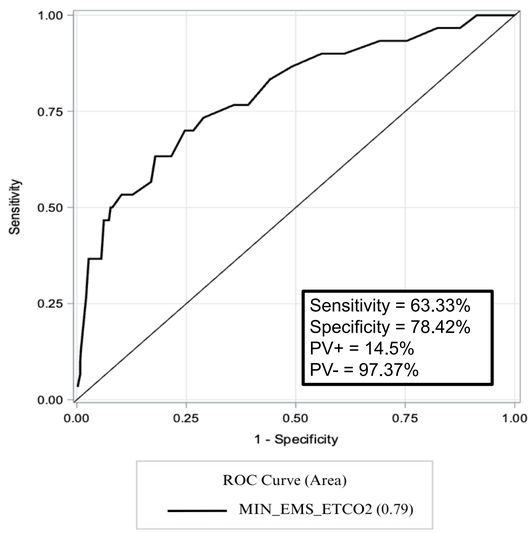


Figure 2 – $ETCO_2$ is a significant predictor of massive transfusion (AUROC of 0.79; CI 0.70-0.88).

### *Excluding Prehospital Cardiac Arrest*

**Mortality**

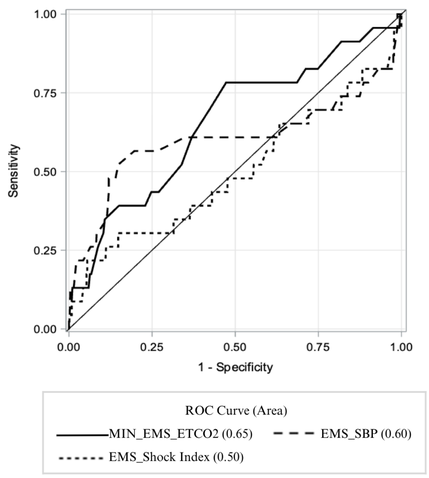


Figure 3 – Excluding prehospital cardiac arrest, $ETCO_2$ is the only predictor of mortality (AUROC of 0.65; CI 0.53-0.78. Youden Index = 22mmHg).

**Massive Transfusion**

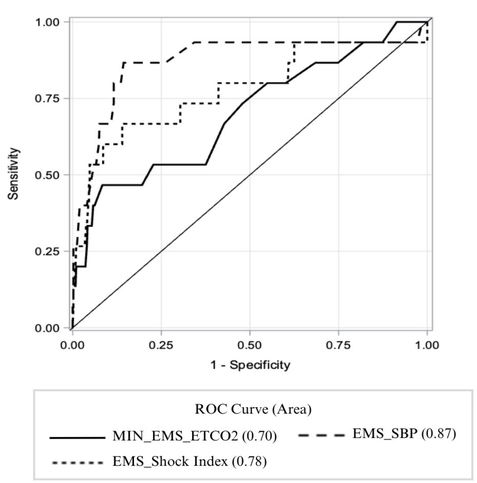


Figure 4 – Excluding prehospital cardiac arrest, $ETCO_2$ is a predictor of massive transfusion (AUROC of 0.70; CI 0.54-0.85, Youden Index = 22mmHg) but weaker than SBP and SI.

## Discussion and Conclusions

- Prior work has demonstrated that prehospital $ETCO_2$ in intubated patients predict mortality.
- $ETCO_2$ values in this population were obtained predominantly (89%) from non-intubated patients via NCC.
- Minimum prehospital $ETCO_2$ was a significant predictor of both mortality and massive transfusion in overall cohort.
- $ETCO_2$ was the only significant predictor of mortality in the cohort that excluded prehospital cardiac arrest but did not outperform SBP or SI to a level of statistical significance.
- **Prehospital $ETCO_2$ gives providers valuable insight into injury severity and shock in both intubated and non-intubated patients.**

## Future Directions

- These findings warrant further study in a multi-institutional trial with both urban and rural EMS systems.
- **May inform three major components of patient care and field trauma triage:**

EMS Transport Destination

Prehospital Interventions (TXA, Blood)

Hospital Resource Allocation

## Disclosures

- The authors do not have any conflicts of interests nor disclosures.

## Acknowledgements

- The Denver Health Paramedic Division EMTs and Paramedics
- This study was supported by a grant from the Pilot Study Grant Program through the Office of Research at Denver Health.

## References