Topics in Trauma Care

B. Dery MD
MCEMS
Goals:

1) Do **Scene Time** and **Total Prehospital Time** matter in trauma?; do they effect mortality in EMS trauma patients?

2) Does initiating an IV on-site, rather than **en route**, prolong Scene Time in EMS trauma patients?

3) Is initiating an IV on-site, rather than **en route**, associated with worse outcomes in EMS trauma?

4) What is permissive hypotension, and how does it relate to the above?

- Review of current literature regarding these issues.
- Review of MCEMS protocols and performance.
- Avoid putting you to sleep.
“The results of early studies evaluating regionalized trauma care systems demonstrated that the reduction of time between injury and definitive care, as well as treatment at a properly staffed and equipped trauma center, were important determinants in reducing trauma-related mortality.”

Sampalis et al, Journal of Trauma, 1993
The results of early studies evaluating regionalized trauma care systems demonstrated that the reduction of time between injury and definitive care, as well as treatment at a properly staffed and equipped trauma center, were important determinants in reducing trauma-related mortality.

Sampalis et al, Journal of Trauma, 1993
EMS Times in Trauma
Does Scene Time matter?


Design:

- Canadian study; urban setting (Montreal); EMS care by physicians.
- Of 8007 trauma patients, 360 were “selected” as being “severely injured”...
Take home points/Conclusions:

• Total pre-hospital time of >60 minutes was associated with increased odds of death. (OR 2.09)

• Use of ALS at scene was not associated with survival. (OR 5.17!!)

• Treatment at a Level I Trauma Center showed significant decreased odds of death

“The results of this study support the need for regionalization of trauma care, and fail to show a benefit associated with ALS care in severely injured trauma patients.”
Does Scene Time matter?


### Some Details:

<table>
<thead>
<tr>
<th></th>
<th>All 360</th>
<th>Died</th>
<th>Lived</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>7.6 min</td>
<td>7.5</td>
<td>7.7</td>
</tr>
<tr>
<td>Scene</td>
<td>20</td>
<td>21.2</td>
<td>19.8</td>
</tr>
<tr>
<td>Transport</td>
<td>7.7</td>
<td>7.8</td>
<td>7.6</td>
</tr>
<tr>
<td>Total</td>
<td>36.6</td>
<td>37.1</td>
<td>35.2</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Pre-Hospital</th>
<th>Number</th>
<th>Died</th>
<th>Lived</th>
</tr>
</thead>
<tbody>
<tr>
<td>All pts.</td>
<td>360</td>
<td>72 (20%)</td>
<td>288</td>
</tr>
<tr>
<td>&lt;60 min.</td>
<td>342</td>
<td>66 (19%)</td>
<td>276</td>
</tr>
<tr>
<td>&gt;60 min.</td>
<td>18</td>
<td>6 (33%)</td>
<td>12 (OR 2.09)</td>
</tr>
</tbody>
</table>
Does Scene Time matter?


**Design:**

- 5,215 patients, all with ISS >10
- Looked at: survival, scene time, transport time and total EMS time.
- 40% of cases excluded due to a missing time.
Take home points/Conclusions:

• “No prehospital time <90 minutes exerted a statistically significant adverse effect on survival.”

• Lower ISS was associated with increased EMS times. (EMS knows “sick” from “not sick”?)

• “Survival” was associated with longer times (and with lower ISS’s).
### Does Scene Time matter?

1995, Prehospital and Disaster Medicine, Petri et al: **“The Effect of Prehospital Transport Time on the Mortality from Traumatic Injury.”**

**Some Details:**

<table>
<thead>
<tr>
<th>ISS</th>
<th>N=3129</th>
<th>Scene time</th>
<th>Total time</th>
</tr>
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<tbody>
<tr>
<td>10-11 (low)</td>
<td></td>
<td>18.9</td>
<td>32.6</td>
</tr>
<tr>
<td>15-19</td>
<td></td>
<td>18.0</td>
<td>32.4</td>
</tr>
<tr>
<td>29+ (sick)</td>
<td></td>
<td>17.2</td>
<td>30.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N=3129</th>
<th>Scene time</th>
<th>Total time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alive</td>
<td></td>
<td>18.7</td>
<td>32.9</td>
</tr>
<tr>
<td>Dead</td>
<td></td>
<td>16.3</td>
<td>27.9</td>
</tr>
</tbody>
</table>
Design:

• Urban population; Portland OR; 1990; retrospective. N=848 “major trauma cases”.

• Looked at “unexpected survivors” and “unexpected deaths”

• Used TRISS method to predict who should have lived or died. (composite of trauma score, ISS, MOI, age)

• 13 unexpected survivors and 20 unexpected deaths; only 12 and 18 used in study due to missing times in 3 cases (≈10%).
Take home points/Conclusions:

• “Overall, the total EMS time interval was significantly shorter for “unexpected survivors” than for “unexpected deaths”. Why?

• Unfortunately they only compared the two unexpected groups to each other.
  - Comparing “expected survivors” to “unexpected deaths” would have been very instructive (initially appeared “not-sick” to EMS?).
  - Comparing “expected deaths” with “unexpected survivors” would have been interesting. (initially appeared “sick” to EMS?).

• “…a timely EMS response in an urban setting...may contribute to beneficial survival outcome.”
Does Scene Time matter?

1995, American Journal of Emergency Medicine, Feero et al:

“Does Out-of Hospital EMS Time Affect Trauma Survival.”

<table>
<thead>
<tr>
<th>Parameter</th>
<th>US’s</th>
<th>UD’s</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>29.5 yrs</td>
<td>50.8 yrs</td>
<td>.01 ←</td>
</tr>
<tr>
<td>Response time</td>
<td>3.5 min</td>
<td>5.9</td>
<td>.04 ←</td>
</tr>
<tr>
<td>Scene time</td>
<td>7.8</td>
<td>11.6</td>
<td>.06</td>
</tr>
<tr>
<td>Trans. Time</td>
<td>9.5</td>
<td>11.7</td>
<td>.17</td>
</tr>
<tr>
<td>Total EMS time</td>
<td>20.8</td>
<td>29.3</td>
<td>.02 ←</td>
</tr>
</tbody>
</table>
Does Scene Time matter?

**Brief Intermission- where are we now (circa 1995)?**

- **Theme:** this body of literature begins to demonstrate *shorter* EMS times for:
  - those who die, or who appear “sicker” to EMS;
  and *longer* times for:
  - those who survive, or who appear “not sick” to EMS.

- Even with good studies, it is hard to tease out which survivors lived because of efficient EMS times; or which or non-survivors died because of longer EMS times.

- **Theme:** this body of literature begins to demonstrate an adverse effect of ALS care/treatments on survival. Why?
Design:


- **Hypothesis**: “Fatality rates from rural vehicular trauma are almost double those found in urban settings”- is this related to “increased prehospital time” in rural settings.

- 45,000 MVC’s analyzed:
  - 34,000 “rural” (75%), and
  - 11,000 “urban” (25%).
Take home points/Conclusions:

• 714 total deaths:
  - 611 “rural” (1.8% of 34,000), vs.
  - 103 “urban (0.9% of 11,000)

• “Based on this statewide analysis of MVC’s, increased EMS prehospital time appears to be associated with higher mortality rates in rural settings.”

• Hard to know if these results generalize to exclusively urban MVC populations.
Does Scene Time matter?

2009, American Journal of Surgery, Gonzalez et al:

“Does Increased EMS Prehospital Time Affect patient Mortality in Rural MVC’s? A Statewide Analysis.”

<table>
<thead>
<tr>
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<th>Resp.T</th>
<th>Scene T</th>
<th>Trans T</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td><strong>Died:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>10.67</td>
<td></td>
<td>18.87</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.45</td>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>6.5</td>
<td>10.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14.14</td>
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<td></td>
</tr>
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<td><strong>Lived:</strong></td>
<td></td>
<td></td>
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<td>Rural</td>
<td>8.54</td>
<td>14.81</td>
<td></td>
<td>7.43</td>
</tr>
<tr>
<td></td>
<td>30.78</td>
<td></td>
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Does Scene Time matter?

2009, American Journal of Surgery, Gonzalez et al:

“Does Increased EMS Prehospital Time Affect patient Mortality in Rural MVC’s? A Statewide Analysis.”

Some (more) Details:

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<tr>
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Design:

- **Hypothesis:** “Evaluate the association between EMS intervals and mortality among trauma patients with field-based physiologic abnormality.”
  - SBP <90; RR <10 or >29; GCS <12; advanced airway

- 2005-2007; 10 urban sites, 146 EMS Agencies.
- 3,656 trauma patients analyzed, all 15 years or older.
- Looked at activation, response, on-scene, transport and total time.
Take home points/Conclusions:

• 806 total deaths (22%)

• “...there was no significant association between time and mortality for any EMS interval...among injured patients with physiologic abnormality in the field.”

• No surprises here: we know that “sick” patients tend to have shorter times and still do worse, with higher mortality than less “sick” trauma patients.
Some Details:

- When total EMS Time used to compare >60 minutes with <60 minutes, there was no association with mortality.
  - very few patients had Total Time >60 minutes.

- Median:
  - Response Times: 3.82- 5.44 minutes
  - Scene Times: 13.9-24.1 minutes
  - Total Times: 28.1-42.1
Does Scene Time matter?

Where are we now (circa 2010)?

- Appear “sick” to EMS: shorter EMS times, and tend to have worse outcomes.
- Appear “well” to EMS: longer EMS times, and tend to have better outcomes...
- Except: when “expected survivor” (well) turns out to be “unexpected death”- i. e. EMS vibe is wrong.
- “Unexpected Deaths” are difficult for EMS to identify on-scene- you will be wrong.
- Theme: EMS vibe is key determinant in scene times; and longer scene times in patients we most stand to be able to help have an adverse effect on mortality.
EMS IV’s in Trauma
260 IV attempts on adult trauma patients in Vermont. All attempts performed in moving ambulance. 81% enroute success rate. Average time to get functioning IV - 4.1 minutes.
1990, American Journal of Emergency Medicine, Slovis et al: “Success Rates for Initiation of Intravenous Therapy Enroute by Prehospital Care Providers.”

**Design:**

- 641 adult patients. Atlanta.
- Both medical and trauma patients.
- All IV starts performed in a moving ambulance.
Take home points/Conclusions:

• “These data suggest that IV lines can be secured with a high degree of success enroute to the hospital by trained personnel, and that prompt transport of unstable patients should not be delayed solely to obtain IV access.”
Some Details:

- At least 1 functioning IV in place prior to arrival:
  
  N=641

  **Medical Patients:**
  - All: 82% success
  - SBP <90: 80% success

  **Trauma Patients:**
  - All: 92% success
  - SBP <90: 95% success
1997, Journal of Trauma, Sampalis et al:
“Ineffectiveness of On-Site Intravenous Lines: is Prehospital Time the Culprit?”

Design:

• Observational study. Trauma patients. Quebec.
• 217 pts. with on-site IV and IVF.
• 217 pts. with no on-site IV or IVF.
• All patients “matched” by prehospital trauma index score. (I feel IV group was “sicker” overall).
• Outcome measured: mortality
IV on-scene or enroute?

1997, Journal of Trauma, Sampalis et al:
“Ineffectiveness of On-Site Intravenous Lines: is Prehospital Time the Culprit?”

Take home points/Conclusions:

• “For prehospital times of less than 30 minutes, the use of on-site IVF replacement provides no benefit, and for longer times, this intervention is associated with significant increase in the risk of mortality.”
1997, Journal of Trauma, Sampalis et al: "Ineffectiveness of On-Site Intravenous Lines: is Prehospital Time the Culprit?"

Some Details:

- **Stage I**: compared mortality between two groups

**IV Group**:
- Mortality: 23%

**No IV Group**:
- Mortality: 6%

**Odds Ratio for Death with IV**: 2.3
Some Details:

- **Stage II**: compared effect of pre-hospital time on the association between IV and mortality

**0-30 minute prehospital time:**
- **No IV**: OR of death 1.0  \( p=0.97 \)
- **IV**: OR of death 1.05

**31-60 minute prehospital time:**
- **No IV**: OR of death 1.0  \( p=0.08 \)
- **IV**: OR of death 3.38

**61-90 minute prehospital time:**
- **No IV**: OR of death 1.0  \( p=0.03 \)
- **IV**: OR of death 8.40
2008, Eastern Association for the Surgery of Trauma
“Practice Management Guidelines for Prehospital Fluid Resuscitation in the Injured Patient”

**Design:**

- Extensive literature review performed.

**Goal:** Answer 5 questions.
- Should IV be attempted in prehospital setting?
- If so, should IVF be given?
- others

**Strength of the Evidence:**
- **Level 1:** convincingly justifiable based on available literature
- **Level 2:** reasonably justified, supported by expert opinion
- **Level 3:** supported by available data, but evidence lacking
Q: Should prehospital access be obtained in EMS setting?

- **Level 1**: *(convincingly justifiable based on available literature)*
  
  No Level 1 recommendation can be made - insufficient data.

- **Level 2**: *(reasonably justified, supported by expert opinion)*
  
  Vascular access at scene of injury should not be performed - delays transport and evidence of benefit is lacking.

- **Level 3**: *(supported by available data, but evidence lacking)*
  
  Placement during transport is feasible and does not delay transport to definitive care.
Recommendations:

Q: If IV obtained, should IVF be given?

• **Level 1**: *(convincingly justifiable based on available literature)*
  
  No Level 1 recommendation can be made—insufficient data.

• **Level 2**: *(reasonably justified, supported by expert opinion)*
  
  a) IVF should be withheld in penetrating torso injuries.
  b) a saline-lock is equivalent to a continuous infusion.

• **Level 3**: *(supported by available data, but evidence lacking)*
  
  a) IVF should be withheld until active bleeding is controlled.
  b) 250cc at a time, titrate to palpable radial pulse, not SBP.
Permissive Hypotension Mini-Course

1) There is no evidence demonstrating a benefit to pre-hospital fluid resuscitation in trauma.

2) Nonetheless, considered standard of care.

3) There are several studies which argue that limiting the initial resuscitation volume:
   - leads to reduced internal hemorrhage,
   - lowers mortality

4) A target of 90mmHg (radial pulses) in 10 and older, and Age x 2 + 70 in <10 y/o, is right.

5) Small (or no!) fluid boluses to hit this target is right. Current literature suggests no more than 250cc’s per bolus.
Design:

- Rural trauma patients only. Alabama.

- One EMS Agency provided IV insertion data for a 1 year period- no IV’s done enroute in that year. 
  \( N= 306 \)

- Following year: study protocol initiated- all IV’s insertions attempted enroute. 
  \( N= 341 \)
Take home points/Conclusions:

• “EMS IV insertion enroute significantly decreases on-scene time and improves IV insertion success rates.”

• On-scene IV attempts occur “at significantly increased rates in the rural setting”.

• “The number of on-scene IV attempts per patient is greater in rural setting.”

• **Why success rates higher enroute:** lighting, arm positioning, supply availability.
### IV on-scene or enroute?

2011, American Journal of Surgery, Gonzalez et al.  
“Rural EMS Enroute IV Insertion Improves IV Insertion Success Rates and EMS Scene Times”

#### Some Details:

<table>
<thead>
<tr>
<th>Attempt Made</th>
<th>Success</th>
<th>Ave. Scene Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st attempt made</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-scene</td>
<td>84%</td>
<td>18.8 min.</td>
</tr>
<tr>
<td>Enroute</td>
<td>96%</td>
<td>14.0</td>
</tr>
<tr>
<td>2nd attempt made</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-scene</td>
<td>66%</td>
<td>21.6 min.</td>
</tr>
<tr>
<td>Enroute</td>
<td>82%</td>
<td>13.4</td>
</tr>
<tr>
<td>3rd attempt made</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-scene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enroute</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The ACS Committee on Trauma suggests IV access may be established enroute, and scene time should not be extended to start an IV.

The ACS suggests that “on-scene resuscitative measures be limited to:
- establish airway
- provide ventilation
- control hemorrhage
- stabilize fractures
- immobilize spine”

Paradox: Aggressive ALS care of trauma patient calls for- IV, IVF, intubation, bleeding control, spine control, medications as indicated.
Does Scene Time matter?

**The Paradox**

- Centers on the benefit of on-scene procedures vs. the delay they cause in definitive care to be provided at the trauma center.
- “Scoop and Run” vs. “Stay and Stabilize”
- Hard to know what the right answer is...
- When *on-scene* interventions/procedures are actually providing “definitive care” they are beneficial to mortality.
  - airway, ventilation/chest, needle, bleeding, spine, fx’s?
- But, when they are not providing “definitive care” they are wasting valuable time which appears to adversely affect mortality.
Does Scene Time matter?

My Take

• I believe the current trauma literature supports:

  1) Providing early “definitive care” is critical.
• I believe the current trauma literature supports:

1) Providing early “definitive care” is critical.

2) “Definitive care” is a moving target, occasionally it is provided on-scene (ABCD issues); but generally requires prompt transport.
I believe the current trauma literature supports:

1) Providing early “definitive care” is critical.

2) “Definitive care” is a moving target, occasionally it is provided on-scene (ABCD issues); but generally requires prompt transport.

3) Properly hitting this moving target requires a thinking, attentive, flexible EMT on-scene.
My Take

- I believe the current trauma literature supports:

  4) Safely minimizing scene and total EMS time is very likely to save lives and should be done.
I believe the current trauma literature supports:

4) Safely minimizing scene and total EMS time is very likely to save lives and should be done.

5) Trauma patients likely do not need an IV; and “never” need one on-scene if it delays transport.
I believe the current trauma literature supports:

4) Safely minimizing scene and total EMS time is very likely to save lives and should be done.

5) Trauma patients likely do not need an IV; and “never” need one on-scene if it delays transport.

6) Saline-lock or small boluses titrated to palpable radial pulses is appropriate—especially if you suspect internal injuries/bleeding.
MCEMS STATEMENT ON TRAUMA CARE/SCENE TIMES

See Trauma 5- “Adult Trauma Destination Guidelines” as warranted.
See Trauma 8- “Pediatric Trauma Destination Guidelines” as warranted.
See Trauma 13- “Hypovolemic Shock” as warranted.
See Trauma 16- “Spinal Immobilization Protocol” as warranted.
See Trauma 17- “Spinal Trauma” as warranted.

1. Trauma is a surgical disease.
2. Trauma patients need to be delivered to the ED as quickly and safely as possible.
3. Even with stable vital signs, patients with significant injuries do not receive “stabilization” in the field.
4. With major injuries or unstable VS, the very most you can do is buy minutes or seconds via aggressive ABCDE management while enroute.
5. **Scene time should be less than 10 minutes in any patient who meets any of the Adult or Pediatric Trauma Destination Guidelines criteria.**
6. The **“Stat Trauma” Provider Impression (PI)** must be **one** of your PI’s for all trauma patients who meet **any** of the Adult or Pediatric Trauma Destination Guidelines criteria.
7. The four themes which MUST guide all trauma care are:
   a. As brief a scene time as is safely possible- our standard is <10 minutes for all trauma patients.
   b. Safe, rapid transport to an appropriate facility.
   c. As much assessment, physical exam, bleeding control, vascular access, etc. as possible done ENROUTE.
   d. Early notification to the ED of the impending arrival of any critical/unstable trauma patient.
8. There is medical literature which suggests that starting a pre-hospital IV on-scene in the severely injured trauma patient may actually increase their mortality- it uses up valuable seconds and minutes. Again- do everything enroute when possible.
9. **YOU DO NOT HAVE TO NORMALIZE SBP TO 120mmHg.** Use hemorrhage control and fluid boluses for a target SBP of **90mmHg** in adults, or age specific SBP in pediatrics.
   a. In general a mentating patient with good radial pulses has an adequate SBP.
10. Be very aware of fluids and do not over resuscitate the stable patient.
11. Assessment and stabilization of the possible cervical spine fracture is of paramount importance in trauma patients → when in doubt, immobilize.

**Benchmark Box:**

*Please see Trauma 1 for EMS System "best practice" benchmarks for Trauma Scene Times, Stat Trauma PI.*
4. With major injuries or unstable VS, the very most you can do is buy minutes or seconds via aggressive ABCDE management **while enroute.**

5. **Scene time should be less than 10 minutes in any patient who meets any of the Adult or Pediatric Trauma Destination Guidelines criteria.**

8. There is medical literature which suggests that starting a pre-hospital IV on-scene in the severely injured trauma patient may actually increase their mortality- it uses up valuable seconds and minutes. Again- do everything enroute when possible.

9. **YOU DO NOT HAVE TO NORMALIZE SBP TO 120mmHg. Use hemorrhage control and fluid boluses for a target SBP of** 90mmHg **in adults, or age specific SBP in pediatrics.**

   In general a mentating patient with good radial pulses has an adequate SBP.
End
TRAUMA “BEST PRACTICE” BENCHMARKS

See Trauma 5- “Adult Trauma Destination Guidelines” as warranted.
See Trauma 8- “Pediatric Trauma Destination Guidelines” as warranted.
See Intro 14- “Best Practice Benchmarking” as warranted.
See Operational P&P 14- “CQI/ QA” as warranted.

- These are some of the “best practice” benchmarks the Agency Quality Directors will be tracking for Trauma Protocols as part of the system CQI plan.
- These System Goals have been identified by the EMSMD as markers of excellence in EMS care.
- They are also highlighted on each protocol in a “benchmark box”.
- Please keep these in mind, and strive for them, as you care and document for patients.

<table>
<thead>
<tr>
<th>TRAUMA SCENE TIME</th>
<th>SYSTEM GOAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>BENCHMARK</td>
<td></td>
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<tr>
<td>• Scene time &lt;10 minutes in any patient who meets any of the Adult or Pediatric Trauma Destination Guidelines criteria.</td>
<td>80% of cases</td>
</tr>
</tbody>
</table>

See Trauma 5- “Adult Trauma Destination Guidelines”.
See Trauma 8- “Pediatric Trauma Destination Guidelines”.

<table>
<thead>
<tr>
<th>“STAT TRAUMA” PROVIDER IMPRESSION</th>
<th>SYSTEM GOAL</th>
</tr>
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<tbody>
<tr>
<td>BENCHMARK</td>
<td></td>
</tr>
<tr>
<td>• “Stat Trauma” is one of the Provider Impressions used for any patient who meets any of the Adult or Pediatric Trauma Destination Guidelines criteria.</td>
<td>100% of cases</td>
</tr>
</tbody>
</table>

See Trauma 5- “Adult Trauma Destination Guidelines”.
See Trauma 8- “Pediatric Trauma Destination Guidelines”.

Trauma 1       Trauma 1       Trauma 1
Does Scene Time matter?


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<tr>
<td>Alive</td>
<td>13.8min</td>
<td>32.7</td>
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<tr>
<td>Died</td>
<td>10.3</td>
<td>26.2</td>
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<tr>
<td>15-19</td>
<td>All</td>
<td>18.0</td>
<td>32.4</td>
</tr>
<tr>
<td>Alive</td>
<td>14.4</td>
<td>32.5</td>
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</tr>
<tr>
<td>Died</td>
<td>13.3</td>
<td>30.1</td>
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</tr>
<tr>
<td>29+ (sick)</td>
<td>All</td>
<td>17.2</td>
<td>30.6</td>
</tr>
<tr>
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<td>15.1</td>
<td>33</td>
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<tr>
<td>Died</td>
<td>11.6</td>
<td>27.9</td>
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