Sepsis

EMS’ 4th Time Critical Event

Paul Zeeb, MD
Chair, Region IV Physician Advisory Board of EMS
If you have seen one EMS, you’ve seen one EMS system!
If you have seen one EMS, you’ve seen one EMS system!!

• 1,100+ EMS systems in Ohio
• Paid full-time, paid part-time, volunteer
• Fire Based, 3rd Service, Private Service (non-profit & for-profit)
• EMT vs. EMTA vs. Paramedic
• Different protocols & medical directors
• Ohio EMS Regional Physician Advisory Boards
Ohio EMS Scope of Practice

<table>
<thead>
<tr>
<th></th>
<th>EMT</th>
<th>AEMT</th>
<th>Paramedic</th>
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<tbody>
<tr>
<td>Pulse Ox/ET CO2</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Intubate</td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>IV &amp; IV Fluids</td>
<td></td>
<td>X</td>
<td>X</td>
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<td>Vasopressors</td>
<td></td>
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<td>X</td>
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<tr>
<td>Finger Stick BS</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Phlebotomy</td>
<td></td>
<td>X</td>
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<tr>
<td>IV Antibiotics</td>
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EMS Provider Authorization to Practice

• EMTs, EMT-As and Paramedics can only practice as authorized by their medical director
• Medical director cannot authorize practice outside scope of practice published by the Emergency Medical, Fire and Transportation Services (EMFTS) Board
• Providers are authorized to practice via written protocol approved by medical director
• Little “on-line” medical control for EMS providers
Sepsis – It’s not that simple

• STEMI – 12 lead ECG
• Trauma – Ohio Trauma Triage Criteria – legislated – patient meets criteria, go to trauma center
• Stoke – LAMS, FAST, MEND, Cincinnati, LASS, RACE – pick one
Sepsis – It’s not that simple & it’s deadly

In-hospital mortality

STEMI - <5%
Trauma - < 5%
Sepsis – 28-50%
Different Mind Set

How we think in the ED:
• Sepsis
• Severe Sepsis
• Septic Shock
It may take time to sort it out.

EMS Thinks:
Sick/Not Sick
No stay & play
Pre-Hospital Screening

Is there a suitable pre-hospital screening tool?
What is a suitable level of sensitivity, specificity, positive predictive value and negative predictive value?
Pre-Hospital Screening Tool

What are the necessary elements of a pre-hospital sepsis screening tool?

1. Suitable for all levels of knowledge/training (EMT, AEMT, Paramedic)
2. Criteria must be measurable in the field.
3. Within scope of practice.
4. Suitable sensitivity and positive predictive value (avoid sepsis-alert fatigue)
5. Linked with actions/treatment to be initiated by pre-hospital providers.
16.3% sensitivity with 97.3% specificity for patients with confirmed severe sepsis, septic shock in ED.

Dorsett, M et. al.
Prehospital Emergency Care Early Online:1-9
### Identification of adults with sepsis in the prehospital environment: a systematic review

Michael A Smyth, 1,2,3 Samantha J Brace-McDonnell, 1,4 Gavin D Perkins 1,4

<table>
<thead>
<tr>
<th>Author</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
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<tbody>
<tr>
<td>Seymour (CIS)</td>
<td>0.76 (95% CI 0.75 to 0.77)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Not reported</td>
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<tr>
<td>Polito (PRESS)</td>
<td>0.85 (95% CI not reported)</td>
<td>0.47 (95% CI not reported)</td>
<td>0.19 (95% CI not reported)</td>
<td>0.96 (95% CI not reported)</td>
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<tr>
<td>Bayer (PRESEP)</td>
<td>0.85 (95% CI 0.77 to 0.92)</td>
<td>0.86 (95% CI 0.82 to 0.90)</td>
<td>0.63 (95% CI not reported)</td>
<td>0.95 (95% CI not reported)</td>
</tr>
<tr>
<td>McClelland (sepsis) (modified Robson tool)</td>
<td>0.43 (95% CI 0.28 to 0.58)</td>
<td>0.14 (95% CI 0 to 0.40)</td>
<td>Not reported</td>
<td>Not reported</td>
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<tr>
<td>McClelland (severe sepsis) (modified Robson tool)</td>
<td>0.30 (95% CI 0.12 to 0.47)</td>
<td>0.77 (95% CI 0.60 to 0.95)</td>
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<tr>
<td>Bayer (modified Robson tool)</td>
<td>0.95 (95% CI not reported)</td>
<td>0.43 (95% CI not reported)</td>
<td>0.32 (95% CI not reported)</td>
<td>0.97 (95% CI not reported)</td>
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<tr>
<td>Wallgren (sepsis) (Robson tool)</td>
<td>0.75 (95% CI not reported)</td>
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<td>Not reported</td>
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<tr>
<td>Wallgren (severe sepsis) (Robson tool)</td>
<td>0.93 (95% CI not reported)</td>
<td>Not reported</td>
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<td>Not reported</td>
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<tr>
<td>Bayer (BAS 90-30-90)</td>
<td>0.62 (95% CI not reported)</td>
<td>0.83 (95% CI not reported)</td>
<td>0.51 (95% CI not reported)</td>
<td>0.89 (95% CI not reported)</td>
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<tr>
<td>Wallgren (sepsis) (BAS 90-30-90)</td>
<td>0.73 (95% CI not reported)</td>
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<tr>
<td>Wallgren (severe sepsis) (BAS 90-30-90)</td>
<td>0.70 (95% CI not reported)</td>
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<td>Bayer (MEWS)</td>
<td>0.74 (95% CI not reported)</td>
<td>0.75 (95% CI not reported)</td>
<td>0.45 (95% CI not reported)</td>
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<tr>
<td>Guerra</td>
<td>0.48 (95% CI not reported)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Not reported</td>
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<tr>
<td>Erwin (sepsis)</td>
<td>0.33 (95% CI 0.18 to 0.53)</td>
<td>0.89 (95% CI 0.08 to 0.94)</td>
<td>0.50 (95% CI 0.28 to 0.72)</td>
<td>0.80 (95% CI 0.70 to 0.87)</td>
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<tr>
<td>Erwin (severe sepsis)</td>
<td>0.20 (95% CI 0.05 to 0.51)</td>
<td>0.94 (95% CI 0.87 to 0.97)</td>
<td>0.29 (95% CI 0.08 to 0.64)</td>
<td>0.91 (95% CI 0.83 to 0.95)</td>
</tr>
<tr>
<td>Shihu</td>
<td>0.75 (95% CI not reported)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Not reported</td>
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<tr>
<td>Travers</td>
<td>0.73 (95% CI 0.61 to 0.83)</td>
<td>0.79 (95% CI 0.75 to 0.82)</td>
<td>0.31 (95% CI 0.24 to 0.38)</td>
<td>0.96 (95% CI 0.94 to 0.98)</td>
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</table>

CIS, critical illness score; MEWS, Modified Early Warning Score; PRESEP, Prehospital Early Sepsis Detection.

BMJ Open 2016;6e011218
Early Identification

**BMJ Open**

**Identification of adults with sepsis in the prehospital environment: a systematic review**

Michael A Smyth,1,2,3 Samantha J Brace-McDonnell,1,4 Gavin D Perkins1,4

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**Strengths and limitations of this study**

- Despite using very broad search criteria, little robust evidence regarding prehospital sepsis screening was identified.
- The studies found employed disparate methodologies, exhibit significant heterogeneity, generally involve small numbers of patients (limiting the precision of reported results) and were invariably of very low quality.
- The conclusions that can be drawn from this systematic review are, therefore, limited and findings should be interpreted with caution.
Prehospital Screening Tool

American Journal of Emergency Medicine

Original Contribution

A prehospital screening tool utilizing end-tidal carbon dioxide predicts sepsis and severe sepsis

Christopher L. Hunter, MD, PhD a,b,*, Salvatore Silvestri, MD a,b, George Ralls, MD a, Amanda Stone, MD a, Ayanna Walker, MD a, Linda Papa, MD, MSc a,b

a Department of Emergency Medicine, Orlando Regional Medical Center, Orlando, FL
b University of Central Florida College of Medicine, Orlando, FL

ABSTRACT

Objective: To determine the utility of a prehospital sepsis screening protocol utilizing systemic inflammatory response syndrome (SIRS) criteria and end-tidal carbon dioxide (ETCO2).

Methods: We conducted a prospective cohort study among sepsis alerts activated by emergency medical services during a 12 month period after the initiation of a new sepsis screening protocol utilizing ≥2 SIRS criteria and ETCO2 levels of ≤25 mmHg in patients with suspected infection. The outcomes of those that met all criteria of the protocol were compared to those that did not. The main outcome was the diagnosis of sepsis and severe sepsis. Secondary outcomes included mortality and in-hospital lactate levels.

Results: Of 330 sepsis alerts activated, 183 met all protocol criteria and 147 did not. Sepsis alerts that followed the protocol were more frequently diagnosed with sepsis (78% vs 43%, P < .001) and severe sepsis (47% vs 7%, P < .001), and had a higher mortality (11% vs 5%, P = .036). Low ETCO2 levels were the strongest predictor of sepsis (area under the ROC curve (AUC) of 0.99, 95% CI 0.99-1.00, P < .001), severe sepsis (AUC 0.80, 95% CI 0.73-0.86, P < .001), and mortality (AUC 0.70, 95% CI 0.57-0.83; P = .005) among all prehospital variables. Sepsis alerts that followed the protocol had a sensitivity of 90% (95% CI 81-95%), a specificity of 58% (95% CI 52-65%), and a negative predictive value of 93% (95% CI 87-97%) for severe sepsis. There were significant associations between prehospital ETCO2 and serum bicarbonate levels (r = 0.415, P < .001), anion gap (r = -0.322, P < .001), and lactate (r = -0.394, P < .001).

Conclusion: A prehospital screening protocol utilizing SIRS criteria and ETCO2 predicts sepsis and severe sepsis, which could potentially decrease time to therapeutic intervention.

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EMS’ Capabilities
What can we do in the field to improve sepsis care?

Assessment
• History – High risk features
• Vital Signs
• Exam
• Capnography
• Fingerstick Blood Sugar
• ? Serum Lactate

Interventions
• Be suspicious
• IV Fluids (AEMT and Paramedic)
• Vasopressors
• Ask for help – “Sepsis Alert”
What have we done via COTS?

<table>
<thead>
<tr>
<th>EMS Agency Name</th>
<th>V</th>
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<tbody>
<tr>
<td>Patient Name</td>
<td></td>
</tr>
<tr>
<td>Date/Time</td>
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</table>

**PATIENT HISTORY**

- Known or Suspected Infection
- Recent Antibiotic Therapy
- Recent Medical/Surgical Procedure
- Recent Hospitalization
- Indwelling catheter
- History of Cancer
- Patient resident of LTC/rehab facility

If patient history is positive for any of the above, continue to “clinical criteria”

**CLINICAL CRITERIA**

- HR > 90
- RR > 20
- Temperature $\geq 100.4$ F or $\leq 96.8$ F

If patient meets 2 or more clinical criteria, AND ETC02 $\leq 25$mmHG, activate sepsis alert

**ED SEPSIS ALERT**

- Sepsis Alert to ED
- Time Sepsis Alert Activated ________

**THERAPEUTIC INTERVENTION**

- Establish Patient Airway/Intubate if necessary
- Administer 100% O2 at 15 liters per minute by non-re-breather mask (NRB), regardless of SpO2.
- Initiate at least one large bore IV of 0.9NS, and preferably two large bore, if time allows, without delaying transport
- Administer rapid infusion of normal saline fluid boluses, reassessing blood pressure, pulse and breath sounds with every 500 ml of fluid given to the patient. (If ↑ rales, D/C bolus and maintain IV KVO)
- Notify Receiving Hospital of Sepsis Alert (if applicable)

**PATIENT MONITORING**

- Vital signs, including temperature and pulse oximetry
- Apply Cardiac Monitor
- Transfer patient flat (if tolerated)
- Breath sounds
One Example
Where can we go from here?

- Sepsis follow up report – we do it for STEMI, trauma, and CVA. Why not sepsis?
- Prehospital blood cultures & antibiotics?
  - How long does transport time need to be to make this reasonable?
- Put norepinephrine back on trucks?
- Is there a role for pre-hospital lactates?
  - Who pays for it?
  - Is ETCO2 acceptable surrogate?
EMS Feedback

### SEPSIS ALERT FEEDBACK REPORT to EMS

<table>
<thead>
<tr>
<th>Date of Arrival</th>
<th>Day of Week</th>
<th>Time of Arrival</th>
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<tbody>
<tr>
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<td>Yesterday</td>
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**Mode of Arrival: EMS – Medic**

**PRESENTING SYMPTOMOLOGY**

**ED Care**

1. Door to Room Times
2. Door to Sepsis Alert Times
3. Door to Blood Draw Times
4. Door to Antibiotics Times
5. Sepsis Alert to Antibiotics Times
6. Door to Out of ED Times
7. Diagnosis
8. Treatment Decision
9. Amount of Fluids Given

**Discharge**

<table>
<thead>
<tr>
<th>Disposition</th>
<th>Home</th>
<th>MOCU</th>
<th>Inpatient Unit</th>
<th>Step-Down Unit</th>
<th>Hospice</th>
<th>Deceased</th>
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*For additional information, please email*

*This information is confidential per Ohio Revised Code Sec. 3305.25 and may not be shared, discussed or distributed outside of the quality process. If the reader of this communication is not an intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited.*
1,185 “Sepsis Alerts” - Two or more SIRS criteria
• One set of blood cultures + blood tube for lactate
• IV ceftriaxone for suspected pneumonia
• IV piperacillin/tazobactam for everything else
• PCN allergic – no ATB
• 4.96 BC contamination rate
• Antibiotics matched (+) BCs for 72% of patients
Sepsis Continuum of Care

- Partner with EMS on sepsis training for EMS providers.
- Is there an opportunity to assist EMS purchase needed equipment?
- Collaborate on common treatment plan:
  - EMS IDs at-risk patient.
  - Sepsis screen by EMS
  - EMS starts IV fluids
  - Sepsis alert prior to patient arrival – hospital mobilizes resources
  - Prompt handoff of care with continuation of prehospital care
  - Feedback to crew
    - Was patient truly septic
    - Time intervals
    - How did the patient do
    - Opportunities for care improvement
Potential Pitfalls

• Sepsis screening too complex.
• Sepsis screening tool exceeds EMS provider’s scope of practice.
• Sepsis screening tool has poor sensitivity or poor specificity.
• Request for sepsis alert not taken seriously by receiving ED. “Sepsis alert fatigue”
In Summary

• Pre-hospital sepsis care – “It’s not complicated, but it’s not easy!”
• If you’ve seen one EMS system, you’ve seen one EMS system.
• There is no perfect sepsis pre-hospital screening tool.
• Collaboration between EMS and the receiving hospital is essential.
Questions?