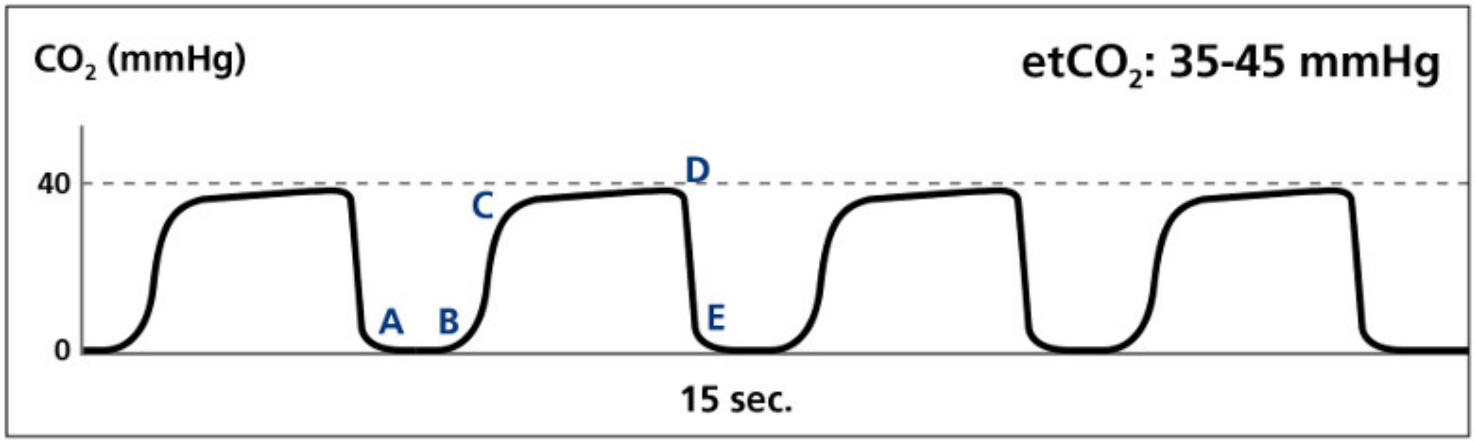
Capturing Captivating Capnography Capabilities

EtCO2 Uses Beyond Tube Placement

EMS State of the Science XXI
March 1, 2019

Normal Capnograph



By default capnography provides information on ventilation, perfusion and metabolism

Asthma and Capnography

- $EtCO_2$ less than 28 or greater than 50 associated with poor outcome (intubation, ICU admission, mortality)
- $EtCO_2$ did not distinguish mild from more severe disease in pediatrics

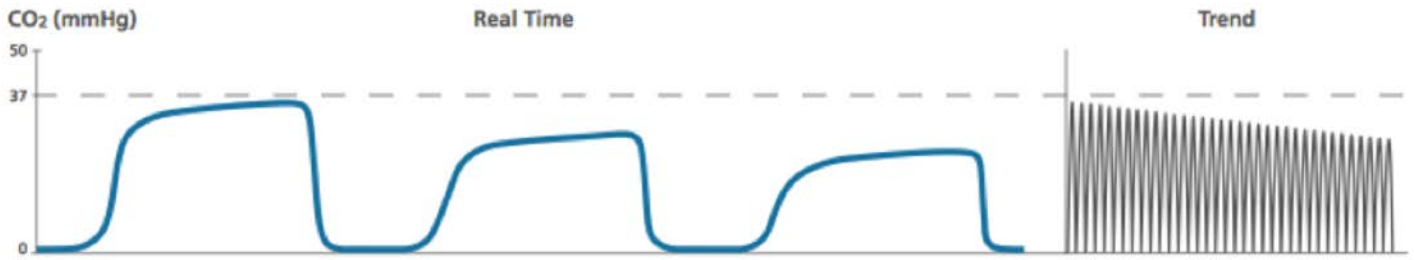
Nagurka R, Bechmann S, Gluckman W, Scott SR, Compton S, Lamba S. Utility of initial prehospital end-tidal carbon dioxide measurements to predict poor outcomes in adult asthmatic patients. Prehosp Emerg Care 2014;(18)2:180-184.

Cardiac Output and Capnography

- Increased cardiac output = increased $EtCO_2$
  - Return of spontaneous circulation
- Decreased cardiac output = decreased $EtCO_2$
  - Cardiac arrest
  - Massive pulmonary embolism
  - Hypovolemia

Pulmonary Embolism and Capnography

- PE decreases perfusion of a segment of the lung
  - Ventilation remains unchanged
- PE increases alveolar dead space
- Tachypnea decreases $EtCO_2$
- PE flattens the slope of phase III due to redistribution of blood flow



Capnography in Trauma

- $EtCO_2$, respiratory rate (RR), systolic BP (SBP), diastolic BP (DBP), pulse (P), and oxygen saturation (SpO_2) and hospital data.
- Cut-off value at 30 mmHg yielded sensitivity 89% (51-99), specificity 68% (59-76), PPV 13% (6-24) and NPV 99% (93-100) for predicting mortality.
- Improve triage and assisting EMS in directing patients to an appropriate trauma center.

Childress K, Arnold K, Hunter C, Rall G, Papa L, Silvestri S. Prehospital end-tidal carbon dioxide predicts mortality in trauma patients. Prehosp Emerg Care 2018;22(2):170-174.

Other Potential Uses

- Post-partum hemorrhage
- Gastrointestinal bleeding
- Ruptured ectopic pregnancy

- No studies have looked at these conditions in the prehospital setting

DKA and Capnography

- Adults
  - A blood glucose greater than 550 mg/dL and $EtCO_2$ of 28 mmHg or less good predictor
  - A blood glucose greater than 550 mg/dl and $EtCO_2$ greater than 35 mmHg can rule out DKA
- Pediatrics
  - $EtCO_2$ < 29 mmHg pretty good predictor
  - $EtCO_2$ > 36 mmHg can rule out DKA

Bou Chebl R, Madden B, Belsky J, Harmouche E, Yessayan L. Diagnostic value of end tidal capnography in patients with hyperglycemia in the emergency department. BMC Emerg Med. 2016 Jan 29;16:7.

Fearon DM, Steele DW. End-tidal carbon dioxide predicts the presence and severity of acidosis in children with diabetes. Acad Emerg Med. 2002;9(12):1373–8.

Sepsis and Capnography

- In sepsis, $EtCO_2$ demonstrates an inverse relationship with lactate level
- Hypoperfusion of the organs leads to an increase in serum lactate and lactic acidosis
- An $EtCO_2$ less than 25 mmHg is a strong marker for severe sepsis
- Was the strongest marker of all prehospital variables examined

Hunter CL, Silvestri S, Ralls G, et al. A prehospital screening tool utilizing end-tidal carbon dioxide predicts sepsis and severe sepsis. Am J Emerg Med. 2016;34(5):813–9.

Practical Applications

What are we really doing?

- Nasal capnography skeptics
- Eagles survey 18 months ago
  - Multiple different uses
  - A few themes

What are we really doing?

- Well-accepted applications
  - Confirmation of airway with waveform
  - Termination of resuscitation
- Monitoring sedation or overdoses
  - Need for ventilatory support
  - Need for airway support?
  - Hold medications

What are we really doing?

- Respiratory monitoring
  - Use of waveforms to guide treatment
  - Use of predictive numbers vs trending
  - CPAP challenges (washout, sample)
- Sepsis evaluation
  - Marker of perfusion

Magic numbers

- 10 ⇨ TOR
- 25 ⇨ Hypoperfusion, acidosis
- 50 ⇨ Hypoventilation (maybe)

- How do we change management?

Sepsis

- Limitations on vitals
- EtCO2 as a marker
- Earlier ED attention

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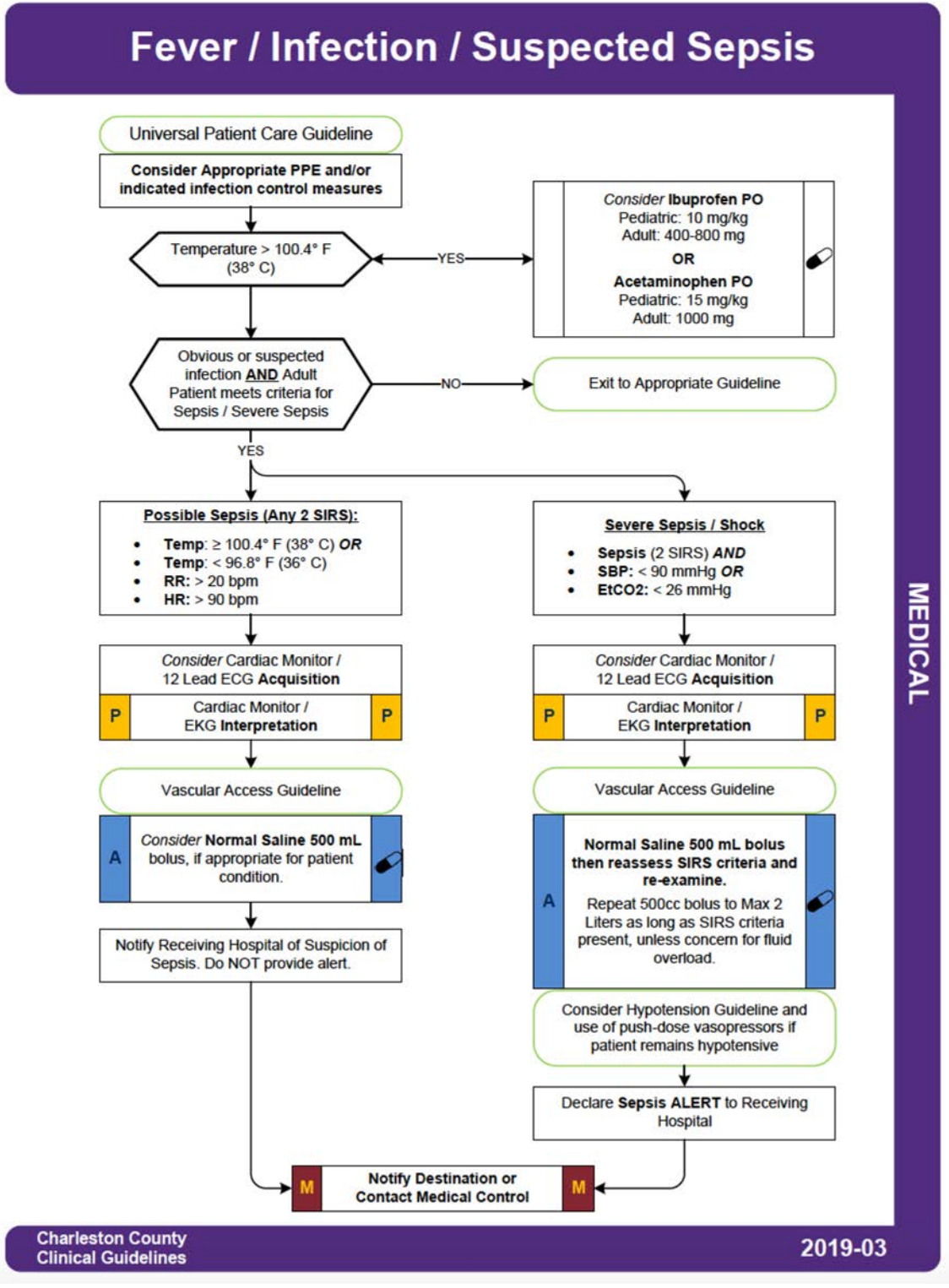
Fever / Infection / Suspected Sepsis
Universal Patient Care Guideline
Consider Appropriate PPE and/or indicated infection control measures
Temperature > 100.4° F (38° C)
YES
Consider Ibuprofen PO
Pediatric: 10 mg/kg
Adult: 400-800 mg
OR
Acetaminophen PO
Pediatric: 15 mg/kg
Adult: 1000 mg
Obvious or suspected infection AND Adult Patient meets criteria for Sepsis / Severe Sepsis
NO
Exit to Appropriate Guideline
YES
Possible Sepsis (Any 2 SIRS):
Temp: ≥ 100.4° F (38° C) OR
Temp: < 96.8° F (36° C)
RR: > 20 bpm
HR: > 90 bpm
Severe Sepsis / Shock
Sepsis (2 SIRS) AND
SBP: < 90 mmHg OR
EtCO2: < 26 mmHg
Consider Cardiac Monitor / 12 Lead ECG Acquisition
P
Cardiac Monitor / EKG Interpretation
P
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P
Cardiac Monitor / EKG Interpretation
P
Vascular Access Guideline
A
Consider Normal Saline 500 mL bolus, if appropriate for patient condition.
Notify Receiving Hospital of Suspicion of Sepsis. Do NOT provide alert.
Vascular Access Guideline
A
Normal Saline 500 mL bolus then reassess SIRS criteria and re-examine.
Repeat 500cc bolus to Max 2 Liters as long as SIRS criteria present, unless concern for fluid overload.
Consider Hypotension Guideline and use of push-dose vasopressors if patient remains hypotensive
Declare Sepsis ALERT to Receiving Hospital
M
Notify Destination or Contact Medical Control
M
MEDICAL
Charleston County Clinical Guidelines
2019-03

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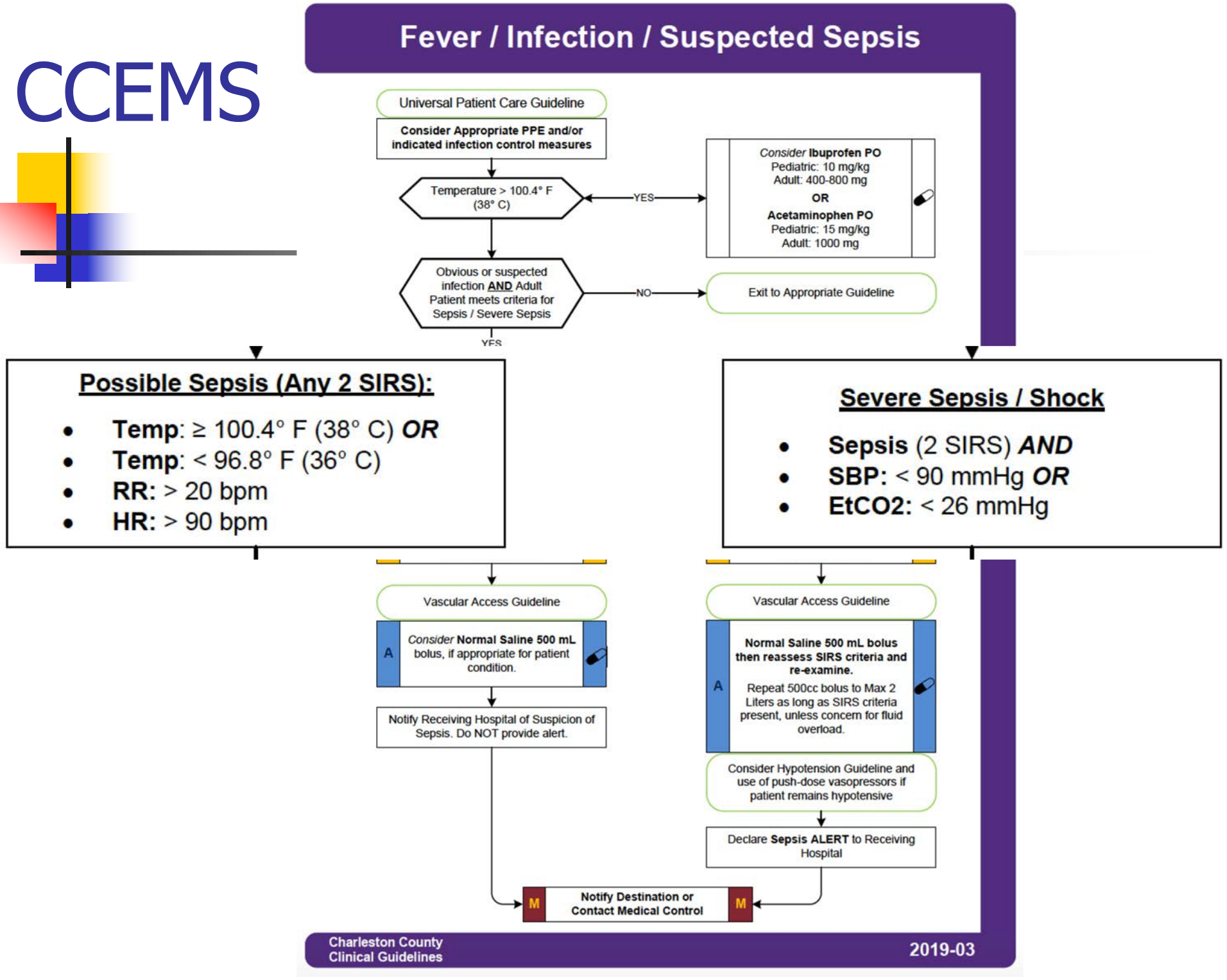
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DKA Case

- 59 yo F worsening AMS x 2 days
- GCS 13
- BG high
- ↓ HR & BP, ↑ RR
- EtCO2 11
- No hyperkalemia on ECG

DKA Case

- Little change w/ NS 600 mL
- Little change w/ PDP
- Any other options?

Closing Thoughts

- Capnography should become a standard vital sign
- Capnography has a place in patient assessment
- Place sick or potentially sick patients on capnography
- Do not wait for an advanced airway prior to using capnography
- Use capnography as a severity marker

Thank You

Questions?

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