Emergency Medical Services at the Crossroads
Institute of Medicine
Tulane University School of Public Health
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Maxwell Healthcare System Criteria

• Equity
• Access
• Efficiency
• Efficacy
• Appropriateness
• Responsiveness
EMS at the Crossroads:

- System Finance
- National credentialing
- Medical Direction
- Coordination
- Communications and Data
- Air Medical Systems
- Accountability
- Disaster Preparedness
- Research
Goals in Designing System

• Reduction in mortality-- unexpected survivors

• Reduction in morbidity

• Reduction in costs of care:
  • cost of transport
  • incremental costs
  • re-hab costs
“While the Federal Aviation Administration is responsible for safety inspections, helicopter licensure, and air traffic control, the committee recommends that states assume regulatory oversight of medical aspects of air medical services including communications, dispatch, and air transport protocols.”
EMS at the Crossroads: air medicine

Issues in air medicine:

Growth

Clinical efficacy and appropriateness

Safety
Issues in Designing System

• Access and Equity
• Medical oversight
• Organization of services
  – dynamic environment—(organization across state lines, multi-state providers)
  – growth (iatrogenic changes in healthcare)
• Practice of medicine (non-physicians)
• Use criteria
• Evidence base for benefits (clinical / costs)
• Risk / Safety
• Quality management / practice variation
The current state of air medical resources in the US 10/06
Access to Trauma Centers in the United States

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The systems approach to the delivery of trauma care is widely accepted as an effective strategy for reducing death due to injury. A critical component of this systems approach is the designation or verification of trauma center hospitals equipped to treat more severely injured patients. Although the overall number of trauma centers has increased over the last decade, recent studies have shown that their geographic distribution varies widely across states. These studies suggest that in many areas of the country residents are

**Context** Previous studies have reported that the number and distribution of trauma centers are uneven across states, suggesting large differences in access to trauma center care.

**Objective** To estimate the proportion of US residents having access to trauma centers within 45 and 60 minutes.

**Design and Setting** Cross-sectional study using data from 2 national databases as part of the Trauma Resource Allocation Model for Ambulances and Hospitals (TRAMAH) project. Trauma centers, base helipads, and block group population were counted for all 50 states and the District of Columbia as of January 2005.

**Main Outcome Measures** Percentages of national, regional, and state populations having access to all 703 level I, II, and III trauma centers in the United States by either ground ambulance or helicopter within 45 and 60 minutes.

**Results** An estimated 69.2% and 84.1% of all US residents had access to a level I or II trauma center within 45 and 60 minutes, respectively. The 46.6 million Americans who had access within an hour lived mostly in rural areas, whereas the 42.8 million Americans who had access to 20 or more level I or II trauma centers within an hour lived mostly in urban areas. Within 45 and 60 minutes, respectively, 26.7% and 27.7% of US residents had access to level I or II trauma centers by helicopter only and 1.9% and 3.1% of US residents had access to level I or II centers only from trauma centers or base helipads outside their home states.

**Conclusion** Selecting trauma centers based on geographic need, appropriately locating medical helicopter bases, and establishing formal agreements for sharing trauma care resources across states should be considered to improve access to trauma care in the United States.

*JAMA. 2005;293:2626-2633*
Air medicine vs. high acuity transport medicine

- Traditional model: “trauma medevac” based on military experience—rapid transport of trauma patient in unique vehicle not tied to roads.
- Time = critical

- Evolving models: critical care teams / transport
- Care = critical
  - Assets of trauma/ tertiary center directly to patient
  - Time dependent care: PCI, Stroke, Neonate.
  - Replacement model for rural hospital (CAH’s).
  - Regional Disaster Systems and Surge Capacity
Air medicine vs. high acuity transport medicine

• Critical Care (“mobile ICU, flying ED”)
  – Scene 30%
  – Inter-hospital 70%

• Scope of Practice =
  – “physician level standing orders”
  – Regional and inter-state practice
  – Fixed wing / international

• Predominant model clinical staffing = RN / CCTP
  – other RN/RN, RN/RT, MD/RN, P/P, P only, Specialty Teams
Air medicine vs. high acuity transport medicine

- Medical oversight = risk analysis: multiple levels: clinical, safety, fiscal, societal

- IF and Scene- medical necessity need established: prospective selection through protocol or OLMD; retrospective utilization review

- Access / level playing field across geography.

- Continuity and integration with tertiary care resources

- Risk benefit ratio – public and clinical transparency
Scene Triage Criteria

London HEMS

Fall >2m  Entrap  LOC  Apnea  Burns  GSW/Stab  Limb threat

Table 1 Summary of the criteria for the primary deployment of the Rotterdam helicopter-transported medical team for trauma patients

<table>
<thead>
<tr>
<th>Category</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Place difficult to reach for ambulances (&lt; 20 min to reach injury scene)</td>
</tr>
<tr>
<td></td>
<td>If, in professional opinion of dispatcher, the HMT provides additional value</td>
</tr>
<tr>
<td>Mechanism of trauma</td>
<td>Motor vehicle accidents with estimated speed of &gt; 30 km/h</td>
</tr>
<tr>
<td></td>
<td>Frontal collisions outside the built-up area of a town</td>
</tr>
<tr>
<td></td>
<td>Fall from &gt; 6 m or third floor</td>
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<tr>
<td></td>
<td>Entrapment in vehicle</td>
</tr>
<tr>
<td></td>
<td>Death of other occupant</td>
</tr>
<tr>
<td></td>
<td>Ejected from vehicle</td>
</tr>
<tr>
<td></td>
<td>Explosions</td>
</tr>
<tr>
<td></td>
<td>Near drowning or diving accidents</td>
</tr>
<tr>
<td></td>
<td>Exposure to toxic chemicals</td>
</tr>
<tr>
<td></td>
<td>Inhalation trauma or severe burns</td>
</tr>
<tr>
<td>Patient condition</td>
<td>Penetrating injuries to head, neck or trunk</td>
</tr>
<tr>
<td></td>
<td>Pelvic, spinal or femur fracture</td>
</tr>
<tr>
<td></td>
<td>Coma (Glasgow Coma Score of ≤ 8)</td>
</tr>
<tr>
<td></td>
<td>Systolic blood pressure &lt; 90 mmHg or pulse &gt; 120 per min</td>
</tr>
<tr>
<td></td>
<td>Major estimated blood loss (&gt; 1 litre)</td>
</tr>
<tr>
<td></td>
<td>Respiratory distress</td>
</tr>
</tbody>
</table>

Ambulances, while on scene, can always request assistance (secondary deployment). HMT, helicopter-transported medical team.

POSITION PAPER
National Association of EMS Physicians

GUIDELINES FOR AIR MEDICAL DISPATCH

David P. Thomson, MD, MS, Stephen H. Thomas, MD, MPH, for the 2002–2003 Air Medical Services Committee of the National Association of EMS Physicians
Improving triage

Table 2: Variables Considered Predictors of Outcome in the Prehospital Setting

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Unit of Measurement</th>
<th>Form for Inclusion in Model Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Years</td>
<td>Linear form</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Breaths per minute</td>
<td>Linear form, Quadratic form</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;=15, 16-20, &gt;20 breaths/min</td>
</tr>
<tr>
<td>Pulse rate</td>
<td>Beats per minute</td>
<td>Linear form, Quadratic form</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75, 76-80, &gt;80 beats/min</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>Millimeters of mercury</td>
<td>Linear form, Quadratic form</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=120, 121-143, &gt;140 mm Hg</td>
</tr>
<tr>
<td>Cause of injury</td>
<td>Motor vehicle passenger or driver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Motorcycle passenger or driver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pedestrian</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other cause of injury</td>
<td></td>
</tr>
<tr>
<td>Glasgow Coma Scale</td>
<td></td>
<td>Normal (6), not normal (&lt;6)</td>
</tr>
<tr>
<td></td>
<td>Motor</td>
<td>Normal (4), not normal (&lt;4)</td>
</tr>
<tr>
<td></td>
<td>Eye opening</td>
<td>Normal (5), not normal (&lt;5)</td>
</tr>
<tr>
<td></td>
<td>Verbal</td>
<td></td>
</tr>
</tbody>
</table>

Mortality in blunt trauma patients

Belinda J. Gabbe, BPhysio(Hons), MAppSc, PhD, Peter A. Cameron, MBBS, MD, FACEM, Rory Wolfe, BSc, PhD, Pam Simpson, BSc(Hons), Karen L. Smith, BSc (Hons), GradDipEpiBiostats, PhD, John J. McNeil, MBBS, FRACP, FAEPHM

<table>
<thead>
<tr>
<th>Prediction Tool</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design data set</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex model</td>
<td>72</td>
<td>78</td>
<td>19</td>
<td>97</td>
</tr>
<tr>
<td>Categorical model</td>
<td>74</td>
<td>76</td>
<td>18</td>
<td>98</td>
</tr>
<tr>
<td>Simple model</td>
<td>75</td>
<td>76</td>
<td>19</td>
<td>98</td>
</tr>
<tr>
<td>Trauma triage guidelines</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physiologic criteria</td>
<td>70</td>
<td>74</td>
<td>16</td>
<td>97</td>
</tr>
<tr>
<td>Anatomic criteria</td>
<td>87</td>
<td>26</td>
<td>8</td>
<td>97</td>
</tr>
<tr>
<td>Combined criteria</td>
<td>92</td>
<td>23</td>
<td>8</td>
<td>98</td>
</tr>
</tbody>
</table>

PPV, positive predictive value; NPV, negative predictive value.
Issues: Future

- Medicine:

- System Design—integration: healthcare, EMS, air medicine
- Medical Oversight
- Patient Selection: (Dx., Triage Criteria, Time/Distance, Other)
- ACN triage technology
- Healthcare market behavior: (market saturation / FP / NFP, urban rural paradox, alignment of incentives and patients)
- Preparedness Costs / (availability response model)
- Ambulance Reimbursement (Medicare / Medicaid / Uninsured)
- Regulatory consistency (Federal / State / Local)
Issues: Future

- Aviation:
  - Preparedness costs (availability response model)
  - Infrastructure costs: (IFR, wx. reporting, technology, helipads)
  - Safety: alignment of incentives / transport = reimbursement
  - Technology costs: airframes, avionics, infrastructure
  - Regulatory Consistency (Federal / State / Local)
**Issues: Future**

- Transport – increased numbers and acuity
- Transport Medicine = sub-specialty
- Integrated system: replacement cost model
  - Regional / multi-state
  - Medical oversight
  - Communications including tele-medicine
  - Ground, HEMS, FW transport
  - Preparedness base funding
Air medicine vs. high acuity transport medicine

• “Expensive” medical therapy from single patient perspective – cost effective strategy from population perspective

• Tempting to equate lower unit costs with cost-effectiveness, and higher unit costs with “cost-prohibitiveness.”

• Funding: preparedness model challenge:
  – Hospital based funding: single patient services / dx.
  – “Fire” based funding: public support
### Cost-Benefit

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Cost / life-yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>NICU (birth wt. 500-999g)</td>
<td>$18,000</td>
</tr>
<tr>
<td>Median, 310 medical interventions</td>
<td>$19,000</td>
</tr>
<tr>
<td>3-vessel CABG for severe angina</td>
<td>$23,000</td>
</tr>
<tr>
<td>Thrombolysis for acute MI</td>
<td>$32,678</td>
</tr>
<tr>
<td>Prophyactic AZT post-needlestick</td>
<td>$41,000</td>
</tr>
<tr>
<td>HEMS scene trauma, ( W = 5 )</td>
<td>$2500</td>
</tr>
<tr>
<td>HEMS scene trauma, ( W = 1 )</td>
<td>$9700</td>
</tr>
<tr>
<td>HEMS use: Massachusetts</td>
<td>$2454</td>
</tr>
<tr>
<td>HEMS system: U.K. &amp; Norway</td>
<td>$10,000-$30,000</td>
</tr>
<tr>
<td>Level I trauma center cost per life saved</td>
<td>$84,000</td>
</tr>
<tr>
<td>Accepted threshold, <em>NEJM</em> 2005</td>
<td>$40,000-$50,000</td>
</tr>
</tbody>
</table>
Issues: Future Policy

- Increasing evidence that cost per life year saved and cost per additional life saved validates availability of resource
  - At what cost is extra life saved acceptable?
  - At what cost is extra life year saved acceptable?
  - Literature 3-30% unexpected survivors
  - Agreed and transparent metrics

- Public expectation: demand vs. need / media
- Healthcare iatrogenic changes
- Air = rural access to time dependent tertiary care
EMS at the Crossroads: accountability

“To build accountability into the system the committee recommends that the Department of Health and Human Services convene a panel of individuals with emergency and trauma care expertise to develop evidence-based indicators of emergency care system performance.”