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Research on the Gap between the Number Matched and the Number of First-year Residents in Japanese Training Hospitals - Are Full-matched Hospitals Really "Good Training Hospitals"?

Koji Tsunekawa [*] [†], Michiyo Nakashima [‡],
Toshiki Shioiri [*] [‡]

Abstract

Introduction: The success of residents is one of the most important factors in the vitality of a hospital. In order to clarify the actual situation of the matching system introduced as a recruiting tool for medical students in Japan, we examined the gap between the number matched and the actual number of first-year residents in the following year and analyzed the cause of this gap. Methods: National and public university (medical school) hospitals were included. All variables were obtained from public data. The change rate was calculated from the number matched, number of first-year residents. And then, summary data, correlation coefficients with other variables were analyzed, and finally multiple regression analysis was performed with the change rate as the independent variable. Results: All the target hospitals found a gap between the number matched and the actual number of first-year residents for the following year. The change rate was significantly correlated with the year of establishment of the medical school ($p<0.05$, $r=0.348$). Multiple regression analysis using a stepwise method also showed year of establishment of the medical school as a significant factor. Discussion and Conclusion: We revealed that the training hospital advertised as “full match” is not at capacity of the actual number of first-year residents. Hospital brand strength may influence the improvement of the gap. However, there is little data on KPIs in postgraduate education, and further data on initial training is required to be made publicly available.

Keywords: matching system, post-graduate medical education, multiple regression analysis.

1 Introduction

Residents are said to be a valuable workforce and source of growth for achieving hospital outcomes [1]. The system for recruiting first-year residents in Japan is called "matching"[2]. Matching is a system devised by Gehl and Shapley [3], and the Ministry of Health, Labour and Welfare (MHLW) uses this system to ensure proper job placement for medical students [4]. On the other hand, hospital executives often advertise the size of the percentage of successful matches (matching rate) in order to publicize the power of the hospital's brand, without

[*] Gifu University Graduate School of Medicine, Division of Medical Education, Gifu, Japan
[†] Department of Institutional Research for Medical Education, Gifu University School of Medicine, Gifu, Japan
[‡] Department of Psychiatry and Psychotherapy, Gifu University Graduate School of Medicine, Gifu, Japan

considering issues such as the regional maldistribution of physicians [5]. In particular, they promote and tout a 100% matching rate as a "full-matched" [6]. However, the number of first-year residents who actually enter the training hospitals in the following year will differ from the number matched. For example, since the matching takes place in October of the previous year, medical students still have the possibility of not graduating, and even if they do graduate, they may fail the national medical examination. In these cases, the actual number of first-year residents hired will be less than the number matched. If the actual number of first-year residents is reduced, the workload of residents, including duty shifts, will increase, affecting their health, work-life balance, and patient safety [7, 8]. On the other hand, medical students who were unmatched in the matching system apply for a second round of recruitment to training hospitals that did not have a full match. If some medical students are then hired in the second round of applications, the actual number of first-year residents hired will be higher than the number matched. The impact may be better than a full-matched. Considering Figure 1, the actual number of first-year residents actually hired in the next year at almost of the training hospitals is likely to be different from the number matched, but the true state is still unclear. Therefore, in order to search for post-matching dynamics, we examined the gap between the number matched and the actual number of first-year residents in the following year, and we analyzed the factors responsible for this gap using multivariate analysis.

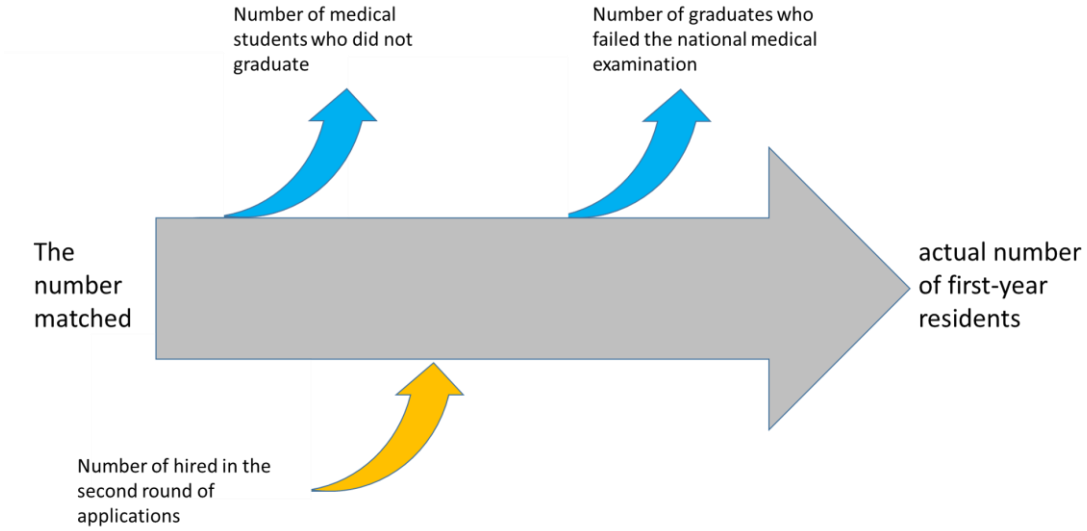

Figure 1: The scheme of post-matching dynamics

2 Material and Methods

National and public university (medical school) hospitals from 2015 to 2021 were included in the study (excluding satellite hospitals). First, Data from the MHLW were used for the number matched, capacity and its quotient, the matching rate, and the pass rate in the national medical examination [9]. Although neither the MHLW nor general training hospitals publish the number of first-year residents, we used data from each university hospital published based on "Item 33: Number of initial first-year residents hired (medical)" in the hospital functional index proposed by the National University Hospitals Councils (NUHC) of Japan [10]. Then, the number of gaps between the number of first-year residents and the number matched was calculated, and the quotient of the number of first-year residents and the number of gaps was the change rate. Other

variables (pass rate in national exam, year of establishment of the medical school, population of the city where has the medical school, ranking of medical school, and female enrolment ratio) referred to data from previous studies [11]. Next, summary data (mean, standard deviation, and quartiles) were calculated for each variable, and a matrix was created using Pearson's correlation coefficients between variables. The correlation coefficients were as follows: no correlation for $|r|<0.2$, weak correlation for $0.2 \leqq |r|<0.4$, moderate correlation for $0.4 \leqq |r|<0.7$, and strong correlation for $0.7 \leqq |r|<1.0$. Finally, a multivariate analysis was performed using multiple regression analysis. A multiple regression analysis was conducted on the one dependent variables, change rate. Explanatory variables included matching rate; pass rate in national medical exam; female enrolment ratio; the year of establishment of the medical school; the population of the city where the medical school is located; and the ranking of the medical school. Variance inflation factor (VIF) was calculated to examine multicollinearity. And, in order to guarantee the generality, forced entry method and forward-backward stepwise selection method with Akaike's Information Criterion (AIC) were used in performing multivariate analysis. Then, Adjusted R-squared was calculated to examine the fit of the models.

R ver. 4.2.3 for Windows was used to perform statistical test. Two-tailed p-values of <0.05 were considered significant. Ethical approval was granted by the GUGSM Ethics Committee (date: 04/11/2022, reference number: 2022-016). The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

3 Results

Forty-one of the 50 target universities had complete data available. All training hospitals with missing data were attributed to the number of first-year residents. The change rate was -9.61 ± 9.87% (Table 1), and all the university hospitals found a gap between the number matched and the actual number of first-year residents for the following year, with 29 hospitals having fewer first-year residents than the number matched, and 5 hospitals having more first-year residents than the number matched.

Table 1: Summary data of each variable

			Quartiles				
	Average	Standard deviation	0%	25%	50%	75%	100%
Change rate	-9.6	9.9	-32.3	-17.5	-8.5	-3.2	9.9
Matching rate	57.3	26.7	4.4	33.3	51.7	78.6	100
Pass rate in national medical exam	91.4	2.4	86.9	90.2	90.9	93.0	96.1
Female enrolment ratio	30.0	8.9	12.8	23	30.8	36.3	46.3
Year of establishment of the medical school	72.1	25.4	40	45	73	95	141
Population of the city where the medical school is located	113.0	195.9	15	28	42	109	921
Ranking of the medical school	66.5	2.1	62.5	65	65	67.5	72.5

Matrix using Pearson's correlation coefficients between variables are shown in Table 2. The change rate was was significantly correlated with the year of establishment of the medical school (r=0.348).

Table 2: Matrix using Pearson's correlation coefficients between variables.

	Change rate	Matching rate	Pass rate in national medical exam	Female enrolment ratio	Year of establishment of the medical school	Population of the city where the medical school is located	Ranking of the medical school
Change rate	—	0.157	0.263	-0.267	0.348＊	0.248	0.234
Matching rate		—	0.147	-0.357＊	0.232	0.499＊	0.48＊
Pass rate in national medical exam			—	-0.103	-0.079	0.08	0.047
Female enrolment ratio				—	-0.688＊	-0.28	-0.46＊
Year of establishment of the medical school					—	0.468＊	0.652＊
Population of the city where the medical school is located						—	0.614＊

Weak (0.2-0.4)
Mediate (0.4-0.7)
＊: p<0.05

Searching for factors using multiple regression analysis, no variables were found to be significant in the forced entry method (Table 3A). In forward-backward stepwise selection method with AIC, the year of establishment of the medical school and the pass rate in the national medical examination were listed as explanatory variables, and the year of establishment of the medical school was positively significant (Table 3B, p=0.015). The VIF was checked and was less than 5 for all variables.

Table 3: Multiple regression analysis with dependent variables as change rate for medical university hospitals. A: Model using the forced entry method, adjusted R-squared =0.07546. , B: Model using the forward-backward stepwise selection method with AIC, adjusted R-squared = 0.1639.

A

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-100.85	91.904	-1.097	0.2802
Matching rate	0.0144	0.0724	0.199	0.8435
Pass rate in national medical exam	1.20109	0.65185	1.843	0.0741
Female enrolment ratio	0.04454	0.25503	0.175	0.8624
Year of establishment of the medical school	0.16253	0.10538	1.542	0.1322
Population of the city where the medical school is located	0.00429	0.01053	0.407	0.6863
Ranking of the medical school	-0.49508	1.12508	-0.44	0.6627

B

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-129.787	55.031	-2.358	0.024
Pass rate in national medical exam	1.201	0.597	2.013	0.051
Year of establishment of the medical school	0.144	0.056	2.558	0.015

4 Discussion

This study revealed the current state of actual resident recruitment by examining the gap between the number matched and the number of first-year residents. In addition, more hospitals (n=29) are decreasing than are increasing (n=5), indicating that the actual number of first-year residents is not at capacity, even though advertised as "full match". However, the published training hospitals were limited to national university hospitals. Moreover, three universities had missing data on the number of first-year residents, despite the NUHC's initiative to advocate for the publication of this information. More rigorous data disclosure is needed. The number of first-year residents employed does not necessarily indicate a good training hospital, and it is desirable to disclose key performance indicators (KPIs) that prove that the training hospital has high outcomes for residents who complete training, or that it has established a system to follow up on residents who have problems [8, 12].

Multiple regression analysis predicts one objective variable from a number of quantitative explanatory variables [13]. The explanatory variables were used from previous studies [11] and theories, as the authors determined that the choice preferences of universities would be similar to those of university hospitals. In multiple regression analysis, since the explanatory variables are determined from previous studies, the forced entry method is generally used. However, in this analysis, since the present analysis is a new study to explore the outcomes of postgraduate education, the stepwise method, which is used when it is difficult to determine the explanatory variables, was used together. In this study, we have identified factors associated with the rate of increase or decrease in the number of residents employed using multiple regression analysis. The year of establishment of the medical school was a significant factor in the change rate, suggesting that the brand equity of the university is a factor in the increase or decrease of first-year residents. The pass rate in the national medical examination was also thought to be due to the fact that many graduates of their own university joined their university hospital as first-year residents. On the other hand, the match rate does not have a significant impact on the change rate, indicating that even training hospitals with high match rate often do not contribute to the actual retention of first-year residents. In addition, it is generally believed that the greater the number of girls, the smaller the percentage enrolled in university hospitals [14], but this analysis did not find any significant difference. This finding is presumably due to the fact that the average age of initial trainee entrants is about 25 years old, which means that life events such as marriage and childbirth, which are factors that contribute to low retention rates, are not yet likely to occur [15].

5 Limitations

As evidenced by the low contribution rate (Adjusted R-squared = 0.1639), it is difficult to measure whether a hospital is a good training hospital because there are very few published KPIs for post-graduate education [16]. In addition, because of the small amount of data in this analysis, it is hoped that similar data will be published not only for university hospitals but also for general training hospitals. In the future, we would like to accumulate more data and conduct research so that we can conduct more detailed analysis. And we hope to construct a system that will enable us to evaluate training programs not only by understanding the gap between the number matched and number of first-year residents as shown in Figure 1, but also, by understanding the dynamics of residents throughout the two years of initial training as shown in Figure 2.

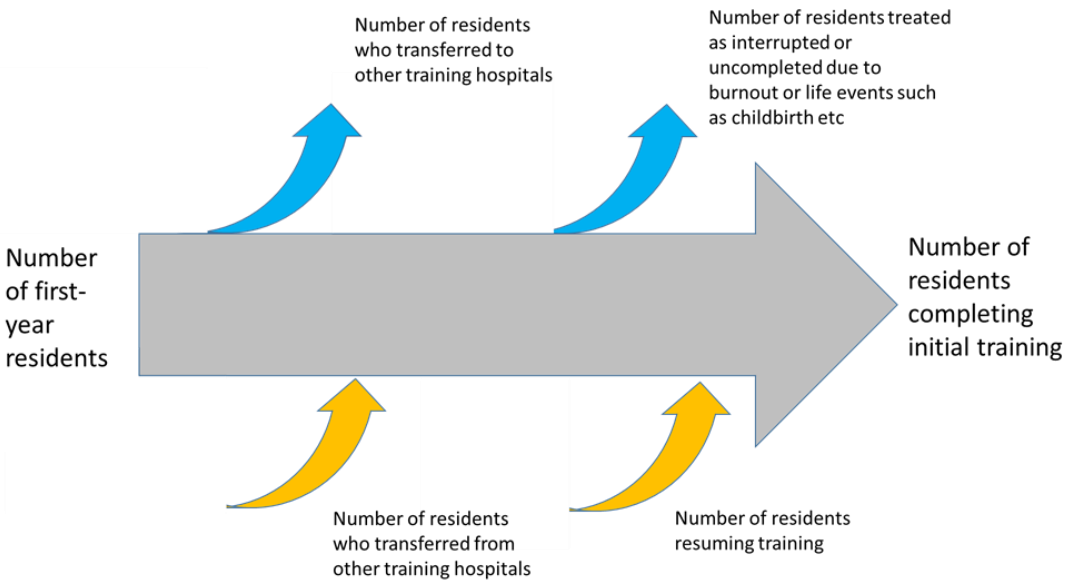

Figure 2: The scheme of initial train completing dynamics

6 Conclusions

A training hospital that achieves a full match is not "truly a training hospital with excellent education". And the KPIs available for program evaluation in postgraduate education are much fewer than those in undergraduate education.

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