



Libraries and Learning Services

# University of Auckland Research Repository, ResearchSpace

## Version

This is the publisher's version. This version is defined in the NISO recommended practice RP-8-2008 <http://www.niso.org/publications/rp/>

## Suggested Reference

Poole, P., Stoner, T., Verstappen, A., & Bagg, W. (2016). Medical students: where have they come from; where are they going? *New Zealand Medical Journal*, 129(1435), 59-67. <https://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2016/vol-129-no-1435-27-may-2016/6896>

## Copyright

Items in ResearchSpace are protected by copyright, with all rights reserved, unless otherwise indicated. Previously published items are made available in accordance with the copyright policy of the publisher.

For more information, see [General copyright](#), [Publisher copyright](#), [SHERPA/RoMEO](#).

# Medical students: where have they come from; where are they going?

Phillippa Poole, Tom Stoner, Antonia Verstappen, Warwick Bagg

## ABSTRACT

**AIMS:** There remain shortages of doctors in rural areas. This study aimed to describe the location and size of New Zealand medical students' hometowns over the past decade; to document changes in intended practice location between entry and graduation; and to explore the relationship between background and intended location of practice.

**METHODS:** All commencing and graduating students from one New Zealand medical programme from 2006–2015 were invited to complete a career intention survey. Students' reported background and practice location intention at entry were compared with intention at exit.

**RESULTS:** Response rates were 92% for entry and 84% for exit surveys. On average, 21% of medical students were from regional-rural (RR) backgrounds, with no significant change over time ( $p=0.4036$ ). Most were admitted via a designated rural entry pathway. Students from RR backgrounds were four times more likely at entry, and nearly three times more likely at exit, to have an RR intention than urban students. Those with an RR intention at entry were three times more likely to have an RR intention at exit than students with an urban intention.

**CONCLUSION:** Medical students from an RR background, or with RR intention at entry to medical school, are more likely to indicate a RR intention upon graduating. Yet students of an urban background with an RR career intention are important to consider. Future research might explore factors which help consolidate RR career choices in both groups.

As in other parts of the world, New Zealand continues to have shortages of doctors practising outside major urban areas, especially in general practice.<sup>1-3</sup> In 2014, there were 1.4 doctors for every 1,000 people in rural New Zealand, compared to 3.7 in urban areas.<sup>4</sup> For years, New Zealand has not trained enough of its own doctors.<sup>5</sup> As a consequence there has been reliance on international medical graduates, especially outside major urban areas.<sup>4</sup> The government has recently increased medical student numbers, with increased numbers of graduates beginning to flow into the workforce.

Medical schools have an obligation to produce graduates with the requisite competencies and disposition to serve their communities.<sup>6,7</sup> Through selection policies and undergraduate experiences, schools may affect the shape of the future workforce. There is a well-established association between coming from a rural background and practising in a rural setting.<sup>2,8-15</sup> Yet, in

2002, under-representation of rural New Zealand medical students was evident, with 85% of students originating from main urban areas (then defined as a centre >30,000 containing 69% of New Zealand's population) and only 3% from rural areas (then areas <1,000 containing 15% of New Zealand's population).<sup>16</sup> In 2004, each of New Zealand's two medical programmes introduced a rural origin admission pathway for 20 students.<sup>17</sup> At that time, 'rural' meant coming from an area of 20,000 or fewer. In 2012, the University of Auckland changed its rural pathway to a regional-rural admission scheme (RRAS).<sup>18</sup> This acknowledged the geography of its upper North Island catchment, and clarified eligibility for those in previously rural areas within the new Auckland super-city boundary. Criteria for RRAS are either to have undertaken pre-secondary education or spent at least 3 years at a secondary school located in a regional-rural area, which is defined as being outside the boundary of New Zealand's

main urban areas (Auckland, Hamilton, Tauranga, Wellington, Porirua, Hutt, Upper Hutt, Christchurch, and Dunedin).<sup>18</sup> Up to 52 places are now available for Auckland students under the RRAS (Faculty of Medical and Health Sciences, personal communication).

Future rural practice is associated with undergraduate experience in rural areas.<sup>10,19,20</sup> To this end, both New Zealand medical programmes have introduced dedicated rural immersion programmes for a subset of the class, with other clinical experiences outside major urban centres for all students.<sup>21,22</sup> It is likely that a rural background and prolonged experience in rural clinical settings interact to increase intentions to work rurally in a rural location.<sup>23</sup> However, these observations may be subject to selection bias, as students from a rural background may be more likely to apply to or be chosen for rural immersion programmes.

From 2006, Auckland medical students have been invited to enrol in the Faculty of Medical and Health Sciences Tracking Health Professional Students and Graduates project (Tracking Project), which aims to investigate the effects of individual characteristics and curricula on career patterns. Since 2013, this project has been linked with the Australasian Medical Schools Outcome Database (MSOD) project with similar aims.<sup>24</sup>

Participants complete an entry survey at the start of their second year and an exit survey at the end of their sixth year. Questions relate to demographics, intentions with respect to discipline and location of future practice, as well factors important in career choice. A finding based on 2006 and 2007 exit data was that 58% of students intended to work in a city, 15% in a regional-rural setting and 27% were undecided.<sup>17</sup> However, these students were selected before the existence of a rural origin pathway, and neither the effect of background nor how intentions changed while at medical school were documented.

The Tracking Project database now contains information on ten entry and ten exit cohorts, with individual student data on career intentions able to be linked between entry and exit for three of these. This study aims to:

- (i) Describe the location of Auckland medical students' home towns and backgrounds;
- (ii) Determine whether urban and rural proportions changed as student numbers increased, and as criteria for rural entry changed to regional-rural entry in 2012;
- (iii) Document patterns of change in intended practice location between entry and exit from the programme;
- (iv) Explore the relationships between student background, size of home town, entry pathway and intended location of practice.

Results may be useful to medical programme leaders, postgraduate training bodies, workforce planners and other stakeholders interested in the workforce outcomes of undergraduate medical training.

## Methods

### Ethical considerations

Ethics approval for the Tracking Project was granted in 2006 by the University of Auckland's Human Participants Ethics Committee, and remains current. The present study used data from students who gave written consent and completed Tracking Project entry and/or exit surveys in the years 2006 to 2015. Analyses were conducted blinded to student identity.

### Definition of rurality

Within New Zealand there is no agreed definition of rurality, being "areas not specifically designated as urban."<sup>25</sup> However, some indication may be derived from the current definition of a city as "50,000 or more."<sup>25</sup> Furthermore, coding in the Tracking Project for size of town has changed over the years, as the New Zealand population has both grown and become more urbanised.

For the purposes of this study, we classified responses for size of town into either <100,000 (regional-rural or 'RR') or 100,000 or more ('Urban'). This was to cover variations in coding of town size over the years, as well as to align with the present University of Auckland regional-rural pathway selection policy. We classified each student either of RR or Urban background by triangulation from the following information:

**Table 1:** Region and background of Auckland medical students 2006–2015.

Region	Number	%	%RR	%Urban
Auckland	1,117	65	1	99
Waikato/Taupō	154	9	44	56
Wellington/Hutt Valley/Wairarapa	82	5	12	88
Bay of Plenty	72	4	74	26
Northland	71	4	90	10
Canterbury	65	4	17	83
Manawatu/Wanganui	46	3	100	0
Hawke's Bay	39	2	100	0
Taranaki	22	1	100	0
Gisborne	19	1	95	5
Nelson	9	0.5	100	0
Otago	9	0.5	56	44
Marlborough	4	0.2	100	0
Westland	4	0.2	100	0
Tasman	3	0.2	100	0
Southland	2	0.12	100	0
<b>Total</b>	<b>1718</b>	<b>100</b>	<b>21</b>	<b>79</b>

- Student report of size of home town (chosen from a list of four population ranges with examples of towns)
- Student response to whether they considered themselves to have 'come from a rural background'
- Location of home town and address (prior to university) relative to current RRAS entry scheme boundaries
- Medical programme office information on students admitted via the rural origin pathway (pre 2012) or RRAS (from 2012).

### Data considerations

For several reasons, sample sizes are smaller than the total number of medical students completing surveys. Students were asked at exit where they intended to practice in all surveys from 2006, but at entry only from 2009 onwards. Other reasons for exclusion were:

- Student had a home address outside New Zealand (all analyses)
- Student was 'undecided' (intention analyses)
- No response to relevant survey question.

### Analysis

Summary statistics were used to describe the cohorts. Comparisons were made using Chi-square or Fisher's exact tests with

Yates's continuity correction. Statistical packages used were Excel and R.

## Results

From 2006 to 2015, 1,935 students completed at least part of an entry survey (response rate 92%), with 1,367 students at least part of an exit survey (response rate 84%). For the linked data—ie, for entry cohorts from 2009 to 2011 corresponding to exit cohorts in 2013 to 2015—364 students completed both surveys, including information on their background. This was 73% of those who were eligible.

### Region of student hometown

The origin of Auckland medical students reporting a hometown in New Zealand is shown in Table 1 (source: Entry survey 2006–2015, n = 1,718). Of these, 369 (21.5%) were from an RR background (population <100,000).

### Trends in urban vs RR background over time

The proportions of students from Urban or RR backgrounds over the past decade are shown in Figure 1. The trend was not significant ( $p=0.4036$ ) even though the absolute number of students entering via the RR pathway has increased steadily from 21 in 2006 to 42 in 2015 (personal communication). Moreover, there was no obvious

Figure 1: Backgrounds of Auckland medical students from 2006–2015.

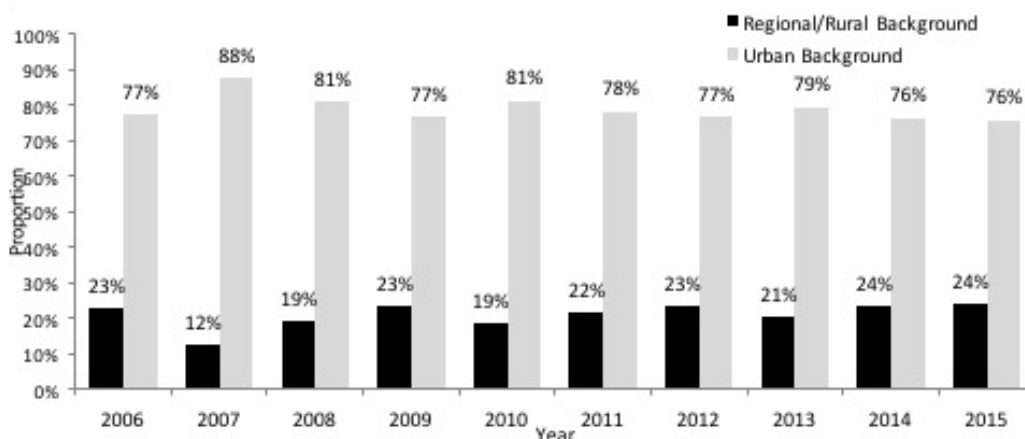


Table 2a: Intentions by background of Auckland medical students at entry 2009–2015.

	RR Career Intention	Urban Career Intention	Total
RR Background	218 (16%)	71 (5%)	289 (22%)
Urban Background	173 (13%)	870 (65%)	1,043 (78%)
<b>Total</b>	<b>391 (29%)</b>	<b>941 (71%)</b>	<b>1,332 (100%)</b>

Table 2b: Intentions by background of Auckland medical students at exit 2010–2015.

	RR Career Intention	Urban Career Intention	Total
RR Background	66 (10%)	43 (7%)	109 (18%)
Urban Background	105 (17%)	390 (65%)	495 (82%)
<b>Total</b>	<b>171 (28%)</b>	<b>433 (72%)</b>	<b>604 (100%)</b>

Table 3: Entry pathway and background of medical students 2006–2015.

Entry pathway	RR Background	Urban Background	Total
General or MAPAS*	169 (10%)	1,309 (76%)	1,478 (86%)
Rural/RRAS	201 (12%)	47 (3%)	248 (14%)
<b>Total</b>	<b>370 (21%)</b>	<b>1,356 (79%)</b>	<b>1,726 (100%)</b>

\*MAPAS= Māori and Pacific admission scheme

change after the introduction of the RRAS selection policy in 2012.

### Effect of student background on intended practice location

The proportion of students who were ‘undecided,’ or did not answer, was 4% at entry and 30% at exit. For those who had decided on location of practice, the relationship with their background is shown Table 2a (entry) and 2b (exit) with the differences statistically significant at both times ( $p < 0.0001$ , source: Entry surveys 2009–2015,  $n = 1,332$ ; Exit surveys 2010–2015,  $n = 604$ ). At both entry and exit, just under two-thirds of students were from an urban background with an urban career intention. On the other hand, at entry 16% of students were from an RR background and had an

RR career intention, but this dropped to 11% in exit cohorts. Put another way, RR background students are over four times more likely than urban students to indicate an RR career intention at entry (relative risk 4.54, 95% CI 3.91–5.29,  $p < 0.0001$ ), and 2.85 times as likely at exit (relative risk 2.85, 95% CI 2.27–3.58,  $p < 0.0001$ ). Yet, the absolute number of urban background students intending a career in an RR area at exit is still greater than the number of RR background students with an RR intention (105 vs 66).

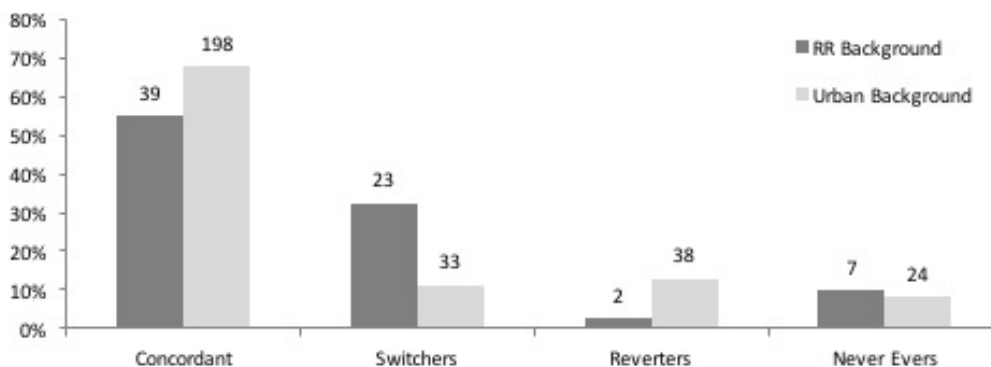
### Background by entry pathway

The admission pathway of medical students compared to their background is shown in Table 3 (source: Entry survey 2006–2015,  $n = 1,718$ ). Over 80% of those

**Table 4:** Patterns of intentions at entry and exit for individual students.

	RR Intention Exit (%)	Urban Intention Exit (%)	Total
RR Intention Entry	63 (17%)	61(17%)	124 (34%)
Urban Intention Entry	35(10%)	205(56%)	240 (66%)
<b>Total</b>	<b>98(27%)</b>	<b>266(73%)</b>	<b>364 (100%)</b>

**Figure 2:** Pattern of change in practice location by background. Bars show the proportion of background cohort, with actual numbers above the bars.



from an RR background came through the rural or RRAS entry pathway.

When classified by entry pathway, rural / RRAS students were over three times more likely than general or MAPAS students to indicate an RR career intention at entry (relative risk 3.43, 95% CI 3.02–3.91,  $p < 0.0001$ ), and over two times as likely at exit (relative risk 2.19, 95% CI 1.69–2.82,  $p < 0.0001$ ).

### Pattern of intended career location at entry and exit

Longitudinally-linked individual student data on background, and career intentions at entry and at exit, were available for 364 students (see Table 4). Most students (74%) had the same career intention at both entry and exit—56% urban/urban and 17% RR/RR. Over a quarter (26%) of students changed their intentions, with more changing from RR to urban, than urban to RR (17% vs 9.6%,  $p < 0.0001$ ). Nearly half of those intending an RR career at entry (49.2%) changed to an urban intention at exit. Yet, if a student had an RR career intention at entry, they were still over three times more likely to have an RR intention at exit than a student with an urban intention at entry (RR 3.48, 95% CI 2.45 to 4.96,  $p < 0.0001$ ).

### The effect of background on changes in intention

We divided students into four groups, based on the concept of Stagg et al.<sup>26</sup> The

‘Concordant’ (65%) were those whose practice location intention at both entry and exit matched their background. ‘Switchers’ (15%) were those who had the same practice location intention as their background at entry, but who changed their intention to the opposite of their background at exit. ‘Reverters’ (11%) were those whose practice location intention at entry was opposite to their background, but who changed to the same as their background at exit. The ‘Never Evers’ (9%) were those whose practice location intention was opposite to their background at both entry and exit. Relationships between student background and intention patterns are shown in Figure 2. There was a higher proportion of Switchers from RR backgrounds compared to urban backgrounds (32% vs 11%), and a higher proportion of Reverters from urban backgrounds compared to RR backgrounds (13% vs 3%), ( $p < 0.0001$ ). Yet, the absolute numbers of Switchers from urban backgrounds exceeded those from RR backgrounds (33 vs 23). In this subset, those from RR backgrounds were almost three times as likely to intend practice in RR areas than those from urban backgrounds (RR 2.97, CI 2.19–4.03,  $p < 0.0001$ ).

## Discussion

This study was based on data from students in a medical programme in New

Zealand's largest city. It described patterns of intended location of practice and related this to student background. The main finding is the importance of a regional-rural (RR) background on an intention to practice in an RR setting. Just over 20% of medical students were from a RR background, with these students over four times more likely than urban students to state an intention of a RR career at entry, and nearly three times at exit. Even though our RR definition included regional centres, these effects are remarkably similar to those reported internationally for rural practice.<sup>8,13-15</sup>

Second, our results highlight the importance of rural preferential pathways into medical programmes.<sup>27</sup> Over 80% of those with an RR background in the Auckland programme had been admitted via the rural or RRAS entry pathways. Moreover, the effect size of a RR career intention in those admitted by rural/RRAS pathway vs general or MAPAS pathways is likely underestimated as students from larger regional towns were not eligible for the rural pathway before 2012, and Māori or Pacific students from an RR background would usually enter via the Māori and Pacific Admission Scheme (MAPAS). Conversely, a small number of students had an urban background by our study definition, yet came via the rural or RRAS pathway. Three quarters of these (35/42) were from entry cohorts from 2006 to 2011 when the definition of 'rural' was less stringent.

We saw an over-representation of students reporting an urban home address, especially from Auckland, with an under-representation from RR areas across New Zealand. To provide context for our finding that 78.5% of students came from urban areas and 21.5% from RR areas, we calculated the expected proportions from the 2013 New Zealand census data.<sup>28</sup> The population in the main urban areas of New Zealand (ie, would be excluded from the RR admission scheme) was about 2.5 million, including 1,415,550 in Auckland, compared to a total New Zealand population of 4,242,051. Hence, about 60% lived in main urban areas (with 33% in Auckland alone) and 40% in RR areas. These proportions are reflected in the recent MCNZ workforce survey, which estimated the New Zealand population in main

urban areas and non-urban areas at 58% and 42% respectively.<sup>4</sup>

These findings suggest there may be potential to increase the number of students from RR areas. On the other hand, the proportion of RR background students has not changed significantly over the past decade, nor is this admission pathway always fully subscribed. Furthermore, our findings are consistent with those reported from Otago, New Zealand's other medical school,<sup>16</sup> before the advent of rural admission pathways. In that study, only 15% of medical students, compared with 31% of the population, came from outside main urban areas. Understanding the potential for growth in RR medical students entering an urban school requires more information on those of an age to apply to medical school, their aptitude and motivation for a medical career, and factors in their choice of medical school.

Third, we found most students (75%) showed stability in location intentions at both entry and exit, with two-thirds showing concordance with their background. Others have shown that having a rural career pathway intention at both entry and exit from medical school increases the likelihood of subsequent rural practice as does having both a rural background and rural career intention.<sup>26</sup> In one study, 25% of practicing physicians in rural US had rural backgrounds, with 32% of these having both a rural background and a rural intention at exit from medical school.<sup>8</sup> On the other hand, we saw evidence of increasing uncertainty in career choice for a subset of students. From being relatively certain at entry, nearly a third of students were undecided on career location at exit. Those from RR backgrounds showed a greater likelihood of switching their intended location to urban practice than vice versa. Possible reasons include social desirability bias in responses from those from RR areas or rural entry pathways;<sup>29</sup> or changes in personal circumstances, job or lifestyle preferences during medical school. While others have found a similar fall off in levels of interest in rural careers in rural background students,<sup>26</sup> our study does not allow us to determine whether this is due to personal or curriculum factors.

While background may be more important than experiences at medical school,<sup>19</sup> rural educational experiences may reinforce commitment for those from rural backgrounds, those inclined towards rural careers, as well encourage a switch in urban students with a rural interest.<sup>2</sup> Currently, every Auckland medical student spends at least one clinical year in a centre outside Auckland, the largest of which is Hamilton (population 150,000). In addition, each student undertakes a rural GP placement. Any student may join the rural social and educational club, Grass-roots. The early post-graduate period, when most doctors confirm career intentions, is also important in rural workforce development.<sup>30</sup> Attrition from RR practice continues after graduation, with one report noting over 50% of rural doctors in Western Australia left within 5 years of commencing postgraduate training.<sup>31</sup> On the positive side, the 10% increase in retention of rural doctors in that study was attributed to government-led education and workforce distribution programmes.<sup>31</sup>

Strengths of the present study include prospective nature of data collection, large sample size and high response rates. There were internal consistencies in the analyses by background and by entry pathway, as well as between entry and exit. Furthermore, the effect size of an RR background was the same whether we calculated this on collated cross-sectional data or the subset with longitudinal prospective data. We made some assumptions, but used a conservative approach

that would underestimate differences. Our coding of urban vs RR appears pragmatic in the New Zealand setting.

Limitations include the self-reported data, including of home address. It is possible that some students interpreted Auckland as their current home address, regardless of where they grew up. Further, those who were undecided on career location or did not answer were removed from the dataset. The effect of this is uncertain, but there is no reason to expect that those excluded would act differently to other participants in terms of future intentions. To understand the predictive effects of the patterns observed, including for those undecided, requires knowledge of the final destination of all students. Now that Auckland has joined the MSOD project, which follows graduates for 8 years, this should be possible. Further studies might explore factors that promote a switch towards or away from an RR career intention in both urban and RR background students. These may be different.

Factors before, during and after medical school influence career decisions.<sup>33</sup> Selecting more medical students from RR backgrounds is one important way to address RR workforce shortages. However, a wider understanding of the capacity of the RR student pool is needed. Given there are more students intending to work in RR settings from urban backgrounds than from RR backgrounds, determining how undergraduate and early postgraduate experiences interact with background to modify initial career choices is an important next step.<sup>20</sup>



**Competing interests:**

Antonia Verstappen is the manager of the Tracking Project. Tom Stoner is a Year 4 medical student. Warwick Bagg is Head of the Medical Programme, and Phillippa Poole Head of the Department of Medicine. Their opinions as authors are not necessarily those of the University of Auckland.

**Acknowledgements:**

We are indebted to all Auckland medical students who completed surveys. Health Workforce New Zealand provided funding for Antonia Verstappen and Tom Stoner.

**Author information:**

Phillippa Poole, Department of Medicine, The University of Auckland, Auckland; Tom Stoner, Faculty of Medical and Health Sciences, University of Auckland, Auckland; Antonia Verstappen, Faculty of Medical and Health Sciences, University of Auckland, Auckland; Warwick Bagg, Medical Programme Directorate, University of Auckland, Auckland, New Zealand.

**Corresponding author:**

Phillippa Poole, Department of Medicine, Faculty of Medical and Health Sciences, The University of Auckland, Private Bag 92019, Auckland 1142, New Zealand,  
p.poole@auckland.ac.nz

**URL:**

[www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2016/vol-129-no-1435-27-may-2016/6896](http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2016/vol-129-no-1435-27-may-2016/6896)

**REFERENCES:**

- Goodyear-Smith F, Janes R. The 2005 Rural Health Workforce Survey. Wellington: Ministry of Health; 2005.
- Boscardin CK, Grbic D, Grumbach K, O'Sullivan P. Educational and individual factors associated with positive change in and reaffirmation of medical students' intention to practice in underserved areas. *Acad Med* 2014;89:1490-6.
- Brooks P, Lapsley H, Butt D. Medical workforce issues. *Med J Aust* 2003;179:206-8.
- Medical Council of New Zealand. The New Zealand Medical Workforce in 2013 and 2014. Wellington: Medical Council of New Zealand; 2016.
- Medical Training Board. The future of the medical workforce: first annual report Nov 2007–Dec 2008. Wellington: Ministry of Health; 2009.
- Boelen C, Woollard B. Social accountability and accreditation: a new frontier for educational institutions. *Med Educ* 2009;43:887-94.
- Gorman D, Poole P, Scott J. On the maldistribution of the medical workforce. *Int Med J* 2007;37:669-71.
- Rabinowitz H, Diamond J, Markham F, Santana A. The relationship between entering medical students' backgrounds and career plans and their rural practice outcomes three decades later. *Acad Med* 2012;87:493-7.
- Feldman K, Woloschuk W, Gowans M. The difference between medical students interested in rural family medicine versus urban family or specialty medicine. *Can J Rural Med* 2008;13:73-9.
- Easterbrook M, Godwin M, Wilson R, Hodgetts G, et al. Rural background and clinical rotations during medical training: effect on practice location. *CMAJ* 1999;160:1159-63.
- Isaac V, Watts L, Forster L, McLachlan CS. The influence of rural clinical school experiences on medical students' levels of interest in rural careers. *Hum Resour Health* 2014;12:48.
- Angel C, Johnson A. Broadening access to undergraduate medical education. *BMJ* 2000;321:1136-8.
- Colwill J, Cultice J. The future supply of family physicians: implications for rural America. *Health Affairs* 2003;22:190-8.
- Ward A, Kamien M, Lopez D. Medical career choice and practice location: early factors predicting course completion, career choice and practice location. *Med Educ* 2004;38:239-48.
- Azer S, Simmons D, Elliott S. Rural training and the state of rural health services: effect of rural background on the perception and attitude of first-year medical students at the University of Melbourne. *Aust J Rural Health* 2001;9:178-85.
- Heath C, Stoddart C, Renwick J. Urban and rural origins of Otago medical students. *New Zealand*

- Med J 2002;115:U238.
17. Pasley T, Poole P. Characteristics of University of Auckland medical students intending to work in the regional/rural setting. *New Zealand Med J* 2009;122:50-60.
  18. RRAS. University of Auckland, 2012. (Accessed February 24th, 2016, at <https://www.fmhs.auckland.ac.nz>.)
  19. Rabinowitz H, Diamond J, Markham F, Paynter N. Critical factors for designing programs to increase the supply and retention of rural primary care physicians. *JAMA* 2001;286:1041-8.
  20. Tolhurst H, Adams J, Stewart S. An exploration of when urban background medical students become interested in rural practice. *Rural Remote Health* 2006;6:452.
  21. Poole P, Bagg W, O'Connor B, et al. The Northland Regional-Rural program (Pūkawakawa): broadening medical undergraduate learning in New Zealand. *Rural Remote Health* 2010;10:1254. Epub 2010 Mar 1
  22. Farry P, Adams J, Walters L, Worley P, Dovey S. Development of the Rural Immersion Programme for 5th-year medical students at the University Of Otago. *New Zealand Med J* 2010;123:16-23.
  23. Worley P, Martin A, Prideaux D, Woodman R, Worley E, Lowe M. Vocational career paths of graduate entry medical students at Flinders University: a comparison of rural, remote and tertiary tracks. *Med J Aust* 2008;188:177-8.
  24. Kaur B, Robertson D, Glasgow N. Evidence-based medical workforce planning and education: the MSOD project. *Med J Aust* 2013;198:518-9.
  25. Statistics New Zealand. Urban/rural profile (experimental) classification categories. Wellington: Statistics New Zealand; 2008.
  26. Stagg P, Greenhill J, Worley P. A new model to understand the career choice and practice location decisions of medical graduates. *Rural Remote Health* 2009;9:1245.
  27. Hsueh W, Wilkinson T, Bills J. What evidence-based undergraduate interventions promote rural health? *New Zealand Med J* 2004;117:U1117.
  28. 2013 Census. Statistics New Zealand, 2013. (Accessed Feb 16, 2016, at <http://www.stats.govt.nz/Census/2013-census.aspx>.)
  29. Arnold H, Feldman D, Purbhoo M. The role of social-desirability response bias in turnover research. *Acad Manage J* 1985;28:955-66.
  30. Woolf K, Elton C, Newport M. The specialty choices of graduates from Brighton and Sussex Medical School: a longitudinal cohort study. *BMC Med Educ* 2015;15:46.
  31. Bailey B, Wharton R, Holman C. Glass half full: Survival analysis of new rural doctor retention in Western Australia. *Aust J Rural Health* 2015 2015; epub Dec 21.
  32. Asch D, Jedrzejewski M, Christakis N. Response rates to mail surveys published in medical journals. *J Clin Epidemiol* 1997;50:1129-36
  33. Khader Y, Al-Zoubi D, Amarin Z, et al. Factors affecting medical students in formulating their specialty preferences in Jordan. *BMC Med Educ* 2008;8:32.