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RESEARCH ARTICLE

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Standardized residency training: An equalizer for residents at different hospitals in Shanghai, China?

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Summary

Background: The residency training programme in Shanghai is the first in China to become standardized; however, there has been no evidence that the programme equalizes training quality. This cross-sectional study examined whether residents in all disciplines at different hospitals perceived equivalent improvement in professional competency after this programme.

Methods: We recruited all 2283 residents who enrolled in the programme in 2013. Before graduation, the residents reported their perceived competency improvement as the primary outcome and their hospital of residency, awareness of the programme's requirements and policies, and demographic information as explanatory variables. We ran multivariate linear regressions and mixed-effect multilevel regression to examine whether the hospital type and the university affiliation were associated with perceived improvement.

Results: A total of 2208 residents completed the survey. Although the adjusted multilevel regression analysis showed that the improvement scores at tertiary specialty hospitals and tertiary general hospitals were lower than those at secondary general hospitals, the difference was not statistically significant. No variance in improvement scores could be explained by the hospital type or university affiliation.

Conclusion: Receiving residency training at hospitals that were traditionally less resourced did not compromise educational quality based on the perception of the residents.

Yao He and Wenji Qian contributed equally to this work.

KEYWORDS
curriculum development, health workforce, medical education, residency training

1 | INTRODUCTION

Health professionals are directly related to the supply and quality of health services.[1,2] A shortage and an inequality of physicians, especially at less-resourced hospitals,[3,4] exist in most countries worldwide. In China, highly qualified physicians usually practise in resourced hospitals such as tertiary hospitals, while less-resourced hospitals, such as secondary hospitals and community health centres, recruit low-quality physicians who have no practical experience.[5] Because of the low quality of physicians and services, less-resourced hospitals have almost no patients, while more resourced hospitals are crowded with patients, and physicians are overloaded.[6,7] Since the quantity and quality of residents directly affect the labour supply of health care professionals, especially physicians, one attempt to address this dilemma is to standardize residency programmes across different hospitals so that the quality of the programmes at less-resourced hospitals is similar to that at more resourced tertiary teaching hospitals.[8-10] In this scenario, although certain tertiary hospitals remain appealing to the best residents, those going to secondary hospitals and community health centres still meet the stringent quality standards of the residency programme. Ultimately, patients can receive quality health care at secondary hospitals and community health centres that is more physically and financially accessible than that at tertiary hospitals, and the health system can finance less overuse of high-cost services at overcrowded tertiary hospitals.[11,12]

Residency training has a long history, and many countries have established sound systems. For example, the first residency programme in the United States was established in 1876.[13] The necessary credential for a residency programme is a doctoral degree in medicine or osteopathic medicine, and such training programmes last 3 to 7 years, depending on the speciality. The Accreditation Council for Graduate Medical Education (ACGME) is responsible for the management of training, including establishing national standards and regularly auditing training sites. Residents' duties and training curriculum are clearly defined in the implementation manual. Training sites, including medical universities, hospitals, and medical centres, need to set up a postgraduate medical education committee to work with the ACGME. After completing several rounds of assessments, residents can finally obtain their licenses, which need regular recertification.[14,15] Similar to the United States, the General Medical Council in the United Kingdom is responsible for the design and management of residency programmes at the national level.[16]

The first residency programme in China was established in 1988 in Shanghai, which served as a pioneering example for other provinces and municipalities.[17] Since then, China has been learning from the standardization of the residency programmes in the United States and the United Kingdom, but complexities specific to China, including the diversity of the resident and trainer population and the disparity between different residency training programmes,[17-19] have hindered progress in adaptation and implementation. To achieve one of the key objectives of China's latest round of health care reform, ie, to ensure the availability of and equitable access to quality care, Shanghai, as a pilot city, implemented the standardized residency training (SRT) programme in 2010 to set quality standards for residency training.[17,20] This programme aims to help residents reach the same professional standards regardless of hospital type to provide high-quality care throughout Shanghai. Fifty teaching hospitals were approved to carry out SRT according to the Standards of Training Bases released by the National Health Commission, which consist of three types, namely, tertiary general, tertiary specialty, and secondary general hospitals.[21] Each hospital is affiliated with one of five universities, ie, Fudan University, Shanghai Jiao Tong University, Tongji University, the Second Military Medical University, and the Shanghai University of Traditional Chinese Medicine. All hospitals are required to adhere to standard requirements related to teaching capacity, financial and organizational management,

resident recruitment, the time and content of training, resident evaluation, quality control, and the human resource management of residents to ensure the quality of training.[22] In Shanghai, all public hospitals of every type, which provide most health care, require physician candidates to have residency certificates that prove professional competency.[23,24] In addition, prior residency training placed residents in permanent positions, which created no incentive for residents to perform their best to reach a set of standards, and residents with mediocre performance did not lose employment.[25] In the Shanghai SRT programme, residents are no longer fixed in one position; instead, they rotate between different departments, and when they graduate, they need to apply for a stable position. These measures have stimulated residents' motivation for learning.[26] Since 2010, the Shanghai SRT programme has enrolled an average of 2400 residents in 21 disciplines per year, and all residents are held to the same standard of performance. The Shanghai SRT programme sets several kinds of examinations during the different phases of training to ensure the quality of residents, including public subject examinations, regular registrations, discharge examinations, annual examinations, and exit examinations. Residents must complete the entire course of training according to the training plan before they can apply for the exit examination, which tests the clinical concepts and clinical skills of residents. The exit examination is unified at the city level, and those who do not pass the standardized exit examination will not be able to graduate from the programme and practise medicine in Shanghai.[27]

However, achieving homogeneous competency among new physicians is a challenging task. In addition to residents' individual demographic background, contextual factors such as the hospital type and university affiliation might influence residents' competency, despite the original intention of standardization. For example, the historical influence of the unequal resource allocation between secondary hospitals and tertiary hospitals could still have a lingering impact on the quality of residency training even after SRT implementation. Moreover, over the first few years of the training programme in Shanghai, no secondary hospital was allowed to train residents.[28] In other words, tertiary hospitals are more experienced in training residents and remain disproportionately better funded by the government.[29,30] In general, this disparity between different residency training programmes is not unique to Shanghai or to China. For example, in the United States, community health centres and other primary care facilities have few resources to run residency programmes, whereas most SRT programmes do not present their residents with the issues that they will face in primary care facilities.[31,32]

There have been very few, if any, published empirical evaluations of SRT in China. Primary studies that reviewed residency training focused on programmes at individual hospitals in China or compared programmes between China and other countries. For residency training in provinces outside Shanghai, the only guide is the national mandatory residency training standards, which many claim lack precision, clarity, and enforceable instructions.[33-35] If standardization in the 2010 Shanghai SRT programme achieves its goal of equalizing quality of care across different hospitals, then Shanghai's approach might be worth replicating in other parts of the country or elsewhere in the world, especially in other developing countries. To provide evidence, this study tests two hypotheses. First, receiving residency training at secondary hospitals is associated with lower perceived improvement compared with receiving training at tertiary general hospitals and tertiary specialty hospitals. Second, a residency programme's university affiliation is associated with a perceived improvement of residents, ie, residents trained at hospitals with the same university affiliation could have levels of perceived improvement that are different from those trained at institutions with other types of affiliation.

2 | METHODS

2.1 | Study design and participants

All 2283 residents who started their residency in 2013 in Shanghai were recruited in the study as a cohort. These residents in Grade 2013 had three different academic degrees: bachelor's, master's, and doctoral degrees. According to the design of SRT in Shanghai, the programme duration ranged from 1 to 3 years, and the higher the degree was, the shorter the duration. Therefore, residents with doctoral degrees usually spent 1 year in training if they could pass

the final examination on time. For residents with master's degrees, the training duration could be 2 years. In other words, the residents in Grade 2013 exited the programme at different study years.

From 2014 to 2016, every June, just before the end of the study year, residents about to graduate were asked to complete an online survey. Therefore, we conducted data collection three times.

We developed the survey questionnaire based on the essential modules and requirements of the Shanghai residency programme and on comments and suggestions from consultants who were experts in medical education and hospital management. The questionnaire included two aspects. The first was the demographic factors of the residents, including their age, gender, and academic degree; the discipline for which they were recruited; their residency hospital; and so on. The second was the capacity evaluation of the residents, including their awareness of the Shanghai SRT programme's policies and requirements and their self-report on their improvement in professional competency due to the SRT programme in each year. The questionnaire used adaptations of the Likert response format for the questions regarding awareness and improvement.[36]

2.2 | Outcome

The outcome was a self-reported score of improvement in professional competency, and the score was a composite of four item scores (Figure 1). The survey asked the participants to rate how much they had improved in four items, ie, theoretical knowledge, clinical skills, teamwork competency, and communication with patients. The participants rated each item on a scale of 1 to 5, where 1 meant no improvement and 5 meant significant improvement.

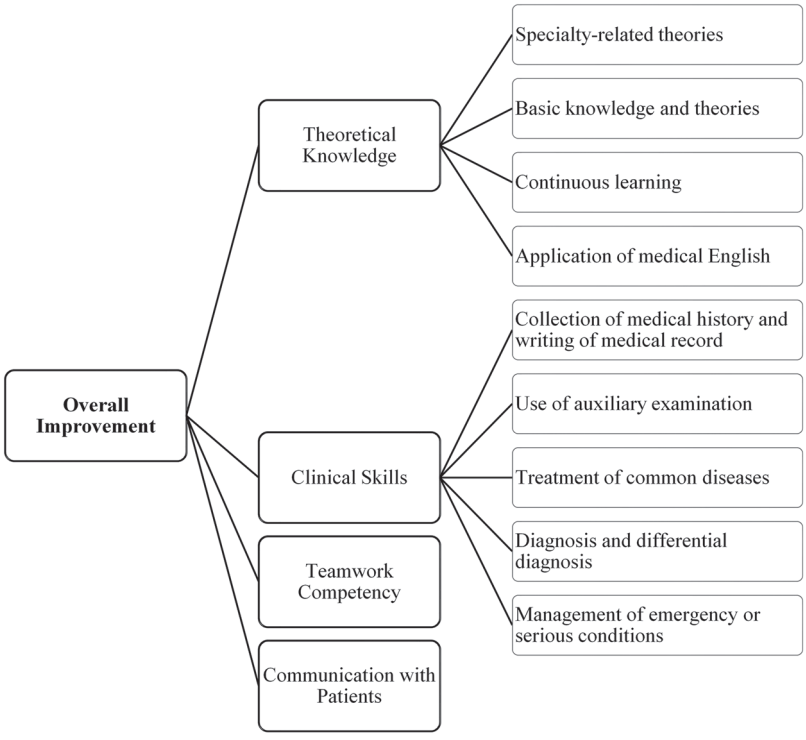

FIGURE 1 The overall improvement score is the average of the residents' ratings of improvement in four items. The theoretical knowledge and clinical skills scores are the averages of the ratings of their subitems

Therefore, each of the four items had a score, and the overall improvement score of each participant was the average of the four item scores. The Cronbach alpha of the improvement score was.9527, which means that the internal consistency of the item scores is high. The improvement score was treated as a continuous variable because it was the sum and average of multiple items, and the intervals between points were assumed to be equal.[37]

2.3 | Independent variables

The explanatory variables were the type and university affiliation of the teaching hospital where a resident was trained. Data on the hospital type and university affiliation were derived from the hospital of residency that the participants reported. We examined the associations of the improvement score with the hospital type and university affiliation while adjusting for the participants' gender (male vs female), age, location of recruitment (Shanghai vs outside Shanghai), academic degree (bachelor's, master's, doctoral, or other), and discipline. We also considered awareness of the residency programme. The survey asked the participants to rate their agreement with the statements that they were completely aware of what the policies of the residency programme were and what the programme's requirements were. The participants self-rated their agreement on a 1 to 5 scale, where 1 meant strongly disagree and 5 meant strongly agree. In the analyses, awareness of the residency programme was treated as two continuous variables, ie, awareness of the programme's policies and awareness of the programme's requirements. Age was continuous in the analyses but recoded into a categorical variable to display the descriptive statistical data.

2.4 | Statistical analysis

For the analyses that examined the association between the improvement score and the hospital of residency, we used the following regression models ($P < .05$). We first ran unadjusted regressions of the improvement score on the hospital type and university affiliation. Then we ran a multiple linear regression, ie, Model 1, of the improvement score on the hospital type and university affiliation while adjusting for the participants' year of graduation from the residency programme, awareness of the programme's policies and requirements, gender, age, recruitment location, academic degree, and discipline.

Potential differences among individuals might stem from the fact that groups that contain individuals are different from each other, while individuals in the same group are similar to each other.[38] In other words, group-level factors such as the hospital type and university affiliation might create contextual effects that interact with or contribute to individual differences.[39] Therefore, we used a mixed-effect multilevel regression model to examine whether the hospital has a contextual effect on individual differences in the improvement score (Model 2). We used the intraclass correlation coefficient, estimated by the ratio of group-level variance to total variance,[40] to show the degree of resemblance among individuals in the same group. The lower the coefficient was, the lesser the resemblance, and the lower the likelihood that individual-level differences can be attributed to the differences between hospitals. Both models were adjusted for the participants' graduation year, awareness of the programme, gender, age, recruitment location, academic degree, and discipline.

All analyses were conducted using Stata 13.0. Those who submitted the survey but did not respond to every question were dropped from the dataset and were excluded from the analyses.

3 | RESULTS

From 2014 to 2016, 2208 residents (96.7%) completed the survey before they graduated from the residency programme. Table 1 presents the participants' demographic and professional characteristics by gender, age group, recruitment location, academic degree, discipline, and the type and university affiliation of the teaching hospitals.

TABLE 1 Demographic and professional characteristics of the 2208 residents who participated in the study

	Number of Participants, %			
	2014 (n = 328)	2015 (n = 936)	2016 (n = 944)	Total
Gender				
Male	147 (44.8)	349 (37.3)	313 (33.2)	809 (36.6)
Female	181 (55.2)	587 (62.7)	631 (66.8)	1399 (64.5)
Age[a]				
≤25	44 (13.4)	34 (3.6)	38 (4.0)	116 (5.3)
26-30	215 (65.6)	776 (82.9)	847 (89.7)	1838 (83.2)
≥30	69 (21.0)	126 (13.5)	59 (6.3)	254 (11.5)
Recruitment location				
Shanghai	102 (31.1)	258 (27.6)	274 (29.0)	634 (28.7)
Outside Shanghai	226 (68.9)	678 (72.4)	670 (71.0)	1574 (71.3)
Degree				
Bachelor's	48 (14.6)	96 (10.3)	544 (57.6)	688 (31.2)
Master's	112 (34.2)	685 (73.2)	365 (38.7)	1162 (52.6)
Doctoral	165 (50.3)	155 (16.6)	34 (3.6)	355 (16.0)
Other	3 (0.9)	0 (0.0)	1 (0.1)	4 (0.2)
Discipline				
Internal medicine	57 (17.4)	160 (17.1)	68 (7.2)	285 (12.9)
Surgery	83 (25.3)	161 (17.2)	71 (7.5)	315 (14.3)
General practice	24 (7.3)	35 (3.7)	227 (24.1)	286 (13.0)
TCM specialty	15 (4.6)	103 (11.0)	57 (6.0)	175(7.9)
Medical imaging	20 (6.1)	50 (5.3)	81 (8.6)	151 (6.8)
OB/GYN	18 (5.5)	65 (6.9)	61 (6.5)	144 (6.5)
Paediatrics	8 (2.4)	52 (5.6)	42 (4.5)	102 (4.6)
Anaesthesiology	17 (5.2)	30 (3.2)	62 (6.6)	109 (4.9)
Stomatology	16 (4.9)	64 (6.8)	25 (2.7)	105 (4.8)
TCM general	4 (1.2)	25 (2.7)	42 (4.5)	71 (3.2)
ER	5 (1.5)	27 (2.9)	42 (4.5)	74 (3.4)
Neurology	16 (4.9)	24 (2.6)	23 (2.4)	63 (2.9)
Ophthalmology	11 (3.4)	21 (2.2)	35 (3.7)	67 (3.0)
Psychiatry	7 (2.1)	11 (1.2)	20 (2.1)	38 (1.7)
ENT	4 (1.2)	14 (1.5)	32 (3.4)	50 (2.3)
Pathology	5 (1.5)	20 (2.1)	9 (1.0)	34 (1.5)
Rehabilitation	0 (0.0)	5 (0.5)	21 (2.2)	26 (1.2)
Oncology	11 (3.4)	31 (3.3)	3 (0.3)	45 (2.0)
Paediatric surgery	1 (0.3)	14 (1.5)	8 (0.9)	23 (1.0)
Dermatology	4 (1.2)	22 (2.4)	8 (0.9)	34 (1.5)
Laboratory	2 (0.6)	2 (0.2)	7 (0.7)	11 (0.5)
Hospital type				
Secondary general	4 (1.2)	19 (2.0)	52 (5.5)	75 (3.4)

(Continues)

TABLE 1 (Continued)

	Number of Participants, %			
	2014 (n = 328)	2015 (n = 936)	2016 (n = 944)	Total
Tertiary specialized	26 (7.9)	163 (17.4)	111 (11.8)	300 (13.6)
Tertiary general	298 (90.9)	754 (80.6)	781 (82.7)	1833 (83.0)
University affiliation of the hospital				
FDU	58 (17.7)	232 (24.8)	266 (28.2)	556 (25.2)
SJTU	168 (51.2)	331 (35.4)	294 (31.1)	793 (35.9)
Tongji	47 (14.3)	108 (11.5)	163 (17.3)	318 (14.4)
SMMU	37 (11.3)	131 (14.0)	116 (12.3)	284 (12.9)
SHUTCM	18 (5.5)	134 (14.3)	105 (11.1)	257 (11.6)

Abbreviations: ENT, ear, nose, and throat; ER, emergency medicine; FDU, Fudan University; OB/GYN, obstetrics and gynaecology; SHUTCM, Shanghai University of Traditional Chinese Medicine; SJTU, Shanghai Jiao Tong University; SMMU, Second Military Medical University; TCM, traditional Chinese medicine; Tongji, Tongji University.
[a]Age is a continuous variable that has been recoded into a categorical variable for presentation here.

The mean improvement score of the whole sample was 3.418 (SD = 0.690). Figures 2 and 3 show the distribution of improvement scores by hospital type and university affiliation, respectively.

Without adjusting for other factors (Table 2), we found that there is no statistically significant association between the improvement scores and the hospital type (R^2 = .002) or university affiliation (R^2 = .002). Adjusting for other factors in Model 1 (Table 2), we found that there is still no statistically significant association between the improvement scores and hospital type or university affiliation (adjusted R^2 = .209). A 1-point increase in the participants' awareness of the residency programme's policies was associated with a 0.105-point increase in the improvement scores (P < .001). Additionally, a 1-point increase in the participants' awareness of the residency programme's requirements was associated with a 0.257-point increase in the improvement scores (P < .001).

Examining whether the hospital (Model 2) had a contextual effect (Table 2), we found a pattern highly similar to that of Model 1. The multilevel regression model shows that the intraclass correlation was 0.5%. Neither the hospital type nor university affiliation was significantly associated with the variation in the improvement scores.

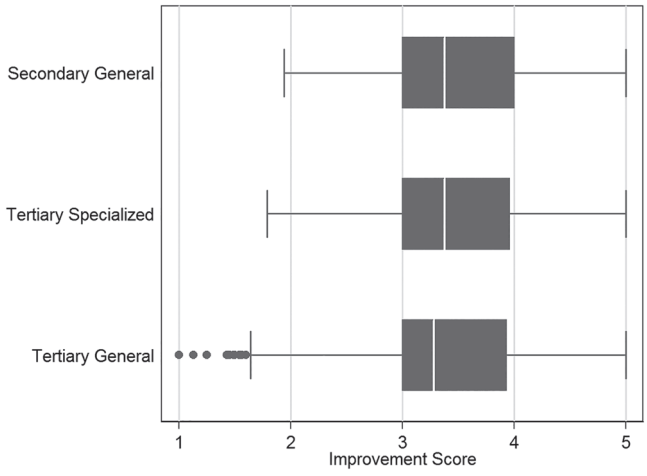

FIGURE 2 Improvement scores of 2208 residents at different types of hospitals

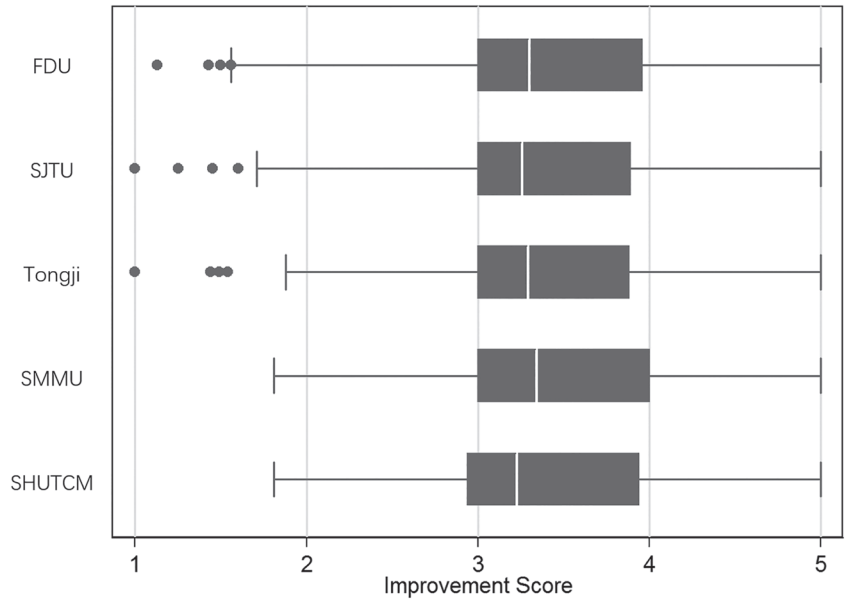

FIGURE 3 Improvement scores of 2208 residents at hospitals with different university affiliations

4 | DISCUSSION

This study demonstrates that the improvement scores were equivalent across the type and university affiliation of the teaching hospitals in both the unadjusted and adjusted analyses. Furthermore, receiving training at a given hospital did not result in a difference in improvement scores based on the multilevel regression analysis.

4.1 | Unified management contributes to uniform quality

To ensure the homogenized quality of residency training programmes, the Shanghai municipal government established the multidepartment joint meeting system of Shanghai SRT to facilitate the standardization process.[41] The joint meeting system, consisting of several key bureaus from the Shanghai municipal government and an expert group, designs the SRT programme and sets relevant policies at the municipal level. The coordinating office of the joint meeting system works with the Centre for Medical Human Resources of Shanghai, the Centre for Shanghai SRT Affairs, and the Shanghai Medical Association to ensure the standardized implementation of the programme's components and enforcement of the programme's policies at individual teaching hospitals. The five universities and their affiliated hospitals have established postgraduate medical education committees to work with the coordinating office and to provide SRT. The expert group, consisting of eight recognized experts from different specialties, conducts regular on-site supervision to ensure the implementation of policies and to find problems. The problems encountered in the process of project promotion can then be solved in a timely manner through direct discussion under the joint meeting system, which guarantees the efficiency of the programme and the enforcement of the programme's policies. With the joint meeting system, the relevant bureaus of the Shanghai municipal government can effectively work together, and the training sites are united.[42] Because of the unified design and management of the joint meeting system (Figure 4), the SRT programme has achieved uniform quality.

TABLE 2 Estimated differences in the improvement scores of the 2208 residents who participated in the study

	Regression Coefficients (Standard Error)		
	Simple	**Model 1**	**Model 2**
Hospital type (secondary general as reference)			
Tertiary specialized	−0.042 (0.089)	−0.045 (0.095)	−0.044 (0.098)
Tertiary general	−0.117 (0.081)	−0.033 (0.078)	−0.041 (0.081)
University affiliation of the hospital (FDU as reference)			
SJTU	−0.064 (0.038)	0.003 (0.037)	0.011 (0.043)
Tongji	−0.063 (0.048)	−0.028 (0.046)	−0.018 (0.053)
SMMU	0.019 (0.050)	0.048 (0.048)	0.072 (0.059)
SHUTCM	−0.057 (0.052)	0.002 (0.104)	0.024 (0.108)
Exit year (2014 as the reference)			
2015	—[a]	0.054 (0.043)	0.053 (0.043)
2016	—[a]	0.263 (0.047)**	0.262 (0.047)**
Policy awareness	—[a]	0.105 (0.029)**	0.103 (0.029)**
Requirement awareness	—[a]	0.257 (0.029)**	0.259 (0.029)**
Intercept	—[a]	2.843 (0.230)**	2.828 (0.230)**
Random effects			
Group-level variance	—[a]	—[a]	0.002 (0.002)
Individual-level variance	—[a]	—[a]	0.368 (0.011)
Intraclass correlation	—[a]	—[a]	0.5%

Notes: The simple, unadjusted regression model analysed only the association between the improvement scores and the hospital type or university affiliation. Model 1 analysed the association between the improvement scores, the hospital type, and university affiliation while adjusting for all personal characteristics and awareness. Models 2 and 3 added analyses of the contextual effects of the hospital type and university affiliation, respectively, to Model 1. The reference categories are residents at secondary general hospitals, Fudan-affiliated hospitals, and a graduation year of 2014. The variables that were controlled for but not reported here are age, gender, recruitment location, academic degree, and discipline; there was no statistically significant association between the improvement scores and these variables. R^2 of simple linear regressions: hospital type, .002; university affiliation, .002. Adjusted R^2 of Model 1 = .376.

Abbreviations: FDU, Fudan University; SHUTCM, Shanghai University of Traditional Chinese Medicine; SJTU, Shanghai Jiao Tong University; SMMU, Second Military Medical University; Tongji, Tongji University.

[a]Not applicable.

*$P < .05$.

**$P < .01$.

4.2 | Measures that bridge the gap between hospitals

Since 2010, the Shanghai SRT programme has undergone a series of major changes to shorten the gap between hospitals, especially between secondary and tertiary hospitals. The detailed rules of the Shanghai SRT programme were promulgated, stipulating the rotating departments, time, objectives, and requirements for each specialty.[43] Additionally, the programme invited medical experts to develop textbooks, evaluation criteria, and graduation requirements for each specialty to enforce rigorous quality control for standardization.[44,45] Regardless of the hospital, residents participate in the same training modules and exit examinations. Trainer quality affects training quality.[46] The Shanghai SRT programme pays considerable attention to the training of trainers. Every year, the programme organizes municipal-wide training that covers all the trainers. Different medical associations also organize regular training for

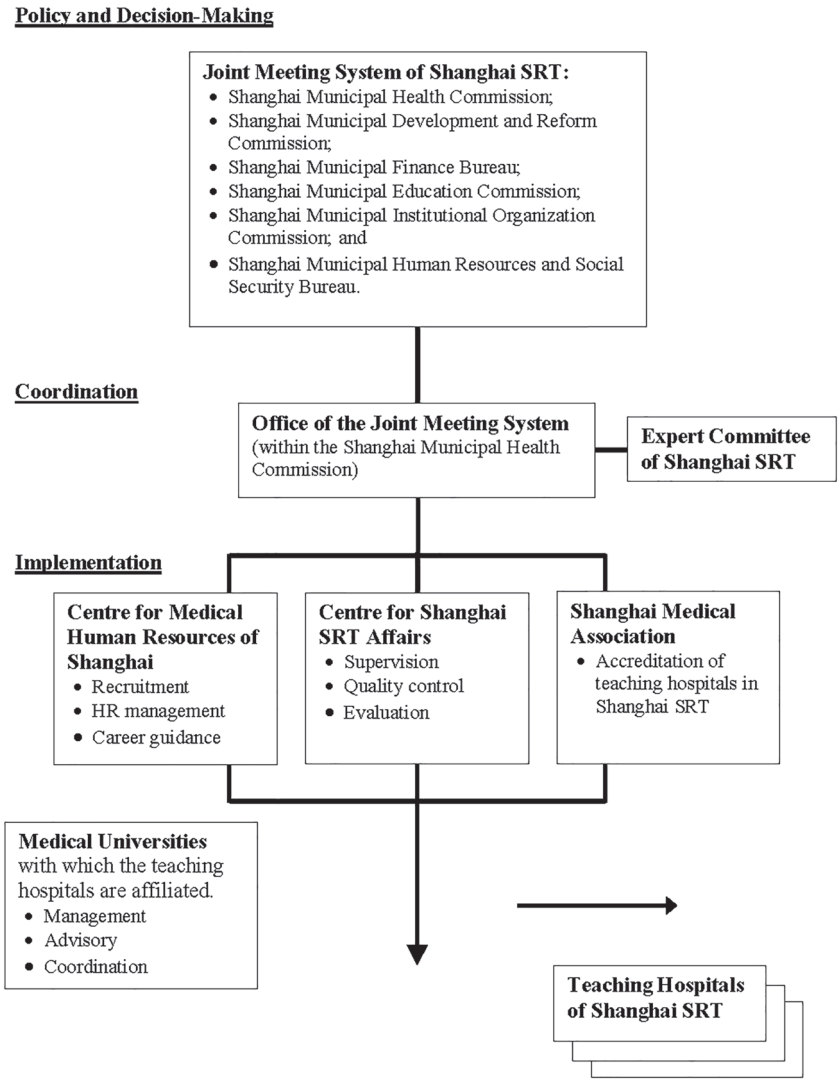

FIGURE 4 Organizational and administrative structure of the Shanghai standardized residency training programme

physicians in their respective specialties. Through the standardized curriculum, examinations, and trainers, the programme helps eliminate the differences in quality between secondary and tertiary hospitals.[47]

4.3 | Increasing residents' awareness further improves the homogeneity of competency

The findings, however, reveal differences in improvement across the years in which the residents exited the programme and across the levels of awareness of the residency programme's policies and requirements. The differences may be explained by the pattern found in a previous study: As a resident spends more time in a programme, he or she becomes more aware of the programme's requirements and more supportive of its policies,[34] and his or her improvement in competency may thus increase.[48] Therefore, increasing current and prospective residents'

awareness of the programme early in the residency or during medical school may reduce their stress and concern about the future, thus enhancing their professional competency.[35,49] Helpful actions that the joint meeting system of Shanghai SRT may take include enlisting successful physicians who have participated in the programme to introduce the programme's components in detail and to explain the purpose and benefit of policies to future residents face to face. Residents, particularly those who spend 1 to 2 years in the programme, may thus develop competency based on their awareness, and competency across the resident population may become more homogeneous.

4.4 | Shanghai's experience in the SRT programme

The success in Shanghai shows that standardization across hospitals and regions is not impossible. The joint meeting system serves as a key reference. Furthermore, the conference system helps achieve unity in a top-down manner; meanwhile, it coordinates relevant departments and resources to ensure the implementation of the SRT programme. Based on the level of implementation, Shanghai's experience in the development of a standardized curriculum, textbooks, evaluation criteria, and graduation requirements can help other developing countries establish standards that meet their own national needs. Shanghai's approaches have overcome most difficulties that exist elsewhere in China, ie, the diversity of the resident and trainer population,[17] the fragmented and sometimes contradictory regulations of medical education and hospital management, and multiple governing agencies.[50] Therefore, Shanghai's programme may serve as a model of standardization that regions in other developing countries can adopt and adapt to their local health systems.

However, in the current Shanghai SRT programme, the admission criteria of the residency programme are not standardized among hospitals, which may lead to inconsistent baseline perceptions of competency before the programme begins. Since tertiary hospitals may have the most competitive admission process, one that reaps top medical students who are already highly competent and still capable of improving to a higher level, the unified training may not meet the training needs of these highly qualified residents. Thus, in addition to unified training, individualized training should be provided in the future for residents according to their abilities.

4.5 | Limitations

Our findings may not be generalizable in terms of time and location because they are based on survey responses from one class of residents in Shanghai.[51] Since the specifics of the Shanghai SRT programme have been changing almost every year since 2010, the responses of those who started their residency earlier or later than 2014 might produce different findings. As the SRT programme has developed, trainers have become more adept at conducting practical training, hospitals have become more sophisticated in managing and assisting residents, and medical students have become more familiar with the purpose and importance of SRT.[52] Therefore, residents who have started the programme recently may have a better overall experience and perceive more improvement in their competency.

Furthermore, the findings are based on self-perceived scores, and they may be a function of a high or low baseline. Objective assessment of competency before and after the programme may produce less biased results. Therefore, we hope to obtain more objective and valid data, such as standardized exit examination scores, to conduct future research.

5 | CONCLUSIONS

Shanghai's SRT achieved a standardized programme and standardized training quality across teaching hospitals of different types and with different university affiliations for residents who started their residency in 2013. The magnitude of improvement in competency increased with the duration of participation in the programme and with residents' awareness of the programme's requirements.

ACKNOWLEDGEMENTS

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Fudan University Institutional Review Board (IRB 00002408&FWA00002399), and the IRB number is #2013-10-0468. Before the question section of the online survey, there was a one-page explanation of the purpose and potential use of the survey data. The participants provided informed consent by starting the survey and submitting their responses. The anonymity and confidentiality of the participants were guaranteed.

AVAILABILITY OF DATA AND MATERIAL

The data that support the findings of this study are available from the corresponding author, JYH, upon reasonable request.

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