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‘Rurality’ and community amenity: How they relate to rural primary care supply and workforce retention

2014 APHCRI/Robert Graham Center Visiting Fellowship Report

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CONTENTS

ACRONYMS

AMA	American Medical Association
ASGS-RA	Australian Statistical Geography Standard Remoteness Area
CEO	Chief Executive Officer
CRERRPHC	Centre of Research Excellence in Rural and Remote Primary Health Care
GP	General Practitioner
HPSA	Health Professional Shortage Area
IMG	International Medical Graduate
LGA	Local Government Areas
MABEL	Medicine in Australia: Balancing Employment and Life study
NHSC	National Health Service Corps
PPR	Population-to-Provider Ratio
RUCC	Rural-Urban Continuum Codes
2SFCA	Two-Step Floating Catchment Area
USA	United States of America

Chapter 1: Fellowship summary

Poorer access to supply of, and retention of, a primary health care workforce remain key characteristics of rural regions of Australia and the United States of America (US), with consequent unacceptable inequalities in the health and well-being of their populations. In response, more equitable access to health care for all populations and improved workforce retention remain key objectives of both Australian and US governments, especially for rural populations.

Whilst many previous studies have investigated key professional factors relating to recruitment and retention of rural primary health care doctors, less attention has been given to the role of community and place factors on supply, access to and mobility of rural doctors. Doctor's location decisions relate both to meeting their professional needs and interests, and to meeting their non-professional satisfaction through, amongst other aspects, various place-related attributes. Thus, observed rural doctor mobility generally results from factors that both push individuals towards rural, and pull individuals away from rural areas. This study (of two related projects) sought to better understand the roles of 'rurality' and community amenity aspects in rural primary health care workforce supply and retention.

Beyond this fellowship, I am a Chief Investigator in two large and related programs, the Centre of Research Excellence in Rural and Remote Primary Health Care (CRERRPHC) as well as the Centre for Research Excellence in Medical Workforce Dynamics which conducts the Medicine in Australia: Balancing Employment and Life (MABEL) study. Within the CRERRPHC, I led the development of a new national Index of Access to rural primary health care in Australia. Within MABEL, I led research on measures of the retention and mobility of the rural primary health care workforce in Australia. The two studies completed as part of my fellowship build on my research expertise through these programs by both expanding into the US context and, where appropriate, comparing outcomes between Australia and the US.

This fellowship, which involved a one-month visit to the Robert Graham Center for Policy Studies in Family Medicine, Washington DC, focused on two related projects which both investigate the role of 'rurality' and community amenity aspects with, in turn, rural primary care workforce supply and retention. More specifically:

- Study 1 aimed to describe the geographic mobility patterns of US rural primary care physicians. In particular, it quantifies, over an extended period, where turnover and mobility of rural physicians occurs and investigates the moderating effect of both area-level and individual-level factors on observed rural retention.
- Study 2 used data from both Australia and the US, including my Australian Index of Access, to investigate the extent to which variations in community amenity aspects explain spatial variations in the supply of rural primary care doctors.

The content of the two studies in this report are both currently under peer-review.

Chapter 2: Study 1 - Mobility and retention of rural primary care physicians: evidence from 2000-2014

INTRODUCTION:

Rural populations of the US continue to experience relative shortages of the supply of primary care physicians,[1] with associated links to poorer health.[2] This shortage is as attributable to maldistribution of the workforce as it is to any workforce undersupply.[3] Difficulties of both recruitment and retention of physicians in rural areas, which greatly contribute to experienced shortages, are well acknowledged.[4] There are many contributing reasons for this ongoing workforce supply disparity, including professional, economical, infrastructural, political, educational and socio-cultural aspects.[5] Whilst considerable research has identified factors that facilitate and impede supply of physicians in rural areas, there is a dearth of quantitative empirical evidence relating specifically to observed geographic mobility and turnover patterns of rural physicians – notably who moves, where to and from, and how often.

The mobility of rural physicians includes moves both within rural areas and the least desirable outcome of leaving the rural workforce entirely by moving to large urban areas. The cost of mobility and staff turnover can be large, both in direct costs[6] but also in terms of service quality to the community.[7] Improved understanding of mobility and retention of rural physicians is important because of its impact on training and workforce policy, and resultant physician supply to both the 'origin' area (that is, the location from which the physician moved) and to the 'destination' area (that is, the location to which the physician has moved). The US government makes considerable investment to health workforce programs specifically oriented towards improving the recruitment and retention rates of physicians in rural areas, with goals to maximise movement into, and minimise movement away from, rural areas. However, to date there is limited evidence across the last 30 years of any macro-level improved distribution of rural physicians.[8-11]

Primary care physicians initially choose to work in rural areas for a variety of reasons. Notably, having a rural interest from rural background, rural training pathways and familiarity to the area by the physician or their spouse,[12-14] as well as professional expectations of increased variety of work and autonomy, and desires for non-professional lifestyle aspects in rural areas increase the attraction and likelihood of rural practice.[15,16] In addition, a number of key policy incentives such as J-1 waivers for international medical graduates (IMG) and National Health Service Corps (NHSC) programs bring other physicians into rural locations,[17,18] with some positive results.[19] Long term retention of rural physicians is largely driven by minimising negative triggers which, if significant enough, contribute to their decision to leave a specific rural community.[20-22] Far less is understood about the characteristics of physician mobility, such as the geographic patterns and frequency of moves.

Whilst the social sciences have rigorously explored the factors influencing both inter- and intra-regional migration of populations, it is not clear whether these same factors influence medical workforce mobility. Much of the literature on physician mobility has focused on two broad categories, without a focus on rural per se. Firstly, a large focus is given to the international movement of physicians, notably on the ethical issues relating to recruitment of physicians from developing countries into developed countries such as the US.[3,23] The second focus is the inter-regional or cross-country movement of physicians (e.g. between East and West regions of the US).[24-26] Meanwhile, literature specific to observed mobility of physicians between rural and metropolitan areas is sparse.[8,27]

Observed rural physician mobility generally results from factors that both push individuals towards rural, and pull individuals away from rural areas. Associations between mobility of physicians and contributing factors have rarely been quantified,[1,28,29] with younger age

(current and recent medical residents) being the dominant common factor linked with increased mobility.[24,30] Baer and colleagues described the strong link between age and mobility by their wineglass model, such that medical students are selected from a wide range of background locations and brought together into a few centralised training locations before diffusing again in their chosen practice locations.[31] Whilst younger age contributes to increased mobility as physicians attempt to settle down in their early career stages, Horner *et al* found the initial tenure period (about 4.5 years) to be very similar between rural and metropolitan physicians.[32]

The characteristics and resources of a rural community also influence observed physician turnover. Pathman *et al* demonstrated a poorer retention of rural physicians based in NHSC-supported locations compared to those in non-NHSC areas.[33] A similar but smaller study found that rural physicians based in Health Professional Shortage Area (HPSA) locations had an increased risk of leaving compared to those in non-HPSA locations.[22] Poorer availability of physicians, most prominent in rural areas with supply shortage, has been linked to increased mobility of physicians in some areas.[26,34] Physicians working in small rural communities additionally report many community-led factors like integration, connection and appreciation contribute to increased retention, but these factors cannot readily be measured from most datasets.[35,36] Place 'attractiveness' has been linked to migration of rural populations,[37-39] however its influence on rural physician's retention or mobility decisions remains unclear.[40]

In an attempt to redress this scarcity of evidence relating to physician mobility, this study aims to describe the geographic mobility patterns of rural primary care physicians. Key contributing factors of interest to this study will be assessed, including the interlinked roles of 'rurality', other place characteristics as well as individual-level characteristics. This evidence will provide a better understanding of the factors behind the observed mobility and retention of rural primary care physicians.

METHODS

Physician location data were taken from multiple years of the American Medical Association (AMA) Masterfile. Specifically, records were drawn from 2000, 2002, 2004, 2006, 2008, 2010, 2012 and 2014 and merged together. Individual-level records were matched based on unique AMA identifiers. All physician work locations were geocoded to the county level, and then classified according to the 2013 9-level Rural-Urban Continuum Codes (RUCC) scale.[41] The six rural RUCC levels were additionally combined into the three population groupings (<2500, 2500-20000, >20000) with adjacency to a metropolitan area used as a separate binary variable.

Individual physicians were observed in up to seven observation periods as potentially moving between an origin and destination across each successive two year interval. This gap was chosen to smooth out possible lag times in the accuracy of location in the AMA datasets. Only primary care physicians (family physicians, pediatrics and general internal medicine) were included in the analyses, with those recorded as being non-active, residents and in federal employment also excluded. All calculations were performed using StataMP 13.1 (StataCorp, College Station, TX, US) with a 5% significance level.

The first analysis examined the mobility rates of all primary care physicians between each RUCC category, both within and between rural and metropolitan counties. All location pairings were categorised as either stayers (retention) or movers (turnover), based on whether they remained in the same RUCC category after each interval. Observed physicians were split into two categories - those only up to 10 years post-residency (capturing early-career mobility) and those 11-35 years post-residency (capturing mid- and late-career mobility, but capped at physicians close to retirement age).

The second analysis used multivariate linear regression models, weighted by population size, to examine county-level retention rates. The retention rate denominator is equal to the number of location pairings where that county is the origin location (irrespective of destination), whilst the numerator is equal to the number of location pairings where that county is both the origin and destination location. Where an observed destination location is metropolitan, all subsequent pairings are ignored until that physician moves back to a rural location. Similarly, physicians could be only first observed as rural physicians in later years due to either moving from a metropolitan area or being new to the dataset (e.g. recent completed resident). Only counties with a minimum of 10 observed pairings with a rural origin location were included in the analysis. The third analysis, using multivariate logit models with clustering, examined individual physicians observed moving from rural counties to urban counties, also only using rural-origin location pairings.

All multivariate models used data from the Robert Wood Johnson Foundation (2014), American Community Survey (2011) and the Health Resources and Services Administration (2014) to examine the effect on mobility of characteristics of place thought to be desirable, such as proximity to a hospital, higher house values, higher accessibility (population-to-provider ratio, PPR), more affluent communities and larger population size, as well as characteristics thought to be less desirable including areas with higher uninsured rates, increased unemployment and those not adjacent to metropolitan areas. The third analyses, split by those up to 10 years post-residency and those 11-35 years post-residency, additionally examined individual characteristics available in the AMA dataset, and include gender, age, IMG status, physician type (osteopathic or medical) and having a rural birthplace.

RESULTS

Between 2000 and 2014, about 1.3 million biyearly location pairings of US primary care physicians were observed. Table 1 (‘younger’, 0-10 years post-residency) and Table 2 (‘older’, 11-35 years post-residency) summarise the level of retention within RUCC categories along the main diagonal. Around 92.7% of younger physicians and 97.1% of older physicians in the three metropolitan categories are retained each interval within their origin RUCC category. The corresponding retention rate across all six rural categories is 80.4% for younger physicians and 91.0% for older physicians. Turnover rates between each possible RUCC category pairings are given in the remaining cells. In total, there were 13,288 observed moves from metropolitan to rural areas (1.1% biyearly rate), almost in balance with 14,068 observed moves from rural to metropolitan areas (9.2% biyearly rate). These biyearly rates were considerably higher for younger physicians, with 1.7% (to rural) and 14.9% (to metropolitan) observed moves. Furthermore, 2,900 physicians moved to a lower (‘more metropolitan’) RUCC but remained rural, whilst 2,507 physicians began rural and moved to a higher (‘more rural’) RUCC. Overall supply remains unevenly distributed with only 11.5% of services in rural areas and 10.5% of primary care physicians beginning in a rural area in their first post-residency position, despite 15.0% of the US population residing in RUCC 4-9 categories (2012 estimates of resident population, by county).

Table 3 measures the association between observed retention rates and place characteristics for all rural counties. Following elimination of counties with only a small number of observed location pairings and other place characteristics with missing values, a total of 1681 rural counties were analysed. Retention rates were significantly better in rural counties given three notable characteristics. Rural counties with a hospital within their area, those with increased population size and those with increased physician supply (provider-to-population ratio) have significantly improved retention. Generally, all three factors are interrelated with rural hospitals more likely in larger populations and areas of physician shortage less likely in more heavily populated areas.

Table 1: Number of movers, locations of moves – Primary care physicians, 0-10 years post-residency, 2000-2014

		Destination location – RUCC category											
		1 (M)	**2 (M)**	**3 (M)**	**4 (R)**	**5 (R)**	**6 (R)**	**7 (R)**	**8 (R)**	**9 (R)**	**Total**		
Origin location – RUCC category	**1 (M)**	277,146 (95.4%)	7,317 (2.5%)	2,884 (1.0%)	1,117 (0.4%)	448 (0.2%)	860 (0.3%)	460 (0.2%)	84 (0.0%)	96 (0.0%)	290,412	Leave metropolitan – to go to rural	1.1%
	2 (M)	7,319 (7.1%)	91,745 (88.5%)	1,984 (1.9%)	919 (0.9%)	303 (0.3%)	791 (0.8%)	457 (0.4%)	101 (0.1%)	84 (0.1%)	103,703		2.6%
	3 (M)	2,865 (6.7%)	1,915 (4.5%)	36,186 (84.9%)	482 (1.1%)	195 (0.5%)	610 (1.4%)	259 (0.6%)	75 (0.2%)	57 (0.1%)	42,644		3.9%
	4 (R)	1,082 (6.8%)	896 (5.6%)	471 (3.0%)	13,052 (81.8%)	69 (0.4%)	211 (1.3%)	125 (0.8%)	22 (0.1%)	24 (0.2%)	15,952	Leave rural – to go to metropolitan	15.4%
	5 (R)	456 (6.0%)	368 (4.8%)	243 (3.2%)	69 (0.9%)	6,142 (80.8%)	106 (1.4%)	156 (2.1%)	10 (0.1%)	47 (0.6%)	7,597		14.0%
	6 (R)	1,008 (6.3%)	873 (5.4%)	672 (4.2%)	257 (1.6%)	100 (0.6%)	12,875 (80.3%)	175 (1.1%)	38 (0.2%)	40 (0.2%)	16,038		15.9%
	7 (R)	568 (5.4%)	469 (4.4%)	317 (3.0%)	152 (1.4%)	176 (1.7%)	193 (1.8%)	8,573 (81.1%)	33 (0.3%)	94 (0.9%)	10,575		12.8%
	8 (R)	110 (6.7%)	108 (6.6%)	79 (4.8%)	39 (2.4%)	14 (0.9%)	58 (3.5%)	26 (1.6%)	1,196 (72.8%)	13 (0.8%)	1,643		18.1%
	9 (R)	133 (5.7%)	112 (4.8%)	89 (3.8%)	28 (1.2%)	71 (3.0%)	54 (2.3%)	127 (5.4%)	18 (0.8%)	1,711 (73.0%)	2,343		14.3%
	Total	290,687	103,803	42,925	16,115	7,518	15,758	10,358	1,577	2,166	490,907		
	Resident *	43,671	16,973	6,773	2,235	1,288	2,310	1,497	229	345	75,321		

*(M) Metropolitan; (R) Rural, *Initial location post-residency*

Table 2: Number of movers, locations of moves – Primary care physicians, 11-35 years post-residency, 2000-2014

		Destination location – RUCC category											
		1 (M)	**2 (M)**	**3 (M)**	**4 (R)**	**5 (R)**	**6 (R)**	**7 (R)**	**8 (R)**	**9 (R)**	**Total**		
Origin location – RUCC category	**1 (M)**	474,389 (98.2%)	4,628 (1.0%)	1,847 (0.4%)	903 (0.2%)	284 (0.1%)	731 (0.2%)	374 (0.1%)	83 (0.0%)	74 (0.0%)	483,313	Leave metropolitan – to go to rural	0.5%
	2 (M)	4,309 (2.5%)	167,701 (95.6%)	1,464 (0.8%)	740 (0.4%)	192 (0.1%)	593 (0.3%)	314 (0.2%)	78 (0.0%)	68 (0.0%)	175,462		1.1%
	3 (M)	1,806 (2.5%)	1,488 (2.0%)	68,952 (93.6%)	444 (0.6%)	132 (0.2%)	555 (0.8%)	214 (0.3%)	61 (0.1%)	47 (0.1%)	73,699		2.0%
	4 (R)	804 (2.7%)	779 (2.6%)	459 (1.5%)	27,570 (91.5%)	63 (0.2%)	236 (0.8%)	150 (0.5%)	17 (0.1%)	37 (0.1%)	30,115	Leave rural – to go to metropolitan	6.8%
	5 (R)	256 (1.8%)	232 (1.7%)	143 (1.0%)	73 (0.5%)	12,885 (92.7%)	80 (0.6%)	148 (1.1%)	28 (0.2%)	62 (0.4%)	13,907		4.5%
	6 (R)	665 (2.4%)	641 (2.3%)	663 (2.4%)	274 (1.0%)	97 (0.3%)	25,327 (90.4%)	235 (0.8%)	56 (0.2%)	59 (0.2%)	28,017		7.0%
	7 (R)	331 (1.7%)	332 (1.7%)	276 (1.4%)	175 (0.9%)	180 (0.9%)	221 (1.1%)	17,630 (91.4%)	45 (0.2%)	109 (0.6%)	19,299		4.9%
	8 (R)	70 (2.5%)	81 (2.9%)	67 (2.4%)	41 (1.5%)	23 (0.8%)	64 (2.3%)	53 (1.9%)	2,387 (85.1%)	19 (0.7%)	2,805		7.8%
	9 (R)	84 (2.1%)	73 (1.8%)	58 (1.5%)	27 (0.7%)	74 (1.9%)	67 (1.7%)	132 (3.3%)	17 (0.4%)	3,459 (86.7%)	3,991		5.4%
	Total	482,714	175,955	73,929	30,247	13,930	27,877	19,250	2,772	3,934	830,608		

(M) Metropolitan; (R) Rural

Table 3: Factors associated with increased county-level retention of rural physicians

	Beta estimate#	P value
Primary care physicians (PPR per 1000 residents)	6.34	<.001
RUCC = 4 or 5	2.65	<.001
RUCC = 6 or 7	1.79	.005
RUCC = 8 or 9	-4.44	<.001
Hospital in region	3.83	<.001
Constant	79.19	<.001
Population uninsured (%)	-0.11	.139
Median house price (per $100K)	-0.21	.567
Unemployment rate (%)	-0.13	.258
Population aged 65+ (%)	0.03	.572
Population non-Hispanic African American (%)	-0.013	.522
Population Hispanic (%)	-0.004	.863
Adjacent to metropolitan	-0.011	.977
Long work commute (%)	0.008	.724
Observations	1681	
R-squared	0.23	

Outcome measure is a score between 0 and 100; e.g. 80 = 80% retention

PPR = provider-to-population ratio; K = $1000 units

There were no additional tested place characteristics which were significantly associated with retention or turnover levels within rural counties. Tested factors included median house prices (usually a strong economic measure of place ‘attractiveness’), unemployment and uninsured levels, demographics including % Hispanic, % African American and % aged 65+, as well as locational information including long work commute levels and a re-categorisation of RUCC into those adjacent to metropolitan (codes 4/6/8) or not.

Table 4 investigates the association between observed moves of rural primary care physicians to metropolitan counties and both county-level place characteristics and individual-level demographics. Results are presented separately for physicians who completed their residency less than 10 years previously and those with 11-35 years post-residency, to minimise the effect of the expected strong association between age and mobility. It is seen that there are notable differences of rural-to-metropolitan mobility between early and later career stage primary care physicians.

Table 4: Factors associated with observed odds of moves of rural primary care physicians to metropolitan counties

	0-10 years post-residency (N=50,001)		11-35 years post-residency (N=93,635)	
	Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
Female	1.20**	1.14-1.26	1.35**	1.27-1.44
Osteopathic	1.02	0.93-1.12	1.49**	1.34-1.66
International Medical Graduate	1.62**	1.49-1.76	1.20**	1.09-1.31
Born in rural area	0.55**	0.50-0.60	0.64**	0.59-0.70
Primary care physicians (PPR per 1000 residents)	0.75**	0.68–0.84	0.60**	0.53-0.68
No hospital in county	1.16*	1.02-1.32	1.05	0.90-1.21
RUCC = 6/7 (ref 8/9)	0.87*	0.78-0.97	0.93	0.82-1.06
RUCC = 4/5 (ref 8/9)	0.81**	0.72-0.91	0.86*	0.75-0.98
Adjacent to metropolitan	1.10**	1.03-1.17	1.33**	1.24-1.43
Median household income (10K units)	1.05	0.99-1.11	1.07*	1.01-1.13
Median house price (100K units)	0.95	0.88-1.02	1.10**	1.03-1.17
Unemployment rate (%)	1.017*	1.001-1.033	1.022*	1.004-1.041
Population aged 65+ (%)	0.976**	0.967-0.985	1.002	0.991-1.012
Population non-Hispanic African American (%)	1.001	0.998-1.004	1.002	0.999-1.006
Population Hispanic (%)	1.002	0.999-1.005	1.005**	1.001-1.008

* p<0.05; ** p<0.01

PPR = provider-to-population ratio; K = $1000 units

There were notable differences of the association between 'rurality' and mobility by physician's career stage. The odds of moving to metropolitan areas are significantly lower in RUCC 4-7 compared to RUCC 8/9 for 'younger' physicians. Older physicians in RUCC 4/5 also have decreased odds of moving to metropolitan compared to RUCC 8/9, but not so for RUCC 6/7. Working in a rural county without a hospital is significantly related to increased risk of moving to metropolitan areas for younger physicians but not so for older physicians. Working in a rural area adjacent to metropolitan populations was associated with increased risk of moving to a metropolitan location for both physician groups, in particular for older physicians.

Outside of the effect of age, other physician characteristics were consistent predictors of mobility. Female physicians, IMGs and those not born in rural areas were all more likely to move back to metropolitan locations irrespective of career stage, whilst older osteopathic physicians were also more likely to move. Similar to county-level turnover in Table 3, physicians located in areas with poorer supply (measured by PPRs) are also significantly more likely to leave rural areas.

County-level demographics were also related to odds of mobility into metropolitan areas. Increased house prices and household incomes were significantly associated with increased mobility for older physicians only, whilst increased unemployment was consistently associated with increased odds of mobility. Younger physicians had a higher risk of mobility in areas with smaller numbers of older residents, whilst older physicians had a higher risk of mobility in areas with larger numbers of Hispanic residents.

DISCUSSION

Primary care physician workforce supply disparities between rural and metropolitan areas remain a significant problem. These data enable a closer examination of the geographic patterns of rural physician mobility, including a first investigation of associations between increased geographic mobility and locational aspects.

Rural populations experience mobility of existing physicians as supply turnover. Irrespective of where the physician is moving to, local rural residents experience a significant loss of supply to their community. Furthermore, unlike larger metropolitan areas and practices, this loss is not easily absorbed by nearby services in small populations of low density. Of great concern is the strong association between rural counties with poorer supply (lower PPRs) and higher turnover of physicians who work in these areas and they are also of significantly higher risk of leaving rural practice altogether, irrespective of career stage. These results are consistent with other non-rural specific studies,[1,34] but highlight the difficult battle to improve physician availability for small rural communities. Rural areas which can least afford to lose physicians are those dealing with difficulties of increased mobility and turnover. Improved retention of rural physicians in these communities needs to be a target of health policies.

Retention of the existing rural physician workforce is significantly worse in the most remote rural communities (RUCC 8 and 9: population <2,500) compared to those in RUCC 4-7 areas. Turnover is also much greater in counties without a hospital, though physicians moving from these areas are only slightly more likely to leave rural practice altogether. Increased turnover in areas without a hospital is likely more problematic due to a lack of alternative service choices for these residents, thus supporting the need for health policies to target rural physicians in these small and often isolated communities, who are likely struggling without a critical mass of other health professionals nearby.

Both female and non-rural backgrounds are widely recognised characteristics of physicians who are less likely to work in rural areas. The results of this study further highlight the difficulty of retaining these two groups of physicians when they do initially spend time in a rural area. Older osteopathic-trained physicians were significantly associated with leaving rural practice, perhaps due to increased initial uptake of rural practice in their early career stages.[42]

Much of the medical literature on rural retention relates to professional issues, whilst the social sciences literature on migration patterns and population mobility mostly relate to environmental aspects. This study is the first on rural physician mobility that investigates the association between rural workforce turnover and place characteristics. Surprisingly, higher rates of turnover were not found among physicians working in poorer rural communities, measured by household income and median house prices, though higher unemployment was significantly associated with poorer retention. Economic aspects appear to have only a minor role in mobility decisions of primary care physicians. Geographic aspects, in particular

small population size and isolated areas without hospital support, instead had a much greater role in mobility.

The net movement of physicians into and out of rural areas was relatively even across the 14 year study period, with close to 13-14,000 moves in each direction observed. Overall, this pattern continues the chronic deficit of physician supply experienced by rural areas. The only way for this rural undersupply to diminish is for rural in-flows to outweigh rural outflows through improved recruitment and retention.

Somewhat unexpectedly, turnover within rural counties had no statistical association with any of the economic or demographic measures. Stronger economic aspects, in particular, were expected to be important when choosing between rural locations – for example, given a choice between a rural town with strong growth versus a rural town with no growth or even slowly 'dying', the latter would deter most individuals; however, this was not reflected by the results of this study over and above physician shortage levels.

Fringe rural locations, adjacent to metropolitan (RUCC 4, 6, 8) were similarly likely to have workforce turnover as other non-adjacent rural counties; however, these rural physicians were more likely to be observed leaving rural practice and particularly for older physicians. It is not known whether these moves coincide with the physician's family moving to metropolitan areas or perhaps the physician is able to commute without the need for their family to also move.

The main limitation of this paper is its reliance on the accuracy of location information in the AMA dataset. Our study used a biyearly approach to smooth out some of the issues regarding timeliness of location changes within the AMA data, but it remains questionable how sensitive this dataset is to the longitudinal movement of physicians. In addition, many physicians practice in more than one location, but this analysis has only used their main work location.

This study is strengthened by the removal of residents from all analysis, as well as the separation of key mobility results by those in their early career stage. It is well recognised that younger physicians are much more likely to change work locations compared to older physicians, and the reasons for moving are likely to be different too. Residents may be required to undertake short-term placements in rural areas, thus moves in and out of rural areas can be observed which are totally un-related to push and pull factors. Shortly after residency, physicians may choose initial employment locations based more on availability rather than preference until their preferred option becomes available.

Increasing rural workforce supply, and maintaining the existing rural physician workforce remain key issues of the US. Using the best available workforce data in combination with place characteristics, this study provides the first quantitative evidence of rural primary care physician mobility. These findings help rural health workforce planners and policymakers to understand which characteristics are most strongly associated with physician geographic mobility each year, how often moves occur and where they might move to and from. In addition, the strength of key community-level push and pull factors have been measured against observed mobility behaviour. Such evidence is useful in guiding more effective targeting of rural health policies and workforce planning and incentives.

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Chapter 3: Study 2 - What contribution does *community amenity* play in accounting for differences of rural primary care workforce supply?

INTRODUCTION

Maldistribution of the primary health care workforce remains a key problem characterising geographically large countries like Australia and the US.[1-3] As a result, residents of many rural communities continue to experience difficulty accessing doctors (that is, general practitioners (GPs) in Australia or primary care physicians in the US) at times of need. Increasingly too, more graduates are choosing medical specialities over general practice or primary care, thus further compounding the difficulties in recruiting and retaining rural primary care doctors.[4, 5] Nonetheless, for those who undertake rural careers, professional satisfaction is high amongst rural primary care doctors[6] with many rural communities serviced by long-standing doctors.[7,8] However, exactly why some specific rural communities are more likely to experience undersupply, and have greater difficulty in attracting and retaining an adequate medical workforce than others is not entirely clear.

The supply of primary care doctors to rural communities depends on pre-existing supply together with both the recruitment and retention of these highly skilled workers. Although much research has identified key professional factors relating to recruitment and retention of rural primary care doctors,[9-12] less attention has been given to the role of community and place factors on supply. Doctor's location decisions relate both to meeting their professional needs and interests, and to meeting their non-professional satisfaction through, amongst other aspects, various place-related attributes. Conceptually, these latter attributes reflect a community's overall amenity or attractiveness, which arguably influence both rural in-migration and retention.[13-16] One small study in Idaho, US, assessed a community's 'assets' to quantify the relative attractiveness of different rural communities, with both professional and non-professional factors found to be important to recruitment and retention.[17] While various community aspects may be important to rural doctor's location decisions, little empirical evidence exists linking community-level amenity with differences of rural primary care workforce supply.[18] It is unclear to what degree undersupply of rural doctors in specific areas correlate with their perception as being 'amenity-poor' or unattractive.

Using data from both Australia and the US, this study investigates the extent to which variations in community amenity aspects explain spatial variations in the supply of rural primary care doctors. This evidence is important in helping understand the role of place characteristics and rural population dynamics in the recruitment and retention of rural doctors.

Australia and the US share geographical similarities, being large in size (3.0 and 3.8 million square miles respectively) but also with vast areas characterised by very low population densities. Defined by the RUCC scale, rural US comprises 15% of the population and 75% of the landmass. Similarly, defined by the Australian Statistical Geography Standard Remoteness Areas (ASGS-RA) scale, rural and remote Australia comprises 30% of the population and 99% of the landmass. Furthermore, only 2% of Australia's population live in 86% of its 'remote' landmass. Despite important differences in their primary care health systems and policies, both countries' rural populations continue to experience similar health workforce shortages and maldistributions.

COMMUNITY AMENITY FOR RURAL DOCTORS

Community amenity is a complex and arguable subjective concept, relating to a location's attractiveness or pleasantness. Critically, it is widely regarded as a key determinant of population location decisions and migration patterns within and between rural and urban areas.[16,19,20] Given that most residents work in close proximity to their place of residence, it follows that the availability of rural primary care doctors is likely less problematic in these more attractive or 'amenity-rich' regions. The geography discipline identifies a number of physical characteristics that enhance the attractiveness of specific rural locations as places to live.[21] These characteristics commonly include warmer winters, temperate and low humidity summers, varying landscape and ready access to water recreation. US researchers have developed a national 'natural amenities' scale based on these area characteristics for each rural county,[22,23] with other amenity scales developed in both Australia and the US including similar input measures.[13,24]

Researchers have shown increased community amenity to be associated with net rural in-migration of the general population to such areas.[13,24,25] However, little is known about the extent to which the specific location decisions of doctors or other highly-skilled professionals are also influenced by amenity, with one Australian study only finding a very weak association of community-level GP shortage and rural amenity aspects.[18] Partridge[16] theorised that the growth of regional areas stems from two key types of factors – (1) economic; and (2) amenity (including natural features and other public services and infrastructure). He found that amenity is a much stronger determinant of high in-migration in the US compared to economic factors, though contrasting results were apparent in Canada.[26] In contrast, lack of amenity has been shown to contribute to long-term net out-migration with households preferring warmer climates and coastal locations.[27] It follows that these poorer amenity locations may also be areas where rural doctors might not prefer to be working.

While rural communities often offer high local amenity including good recreational opportunities, they can also appear unattractive because of their relative isolation and poorer access to desirable services and professional opportunities.[28,29] Reduced population density and increased distance to major urban areas have been shown to be dominant reasons for lower rural in-migration.[20] In contrast, strong economic growth characterises many fringe urban areas compared with other more isolated rural communities.[16,19] Isolation is particularly difficult for those communities which have limited natural amenities,[30] as young adults move away to seek better employment opportunities. This contrasts with population growth evident in many coastal communities[19] or those characterised by the availability of key services and infrastructure such as regular and easy access to air travel.[31]

Several studies have investigated the role of place characteristics and attractiveness for rural health worker location decisions. One recent survey of rural hospital Chief Executive Officers (CEO) on staff recruitment found that the prime factor associated with staff recruitment was whether their place of residence and employment was a good place to raise their family - notably, that it was safe and had good schools.[32] Similarly, an Australian survey of young doctors considering rural practice found they wanted a positive place to live with good access to public amenities and spouse employment opportunities.[33] Another Australian survey of doctors of all ages found the key deterrent to rural practice was isolation associated with small and inland communities together with poor social interaction opportunities.[11] Irrespective of location, doctors working in small rural communities experience many increased professional demands such as longer working hours and greater likelihood of after-hours work, as well as other problematic non-professional issues such as limited opportunities for spouse employment and schooling.[6] Key reasons for various rural health care provide shortages have recently been identified, with financial viability aspects of professional practice being prominent.[34]

In short, it is apparent that various rural amenity aspects impact on population migration decisions generally, although it is less clear what the roles of specific aspects of amenity are for recruitment and retention decisions of rural primary care doctors. This study seeks to overcome this knowledge gap by assessing the contribution of rural amenity to observed supply of primary care doctors in Australia and the US.

METHODS

Measures of supply

One widely used measure of workforce supply in both health policy and health services research is PPRs. PPRs are defined by static geographic boundaries, with a simple and easily understood calculation of the ratio between availability (volume of services) and demand (population size) within each boundary. PPRs have long been utilised in national rural health workforce policies including the US's Medically Underserved Areas and Health Professional Shortage Areas and Australia's District of Workforce Shortage Areas and Areas of Need[35,36] to identify regions characterised by workforce under-supply. Despite this usage, PPRs are widely criticised for their use of pre-defined boundaries and assumption that all service utilisation occurs within these boundaries.[37,38] This has led to development over the last decade of the two-step floating catchment area (2SFCA) method, which removes the need for administrative boundaries by instead using catchments which are centred on population and service locations, with their sizes determined by the utilisation behaviour of the population.[39-42] While the 2SFCA method framework has growing support, most development has occurred in small-scale testing and it remains a complex method to apply, with only one recent measure completed at the national level for Australia.[43] To date, the 2SFCA method has not been developed nationally in the US, thus necessitating continued usage of PPRs.

For this study, PPRs were calculated for both the US and Australia, with 1949 rural counties in the US (defined by RUUC, 4-9, average county population ~23,000) and 371 rural local government areas (LGAs) in Australia (defined by Australian Standard Geographical Classification – Remoteness Areas 2-5, excluding LGAs that contain cities of >50,000 population and those without an urban area of >500 population, average LGA population ~12,000). US service data were drawn from the 2014 AMA Masterfile for all primary care physicians (family physicians, pediatrics and general internal medicine), while Australian service data (full-time equivalence) were drawn from the 2012 Australian Government's Medicare Benefits Schedule dataset for all billing general practitioners. PPRs were then calculated using service volume and population size for each respective region. In addition, McGrail's 2015 2SFCA method (details described elsewhere[43]) was measured for all 1116 Australian rural towns with populations between 500 and 50,000 residents.

Measures of community amenity

Measures of three broad dimensions of community amenity were included in this study, namely isolation/proximity, economic and socio-demographic. Firstly, the possible isolation from professional and non-professional support and services remains a key aspect of working and living as a rural doctor. Being located nearby to both a hospital and larger metropolitan areas are thought to be desirable to doctors, similarly good access to schools and coastal recreation are also seen as desirable, whilst isolation through long commuting travel or living in remote areas are less desirable. Secondly, economically poorer rural locations may reflect those of reduced attractiveness (smaller populations, lower house prices) and populations with less discretionary spending on health care. In contrast, more affluent rural locations are likely to be desirable to doctors choosing between locations. Thirdly, socio-demographic aspects may relate to a location's attractiveness. Consideration was given to including a composite deprivation measure[44,45] but we chose to use only the most relevant components of unemployment, household income and post-high school education. The full list of community amenity aspects included in this study are summarised

in Table 1. Data were collated from the American Community Survey (2011), Robert Wood Johnson Foundation (2014) and the Australian Census of Population and Housing (2011). Proximity measurements were calculated using straight distances and ArcGIS 9 software.

Table 1: List of rural amenity aspects available in this study

Dimension	Community amenity aspect	US data	Australia data
Isolation / proximity	Having hospital in region / proximate to hospital	✓	✓
	Proximate to private schools	n/a	✓
	Proximate / adjacent to large metropolitan city	✓	✓
	Work commute length	✓	n/a
	Proximate to coast	n/a	✓
	Remote areas (ASGC-RA 4-5)	n/a	✓
Economic	Population size	✓	✓
	House prices	✓	✓
	Household income	✓	✓
	Health insured coverage	✓	n/a
	'Affluence' – access to locations for physical activity	✓	n/a
Socio-demographic	% Aged 65+	✓	✓
	% Unemployed	✓	✓
	% Educated above high school	✓	✓
	% Indigenous (Australia) or % American Indian (US)	✓	✓

n/a = Not applicable (e.g. Primary care insurance in Australia is universal; Proximity to coast or private school in US considered much less relevant)

Statistical analysis

The relationship between supply and community amenity indicators was initially examined by calculating zero-order correlations. Multi-variate linear regression models were then calculated for each of the three supply measures. All statistical models in this paper have applied population size weights. All calculations were performed using either StataMP 13.1 for US data or StataSE 12 for Australian data (StataCorp, College Station, TX, US) with a 5% significance level.

We chose not to include climate or topographic aspects directly for specific locations in our analysis. These aspects have strong spatial autocorrelation between adjacent locations, thus they are not likely to be sensitive to small area differences of supply and they fail the requirement for independence within regression models. Instead, all statistical models included State as a co-variate but these effect sizes are not reported. Inclusion of the State variable captures its association with overall supply, which may relate to climate attraction, State-level policies (not measured in this study), or other aspects not considered.

RESULTS

The distribution of scores for the 3 supply measures is summarised in Figure 1, highlighting the wide range of doctor supply across different rural locations.

Figure 1: Distribution of the three study measures of supply

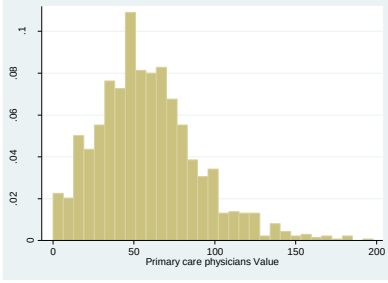
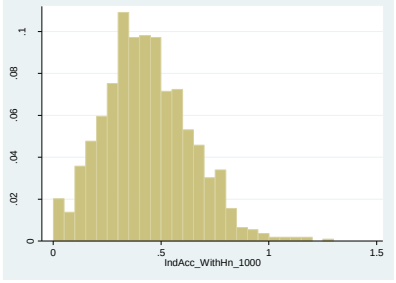
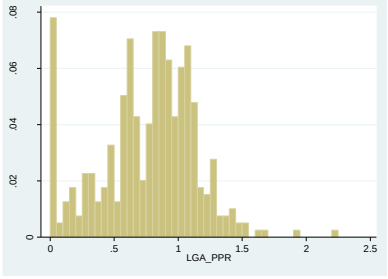
(1) US rural countys – PPRs	(2) Australian rural towns – 2SFCA	(3) Australian rural LGAs - PPRs
		

Table 2 summarises the correlations between community amenity aspects and each supply measure. Increased population size and having a nearby hospital are consistent positive correlates with improved medical workforce supply. Additionally, communities where residents are well educated, more popular to home purchasers, and located nearer to the coast (Australia) and private schools (Australia) or county affluence (US) were also associated with improved medical workforce supply. In contrast, communities that are most isolated in remote Australia or characterised with long work commutes (US) had poor supply. The respective medical insurance systems appears to produce opposite outcomes, with Australia's universal access seeing higher supply in communities whose populations are older, more unemployed with poorer income, whilst the US sees poorer supply in such communities.

Table 2: Correlations between supply and community amenity aspects

	US county (PPR)	Australian towns (2SFCA)	Australian LGAs (PPR)
Having hospital in region / proximate to hospital	0.311	0.161	0.276
Proximate to private schools	n/a	0.292	0.228
Proximate / adjacent to large metropolitan city	-0.196	-0.0349	0.004
Remote areas	n/a	-0.129	-0.271
Work commute length	-0.336	n/a	n/a
Proximate to coast	n/a	0.189	0.157
Population size	0.202	0.474	0.298
House prices	0.287	0.079	0.125
Household income	0.172	-0.051	-0.379
Health insured coverage	-0.186	n/a	n/a
'Affluence' – access to locations for physical activity	0.295	n/a	n/a
% Aged 65+	0.015	0.152	0.455
% Unemployed	-0.084	0.211	0.214
% Educated above high school	0.263	0.121	0.073
% Indigenous (Australia) or % American Indian (US)	0.023	-0.073	-0.190

Table 3 summarises the association between rural community amenity aspects and each supply measure using ordinary multivariate linear regression models. It can be seen that all amenity aspects were significantly associated with distribution of the primary care workforce in US counties, though the role of household income has reversed. This model, in combination with State effects, captures almost half of the observed variation in PPR scores. Both Australian models captured a smaller proportion of the observed variation in supply. Aspects which are consistently associated with significantly better supply across both countries include having a hospital in the region, larger population size of main town in region, more elderly residents, better educated community and increased housing prices in region.

Table 3: Summary of multivariate linear regression models of rural supply

	US county (PPR)	Australian towns (2SFCA)	Australian LGAs (PPR)
Having hospital in region / proximate to hospital	Higher ***	n/s	Higher ***
Proximate to private schools	-	n/s	n/s
Proximate / adjacent to large metropolitan city	Lower ***	n/s	n/s
Remote areas	-	n/s	n/s
Work commute length	Lower ***	-	-
Proximate to coast	-	Higher **	n/s
Population size	Higher ***	Higher ***	Higher *
House prices	Higher ***	n/s	Higher **
Household income	Lower *	n/s	n/s
Health insured coverage	Lower *	-	-
'Affluence' – access to locations for physical activity	Higher ***	-	-
% Aged 65+	Higher ***	Higher **	Higher *
% Unemployed	Lower **	Higher **	n/s
% Educated above high school	Higher ***	Higher ***	n/s
% Indigenous (Australia) or % American Indian (US)	Lower ***	n/s	n/s
Model R-Squared	0.48	0.35	0.39

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; n/s not significant
State was included in all models

DISCUSSION

This important study provides the first empirical evidence of the extent to which community amenity contributes to differences of supply of rural primary care doctors in both Australia and the US. Overall, these data support the idea that the rural medical workforce are distributed with bias towards more affluent and educated areas, whilst supply is more problematic in smaller, poorer and more isolated rural towns which are struggling to attract adequate supply of primary care services.

Two significant covariates associated with increased workforce supply were larger rural communities and those with a hospital nearby. Consistent with poorer retention,[46] working as a rural doctor is more challenging in smaller rural communities where a strong peer support network is not readily available. Working in such places can limit opportunities for professional collegiality, limit sharing of workload (especially on-call / after-hours work), increase difficulty of taking time-off, professionally isolating where there is not a local hospital for referral of their patients which also limits ability to participate in procedural work. It is worth noting that in Australia, some policies relating to the rural medical workforce have shifted their focus away from solely 'remoteness' and more to considering community size, with these data supporting the Australian government's decision.[47,48]

Increased supply of rural doctors was also associated with better serviced / more affluent regions. Economists argue that house prices are a strong indicator of a location's attraction,[49] and it was seen that doctors are also more likely to work in rural areas with higher housing prices across both countries. Given that the earning power of doctors is generally well-above average, their preference is to choose more attractive locations for residence, and thus paying the higher housing premium. The US measure of county affluence was additionally significantly associated with increased doctor supply. While we didn't directly measure access to other services such as adequate shopping, employment, cultural and other recreation opportunities, it is known that these are all strongly related to larger populations. Additionally, while poorer access to schools was not significant within our Australian models, this measure is strongly correlated with population size (>0.5) and shown to be a major reason for dissatisfaction of doctors living in smaller rural areas.[6]

The attraction of a coastal location is also well-recognised within Australian rural migration,[13] and this too was reflected in increased doctor supply in coastal towns. Notably, Australia's population hierarchy is largely centred on a few coastal metropolitan cities (1.1 – 4.0 million residents), while its 'regional centres' (hubs outside these cities) are mostly only 5-10% in size of the largest metropolitan city in that state. In contrast, the US settlement hierarchy exhibits less urban primacy, with most states having multiple regional/urban cities that are 25-80% the population of the largest metropolitan city in that state. Rural counties that fall between, or are adjacent to, the larger service centres are those where commuting distances are longer, so it follows that supply of doctors is poorer in these interstitial locations. Whilst remote areas of Australia are associated with poorer medical workforce availability, this was not reflected in the multivariate model, largely due to its collinearity with coastal proximity, population size, education levels and % elderly.

Locations with a high percentage of elderly residents were consistently associated with significantly higher workforce supply. This age cohort is by far the largest user of primary care, so it should not be surprising that its supply is higher in such communities. What can't be measured by this study, however, is the greater health needs (demands) required by this cohort, so it is difficult to tell whether the higher workforce supply accords with their increased needs, and whether this reflects this as an attractive aspect to rural doctors, or not. Similarly, Australia's Indigenous populations and US's American-Indian populations are concentrated more in smaller communities located throughout rural and remote regions and have significantly higher health needs than other Australians or Americans; however this aspect has a negligible or negative association with supply despite their increased needs. Whether this negative outcome reflects a low attraction aspect to rural doctors is unclear.

Not having a universal access medical insurance system places particular importance of ability to pay within US primary care doctor's location decisions. It is not surprising that supply levels were significantly lower in rural areas with more uninsured residents. However, associations between other socio-economic and socio-demographic amenity aspects and supply are less clear with household income and unemployment having contrasting associations with supply when comparing the two countries. Supply was higher in locations with more residents educated above high school in both countries, though this study cannot determine how this makes a location more attractive to doctors.

This study is conceptually based on the linkage between key amenity characteristics of different 'places', and supply, with supply reflecting the personal decisions of doctors to choose one work location over another. We recognise that doctor behaviour is based on a large array of information and filters which are significantly more complex than this study has investigated. In addition, there may be sub-categories of these amenity aspects which we have overlooked. For example, all schools and hospitals were assumed to be homogeneous but these vary greatly in size, composition and quality. Moreover, personal satisfaction may largely relate to specific individual level preferences or needs of the family that are unrelated to community amenity.

A key limitation of this study is that professional factors have not been directly considered. Some of these factors may be reflected by the significant association between higher supply and both larger populations and having a nearby hospital, additional professional factors such as lack of procedural work, onerous on-call arrangements, difficulties in getting locum relief, inadequate workforce mix and poor infrastructure were not included. Notably, little is known whether community amenity aspects outweigh professional factors in location decision making of doctors. Other limitations include an assumption throughout this paper that higher supply is always better, though it is possible for some rural communities to be oversupplied. In addition, supply is only one measure of workforce distribution, with turnover / retention being an important alternative measure, especially for remote areas.[46]

CONCLUSION

Continued maldistribution of the rural primary care workforce suggests that the current policies and solutions are not entirely effective in their quest to overcome workforce shortages in some areas. Many policies and research papers continue to assume ‘rural’ to be one and the same for all non-metropolitan areas, but this can overlook major differences. This study highlights that the rural medical workforce is biased towards more affluent and educated areas, whereas smaller and more isolated rural towns continue to struggle to attract adequate supply of primary care services. Future primary care workforce policies need to place a greater focus on rural communities that, for a variety of reasons, may be less amenable to doctors wanting to begin or remain working there.

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Chapter 4: Policy recommendations

There are a multitude of medical workforce distribution incentive programs, which are predominantly based on broad definitions of ‘rurality’. In the last 5 years, geographical ‘remoteness’ has been the key tool for identifying eligible locations with a shift in the last 6 months to a combined population size and remoteness system (Modified Monash Model). These studies confirm that smaller population size is significantly associated with both increased mobility (poorer retention in a community) and poorer supply, thus being a key factor for where resources should be targeted.

Poorer supply was also a strong factor associated with poorer retention of rural doctors. Australia has somewhat identified such areas using the District of Workforce Shortage determination (which are defined as those with ‘supply’ below the national average). However, this determination has previously only been used for recruitment policies. Our study confirms that poorer ‘supply’ should also be considered for targeting retention resources. When combined with smaller population size, such communities are highly vulnerable with poorer supply and poorer retention having a large impact where the workforce is already small to begin with. Rural areas which can least afford to lose doctors are those dealing with difficulties of increased mobility and turnover. Improved retention of rural physicians in these communities needs to be a target of health policies.

Furthermore, rural doctor supply and retention are poorer in regions without a nearby hospital in addition to their smaller population. Health policies need to consider the impact on doctors working in such communities, who are likely struggling with the isolation and lack of a critical mass of other health professionals nearby.

Community amenity can also contribute to differences of rural supply, but for the most part did not impact on retention (based on US data). Notably, supply was increased in more educated, affluent and economically attractive areas (measured by housing price). Our data also confirmed the popular notion of the pull of the coast, with such areas having significantly higher supply. Community characteristics such as these are not amenable through policy; however, rural areas that have low community amenity may require targeting of resources to compensate for their reduced ‘attractiveness’.

Continued maldistribution of the rural primary care workforce suggests that the current policies and solutions are not effective in their quest to overcome workforce shortages in some areas. ‘Rural’ communities of the same population size and/or remoteness should not be assumed to be one and the same for all non-metropolitan areas. Policies need to place a greater focus on rural communities that may be less amenable to doctors wanting to work and/or live there.