Big data, small populations: unpacking health inequalities using linked data
Louisa Jorm
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Indigenous health gap

- Compared to other Australians, life expectancy is 10.6 years less for males and 9.5 years less for females.
- Burden of disease (disability-adjusted life years, DALYs) is 2.3 times higher in Indigenous Australians.
- Biggest contributors to this gap are:
  - cardiovascular diseases (19%)
  - mental and substance use disorders (14%)
  - injuries (14%)
  - respiratory diseases (10%)
  - cancer (9%)

AIHW (2016). *Australian Burden of Disease Study: Impact and causes of illness and death in Aboriginal and Torres Strait Islander people 2011.*
Summary

- Indigenous Health Outcomes Patient Evaluation (IHOPE)
  - Revascularisation following AMI
  - Road traffic injuries
  - Cataract surgery
- Seeding Success
  - Maternal age and offspring developmental vulnerability
The IHOPE study

Where are the gaps?

In health outcomes

In treatment and access

What is the contribution of: Area, SES, Remoteness? Hospitals, Health system?
Research focus

• Acute myocardial infarction
• Road traffic injuries
• Unintentional injuries in children
• Cataract procedures
• Otitis media procedures in children
• Potentially preventable hospitalisations
• Breast conserving surgery
IHOPE data

Total persons
1
2
3
4
5
6
7
8
.
.
7,383,367

NSW Admitted Patient Data Collection
Jul00 to Mar14
32,927,562 records
7,383,367 persons

Fact of death (NSW RBDM)
Jul00 to Mar14
646,304

Cause of death (ABS)
Jul00 to Dec13
631,912
## Characteristics of people admitted to hospital with AMI

<table>
<thead>
<tr>
<th></th>
<th>Indigenous</th>
<th>Non-Indigenous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age (years)</td>
<td>54</td>
<td>66</td>
</tr>
<tr>
<td>Current smokers</td>
<td>51%</td>
<td>27%</td>
</tr>
<tr>
<td>Private health insurance</td>
<td>16%</td>
<td>45%</td>
</tr>
<tr>
<td>Live in most disadvantaged areas</td>
<td>48%</td>
<td>26%</td>
</tr>
<tr>
<td>First admitted to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- major city hospital</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>- hospital with specialist cardiac facilities</td>
<td>27%</td>
<td>44%</td>
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</tbody>
</table>
Multilevel modelling

• Models data that are clustered
  – e.g. live in same neighbourhood, go to the same hospital

• Individuals within clusters are more similar than those in other clusters because of shared exposures (often unmeasured)

• Clustering can impact on standard errors and parameter estimates if not taken into account

• Particular issue for Indigenous health research
  – ~40% of NSW Indigenous people live in major cities
  – ~70% of NSW non-Indigenous people live in major cities
How is multilevel modelling different?

Single level regression model

Fits an average association

Multilevel regression model
(random intercept)

Strength of association may vary between areas
Revascularisation: “unpacking” the gap

Age, sex, year, MI type

0.63 (0.57, 0.70)

An Aboriginal person in NSW has a 37% lower hazard of revascularisation within 30 days of AMI than a non-Aboriginal person of the same age, sex, year of admission and AMI type.
Revascularisation: “unpacking” the gap

Age, sex, year, MI type  
+ Hospital of admission (random effect) 

<table>
<thead>
<tr>
<th>Hazard ratio</th>
<th>Hazard ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.63</td>
<td>(0.57, 0.70)</td>
</tr>
<tr>
<td>0.82</td>
<td>(0.74, 0.91)</td>
</tr>
</tbody>
</table>

Once we compare within hospitals, the disparity reduces - an Aboriginal person has a **18%** lower hazard of revascularisation than a non-Aboriginal person of the same age, sex, year of admission, AMI type, admitted to the same hospital.

Comorbidity burden on admission

Aboriginal people have higher rates of these conditions recorded in hospital data than non-Aboriginal people.

COPD
Diabetes with complications
Chronic renal failure
Diabetes
Congestive heart failure
Acute renal failure
Dementia
Pulmonary oedema
Cerebrovascular disease
Cardiac dysrhythmias
Cancer
Peripheral vascular disease
Depression
Shock

● Prevalence ratio - Aboriginal to non-Aboriginal prevalence
Revascularisation: “unpacking” the gap

Age, sex, year, MI type  
+ Hospital of admission (random effect)  
+ Selected comorbidities

Once we adjust for comorbidities the gap is further reduced

Revascularisation: “unpacking” the gap

*After adjusting for substance use and private health insurance, there is no longer a significant difference*
How can the findings inform policy?

Where are the gaps?

- **Age at first heart attack**
  - Aboriginal people 12 years younger at first AMI
  - Greater disparity in young and women
  - Importance of prevention and management of early heart disease symptoms

- **Cardiac procedures**
  - Aboriginal people admitted with AMI less likely to get revascularisation
  - Related to hospital of admission and higher rate of comorbidities such as diabetes and renal failure

- **Mortality after AMI**
  - No difference in 30-day mortality after AMI, but Aboriginal people more likely to die within 1 year
  - Importance of follow-up care and managing multimorbidity
  - Possible link to lower procedure rates?
Hospitalised road transport injury
Is there a disparity in road transport injury?

<table>
<thead>
<tr>
<th></th>
<th>IRR adjusted for age and sex</th>
<th>IRR adjusted for age, sex and area</th>
</tr>
</thead>
<tbody>
<tr>
<td>All road transport injuries</td>
<td>1.18 (1.09-1.28)</td>
<td>1.00 (0.96-1.04)</td>
</tr>
<tr>
<td>Small vehicle</td>
<td>1.14 (1.03-1.27)</td>
<td>1.01 (0.94-1.08)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>1.76 (1.55-1.99)</td>
<td>1.96 (1.75-2.19)</td>
</tr>
<tr>
<td>Bicycle</td>
<td>1.24 (1.12-1.37)</td>
<td>1.18 (1.08-1.29)</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>0.98 (0.82-1.17)</td>
<td>0.64 (0.59-0.70)</td>
</tr>
</tbody>
</table>

Disparities by area

IRRs (incidence rate ratios)

Aboriginal rate higher

Non-Aboriginal rate higher

Pedestrian

Bicycle

Motorcycle

Small vehicle

Rank of Statistical Local Area by effect size

Pedestrian injury rate ratio

+ = Aboriginal rate significantly higher

Aboriginal rate higher
Non-Aboriginal rate higher

Kempsey
Griffith
Albury
Tweed Heads
Ballina
Richmond Valley (Bal)
Grafton
Coffs Harbour (Pt A & Pt B)
Armidale
Nambucca
Kempsey
Greater Taree
Dubbo
Narromine
Parkes
Orange
Bathurst
Shoalhaven (Pt A)
Eurobodalla
Bega Valley

Falster MO, Randall DA, Lujic S, Ivers R, Leyland AH, Jorm LR.
Summary - Serious road traffic injuries

Where are the gaps?

Small vehicle injuries
- Aboriginal people have higher risk of small vehicle injuries on average, but due to area of residence – within areas, there is no difference in risk.
- Overall risk for all is highest in regional areas, and safety campaigns and population-wide interventions are needed.

Bicycle and pedestrian injuries
- Within areas, Aboriginal people have higher risk of bicycle and pedestrian injuries.
- Targeted interventions needed in high risk areas.
Cataract surgery

- Procedure rates in NSW 2001 to 2008:
  - 641 per 100,000 for Aboriginal people
  - 863 per 100,000 for non-Aboriginal people
  - Rate ratio of 0.74 (0.71–0.77)

- Despite evidence that Aboriginal people have a higher prevalence of cataracts

Disparity in cataract surgery by SES and remoteness

Disparity is greatest in less disadvantaged and more urban areas

Socio-economic status of area of residence

Remoteness of area of residence
Areas with higher rates of cataract surgery in Aboriginal people

Summary – Cataract surgery rates

Aboriginal people are less likely to get cataract surgery than non-Aboriginal people, particularly in major cities, despite evidence that rates of cataract higher in Aboriginal people.

Areas with targeted services for Aboriginal people go against the trend!

To increase the numbers of cataract surgeries provided, issues of availability and accessibility of public services, cost, and cultural competency in each region, particularly in major cities, need to be improved.
The Seeding Success Study

Born in NSW
(Birth registrations, perinatal records)

Started school 2009/12
(Australian Early Development Census)

166,278 children

What is currently in the data resource?
Primary outcome: child development at age five

Australian Early Development Census: collected every three years nationally since 2009
What is the risk of developmental vulnerability at age five by maternal age at childbirth in Aboriginal and non-Aboriginal children?

Births by maternal age at childbirth and Aboriginality

Legend: Light blue, non-Aboriginal births.

Births by maternal age at childbirth and Aboriginality

Legend: Light blue, non-Aboriginal births; light red, Aboriginal births.

Risk of vulnerability on one or more domains of child development by maternal age and Aboriginality

Legend: Light blue, non-Aboriginal births; light red, Aboriginal births; dark blue, vulnerability non-Aboriginal children.

Risk of vulnerability on one or more domains of child development by maternal age and Aboriginality

Legend: Light blue, non-Aboriginal births; light red, Aboriginal births; dark blue, vulnerability non-Aboriginal children; dark red, vulnerability Aboriginal children.

What is the **magnitude of the inequality** in child development outcomes across the maternal age range?

How much of the inequality can be explained by differences in **demographic characteristics and modifiable early childhood exposures**?

Aboriginal-to-non-Aboriginal risk difference by maternal age at childbirth

Summary of findings

- Aboriginal babies are born to younger mothers
- Children born to young mothers have highest risk, regardless of Aboriginality
- Aboriginal children have higher risk across the maternal age range
- Absolute inequality increases with increasing maternal age
- Differences in socio-demographic characteristics and modifiable exposures account for some of the inequality

Conclusions

• Whole-of-population linked routinely collected data methods have unique power to explore health disparities
  – “unpack” contributions of personal, geographic and service factors
  – identify targets for intervention

• It is essential that geography is taken into account in studies of health disparities
  – especially where there are significant urban-rural differences in the distribution of disadvantaged populations and health services

• The simplest of data linkages hugely increases the value of routinely collected data!