Development of a Database for Comparative Effectiveness Research (CER) on Prehospital and In-hospital Emergency Care

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Project team

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  (Winthrop U Hosp, Englewood Hosp & MC)
Project motivation

• Emergency medicine
  – Wide range of diagnoses & procedures
  – Time sensitive, ambiguous situations
  – Evidence base less developed than other specialties

• Prehospital emergency medical service (EMS)
  – Even less evidence-based
  – Historically separate from rest of health sector
  – Intensely local/under-resourced

• IOM reports (2006/2007) ==> priority area for research

• **Barrier**: Lack of large-scale integrated databases across emergency care settings
Specific Aims of Enhanced Data Grant

1. Build a sustainable database to support comparative effectiveness research (CER) on medical care provided across prehospital and hospital settings in NJ.

2. Demonstrate the utility of the database by evaluating out-of-hospital cardiac arrest (OHCA) outcomes in therapeutic hypothermia (TH) centers versus other hospitals.
Overview of component databases

1. NJ Discharge Data Collection System
   - Hospital inpatient/ED billing records

2. EMS Data Warehouse
   - EHRs maintained by ambulance companies
   - Pilot data in 2006, Statewide in 2008
   - Include response times, vital signs, prehospital procedures, etc.
   - Universal participation among advanced life support (ALS) units
   - ≈ 50% participation among basic life support (BLS) units

3. Mortality data (State vital records system)

Data years: 2009-2010 linked. 2011 in process.

Supplemental data collection: Hospital TH survey
Overview of data linkage

**COMPONENT 1:** Prehospital EMS records

- Group unique individuals with common ID.
- Remove individuals with no prehospital EMS use.

**COMPONENT 2:** Hospital records

- Link relevant mortality records to individuals.

**COMPONENT 3:** Mortality records

- FINAL LINKED DATABASE: Remove patient identifying information & retain encrypted IDs.
Mechanics of data linkage

- Patient identifiers across components
  - **Primary**: Name, DOB, SSN
  - **Secondary**: Sex, race/ethnicity, residential zip code

- LinkKing software
  - Combination of deterministic & probabilistic linkage

- Must have **at least one** of the **primary identifiers**
  - No problem for hospital & mortality data
  - EMS records: Reduced from 1,253,208 to 899,314 (↓ 28.2%)

- Retain linked records w/highest probability of a valid match based on LinkKing “certainty levels”
### Units of analysis, 2009-2010

<table>
<thead>
<tr>
<th>Unit of Analysis</th>
<th>Number of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total EMS records</strong></td>
<td>899,314</td>
</tr>
<tr>
<td>Records with EMS treatment and transport</td>
<td>706,584</td>
</tr>
<tr>
<td>Subset of above records linked to a hospital record</td>
<td>535,771*</td>
</tr>
</tbody>
</table>

| **Unique EMS incidents**                                            |                        |
|---------------------------------------------------------------------|                        |
| Unique EMS incidents linked to a hospital record                    | 490,068                |

| **Unique individuals**                                              |                        |
|---------------------------------------------------------------------|                        |
| Unique individuals with linked mortality record                     | 56,354                 |

* 75.8% of treated & transported cases linked to a hospital record (Linkage rate varies by condition treated)
Multiple unit EMS response

<table>
<thead>
<tr>
<th>EMS units</th>
<th>Number of incidents</th>
<th>Percentage of incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>664,657</td>
<td>85.2%</td>
</tr>
<tr>
<td>2</td>
<td>112,601</td>
<td>14.4%</td>
</tr>
<tr>
<td>3</td>
<td>2,731</td>
<td>0.35%</td>
</tr>
<tr>
<td>4 or more</td>
<td>308</td>
<td>0.04%</td>
</tr>
</tbody>
</table>

* Number of EMS units per incident varies by response type
Cardiac arrest analysis

- **Population**: Adults treated & transported by EMS for OHCA

- **Comparison**: Transport to TH centers vs other hospitals

- **Outcomes**: Neurologically intact survival …
  - to discharge
  - at 30 days post-arrest
Exclusion/outcome analysis, 2009-2010

Adult Treated OHCA
N= 6,887

Resuscitation Terminated in Field, N= 1,133

Treated & Transported
N= 5,754

Hospital Link Not Found, N= 737

Linkage rate: 87.2%

Died in Hospital
N= 4,185

Survived to Discharge
N= 832

Transferred
N= 166

Neurologically Intact Survival to 30 days, N= 259

Died/Poor Neurological Outcome within 30 Days, N=407
### Descriptive analysis of patients at TH vs other hospitals

<table>
<thead>
<tr>
<th>Neuro intact survival</th>
<th>TH centers (N = 2,363)</th>
<th>Other hospitals (N = 2,479)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To discharge*</td>
<td>11.9%</td>
<td>8.2%</td>
</tr>
<tr>
<td>At 30 days*</td>
<td>7.4%</td>
<td>3.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Selected covariates</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EMS response time*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 4 minutes</td>
<td>16.8%</td>
<td>14.4%</td>
</tr>
<tr>
<td>4-8 minutes</td>
<td>41.6%</td>
<td>36.0%</td>
</tr>
<tr>
<td>More than 8 minutes</td>
<td>41.6%</td>
<td>49.6%</td>
</tr>
<tr>
<td>Witnessed arrest*</td>
<td>60.0%</td>
<td>55.0%</td>
</tr>
<tr>
<td>Defibrillation by EMS*</td>
<td>52.3%</td>
<td>46.1%</td>
</tr>
<tr>
<td>Shockable rhythm</td>
<td>9.2%</td>
<td>8.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of hospital beds*</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 200</td>
<td>19.6%</td>
<td>46.1%</td>
</tr>
<tr>
<td>200-399</td>
<td>49.8%</td>
<td>42.4%</td>
</tr>
<tr>
<td>400 and above</td>
<td>30.6%</td>
<td>11.5%</td>
</tr>
<tr>
<td>Teaching hospital*</td>
<td>14.8%</td>
<td>7.6%</td>
</tr>
<tr>
<td>Female sex</td>
<td>37.2%</td>
<td>36.4%</td>
</tr>
</tbody>
</table>
Final thoughts

• Successful linkage of EMS/hospital/mortality data for 2009-2010, 2011 underway

• Analysis of TH for OHCA patients currently under review

• Linked database available for future applications
  – CER on prehospital/hospital procedures
  – Public health surveillance/planning
  – Other applications