Geospatial Solutions for Critical Care Resource Evaluation and Planning

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Geographical Information Systems

Computerised systems that allow geocoded data of different types and sources to be linked, based upon their spatial location, so as to explore their spatial relationships
Geographical Information Systems

- Used to identify population variation in relation to specialised services

- Population and geographic factors are known to substantially impact upon patient mortality and health service accessibility

- Increasing emphasis towards the regionalisation of specialised health services
Population
(2006 census data)
Population
(change 1996 – 2011)
Population
(change 1996 – 2011 by state and regions)
Tertiary Medical Care

- Typically resource intensive, specialized and high cost
  - Regionalized
- Outcome may be associated with patient volume
- Aligned with other tertiary services
- Examples
  - Trauma
  - Neurosurgery
  - Burns
  - Acute spinal injury
Intensive Care

- Specialised service
- ICU admissions - 4% of all non day stay hospital separations
- Approx 125,000 pts per year in Australia
- Resource intensive
- High cost
- Emergency admissions with high severity of illness
“Retrieval”

Medical escorted out of hospital patient transportation

• Born out of necessity to provide equity in acute medical service provision for the “outback”
• "greatest single contribution to the effective settlement of the far distant back country that we have witnessed in our time..."
• War time experience of rapid response, early resuscitation and prompt delivery to definitive care
• Critical Care Transport services – “ICUs in the sky”
Patients admitted to an ICU

![Bar chart showing the percentage of patients admitted to different types of ICUs based on ICU and hospital sources.](chart.png)
Patients admitted to an ICU and source is other hospital by Region

- ICU source is Other Hospital
- Hospital source is Other Hospital

ACT  NSW  NT  NZ  QLD  SA  TAS  VIC  WA

%
Patients admitted to an ICU and source is other hospital by year

ICU source is Other Hospital

Hospital source is Other Hospital

%
Patients admitted to an ICU and hospital source is another hospital by ICU type and Year
<table>
<thead>
<tr>
<th>ICU source of Admission</th>
<th>Operating Theatre</th>
<th>Emergency Department</th>
<th>Ward</th>
<th>Other Acute Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>62.7 (CI 62.6, 62.8)</td>
<td>54.1 (CI 54, 54.2)</td>
<td>63 (CI 62.3, 63.2)</td>
<td>55.7 (CI 55.4, 55.9)</td>
</tr>
<tr>
<td><strong>APACHE II score</strong></td>
<td>13.1 (CI 13.1, 13.2)</td>
<td>15.4 (CI 15.3, 15.4)</td>
<td>19 (CI 19, 19.1)</td>
<td>18.2 (CI 18.1, 18.3)</td>
</tr>
<tr>
<td><strong>APACHE II Risk of Death</strong></td>
<td>0.149 (CI 0.15, 0.15)</td>
<td>0.224 (CI 0.22, 0.23)</td>
<td>0.332 (CI 0.33, 0.33)</td>
<td>0.302 (CI 0.30, 0.31)</td>
</tr>
<tr>
<td><strong>ICU length of stay (days)</strong></td>
<td>3.0 (CI 2.97, 3.02)</td>
<td>3.4 (CI 3.4, 3.43)</td>
<td>4.9 (CI 4.86, 4.98)</td>
<td>5.4 (CI 5.3, 5.5)</td>
</tr>
<tr>
<td><strong>Hospital length of stay (days)</strong></td>
<td>19.2 (CI 19.1, 19.4)</td>
<td>11.8 (CI 11.6, 11.9)</td>
<td>26.4 (CI 26.1, 26.7)</td>
<td>15.6 (CI 15.4, 15.9)</td>
</tr>
<tr>
<td><strong>Hospital Mortality</strong></td>
<td>7.6%</td>
<td>16.7%</td>
<td>31.1%</td>
<td>30.1%</td>
</tr>
<tr>
<td><strong>Standardised Mortality Rate</strong></td>
<td>0.51</td>
<td>0.75</td>
<td>0.94</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Retrieval Services

- 65 services completed a survey
  - one non responder
- 11 from NZ and 54 from Australia

- 58.5% being hospital affiliated
  - 36% Metro regional hospital
  - 36% Rural regional hospital
  - 28% Metro

- 63% utilised Helicopter
- 69% utilised fixed wing
- 91% utilised road vehicles
- 55% utilised all 3 modes of transport
Global perspective
Focusing on Regions – ICU and Retrieval resources
Focusing on Regions - urban
Source of patient whose ICU source of admission is another hospital
Accessibility to an ICU
Infrastructure
GIS Program capacity - layers
GIS Program capacity - legend
GIS Program capacity - queries
Regionalization and accessibility are contrasting challenges for delivery of equitable health care.

...do influence patient outcomes...

....thus equity and delivery require planning, strategic positioning and regular evaluation
Summary

Associations between population demographics - medical resources - patients - infrastructure can be examined by using geospatial methods.

Advantages over “conventional” less “visual” methods.

Complimentary
Summary

Implications for planning of ICU resource allocation, improving accessibility (e.g., Retrieval utilization) and impact of any such actions upon patient outcomes and resource costs.