A model for monitoring Pre-hospital & Emergency Department factors contributing to road ambulance use

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Prof Allan Chang
Dr K Humphrey
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South Brisbane
Mater ambulance study

• Model for surveillance of ambulance activity
• Detects inappropriate use
• May be used to promote appropriate ambulance utilisation
Mater ambulance study

- Model for surveillance of ambulance activity
- Detects inappropriate use
- May be used to promote appropriate ambulance utilisation
Ambulance funding 1998-2003

Funding index

Australia - total

Cost per patient transported 2002-03

$ per patient transport

- NSW
- VIC
- QLD
- WA
- SA
- TAS
- ACT
- NT
Cost per patient transported 2002-03

$ per 1000 people

NSW      VIC      QLD      WA      SA      TAS      ACT      NT

NATIONAL
Ambulance expenditure 2002-03

$ per 1000 people

NSW  VIC  QLD  WA  SA  TAS  ACT  NT

NATIONAL
<table>
<thead>
<tr>
<th></th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>WA</th>
<th>SA</th>
<th>TAS</th>
<th>ACT</th>
<th>NT</th>
<th>Aust</th>
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<td>1999-2000</td>
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<td>177958</td>
<td>166518</td>
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<td>199789</td>
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<td>% increase</td>
<td>51.1</td>
<td>23.9</td>
<td>20.0</td>
<td>8.5</td>
<td>13.1</td>
<td>38.6</td>
<td>22.3</td>
<td>56.7</td>
<td>28.8</td>
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## Emergency & urgent ambulance transport

<table>
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<tr>
<th></th>
<th>NSW</th>
<th>VIC</th>
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<th>TAS</th>
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<th>Aust</th>
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<td><strong>1999-2000</strong></td>
<td>490577</td>
<td>272857</td>
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<td>72659</td>
<td>85773</td>
<td>34667</td>
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<td><strong>2000-2001</strong></td>
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<td>275219</td>
<td>269500</td>
<td>71984</td>
<td>116417</td>
<td>32570</td>
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<td><strong>2001-2002</strong></td>
<td>491123</td>
<td>291896</td>
<td>306423</td>
<td>78831</td>
<td>124027</td>
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<table>
<thead>
<tr>
<th></th>
<th>% increase</th>
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<tr>
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<td>0.1</td>
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## Comparative expenditure increases 1999 - 2002

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>“True” emergencies</td>
<td>10.0%</td>
</tr>
<tr>
<td>NON emergent</td>
<td>28.8%</td>
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</table>
Mater Ambulance Study
Variables can be identified that influence requests for ambulance transport

- Increased age
- Higher illness acuity
- Greater need for admission
- Distance of hospital from home
- Non business hours and weekends
- Ambulance fees not charged to user
BACKGROUND

Change to ambulance funding in 2003

Prior to June 2003:
- User pays
- Family subscriptions = “insurance”

July 2003 onwards:
- Ambulance funder by community “levy”
- No direct charges for users.
METHODS

SETTING

• Urban adult public ED within 5 km of Brisbane CBD
• Limited trauma
• Tertiary O&G  (exclusive provider for southside of Brisbane)
METHODS

• Data: All ED attendances for each of the years 2002 & 2004 (55397 patients)  
  (ie: the year before and after the introduction of the Community Ambulance charge by the Qld Government in 2003)

• Ambulance users vs non ambulance users compared

• Ambulance utilisation analysed w.r.t.
  – 2002 with 2004
  – Age
  – Illness acuity
  – Need for admission
  – Distance of hospital from home
  – Non business hours and weekends
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  – Illness acuity
  – Need for admission
  – Distance of hospital from home
  – Non business hours and weekends
STATISTICS

• Chi squared testing
  – 2002 vs 2004
  – ambulant vs non ambulant

• Multivariate logistic regression
  – Hypothesised variables for ambulance utilisation (age, acuity, need for admission, distance of hospital, non business hours)

• Path analysis model
  – Analysis of the cascading inter-relationships between variables that lead to ambulance use.
## Mater Ambulance Study

### STATISTICS

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>Adjusted odds ratio</th>
<th>95% CI</th>
<th>Correlation Coeff</th>
<th>Standard Error</th>
<th>Z</th>
<th>P value</th>
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<tbody>
<tr>
<td>Night (8pm-8am)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Weekend</td>
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</tr>
<tr>
<td>Age &gt; 60</td>
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<tr>
<td>&gt;10 km from hospital</td>
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<td></td>
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</tr>
<tr>
<td>Requires admission</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>High acuity</td>
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<td>Year 2004</td>
<td></td>
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</tr>
<tr>
<td>Female</td>
<td></td>
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</tr>
<tr>
<td>CONSTANT</td>
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<td>Predictor variable</td>
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<tr>
<td>Night (8pm-8am)</td>
<td>1.5295</td>
<td>1.4540 – 1.6091</td>
<td>0.425</td>
<td>0.0259</td>
<td>16.4359</td>
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<tr>
<td>Weekend</td>
<td>1.0419</td>
<td>0.9884 – 1.0982</td>
<td>0.041</td>
<td>0.0269</td>
<td>1.5267</td>
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<tr>
<td>Age &gt; 60</td>
<td>1.4175</td>
<td>1.4013 – 1.4340</td>
<td>0.349</td>
<td>0.0059</td>
<td>59.3342</td>
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<tr>
<td>&gt;10 km from hospital</td>
<td>1.1490</td>
<td>1.0957 – 1.2049</td>
<td>0.139</td>
<td>0.0242</td>
<td>5.7312</td>
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<tr>
<td>Requires admission</td>
<td>2.2793</td>
<td>2.1619 – 2.4031</td>
<td>0.824</td>
<td>0.0270</td>
<td>30.5411</td>
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<tr>
<td>High acuity</td>
<td>2.0198</td>
<td>1.9456 – 2.0934</td>
<td>0.721</td>
<td>0.0183</td>
<td>38.3786</td>
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<tr>
<td>Year 2004</td>
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<td>1.1188 – 1.1729</td>
<td>0.136</td>
<td>0.0120</td>
<td>11.2764</td>
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<tr>
<td>Female</td>
<td>1.1305</td>
<td>1.0778 – 1.1855</td>
<td>0.123</td>
<td>0.0243</td>
<td>38.3786</td>
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<td>-274.19</td>
<td>24.1296</td>
<td>-11.3631</td>
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</tbody>
</table>
Path analysis

Cascading interactions of factors leading to ambulance transport
Three LEVELS in a sequence of cascading events.

- **Level 1**: Personal & Environmental influence
- **Level 2**: Clinical acuity, Need to admit influence
- **Level 3**: Ambulance utilisation
Three LEVELS in a sequence of cascading events.

Level 1
**Personal & Environmental**

- Determined in ED
- Surrogate measures of illness severity at time of ambulance request.

Level 2
**Clinical acuity, Need to admit**

- Determined in ED
- Surrogate measures of illness severity at time of ambulance request.

Level 3
**Ambulance utilisation**
Three LEVELS in a sequence of cascading events.

Level 1
Personal & Environmental

Relative strength of these influences can be quantified

Level 2
Clinical acuity, Need to admit

Level 3
Ambulance utilisation
<table>
<thead>
<tr>
<th>PATIENTS’ CHARACTERISTICS</th>
<th>CLINICAL INDICES</th>
<th>OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
PATIENTS’ CHARACTERISTICS

- Night
- 2004
- > 10 km
- Female
- Elderly

CLINICAL INDICES

- High Acuity
- Requires Admission

OUTCOME

Arrival by Ambulance

CLINICAL INDICES OUTCOME PATIENTS’ CHARACTERISTICS
PATIENTS’ CHARACTERISTICS

CLINICAL INDICES

OUTCOME

Night

2004

> 10 km

Female

Elderly

0.36

High Acuity

Requires Admission

Arrival by Ambulance

0.04

0.06

0.03

0.02

0.07

0.02

0.05

0.08

0.10

0.02

0.09

0.16

0.05

0.17

0.16

0.30

0.36

0.27
PATH ANALYSIS

Linear regression coefficients are calculated for pre-specified variables.

Descriptive method to relate the cascade of sequential events leading to ambulance use.

Variables earlier in the path sequentially affect those further down the cascade.

Capable of examining interactions between all variables.

Explains cascading influence from the personal and environmental to the clinical (acuity, need for admission) which ultimately lead to request for ambulance transport.
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Variables earlier in the path sequentially affect those further down the cascade.

Capable of examining interactions between all variables.

Explains cascading influence from the personal and environmental to the clinical (acuity, need for admission) which ultimately lead to request for ambulance transport.
DISCUSSION

Clinical acuity (as assessed in ED) is combined with patient demographic and other data into a multifactorial path analysis model that describes ambulance utilisation.

Statistically significant positive correlations between ambulance utilisation and:

- Increased age
- Higher disease acuity
- Likelihood of admission
- Female gender
- Night time
- Distance > 10 km from hospital
Clinical acuity (as assessed in ED) is combined with patient demographic and other data into a multifactorial path analysis model that describes ambulance utilisation.

Statistically significant positive correlations between ambulance utilisation and:

- Increased age
- Higher disease acuity
- Likelihood of admission
- Female gender
- Night time
- Distance > 10 km from hospital
- 2004 vs 2002
Clinical acuity (as assessed in ED) is combined with patient demographic and other data into a multifactorial path analysis model that describes ambulance utilisation.

Statistically significant positive correlations between ambulance utilisation and:

- 2004 vs 2002
- Suggests that removal of “user pays” led to increased inappropriate use of ambulance.
- Assoc. with reduced clinical acuity & need for admission
DISCUSSION

The Path analysis tool permits quantitative surveillance of the various factors that lead to ambulance utilisation.

Potential to optimise ambulance utilisation by strategies that modify the relative influence of these variables viz:

- Public education
- Review of Ambulance systems’ Operational Policies
- Funding & finance
- Health system planning (eg: location of GPs, hospitals, health centres)
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• Public education
• Review of Ambulance systems’ Operational Policies
• Funding & finance
• Health system planning (eg: location of GPs, hospitals, health centres)
Conclusion

- The Mater Ambulance Study examined the relative influence of demographic and clinical factors on ambulance utilisation.

- A Path analysis tool was developed that quantifies the relative influence of these factors.

- This tool may assist the development of strategies to optimise the utilisation of ambulance resources in the community.
The Mater Ambulance Study examined the relative influence of demographic and clinical factors on ambulance utilisation. This tool may assist the development of strategies to optimise the utilisation of ambulance resources in the community. A Path analysis tool was developed that quantifies the relative influence of these factors.

Questions?