‘Rurality’ and Geographic Amenity: How they relate to rural primary care accessibility and workforce retention

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Visiting Scholar, RGC
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About me

- Training: Statistics (general), IT (programming)
  - Research assistant in various health related projects

- PhD: 2008 (Australia)
  - Supervised by a geographer, rural health focus
  - Aim to better measure spatial differences of access
  - Development of the 2SFCA methodology
My home

Melbourne

[Map of Australia with Melbourne marked]
Australian policies...

The new rural classification system comes into force next year, but its many anomalies have perplexed GPs throughout Australia.
Australia’s population

Metropolitan =
- 69.9% population
- 0.2% area

Rural / regional =
- 27.8% population
- 13.4% area

Remote =
- 2.3% population
- 86.4% area
Compared to metropolitan residents...

- Life expectancy of rural Australians about 4 years lower and >10 years lower for Indigenous in rural
- Key lifestyle risks – e.g. smoking, obesity, alcohol, activity – higher prevalence in rural
- Rural/regional utilise 15-20% less GP services and 25-40% less specialist services
- Remote utilise 30-40% less GP services and 60-70% less specialist services
My research theme(s)

- Chronic shortages and maldistribution of the rural health workforce
- Primary care is the system entry point
- Drivers and levers for change through health policy
- ...but poor awareness where and how to target support(s)

Key themes:

- Improved measures of workforce shortage and accessibility
- Improved understanding of rural medical workforce supply and distribution
- Improved resource allocation via evidence-based policies
Key project 1: MABEL

MABEL = Medicine in Australia: Balancing Employment and Life

- National longitudinal study of 15-20% of all doctors
- Yearly survey, began in 2008, currently completing Wave 7 (funding for another 2 years) with yearly retention of 80% participants
- Survey includes >80 questions, most repeated yearly
- About 3000-3500 GPs
- About 3800-4300 Specialists

http://mabel.org.au
Rural workforce supply and distribution theme:

• To better understand decisions to stay in, or leave, rural and remote areas
• To provide evidence of the effectiveness of rural medical workforce policies

2010 – now...

• 11 publications (e.g. professional satisfaction, rural background, rural location preferences, mandated IMGs, specialist outreach, retention incentive preferences)
“The Coalition Government has listened to these [previous perverse incentive] concerns, and will now introduce a new classification system, the Modified Monash Model (MMM), for the purposes of health workforce programmes.”

…MMM developed by Prof John Humphreys and Dr Matthew McGrail
Key project 2: CRERRPHC

CRERRPHC = Centre of Research Excellence in Rural and Remote Primary Health Care

Supported by APHCRI 2011-2014

• **Stream 1:** Develop a better understanding and improved measure of access to PHC services
• **Stream 2:** Develop an evaluation framework for monitoring impact of PHC services on access and equity of health outcomes
• **Stream 3:** Develop and evaluate appropriate sustainable PHC service models in priority health areas

[https://www.crerrphc.org.au/](https://www.crerrphc.org.au/)
Key aim...to develop a national-level measure of (rural) primary care accessibility that is:

- Constructed using **smallest** possible geographical unit
- Uses **current, accurate** data and latest methodologies
- **Sensitive** to data input changes

- **Two-step floating catchment area (2SFCA) method**
Spatial accessibility

• Rural population’s perspective...
  – Spatial accessibility to primary care is key
  – Must be adequate supply (volume and type) to meet community needs
  – Must be within reach (proximal)
Provider: population ratios (PPRs)

- Provider: population ratios (PPRs) are a widely used measure of spatial accessibility in health.

Key assumptions:
1. All access occurs within region boundary
2. Proximity barrier is negligible
PPRs in (rural) health policy

PPRs have a strong appeal in health policy:
• easily understood (e.g. 1:2,000)
• easy to calculate

• In USA health policy, PPRs a component of both MUA (Medically Underserved Area) and HPSA (Health Professional Shortage Areas)

• In Australian health policy, PPRs define DWS status (District of Workforce Shortage)
Key assumptions:

1. All access occurs within region boundary
   *Increasingly true as regions grow in size*

2. Proximity barrier is negligible
   *Increasingly true as regions shrink in size*

Problem...conflicting issues
The 2SFCA method

Step 1: For each service location (j) of volume $S_j$, determine what population size (summed $P_k$) can potentially access that service (up to the catchment border = $d_{\text{max}}$)

$$ R_j = \frac{S_j}{\sum_{k \in [d_{jk} < d_{\text{max}}]} P_k \cdot f(d_{jk})} $$

Step 2: For each population location (i), determine what services (j) can potentially be accessed by that population (up to the catchment border = $d_{\text{max}}$), and aggregate the PPRs for these services ($R_j$)

$$ A_i = \sum_{j \in [d_{ij} < d_{\text{max}}]} R_j \cdot f(d_{ij}) $$
Travel differences

Similar shape to distance-decay functions seen earlier.

![Kaplan-Meier survival function](chart)

<table>
<thead>
<tr>
<th>Percentiles (minutes)</th>
<th>Closely-settled (minutes)</th>
<th>Sparsely-settled (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>31.9</td>
<td>54.1</td>
</tr>
<tr>
<td>10th</td>
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</tr>
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<td>25th</td>
<td>20</td>
<td>30</td>
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<td>50th</td>
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<td>45</td>
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<td>75th</td>
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<td>60</td>
</tr>
<tr>
<td>90th</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>95th</td>
<td>60</td>
<td>120</td>
</tr>
</tbody>
</table>
Variable rural catchments

Catchment sizes are intended to ‘match’ population behaviour:

• Travel behaviour relates to population dispersion
• Service catchments grow in more dispersed settings (providing services to a wider area)
• Population catchments also grow in more dispersed settings (accepting of further travel)

*Thus, the 2SFCA method should match these traits in ‘more rural’ areas.*
RGC – Project 1: “Accessibility”

Starting point = accessibility for Australia (2SFCA)

**Aim:** To explore, using a comparison of Australia and the USA, what contributes to spatial differences of primary care accessibility in rural areas:

- ‘Rurality’
- Place attractiveness (geographic amenity)
- State-level policies

• Expand to USA model
### ‘Rurality’: Australia vs USA

<table>
<thead>
<tr>
<th>Rurality</th>
<th>Area (Mi²)</th>
<th>Population</th>
<th>% Area</th>
<th>% Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUCC 1</td>
<td>281,947</td>
<td>168,523,961</td>
<td>9.5%</td>
<td>55.0%</td>
</tr>
<tr>
<td>RUCC 2-3</td>
<td>660,936</td>
<td>92,341,638</td>
<td>22.4%</td>
<td>30.1%</td>
</tr>
<tr>
<td>RUCC 4-5</td>
<td>363,410</td>
<td>18,208,687</td>
<td>12.3%</td>
<td>5.9%</td>
</tr>
<tr>
<td>RUCC 6-7</td>
<td>1,055,028</td>
<td>22,898,842</td>
<td>35.7%</td>
<td>7.5%</td>
</tr>
<tr>
<td>RUCC 8-9</td>
<td>593,521</td>
<td>4,701,878</td>
<td>20.1%</td>
<td>1.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,954,842</strong></td>
<td><strong>306,675,006</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remoteness</th>
<th>Area (Mi²)</th>
<th>Population</th>
<th>% Area</th>
<th>% Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASGC-1</td>
<td>24,527</td>
<td>15,064,833</td>
<td>0.3%</td>
<td>70.2%</td>
</tr>
<tr>
<td>ASGC-2</td>
<td>345,447</td>
<td>3,982,691</td>
<td>4.5%</td>
<td>18.6%</td>
</tr>
<tr>
<td>ASGC-3</td>
<td>1,067,865</td>
<td>1,952,011</td>
<td>13.9%</td>
<td>9.1%</td>
</tr>
<tr>
<td>ASGC-4</td>
<td>998,895</td>
<td>280,164</td>
<td>13.0%</td>
<td>1.3%</td>
</tr>
<tr>
<td>ASGC-5</td>
<td>5,250,857</td>
<td>176,014</td>
<td>68.3%</td>
<td>0.8%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>7,687,591</strong></td>
<td><strong>21,455,713</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Spatial accessibility

Despite problems of PPRs, only measure in USA (by counties)

Equivalent PPR by Local Government Areas (Oz)

2sfca measure by town
Place attractiveness

Economic:
• House price, Income, Uninsured, Exercise

Proximity (near to) [and rurality]:
• Hospital, Metropolitan/Capital, Schools & Coastline (Aus), Work commute, Population

Socio-demographic:
• Education, Indigenous, Unemployed, Aged 65+

State (included, not explored):
Analysis: Linear Regression

3* Linear regression models (popu size weighted):
Dependent (outcome) = accessibility score for each location:
- USA – County (N=1949): $R^2 = 0.49$
- Aus – LGA (N=397): $R^2 = 0.40$
- Aus – Town (N=1091) [pop 500–50,000]: $R^2 = 0.38$

Independent (‘predictors’) = economic, proximity / rurality, socio-demographic, state
USA model

Higher accessibility
- Higher house value
- More 'affluence' (exercise)
- RUCC 6/7 wrt 8/9
- RUCC 4/5 wrt 8/9
- More 65+
- More educated

Lower accessibility
- More uninsured
  - More income
- Longer commute
- Adjacent to metro
- No hospital in region
- More American/Indian
- More unemployed
Australian models

Town-level:

Higher accessibility
- Close to private schools
- Close to coastline
- Close to State capitals
- Larger population
- More educated
  - Remote areas

Lower accessibility
- Indigenous

Region-level:

Higher accessibility
- Larger population
- Increased pop. Density
- Having a hospital
- Higher house value
- More 65+
  - More unemployed
STRONG factors – higher accessibility:

• Larger town/community population
  *Doctors prefer to work in larger support networks*

• Located near to a hospital
  *Doctors prefer not to work in professional isolation*

• Increased house price / affluence
  *Doctors prefer to work/live in ‘nice’ areas*
Results: comparison (2)

MODERATE factors – higher accessibility:

- **Aus**: Nearby to coastline / capital city
  - ‘Nice’ areas and within reach of larger cities
- **US**: More insured, US/Aus: More educated
  - ?Affluence, earning capacity
- **Aus**: Few indigenous
  - Higher prevalence in extreme remote regions
- **US/Aus**: More age 65+
  - Unsure if ‘attraction’ or just higher demand / need
So what?

**Original aim:** What contributes to spatial differences of accessibility?

These data help to unpack ‘rural’ coming in many different ‘flavours’…and health policy / incentives need to reflect these differences.

More of this:

**Senator the Hon Fiona Nash**
Assistant Minister for Health
Senator for New South Wales
Deputy Leader of the Nationals in the Senate

MEDIA RELEASE

31 October 2014

Government Announces Changes to Attract More Doctors to the Bush
RGC – Project 2: “Rural retention”

Accessibility = $f_x$ (current ‘stock’, recruitment, retention, mobility)

**Aim:** To explore, using observed USA rural workforce, what contributes to spatial differences of rural primary care retention
Retention measures

Dataset = AMA (2000-2014, all even years), primary care, active, non-resident only
Retention = Same ‘rurality’ (RUCC) after 2 years (up to 7 periods per doctor).

(1) ‘Churn’ or ‘turnover’ = volume not retained / total observed doctors (per county)
(2) ‘To less rural’ = individuals who move to a more urban RUCC, but stay within rural areas
(3) ‘To urban’ = individuals who move rural to urban
# Observed locations:

<table>
<thead>
<tr>
<th>Origin RUCC</th>
<th>Destination RUCC</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>868,710</td>
<td>13,066</td>
<td>5,264</td>
<td>2,270</td>
<td>797</td>
<td>1,808</td>
<td>960</td>
<td>192</td>
<td>211</td>
<td>893,278</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>12,673</td>
<td>296,542</td>
<td>3,753</td>
<td>1,863</td>
<td>550</td>
<td>1,560</td>
<td>871</td>
<td>201</td>
<td>175</td>
<td>318,188</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>5,098</td>
<td>3,723</td>
<td>120,469</td>
<td>1,019</td>
<td>351</td>
<td>1,305</td>
<td>523</td>
<td>151</td>
<td>117</td>
<td>132,756</td>
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<tr>
<td>4</td>
<td></td>
<td>2,112</td>
<td>1,875</td>
<td>1,029</td>
<td>48,067</td>
<td>150</td>
<td>530</td>
<td>327</td>
<td>49</td>
<td>74</td>
<td>54,213</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>778</td>
<td>644</td>
<td>423</td>
<td>167</td>
<td>22,127</td>
<td>210</td>
<td>341</td>
<td>43</td>
<td>129</td>
<td>24,862</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>1,881</td>
<td>1,694</td>
<td>1,510</td>
<td>598</td>
<td>221</td>
<td>46,372</td>
<td>471</td>
<td>116</td>
<td>122</td>
<td>52,985</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>1,004</td>
<td>910</td>
<td>672</td>
<td>382</td>
<td>398</td>
<td>486</td>
<td>32,019</td>
<td>90</td>
<td>255</td>
<td>36,216</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>205</td>
<td>215</td>
<td>166</td>
<td>91</td>
<td>40</td>
<td>150</td>
<td>91</td>
<td>4,585</td>
<td>38</td>
<td>5,581</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>244</td>
<td>204</td>
<td>167</td>
<td>64</td>
<td>176</td>
<td>145</td>
<td>308</td>
<td>47</td>
<td>6,887</td>
<td>8,242</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td>892,705</td>
<td>318,873</td>
<td>133,453</td>
<td>54,521</td>
<td>24,810</td>
<td>52,566</td>
<td>35,911</td>
<td>5,474</td>
<td>8008</td>
<td>1,526,321</td>
</tr>
</tbody>
</table>
‘Churn’ outcome:

Example:
2000: 20 active doctors  ...  2002: 16 stayed, 4 moved
   2002: 6 new + 16 stayed = 22 active doctors
2002: 22  ...  2004: 14 stayed, 8 moved

County retention rate =
   # stayers = 30 / # observed = 42 = 71%
i.e. Churn / turnover rate = 29%
Churn: Regression results

Dependent (outcome) = ‘retention’ rate per rural county (N=1686).

Independent (‘predictors’) = county-level factors:
  - accessibility, economic, proximity / rurality, socio-demographic, state.

3 strong significant area-level predictors only:
  - Having a hospital in region
  - Increased population size (RUCC)
  - Higher accessibility value
Accessibility: Counties already experiencing lower accessibility also see increased turnover - poorer supply and continuity of care.

No hospital: Increased turnover where doctors are more isolated and patients already have poorer access to alternative care.

Smaller urban towns: Regions with smaller critical mass and where a loss of services impacts greatest, experience higher turnover.
Individual retention: Regression results

All rural primary care / family physician doctors:

Outcome 1: Mover to less rural:
- Female
- Osteopathic
- Young
- IMG
- Urban-born
- Low accessibility area
- Low income area
- Low house value area
- No hospital
- Has more 65+ population
- Has fewer African-Indian
- Has fewer Hispanic

Outcome 2: Mover to urban:
- Female
- Osteopathic
- Young
- IMG
- Urban-born
- Low accessibility area
- Higher income area
- Higher house value area
- More unemployed
- Smaller population size
- Adjacent to metropolitan
- Has fewer 65+ population
- Has more African-Indian
- Has more Hispanic
Individual retention: Regression results

Young (<10 year post-residency) family physician:

Outcome 1: Mover to less rural:
- No gender difference
- Osteopathic
- No IMG difference
- No urban-born difference
- Low accessibility area
- Low house value area
- No hospital
- Has more 65+ population

Outcome 2: Mover to urban:
- Female
- No MD/DO difference
- IMG
- Urban-born
- Low accessibility area
- Has fewer 65+ population
- No hospital
- Smaller population
- Adjacent to metropolitan
So what?

- Significant factors include both individual-level and area-level
- Factors influencing retention of ‘young’ doctors are different – critical to future supply
- Retention of rural primary care doctors is critical to maintaining accessibility
- Health policies must target doctors working in ‘problematic’ rural settings
Thanks

Great experience to immerse myself in USA setting.

I intend to continue collaborative research with RGC staff for many years ($s)...