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Who Are the Health Workers and Where Are They? Revealed Preferences in Location Decision among Health Care Professionals in the Philippines

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Abstract

Health human resource (HHR) is critical in the delivery of health care services. However, the available evidences on their geographic distribution and availability remains quite limited in the scope of cadres studied, i.e., mostly physicians, and in global reach, i.e., mainly in English-speaking developed countries. This paper aims to bridge this gap in the literature by assessing the supply of a broader set of health care workers in the Philippines, and analyzing the different factors that affect their location decision. Similar to other countries, we find indications that HHRs in the Philippines are more likely to locate in regions where their earnings potential may be greatest, and in proximity to communities where they were trained. However, we don't find empirical support that HHRs from ethnolinguistic minorities are more likely to work in areas with higher ethnic concentrations. We also document large disparities in HHR density that is masked by national-level statistics. Indeed, data over the last twenty-five years show increasing polarization in the spatial distribution across all cadres of HHRs in the Philippines.

Keywords: Health human resource, Location choice, Philippines

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Michael R.M. Abrigo and Danica Aisa P. Ortiz[1]

1. Introduction

Health human resource (HHR) plays a critical role in the delivery of health care services. It is therefore quite surprising that little is known about their geographic availability and accessibility (Guagliardo, 2004). Indeed, of the limited evidences available, much are focused on English-speaking industrialized economies and largely on only a subset of the available HHR cadres, particularly on physicians (Dolea, et. al., 2010).[2]

This study aims to contribute to the literature by assessing the supply of health care workers in a developing country context, in this case the Philippines, and analyzing locational factors that influence the decision of HHRs on where to practice their profession. We depart from other studies by looking at a broader set of HHR cadres, including physicians, nurses and midwives, as well as dentists, nutritionist-dieticians, optometrists and opticians, among others.

While at the national level there appears to be sufficient supply of health care workers in the Philippines when compared with international metrics, disaggregated data on HHR density show a much more nuanced picture. Less than 25 percent of cities and municipalities have HHR density above the 41 physicians, nurses and midwives per 10,000 population recommended by the World Health Organization (WHO, 2016). This leaves as much as three-quarters of cities and municipalities in the country with potentially insufficient number of HHRs to provide health care services. Indeed, over the last twenty-five years, health care workers are increasingly concentrated geographically.

Based on a discrete-choice location model that we estimated using Philippine data, we find that health care workers in the country are more likely to work in areas with greater earning potentials, and in communities close to where they are trained, similar to findings in other countries (e.g. Dolea, et. al., 2010; Buykx, et. al., 2010). However, we did not find any empirical support to the claim that improving ethnic diversity among HHRs increases access in underserved areas (c.f. Kington, et. al., 2011). Instead, we document the reverse: HHRs from ethnolinguistic minority are less likely to work in areas with high ethnic concentration – even more averse than HHRs of non-minority background.

The rest of the study is organized as follows. In the next section, we look at statistics on the inflow of new health care workers, and exit from the domestic labor market through temporary international migration. In Sections 3 and 4, we present HHR stock estimates and their characteristics based on information from several rounds of the country's population census. In Section 5, we discuss the results of a discrete-choice location model we estimated for health care workers. Finally, we conclude with a summary of our key findings and a discussion of the potential implications to policy of our results.

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[1] Senior Research Fellow and former Research Associate, respectively, at the Philippine Institute for Development Studies (PIDS). The authors are grateful for discussions from participants at the PIDS Research Seminar Series. All remaining errors are by the authors.

[2] See McPake, et. al. (2014) for an example of studies focusing on developing countries.

2. Entry and out-migration

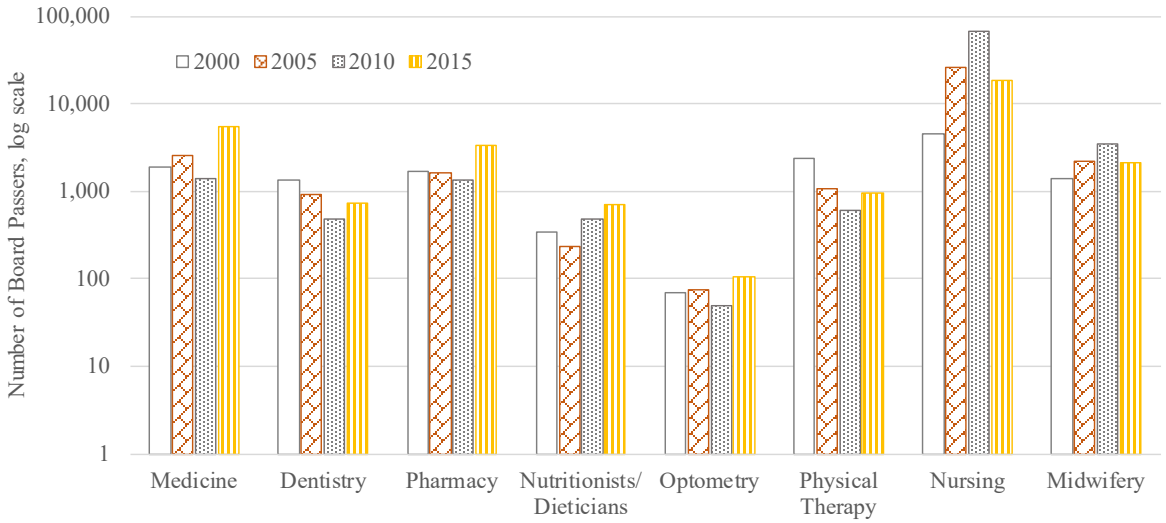
The practice of health care professions in the Philippines is regulated by different laws, including those for medicine (Republic Act [R.A.] 2382), dentistry (R.A. 9484), nursing (R.A. 9173), pharmacy (R.A. 10918), nutrition and dietetics (R.A. 10862), optometry (R.A. 8050), physical and occupation therapy (R.A. 5680 and 11241), and midwifery (R.A. 7392). Except for a few professions, including dentistry, optometry and midwifery, the practice of many of these professions in the Philippines are open to foreign citizens, as provided for in the respective board laws that govern the practice of each profession, although may be subject to other rules, including the Labor Code of the Philippines (Presidential Decree 442, as amended). In particular, Article 40 of the Labor Code only allows the issuance of employment permits to foreign workers when a "competent, able and willing" person to perform the services is not available in the Philippines.

Figure 1 presents the number of individuals admitted to each health care profession board between 2000 and 2015 from the Philippine Regulatory Commission as cited by the National Statistical Coordination Board [NSCB] (2001, 2006, 2011) and the Philippine Statistics Authority [PSA] (2016a). Except for dentistry and physical therapy, there appears to be a general upward trend in the number of board passers among the different health care professions in the past 15 years.

Nurses comprise the largest number of new health care professionals annually among the different cadres presented. In 2000, about 4,600 among 9,300 applicants passed the board exam for nursing. This has ballooned to about 67,000 out of 175,000 applicants in 2010, before settling to about 18,800 passers out of 36,400 applicants in 2015.

The country also produces a substantial number of physicians, pharmacists and midwifery professionals in terms of number of board passers, particularly in more recent years. Among physicians, for example, the number of board passers in medicine increased from about 1,900 in 2000 to 5,500 in 2015. This is partly due to the increase in number of applicants, which almost doubled to about 6,800 in 2015 from only 3,600 in 2000, and partly to the increased passing rate, which has grown to 80.1 percent in 2015 from only 52.4 percent in 2000.

Figure 1. Number of board passer by health profession: Philippines, 2000-2015



Source: Philippine Statistical Yearbook, NSCB (2001, 2006, 2011) and PSA (2016).

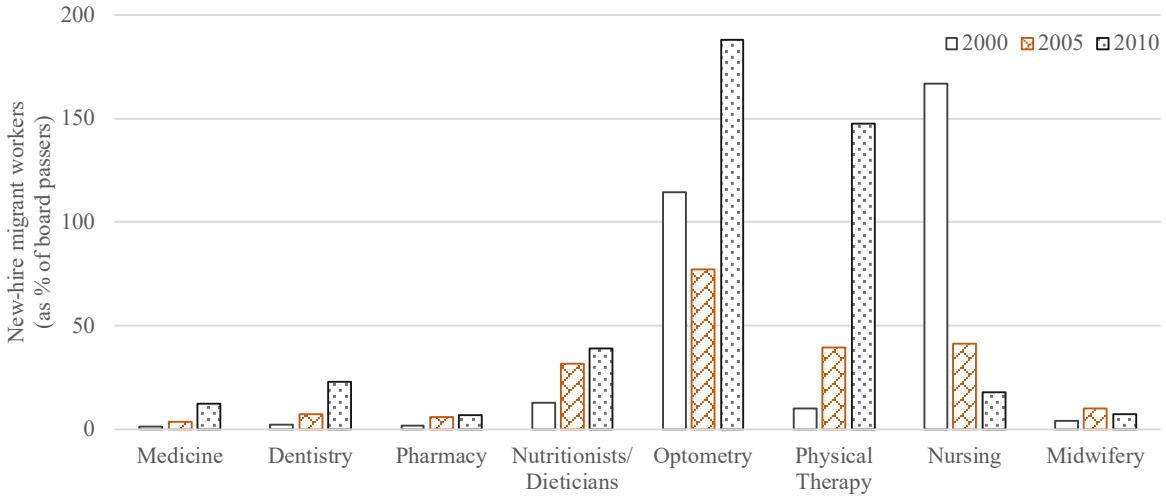
The number of pharmacy and midwifery board passers, on the other hand, increased to about 3,300 and 2,200 in 2015 from 1,700 and 1,400 in 2000, respectively. Unlike physicians, however, the increase in board passers among pharmacists and midwifery professionals are mainly due to the increase in board takers, rather than passing rates, which has even declined for midwifery professionals, over the same time period.

Among the cadres presented, only dentists and physical therapists have posted declines in the number of board passers over the past 15 years. In 2000, about 1,300 dentists and 2,400 physical therapists passed their respective board exams. These have declined to about 700 dentists (written exam only), and 1,000 physical therapists in 2015. While there has been a general upward trend in the passing rate of the dentistry and physical therapy board exams, the number of test takers have been declining since 2000.

Many of these Philippine-trained health care professionals do not necessarily end up working in the Philippines (Castro-Palaganas, et. al., 2017; Cheng, 2009; Lorenzo, et. al., 2005). In 2010, for example, about 13,900 health care professionals were newly hired for temporary employment overseas (Philippine Overseas Employment Administration [POEA], 2016). A large majority of this figure is composed of nurses (86.9%), although there were also significant numbers of physical therapists (6.4%), midwifery professionals (1.9%), nutritionist and dieticians (1.3%), and physicians (1.3%). These do not include health care professionals who were migrating under different occupation classes, as well as Filipino temporary migrant workers with continuing contracts, and permanent migrants.

Figure 2 shows the flow of new-hire temporary migrant workers as a share of board passers between 2000 and 2010. Except for optometrists and physical therapists, the figure shows that the number of new health care professionals, i.e., board passers, are greater than the number of new out-migrants, implying net addition to the stock of health care professionals in the domestic labor force. When we consider the patterns over time, however, except for nursing, there appears to be a general increasing trend in the rates, at least until 2010.

Figure 2. New-hire international migrant workers as share of new board passers by health care profession: Philippines, 2000-2010



Source: Philippine Statistical Yearbook, NSCB (2001, 2006, 2011), PSA (2016), and POEA (2016).

The number of new-hire temporary migrant workers among optometrists and physical therapists exceeded the number of new board passer by 88 and 47 percent, respectively, in 2010. This appears to be a recent trend for physical therapists, but not for optometrists. The outflow of new-hire nurses also exceeded the number of board passers in 2000. However, the rates have since gone down with the surge in the number of nursing board passers (Figure 1). By 2010, new-hire temporary migrant worker nurses only comprise less than 20 percent as a share of nursing board passers for that year.

3. Stock estimate

While the statistics on the annual inflow of new health care professionals and outflow of new-hire temporary migrant workers may be instructive, it does not, however, show a comprehensive picture of the supply of health human resource (HHR) available in the country. As noted in the previous section, the statistics on outflows does include information on the number of health care professionals who migrated to other countries under different categories, including different occupational classes and migrant type. Further, we are not able to capture other forms of exits, i.e., permanent or temporary retirement, as well as career shifts, i.e., health care professionals with other primary occupations, and re-entry, i.e., among previously retired and migrant workers, in the domestic labor market.

Table 1 presents the stock of ten HHR cadres in the Philippines in 1990, 2010 and 2015 based on the country's population censuses (National Statistics Office [NSO], 1992, 2012; PSA, 2016b).[3] The count of health care workers presented correspond to those people who responded as employed with the indicated occupations,[4] rather than based on training or education. As such, it only counts those who were employed in the Philippines at the time of the census, and exclude those who were either not employed or were working in other countries.

Over the last twenty-five years, the stock estimates suggest that the country has experienced robust growth in the number of some HHR cadres, including physicians (2.6% annual growth), pharmacists (4.8%), physiotherapists (6.5%), professional nurses (7.7%), and medical and pharmaceutical technicians (4.4%), with the stock of each of these cadres growing faster than the 2.0-percent annual growth recorded for the whole Philippine population between 1990 and 2015. Lagging behind, however, are dentists (1.8% annual growth), nutritionists and dieticians (0.2%), and optometrists and opticians (0.0%).

There appears to be a significant drop in the number of professional midwives between 2010 and 2015. However, this may be the result of a definitional change in standard occupational classification employed between the two census rounds. Combining the numbers for both professional midwives and nursing/midwifery technicians, we see an indication of an increase in the stock of midwives between 1990 and 2010, but a decrease between 2010 and 2015.

[3] It is important to note that the 2015 figures are based on the 2012 Philippine Standard Occupational Classification (PSOC), while earlier estimates are based on the earlier 1992 PSOC. Further, the 1990 and 2010 estimates use the ten-percent household sample from the Census of Population, which are given a more elaborate set of questionnaire compared with the standard population census household questionnaire.

[4] The Census of Population (and Housing) asks individuals of their usual activity or occupation with a reference period of past 12 months.

Table 1. Health human resource (HHR) by type: Philippines, 1990-2015

	Count (Thousands)			Rate (per 10,000 population)			Spatial disparity (Gini coefficient)		
	1990	2010	2015	1990	2010	2015	1990	2010	2015
Physicians	27.3	32.3	52.0	4.5	3.5	5.2	0.69	0.77	0.84
Dentists	15.1	23.6	23.9	2.5	2.6	2.4	0.63	0.73	0.79
Pharmacists	8.6	17.1	27.5	1.4	1.9	2.7	0.51	0.65	0.75
Nutritionists/Dieticians	4.4	3.7	4.6	0.7	0.4	0.5	0.43	0.55	0.68
Optometrists/Opticians	4.0	2.9	4.0	0.7	0.3	0.4	0.50	0.50	0.69
Physiotherapists	2.1	7.7	10.0	0.3	0.8	1.0	0.48	0.62	0.75
Professional Nurses	54.8	253.5	351.1	9.0	27.5	34.9	0.68	0.78	0.75
Professional Midwives	28.8	27.4	7.0	4.8	3.0	0.7	0.51	0.57	0.63
Medical/Pharmaceutical Technicians	15.0	44.7	43.5	2.5	4.9	4.3	0.56	0.73	0.77
Nursing/Midwifery Technicians	7.2	29.3	46.7	1.2	3.2	4.6	0.44	0.62	0.60

Note: Authors' estimates based on data from NSO (1992, 2012), and PSA (2016b). Estimates for 1990 and 2010 use the 1992 Philippine Standard Occupational Classification (PSOC), while the 2015 estimates are based on the 2012 PSOC. Also, the 1990 and 2010 estimates are calculated from the 10 percent sample-households of the population census, while the 2015 estimates are based on full enumeration data. Spatial Gini coefficients are calculated using cities and municipalities as observation units.

The above observations ultimately influence the number of HHR per population in the country. In 2015, for every 10,000 population in the Philippines, there were 34.9 professional nurses, 8.6 health care technicians, 5.2 physicians, 2.7 dentists, 1.0 physiotherapists, 0.7 professional midwives, 0.5 nutritionists and dieticians, and 0.4 optometrists and opticians employed in the country. Except for dentists, nutritionists and dieticians, optometrists and opticians, and midwives, the rates for each cadre have been increasing over the past twenty-five years.

Several HHR density thresholds assessing the adequacy of HHR supply based on different methodologies have been proposed in the literature. In the *2006 World Health Report*, for example, the WHO proposed a density of 23 skilled health care workers, comprising of physicians, nurses and midwives, per 10,000 population as necessary to attain an 80 percent coverage in skilled birth attendance (WHO, 2006). The International Labor Organization (ILO), using a different methodology rooted on social protection systems and outcomes, proposed a density of 34 physicians, nurses and midwives per 10,000 population in its *World Social Security Report 2010-2011* (ILO, 2011), which it subsequently updated to 41 per 10,000 population (ILO, 2014).

More recently, the WHO updated its threshold to 45 skilled health care workers per 10,000 population based on the median level of attaining 80 percent coverage for 12 selected Social Development Goals (SDG) indicators. The SDG tracker indicators used include access to antenatal care, antiretroviral therapy, cataract treatment, diabetes treatment, DPT3 immunization, family planning, hypertension treatment, potable water, sanitation, skilled birth attendance, tobacco smoking, and tuberculosis treatment (WHO, 2016).

The density of health care workers in the Philippines are around the ballpark of the above thresholds. In 2015, the composite density of physicians, professional nurses and professional midwives in the Philippines reached 40.8 per 10,000 population, which is above the 2006 WHO- and 2011 ILO-thresholds, and only slightly below the 2014 ILO- and 2016 WHO-thresholds. This HHR density in the Philippines has more than doubled from only 18.3 per 10,000 population in 1990.

That said, the supply of the different cadres of health care workers are highly uneven when we consider their geographic distribution within the country. Indeed, between 1990 and 2015, we can see an increasing inequality in the spatial distribution, as measured by the Gini coefficient, among all cadres of health care workers that we consider in this report. The spatial Gini coefficient is calculated using cities and municipalities as observation units. It ranges between zero, indicating perfect spatial equality in distribution, i.e., all cities and municipalities have the same health worker density, and one, indicating perfect inequality in distribution, i.e., all health care workers are in only one municipality or city.

In 2015, the most spatially concentrated cadres include physicians (spatial Gini index = 0.84), dentists (0.79), medical and pharmaceutical technicians (0.77), pharmacists (0.75), physiotherapists (0.75), and professional nurses (0.75). Some of these cadres have experienced the greatest degrees of polarization over the past twenty-five years. Between 1990 and 2015, the largest increase in spatial Gini coefficients may be observed among physiotherapists (+28% points), nutritionists and dieticians (+25% points), pharmacists (+23% points), and medical and pharmaceutical technicians (+21% points). Physicians and professional nurses were the most highly spatially concentrated in 1990, with their spatial Gini coefficients estimated at 0.69 and 0.68, respectively.

4. Demographic characteristics

The population censuses allow the disaggregation of the stock of health care workers by different demographic characteristics. Using individual-level information, we describe the characteristics of health care workers by sex, age, marital status, ethnolinguistic minority status, and broad regions of residence. Table 2 shows the distribution of health care workers by these characteristics in 1990, 2010 and 2015.

4.1. Sex

There appears to be a move towards greater feminization in traditionally male-dominated health care professions, e.g. medicine and physiotherapy. In 1990, majority of physicians (51.5%) and physiotherapists (58.2%) are men. By 2015, however, the sex distribution in these occupations have shifted towards more female participation, with women comprising 56.9 percent of physicians and 61.9 percent of physiotherapists.

Traditionally female-dominated occupations, e.g. nursing, midwifery, nutrition and dietetics, and pharmacy, on the other hand, are moving towards greater gender equality. In 1990, women made up a large majority of midwives (99%), pharmacists (93.6%), nutritionists and dieticians (92. 2%), and nurses (90.6%). Women continue to dominate these occupations. In more recent years, however, there are greater participation among men in these occupations. In 2015, for example, 25.9 percent of nurses and 16.6 percent of pharmacists were males.

Dentistry remains female-dominated, but more feminized in more recent years. The share of female dentists has increased to 69.2 percent in 2015 from 63.5 percent in 1990.

4.2. Age

Besides a few exceptions, the country's health care workforce is ageing. The greatest ageing may be observed among dentists, and optometrists and opticians. This may be a direct consequence of the observed rates of entry and exit among these cadres. As noted in the earlier section, the number of board passers has been declining among dentists, while the number of new-hire optometrists for international employment outpaces the number of new board passers. In 1990, the median age of dentists, and optometrists and opticians in the country were 31- and 33-years, respectively. These have increased to 44- and 45-years, respectively, by 2015.

The median ages of other cadres of health care workers are also increasing, although not as fast as those for dentists, and optometrists and opticians. The median ages among physicians, and nutritionist-dieticians increased by six years over the past twenty-five years to 42- and 37-years, respectively, in 2015. The median age among physiotherapists also increased, but only by two years, from 34 years in 1990 to 36 years in 2015.

Only two cadres are getting younger: pharmacists and professional nurses. In 1990, the median age of pharmacists and professional nurses were 34- and 31-years, respectively. By 2015, these have gone down to 32- and 28-years, respectively, as a direct result of the increasing number of new board passers, who are generally younger, in these fields. This is despite the increasing trend in the number of new-hire temporary Filipino health care migrant workers, particularly among professional nurses.

Table 2. HHR by Type, Sex, Age group and Region of residence: Philippines, 1990, 2010 and 2015

A. Health Human Resource, 1990

	Professionals								Health Associates, Tech-nicians
	Physicians	Dentists	Phar-macists	Nutri-tionists/ Dieticians	Opto-metrists/ Opticians	Physio-therapists	Nurses	Midwives	
Count (Thousands)	27.3	15.1	8.6	4.4	4.0	2.1	54.8	28.8	22.2
By Sex (%)									
Male	51.5	36.5	6.4	7.8	31.0	58.2	9.4	1.0	27.4
Female	48.5	63.5	93.6	92.2	69.0	41.8	90.6	99.0	72.6
By Age group (%)									
20-29	22.5	42.5	34.0	39.3	38.7	37.5	37.8	35.6	42.5
30-39	35.3	26.4	28.7	39.6	25.5	24.3	49.1	41.3	33.4
40-49	18.0	8.9	11.8	14.9	17.4	15.3	7.8	9.7	12.8
50-59	14.0	13.2	15.2	5.1	13.8	14.0	3.5	8.2	6.1
60+	9.9	8.2	9.2	0.9	3.3	6.1	0.9	1.6	2.2
By Marital status (%)									
Never married	30.0	40.2	35.2	42.6	31.3	34.6	40.8	36.7	44.4
Ever married	70.1	59.8	64.8	57.4	68.7	65.4	59.2	63.4	55.6
By Ethnolinguistic group (%)									
Non-minority (1M+ speakers)	96.2	96.4	94.7	93.1	97.4	95.6	93.8	93.6	92.5
Minority (<1M speakers)	3.8	3.6	5.3	6.9	2.6	4.4	6.2	6.4	7.5
By Region of residence (%)									
Mega Manila	58.4	68.1	54.0	55.0	67.9	72.0	50.9	42.8	52.3
Balance Luzon	13.3	14.0	11.0	17.5	10.4	8.1	17.8	21.9	16.8
Visayas	16.1	9.2	14.7	17.2	11.5	8.1	19.0	16.1	14.3
Mindanao	12.2	8.8	20.3	10.4	10.3	11.8	12.2	19.3	16.6

Note: Authors' estimates based on data from NSO (1992, 2012), and PSA (2016b). See note on Table 1 for additional information. na – Estimate not available.

Table 2. HHR by Type, Sex, Age group and Region of residence: Philippines, 1990, 2010 and 2015 (continued)

B. Health Human Resource, 2010

	Professionals								Health Associates, Tech-nicians
	Physicians	Dentists	Phar-macists	Nutri-tionists/ Dieticians	Opto-metrists/ Opticians	Physio-therapists	Nurses	Midwives	
Count (Thousands)	32.3	23.6	17.1	3.7	2.9	7.7	253.5	27.4	74.1
By Sex (%)									
Male	43.8	32.0	13.2	7.1	28.1	37.5	25.9	1.7	24.9
Female	56.2	68.1	86.8	92.9	72.0	62.5	74.1	98.3	75.1
By Age group (%)									
20-29	11.3	10.8	32.8	18.5	7.0	24.8	54.3	12.7	31.0
30-39	32.1	32.7	34.2	28.6	32.2	66.1	25.8	32.2	30.8
40-49	26.9	39.0	18.6	24.8	33.1	7.1	11.1	26.3	19.8
50-59	18.6	12.5	9.7	25.3	16.8	1.7	7.9	24.6	14.0
60+	11.2	5.0	4.7	2.9	10.9	0.4	0.8	3.6	3.3
By Marital status (%)									
Never married	28.9	23.1	36.1	30.0	17.5	50.8	57.0	18.2	35.0
Ever married	71.1	77.0	63.9	70.0	82.5	49.2	43.0	81.8	65.0
By Ethnolinguistic group (%)									
Non-minority (1M+ speakers)	91.3	91.2	90.9	89.3	88.7	92.6	90.1	87.7	89.9
Minority (<1M speakers)	8.7	8.8	9.1	10.7	11.3	7.4	9.9	12.3	10.1
By Region of residence (%)									
Mega Manila	60.3	66.8	53.0	57.5	60.3	66.8	53.9	38.3	48.2
Balance Luzon	10.9	14.4	14.3	16.1	12.7	13.4	15.0	20.0	17.7
Visayas	16.4	10.5	17.2	14.3	14.7	12.4	15.5	18.7	17.2
Mindanao	12.5	8.2	15.5	12.2	12.3	7.4	15.6	23.0	17.0

Note: Authors' estimates based on data from NSO (1992, 2012), and PSA (2016b). See note on Table 1 for additional information. na – Estimate not available.

Table 2. HHR by Type, Sex, Age group and Region of residence: Philippines, 1990, 2010 and 2015 (continued)

C. Health Human Resource, 2015

	Professionals								Health Associates, Tech-nicians
	Physicians	Dentists	Phar-macists	Nutri-tionists/ Dieticians	Opto-metrists/ Opticians	Physio-therapists	Nurses	Midwives	
Count (Thousands)	52.0	23.9	27.5	4.6	4.0	10.0	351.1	7.0	90.2
By Sex (%)									
Male	43.1	30.8	16.6	11.7	27.9	38.1	25.9	9.9	22.9
Female	56.9	69.2	83.5	88.3	72.1	61.9	74.1	90.1	77.1
By Age group (%)									
20-29	12.5	10.4	42.3	32.8	7.2	26.9	60.2	32.1	33.3
30-39	29.4	24.5	29.7	21.7	24.1	51.4	20.8	17.0	22.4
40-49	25.9	35.9	16.9	19.0	35.3	17.3	12.6	28.3	25.0
50-59	21.0	23.3	7.6	21.0	22.3	3.2	4.7	16.4	12.7
60+	11.1	5.9	3.5	5.3	11.1	1.2	1.5	5.9	5.8
By Marital status (%)									
Never married	32.7	26.1	48.7	43.0	22.0	49.7	61.8	34.6	37.7
Ever married	67.3	73.9	51.3	57.0	78.1	50.3	38.2	65.4	62.3
By Ethnolinguistic group (%)									
Non-minority (1M+ speakers)	na	na	na	na	na	na	na	na	na
Minority (<1M speakers)	na	na	na	na	na	na	na	na	na
By Region of residence (%)									
Mega Manila	59.9	67.3	53.7	56.5	63.2	66.2	48.6	27.2	43.2
Balance Luzon	12.3	14.0	16.2	14.7	14.3	15.1	17.5	20.5	21.4
Visayas	15.4	10.2	15.3	12.5	11.5	11.6	17.2	19.6	15.4
Mindanao	12.5	8.5	14.9	16.3	10.9	7.1	16.7	32.8	20.0

Note: Authors' estimates based on data from NSO (1992, 2012), and PSA (2016b). See note on Table 1 for additional information. na – Estimate not available.

4.3. Marital status

The proportion of ever-married dentists, and optometrists and opticians have increased over the last twenty-five years. In 1990, about 60 percent of dentists and 69 percent of optometrists and opticians were ever married. These ever-married rates have increased to 74- and 78-percents, respectively, in 2015.

The proportion of never-married health care workers, on the other hand, are increasing among other cadres. The increase over the last twenty-five years are highest among nurses (+21% points), physiotherapists (+15% points), and pharmacists (+14% points).

These observations potentially reflect the age distribution of the different cadres, as well as selective entry and exit into local employment among these professions, among others.

4.4. Ethnolinguistic minority status

We use ethnolinguistic affiliation as a proxy indicator for socioeconomic status and measure of inclusion. Anecdotal evidences show that people from indigenous cultural communities have higher rates of material deprivation (Rovillos and Morales, 2002; World Bank, 2015). In this report, we define ethnolinguistic minority as those persons who self-ascribe as belonging to an ethnolinguistic group with less than one million speakers in the Philippines at the time of the population census.

The proportion of ethnolinguistic minority among the health care workforce has increased between 1990 and 2010. In 1990, about one in every twenty HHR were from ethnolinguistic groups with less than one million speakers. Twenty years later, this has increased to about one in every ten HHR.

The statistics suggest increasing ethnolinguistic inclusion among all the different cadres of health care workforce. The greatest improvement may be observed among optometrists and opticians (+8.8% points), dentists (+5.2% points), and physicians (+4.9% points).

However, when we compare these rates with the proportion of ethnolinguistic minorities in the population, there appears to be more than ample room for growth. For reference, the share of ethnolinguistic minorities in the total population were 12- and 14-percent in 1990 and 2010, respectively. The share of ethnolinguistic minorities in all health workforce cadres that we consider are below these thresholds.

4.5. Residence

Except for professional nurses and professional midwives, the Mega Manila region, composed of the National Capital Region and surrounding MIMAROPA and Central Luzon, has remained to be the residence of more than half of all health care workers in each cadre in the country between 1990 and 2015. Among dentists and physiotherapists, about a third reside in the Mega Manila region in 2015.

The dominance of Mega Manila, however, has weakened in favor of other regions. In particular, the share of health care workings residing in the rest of Luzon has increased among pharmacists, optometrists and opticians, and physiotherapists. The share residing in Mindanao, on the other hand, increased among nutritionist-dieticians, and nurses.

Figure 3 presents the geographic distribution of the composite HHR density of physicians, professional nurses, and profession midwives across cities and municipalities of residence in 2015. While we have shown in Table 1 that the skilled health care worker density in the Philippines is around the recommended WHO and ILO thresholds, this does not necessarily hold true across the whole country. Indeed, less than 25 percent of cities and municipalities have HHR density higher than 41 per 10,000 population in 2015. As shown in the figure, much of these cities and municipalities are located in the northern part of the Philippines, i.e., in Luzon, and in more developed communities, i.e., cities and urban areas.

The spatial distribution of HHR density is disaggregated and shown for each cadre in Figure 4. For comparison, the government's *National Objectives for Health 2017-2022* (Department of Health, 2018) uses the following HHR per 100,000 population density as thresholds to measure health human resource adequacy: 5 physicians, 10 nurses, and 20 midwives, considering only those employed in the public sector.

The HHR density presented in Figure 4 shows that about a quarter of cities and municipalities do not meet the threshold for physician density if we consider health care workers in both public and private sectors.[5] The distribution of nurses appears to be more adequate with less than two percent of cities and municipalities not meeting the threshold. Among midwives, however, more than 90 percent of cities and municipalities did not pass the threshold in 2015 if we only consider professional midwives.

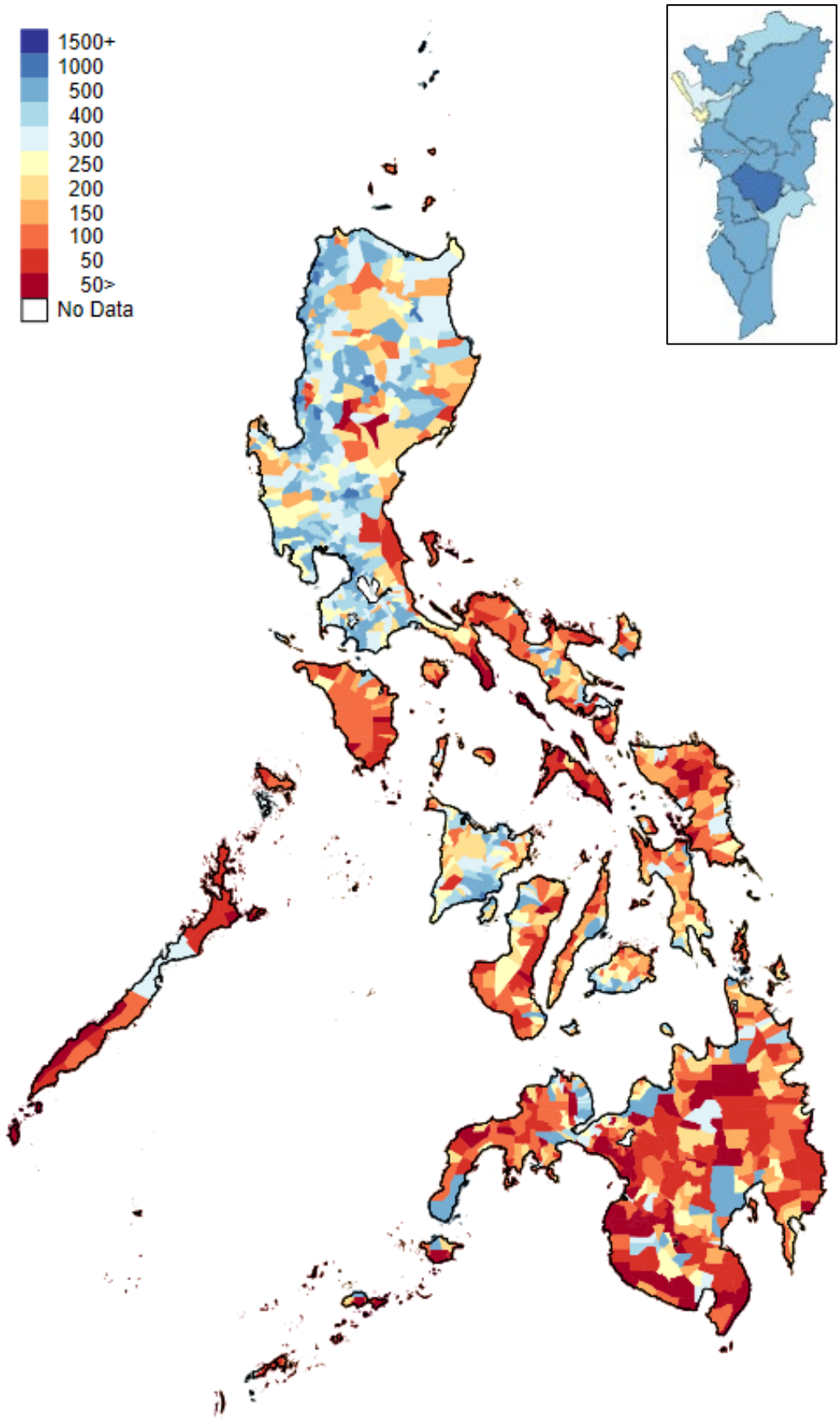
5. Location decision

The spatial distribution of health care workers in the Philippines has been increasingly being concentrated over the past twenty-five years as shown in Table 1. However, the narrative presented in the previous sections on the spatial distribution of health care workers may slightly change when we consider the location of health care practice instead of residence location among HHR. This is only possible, however, with the decennial census of population wherein place of work is also collected among a sample of households.

Health care workers are relatively more mobile compared with other workers in the Philippines. In the 2010 population census, for example, only two percent of all those reported employed in the country were working in areas other than their province of residence. This rate is much higher among all cadres of health care workers, particularly among physiotherapists (17.8%), nutritionists and dieticians (17.9.0%), pharmacists (15.5%), physicians (14.6%) and professional nurses (12.8%). Other cadres are also more mobile relative to the general population, but are comparatively less so compared with those HHR cadres already mentioned. Only 9.8 percent of optometrists and opticians, 8.8 percent of dentists, and 5.3 percent of professional midwives reported working outside their province of residence in 2010. Arguably, the latter set of HHR cadre rely on relatively immobile equipment for their health care practice.

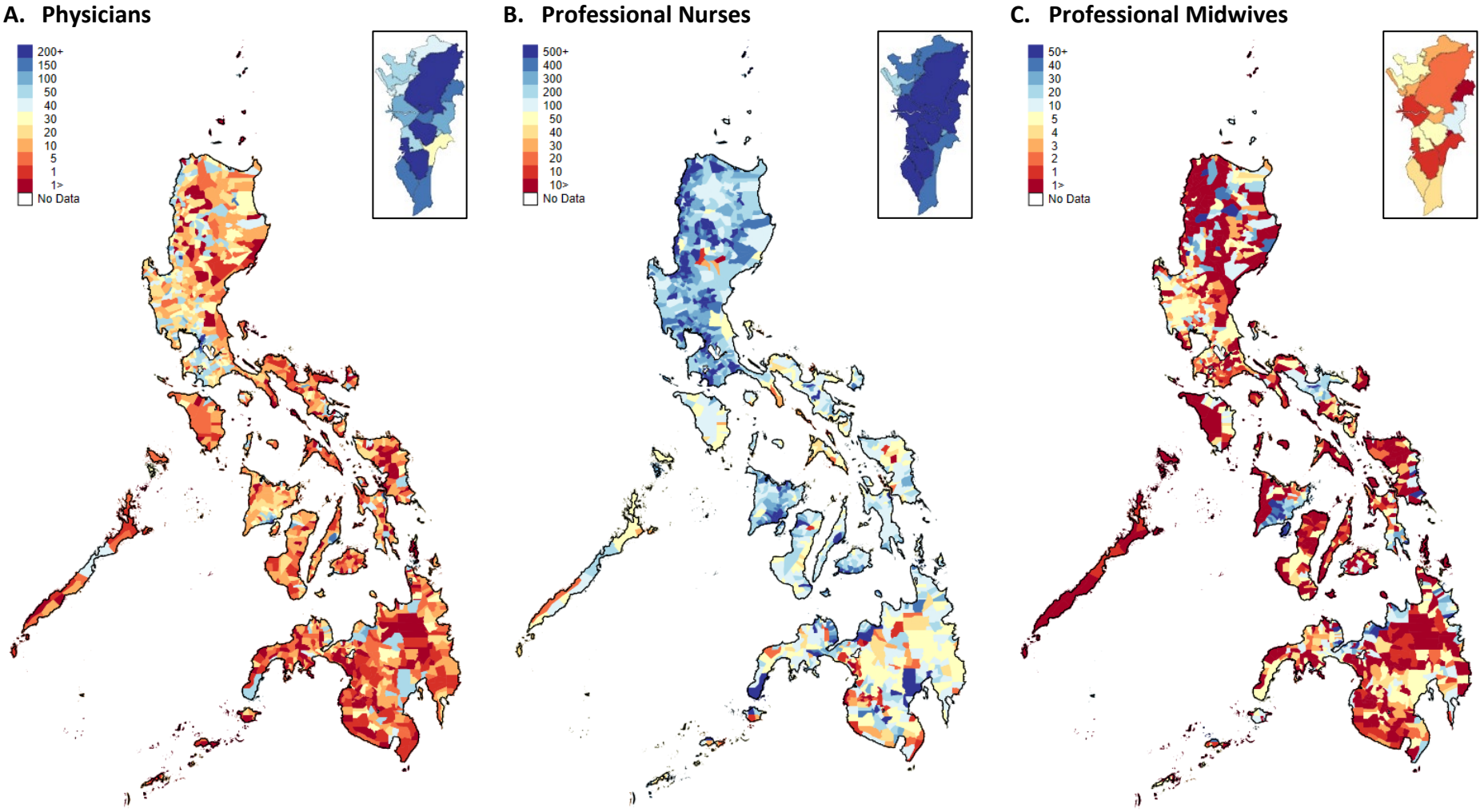
[5] Unfortunately, we cannot disaggregate the type of employer in the 2015 population census.

Figure 3. HHR per 100,000 population by city and municipality of residence, 2015



Note: Authors' estimates based on data from PSA (2016). The composite index includes physicians, professional nurses and professional midwives. Inset: National Capital Region.

Figure 4. HHR per 100,000 population by selected type and by city and municipality of residence, 2015



Note: Authors' estimates based on data from PSA (2016). Inset: National Capital Region.

In order to quantify and assess the contribution of different factors on the decision of HHRs on where to practice their profession, we estimate discrete-choice models where we take into account different locational and individual characteristics. As shown in earlier studies, health care workers are likely to practice their profession close to their area of training (Seifer, et. al., 1995; Watson, 1980; Raha, et. al., 2009), and in regions where their potential income may be highest (Lemiere, et. al., 2011; Hurley, 1991). Individual characteristics, e.g. rural upbringing (Buykx, et. al., 2010), has been found to likewise mediate HHR location choice.

Using a random utility framework (Luce, 1959; McFadden, 1973), we derived an empirical discrete-choice location model with parameters that we estimated from data. At the core of the model is the utility-maximization notion that individuals choose to locate where their net benefit may be highest. Separate models are estimated for different HHR cadres, and for different HHR characteristics. A more detailed description of the estimation methodology, including a summary of variables and data sources, is presented as an Appendix.

In the model specification, we control for municipal- or city-level poverty rates, night lights luminosity, and per capita local government income to capture area-wide levels of economic activity to proxy for potential demand for HHR. The availability of landline network in the area and its cityhood status are also included to capture access to amenities. We also control for the presence of hospitals and tertiary education institutions as proxies for health care training institutions. We include historical life expectancy at birth to minimize the influence of reverse causality between locational health outcomes and HHR location-choice decision. Ethnic concentration, measured as the sum of the squared shares of each ethnolinguistic group in an area's total population, is also added to capture the degree of cultural homogeneity in an area, and is used as proxy measure for indigenous cultural communities. Finally, we also control for province fixed-effects to capture the influence of unobserved confounders that are common among cities and municipalities located within the same province.

In our analysis, we focus on three cadres of health care workers, namely, physicians, professional nurses, and professional midwives. This allows us to compare the relative magnitudes of the degree of influence of different locational and individual characteristics on the location decision of different HHR cadres. Much of the previous research on location choice among health care workers focused exclusively on physicians (Dolea, et. al., 2010). Further, the three cadres are often the reference professions used in assessing the adequacy of health care worker supply (WHO, 2006, 2016; ILO, 2011, 2014).

5.1. By health care profession

Table 3 presents the discrete-choice model estimates for physicians (Panel A), professional nurses (Panel B), and professional midwives (Panel C). Locational characteristics are added sequentially (Columns 1 to 4) to provide indication of the relative stability of the parameter estimates with the inclusion of additional controls. We focus on the full model (Column 4) in the discussions. The parameter estimates are presented as odds ratios (OR).

The estimates show that the odds of physicians, nurses and midwives practicing their profession in cities and municipalities with hospitals and tertiary education facility landline are higher, although the magnitudes differ across cadres. Nurses, for example, are three times more likely to locate in a city or municipality with a hospital, while the odds are slightly lower for physicians (OR = 2.8, t = 8.56) and midwives (OR = 2.1, t = 10.60). This suggest differences in the relative importance of these facilities in the location decision of the different cadres.

Table 3. Discrete-choice location model

A. Physicians

	(1)	(2)	(3)	(4)
Life expectancy at birth	1.340***	0.943	1.008	0.964
	[8.703]	[-1.490]	[0.197]	[-0.650]
Per capita LGU income, log		2.216 ***	1.471***	1.226
		[10.652]	[3.049]	[0.720]
Night lights luminosity, log		2.364 ***	1.742***	1.400
		[5.149]	[3.452]	[1.426]
Poverty rate		0.998	0.991	0.909***
		[-0.211]	[-1.118]	[-3.519]
City (=1)			4.691***	2.643***
			[7.856]	[4.282]
Ethnic concentration			0.406	0.035**
			[-1.200]	[-2.261]
With hospital (=1)			2.478***	2.766***
			[6.534]	[8.556]
With landline (=1)			1.560**	1.659**
			[2.432]	[2.447]
With college (=1)			1.336*	1.459***
			[1.883]	[3.223]
Province fixed-effects	No	No	No	Yes
Observations	1,634	1,590	1,459	1,459
Pseudo-R2	0.009	0.255	0.314	0.562

Note: *** p < 0.01, ** p < 0.05, * p < 0.10. Estimates are odd ratios. Figures in brackets are t-statistics.

Table 3. Discrete-choice location model (continued)

B. Professional Nurses

	(1)	(2)		(3)	(4)
Life expectancy at birth	1.297***	0.925	***	0.984	1.002
	[8.905]	[-2.825]		[-0.537]	[0.058]
Per capita LGU income, log		2.022	***	1.281**	1.121
		[10.015]		[2.411]	[0.558]
Night lights luminosity, log		2.280	***	1.689***	1.855***
		[6.865]		[4.183]	[3.565]
Poverty rate		0.994		0.984**	0.936***
		[-0.988]		[-2.460]	[-3.732]
City (=1)				4.339***	2.869***
				[8.542]	[6.209]
Ethnic concentration				0.418*	0.108**
				[-1.680]	[-2.194]
With hospital (=1)				2.905***	2.997***
				[11.931]	[13.155]
With landline (=1)				1.428***	1.357**
				[2.586]	[2.025]
With college (=1)				1.646***	1.647***
				[4.721]	[5.415]
Province fixed-effects	No	No		No	Yes
Observations	1,634	1,590		1,459	1,459
Pseudo-R2	0.014	0.323		0.407	0.613

Note: *** p < 0.01, ** p < 0.05, * p < 0.10. Estimates are odd ratios. Figures in brackets are t-statistics.

Table 3. Discrete-choice location model (continued)

C. Professional Midwives

	(1)	(2)		(3)	(4)
Life expectancy at birth	1.130***	0.938	***	0.980	0.964**
	[7.167]	[-5.130]		[-1.420]	[-2.464]
Per capita LGU income, log		1.588	***	1.079	1.079
		[9.565]		[1.260]	[1.286]
Night lights luminosity, log		1.703	***	1.402***	1.499***
		[9.159]		[5.421]	[6.082]
Poverty rate		1.000		0.995	0.990
		[0.029]		[-1.470]	[-1.507]
City (=1)				2.931***	2.529***
				[8.135]	[9.818]
Ethnic concentration				0.524***	0.414***
				[-3.102]	[-3.958]
With hospital (=1)				2.034***	2.068***
				[11.212]	[10.595]
With landline (=1)				1.238**	1.228**
				[2.397]	[2.241]
With college (=1)				1.281***	1.231***
				[3.902]	[3.138]
Province fixed-effects	No	No		No	Yes
Observations	1,634	1,590		1,459	1,459
Pseudo-R2	0.027	0.374		0.489	0.699

Note: *** p < 0.01, ** p < 0.05, * p < 0.10. Estimates are odd ratios. Figures in brackets are t-statistics.

Physicians, nurses, and midwives are more likely to work in cities and municipalities with greater access to amenities. They are about 2.5 (midwives, t = 9.82) to 2.9 (nurses, t = 13.16) times more likely to work in cities. They are also 1.2 (midwives, t = 2.24) to 1.7 (physicians, t = 2.45) times more likely to work in areas with landline network.

Relatedly, they are less likely to work in areas with high levels of ethnic concentration. The aversion for higher ethnic concentration is highest among physicians (OR = 0.035, t = -2.26), followed by nurses (OR = 0.108, t = 2.94). Midwives are also less likely to work in cities and municipalities with higher ethnic concentration, but at much lesser degree compared to the other two cadres (OR = 0.414, t = -3.96).

The level of local economic development appears to also matter to the three cadres of health care workers. Nurses and midwives are more likely to work in areas with higher economic activity as captured by night light luminosity. Physicians, on the other hand, are about 10 percent less likely to work (OR = 0.909, t = -3.52) in a comparable city or municipality but has a one percentage point higher poverty incidence. A similar OR for poverty incidence may be observed among nurses (OR = 0.936, -3.73).

5.2. By characteristics of health care worker

Individual characteristics of health care workers may mediate their decision to practice their profession in certain areas. Laven and Wilkinson (2003), for example, found in their systematic review of evidences that physicians with rural backgrounds, e.g. have been raised in, have partner from, or had training in a rural setting, is associated with greater chance of practicing medicine in rural areas. Arguably, there may also be material differences in the location decision among health care workers of different sexes, marital status, and age groups since the opportunity costs faced by health care professionals may differ along these dimensions.

Table 4 reports discrete-choice location models for physicians (Panel A), professional nurses (Panel B), and midwives (Pane C) disaggregated by sex, marital status, ethnolinguistic minority status, and age group. We only report the full model in the interest of space.[6]

While there appears to be some important differences in the model estimates by sex, there is not enough evidence to suggest the male and female health care professionals have different preferences over locational characteristics among physicians ($\lambda^2 = 4.91$, p = 0.767), nurses ($\lambda^2 = 4.46$, p = 0.813), and midwives ($\lambda^2 = 9.18$, p = 0.327). Except for professional midwives, we also cannot reject the hypothesis that there are no generational differences, as captured by the broad age groups, in the magnitude of influence of different locational factors among physicians ($\lambda^2 = 12.74$, p = 0.623), and nurses ($\lambda^2 = 2.96$, p = 1.000).

Among midwives, those in their 60s are less likely to work in cities and municipalities with lower local government income per capita (OR = 0.707, t = -2.43) compared with other age groups. Those in their 60s are also more likely to work in areas with tertiary education facilities (OR = 1.644, t = 2.04).

[6] Estimates for the other models are available from the authors by request.

Table 4. Discrete-choice location model by demographic characteristics HHR

A. Physicians

	Sex		Marital Status		Ethnolinguistic group		Age group		
	Male	Female	Ever married	Never married	1M+	<1M	20s-30s	40s-50s	60s and older
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Life expectancy at birth	0.966	0.961	0.976	0.919	0.965	1.851***	0.929	0.974	1.005
	[-0.629]	[-0.687]	[-0.463]	[-1.185]	[-0.623]	[13.758]	[-1.105]	[-0.487]	[0.103]
Per capita LGU income, log	1.219	1.234	1.222	1.249	1.254	0.961	1.257	1.204	1.215
	[0.706]	[0.735]	[0.754]	[0.692]	[0.808]	[-0.099]	[0.727]	[0.682]	[0.852]
Night lights luminosity, log	1.485*	1.325	1.436*	1.252	1.411	1.215	1.325	1.406*	1.385
	[1.733]	[1.151]	[1.723]	[0.689]	[1.442]	[0.655]	[0.969]	[1.675]	[1.326]
Poverty rate	0.920***	0.898***	0.916***	0.881***	0.913***	0.853***	0.876***	0.919***	0.931***
	[-3.234]	[-3.660]	[-3.705]	[-2.949]	[-3.324]	[-3.933]	[-3.386]	[-3.573]	[-3.000]
City (=1)	2.443***	2.816***	2.699***	2.496***	2.697***	2.230*	2.444***	2.911***	2.198***
	[3.965]	[4.430]	[4.620]	[3.271]	[4.525]	[1.852]	[3.384]	[4.826]	[3.463]
Ethnic concentration	0.043**	0.030**	0.052**	0.011**	0.039**	0.013***	0.014**	0.054**	0.100**
	[-2.192]	[-2.299]	[-2.215]	[-2.397]	[-2.133]	[-3.282]	[-2.477]	[-2.062]	[-1.991]
With hospital (=1)	3.133***	2.519***	2.999***	2.126***	2.603***	6.881***	3.210***	2.427***	3.326***
	[7.653]	[6.836]	[8.704]	[3.878]	[7.735]	[4.977]	[6.413]	[5.953]	[5.160]
With landline (=1)	1.683**	1.663**	1.682**	1.517	1.871***	0.794	1.116	1.962***	1.960**
	[2.188]	[2.215]	[2.566]	[1.053]	[2.862]	[-0.570]	[0.341]	[3.000]	[2.021]
With college (=1)	1.539***	1.397***	1.412***	1.659**	1.387***	2.109**	1.537**	1.455***	1.358
	[3.009]	[2.606]	[2.866]	[2.509]	[2.651]	[2.287]	[2.391]	[2.755]	[1.438]
Province fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,459	1,459	1,459	1,459	1,459	1,459	1,459	1,459	1,459
Pseudo-R2	0.550	0.570	0.548	0.608	0.558	0.630	0.610	0.529	0.528

Note: *** p < 0.01, ** p < 0.05, * p < 0.10. Estimates are odd ratios. Figures in brackets are t-statistics.

Table 4. Discrete-choice location model by demographic characteristics HHR (continued)

B. Professional Nurses

	Sex		Marital Status		Ethnolinguistic group		Age group		
	Male	Female	Never married	Ever married	1M+	< 1M	20s-30s	40s-50s	60s and older
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Life expectancy at birth	0.995	1.005	0.998	1.006	1.005	0.869 ***	0.996	1.030	0.989
	[-0.111]	[0.111]	[-0.060]	[0.140]	[0.120]	[-3.957]	[-0.092]	[0.737]	[-0.256]
Per capita LGU income, log	1.113	1.124	1.064	1.163	1.137	0.971	1.138	1.041	1.297
	[0.511]	[0.573]	[0.307]	[0.731]	[0.607]	[-0.149]	[0.617]	[0.211]	[1.112]
Night lights luminosity, log	1.759***	1.889***	1.972***	1.765 ***	1.830***	2.080 ***	1.844***	1.884 ***	1.967 ***
	[2.985]	[3.765]	[4.406]	[3.003]	[3.295]	[4.181]	[3.368]	[4.317]	[2.804]
Poverty rate	0.924***	0.940***	0.946***	0.927 ***	0.936***	0.932 ***	0.932***	0.948 ***	0.963
	[-3.780]	[-3.665]	[-3.725]	[-3.685]	[-3.468]	[-4.190]	[-3.688]	[-3.823]	[-1.380]
City (=1)	2.958***	2.835***	2.943***	2.813 ***	2.900***	2.670 ***	2.879***	2.842 ***	2.561 ***
	[5.983]	[6.220]	[6.517]	[5.916]	[6.258]	[4.065]	[6.111]	[6.220]	[3.285]
Ethnic concentration	0.084**	0.118**	0.124**	0.097 **	0.113**	0.075 ***	0.103**	0.133 **	0.127 *
	[-2.243]	[-2.160]	[-2.119]	[-2.233]	[-1.994]	[-3.865]	[-2.195]	[-2.112]	[-1.783]
With hospital (=1)	3.148***	2.948***	2.911***	3.071 ***	3.019***	2.708 ***	2.937***	3.248 ***	2.720 ***
	[11.122]	[12.928]	[12.593]	[12.118]	[12.422]	[5.981]	[12.250]	[12.270]	[2.853]
With landline (=1)	1.464**	1.342**	1.303*	1.449 **	1.447**	1.204	1.339*	1.442 **	2.645 *
	[2.030]	[2.005]	[1.867]	[2.142]	[2.263]	[0.943]	[1.821]	[2.463]	[1.665]
With college (=1)	1.753***	1.614***	1.694***	1.612 ***	1.654***	1.560 ***	1.633***	1.705 ***	1.498
	[5.169]	[5.231]	[5.850]	[4.718]	[5.156]	[2.689]	[5.093]	[5.549]	[1.309]
Province fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,459	1,459	1,459	1,459	1,459	1,459	1,459	1,459	1,459
Pseudo-R2	0.62	0.61	0.599	0.623	0.602	0.802	0.612	0.606	0.698

Note: *** p < 0.01, ** p < 0.05, * p < 0.10. Estimates are odd ratios. Figures in brackets are t-statistics.

Table 4. Discrete-choice location model by demographic characteristics HHR (continued)

C. Professional Midwives

	Sex		Marital Status		Ethnolinguistic group		Age group		
	Male	Female	Never married	Ever married	1M+	< 1M	20s-30s	40s-50s	60s and older
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Life expectancy at birth	0.318***	0.971*	0.983	0.918***	0.988	0.797***	0.950**	0.983	2.105***
	[-32.930]	[-1.954]	[-1.177]	[-3.230]	[-0.747]	[-3.511]	[-2.189]	[-1.043]	[39.679]
Per capita LGU income, log	1.018	1.076	1.077	1.076	1.122**	0.707**	1.137	1.051	0.753*
	[0.089]	[1.241]	[1.288]	[0.637]	[1.966]	[-2.268]	[1.573]	[0.809]	[-1.695]
Night lights luminosity, log	1.309	1.498***	1.448***	1.721***	1.551***	1.070	1.685***	1.354***	1.488**
	[1.198]	[6.149]	[5.785]	[4.352]	[6.472]	[0.360]	[5.950]	[4.861]	[2.326]
Poverty rate	0.918***	0.991	0.991	0.984	0.994	0.965**	0.996	0.986**	0.978
	[-3.221]	[-1.441]	[-1.461]	[-1.283]	[-0.962]	[-2.078]	[-0.490]	[-2.312]	[-1.333]
City (=1)	3.087***	2.504***	2.455***	2.840***	2.344***	5.735***	2.705***	2.344***	2.947***
	[3.218]	[9.619]	[9.351]	[6.700]	[9.414]	[5.704]	[8.020]	[8.956]	[4.043]
Ethnic concentration	0.309	0.417***	0.425***	0.369***	0.418***	0.357**	0.323***	0.517***	0.345*
	[-1.204]	[-3.914]	[-3.817]	[-2.660]	[-3.708]	[-2.368]	[-3.923]	[-2.857]	[-1.778]
With hospital (=1)	1.888	2.071***	2.114***	1.807***	2.109***	1.834***	1.972***	2.207***	1.308
	[1.275]	[10.587]	[10.514]	[4.243]	[10.532]	[3.629]	[7.147]	[9.905]	[1.123]
With landline (=1)	0.530	1.227**	1.208**	1.241	1.289***	0.998	1.391***	1.100	1.120
	[-1.222]	[2.219]	[2.038]	[1.159]	[2.581]	[-0.013]	[2.590]	[0.942]	[0.354]
With college (=1)	1.158	1.234***	1.182**	1.591***	1.295***	0.875	1.203**	1.217**	1.903***
	[0.342]	[3.184]	[2.455]	[3.375]	[3.863]	[-0.747]	[2.058]	[2.534]	[2.764]
Province fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,459	1,459	1,459	1,459	1,459	1,459	1,459	1,459	1,459
Pseudo-R2	0.393	0.696	0.669	0.667	0.725	0.469	0.658	0.640	0.360

Note: *** p < 0.01, ** p < 0.05, * p < 0.10. Estimates are odd ratios. Figures in brackets are t-statistics.

In terms of marital status, while physicians generally are more likely to work in cities and municipalities with hospitals, single physicians are less likely than those ever married to do so (OR = 0. 632, t = -1.90). Single professional midwives, on the other hand, are more likely to work in areas with greater economic activity, as captured by more intense night lights luminosity, compared with ever married midwives (OR = 1.172, t = 1.82). There is not enough evidence to suggest that never- and ever-married nurses behave differently in their location decision ($\lambda^2 = 5.15$, p = 0.742).

Physicians from ethnolinguistic minorities are less likely than those from non-minority groups to work in cities and municipalities with higher poverty rates (OR = 0.965, t = -1.90), or with higher ethnic concentration (OR = 0.156, t = -1.87). Instead, they are more likely to work where there are hospitals (OR = 2.180, t = 1.90). However, they also less likely to work in areas with higher night lights luminosity (OR = 0.661, t = -2.08). Similar observations may be inferred for ethnolinguistic minority and non-minority nurses and midwives, particularly on the influence of poverty rates, night lights luminosity, and ethnic concentration.

6. Policy implications

This study reports on several important trends in the flow and stock of health human resource in the Philippines over the past twenty-five years. We showed that while the HHR density at the national level closely approximates – and even surpasses – some of the international thresholds measuring the adequacy of HHR supply, the increasing polarization in the spatial distribution of HHRs suggests that many localities may actually have limited access to health care professionals. While the number of health care workers are generally increasing, especially among professional nurses, we also document declining HHR density for some cadres of health care professionals, particularly of nutritionist-dieticians, optometrists and opticians, and physiotherapists, which results from the trends in workforce entry and exit in these occupations. Indeed, we provide indications that new out-migration of health care workers are increasing in proportion to new health care professionals. This emerging concern may prove to be critical in the longer term.

The discrete-choice analysis of the factors that influence the decision of health care workers on where to practice their profession confirms many of the observations in other settings. Health care workers in the Philippines are more likely to locate in areas with greater earning potentials, and in communities close to where they are trained. However, the results suggest that those from ethnolinguistic minorities are not more likely to choose to practice in more economically depressed areas, or in regions with higher ethnic concentration. This challenges the dominant notion that increasing the ethnic diversity of HHRs may improve access to health care in underserved areas that has been documented in other countries (e.g. Kington, et. al., 2001).

This study highlights some important policy considerations in designing programs to attract and retain health care workers in underserved areas. First, boosting household incomes through local economic development appears to be essential in ensuring the economic viability of any professional practice, particularly in health care. While the government plays an important role in the more equitable distribution of health care workers across the country, the critical contributions of the private sector cannot be discounted. Supporting private health care practice through the country's social health insurance system or a similar voucher scheme may provide greater incentives for health care workers to practice in underserved areas.

Second, there may be a need to reassess common- and deep-rooted beliefs on health care professional practice. For example, although altruistic motives among health care practitioners to serve in rural areas may be important in recruiting HHR for rural practice, it may not necessarily be the most sustainable. Both pecuniary and non-pecuniary incentives matter (Leonardia, et. al., 2012). Also, targeted interventions to increase the number health care workers among minorities may be important for social inclusion, but may not necessarily improve health care access among them.

Finally, with the apparent undersupply of health care workers, especially of physicians, in some cities and municipalities, it may be prudent to explore alternative modes of service delivery. Technology solutions may bridge some of the important gaps (Lewis, et. al., 2012), particularly on remote medical consultations and diagnosis, and in record management. There may also be a role for certification of some primary health care skills that may be done by other cadres of health care professionals, instead of relying on the limited supply of physicians. Nurse-practitioners in the US, Canada and the United Kingdom, for example, may assess patients' needs, interpret diagnostic and laboratory tests, prescribe medication, and formulate treatment plans, which may also be explored for the Philippine context.

References

Buykx, P., J. Humphreys J. Wakerman and D. Pashen (2010). Systematic review of effective retention incentives for health workers in rural and remote areas: Towards evidence-based policy. *Australian Journal of Rural Health*, 18(3), 102-109.

Cabigon, J.V. and W. Flieger (1999). 1995 gender-specific life tables for the Philippines, its regions and provinces. NSCB Monograph 7. Makati City, Philippines: National Statistical Coordination Board.

Castro-Palaganas, E., D.L. Spitzer, M.M.M. Kabamalan, M.C. Sanchez, R. Caricativo, V. Runnels, R. Labonte, G.T. Murphy, and I.L. Bourgeault (2017). An examination of the causes, consequences, and policy responses of the migration of highly trained health personnel from the Philippines: The high cost of living/leaving—a mixed method study. *Human Resources for Health*, 15, 25.

Cheng, M.H. (2009). The Philippines' health worker exodus. *Lancet*, 373(9658), 111-112.

Department of Finance, Bureau of Local Government Finance [Philippines] (2019). LGU fiscal data. Online database. Retrieved on 25 June 2019 from http://blgf.gov.ph/lgu-fiscal-data/

Department of Health [Philippines] (2008). *National objectives for health 2017-2022*. Manila, Philippines: Department of Health.

Dolea, C., L. Stromont, J.-M. Braichet (2010). Evaluated strategies to increase attraction and retention of health workers in remote and rural areas. *Bulletin of the World Health Organization*, 88, 379-385.

Goodman, S., A. Benyishay and D. Runfola (2017). Overview of the Geo Framework.

Guagliardo, M.F. (2004). Spatial accessibility of primary care: Concepts, methods and challenges. *International Journal of Health Geographics*, 3:3.

Guimaraes, P., O. Figueirido and D. Woodward (2004). Industrial location modelling: Extending the random utility framework. *Journal of Regional Science*, 44(1), 1-20.

Human Development Network [Philippines] (2005). *Philippine human development report 2005: Peace, human security and human development in the Philippines*, 2nd Ed. Quezon City, Philippines: Human Development Network.

Hurley, J.E. (1991). Physicians' choices of specialty, location, and mode: A reexamination within an interdependent decision framework. *Journal of Human Resources*, 26(1), 47-71.

International Labor Organization (2011). *World social security report 2010-2011: Providing coverage in times of crisis and beyond*. Geneva, Switzerland: International Labor Organization.

International Labor Organization (2014). *World social security report 2014-2015: Building economic recovery, inclusive development and social justic*. Geneva, Switzerland: International Labor Organization.

Kington, R., D. Tisnado and D.M. Carlisle (2001). Increasing racial and ethnic diversity among physicians: An intervention to address health disparities? In B.D. Smedley, A.Y. Stith, L. Colburn, et. al., *The right thing to do, the smart thing to do: Enhancing diversity in the health professions: Summary of the symposium on diversity in health professions in honor of Herbert W. Nickens, M.D*. Washington, D.C.: National Academies Press.

Laven, G. and D. Wilkinson (2003). Rural doctors and rural backgrounds: How strong is the evidence? A systematic review. *Australian Journal of Rural Health*, 11(6), 277-284.

Lemiere, C., C.H. Herbst, N. Jahanshahi, E. Smith and A. Soucat (2011). *Reducing geographical imbalances of health workers in Sub-Saharan Africa: A labor market perspective on what works, what does not, and why*. Africa Human Development Series. Washington, D.C.: World Bank.

Leonardia, J.A., H. Prytherc K. Ronquillo R.G. Nodora and A. Ruppel (2012). Assessment of factors influencing retention in the Philippine National Rural Physician Deployment Program. *BMC Human Resources for Health*, 12, 411.

Lewis, T., C. Synoweic, G. Lagomarsino and J. Schweitzer (2012). E-health in low- and middle-income countries: Findings from the Center for Health Market Innovations. *Bulletin of the World Health Organization*, 90, 332-340.

Lorenzo, F.M.E., J.F. Dela Rosa, G.R. Paraso, S. Villegas, C. Isaac, J. Yabes, F. Trinidad, G. Fernando, and J. Atienza (2005). *Migration of health workers: Country case study for the Philippines.* Geneva, Switzerland: Institute of Health Policy and Development Studies, International Labor Office.

Luce, R.D. (1959). *Individual choice behavior*. New York: Wiley.

McFadden, D. (1973). Conditional logit analysis of qualitative choice behavior. In P. Zarembka, Ed., *Frontiers in econometrics*. New York: Academic Press.

McPake, B., A. Scott, and I. Edoka (2014). *Analyzing markets for health workers: Insights from labor and health economics*. Washington, D.C.: World Bank.

National Statistical and Coordination Board (2001). *2001 Philippine Statistical Yearbook*. Makati City, Philippines: National Statistical and Coordination Board.

National Statistical and Coordination Board (2006). *2006 Philippine Statistical Yearbook*. Makati City, Philippines: National Statistical and Coordination Board.

National Statistical and Coordination Board (2011). *2011 Philippine Statistical Yearbook*. Makati City, Philippines: National Statistical and Coordination Board.

National Statistical Coordination Board (2013). The 2006 and 2009 municipal and city level poverty estimates. Makati City, Philippines: National Statistical Coordination Board.

National Statistics Office (1992). *Census of Population and Housing 1990*. Public-use file. Manila, Philippines: National Statistics Office.

National Statistics Office (2012). *Census of Population and Housing 2010*. Public-use file. Manila, Philippines: National Statistics Office.

Philippine Overseas Employment Administration (2016). OFW Statistics. Online database. Accessed on 15 June 2019 at http://www.poea.gov.ph/ofwstat/ofwstat.html

Philippine Statistics Authority (2016a). *2016 Philippine Statistical Yearbook*. Quezon City, Philippines: Philippine Statistics Authority.

Philippine Statistics Authority (2016b). *Census of Population 2015*. Public-use file. Quezon City, Philippines: Philippine Statistics Authority.

Raha, S., P. Berman and A. Bhatnagar (2009). *Career preference of medical and nursing sutdents in Uttar Pradesh*. Washington, D.C.: World Bank.

Rovillos, R.D. and D.N. Morales (2002). *Indigenous peoples/Ethnic minorities and poverty reduction: Philippines*. Manila, Philippines: Asian Development Bank.

Schmidheiny, K. and M. Brulhart (2011). On the equivalence of location choice models: Conditional logit, nested logit and Poisson. *Journal of Urban Economics*, 69(2), 214-222.

Seifer, S.D., K. Vranizan and K. Grumbach (1995). Graduate medical education and physician practice location: Implications for physician workforce policy. *Journal of the American Medical Association*, 274(9), 685-691.

Small, C. and C.D. Elvidge (2013). Night on earth: Mapping decadal changes of anthropogenic night light in Asia. International Journal of Applied Earth Observation and Geoinformation, 22, 40-52.

Small, C., F. Pozzi and C.D. Elvidge (2005). Spatial analysis of global urban extent from DMSP-OLS night lights. Remote Sensing of Environment, 96(3–4): 277-91.

Wang, Y.H. (1993). On the number of successes in independent trials. *Statistica Sinica*, 3, 295-312.

Watson, Collin J. (1980). The relationship between physician practice location and medical school area: An empirical model. *Social Science & Medicine*, 14D(1), 63-69.

Williamsburg, VA: AidData, College of William and Mary. Accesed on 15 October 2018 from http://geo.aiddata.org/. DOI:10.13140/RG.2.2.28363.59686

World Health Organization (2006). *World health report 2006: Working together for health*. Geneva, Switzerland: World Health Organization.

World Health Organization (2016). Health workforce requirements for universal health coverage and the sustainable development goals. Background paper No. 1 to the Global Strategy on Human Resources for Health. Geneva, Switzerland: World Health Organization.

Appendix A. Discrete-choice location model

An empirical model of location decision of health care workers may be derived using a standard random utility framework (c.f. Luce, 1959; McFadden, 1973). Consider a health care worker, indexed by $i = \{1, 2, \dots, N\}$, who is faced with the problem of choosing a location, indexed by $j = \{1, \dots, L\}$, of where to practice their profession. Suppose the indirect utility derived by that health care worker for choosing any location, say s, is given by

$$V_{is} = V(\boldsymbol{Z_s}; \boldsymbol{X_i}) = \boldsymbol{Z_s\beta} + \boldsymbol{X_i\gamma} + \xi_{is}.$$

The vectors $\boldsymbol{Z_s}$ are locational attributes, $\boldsymbol{X_i}$ are individual characteristics of the health care worker, and $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are conformable vectors that capture the relative weights of individual and locational characteristics in individual preferences. The random variable ξ captures unobserved idiosyncratic differences among individual-location pairs.

It is trivial to show that the probability of choosing any location s over any other location in j implies that

$$P\left[V_{is} \geq V_{ij}\right] = P\left[\xi_{is} - \xi_{ij} \geq \left(\boldsymbol{Z_j} - \boldsymbol{Z_s}\right)\boldsymbol{\beta} + (\boldsymbol{X_i} - \boldsymbol{X_i})\boldsymbol{\gamma}\right] \forall\, j \neq s$$

with the distribution of ξ_{ij} providing basis for the functional form that may be estimated from data. McFadden's (1973) conditional logistic formulation is based on a Type-I generalized extreme value (GEV) distribution for ξ_{ij}. Note that in the above formulation $(\boldsymbol{X_i} - \boldsymbol{X_i}) = \boldsymbol{0}$, and therefore drops out of the equation. The model therefore excludes cases where individual and locations interact, e.g. in the case of mixed logit models, such that $\boldsymbol{\gamma}$ vary with location or locational characteristics.

It can be shown that the total number of individuals, N_s, who eventually decide to practice their chosen profession in each location follows a Poisson-binomial distribution (c.f. Wang, 1993; Guimaraes, et. al., 2004; Schmidheiny and Brulhart, 2011) with likelihood function given by

$$\boldsymbol{\mathcal{L}} = \prod_{\boldsymbol{j}} P_s^{N_s} = \prod_{\boldsymbol{j}} P\left[\bar{\xi}_s - \bar{\xi}_J \geq \left(\boldsymbol{Z_j} - \boldsymbol{Z_s}\right)\boldsymbol{\beta}\right]^{N_s}$$

By similarly assuming as McFadden (1973) that ξ_{ij} follows a Type-I GEV distribution, we can empirically estimate the above equation using a generalized linear model with binomial distribution and a logistic link function. We estimate separate models by sex, age, marital status, ethnolinguistic minority status, and broad age group order to capture differential influences of locational decision across different classes of individuals.

In our estimation, we limit the sample to health care professionals who reported working in the Philippines at the time of the census. We therefore exclude health care professionals who reported either working abroad, or not working. As such, the models we estimated may be viewed as one arm of a multi-stage decision process. That is, we capture the location decision process of health care professionals who have already decided to work in the Philippines.

Appendix B. Variables and data sources

The discrete-choice location models that we employed in this study are based on municipal and city level data from various sources, which are merged to the base file using the Philippine Standard Geographic Codes. The base file includes the counts of health care workers by occupation, geographic area, sex, marital status, ethnolinguistic group, and age group, which are directly calculated from the 2010 Census of Population and Housing (NSO, 2012). Included in the 2010 is a form that takes stock of the facilities (e.g. hospitals, educational institutions, landline network, etc.) available at the barangay (village) level.

We add the following variables to the base file. Headcount poverty rates at the municipal and city level are from the 2009 small-area poverty estimates by the NSCB (2013). Per capita local government unit (LGU) income in 2010 are calculated from LGU financial data collated by the Department of Finance, Bureau of Local Government Finance (2019), and population count from NSO (2012). Province-level life expectancy at birth are from Cabigon and Flieger (1999) as cited in Human Development Network [Philippines] (2005). DMSP-OLS night-light luminosity composites (Small, et. al., 2005; Small and Elvidge, 2013) averaged for 2010 are downloaded at the municipal and city level from AidData of the William and Mary's Global Research Institute (Goodman, et. al., 2017).