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Index of Access: a new innovative and dynamic tool for rural health service and workforce planning

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Abstract

Objective. Improving access to primary health care (PHC) remains a key issue for rural residents and health service planners. This study aims to show that how access to PHC services is measured has important implications for rural health service and workforce planning.

Methods. A more sophisticated tool to measure access to PHC services is proposed, which can help health service planners overcome the shortcomings of existing measures and long-standing access barriers to PHC. Critically, the proposed Index of Access captures key components of access and uses a floating catchment approach to better define service areas and population accessibility levels. Moreover, as demonstrated through a case study, the Index of Access enables modelling of the effects of workforce supply variations.

Results. Hypothetical increases in supply are modelled for a range of regional centres, medium and small rural towns, with resulting changes of access scores valuable to informing health service and workforce planning decisions.

Conclusions. The availability and application of a specific 'fit-for-purpose' access measure enables a more accurate empirical basis for service planning and allocation of health resources. This measure has great potential for improved identification of PHC access inequities and guiding redistribution of PHC services to correct such inequities.

What is known about the topic? Resource allocation and health service planning decisions for rural and remote health settings are currently based on either simple measures of access (e.g. provider-to-population ratios) or proxy measures of access (e.g. standard geographical classifications). Both approaches have substantial limitations for informing rural health service planning and decision making.

What does this paper add? The adoption of a new improved tool to measure access to PHC services, the Index of Access, is proposed to assist health service and workforce planning. Its usefulness for health service planning is demonstrated using a case study to hypothetically model changes in rural PHC workforce supply.

What are the implications for practitioners? The Index of Access has significant potential for identifying how rural and remote primary health care access inequities can be addressed. This critically important information can assist health service planners, for example those working in primary health networks, to determine where and how much redistribution of PHC services is needed to correct existing inequities.

Additional keywords: primary care, resource allocation.

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Introduction

Minimising primary health care (PHC) access barriers has long been,[1] and remains,[2] one of the most important issues facing health service planners charged with ensuring adequate and equitable health care services for residents in rural and remote areas. In particular, questions about the location of, as well as how many, health facilities, health workers and health services are required to ensure adequate PHC are central issues confronting

health service planners. This applies to all Australian states and territories, as well as other comparable countries, such as Canada[3] and elsewhere.[4,5]

Many rural communities are recognised as having higher amenity, typically those with attractive environments and located in nearby fringe areas or larger regional centres, with such communities generally having less difficulty in attracting health professionals.[6] In contrast, other rural and remote communities, because of place differences, such as harsh climate, lack of natural amenity or economic opportunities, demographic structure and geographic isolation, are less attractive.[7,8] Moreover, such communities often lack the critical population mass needed to support sustainable health services and face greater difficulties in attracting and retaining PHC workers.[9] Consequently, poorer access to health services in these rural areas, which are frequently characterised by health workforce shortages, remains a critical issue for health policy makers and service planners.[10]

In order to effectively address this issue through health policy and planning, several aspects need to be better understood. First, how well do current measures of workforce shortage used by the Australian government capture the key aspects of access to health care services? That is, how good are indicators of workforce shortage as surrogates for health care access by rural and remote populations? Second, how useful are geographical classifications as proxy measures of access to health care services? Thus, the aim of the present paper was to show that how access to PHC services is measured has important implications for health service and workforce planning.

In order to address this aim, we first demonstrate the shortcomings and risks associated with a continued reliance solely on measures of workforce shortage or generic geographical classifications to inform rural health service planning. Second, in an attempt to improve on these shortcomings, a more sophisticated measurement of access to health services, namely the Index of Access, is proposed, which can improve targeting of resource allocation and planning of PHC services. Third, the usefulness of this innovative tool to measure national PHC access is illustrated with a case study to demonstrate its improved potential for health service planners to redress long-standing access barriers among rural and remote Australian populations.

Need for an improved measure of access for health service planning

Historically, access to health services has mostly been measured regionally using provider-to-population ratios (PPRs), which measure a ratio of health worker numbers (supply) to population numbers (demand) within a defined geographical region. For example, Health Workforce Australia recently reported PPRs for doctors within each Australian Standard Geographical Classification – Remoteness Area (ASGC-RA).[11] A further current example of the application of PPRs in Australian national health workforce policy is the District of Workforce Shortage (DWS) measure.[12] DWS status is a binary indicator of access to general practitioner (GP) services that uses a more refined measure of provider supply (Medicare billing statistics) to calculate PPRs within Statistical Local Areas (recently updated to Statistical Area Level 2 (SA2)[13] geography) and compare these to a national average PPR.[14] The reliance on PPRs assumes that all individuals access services only within a sharply demarcated geographical region. However, this is often not the case, especially in more closely settled areas where choice of providers exists. Moreover, PPRs assume that within each defined geographical region, proximity to providers and patient mobility are negligible issues; this is also often not true, especially in sparsely settled areas.[15] In addition, the identification of DWS regions is solely defined by a region's PPR score being below the national average, which excessively discriminates between borderline shortage and borderline non-shortage areas, and discriminates poorly between borderline shortage areas and areas with chronic and large shortages.

Standard geographical classifications, such as the Rural and Remote Metropolitan Area (RRMA)[16] classification and the ASGC-RA, have also been used as proxy measures of access for national health service planning and resource distribution purposes in Australia. The allure to government of using a 'standard' geographic classification like ASGC-RA is that values remain relatively constant over time, albeit updated on a 5-yearly cycle, and its 'off-the-shelf' readiness for application across a raft of government programs. Such classifications are meant to maximise between-group variance and minimise within-group variance, and so assist planners in their quest to group similar areas or communities and overcome apparent inequities. However, a key limitation is that the application of RRMA and ASGC-RA classifications to PHC access problems assumes relevance of the aspect being measured (in this case 'population size' and 'remoteness' respectively) to the population's experiences of gaining access to PHC in times of need. A third classification, the Modified Monash Model,[17,18] came into use in rural health policy in 2015 as a more relevant tool for some government rural workforce programs. Although the Modified Monash Model was developed on indicators of rural GP work experiences by geography, it too is a proxy measure of access that shares the limitations relating to its use of population size and remoteness to classify locations.[19]

In reality, the concept of access is highly complex and multifaceted,[20,21] so it is hardly surprising that these geographical classifications and simple PPRs fail to sufficiently capture important components of PHC access. Consistent the seminal exploration by Penchansky and Thomas of the concept of access,[20] measures of access should reflect the degree of 'fit' between health care services and systems and the populations needing health care. This 'fit' should extend across each of the dimensions of access, however defined,[22–24] such that all dimensions important for ensuring health care access for the particular population under consideration are incorporated into the measure of access. By using such multifaceted measures, health service planners can better differentiate populations that experience comparatively poorer access to health services, and intervene to correct identified disadvantage in achieving equitable health outcomes.

Given these important limitations of the main current measures of PHC access used by policy makers, researchers are increasingly focusing their attention on developing improved measures of access to underpin health service planning. One such Australian measure is the recently developed national Index of

Access to GP and remote area nurse (RAN) services,[25] which seeks to better enumerate the ease with which a person can avail themselves of PHC services at a time of need.

An innovative national Index of Access

The Index of Access differs significantly from existing classifications used for primary health service planning in Australia in two important ways: (1) it integrates multiple dimensions of access to PHC; and (2) it uses a two-step floating catchment area (2SFCA) methodology.[15,26] With regard to the first difference, the dimensions captured by the Index of Access take account of variations in the patterns of need for health care, availability of GP and RAN services and geographical differences in patterns of population settlement (Fig. 1).

With regard to the second difference, the Index of Access uses the sophisticated 2SFCA method, the details of which have been outlined fully elsewhere[15,25,27] and are summarised in Box 1. The 2SFCA models simultaneously adjust for potential population demands for PHC from any location, PHC service availability at any location, the relative health needs of populations and travel behaviours of populations related to their proximity to services. These methodological strengths and improvements to existing measures of access are leading to 2SFCA models being increasingly used at a national level to assess relative access to PHC services.[28,29] The resulting geographical pattern of access for Australia measured using the Index of Access is shown in Fig. 2*a*.

The Index of Access confers several critically important advantages over existing geographical classifications and simple PPRs for measuring health service access and, subsequently, for health service planning. One key advantage of the Index of Access is its ability to capture multiple aspects of access in a single measure: the PHC services available to a population at any location, the population's ability to transcend distance barriers in accessing PHC and variation in population need for PHC services. This means that the Index of Access better approximates the population's access, and therefore a significantly improved and more accurate empirical basis is available to guide resource allocation and service planning.

A further key advantage of the Index of Access is that modelling of variations to the data inputs for calculating the index is possible. For example, the effect of recruitment of additional health professionals to previously under-served areas can be readily modelled. Conversely, changes in access patterns resulting from the loss of workforce can also be readily factored in to the modelling. This process is particularly advantageous to health service planners because it enables an assessment of the effect of such changes on variations in access. Such sensitivity analyses thereby facilitate questions of key interest to policy makers and workforce planners to be explored, including, for example: (1) how much does access change locally given specific adjustments to the inputs, such as loss of services; (2) how much is access forecast to change locally given changes in context, such as aging of the population; (3) what services are (additionally) needed, and where, in order to achieve a specific level of access; and (4) to what extent are workforce recruitment or retention incentives achieving improved access in different communities?

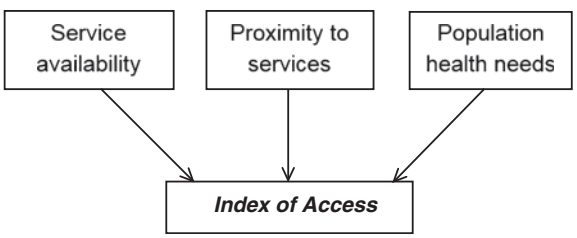

Fig. 1. Key dimensions captured by the Index of Access.

Case study: hypothetical modelling of increased supply

Potential benefits of the Index of Access to health service planning can be demonstrated using a case study approach and hypothetical data. Focusing on one example region (approximate area 110 000 km^2, population 230 000), the Index of Access map is shown in Fig. 2*b*. In this demonstration case study, actual access scores have been randomly adjusted by up to ±20% to ensure confidentiality while still representing a reasonably close approximation of access to PHC in this region. This baseline map allows health service planners to identify areas where populations have relatively poor access to PHC providers (those areas shaded in the palest category) and any population centres within these areas. In Fig. 2*b*, it can be seen that three small rural towns have the lowest level of access compared with other population centres in the region.

Box 1. Overview of the two step floating catchment area (2SFCA) method

Step 1: Calculate service catchments – for each provider or service location (j) of volume S_j, determine what population size (summed P_k) can potentially access that provider (up to the catchment border = d_{max}) and calculate the ratio of providers to the population (R_j).

$$R_j = S_j / \Sigma_{k \in [djk < dmax]} P_k * HN_k * f(d_{jk})$$

Step 2: Calculate population catchments – for each population location (i), determine what services (j) can potentially be accessed by that population (up to the catchment border = d_{max}), and aggregate the PPRs for these services (R_j) as calculated in Step 1. The resultant score (A_i) is also the *Index of Access* value for each location (i).

$$A_i = \Sigma_{j \in [d_{ij} < d_{max}]} R_j * f(d_{ij})$$

Distance decay functions $f(d_{jk})$ and $f(d_{ij})$ are additionally shown here (range: between 0 = full distance decay and 1 = no distance decay), and a health needs weighting function HN_k in Step 1 (range:1.0 to 1.5 = 50% higher needs).

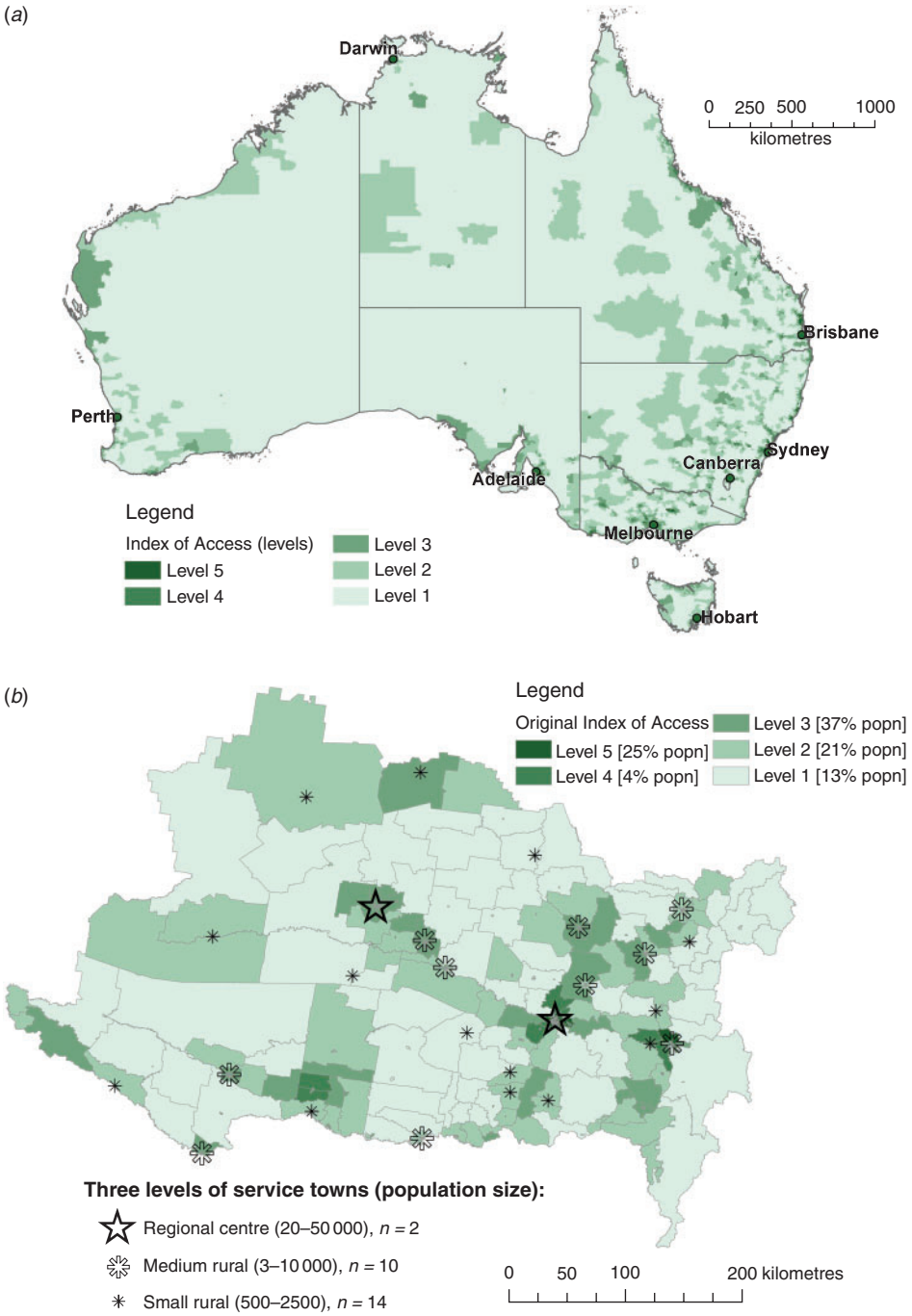

Fig. 2. Index of Access map for (*a*) the whole of Australia and (*b*) the case study region. Note, there is a ±20% adjustment to actual data in the map shown in (*b*). Popn, population.

In this case study hypothetical, changes have also been made to the supply layer of the Index of Access. Three scenarios have been investigated in this sensitivity analysis. Each scenario models the effect of having an additional six full-time equivalent (FTE) GPs within this region; however, in each of the scenarios the GPs are distributed in different-sized service towns: (1) regional centres, namely four FTE to one regional centre and two FTE to the other, as shown in Fig. 3*a* (distribution is proportional to population sizes); (2) medium rural, with one FTE each to the six towns noted in Fig. 3*b*; or (3) small rural, with one FTE each to the six towns noted in Fig. 3*c*.

The percentage change to the original Index of Access scores in each hypothetical scenario is mapped in Fig. 3*a*–3*c* and these changes are assessed against the size of the population whose access improves, as summarised in Table 1. Fig. 3*d* shows how the Index of Access map would look under Scenario 3, when the six

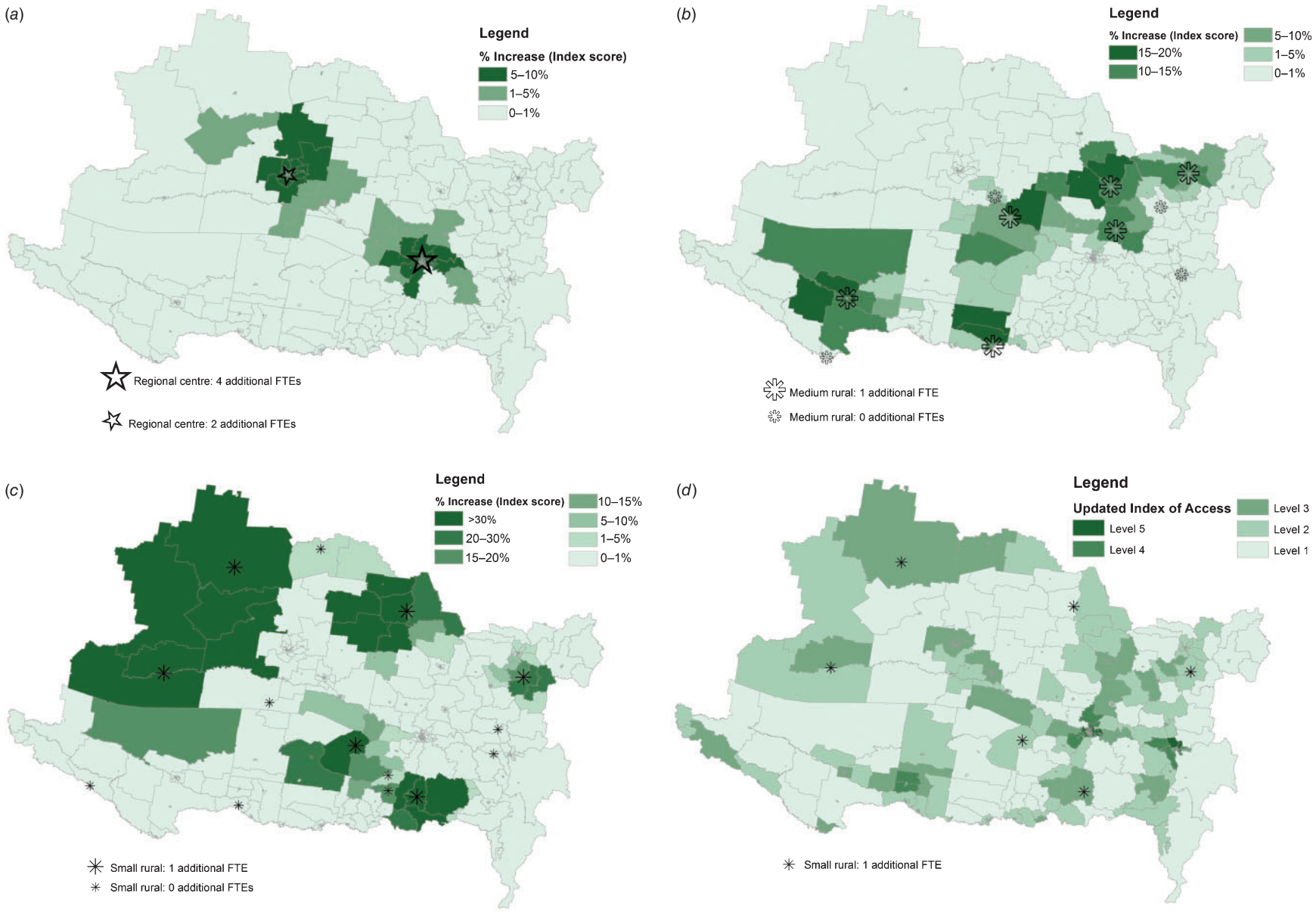

Fig. 3. Changes to the Index of Access by the addition of (*a*) six additional services in regional centres, (*b*) six additional services in medium rural towns and (*c*) six additional services in small rural towns. (*d*) Updated Index of Access under scenario (*c*). FTE, full-time equivalent.

Table 1. Summary of the total case study region population whose access improves at each level

Relative increase in access score (%)	% Population change (sum to 100%)		
	Regional centres	Medium rural	Small rural
0–1	53.5	66.2	78.7
1–5	10.2	11.5	11.0
5–10	36.3	8.3	1.2
10–15		9.9	0.6
15–20		4.1	1.7
20–30			1.3
>30			5.5

additional GPs moved to the small rural towns as per Fig. 3*c*. It demonstrates, for example, that for some locations having an additional GP improves the access to PHC for residents above the lowest quintile, whereas in other locations it may take more than one additional GP for a similar absolute improvement in PHC access to be evident.

These results demonstrate a key strength of the Index of Access, namely its ability to measure small area differences in PHC access. The case study highlights differences in the change in access scores and the proportion of the population affected according to whether the additional GPs are located in regional centres, medium rural towns or small rural towns. Additional services in regional centres, where PHC access is already hypothetically at intermediate levels, as shown in Fig. 2*b*, does not increase the access scores greatly, but does improve access for the largest percentage of the population. In contrast, additional GP services in small rural towns only affects a small percentage of the population, but it can greatly increase the level of PHC access for these populations, which tended to be poorer at the outset.

The way forward in planning access to PHC services

Health service planning strategies based on inadequate measures of access risk perpetuating or even exacerbating existing inequities in access to PHC services, particularly those that are most evident in rural and remote areas. To ameliorate this risk, governments should consider adopting alternative 'fit-for-purpose' measures of PHC access. In this regard, the Index of Access has considerable strengths compared with existing measures. In addition, as demonstrated by the case study, the Index of Access can be a valuable policy planning tool to test the effect on PHC access of changes in a range of supply and demand factors, such as changing workforce participation patterns and population growth or aging. The Index of Access can also be used to monitor location changes in PHC access, accurately identifying areas with decreasing or increasing access, thus providing better evidence of where recruitment and retention programs have worked and where future programs should be targeted.

Critically, however, the Index of Access method relies heavily on the input of appropriate data, which are required in a non-aggregated form and at a small geographical scale. These requirements are generally met for demographic data, with regular census collections and data releases at a fine geographic resolution. Geographic information system (GIS) technology also now enables proximity calculations (between populations and services) to be undertaken without great difficulty. However, there remain several outstanding data issues. First, further work is required to collect and make available national mortality and morbidity data at a fine geographical resolution so that variation in health needs can be factored directly into the model, rather than using surrogate measures that may not adequately capture this important component. Second, better data are desirable for measuring road quality, and private and public transport availability. Third, enumeration of PHC services remains problematic because, in many instances (notably dentists and the various allied health professions), these data are difficult to source. However, an issue for all health professions is that regular updates of workforce data are required because these variables are subject to frequent change and are rapidly outdated as health professionals change location and join or leave the workforce. In addition, privacy legislation or data gatekeepers can provide administrative barriers to data acquisition, although 'in-house' analysis may overcome this issue.

Of course, the complex and sophisticated methodology used to construct the Index of Access does require specific expertise to construct and update. Moreover, the Index of Access is dependent on combining specific and comprehensive data at a fine geographical scale (which are not always readily available) in order that sensitivity to detect geographical differences in access is retained. Nevertheless, in many circumstances these disadvantages may be mitigated and the benefits of using such an improved measurement realised.

In addition, the Index of Access focuses on primary rather than secondary care, and on GP and RAN services rather than capturing the full range of primary care services (e.g. different allied health disciplines, diagnostic services, Indigenous health workers). It is likely to be inappropriate to combine all types of primary care providers into a single composite Index of Access because of the heterogeneity of health care services provided by primary care providers from the various disciplines. However, the underpinning 2SFCA method can be applied to another type of primary care service or to secondary care to provide useful empirical evidence to inform policy making. This includes applying the methodology to measure the effect of Telehealth on access for rural populations,[30] which is also not currently captured by the Index of Access. As access to Telehealth care increases, healthcare planners could consider measuring the extent of Telehealth penetration into rural and remote areas using 2SFCA methods.

Conclusion

Combating access disparities remains a central issue for rural health service planners seeking to reduce inequities of access to primary health services. The availability and application of a specific 'fit-for-purpose' access measure enables improved policies and allocation of resources. The new Index of Access outlined here is designed to provide a more accurate empirical basis for planning and distribution of health resources in Australia. This measure has great potential for improving how PHC access inequities are identified and for guiding where and how much redistribution of PHC services is needed to correct such inequities.

Competing interests

The authors have no competing or conflicts of interest to declare.

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