*Family Practice*, 2018, Vol. 35, No. 2, 193–198
doi:10.1093/fampra/cmx087
Advance Access publication 8 September 2017

OXFORD

Health Service Research

# The never ending road: improving, adapting and refining a needs-based model to estimate future general practitioner requirements in two Australian states

**Caroline O Laurence[a,*], Troy Heywood[a], Janice Bell[b], Kaye Atkinson[b] and Jonathan Karnon[a]**

[a]School of Public Health, The University of Adelaide, Adelaide, South Australia, Australia [b]Western Australian General Practice Education and Training, Perth, Western Australia, Australia.

*Correspondence to Caroline O Laurence, School of Public Health, The University of Adelaide, Adelaide, South Australia 5005, Australia; E-mail: caroline.laurence@adelaide.edu.au

## Abstract

**Background.** Health workforce planning models have been developed to estimate the future health workforce requirements for a population whom they serve and have been used to inform policy decisions.
**Objectives.** To adapt and further develop a need-based GP workforce simulation model to incorporate current and estimated geographic distribution of patients and GPs.
**Methods.** A need-based simulation model that estimates the supply of GPs and levels of services required in South Australia (SA) was adapted and applied to the Western Australian (WA) workforce. The main outcome measure was the differences in the number of full-time equivalent (FTE) GPs supplied and required from 2013 to 2033.
**Results.** The base scenario estimated a shortage of GPs in WA from 2019 onwards with a shortage of 493 FTE GPs in 2033, while for SA, estimates showed an oversupply over the projection period. The WA urban and rural models estimated an urban shortage of GPs over this period. A reduced international medical graduate recruitment scenario resulted in estimated shortfalls of GPs by 2033 for WA and SA. The WA-specific scenarios of lower population projections and registrar work value resulted in a reduced shortage of FTE GPs in 2033, while unfilled training places increased the shortfall of FTE GPs in 2033.
**Conclusions.** The simulation model incorporates contextual differences to its structure that allows within and cross jurisdictional comparisons of workforce estimations. It also provides greater insights into the drivers of supply and demand and the impact of changes in workforce policy, promoting more informed decision-making.

**Key words:** General practice, health manpower, health service needs and demands, policy

## Introduction

Health workforce planning models have been developed to estimate the future health workforce requirements for a population whom they serve. They have been used extensively by governments to inform policy decisions and have become more sophisticated as data and methods improve. Simplistically, these models determine the supply of the workforce, the demand or need for the workforce and identify if any gaps exist between these two elements over a projection period. The approach taken to measure supply tends to be similar across most models, with most using a stock and flow approach, with

some models incorporating cohort differences when measuring the flow of stock (1–3). In contrast, there are a variety of approaches for measuring demand, ranging from simple benchmarking to complex needs-based measures (4–7). In addition to estimating future requirements, the more sophisticated simulation models can also be used to assess the impact of policy scenarios on different determinants of supply and demand to assist policymakers to make the best decisions.

To date, most workforce modelling is done at a national level and focuses on one discipline area, driven in part by the availability of data. Attempts to build workforce planning models at regional levels have been undertaken in USA (8), Canada (9) and Australia (10), but this brings its own limitations such as greater chance of error and uncertainty as the geographic area reduces. This is of particular significance in Australia where the majority of the population is urban based.

The type of approach used, the jurisdictional level and the discipline chosen are often determined by the availability and quality of the data to populate the model. As data and methods improve, more complex models can be built that allow a better understanding of the drivers of demand and supply. Moreover, there is the potential to customize models to meet requirements of particular stakeholders that reflect their local requirements.

The aim of this article was to illustrate how a simulation model built for one jurisdiction was improved and expanded to become a more flexible model that incorporates geographic distribution and locally relevant assumptions and scenarios.

## Methods

### The South Australian model

A simulation model was developed for the GP workforce in South Australia (SA). Details of the model design have been published elsewhere (10). Briefly, the model has two submodels—supply and need. To estimate supply, a stock and flow approach was used which represented the flow of the current stock of GPs by age groups and sex, and new entrants (graduates and in-migration) between states of employment that reflected location (urban and rural), work status (part time and full time) and exits from the workforce (permanent and temporary). Transition probabilities were estimated for the movement of GPs between the employment states. To estimate the need for GP services, the age- and sex-specific prevalence and incidence of disease categories in SA were mapped to GP activity using data from the Bettering Evaluation and Care of Health (BEACH) Programme to estimate service requirements (numbers of consultations) by disease, age and sex. The number of full-time equivalent (FTE) GPs required to meet the predicted need for consultations was estimated annually to the year 2033.

The baseline scenario represented changes in population demographics, assuming constant age- and gender-specific disease incidence and prevalence rates to represent need and a continuing upward trend in level of services. The baseline scenario was adapted to assess the effect of various policy options, as well as uncertainty around the baseline predictions of workforce supply and population need (10). Four scenarios were applied to the needs submodel and three to the supply submodel (11).

### Extended Western Australian model

The SA model was then applied to Western Australia (WA), and in this process improvements and adaptations were made, which resulted in a more flexible but also more complex model. The key changes that were made were the following: the underlying assumptions used in the model; the policy and non-policy scenarios modelled; and the building of a separate rural and urban model.

The key differences in the input parameter values for the rural and urban models included the entry of GP registrars into the workforce, specifically the proportion entering rural or urban practice and the number of international medical graduates (IMGs) entering the WA workforce. The latter was important as 55% of rural GPs in WA in 2015 were IMGs (12). Additionally, GP working hours and average GP attendances were calculated separately for rural and urban settings by age and sex. Attendance rates for different health conditions were estimated using data on conditions managed reported for urban and rural WA by the BEACH Programme. Location was defined as either urban or rural, based on Australian Standard Geographical Classification Remoteness Areas (13). This classification system has five categories (RA1 to RA5), and for this study, they were collapsed into two: RA1 (Major cities), defined as urban, and RA2–RA5 (Inner regional, Outer regional, Remote and Very remote), defined as rural. Additionally, for the need submodel, separate population projections were obtained for the WA rural and urban populations using Series B Australian Bureau of Statistics (ABS) projections. Age- and sex-specific disease incidence and prevalence rates for the Australian population were applied to the predicted WA rural and urban populations in each year of analysis.

The scenarios used in the SA model were also included in the WA model with the addition of three scenarios (Table 1). One scenario tested the impact of lower population projections for WA, the second scenario tested the impact of unfilled GP training positions (80% of training positions filled) and the third scenario recognized the contribution that GP registrars make to the workforce while training.

To assess the impact of a policy on the different jurisdictions, the scenario that modelled a reduction in the recruitment of IMGs in rural areas was applied in SA and WA (Table 1).

To illustrate the flexibility of the simulation model developed, three sets of results will be presented. The first results compare the estimated GPs required across the two jurisdictions, SA and WA, from 2013 to 2033. The second results present the estimated GPs required for rural and urban WA based on the two separate models built. The last results are based on the scenario analysis and show the impact of registrar work value in the estimated GPs required and also compare the IMG scenario for SA and WA. The complete WA results are presented elsewhere (14).

## Results

### Jurisdiction comparison of estimated need for general practitioners in South Australia and Western Australia

The estimated GP requirements for SA and WA's base scenario are shown in Figure 1. In the base scenario for all of WA, there is an estimated shortage of GPs from 2019 onwards. This shortage is estimated to be 126 FTE GPs (95% confidence interval, CI −163 to −85) in 2023 and 493 FTE GPs (95% CI −592 to −397) in 2033. In contrast, the base scenario for SA estimates an oversupply of GPs over the projection periods, though this oversupply declines steadily to 28 FTE GPs (95% CI −93 to 260) by 2033.

### Rural and urban model for Western Australia

The estimates for the supply and need for WA GPs from the urban and rural models are shown in Figure 2. In the base scenario for urban WA, there is an estimated shortage of GPs over the entire projection period, estimated to be 315 FTE GPs (95% CI −377 to −286) in 2023 and 678 FTE GPs (95% CI −869 to −597) in 2033. The results from the rural model estimate a small excess of GPs

**Table 1.** Summary of scenarios used in this analysis

| Scenario | Description | Measures | Scenario focus |
|---|---|---|---|
| 1. Base scenario | Uses base year data—2003–2004 | Projections commence 2013 | |
| 2. Lower population projections | Slower population growth in Western Australia | Series C Population projections (lower rates of fertility, migration and life expectancy) | Non-policy |
| 3. Unfilled training places | Unfilled Australian General Practice Training positions | Only 80% Western Australia proportion of training places filled between 2015 and 2033 | Policy |
| 4. Registrar work value | General practice registrars are included in provider stock | Work value for registrars in each year of training. Year 1 (Basic and Advanced) 50% work value and Year 2 (Subsequent) 75% work value | Non-policy |
| 5. International medical graduates | Change in number of IMGs entering the workforce for rural South Australia and Western Australia | 25% decrease in number of international medical graduates entering rural general practice by age, sex and work status from 2015 | Policy |

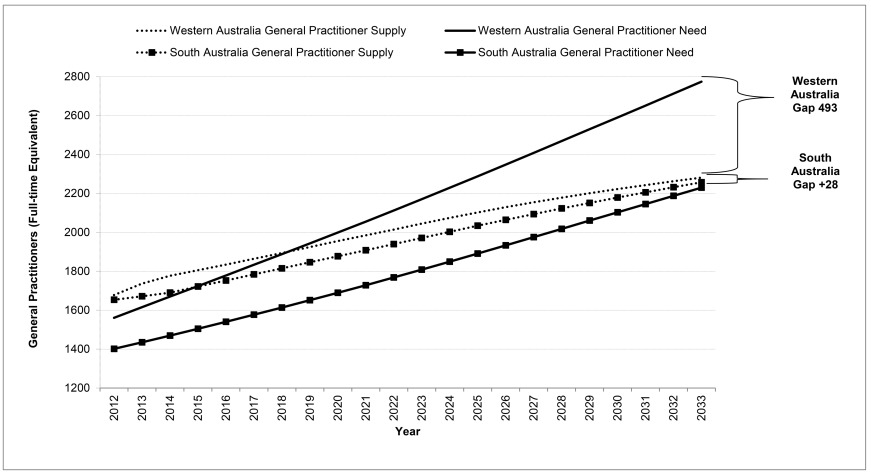


**Figure 1.** Comparison of baseline estimations of GP requirements for Western Australia and South Australia, 2013–33.

over the projection period. This excess is estimated to be 42 FTE GPs (95% CI −7 to 84) in 2023 and 2 FTE GPs (95% CI −103 to 97) in 2033.

### New scenarios

The results for the three WA-specific scenarios—lower population growth rates, unfilled training positions and registrar work value — are shown in Table 2.

Under the lower population projections scenario for all WA (using ABS Series C projections), there is an estimated shortage of GPs from 2020 onwards. This shortage is estimated to be 58 FTE GPs (95% CI −90 to −19) in 2023 and a shortage of 321 FTE GPs (95% CI −443 to −204) in 2033.

Under the 80% training places filled scenario for all WA, there is an increase in the estimated shortfall of GPs relative to the baseline scenario (Table 2). The shortage under this scenario is estimated to be 197 FTE GPs (95% CI −238 to −157) in 2023 and 633 FTE GPs (95% CI −698 to −536) in 2033.

Under the registrar work value scenarios, the contribution of registrars to the GP supply reduces the impact of the undersupply found in the base scenario. The excess is estimated to be only 21 FTE GPs (95% CI −16 to 62) in 2023 and a shortage of 344 FTE GPs (95% CI −443 to −248) in 2033 (Table 2).

### Comparison of policy scenario outcomes across two jurisdictions

A comparison of the results under the reduced IMG recruitment for WA and SA is shown in Figure 3. For both SA and WA, this scenario results in an estimated shortfall of GPs by 2033. For WA, the shortage is estimated to be 883 FTE GPs (95% CI −975 to −788) in 2033, and for SA, the shortfall of GPs is estimated to be 114 FTE (95% CI −236 to 114).

## Discussion

This article illustrates the benefits of building a flexible and adaptable simulation model to estimate the future requirements for the GP workforce in Australia. The model's structure can provide workforce estimations at a state level, a rural and urban level and can incorporate local assumptions and customized scenario analysis.

At the same time, the model allows a better understanding of drivers of demand and supply and the impact of alternative strategies on this workforce. Applying the model at the jurisdictional level moves it away from a macro-level view of the GP workforce and provides evidence on how the workforce estimations vary across states. The base scenario results for SA and WA show a very different future in terms of GP workforce requirements, with SA showing a surplus for most of the projection period and WA a shortage. A key driver

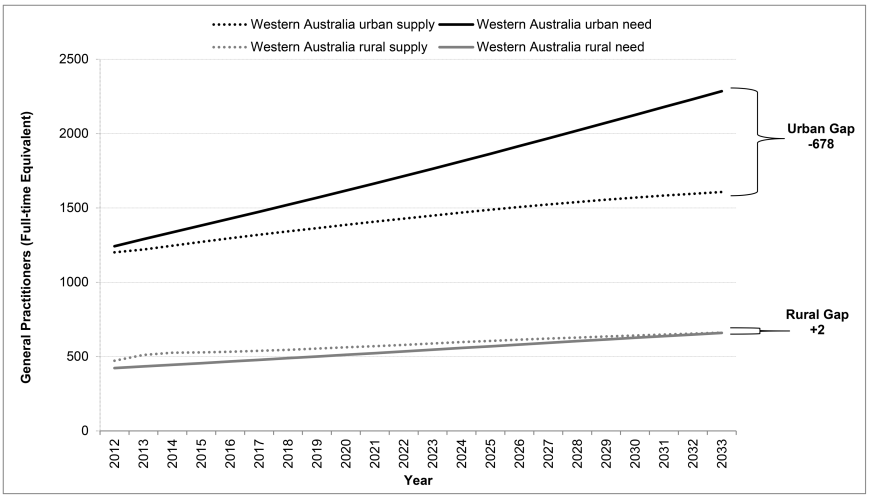


**Figure 2.** Estimated GP requirements for urban and rural Western Australia, 2013–33.

**Table 2.** Summary of full-time equivalent general practitioner estimates for Western Australia for the base and two scenarios, 2013, 2033 and 2013

| Scenario | 2013 | 2023 | 2033 |
|---|---|---|---|
| Base | | | |
| Supply | 1737 | 2045 | 2281 |
| Demand | 1616 | 2170 | 2774 |
| Mean gap (95% CI) | 121 (115, 130) | −126 (−163, −85) | −493 (−592, −397) |
| Lower population projections | | | |
| Supply | 1737 | 2045 | 2281 |
| Demand | 1614 | 2103 | 2602 |
| Mean gap (95% CI) | 123 (121, 127) | −58 (−90, −19) | −321 (−443, −203) |
| Registrar work value | | | |
| Supply | 1737 | 2192 | 2430 |
| Demand | 1616 | 2170 | 2774 |
| Mean gap (95% CI) | 121 (115, 130) | −16 (−16, 62) | −344 (−443, −248) |
| 80% unfilled training places | | | |
| Supply | 1737 | 1973 | 2141 |
| Demand | 1616 | 2170 | 2774 |
| Mean gap (95% CI) | 121 (106, 128) | −197 (−283, −157) | −633 (−698, −536) |

of these results is the population growth rate and the related demographic profile of each state. Until recently, WA has experienced an extended period of population growth, and in 2013 had the fastest growth rate of all Australian states and Territories at 2.1%, while SA's growth rate was only 0.9% (15). The population projections continue this growth over the model's projection horizon, with WA's population growing by 64% and SA's by 18%. These growth rates reflect the age structure of the population, with a larger younger population in WA (49% of the WA aged under 44 years compared with 44% in 2013) and an ageing population in SA (17% of populated aged over 64 years compared with 13% in WA in 2013) as well as economic growth within the mining sector in WA which attracted increased migration to the state. In turn, these differences result in different patterns of GP utilization and illness within the population, and thus different estimates of need in the model. In terms of GP supply, the baseline scenarios for SA and WA indicate a growth rate of 31% between 2013 and 2033. For WA, this is well below the population growth rate and SA well above, and it largely explains the shortfall required to meet the estimated level of services required in WA and the surplus in SA.

It is possible that the WA population growth rate (ABS Series B) used in the base case was too high and does not account for changes in migration occurring as a result of economic changes in the state in more recent years. The scenario analysis undertaken using a lower population growth (ABS Series C) addresses this issue, reducing the growth rate to 51% over the project period. While the results saw a reduced estimate in the number of GP required, there was still a shortage of GPs in WA.

By developing an urban and rural model for WA, we were able to better understand regional differences in workforce supply and demand. The model's baseline scenario indicates that for WA, there will be a shortage in the GP workforce over the next 20 years, but the results from the urban and rural models show that this shortage is not uniform across WA. The model estimates that in rural WA, there will be a small excess of GPs or what could be termed a 'balanced workforce' while urban WA will experience a growing shortage of GPs. These predicted differences are driven by lower levels of service need in rural populations resulting from a combination of differences in incidence and prevalence cases due to differences in the age distribution of urban and rural areas and in GP attendance rates

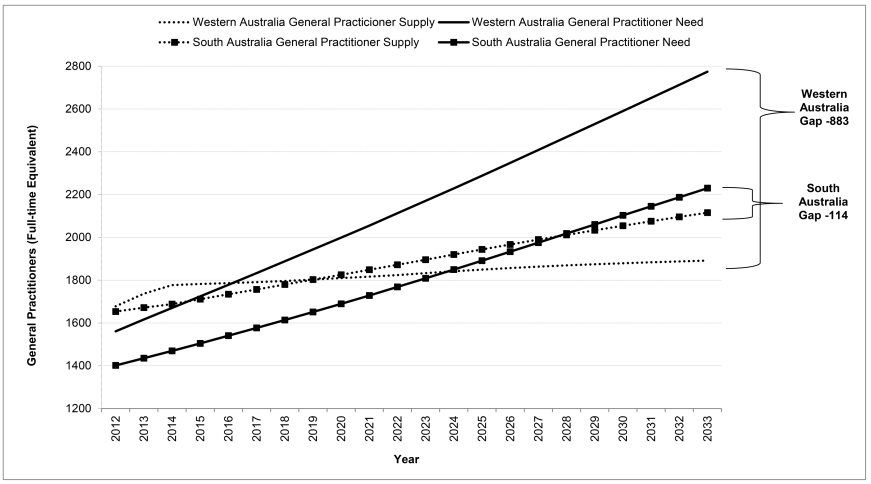


**Figure 3.** Estimated future supply and need for South Australia and Western Australia GPs with reduced international medical graduates recruitment, 2013–33.

for different conditions. It is this urban shortage that is contributing to the overall GP shortage seen in WA. This future estimation is supported by current indicators on GP service usage which suggests that access issues (i.e. GP shortages) are the likely driver of this in urban WA. Medicare Australia data shows that the WA population has a lower average numbers of attendances than the national average and a lower percentage of very high frequent GP attenders across all its regions, ranging between 2.3% and 7.3% of the population and well below comparable regions elsewhere in Australia (16,17). In WA urban and outer metropolitan areas, there are higher percentages of the population using emergency departments, particularly for conditions that could be seen by the GP; higher percentages of potentially avoidable hospitalizations; longer waiting times for GP appointments and a higher percentage unable to see their preferred GP (16,17).

The balanced rural GP workforce shown in the rural WA baseline scenario suggests that the policies related to addressing workforce maldistribution in terms of rural areas have been successful in WA through organizations such as Rural Health West and WAGPET. These include the recruitment of IMGs and rural training placements (12) and are likely to result in a sufficient supply of GPs to provide the service levels required in rural and remote regions but only if they are maintained.

The scenario analysis used in the modelling accommodated customized scenarios such as the registrar work value scenario in WA, but also allowed a comparison of the effects of potential changes in national policies on different jurisdictions, as illustrated by the reduction in IMG recruitment scenario.

The scenario based around unfilled GP training places had only a small impact on the overall supply of GPs in WA. However, the registrar work value scenario shows the important contribution to the WA GP stock and service provision that registrars make and the role they play in reducing the magnitude of the GP shortage.

The policy-based scenario of reducing the recruitment of IMGs in rural WA and SA illustrates two things. Firstly, the differing impact of changing a national workforce policy across jurisdictions, and secondly, the reliance we have on this workforce to address GP shortages in rural and remote Australia. For both WA and SA, a small reduction in the number of IMGs recruited to rural areas (25%) had a negative impact on the supply number of GPs, pushing WA into a greater shortage and moving SA from a surplus to a shortage. This scenario shows that the reliance on this particular workforce makes it very vulnerable to policy changes related to this group or factors that may affect the recruitment of IMGs such as competition for their services from other countries or states. The former is a strong possibility with the government aiming for self-sufficiency in its medical workforce. However, if this is to be achieved without adverse outcomes, effective strategies that recruit Australian GP graduates to work in rural and remote areas are required. Some examples can be found (18,19), although they are likely to be insufficient to address the numbers required (20).

A key limitation of this study is data quality. Data quality issues are unavoidable in such modelling that is heavily reliant on a variety of sources that have been collected over time, from disparate sources or where the initial purpose of the data collection was not specifically designed with workforce modelling in mind. Additionally, the modelling process is also limited by the need to introduce assumptions in a variety of key parameters. Unknown future policy changes or dramatic changes emerging exogenously in population preferences for accessing medical services could have significant ramifications for the modelling results presented. The modelling is therefore limited by the assumption that the broader environment in which GPs operate and provide their services (outside of the specific changes included in the modelling) will largely be maintained into the future. Finally, this study focused only on the GP workforce and as such estimated the future workforce requirements in isolation from the wider healthcare system and other health workforces. It was therefore not possible to see the knock on effect of potential changes in workforce policy targeting the GP workforce to other areas of the health workforce. While this is a limitation, the focus on one discipline area allowed a more in-depth analysis of this workforce and for consideration of different settings. To some extent, the scenario modelling represents an attempt to reflect these unknowns by presenting the impact of the more realistic changes that might occur in future and providing broad indications of the sensitivity of results to those factors.

## Conclusion

This study illustrates the flexibility of a needs-based GP simulation model built to estimate the future GP requirements. The original simulation model has been expanded to include a rural and urban model, and in doing so, it has shown that it is possible to adapt the model to regional levels and so provide more nuanced estimations

of workforce requirements. This allows contextual differences to be incorporated more readily into the models and for policymakers to assess the effect of policies or changes in the workforce and population not only across jurisdictions, but also in different settings. The model can be further refined as new and better quality data becomes available.

## Acknowledgements

Information in this article is drawn from data from the BEACH Programme analysed and supplied by the Family Medicine Research Centre, the University of Sydney and the Australian Institute of Health and Welfare. We thank members of the South Australian Research Reference Group and the Western Australian Stakeholder Group who provided invaluable input to the study.

## Declaration

Funding: Health Workforce Australia and Western Australian General Practice Education and Training Ltd. COL is the recipient of an Australian Research Council Early Career Researcher Award (DE120101202) funded by the Australian Government.
Ethical approval: the Human Ethics Research Committee, University of Adelaide, H-2012-065.
Conflict of interest: none.

## References

1. O'Brien-Pallas L, Baumann A, Donner G *et al*. Forecasting models for human resources in health care. *J Adv Nurs* 2001; 33: 120–9.
2. US Department of Health and Human Services HRaS and National Center for Workforce Analysis. *Technical documentation for HRSA's health workforce simulation model*. Rockville, MD: US Department of Health and Human Services, 2014.
3. Van Greuningen M, Batenburg RS, Van der Velden LF. The accuracy of general practitioner workforce projections. *Hum Resour Health* 2013; 11: 31.
4. Roberfroid D, Leonard C, Stordeur S. Physician supply forecast: better than peering in a crystal ball? *Hum Resour Health* 2009; 7: 10.
5. Dussault G, Buchan J, Sermeus W, Padaiga Z. *Assessing Future Health Workforce Needs*. Geneva, Switzerland: World Health Organisation, 2010.
6. Ono T, Lafortune G, Schoenstein M. *Health Workforce Planning in OECD Countries: A Review of 26 Projection Models from 18 Countries*. Paris, France: OECD Publishing, 2013.
7. Dreesch N, Dolea C, Dal Poz MR *et al*. An approach to estimating human resource requirements to achieve the Millennium Development Goals. *Health Policy Plan* 2005; 20: 267–76.
8. Robert Graham Center. *Methodology for State-Level Projections of Primary Care Physician Workforce*. Washington, DC: Robert Graham Center, 2013 [cited 28 September 2016]. http://www.graham-center.org/dam/rgc/documents/maps-data-tools/maps-methodology/state-workforce-methodology.pdf (accessed 25 September 2016).
9. Singh D, Lalani H, Kralj B *et al*. *Final Report: Ontario Population Needs-based Physician Simulation Model*. Ontario, Canada: Ministry of Health and Long-Term Care, 2010.
10. Laurence CO, Karnon J. Improving the planning of the GP workforce in Australia: a simulation model incorporating work transitions, health need and service usage. *Hum Resour Health* 2016; 14: 13.
11. Laurence COM, Karnon J. What will make a difference? Assessing the impact of policy and non-policy scenarios on estimations of the future GP workforce. *Hum Resour Health* 2017; 15: 43.
12. Rural Health West. *Western Australia's General Practice Workforce Analysis Update: November 2015*. Perth, Australia: Rural Health West, 2016.
13. Australian Bureau of Statistics. *ASGC Remoteness Classification: Purpose and Use*. Canberra, Australia: ABS, 2003.
14. Laurence C, Heywood T. *Estimating the Future General Practice Workforce in Western Australia: final report*. Adelaide, Australia: The University of Adelaide, 2015.
15. Australian Bureau of Statistics. 3101.0 Australian Demograhic Statistics, September 2014. [Web page]. Canberra, Australia: ABS, 2015 [cited 19 June 2015]. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/3101.0Main+Features1Sep%202014?OpenDocument# (accessed 19 June 2015).
16. National Health Performance Authority. *Health Communities: Australians' Experiences with Access to Health Care in 2011–12*. Sydney, Australia: NHPA, 2013.
17. National Health Performance Authority. *MyHealthyCommunities*. NHPA, 2015 [cited 19 June 2015 ]. http://www.myhealthycommunities.gov.au/ (accessed 19 June 2015).
18. Playford DE, Evans SF, Atkinson DN, Auret KA, Riley GJ. Impact of the Rural Clinical School of Western Australia on work location of medical graduates. *Med J Aust* 2014; 200: 104–7.
19. McGrail M, Russell D, Campbell D. Vocational training for general practitioners in rural locations is critical for the Australian rural medical workforce. *Med J Aust* 2016; 5: 217–21.
20. Ranmuthugala G. Rural recruitment and training promotes rural practice by GPs, but is it enough to retain them? *Med J Aust* 2016; 205: 210–1.