"After-service effects of a financial incentive programme for return of service in underserved areas: implications for policies to retain a physician workforce in rural areas"

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Abstract

Existing evidence supports the effectiveness of financial incentive policy for medical students and early-career physicians in return for obligatory rural service. But whether the experience of contractual rural service affects the physician's choice of practice location after the service is completed is unknown. This study analysed practice location of Jichi Medical University (JMU) graduates. JMU is a Japanese medical education programme with a contract system under which all the graduates have the obligation to serve in underserved areas for about six years in exchange for having 6-year undergraduate tuition waived. 484 JMU graduates who were under rural service in 2000 and had completed the service by 2006 were enrolled. Rurality of communities was determined by population density quintiles. The proportion of those practicing in the communities of highest rurality quintile in 2000 (30.8%) decreased dramatically (8.7%) in 2006, but the geographic distribution of the participants after contract was still biased toward rural areas compared with the distribution pattern of all Japanese physicians. The flow of participants from rural to urban was almost unidirectional. 452 (93.4%) in 2006 practiced in places with the same or lower rurality, while only 32 (6.6%) practiced in places with higher rurality as compared to the placements of 2000.

Multivariate analysis showed that service experience in the communities of the first and second highest quintiles of rurality was associated with choosing such places even after contract (odds ratio 4.65; 95% confidence interval 2.37-9.13), independently of known predictors of rural practice, such as having rural background (2.85; 1.58-5.17) and primary care specialty choice (3.13; 1.43-6.87). Although the effect of contractual rural service substantially decreased after finishing the service, the experience of rural service early in the physician's career has a positive impact on the later choice of rural practice, supporting a policy that attracts early-career physicians to rural areas.

Introduction

Various policies have been implemented to redress the shortage of physicians in rural areas. Placing early-career physicians in rural areas based on financial incentives is one of the measures (Barnighausen & Bloom, 2009b). The financial incentive is mostly conducted through binding scholarships for medical students and loan forgiveness programmes for young physicians (Barnighausen & Bloom, 2009a). These programmes exist, for example, in the United States (Pathman, Taylor, Konrad, King, Harris, Henderson et al., 2000; Weaver, 1990), Japan (Matsumoto, Inoue, & Kajii, 2008b), Australia (Department of Health and Ageing), Canada (Anderson & Rosenberg, 1990), New Zealand (Dunbabin, McEwin, & Cameron, 2006), and South Africa (Ross, 2007). The financial incentive for return of service is one of the few policies with substantial scientific evidence to redress inequitable distribution of physicians (Barnighausen & Bloom, 2009b). The Japanese government has recently announced that the enrolment limit of the national scholarship programme with expected return of rural service has increased from 100 at a single medical school to 350 at schools in all of the 47 prefectures (Ministry of Health, Labour and Welfare, 2007). In the US, the number of state scholarship and loan forgiveness programmes doubled from 39 in 1990 to 82 in 1996 (Pathman et al., 2000).

It is apparent that financial incentive in exchange for rural service solves, to some degree, the immediate shortage of physicians in rural areas (Barnighausen & Bloom, 2009b). However, the long-term effect of such financial incentive programmes is controversial. Some financial incentive programmes were reported to retain their physicians in rural and underserved areas not only during but also after their contractual periods of rural service (Matsumoto et al., 2008b; Rosenblatt, Saunders, Shreffler, Pirani, Larson, & Hart, 1996). However, to date there is no study that addresses whether the long-term effect reported in previous studies is caused by the

programme itself, or by selection bias of the programme participants, such as the high proportions of those with rural backgrounds, those with primary care, and those who had intention to choose rural practice before admission. All of these factors are known causes of the choice of rural practice (Barnighausen & Bloom, 2009b).

The study herein follows up geographic distribution of graduates of Jichi Medical University (JMU) in Japan, which is a full scholarship medical education programme with 6- to 7-year obligatory service in underserved areas (Inoue, Hirayama, & Igarashi, 1997; Matsumoto et al., 2008b; Matsumoto, Inoue, & Kajii, 2008c). The underserved municipalities to which JMU graduates are dispatched have a wide variation in rurality. This study utilises this variation, and evaluates how the service experience in areas with high rurality affects the after-service choice of practice location, adjusting for effects of the known causal factors of choosing rural practice.

Methods

Jichi Medical University

Deails of Jichi Medical University (JMU) have been reported previously (Inoue et al., 1997; Inoue, Matsumoto, & Sawada, 2007; Matsumoto, Inoue, & Kajii, 2008a; Matsumoto et al., 2008b, c; Matsumoto & Kajii, 2009). Briefly JMU is a publicly funded medical school whose sole mission is to produce rural doctors and distribute them nationwide. JMU annually recruits two or three high-school graduates from each of the all 47 prefectures of Japan. All of the students are confirmed in admission interviews to be willing to work in rural areas. The students are fully funded by the home prefectures for the entire six years of undergraduate education at JMU and are committed to working for medical institutions in the home prefectures for nine years after JMU graduation.

Obligatory rural service

The nine-year obligation after graduation usually consists of three years of postgraduate training and six years of rural dispatch. During the rural dispatch, JMU graduates work for public clinics or hospitals in rural or underserved areas in their home prefectures. The rural and underserved areas to which JMU graduates are sent are determined by each prefecture according to the demand-supply balance of physicians. Upon completion of the nine-year obligation, JMU graduates can choose their workplaces freely. Graduates who breach the obligation must pay 22,600,000 yen (equivalent to 150,667 GBP) plus interest charges of 10% a year after graduation.

Rural and underserved areas

Although all of the entrants to JMU were ascertained in admission interviews to have a desire to serve rural and underserved people, a small proportion of JMU graduates under rural duty serve in non-rural areas. In 2004, for example, the proportion of JMU graduates under contractual rural service who practice in communities with more than 50,000 in population was 14.9% (Matsumoto et al., 2008b). This is because “rural” and “underserved” are defined differently in each prefecture. In some prefectures, JMU graduates are dispatched to hospitals in middle-sized cities because the prefectures recognise that physician shortage is more serious in such city hospitals than in clinics of smaller towns. This study utilises this variation in rurality of places to which JMU graduates are dispatched. The diversity in rurality enables us to examine whether early-career service experience in genuinely rural areas influence the physician’s choice of practice location after the service, and if such influence exists, whether the influence is independent of known causal factors for choice of rural practice such as rural background and primary care specialty of the physician.

Subjects and Data Collection

Details of the study design were reported previously (Matsumoto et al., 2008a, b; Matsumoto & Kajii, 2009). This retrospective cohort study uses baseline data of personal information for 2,988 JMU students who graduated between 1978 and 2006. Follow-up data consist of workplace addresses in 2000 and 2006. JMU officials conducted the follow-ups using mail surveys and telephone surveys when necessary. Follow-up rates of workplace addresses were 98.7% in 2000, and 98.0% in 2006. 97% of JMU graduates have completed or are completing their obligation (Matsumoto & Kajii, 2009).

Among the 2,988 graduates, we excluded 106 who dissolved the contract by 2006. From the remaining 2,882 graduates, we extracted 964 who were still under the 9-year contract in 2000. Among them, we excluded 334 who were in clinical training or were studying for a PhD in 2000. We also excluded 145 who were still under the contract in 2006. In the end, the final subjects for analysis were 484 graduates who were under contractual service in 2000 and had completed the contract by 2006.

Japan’s 47 prefectures were made up of 3,132 municipalities in 2004. Municipalities (cities, towns and villages) are the basic geographic units of administration. To assess rurality, the 3,132 municipalities were ordered according to population density, and divided into five groups from “quintile1” (group with the lowest population densities)

to “quintile 5” (that with the highest density), so that each quintile had 20% of the all municipalities. The cut-off values for quintiles were 48.5, 125.2, 297.8, and 840.5 persons per square kilometres (Supplementary Table). INSERT LINK TO SUPPLEMENTARY TABLE HERE The background address (the parents’ home address at the time of admission) and follow-up addresses of each subject were ranked between 1 and 5 based on the rank of the quintile group of municipalities the address belongs to (Statistic Bureau, 2005). Due to mergers, the borders of municipalities were substantially changed between 1978 and 2006. We thus converted all the addresses to the addresses based on the 2004 municipality borders. Population and area data were excerpted from the 2004 National Population Census, and the data on the number of all Japanese physicians in each municipality were obtained from the National Physician Census 2004, in which all medical doctors practicing in Japan are obliged to register their work addresses.

Of all of the self-declared specialties registered in the follow-up data, internal medicine, general surgery, pediatrics, community medicine, and general medicine were considered as primary care specialties.

Statistical Analysis

Statistical analyses were carried out using SPSS® for Windows, version 11.5 (SPSS Inc., Japan). The associations between practicing in rural areas after contractual rural service in 2006, and various baseline/follow-up variables were examined using logistic regression analysis. Prefectures were dichotomised into rural (23 prefectures) and urban (24 prefectures) according to the proportion of population in quintile 1 and 2, and this variable was also examined as a covariable in the logistic regression since rurality of prefecture can influence the rurality of municipality to which JMU graduates are sent. Goodness-of-fit was confirmed through the Hosmer-Lemeshow method. All analyses were two-tailed, and $P<0.05$ was considered statistically significant.

The study design and procedure were approved by the Ethical Committee of Epidemiologic Research at Jichi Medical University.

Results

Comparisons of basic characteristics, geographic background, and practice location between JMU graduates and all physicians in Japan are shown in Table 1. Most of the participants are more likely to be young, early-career, male, and primary care

physicians as compared with all Japanese physicians. Most of the participants have urban origin. The proportion of those practicing in the most rural places under contract (30.8%) decreased remarkably after contract (8.7%). However, the geographic distribution of the participants after contract was still biased toward rural areas compared with the distribution pattern of all Japanese physicians.

INSERT TABLE 1 HERE

Comparisons of rurality between practice locations under contractual service (2000) and those after the contract (2006) are shown in Table 2. The flow of participants from rural to urban was almost unidirectional. Although 452 (93.4%) participants stayed in places with the same rurality or moved to more urban places, only 32 (6.6%) moved to more rural places than the places assigned when under contract. The dispatched places under contract generally represented the greatest level of rurality the participants experienced during the observed period.

INSERT TABLE 2 HERE

Table 3 shows the results of multivariate analysis evaluating the association between experience of rural service under contract, and voluntary rural practice after contract. In addition to the known predictive factors of rural practice such as rural background and primary care specialties of the physician, rural service experience was independently and positively associated with rural practice after contract. The association of rural service experience (odds ratio 4.65; 95% confidence interval 2.37-9.13) was even stronger than that of rural background (2.85; 1.58-5.17) and primary care (3.13; 1.43-6.87).

INSERT TABLE 3 HERE

Discussion

The experience of rural service in early career positively affected the physician's post-contract choice of rural practice, independently of known predictors of rural practice such as rural background and primary care specialties. The influence of early-career rural service is robust even against the confounding effect of pre-admission intention to work in rural areas, as all of the JMU graduates were confirmed to have such intention at the time of admission. The influence of early-career rural service had an even stronger effect than possessing a rural background or primary care specialties. The placement effect of contractual rural service substantially decreased after the physicians completed the contract. The places to which physicians were dispatched under contract were, in most cases, the places of maximum rurality the physicians potentially experienced after finishing the contract.

Thus, physicians who did not experience rural practice early in their careers are quite unlikely to practice in rural areas later in careers.

The strengths of this study are high follow-up rate (99% in 2000 and 98% in 2006) and low contract breach rate (3%). These allow the study participants to be an unbiased cohort among all of the JMU graduates. As all of the participants are from the same education programme, immeasurable variables of participants, such as original intention to work in rural areas and influence of undergraduate education, are not different among subgroups of the cohort. This homogeneity of the cohort enabled us to test the real independence of association between service location and post-service location.

A limitation of this study is the uniqueness of JMU. Because of the uniqueness, attention is required when the results are compared or applied to other programmes. For example, JMU is a 6-year boarding school with its undergraduate curriculum focusing on rural medicine and rural clinical clerkship. The contract compliance and practice choice after contract of JMU graduates thus should be different from those of physicians who go to rural places due merely to financial incentives. A definition of what constitutes “rural” is also a limitation. The median population density of rural municipalities in this study was 48.5 persons per square kilometre (interquartile range 23.8-83.7), while the value of US rural counties defined by the same criteria (the communities with lowest two quintiles of population densities) was 4.7 persons per square kilometre (1.7-8.1). Therefore, attention should be paid to these characteristics of the study context when the results of this study are evaluated and applied elsewhere.

It has been reported that post-obligation JMU graduates had a four-times higher rate of practicing in rural areas compared to non-JMU physicians (Matsumoto et al., 2008b). The results of this current study add new evidence that even among JMU graduates, those who experience highly rural areas are more likely to choose such areas than the JMU peers without rural experience. Rural experience early in the career as a predictor of future rural practice was suggested by previous studies. Primary care physicians who were trained in rural residency programmes reportedly practice in rural areas with a higher probability than those who were trained in non-rural areas (Bowman & Penrod, 1998; Pathman, Steiner, Jones, & Konrad, 1999). Reports of practice location choices of National Health Service Corps (NHSC), the largest of the US federal scholarship programmes with obligatory rural service, suggest the effectiveness of early-career rural experience with financial incentives (Rosenblatt, et al., 1996).

In spite of the above evidence favouring early-career rural experience with financial incentives, the long-term effects of such programmes per se is still controversial. This

is because participants of such programmes are in general more likely to have positive predictors of rural practice such as rural background, primary care and original intention to practice in rural areas than non-participant physicians. It has not been clear whether the effects of financial incentive programmes on long-term retention are due entirely to the selection bias, or partially due to early-career rural experience imposed by the programmes (Barnighausen & Bloom, 2009b). The results of this study made it clear that the effect of rural service in the early stages of a career is not only an independent but also a stronger predictor of post-obligation rural practice of a physician.

It is possible that early-career rural experience removes a part of psychological barrier of physicians to rural practice caused mainly by their ignorance and a lack of rural experience. The geographic background of medical students is highly biased to urban areas. The locations of medical schools are also biased to large cities. Most physicians thus have few life experiences connected to rural locations when they are licensed. Early-career rural experience, whether it be due to obligation or not, potentially teaches young physicians the joy and fulfilment of rural practice. Moreover, the physicians and their families build their lives in the rural areas, which would potentially encourage their settlement in these areas. These factors may facilitate the young physicians to think of rural practice as a viable choice for their future career.

The results of this study support a policy that attracts early-career physicians to rural areas with financial incentives. The impact is not only the rural workforce years of obligated service but also the workforce years provided by graduates that stayed as the result of the intervention. Such a policy not only can redress the immediate shortage of physicians in rural areas, but also may lead to a long-term improvement of geographic maldistribution of physicians overall. Examples of such a policy are JMU in Japan, NHSC and state scholarship/loan-forgiveness programmes in the US (Pathman et al., 1992; Pathman et al., 2000; Rosenblatt et al., 1996; Weaver, 1990), Ontario's Underserviced Area Program in Canada (Anderson & Rosenberg, 1990), and Medical Rural Bonded Scholarships in Australia (Department of Health and Ageing). The content of financial incentive, educational component included in the programme, and length of rural service, however, are substantially different in each programme (Barnighausen & Bloom, 2009b). The results of this study thus do not guarantee that rural experience in any of these financial incentive programmes can influence a physician's choice of rural practice as favourably as JMU.

In addition, the results of this study might support the effectiveness of the mandatory national health service, in which all of the early-career physicians are obliged to work

in rural areas for a certain period, in exchange for their physician licenses. This type of mandatory service is conducted in, for example, Ecuador (Cavender & Alban, 1998), Thailand (Rohde, Cousens, Chopra, Tangcharoensathien, Black, Bhutta et al., 2008), and Dominican Republic (Ugalde, 1984). Although the positive association between early-career rural experience and future rural practice potentially justifies such a policy, all of the subjects of this study have voluntarily chosen to participate in the financial incentive programme of JMU, and in this sense, it is not necessarily valid to apply the finding to the mandatory programmes, where young physicians have no choice but to practice in rural areas.

The results also suggest a risk of a physician employment system and postgraduate clinical training system in which early-career physicians heavily concentrate in urban places. Physicians without early-career rural experience are probably highly unlikely to choose rural practice in their later careers. This keeps the existing maldistribution of physicians unchanged, or can even make it worse. In Japan, physicians under postgraduate training have recently been increasingly concentrating in urban areas (Toyabe, 2009). Political interventions to this trend would be needed in order not to exacerbate the maldistribution of physicians.

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Table 1. Characteristics of the study-enrolled Jichi Medical University (JMU) graduates (N=484) and all physicians in Japan (N=270,371)

	JMUs	All physicians
Male, %	89.7	83.5
Age in 2006, mean	38.3	47.8
Primary care,* %	74.4	50.0
Quintile population density of background municipality, %		
1: most rural	5.0	
2	11.4	
3	14.5	
4	26.4	
5: most urban	42.8	
Quintile population density of municipality under service** in 2000, %		
1	30.8	
2	28.1	
3	18.0	
4	13.6	
5	9.5	
Quintile population density of municipality after service*** in 2006, %		
1	8.7	1.1
2	10.1	2.9
3	10.7	7.0
4	26.4	18.0
5	44.0	71.1

*Primary care includes internal medicine, general surgery, pediatrics, community medicine, and general medicine.

**Under the contractual service in underserved areas

***After the contractual service in cases of JMUs (the other physicians have no contract)

Table 2. Comparison of geographic distribution of JMU graduates before and after completing contractual rural service

			Rurality of workplace after service (2006)*					
			Most rural				Most urban	
			1	2	3	4	5	Total
Rurality of workplace under service (2000)*	Most rural 1	n	27	11	12	44	55	149
		%	18.1	7.4	8.1	29.5	36.9	100
	2	n	10	31	11	28	56	136
		%	7.4	22.8	8.1	20.6	41.2	100
	3	n	4	6	26	21	30	87
		%	4.6	6.9	29.9	24.1	34.5	100
	4	n	1	1	3	28	33	66
		%	1.5	1.5	4.5	42.4	50.0	100
	Most urban 5	n	0	0	0	7	39	46
		%	0	0	0	15.2	84.8	100

Table 3. Associations of participant characteristics with choice of rural practice after completing contract*

	Odds ratio	95% confidence interval	P
Age (1 year increase)	1.12	1.01 - 1.25	0.027
Male	1.76	0.67 - 4.60	0.251
Rural background*	2.85	1.58 - 5.17	0.001
Rural prefecture**	2.26	1.29 3.96	0.004
Primary care	3.13	1.43 - 6.87	0.004
Rural experience under service*	4.65	2.37 - 9.13	<0.001

Logistic regression model with all the presented factors being explanatory covariable

*"Rural" was defined as municipalities in quintile 1 and 2.

**"Rural" was defined as prefectures with the proportion of population in quintile 1 and 2 are in the lower half among all the 47 prefectures.

Supplementary Table. Municipality quintiles sorted according to population density

Quintile of municipalities	Population density range persons/km2	Physicians/100,000 population median	(IQR*)
1: most rural	- 48.5	65.5	(43.1 - 100.5)
2	48.5 - 125.2	73.8	(43.7 - 131.6)
3	125.2 - 297.8	92.6	(50.3 - 155.5)
4	297.8 - 840.5	109.1	(62.4 - 187.9)
5: most urban	840.5 -	147.8	(97.5 - 213.7)

*Interquartile range