Urban-rural differences in prostate cancer outcomes in Australia: what has changed?

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ABSTRACT

OBJECTIVE: To update trends previously reported to assess whether men in rural and urban areas of Australia now have more equitable access to prostate cancer services resulting in better outcomes.

DESIGN: Descriptive study using population-based data from 1982 to the 2008/09 financial year (depending on data availability).

SETTING: Australia.

PATIENTS, PARTICIPANTS: Men aged 50–79 years.

MAIN OUTCOME MEASURES: Age-standardised rates per 100 000 men aged 50–79 years for incidence of prostate cancer, PSA tests, radical prostatectomy and prostate cancer mortality and 5-year survival rates.

RESULTS: Despite overall increasing rates of PSA screening and radical prostatectomy, reductions in mortality and improvements in survival throughout Australia, the excess of prostate cancer mortality for men living in regional and rural areas has actually continued to increase. In an environment of similar incidence rates, mortality was higher in rural areas compared with urban areas (rural: 56.9/100,000; urban: 45.8/100,000; p<0.01); rates of radical prostatectomy (rural: 182.2/100,000; urban: 239.2/100,000; p<0.01) and PSA screening (rural: 21,267.4/100,000; urban: 24,605.9/100,000; p<0.01) continue to be lower among rural men; and survival outcomes remain poorer among rural men (5-year relative survival, rural: 87.7%; urban 91.4%; p<0.01).

CONCLUSIONS: With some limitations, these ecological data demonstrate that the utilisation of diagnostic and treatment services among men living in rural areas of Australia remains lower than their urban counterparts, their survival and mortality outcomes are poorer, and these differentials are continuing. There is an urgent need to further explore reasons for these differences and implement changes so these inequalities can be addressed.
INTRODUCTION
In a previous study \[1\] we described a statistically significant and increasing excess for prostate cancer mortality in regional and rural areas of Australia compared with capital cities. These results showed that the probability of having a PSA test, subsequent management of prostate cancer by radical prostatectomy as well as the likelihood of survival depended on where a man lived.

With the increasing focus on health inequalities experienced by Australians living in rural areas,\[2\] and the ability of reported trends to change with extended time periods,\[3, 4\] we felt it important to update and disseminate previously reported trends to assess whether men in Australia now have more equitable access to prostate cancer services in both urban and rural areas and to monitor cancer outcomes.

METHODS
Similar methodology to that reported previously \[1\] was used, with the addition of data on survival and PSA screening (see Table 1). The introduction of a Medicare item number specifically for PSA screening was fully introduced in the 2001/02 financial year. Age was limited to 50-79 years and geography based on usual address at diagnosis categorised into “Capital City” versus rest of Australia according to Statistical Divisions.

Directly age-standardised (2001 Australia) rates per 100,000 men aged 50-79 years were calculated for each of the outcome measures, stratified by geographical location. The ratios of the age-standardised rates for men from regional/rural areas compared to men living in capital cities were also computed each year for the various outcome measures. Joinpoint regression was used to determine the associated trend lines.\[5\]

Relative survival was calculated using the cohort method, with mortality follow-up to December 31st 2006. Hazard ratios comparing the survival outcomes for rural and urban men were calculated for the diagnosis periods: 1982-89, 1990-99 and 2000-04.
RESULTS

**PSA testing and screening**: PSA testing has increased in both urban and rural areas (Figure 1), although the converging trends meant that the rate ratio (rural:urban) for PSA testing has moved significantly closer to unity over time, from 0.76 (95%CI=[0.75,0.76]) in 1995/96 to 0.93 (95%CI=[0.93,0.94]) in 2008/09. The incidence of PSA tests carried out specifically for screening purposes has also increased in urban and rural areas (Figure 1). In contrast to the rates for all PSA testing, the rural:urban rate ratio in PSA screening has exhibited a small (non-significant) shift away from one over time (Figure 2).

**Incidence**: Due to similar prostate cancer incidence trends over time (Figure 1), the rural:urban incidence rate ratio has tended to fluctuate around unity or slightly below for most of the study period (Figure 2). In 1986-1991, the percentage of men diagnosed who were 50-59 years was similar in urban and rural areas (6.7% versus 6.8%; p=0.232) while in 2000-2005 the percentage had increased and was higher in urban areas (19.5% versus 16.4%; p<0.001).

**Radical Prostatectomy**: There was a sharp increase in the age-standardised rate of radical prostatectomy procedures during the study period from 1999/00 onwards. Men living in regional and rural areas remained significantly less likely to have had a radical prostatectomy compared with their capital city counterparts (Figure 2), with a rate ratio of 0.76 (95%CI=[0.72,0.80]) in 2007/08.

**Survival**: Nationally, 5-year survival among men diagnosed with prostate cancer increased from 61.3% (95%CI=[60.5%,62.1%]) during the 1980s up to 83.7% (95%CI=[83.3%,84.1%]) in the 1990s and 89.9% (95%CI= [89.4%,90.4%]) during the early 2000s. While these increases were evident among men living in both urban and rural areas, survival was lower among rural men, with this differential widening over time (Figure 3).

**Mortality**

The decrease in prostate cancer mortality that commenced in 1993 for both urban and rural areas has continued up to 2007 (Figure 1). Prostate cancer mortality among men in rural areas has, however, remained significantly higher than in urban areas (Figure 2) with the rural:urban rate ratio increasing over time to 1.24 (95%CI=[1.11,1.38]) in 2007 (Figure 2).
DISCUSSION

Although incidence rates in both urban and rural parts of Australia are similar, the most recent data available shows that mortality was higher in rural areas compared with urban areas (consistent with the excess in all-causes mortality experienced by men living in rural areas of the country\[6\]); rates of radical prostatectomy and PSA screening continue to be lower among rural men; and although survival rates for prostate cancer in Australia are among the highest in the world,\[7\] survival outcomes remain poorer among rural men.

The distinctive prostate cancer incidence rate trends over time are strongly influenced by the uptake of PSA screening\[4\]. In isolation, similar incidence trends could suggest that PSA screening has had an equivalent impact on the diagnosis of prostate cancer in urban and rural areas. This hypothesis is countered by the consistently lower rates of PSA screening in rural areas demonstrated in this study. Similar incidence trends, lower rates of PSA screening and lower rates of radical prostatectomy (a procedure specific to the treatment of localised prostate cancer) would, however, be consistent with the hypothesis that a greater proportion of prostate cancers diagnosed in rural areas of Australia are diagnosed due to symptoms, as reported previously in New South Wales\[8\] and reinforced by the different age distributions at diagnosis.

Problematically, data on stage or even serum PSA at diagnosis is not available on a national basis. The previous NSW study also reported poorer survival outcomes \[8\] and lower rates of radical prostatectomy\[9\] among rural men diagnosed with prostate cancer, and, while stage was an important factor, these differentials still remained after adjusting for spread of disease, suggesting there may be other unknown factors involved in the survival differential.

Even in an environment of equitable PSA screening, the extent to which prostate cancer patients have access to different treatment options and follow up care is unknown. For example, in the absence of clear national guidelines surrounding the results of PSA screening, systematic variation in practice may occur. As well, in regional areas where urological and radiation services are sparser, patterns of care will vary. Further research is required to quantify the associations between prostate cancer diagnostic and treatment outcomes and key area-level characteristics and individual-level demographic, clinical and psychosocial factors\[10\] so that health services policy and planning strategies to manage this illness can be guided by evidence.
Of the variables included in this study PSA screening is the most amenable to change. Recommending an increase in the rate of PSA screening in rural areas is currently problematic because of the equivocal and controversial evidence supporting PSA screening. Since our earlier report[11], initial results of two large-scale prostate cancer screening trials have been published[11, 12]. Although results were analysed at earlier follow-up time points than is optimal for assessing prostate cancer survival benefit, these international studies suggest that in the presence of already high PSA testing, organised PSA population screening programs are likely to result in over-diagnosis and overtreatment with little reduction in mortality.[13] Conversely, where the prevalence of asymptomatic detection is low, there is some evidence of greater potential for screening programs to save lives.[14]

It remains unclear whether raising the prevalence of PSA screening would reduce the inequity in outcomes among rural men in Australia, given our data show a relatively high level of screening (25% of rural compared with 28% of urban men) already occurs. Any negatives need to be weighed against lower rates of surgical treatment, poorer survival and higher mortality due to prostate cancer in regional and rural parts of the country. It has been suggested that under these circumstances, a well-co-ordinated screening program, in conjunction with improved access to specialised diagnostic, monitoring and treatment services, may reduce the incidence of advanced prostate cancer[13].

Due to the difficulties in obtaining a consistent geographical concordance across time, we were intentionally conservative in defining urban areas. It is likely that the “rural” group contains a substantial proportion of men living on the outskirts of the capital city boundaries and enjoying similar access to diagnostic and treatment services as those men living in capital cities. Thus our results could reflect an underestimate of the true rural:urban differential. That we were unable to obtain population-based data on the use of radiotherapy procedures is a limitation, since this is the other major form of treatment with curative intent for men with prostate cancer.[13] Finally, it remains possible that the lack of change in the mortality differential is influenced by the longer time-delay effect from prostate cancer diagnosis to death,[15] however with each passing year since the widespread introduction of PSA testing in Australia in 1993 this explanation is looking less likely.

While ecological data such as these can highlight inequalities in service utilisation and outcomes, they are unable to establish causes. However, given that these data demonstrate that the utilisation of diagnostic and treatment services among men living in rural areas of Australia is lower than their urban counterparts, that their survival and mortality outcomes are consistently poorer, and that
these differentials are continuing, these results demonstrate the urgency to further explore reasons for these differences and implement changes so these inequalities can be addressed.
Table 1: Details for outcome measures reported in this study

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Time period</th>
<th>Codes</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSA Testing</td>
<td>1995/96-2008/09</td>
<td>MIN: 66655, 66656, 66659, 66660</td>
<td>Medical Benefits Division, Department of Health and Ageing</td>
</tr>
<tr>
<td>PSA Screening</td>
<td>2001/02-2008/09</td>
<td>MIN: 66655</td>
<td>Medical Benefits Division, Department of Health and Ageing</td>
</tr>
<tr>
<td>Radical prostatectomy</td>
<td>1995/96-2007/08</td>
<td>ICD-9-CM: 60.5;</td>
<td>Hospitals Unit, Australian Institute of Health and Welfare</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ICD-10-AM: 37209-00, 37210-00, 37211-00</td>
<td></td>
</tr>
</tbody>
</table>

Note: Mortality data was based on year of death except for the latest year (2007) which was based on year of registration of death.
Population data provided by the Australian Bureau of Statistics.

Abbreviations:  ICD = International Classification of Diseases.
MIN = Medical Item Number
CM = Clinical modification
AM = Australian modification.
PSA Testing/Screening Trends for all PSA testing rates:
- Capital city: 1995/96-2008/09 = +5.7% (+5.0%,+6.3%)
- Regional/rural: 1995/96-2002/03 = +5.9% (+4.2%,+7.7%)
  2002/03-2008/09 = +9.1% (+7.5%,+10.7%)

Trends for PSA screening rates only:
- Capital city: 2001/02-2008/09 = +7.1% (+4.8%,+9.4%)
- Regional/rural: 2001/02-2008/09 = +6.0% (+4.1%,+7.8%)

Incidence Trends for prostate cancer incidence rates:
- Capital city
  - 1986-1994 = +15.8% (+11.6%,+20.2%)
  - 1994-1998 = -9.5% (-20.0%,+2.4%)
  - 1998-2005 = +5.6% (+2.4%,+8.9%)
- Regional/rural
  - 1986-1994 = +13.9% (+10.3%,+17.7%)
  - 1994-1998 = -8.6% (-18.1%,+2.1%)
  - 1998-2005 = +6.3% (+3.5%,+9.1%)

Radical Prostatectomy Trends for radical prostatectomy rates:
- Capital city
  - 1995/96-1999/00 = +4.0% (-7.7%,+17.2%)
  - 1999/00-2007/08 = +14.8% (+11.7%,+17.9%)
- Regional/rural
  - 1995/96-1999/00 = +9.7% (-3.1%,+24.1%)
  - 1999/00-2007/08 = +14.7% (+11.8%,+17.6%)

Mortality Trends for prostate cancer mortality rates:
- Capital city
  - 1985-1993 = +2.4% (+1.1%,+3.6%)
  - 1993-2007 = -3.3% (-3.8%,-2.8%)
- Regional/rural
  - 1985-1993 = +3.0% (+1.2%,+4.9%)
  - 1993-2007 = -2.8% (-3.4%,-2.1%)

Notes: 
1. Rates are age-standardised to the 2001 Australian Standard Population.
2. Trends modelled using joinpoint regression.
3. Linear trends are expressed in terms of estimated average yearly percentage change, with 95% confidence intervals shown in brackets.
Figure 2: Rate ratios for regional/rural areas compared to capital cities for PSA screening, prostate cancer incidence, radical prostatectomy and prostate cancer mortality by locality

### PSA Screening

Trend for PSA screening rate ratios:
2001/02-2008/09 = -1.0% (-2.4%, +0.3%)

### Incidence

Trends for prostate cancer incidence rate ratios:
1986-1995 = -1.3% (-2.2%, -0.4%)
1995-2005 = +0.8% (+0.3%, +1.4%)

### Radical Prostatectomy

Trend for radical prostatectomy rate ratios:
1995/96-2007/08 = +1.0% (-0.0%, +2.1%)

### Mortality

Trend for prostate cancer incidence rate ratios:
1985-2007 = +0.6% (+0.2%, +1.0%)

Notes:
1. Y-axis is shown on a log scale.
2. Graphs show point estimates for rate ratios with 95% confidence intervals.
3. Linear trends are expressed in terms of estimated average yearly percentage change, with 95% confidence interval shown in brackets.
Figure 3: Relative survival estimates for Capital city and Rural/Regional areas (with 95% confidence intervals).

Hazard ratios for men with prostate cancer in rural/regional areas compared to capital cities (95% confidence intervals shown in brackets):
1982-1989  1.01 (0.97-1.05)
1990-1999  1.14 (1.11-1.17)
2000-2004  1.24 (1.17-1.31)
REFERENCES