Is Physician Gender Associated with the Patient Recovery Time? *

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Abstract

Many previous studies have found differences in medical experience brought between male and female physicians, with female physicians care more about mental comfort for the patients. However, similar studies in China havent been conducted and analyzed yet. Based on 2333 questionnaires collected from hospitals in three provinces and cities in China, we examined the relationship between the physician gender and the patient recovery time, adjusted for patient characteristics, physician characteristics, hospital fixed effects, region fixed effects and computationally selected features. We use Ridge, Lasso and Kfold cross validation to select those feature. We adopted the ordinal logistic regression approach for analysis and recovered a significant empirical result: the recovery time of patients treated by male physician are 0.67 times more likely than the recovery time of patients treated by female physician to be in the short category. This indicates that patient treated by male physician averagely recovered faster than those treated by female patient. This finding suggests that the differences in medical practice pattern exist between male and female physicians, which may have important clinical implications for Chinas outgoing medical reform, for example, an on-job training provided for male physicians to enhancing mental comfort skills.

keywords: physician gender, medical experience, medical reform.

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1 Introduction

Health, as one of the human capital (Grossman, 1999), plays an important role in driving economic growth. Physician, as the provider of medical treatment, almost determined the patients' health status due to asymmetric information. As China is undergoing a comprehensive medical reform, the study on medical quality is urgently needed. In this paper, based on the 2333 questionnaires collected from hospitals in three provinces and cities, I will investigate the relationship between the physician attributes (age, gender, title, etc.) and the patient medical experience (recovery time, satisfactory, etc.) and furthermore, I will estimate the effects of physician gender difference on the patient recovery time.

Across the literature, many studies on the related topic have been done. Bertakis compare patient health status, patient satisfaction, and physician practice style between family practice and internal medicine. They randomly assigned 509 new adult patients to family practice or internal medicine clinics at a university medical center and followed for 1 year of care. They found that there were significant differences in practice styles between family physicians and internists due to the physician's behavior. They suggest physician improve psychosocial aspects of care, which was predictive of improvements in patient health status. They also suggested a practice style emphasizing patient activation which was predictive of improvements in patient satisfaction (Bertakis et al., 1998). Hajjaj summarized in his review that non-clinical influences on clinical decision-making profoundly affect medical decisions. These influences include patient-related factors such as socioeconomic status, quality of life and patient's expectations and wishes, physician-related factors such as personal characteristics and interaction with their professional community, and features of clinical practice such as private versus public practice as well as local management policies (Hajjaj et al., 2010). Persai conducted two cross-sectional surveys were administered among patients and physicians working in primary health care facilities in 12 districts of two states in India and used multivariable logistic regression to investigate associations between individual components of 5As interventions and patients' satisfaction

with the counseling services. They found that incorporating 5As interventions in the delivery of primary care would likely increase patients' satisfaction with physicians' delivered counseling services. That is to say, patients' recommendation of counseling services will aid in demand generation for cessation services in primary care (Persai et al., 2014). Santiago use the patient satisfaction and communication scores collected during the academic year 20152016 were obtained for 369 physicians at Indiana University Health system, and finds that median and mean of scores were lower for women physicians and underrepresented physicians (Sotto-Santiago et al., 2019).

Among all those influential factors researched by other scholars, this paper will focus on uncovering the physician personal characteristics that influence the treatment and trying to answer the question of how to improve the medical experience. Physician's gender, age and ethnicity may play a role in decision-making. For example, female physicians were more likely than male physicians to be influenced by the patient's psychosocial factors and expectations when making decisions (Tracy et al., 2005). Younger physicians order more tests than older physicians (McKinlay et al., 2002). Female physicians spend more time with their patients, and the consultation is usually longer when there is gender concordance between the physician and the patient (Franks and Bertakis, 2003). Female physicians spend more consultation time on disease-preventive services and counseling than male physicians, and male physicians usually spend more time on technical practical issues and discussion of substance abuse (Bertakis et al., 2003).

Furthermore, the recognition of the relevance of sex and gender differences in medicine has significantly increased in the last 20 years. Nonetheless, the implementation of these aspects into clinical practice still needs future work. Based on the survey data, some literature trying to address the problem by estimating the effects of physician gender difference on the patient medical quality. Bertakis randomly assigned 118 male and 132 female adult new patients, having no stated preference for a specific physician, were randomly assigned to university hospital primary care residents, and their initial encounters were videotaped. They found that the difference between male and female physicians in total time spent with patients was small and

statistically insignificant, and diminished further when controlling for patient gender and health status. Female physicians, however, were observed to engage in more preventive services and to communicate differently with their patients (Bertakis et al., 1995). Kim examined the association between the gender of primary care physicians and the quality of diabetes care they provided to their patients participating in the Translating Research Into Action for Diabetes study, and found that patients of female physicians received a similar quality of care compared with patients of male physicians (Kim et al., 2005). Bertakis reuse the data in Bertakis et al. (1998) and indicate that there are significant differences in the practice style behaviors of female and male doctors. Female doctors provide more preventive services and psychosocial counseling; male doctors spend more time on technical practice behaviors, such as medical history taking and physical examination (Bertakis, 2009). Prigione invited all members of the German Society for General and Abdominal Surgery to participate in an online-based survey to determine the relevance and incorporation of sex and gender aspects in gastrointestinal medicine and surgery. In this survey, more than 50% of the participants reported including sex and gender aspects into consultation, diagnosis, and management at least occasionally. However, 44% reported no knowledge of the formal definition of 'gender medicine', suggesting potential differences in the perception of the notion of gender (Oertelt-Prigione et al., 2014). Jefferson investigated the effect of physician gender on consultation length in UK hospital outpatient clinics and compared this, through meta-analysis, with previous studies outside the UK. There are a total of 174 observations of outpatient consultations with 10 hospital specialists (consultants) from different specialties in two UK hospital trusts. They found no statistically significant difference in the length of consultations for male and female doctors in these UK hospital settings. When pooled with existing studies, consultations with women doctors were found to be approximately two minutes longer than with men (Jefferson et al., 2015).

From above reviews, although many studies have answered similar questions that what's relationship between the physical attributes and the patient medical experience, not much literature has studied situations in Chinas medical environment.

Whats more, in other literature, the effect of physician gender on medical quality is ambiguous and needs further research. Therefore, I will utilize the data and try to identify the effects of physician gender difference on the patient recovery time. In this paper, I will use the survey data collected from Shanxi Province, Heilongjiang Province and Beijing in 2017, in total 2333 samples after data cleaning. This data hasn't gone public so there is literature based on this dataset. There are some papers use the similar survey or questionnaire data ((Bertakis et al., 1995), (Bertakis, 2009), (Oertelt-Prigione et al., 2014)). As for the models or methods, logistic regression and meta-analysis is mostly used. In my paper, I will use multi-nominal logistic regression for identification. In terms of contribution, I am trying to identify the area of improvement for current medical practice and generate policy implications for the undergoing medical reforms.

2 Theory

Based on previous literature, logistic regression and meta-analysis is mostly used. Since our dependent variable is ordered, multinonial logistic regression is for non-ordered dependent variable. Therefore, this paper will use ordinal logistic regression for identification. The ordinal logistic regression implementation in STATA is ologit package, which use the following equation:

$$\log\left(\frac{P(TotalTime \leq j)}{1 - P(TotalTime \leq j)}\right) = \alpha_j - (\boldsymbol{\beta}\mathbf{X}) \quad j = 1, 2, ..., J-1 \tag{1}$$

This package incorporates a negative sign so that there is a direct correspondence between the slope and the ranking. Thus a positive coefficient indicates that as the value of the explanatory variable increases, the likelihood of a higher ranking increases.

In our paper, the equation is:

$$\log\left(\frac{P(Y \leq j)}{1 - P(Y \leq j)}\right) = \alpha_j - (\beta_1 PhysicianGender + \beta_k Z_k) \quad j = 1, 2, ..., J-1 \quad (2)$$

where Y is the dependent variable total recovery time with three category (short, medium, long), PhysicianGender is the independent variable with two categories (1 for male and 0 for female), Z is a group of confounding variables. This package incorporates a negative sign so that there is a direct correspondence between the slope and the ranking. Thus a positive coefficient indicates that as the value of the explanatory variable increases, the likelihood of a higher ranking increases.

To choose confounding variables, we referred to the model specification in previous literature (Tsugawa et al., 2017) and tried to estimate the association between physician gender and total recovery time using four regression models.

Model A compared total recovery time between male and female physicians, adjusting for patient characteristics. Model B adjusted for all variables in model A plus hospital fixed effects (ie, hospital indicators and province indicators), effectively comparing male and female physicians within the same level of hospital. Model C adjusted for all variables in model B plus physician characteristics, to evaluate if the differences in patient recovery time between male and female physicians could be explained by other physician characteristics that are correlated with physician gender. As for Model D, for the features in the survey but have not included in the former model, we selected some of them using Ridge and Lasso method. After calculating the mean score from two methods, we choose two additional variables, which are num. of hospital (number of hospitals visited by the patient), num. of visits (number of visits by patient). Model D adjusted for all variables in model C plus selected features.

3 Data

This study was supported by the China Center for Health Economic Research (CCHER) and patient consent was not required. We referred *Guidelines for the Diagnosis and*

Treatment of Chronic Cough in Children for questionnaire design. We collected sample from hospitals in three regions and cities, Shanxi Province, Heilongjiang Province and Beijing, which can represent the big picture of whole Chinas medical reform since these three regions and cities are in the different development stage. Our study population was restricted to children under 16 with chronic cough, because (1 chronic cough is a high-occurrence disease during the data collection period, and (2) chronic cough normally happens, so we can exclude singular samples such as cancers or HIV. Our questionnaire has four parts, patient attributes, physician attributes, hospital attributes and regional fixed effect, Patient experience. Here is a summary statistics of the data.

Table 1: Summary Statistics of Patient Characterisitcs

		isnull	Female Physician	Male Physician	pval	ptest
n			1293	1040		
total time	long	0	592 (45.8)	424 (40.8)	0.017	Chi-squared
	medium		368 (28.5)	349 (33.6)		
	short		333 (25.8)	267 (25.7)		
patient gender	Female	0	785 (60.7)	338 (32.5)	¡0.001	Chi-squared
	Male		508 (39.3)	702 (67.5)		
patient age	0-5	0	289 (22.4)	193 (18.6)	¡0.001	Chi-squared
	5-8		339 (26.2)	330 (31.7)		
	8-12		581 (44.9)	410 (39.4)		
	above 12		84 (6.5)	107 (10.3)		
illness type	Allergic cough	0	123 (9.5)	116 (11.2)	0.410	Chi-squared
	Cough after respiratory infection		684 (52.9)	546 (52.5)		
	Cough variant asthma		60 (4.6)	56 (5.4)		
	Upper respiratory cough syndrome		426 (32.9)	322 (31.0)		

From Table 1 and Table 2, we can see that patient characteristics and physician characteristics are almost balanced across physician gender. A detailed summary statistic is in the appendix section.

Table 2: Summary Statistics of Physician Characterisitcs

		isnull	Female Physician	Male Physician	pval	ptest
n			1293	1040		
physician age	20-30	0	46 (3.6)	34 (3.3)	0.010	Chi-squared
	30-35		235 (18.2)	203 (19.5)		
	35-40		415 (32.1)	396 (38.1)		
	40-50		477 (36.9)	324 (31.2)		
	above 50		120 (9.3)	83 (8.0)		
physician title	Attending doctor	0	548 (42.4)	462 (44.4)	0.569	Chi-squared
	Chief physician		400 (30.9)	296 (28.5)		
	Deputy director		283 (21.9)	227 (21.8)		
	Resident physician		62 (4.8)	55 (5.3)		

4 Analysis and Results

For the first three models, we can just simply run the ordinal logistic regression. Before that, for the Model D, we will firstly do a computational part, that is feature engineering for the untouched variables using Ridge and Lasso. By splitting data into many folds, we respectively applied Ridge and Lasso selection. Then, we get the mean score of both methods and rank feature according to their mean score.

Table 3: Feature Importance using Ridge and Lasso

	Ridge	Lasso	Mean
num. of hospital	1.00	1.00	0.87
num. of visits	0.85	0.84	0.76
asking length	0.21	0.21	0.17
understanding	0.19	0.19	0.16
asking history	0.11	0.11	0.10
explanation	0.10	0.10	0.08
physician attitude	0.07	0.07	0.06
department type	0.07	0.07	0.06
clearify	0.07	0.07	0.06
total spending	0.06	0.06	0.05
cure time	0.03	0.03	0.03
chat	0.02	0.02	0.02
physical check time	0.01	0.01	0.01
asking history time	0.01	0.01	0.01
chat time	0.00	0.00	0.00
asking time	0.00	0.00	0.00
affordability	0.01	0.00	0.00

From the table 3, we selected the first two features, which are num. of hospital (number of hospitals visited by the patient), num. of visits (number of visits by patient). Then, we run the four models and incoporate them into one table.

Robustness Check In order to check the robustness, we used cross-validation to test our model. Firstly, we divided our data into training sample and testing sample with 2/3 split. Then, we will put the testing sample aside until we calculate the out-of-sample accuracy score. Secondly, we fit ordinal logistic regression for each training sample and recover the coefficients. Thirdly, we will put our estimated model into testing sample and calculate the mean square error. With five times of data splitting, we take mean of the five coefficients and mean square error. Then we get the following result:

$$MSE_A = 0.55, MSE_B = 0.52, MSE_C = 0.52, MSE_D = 0.49$$

From the result, we can say that our result is robustness. And here is the averaged coefficient of four models:

Table 4: Association Between Physician Gender and Total Recovery Time

	Model A	Model B	Model C	Model D
total time				
physician gender	0.123	0.306***	0.306***	0.395***
	(1.54)	(3.69)	(3.68)	(4.61)
age	-0.0845***	-0.0597*	-0.0587*	-0.0679**
	(-3.41)	(-2.36)	(-2.30)	(-2.60)
gender	-0.0579	-0.135	-0.124	-0.0633
	(-0.73)	(-1.66)	(-1.51)	(-0.76)
illness type	-0.0301	-0.0561	-0.0308	-0.0511
	(-0.55)	(-1.00)	(-0.54)	(-0.89)
hospital type		0.0385	0.0520	0.0603
		(0.91)	(1.22)	(1.36)
province code		0.608***	0.587***	0.505***
		(12.66)	(12.14)	(8.83)
physician age			-0.128**	-0.0682
			(-3.00)	(-1.55)
physician title			-0.0320	-0.0224
			(-0.70)	(-0.48)
num. of hospitals				0.994***
				(12.85)
num. of visits				-0.507***
				(-9.32)
cut1				
Constant	-1.621***	0.0348	-0.405	-0.0877
	(-7.61)	(0.13)	(-1.35)	(-0.26)
cut2				
Constant	-0.293	1.449***	1.016***	1.460***
	(-1.39)	(5.32)	(3.38)	(4.29)
Observations	2333	2333	2333	2333

t statistics in parentheses

Source: data from a survey research conducted by CCER

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

From the table 4, we can see that Model A is not significant since we include too few variables. In the other three models, we obtained similar coefficient and all of them are significant. Based on Model D, we can get the following estimation (Agresti and Kateri, 2011).

$$\log\left(\frac{P(Y \leq 1)}{1 - P(Y \leq 1)}\right) = -0.0877 - (0.395 PhysicianGender + \beta_k Z_k) \tag{3}$$

$$\log\left(\frac{P(Y \leq 2)}{1 - P(Y \leq 2)}\right) = 1.460 - (0.395 PhysicianGender + \beta_k Z_k) \tag{4}$$

Then, the odds ratio for physician gender is

$$e^{-\beta_1} = e^{-0.395} = 0.67 \tag{5}$$

Thus the recovery time of patients treated by male physician are 0.67 times more likely than the recovery time of patients treated by female physician to be in the short category. This indicates that patient treated by male physician averagely recovered faster than those treated by female patient.

5 Conclusion

From above, we found that patients treated by female physicians had shorter recovery time than patients cared for by male physicians. To understand the result, we looked through literature for anecdotal evidence. There are many cases that male physician and female physician have different medical practice. Many aspects or gender divergence in characteristics may lead to the result. Female physicians are more likely to adhere to clinical guidelines ((Kim et al., 2005), (Tsugawa et al., 2017)), use more patient-centered communication (Roter et al., 2002), perform as well or better on standardized examinations (Ferguson et al., 2002), and provide more psychosocial counseling to their patients than do their male peers (Roter et al., 2002). Due

to asymmetric information in medical market, that physicians professor knowledge dominates that of patients, patients are more likely to be uncomfortable or unsecured of physicians medical treatment. While if non-clinical communication happened during the treatment, which is normally conducted by female physicians, the knowledge can be channeled to patients and further assure patients, which may lead to a healthy attitude from patients side. Since literature have found that a positive attitude will benefit the treatment of diseases and recover faster.

To conclude, our finding may have important clinical implications for Chinas undergoing medical reform. In physician-patient asymmetric information market, to improve the quality and efficiency of treatment, an on-job training should be provided for all physicians. The government should take the responsibility to urge physician to fill in the gap between physicians and patients, to channel their thoughts to innocent patients, and to ease the mental anxiety of their patients.

APPENDIX

A-1 Summary Statistics by Physician Gender

		isnull	Female	Male	pval	ptest
n			1293	1040		
total time	long	0	592 (45.8)	424 (40.8)	0.017	Chi-squared
	medium		368 (28.5)	349 (33.6)		
	short		333 (25.8)	267 (25.7)		
physician gender	Female	0	1293 (100.0)		¡0.001	Chi-squared
	Male			1040 (100.0)		
physician age	20-30	0	46 (3.6)	34 (3.3)	0.010	Chi-squared
	30-35		235 (18.2)	203 (19.5)		
	35-40		415 (32.1)	396 (38.1)		
	40-50		477 (36.9)	324 (31.2)		
	above 50		120 (9.3)	83 (8.0)		
physician title	Attending doctor	0	548 (42.4)	462 (44.4)	0.569	Chi-squared
	Chief physician		400 (30.9)	296 (28.5)		
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	Resident physician		62 (4.8)	55 (5.3)		
patient gender	Female	0	785 (60.7)	338 (32.5)	¡0.001	Chi-squared
	Male		508 (39.3)	702 (67.5)		
patient age	0-5	0	289 (22.4)	193 (18.6)	¡0.001	Chi-squared
	5-8		339 (26.2)	330 (31.7)		
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	above 12		84 (6.5)	107 (10.3)		
illness type	Allergic cough	0	123 (9.5)	116 (11.2)	0.410	Chi-squared
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	Cough variant asthma		60 (4.6)	56 (5.4)		
	Upper respiratory cough syndrome		426 (32.9)	322 (31.0)		
province code	1	0	384 (29.7)	218 (21.0)	¡0.001	Chi-squared
	2		155 (12.0)	110 (10.6)		
	3		754 (58.3)	712 (68.5)		
hospital type	clinic	0	604 (46.7)	446 (42.9)	0.008	Chi-squared
	first-class hospital		269 (20.8)	250 (24.0)		
	normal hospital		61 (4.7)	77 (7.4)		
	specilized children hospital		359 (27.8)	266 (25.6)		
	unknown			1 (0.1)		
asking history		0	4.0 [3.0,6.0]	4.0 [2.0,6.0]	0.104	Kruskal-Wallis
num. of hospital	0	0	423 (32.7)	273 (26.2)	0.003	Chi-squared
	1		794 (61.4)	704 (67.7)		
	2		76 (5.9)	63 (6.1)		
asking time		0	3.0 [2.0,8.0]	3.0 [2.0,8.0]	0.402	Kruskal-Wallis
num. of visits	0	0	564 (43.6)	525 (50.5)	0.010	Chi-squared
	1		613 (47.4)	420 (40.4)		
	2		40 (3.1)	35 (3.4)		
	3		21 (1.6)	21 (2.0)		
	4		55 (4.3)	39 (3.8)		
total spending	100-200	0	387 (29.9)	411 (39.5)	¡0.001	Chi-squared
	200-500		367 (28.4)	191 (18.4)		
	50-100		255 (19.7)	246 (23.7)		
	above 500		124 (9.6)	85 (8.2)		
	under 50		160 (12.4)	107 (10.3)		
asking length	long	0	485 (37.5)	417 (40.1)	0.061	Chi-squared
	medium		395 (30.5)	282 (27.1)		
	short		35 (2.7)	47 (4.5)		
	very long		346 (26.8)	271 (26.1)		
	very short		32 (2.5)	23 (2.2)		

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