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Training and retention in rural and remote Australia: Examining the association between GP vocational training placements and subsequent practice location in Western Australia

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ABSTRACT

This paper aims to provide insights on the association between exposure to rural general practice vocational training placements and subsequent rural practice location in Western Australia. We further explore the possibility that the observed associations might depend on an individual's rural upbringing and or an individual's exposure to general practice during medical school. To this end, a cross-sectional analysis of practice location of 353 general practitioners who completed their vocational training through WA General Practice Education and Training between 2010 and 2017 was conducted. The empirical analysis uses a fully recursive conditional mixed process estimator to jointly estimate the probabilities that a general practitioner (GP) completes their vocational training placement at a rural location and subsequently practices at a rural location. The results show that GPs who chose rural locations for their first and last vocational training placements are more likely to practice at a rural location compared to their counterparts choosing metropolitan locations. Also, the probability of subsequent rural practice is further strengthened by having a rural background and having exposure to general practice during medical school even after controlling for potential confounders. The results also indicate that GPs stay in rural locations for reasons linked to their career, family and lifestyles. This evidence underscores the importance of vocational training organisations in WA and reinforces the need for ongoing rural opportunities in training to ameliorate location-based disparities in the distribution of the GP workforce in Western Australia.

1. Introduction

Australia's healthcare system faces several challenges (Armstrong et al., 2007), one of which pertains to the ongoing issue regarding the mismatch between the spatial distribution of people and that of healthcare providers (geographical maldistribution) especially in rural and remote areas of the country. To ensure a more sustainable and affordable health workforce for the future, there have been several calls for reforms and a shift from the so called 'business-as-usual' approach with many stakeholders recognising the importance of a multisectoral approach as part of the solution to ensure an adequate supply and retention of health workers in rural and remote locations of the country (HealthWorkforce Australia, 2012). Despite several health workforce strategies being implemented by the Australian government to address the problem, we continue to observe General Practitioner (GP)[1] shortages in rural and remote areas of the country (Mason, 2013).

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[1] In Australia, a general practitioner (GP) is a medical specialist who undergoes specialised vocational training that is facilitated by regional training organisations (RTOs) across the country and attains a fellowship to show that he or she is competent across the core skills of general practice. General practice is a recognised medical specialty (in some countries called family medicine) where doctors must undertake extensive vocational training to qualify as medical specialists. The Royal College of General Practitioners (RACGP) and the Australian College of Rural and Remote Medicine (ACRRM) are the two professional bodies that oversee the overall professional training standards in GP education in Australia. These colleges award the Fellowship of RACGP (FRACGP) and Fellowship of ACRRM (FACRRM) respectively, to all junior doctors who successfully complete the college assessments to become registered as specialist GPs with the Medical Board of Australia (RACGP, 2021).

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The accessibility of the Australian medical workforce is greatly reliant on the distribution of its personnel to areas in greatest need. This distribution is evaluated using the number of full-time equivalent (FTE) health professionals within a given area relative to the estimated resident population of that same area (Australian Institute of Health and Welfare, 2019). The FTE is derived from the total hours worked in a standard working week, typically 40 hours for medical practitioners in Australia . Considering all registered health professionals, the total number of employed FTE clinicians declines with remoteness, a pattern that has been observed since 2013 (Australian Institute of Health and Welfare, 2020). For example, in 2018, there were 395 clinical FTEs per 100,000 people working as medical practitioners in major cities of Australia compared to 288 clinical FTEs per 100,000 people in inner regional areas; 262 clinical FTEs per 100,000 people in outer regional areas; 308 clinical FTEs per 100,000 people in remote areas; and 231 clinical FTEs per 100,000 people in very remote areas (Australian Institute of Health and Welfare, 2020). Across all health professionals in 2018, major cities had the greatest number of working FTE clinicians (1927 clinical FTE per 100,000 people) when compared to all other remoteness areas (1679 FTE per 100,000 people in inner regional areas; 1550 FTE per 100,000 people in outer regional areas; 1733 FTE per 100, 000 people in remote areas; and 1668 FTE per 100,000 people in very remote areas). Thus, the distribution or density of the medical workforce largely favours metropolitan as opposed to rural and remote areas of Australia.

While Australia has made remarkable progress in terms of the number of medical graduates it produces every year relative to other developed countries (Oganisation for Economic Co-operation and Development, 2018), location-based inequities in the distribution of the health workforce remains a persistent and ongoing issue (Mason, 2013). Over recent years several strategies and programs have been implemented by the Australian government and aimed at addressing the geographical imbalance of the health workforce including increasing the number of GP training places, creation of a rural pathway within the Australian General Practice Training (AGPT)[2] program, incentive payments and a restriction on provider numbers for overseas trained doctors. Despite these policy developments, we are still observing a shortage of GPs in rural, remote, and outer metro areas and little clarity and evidence exists regarding what strategies are effective in keeping GPs in rural and remote locations.

This study examines the association between GP vocational training placement location and subsequent practice location. First, we assess the individual and joint importance of the first and last GP vocational training placement location on subsequent practice location of GPs who have undergone AGPT training in WA between 2010 and 2017. Second, we adopt innovative and robust empirical methods that account for potential selection bias associated with the choice of GP vocational training placement locations. To this end, we jointly model subsequent rural practice and choice of GP vocational training placement location within a fully recursive triangular system estimated via the Full Information Maximum Likelihood procedure within a conditional mixed process framework as well as rely on the control function method as a sensitivity check to minimise the potentially ensuing bias (Wooldridge, 2015). Third, we assess whether the placement location-subsequent practice location association might depend on an individual's upbringing (rural or urban) and Rural Clinical School experience or a combination of the two. Lastly, we explore possible reasons why some GPs might choose to practice rurally post vocational training than others.

2. Related literature

Health workforce shortages in rural and remote locations are common to nearly every country and pose a serious challenge to the provision of health services in an equitable manner. These shortages are a function of both recruitment and retention of health workers. Recruitment entails attracting and selecting health workers to an organisation or a particular role and is a pre-requisite for retention – the duration of time between initiation and cessation of employment (John Humphreys et al., 2017). Much is known about the factors associated with the recruitment and retention of medical doctors in rural and remote locations across countries (World Health Organization, 2010). Research has primarily focused on recruitment and retention aspects because these can be influenced easily as opposed to factors that are economic or political in nature (Lehmann et al., 2008). Factors associated with retention are thought to be more modifiable relative to those linked to recruitment (Hancock et al., 2009). For instance, changes to work-life balance or work schedules are possible and can be done while rural background is non-modifiable (Pathman et al., 2004). However, several research gaps have been noted in the previous evidence including the need for high-quality evidence to inform health workforce policy and planning (World Health Organization, 2010). Moreover, a comprehensive synthesis of the previous literature suggests the need for more evidence base to demonstrate the effectiveness of available strategies to address workforce shortages in rural and remote locations in varied contexts (P. Buykx, J. Humphreys, J. Wakerman, & D. Pashen, 2010; John Humphreys et al., 2017).

Previous studies identified several factors associated with practice location including those related to either or a combination of political, personal, cultural, economic, organisational, and professional factors (Dussault and Franceschini, 2006). An individual's rural background has been amongst the top cited predictors of subsequent rural practice (P. Buykx et al., 2010; Daniels et al., 2007; Geyman et al., 2000; M. R. McGrail, D. J. Russell, & D. G. Campbell, 2016). Indeed, previous connections to rural areas either through basic vocational training, secondary education, or both, could promote rural practice (Eley et al., 2012; McGrail, O'Sullivan and Russell, 2018). A rural background could impact future practice in rural locations through cultural and physical differences between rural and urban settings (Christman, 2004). Rural areas are typically classified as so due to their vast land area characterised by low population and resource density (Woods, 2004). Moreover, people living in rural areas are thought to have a stronger connection to their physical environment when compared to people of urban origin (Woods, 2004). These differences are more likely to create functional dichotomies that potentially influence the choice of practice location (Hancock et al., 2009). Recent research from Australia also suggest that assisting medical students to develop more realistic expectations regarding rural practice (rural practice self-efficacy) early on can help them make informed decisions and subsequently promote rural practice (Bentley et al., 2019). The career stage of medical graduates in combination with their rural origin has also been cited as an important determinant of rural practice with an estimated 33–36% of mid- and late-career rural origin graduates more likely to be practicing rurally in Australia (McGrail and Russell, 2017).

One strategy that has been proposed in the literature and touted to promote rural practice in Australia and other countries has been the development of a "rural pipeline" (Woolley and Ray, 2019), an initiative first proposed in the United States (Council on Graduate Medical Education, 1998). This involves locating vocational training organisations in rural and remote locations where medical students are exposed to extensive rural experiences as part of their training upon which they can smoothly transition to rural practice (Kitchener, 2020; Woolley and Ray, 2019). Having a purposive selection strategy with a rurally oriented curriculum that is supported by high-quality clinical training exposure

[2] Doctors who wish to pursue a career in primary health care in Australia may enter the Australian General Practice Training (AGPT) program – an Australian government initiative that receives funding from the Department of Health and is administered through Regional Training Organisations (RTOs) based in rural, regional and metropolitan areas of Australia, with WA General Practice Education and Training (WAGPET) providing training in Western Australia (Australian Government Department of Health, 2018).

in local hospitals with a sufficient number of internship places made available for medical students regardless of their interest in rural practice can help promote rural practice early on in their career (Woolley and Ray, 2019). In other research, prevocational exposure to general practice has also been linked to rural practice (Playford et al., 2014) with others arguing that it is the nature of the students choosing to study in rural locations rather than the "nurture" or experiences during their course that matters for subsequent career choices (Somers and Spencer, 2012). This observation is consistent with research from the United States that attributes an individual's urge to serve their community as an important predictor of rural practice (Odom Walker et al., 2010). Moreso, research from the United States has also shown that medical graduates with repeated exposure to and training in rural areas have a higher probability of practising rurally when compared to their counterparts with no rural exposure (Rabinowitz et al., 2013; Wendling et al., 2016). In Australia, the regionalisation of vocational training centres for GPs has been linked to improved retention of GPs in regional Queensland where an estimated 53% retention rate has been recorded with only a few of the alumni moving to metropolitan areas such as in Brisbane (Kitchener, 2020).

Financial incentives have also been amongst the policy considerations to improve retention of health workers in regional areas despite the available evidence in developed countries showing mixed results (Bärnighausen and Bloom, 2009; Lagarde and Blaauw, 2009; World Health Organization, 2010). The question has been whether these incentives are a sustainable policy option to promote GP recruitment and retention to rural and remote locations. However, a systematic review of the literature by P. Buykx et al. (2010) concluded that financial incentives as a strategy to improve retention in rural areas have not previously been effective. This conclusion is further supported in more recent research from Australia, in which Jongsay and colleagues found that while extension of financial incentives to newly eligible rural locations in Australia attracted more newly qualified GPs, there was no evidence to suggest that such incentives changed the overall stock of GPs in rural locations relative to metropolitan areas (J. Yong, A. Scott, H. Gravelle, P. Sivey, & M. McGrail, 2018). Apart from financial incentives, several other factors have also been linked to rural practice including professional or organisational considerations (John Humphreys et al., 2017; Russell et al., 2012), changes in family dynamics (McGrail, Russell and O'Sullivan, 2017), and external factors such as climate and amenities (McGrail et al., 2011).

A cursory examination of the available literature especially from Australia shows that there is very little clarity and empirical evidence suggesting specific strategies that work to keep GPs in rural practice. As such, this study examines the association between GP vocational training placement locations and subsequent practice location. Unlike previous studies in Australia, such as that by M. R. McGrail et al. (2016), we use information on the first and last GP vocational training placement to assess how these are both individually and jointly associated with subsequent practice location among GPs who have undergone AGPT training in WA between 2010 and 2017. The empirical strategy used is robust in that it fully accounts for potential bias associated with self-selection into rural placements by junior doctors.

3. Data and methods

3.1. Study area – remoteness areas of WA

The study area is WA - a state occupying an estimated 32.9 percent of the land area of Australia (excluding external boundaries) and situated in the western part of the country (Australian Government, 2021). Fig. 1 illustrates the areas of varying degrees of geographical remoteness within WA (Australian Bureau of Statistics, 2018). Remoteness areas (RA) are geographic classifications used to group areas with similar characteristics and often used to describe regional disparities in a range of outcomes including the distribution of the health workforce in Australia (Australian Institute of Health and Welfare, 2004). In Australia, there are five main classifications: major cities, inner regional,

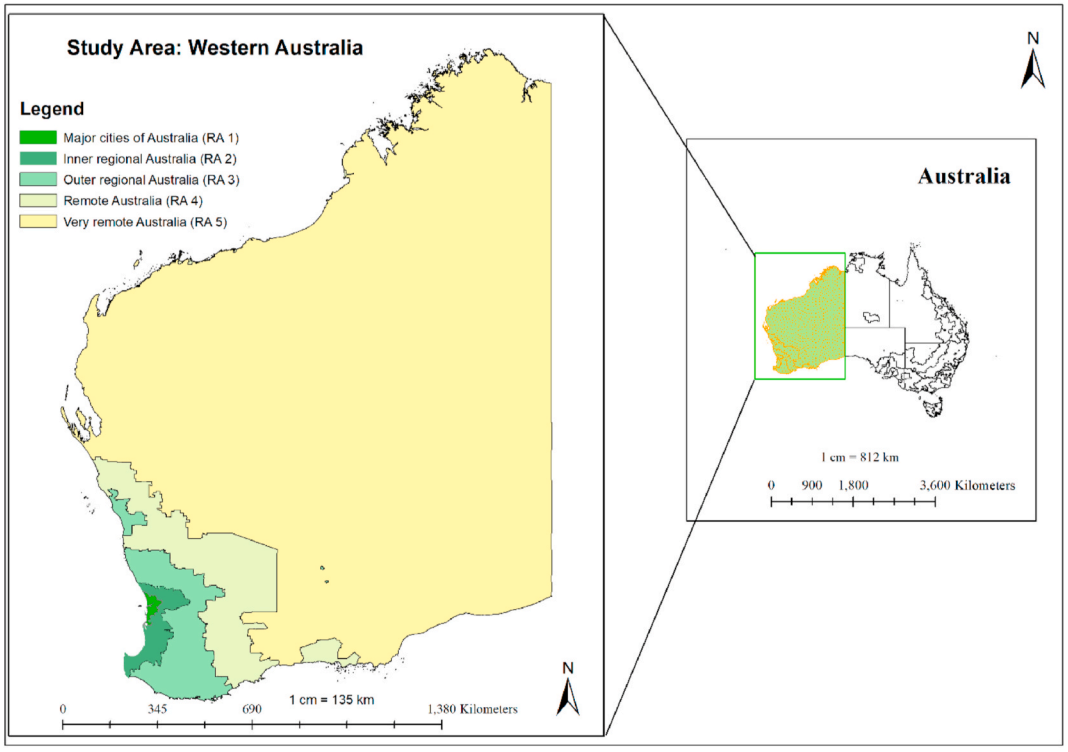

Fig. 1. Map of the state of Western Australia (WA) showing areas of varying degrees of geographical remoteness ranging from major cities of Australia (RA 1) to very remote Australia (RA 5). This map was generated in ArcGIS/ArcMap version 10.8.1 using data (in the form of shape files) publicly available from the Australian Bureau of Statistics (ABS) (Australian Bureau of Statistics, 2018).

outer regional, remote, and very remote (see Fig. 1) (Australian Institute of Health and Welfare, 2004).

3.2. Data source

The empirical analysis uses data collected using both quantitative and qualitative methodologies that involved the use of survey and interview methods to a sample of GP graduates who had completed their training within the AGPT program in WA between 2010 and 2017. All the surveys and semi-structured interviews were conducted or facilitated through WAGPET.

3.2.1. Survey of GP graduates

Out of the 537 GPs who graduated from the AGPT program in WA between 2010 and 2017, 356 graduates responded to the survey, representing a response rate of 66%. From the 356 graduates, we excluded three individuals that had missing information on the current practice location, to make available an analysis sample of 353 GP graduates. The purpose of the telephone surveys was to assess the scope of practice and service provision of GPs who had completed their training through WAGPET as mentioned. Contact details of study participants were accessed from WAGPET databases with participants contacted by phone and asked to complete a short questionnaire on the type and size of their current practice (e.g., general practice, hospital, specialist clinic, other or if not practicing in GP), workload (sessions per week) and whether they practice procedural work. Data on changes in practice over time was also collected through asking a series of questions on the practice locations of GP graduates since completing their vocational training. For this, information on postcode, suburb and type of practice was collected.

3.2.2. GP graduate interviews

To understand the personal and professional retention factors associated with GP graduates' current practice location, WAGPET also conducted semi-structured interviews. The randomly selected sample of graduates had good coverage across a range of characteristics including practice location from city, outer metropolitan, rural and remote areas, gender, and age. The scope of practice and service provision, practice location(s), changes in practice over time, placement locations and moratorium status, reasons for staying in practice locations, including sociodemographic information such as gender, year and country of birth, qualifications, indigenous status, and rural background were all collected. These interviews explored the reasons why participants chose their current practice location, what personal (e.g., family, lifestyle) and professional factors (e.g., support, access to locums, after hours work among others) were important and which of these were important in keeping them at their current location. Following consent all interviews were digitally recorded and transcribed. Data was inductively analysed into themes to explore respondents' perspectives and experiences. Each interview was conducted by telephone and lasted approximately 30 minutes.

In this study, there was no missing data for majority of the variables used for the main analysis. However, in cases where some variables had incomplete data (especially those relating to the reasons for staying in certain locations), only observations with non-missing data were considered.

3.3. Statistical analysis

3.3.1. Descriptive analysis

We first present summary statistics for the overall sample as frequencies, means and standard deviations for continuous variables and as frequencies and percentages for categorical variables. Second, we test for potential differences in the distribution of categorical variables between GPs that remain in rural practice post vocational training and compared to those that switch to practice in urban/metropolitan areas. We test for potential meaningful differences using standard measures of association such as the chi-square test statistic and Fisher's exact test (used in cases when the cell counts for some categorical variables was too small (below five)) and standard pairwise sample t-tests for continuous variables.

3.3.2. Empirical approach

The primary goal of the study is to examine the association between GP vocational training placement locations and subsequent practice location. To understand this association, we wish to estimate the following regression model:

$$Y_i = \alpha + \beta Placement_{ij} + X_i^{'}\Theta + \zeta_1 + \varepsilon_i \quad (1)$$

where Y_i represents a binary indicator measuring the current rural practice location for the i^{th} individual; $Placement_{ij}$ is an indicator representing GP vocational training placement location for the i^{th} individual and $j = [f,\ l]$ represents the first and last vocational training placement location, respectively; $X^{'}$ is a vector of characteristics such as age, gender, rural background, and cohort or fellowship year fixed effects; ζ_1 is a term that captures unobserved heterogeneity assumed to be uncorrelated with elements in the vector $X^{'}$; and ε_i is an idiosyncratic error term capturing all the remaining unobserved variation. A potential econometric problem that may complicate estimation of equation (1) is the possibility for some GPs to self-select into rural vocational training placement locations, owing to their stronger preference for rural practice. If left unaccounted for, such bias could overestimate the measured association of placement and current practice location. This observation requires that we model the probability of choosing a vocational training placement location separately. Thus, placement location ($Placement_{ij}$) in this instance is expressed as follows:

$$Placement_{ij} = a_0 + X_i^{'}\Phi + \zeta_2 + u_i \quad (2)$$

The vector $X_i^{'}$ contains similar characteristics as before; ζ_2 represents unobserved heterogeneity which is assumed to be uncorrelated with the vector $X_i^{'}$ and u_i is an error term capturing the remaining variation. To minimise potential bias due to self-selection, we jointly estimate the probability of currently practising at a rural location (equation (1)) together with the probability of vocational training placement at a rural location (equation (2)) within a fully recursive conditional mixed process (CMP) framework. The system is full recursive in the sense that current practice location is expressed as a function of placement location and not vice versa. In other words, an individual's choice of vocational training placement location could predict their future practice location and not vice versa. In essence, we are estimating a bivariate probit regression model using the Full Information Maximum Likelihood (FIML) approach in which we allow for correlation between the unobserved terms from the placement and subsequent practice location equations. Joint modelling accounts for the possibility that the covariance between the unobserved heterogeneity terms could be non-zero due to selectivity bias. The joint maximum likelihood functions can be expressed as follows:

$$\int_{\zeta_2}\int_{\zeta_1}\left[\prod L_2(\zeta_2)\prod L_1(\zeta_1)\right]f(\zeta_2,\zeta_1)d_{\zeta_2}\,d_{\zeta_1} \quad (3)$$

where L_1 and L_2 represent the conditional likelihood functions of equations (1) and (2), respectively; $f(\zeta_2,\zeta_1)$ represents the joint distribution of the unobserved heterogeneity elements from equations (1) and (2) and is assumed to follow a normal distribution expressed as follows:

$$\begin{pmatrix}\zeta_2\\ \zeta_1\end{pmatrix} \sim N\left(\begin{bmatrix}0\\ 0\end{bmatrix}, \begin{bmatrix}\delta_2^2 & \\ \rho_{12}\delta_2\delta_1 & \delta_1^2\end{bmatrix}\right) \quad (4)$$

The joint model estimated via FIML is identified through allowing for cross-equation correlation among the error terms from equations (1) and (2) and by the recursive nature of the system thereby, deriving selection-

bias corrected estimates. As a robustness check, we also adopt a control function approach in which we include a generalised residual term (also known as the inverse Mills ratio (IMR) that is generated from the probit regression examining the factors associated with vocational placement location at a rural location) in the subsequent practice location equation. The generalised residual or IMR is defined as the ratio of the standard normal probability density function to the standard normal cumulative distribution function (Wooldridge, 2015).

In the empirical frameworkhmj, one of the equations examines the factors associated with the choice of a rural vocational training placement (equation (2) above) – a dummy variable that equals one if vocational training placement (first, last, or both placements) occurred at a rural location (RA 2–5) and zero otherwise. This equation is estimated using a standard probit regression and includes as additional control variables; age (in years), gender (=1 if female), first vocational training placement (where applicable), rural background, country of birth (=1 if born in Australia), binary indicators for awareness about the Rural Procedural Grants Program, rural clinical school, advanced skills training, moratorium and cohort year fixed effects. The second equation (main outcome equation or equation (1) above) investigates the factors associated with subsequent rural practice – a dummy variable equalling one if current practice was at a rural location and zero otherwise. In addition to including a dummy indicator for vocational training placement location and the explanatory variables included in equation one, this equation also controls for full time equivalent week, scope of practice (=1 if scope of practice has increased post vocational training). The latter variables are the excluded variables from the placement equation. Thus, the recursive nature of the system coupled with the covariance restrictions imposed by including a fixed effect in each equation, helps to identify the system (Chamberlain and Griliches, 1975). In this study, a location was considered rural if the postal code fell in remoteness areas (RA) 2–5 and urban if the postal code was in RA 1 with all classifications based on the Australian Standard Geographic Classification Remoteness Areas (ASGC-RA) (now called Australian Statistical Geography Standard (ASGS)) (Australian Institute of Health and Welfare, 2018).

To capture the combined association of placement locations with subsequent practice, we concatenated the first and last GP vocational training placements to create a four-category variable consisting of the following: (i) first and last vocational training placements were at urban locations; (ii) first vocational training placement was urban while last vocational training placement was at a rural location; (iii) first vocational training placement was rural while last vocational training placement was at an urban location; and (iv) first and last vocational training placements were at rural locations. Combining the first and last vocational training placement locations allows us to assess whether GPs who experience repeated exposure to rural areas during training are more inclined to practice at a rural location. All data analyses were conducted using Stata version 15.1 (StataCorp, 2017).

3.4. Ethics approval

Ethical approval for this study was provided by Curtin University Human Research Ethics Committee (reference, HRE-2017-0601).

4. Results

4.1. Descriptive statistics

Table 1 shows that our sample is predominantly female (72%) with an average age of 37 years, 56% were born in Australia, 90% still practice in WA – their state of vocational training, and 67% worked in an area of special interest other than community GP. Only 13.6% had lived in rural Australia for at least five years (consecutive) between the ages

Table 1
Summary statistics for selected variables for the overall sample and stratified by whether the GP still works in the same rural location as their last rural vocational training placement location.

Variables	Overall		Last accredited GP vocational training placement location was rural and current practice location is rural?				p-value
			No		Yes		
	Count	%	Count	%	Count	%	
First vocational placement was rural	169	47.9	73	31.5	96	79.3	<0.001
Last vocational placement was rural	178	50.4	57	24.6	121	100.0	<0.001
Current practice location is rural	130	36.8	9	3.9	121	100	
Female	256	72.5	171	73.7	85	70.2	0.490
Born in Australia	198	56.1	123	53.0	75	62.0	0.107
Rural Australian background	48	13.6	27	11.6	21	17.4	0.137
Principle practice state is WA	319	90.4	216	93.1	103	85.1	0.016
Rural pathway of training	145	41.1	61	26.3	84	69.4	<0.001
Rural Clinical School (RCS)	60	17.0	30	12.9	30	24.8	0.005
Advanced Skills Training (AST)	54	15.3	16	6.9	38	31.4	<0.001
Work in an area of special interest besides community GP	235	66.6	150	64.7	85	70.2	0.290
Australian Medical Graduate	276	78.2	185	79.7	91	75.2	0.327
Know about the Rural Procedural Grants program	199	56.4	99	42.7	100	82.6	<0.001
Ten year moratorium	74	21.0	42	18.1	32	26.4	0.068
Program cohort year							
2006–2008	52	14.7	37	15.9	15	12.4	
2009	35	9.9	22	9.5	13	10.7	
2010	38	10.8	21	9.1	17	14.0	
2011	54	15.3	40	17.2	14	11.6	
2012	48	13.6	22	9.5	26	21.5	
2013	61	17.3	44	19.0	17	14.0	
2014–2015	65	18.4	46	19.8	19	15.7	0.039
Age at survey (in years)[a]	353	37.5	232	37.3	121	37.8	0.419
Number of qualifications[a]	353	2.2	232	2.2	121	2.2	0.679
Years since graduating from the AGPT program[a]	353	2.6	232	2.7	121	2.5	0.413
Number of special interest areas other than community general practice[a]	353	1.3	232	1.1	121	1.6	0.002
Total FTE weeks[a]	353	0.69	232	0.66	121	0.74	0.003
Number of GP graduates	353		232		121		

Notes: *Fisher's exact test p-values reported. [a] Standardized sample *t*-test results and their corresponding p-values are reported.

5–18 years, 37% were currently practising at a rural location, 21% were serving the 10-year moratorium - a requirement imposed by the Australian government to some doctors seeking to practice in Australia to work in a District of Workforce Shortage (DWS) area for ten years from the date of their first medical registration in Australia, 56% knew about the Rural Procedural Grants Program, 17% had RCS experience, and 41% had rural pathway of training.

Regarding comparisons between GPs that had stayed at the same rural location as their last vocational training placement location to those that had switched, we observe statistically significant differences in terms of first placement location ($p < 0.001$), rural pathway of training ($p < 0.001$), RCS ($p < 0.001$), advanced skills training ($p < 0.001$), awareness regarding the Rural Procedural Grants Program ($p < 0.001$), cohort or fellowship year ($p < 0.039$), special interest areas ($p < 0.002$), and total FTE weeks ($p < 0.003$). We observed no meaningful differences in terms of gender, rural background, Australian medical graduate status, working in an area of special interest other than community GP, age, number of qualifications, and years since completing training (Table 1).

In Table 2, we provide the distribution of current rural practice by vocational training placement location. The results show that on the average, 37% of GPs currently practice at a rural location. Out of the 152 GPs who had their first and last vocational training placement at an urban location, about 5% currently practice rurally, 78% among GPs whose first and last vocational training placement was at an urban and rural location, respectively, 4.3% among GPs whose first and last vocational training placement was rural and urban, respectively, and 66% among GPs who had both their first and last vocational training placements at rural locations, respectively. On average, the current rural practice rate among GPs with a rural background was somewhat higher, 48% compared to 35% among their counterparts. Among GPs who had their first and rural placements at a rural location, current rural practice was 94% if they had a rural background compared to 62% if they did not have a rural background. For GPs who had their first and last vocational training placement at a rural location, the average current rural practice was about 88% if they had RCS experience compared to 61% among those without RCS experience.

4.2. Current practice location vs vocational training placement location

Table 3 shows the results from the multivariable probit and bivariate probit regressions examining the association between vocational training placement location and current practice location. We present the coefficients and marginal probability effects (marginal effects) with their corresponding standard errors shown in parentheses. For brevity, only results from the main (current practice location) equation are reported while those from the auxiliary (placement location) equation are presented as supplementary materials. Columns (1) and (2) of Table 3 show the results when we do not account for potential bias due to self-selection into rural vocational training placement location. The results show that age and country of birth are positively associated with the probability of rural practice and statistically significant at the 5% level. Knowledge about the Rural Procedural Grants Program is positively associated with rural practice while an increased scope of practice post vocational training is negatively associated with subsequent rural practice but not statistically significant at the 5% level. The results also show that the average predicted probability of current rural practice is about 0.44 greater for a GP whose last vocational training placement was at a rural location compared to one whose last vocational training placement was at an urban location. The joint estimation results are presented in columns (3) and (4) and show that the average predicted probability of rural practice is about 9% lower (i.e., marginal effect of 0.40) among GPs whose last vocational placement was at a rural location and statistically significant at the 1% level. However, considering the current analytical sample, the overall influence of self-selection into rural vocational training placements does not appear to be significantly impacting our results given the positive and statistically insignificant coefficient on *atanhrho*. The term *atanhrho* reported at the bottom section of Table 3 is the arc-hyperbolic transformation of rho to an unbounded scale and is the primary measure for selection bias (see Roodman (2011)). This term is positive and statistically insignificant (coefficient = 0.391, standard error = 0.299) implying that there are unobserved factors that drive both the probability of rural practice and choice of rural vocational training placement location. Given that this term is statistically insignificant, estimating the probability of current rural practice using a standard nonlinear model such as probit/logit regression will yield consistent estimates that are almost similar to those from a joint regression model that accounts for selection bias as is the case here. The log likelihood values from the two models confirm this observation as they are indeed very similar (i.e., -243.1 vs 242.1).

4.3. Current practice location, early experiences and vocational training placement locations

Figs. 2 and 3 plot the average predicted probabilities (including the 95% confidence intervals (CI) around each point estimate) for current practice location conditional on vocational training placement location including an assessment of potential heterogeneities due to earlier experiences i.e. rural background, RCS experience or both. We estimate the probability of current rural practice conditional on having the first or last vocational training placement at a rural location and whether such probability might differ depending on having earlier experiences. In essence, we are estimating a model that predicts the average probability of current rural practice accounting for the possibility of interactions between early experiences and vocational training placement location. Fig. 2 plots the average predicted probabilities (95% CIs are shown as vertical bars around each point estimate) for subsequent practice location for different scenarios. The left panel of Fig. 2 shows that on the average, GPs who have had their first vocational training placement at an urban location are about 20% more likely to practice at a rural location but this predicted probability rises to about 50% when we consider the potential mediating role of rural background and

Table 2
Distribution of current practice location by vocational training placement location and for selected subgroups of the overall sample.

	Overall sample		First urban placement-last urban placement		First urban placement-last rural placement		First rural placement-last urban placement		First rural placement-last rural placement	
	Count	%	Count	%	Count	%	Count	%	Count	%
Overall sample	353	36.8	152	5.3	32	78.1	23	4.3	146	65.8
Rural Australian background										
Yes	48	47.9	23	4.3	5	100.0	3	33.3	17	94.1
No	305	35.1	129	5.4	27	74.1	20	0.0	129	62.0
Rural Clinical School (RCS) experience										
Yes	60	56.7	23	13.0	8	100.0	4	25.0	25	88.0
No	293	32.8	129	3.9	24	70.8	19	0.0	121	61.2

Notes: First urban-last urban implies that the first GP vocational training placement was at an urban location while the last GP vocational training placement was at a rural location (similar interpretation applies to other columns).

Table 3
Simultaneous recursive estimation of the association between vocational training placement location and subsequent practice location among general practitioners who completed their vocational training with WAGPET between 2010 and 2017.

	No control for potential selection bias				Controls for potential selection bias			
	Coefficient	Std. error	Marginal effect	Std. error	Coefficient	Std. error	Marginal effect	Std. error
Specifications	(1)		(2)		(3)		(4)	
Last vocational placement was rural	2.45***	(0.27)	0.44***	(0.03)	2.06*	(0.96)	0.40***	(0.12)
Age (in years) at survey date	0.05**	(0.02)	0.01**	(0.00)	0.05**	(0.02)	0.01**	(0.00)
Female	0.12	(0.22)	0.02	(0.04)	0.10	(0.22)	0.02	(0.04)
Rural background	0.56	(0.34)	0.10	(0.06)	0.58	(0.34)	0.11	(0.07)
Australian born	0.78**	(0.24)	0.14***	(0.04)	0.67	(0.35)	0.13*	(0.05)
Know about the Rural Procedural Grants Program	0.43*	(0.22)	0.08*	(0.04)	0.56	(0.35)	0.11	(0.08)
Advanced skills training	0.29	(0.27)	0.05	(0.05)	0.42	(0.40)	0.08	(0.09)
Rural Clinical School	0.55	(0.30)	0.10	(0.05)	0.56	(0.30)	0.11	(0.06)
Full time equivalent week	0.20	(0.45)	0.04	(0.08)	0.20	(0.44)	0.04	(0.09)
Increased scope of practice post training	−0.51*	(0.21)	−0.09*	(0.04)	−0.51*	(0.20)	−0.10*	(0.04)
Cohort year fixed effects	Yes		Yes		Yes		Yes	
/atanhrho_12					0.391	0.299		
Log likelihood	−243.1		−243.1		−242.2		−242.2	
Observations	353		353		353		353	

Notes: ***Significant at 1% level; **significant at 5% level; *significant at 10% level. [a] The correlation between the heterogeneity components of the current practice location equation and last vocational training placement location equation is measured by */atanhrho_12*.

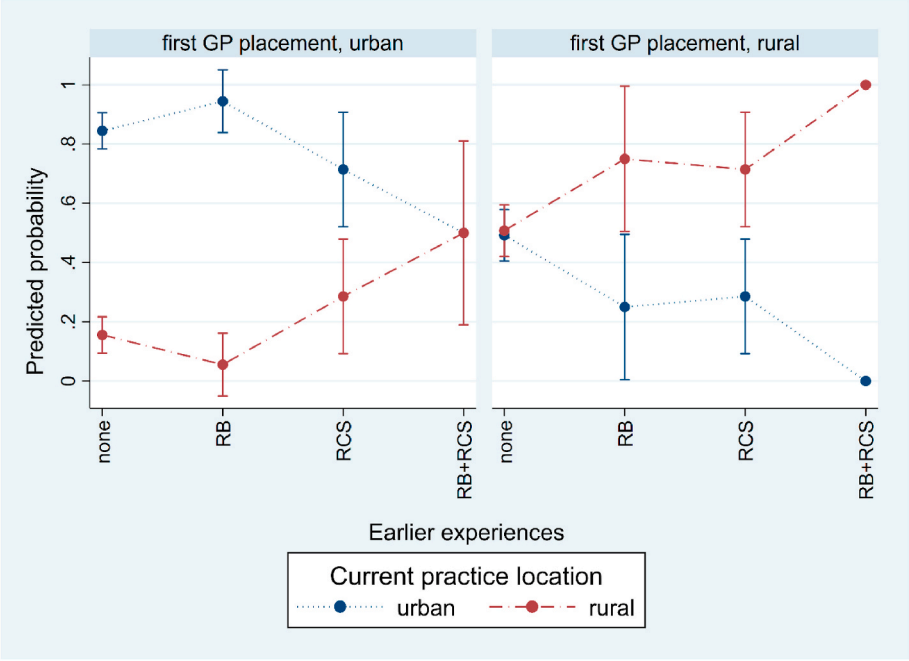

Fig. 2. Average predicted probabilities for subsequent practice location of GP graduates who completed their vocational training program through the Western Australian General Practice Education and Training (WAGPET) between 2010 and 2017 (inclusive). Predictive margins are stratified by first GP vocational training placement (rural vs urban) and by earlier experiences based on having either rural background (RB) (Australian) or Rural Clinical School (RCS) or both, i.e. none; RCS; RB; and RB & RCS combined. Predicted probabilities are generated from a multivariable logistic regression in which the dependent variable equals one if current practice location was at a rural location and zero otherwise. The following were included as additional control variables: age, gender, rural background, country of birth, advanced skills training, awareness about the Rural Procedural Grants program, full time equivalent weeks, Rural Clinical Skills (RCS) experience, scope of practice, and cohort fixed effects.

prevocational exposure to general practice through RCS experience. Among GPs whose first vocational placement was at a rural location, the predicted probability for current rural practice stood at about 50% if they had no rural background or RCS experience. The predicted probability for current rural practice among GPs whose first vocational training placement was at a rural location rose to about 78 and 76% if they had a rural background and RCS experience respectively. GPs with a rural background and RCS experience (only eight of them) were highly likely to be currently practising rurally.

Fig. 3 plots the average predicted probabilities for current rural practice among GPs whose last vocational training placement was at an urban or rural location and stratified by earlier experiences. The average predicted rural practice rate among GPs whose last vocational training placement was at a rural location averages 60% among those with no early experiences, 94% among those with a rural background, 88% among those with RCS experience and 100% among the 11 GPs who had both a rural background and RCS experience. Figs. 2 and 3 all highlight the combined importance of placement locations and earlier experiences on subsequent practice location.

4.4. *Repeated exposure to rural vocational training placements and subsequent rural practice*

Table 4 presents the estimates examining the association between subsequent rural practice and choice of first and last rural vocational training placements. Columns (1) and (2) report the estimates when we do not account for potential selection bias. We observe that age, country of birth and knowledge about the rural procedural grants program are all positively correlated with rural practice. The results also show that the average predicted probability of rural practice is about 0.36 greater for a GP whose first and last vocational training placement was at a rural location and statistically significant at the 1% level. This average predicted probability rises by an estimated 11% to 0.40 when we jointly model the choice of rural vocational training placement location and

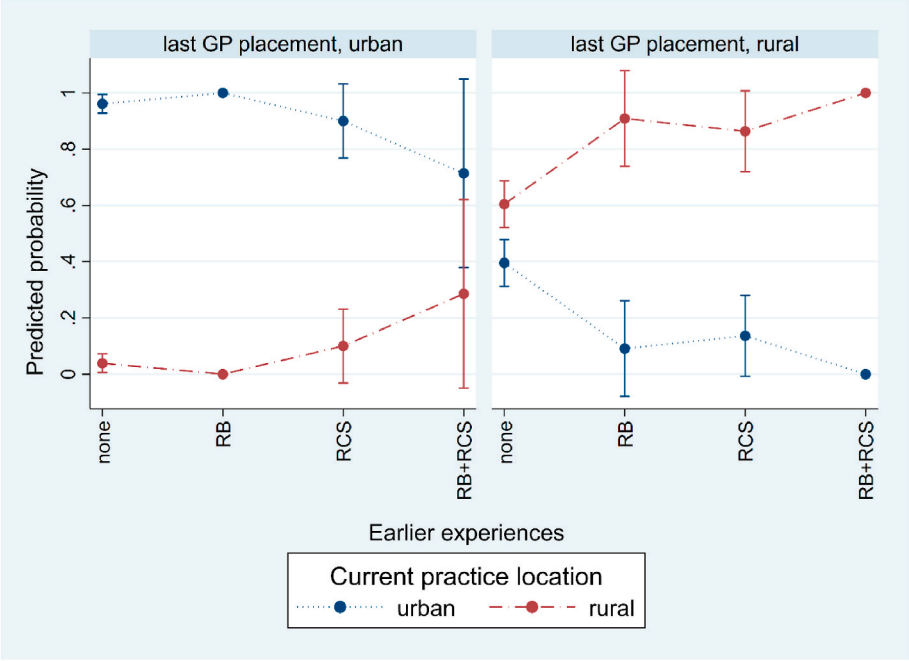

Fig. 3. Average predicted probabilities for subsequent practice location of GP graduates who completed their vocational training program through the Western Australian General Practice Education and Training (WAGPET) between 2010 and 2017 (inclusive). Predictive margins are stratified by last GP vocational training placement (rural vs urban) and by earlier experiences based on having either rural background (RB) (Australian) or Rural Clinical School (RCS) or both, i.e. none; RCS; RB; and RB & RCS combined. Predicted probabilities are generated from a multivariable logistic regression in which the dependent variable equals one if current practice location was at a rural location and zero otherwise. The following were included as additional control variables: age, gender, rural background, country of birth, advanced skills training, awareness about the Rural Procedural Grants program, full time equivalent weeks, Rural Clinical Skills (RCS) experience, scope of practice, and cohort fixed effects.

Table 4
Simultaneous recursive estimation of the association between GP vocational training placement location and subsequent rural practice among GPs who completed training with WAGPET between 2010 and 2017.

	No control for potential selection bias				Controls for potential selection bias			
	Coefficient	Std. error	Marginal effect	Std. error	Coefficient	Std. error	Marginal effect	Std. error
Specification	(1)		(2)		(3)		(4)	
First and last vocational training placements were rural	1.56***	(0.20)	0.36***	(0.03)	1.82*	(0.93)	0.40**	(0.15)
Age (in years) at survey date	0.04**	(0.02)	0.01**	(0.00)	0.04**	(0.02)	0.01*	(0.00)
Female	−0.07	(0.19)	−0.02	(0.04)	−0.10	(0.21)	−0.02	(0.04)
Rural background	0.37	(0.22)	0.08	(0.05)	0.34	(0.23)	0.07	(0.06)
Australian born	0.74***	(0.22)	0.17***	(0.05)	0.83*	(0.37)	0.18**	(0.06)
Know about the Rural Procedural Grants Program	0.59**	(0.19)	0.13**	(0.04)	0.50	(0.37)	0.11	(0.10)
Advanced skills training	0.56*	(0.25)	0.13*	(0.06)	0.47	(0.40)	0.10	(0.10)
Rural Clinical School	0.50	(0.26)	0.11	(0.06)	0.50	(0.26)	0.11	(0.06)
Full time equivalent week	0.62	(0.35)	0.14	(0.08)	0.60	(0.35)	0.13	(0.08)
Increased scope of practice post training	−0.40*	(0.18)	−0.09*	(0.04)	−0.39*	(0.18)	−0.09*	(0.04)
/atanhrho_12[a]					−0.17	(0.61)		
Cohort year fixed effects	Yes		No		Yes		No	
Observations	353		353		353		353	
Loglikelihood	−314.7		−314.7		−314.7		−314.7	

Notes: ***Significant at 1% level; **significant at 5% level; *significant at 10% level. [a] The correlation between the heterogeneity components of the current practice location equation and that from the first and last vocational training placement location equation is measured by */atanhrho_12*.

subsequent rural practice. Despite its statistical insignificance, the negative coefficient of −0.17 on *atanhrho* suggests the presence of unobserved factors that increase the probability of choosing the first and last rural vocational training placements while at the same time decrease the likelihood of rural practice.

4.5. Robustness checks

To test the sensitivity of our main estimates from Tables 3 and 4, we also adopted a control function approach as described earlier. The results for these analyses are presented as supplementary material. The results show that our estimates are robust to alternative model specification and remain statistically significant. The differences in magnitude of the coefficients and marginal effects are negligible and enhances our confidence in the main results (see Tables A1 and A2 and A3 in the supplementary material).

4.6. What are some of the reasons for staying rurally?

Table 5 presents the results from multivariable probit regressions exploring the possible reasons some GPs have remained in the rural locations similar to their last vocational training placement. The dependent variable in each model is a dummy variable equalling one if a GP was currently practising at the rural location similar to their last vocational training placement and zero otherwise. In addition to the reasons for staying rurally (included in separate regression models), we included other controls for gender, age, rural background, rural clinical school experience and an indicator whether the first vocational training placement was rural or not. The results indicate that GPs that remained at rural locations similar to their last vocational training placement location did so for reasons linked to their career (marginal effect = 0.15, standard error 0.05), lifestyle (marginal effect = 0.18, standard error = 0.05), were rurally bonded (marginal effect = 0.32, standard error = 0.11) and moratorium (marginal effect = 0.21, standard error = 0.07).

Table 5
Multivariable probit regression estimates examining the reasons why some GPs stayed in the rural locations similar to their last vocational training placement location.

Specification	Coefficient	Standard error	Marginal effect	Standard error
Reasons for staying[a]				
Family	0.37*	(0.17)	0.10*	(0.05)
Career	0.51**	(0.17)	0.15**	(0.05)
Financial	0.45	(0.27)	0.13	(0.08)
Lifestyle	0.65***	(0.18)	0.18***	(0.05)
Rurally bonded	1.61**	(0.58)	0.32**	(0.11)
Moratorium	1.01**	(0.32)	0.21**	(0.07)

Notes: ***Significant at 1% level; **significant at 5% level. Heteroskedasticity robust standard errors are shown in parentheses. [a] Each row represents estimates from a separate multivariable probit regression where the dependent variable is a dummy variable equaling one if an individual GP still practiced at a rural location similar to their last vocational training placement and zero otherwise. Each regression included additional controls for gender, age, rural background, rural clinical school experience and a dummy variable indicating that the first GP vocational training placement was at a rural location.

All the noted results are statistically significant at the 5% significance level.

5. Discussion

This study investigates the association between vocational training placement location and subsequent practice location among GP graduates who completed their training with WAGPET between 2010 and 2017. We use information on the first and last GP vocational training placement to assess whether these are both individually and jointly associated with subsequent rural practice. We also investigate whether the strength of this association might depend on an individual's rural upbringing, prevocational exposure to general practice (i.e., rural clinical school experience), or both. We jointly model the choice of rural vocational training placement and the probability of rural practice within a Full Information Maximum Likelihood model that allows for the possibility of correlation between unobserved factors that might possibly drive the choice of vocational training placement location and subsequent practice. We also examine some of the underlying reasons why GPs might opt to practice in the rural locations that are similar to their last vocational training placement location. While the issue of geographical maldistribution of the health workforce has previously been studied in Australia (J. Humphreys et al., 2001; Humphreys et al., 2002; Russell et al., 2012; Scott et al., 2013; Jongsay Yong, Anthony Scott, Hugh Gravelle, Peter Sivey and Matthew McGrail, 2018), there is a dearth in empirical evidence on the association between vocational training placement locations and subsequent practice and how this association might depend on the interplay between rural background and RCS experience. This is particularly important for health workforce planning in Australia, given the coexistence of persistent health disparities between people living in urban compared to those in rural locations and the uneven distribution of the health workforce in these areas (Australian Bureau of Statistics, 2018).

We established that having the first and last vocational training placement at a rural location is highly associated with an increased probability for subsequent rural practice. The first rural vocational training placement is also highly predictive of the last rural vocational training placement. These observations may be explained by the realisation that when GPs make their placement preferences, they incorporate their desired future work locations. It is also conceivable that the first placement acts as more of a discovery or exploratory phase where junior doctors gather important experiences and information to make informed choices about subsequent practice locations. This result stresses the importance of incorporating the preferences of junior doctors deciding their practice location. This finding reflects that vocational training placement preferences by junior doctors are an important marker for subsequent practice location in career intentions and hence should be given an important consideration (Walters et al., 2016). This result is also consistent with previous research that identifies previous connections to rural locations either through vocational training placement opportunities, secondary education, or both as having a positive impact on future career intentions (McGrail et al., 2018). Thus, individuals who have had some exposure to rural locations are more likely to venture into rural practice. Given that we also found that some GPs stayed in rural locations due to reasons linked to their career, having exposure alone will not be enough to promote future rural practice. Instead, having rural exposure through training coupled with a positive experience will be key to promoting rural practice (Brodribb et al., 2016). Exposure to working in rural settings is more likely to improve junior doctors' understanding of the rural context and enable them to make realistic expectations about working and living in rural areas in the future – this has been termed 'rural practice self-efficacy' (Bentley et al., 2019; Brodribb et al., 2016). The latter observation is also consistent with findings from the medical literature that contents that the rural experience gives registrars an internal attitudinal set which reflects the individual resilience or vulnerability that doctors embrace through responding to pressures associated with greater responsibility and higher workloads associated with rural practice (Bayley et al., 2011). Our results also indicate that GPs with repeated rural exposure through having the first and last vocational training placement at a rural location are more likely to practice rurally. This finding is consistent with previous research in the United States that show that medical students with repeated exposure to and training in rural areas have increased interest in rural practice and remain in rural practice longer (Rabinowitz et al., 2013). This result also reflects that by having the rural exposure, junior doctors are able to adjust to the demands of rural medicine, such as holding after hours on-call roles. In a way, it allows junior doctors to work outside their comfort zones and respond to the demands of rural practice (Bayley et al., 2011). Additionally, we found that the association between rural vocational training placement location and subsequent rural practice appears to get stronger when we consider having a rural background or RCS experience. Previous research has shown that a positive rural training experience coupled with having a rural background positively influence the prospect of practicing rurally (Eley et al., 2012; Isaac et al., 2014). Previous research has also shown that students who are raised from a rural community are more likely to seek out rural environments in general and tend to practice in communities that are comparable to their own hometowns where they grew up (Costa et al., 1996; Matsumoto et al., 2008). This finding is also consistent with research from qualitative studies that show that physicians desire to practice in areas similar to where they grew up (Tolhurst et al., 2006). These results are consistent with previous findings showing the importance of earlier experiences and exposure to rural training during undergraduate (Rabinowitz et al., 2013) and from twin studies that suggest that residential environment in childhood is attributed to more than 50% of the variability in residence choices in younger adults (Whitfield et al., 2005).

Additionally, we found that GPs stay rurally due to reasons linked to their career, family, and lifestyle factors. While financial reasons appeared to positively correlate with subsequent rural practice, the measured association was not statistically significant. These findings are consistent with previous related studies in Australia (Penny Buykx, John Humphreys, John Wakerman and Dennis Pashen, 2010; J. Humphreys et al., 2001; J. S. Humphreys et al., 2002). Previous literature has shown that reasonable workloads and call schedules have a positive impact on rural practice (J. S. Humphreys, Jones, Jones and Mara, 2002a; Pathman et al., 2004). Also, weakly consistent with our findings, a recent study in Australia pointed towards the importance of rural financial incentives and suggested that they be targeted to newly qualified GPs in Australia (Jongsay Yong et al., 2018). This analysis did not evaluate the effects of

financial incentives on subsequent practice location but, can infer their potential role to influencing short-term distribution of the health workforce in rural settings. A recent comprehensive review of the literature shows that financial incentives are not that effective in influencing retention of health workers in rural and remote Australia (P. Buykx et al., 2010). Other factors associated with increased probability for subsequent rural practice included age, country of birth, and knowledge about the rural procedural grants program. The importance of age, for example, has also been echoed in previous studies in Australia (Humphreys et al., 2002; Matthew R McGrail, Deborah J Russell, & David G Campbell, 2016).

This study is not without its limitations. First, and most importantly, we revealed mere associations and did not in any way establish a causal connection between vocational training placement location and subsequent rural practice. Thus, our estimates should be interpreted with caution. Second, given our reliance on cross-sectional data, we fail to capture the much more complex and dynamic aspects of GP mobility which longitudinal datasets are able to do. Lastly, while our models accounted for the possibility of bias due to self-selection into rural vocational training placements, it is possible that the estimates we report could still be minimally biased. However, the statistically insignificant correlation between the unobserved factors driving vocational training placement location and rural practice is a possible indicator that selection bias might not be adversely impacting our results to a greater degree. Regardless, we make vital contributions to the current discussions around the recruitment and retention of health workers in rural and remote locations of Australia.

6. Conclusion

This study analysed individual-level data from WAGPET graduates who completed training between 2010 and 2017. We found that GPs choosing rural locations for their first and last vocational training placements are more likely to practice rurally. The average predicted probability for rural practice increases when we consider having a rural background and prevocational exposure to general practice (RCS experience). From a policy standpoint, there is a need for ongoing and continued support to organisations that help junior doctors to choose their preferred vocational training placement locations. Also, ongoing support to programs targeted at increasing rural exposure to medical students are needed. Given that factors related to career, family and lifestyle are positively correlated with staying rurally, health workforce strategies should prioritise GP assistance with community integration including continued support for family-related changes, such as childbirth. Finally, strategies that provide ongoing professional support to GPs are also essential to rural retention. Overall, the results of this study suggest that health workforce policies should prioritise continued support to programs that are intended to increase medical students' interest in rural practice as well as support to organisations that assist junior doctors to choose their preferred vocational training placement locations.

Credit author contribution statement

Marshall Makate: Conceptualisation; Methodology; Software; Data curation; Writing – original draft preparation, and Writing – review & editing; Project administration; Visualisation. Tonia Ledwith: Conceptualisation; Writing – original draft preparation, and Writing – review & editing; Project administration. Suzanne Robinson: Conceptualisation; Resources; Supervision; Project administration; Funding acquisition; and Writing – review & editing. Janice Bell: Conceptualisation; Supervision; Project administration; Writing – review & editing. Sonia Miller: Project administration; Writing – review & editing. Isabelle Broderick: Conceptualisation; Project administration; Funding acquisition; and Writing – review & editing.

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Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jrurstud.2021.06.019.

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