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Comparative effectiveness of structured surgical residency and rotational training in general surgery: A cross-sectional study

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Abstract

Background. Clinical learning is important for general surgeons. Besides, postgraduate degree teaching and standardized training of resident physicians are important for general surgeons. Traditional training for resident physicians prescribed by the Chinese authorities is rudimentary.

Objectives. To evaluate the effects of a structured residency training program and standardized training on the overall performance of resident doctors.

Materials and methods. After the 100 resident doctors completed the course and clinical training, their theoretical skills scores (theoretical examination and objective scores), practical skills scores (teaching quality), and satisfaction data were included in the study analyses. Since 2020 (the data from the past 5 years), there have been 30 resident doctors at the structured residency training program (RT cohort) and 70 are rotating in the surgical department (SDR cohort).

Results. Seven (10%) residents from the SDR cohort failed at least one theoretical assessment. None of the resident doctors from the RT cohort failed in any of the theoretical skills. The theory examination paper marks ($p < 0.001$), the case analysis score ($p = 0.003$), the medical record writing score ($p < 0.001$), the physical examinations score ($p < 0.001$), and the basic theoretical knowledge score ($p = 0.016$) of resident doctors from the RT cohort were better than those of residents from the SDR cohort. Among the practical skills, interest in promotion ($p = 0.023$) and knowledge consolidation effect ($p = 0.026$) were reported as higher among resident doctors of the RT cohort than those of resident doctors of the SDR cohort.

Conclusions. New students admitted to professional master's degree programs in clinical medicine in China will be required to participate in certified resident training. The structured residency training program has better effects than rotating in the surgical department based on the overall performance of the resident doctor.

Key words: clinical learning, general surgery teaching, medical graduates, resident physicians, standardized training

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Highlights

- Structured residency training improves theoretical and practical skills in general surgery.
- Resident doctors in structured training achieved significantly higher examination and clinical performance scores.
- Standardized surgical training improves knowledge consolidation and promotes learning interest among residents.
- Certified residency training outperforms traditional surgical department rotations in overall resident performance.

Background

General surgery is a core surgical specialty.[1] The department of general surgery is the mainstay of surgical practice. In addition, it is also one of the main departments requiring rotations during the standard training of resident physicians.[2] General surgery is a basic subject for practitioners, especially surgeons.[1] Medical graduates are physicians, but they are not fully trained when they graduate from the program. At present, standardized training for resident physicians in most institutions in mainland China is carried out in accordance with the Chinese Ministry of Health guidelines, and the curriculum features variable training durations and high-level, generalized syllabus guidelines, which are managed by individual institutions.[3] To improve the quality of practice among medical graduates in China, high-quality training is needed for medical graduates to become doctors.[4] The practice patterns of general surgeons are still diverse, reflecting the continuing need for a broad training paradigm that allows for specialization.[5]

Traditional training programs previously established by regulatory bodies were less standardized compared with modern competency-based curricula.[6] Problem-based learning and case-based learning for general surgeons,[7] assistant general practitioners,[8] and joint surgery,[9] as well as a multidisciplinary team-combined flipped classroom teaching model for radiologists,[10] have been reported to be effective in improving both theoretical comprehension and practical skill scores. Details of comparative studies on teaching/training for physicians in different specialties and settings are presented in Table 1.[6–12] Little is known about the comparative effectiveness of structured residency training compared with rotational placements in general surgery. Structured residency training and rotational placements in general surgery need to be compared in terms of clinical competence, patient care, and professional development.

Objectives

The objectives of the current study were to compare theoretical scores (theoretical examination scores and objective scores), practical skill scores (teaching quality), and satisfaction among resident physicians who received general surgery teaching during standardized training in a Chinese setting.

Materials and methods

The protocol for this study was prepared by the authors themselves. The study was approved by the Ethics Committee of Minhang Hospital, Fudan University (Shanghai, China; approval No. 2020-010-01K, issued on January 2, 2020). The study was conducted in accordance with Chinese law and the 2008 Declaration of Helsinki. Written informed consent was obtained from participants before the commencement of the study.

A preliminary cross-sectional study was performed from January 15, 2020, to May 15, 2025, at Minhang Hospital.

Resident physicians in clinical general surgery who worked and took part in general surgery teaching or standardized training were included in the analyses. Physicians who did not complete general surgery teaching or standardized training were excluded from the study.

Sample size calculations

The study was based on the assumption that there would be a 10% improvement in theoretical and practical skill scores among physicians admitted to the general surgical residency training base compared with those admitted to other bases who had been rotating in the surgical department. Based on these assumptions, a significance level (α) of 0.05 for a 2-tailed test, and a target statistical power of $1 - \beta = 0.80$, calculated using OpenEpi v. 3.01 (OpenEpi Development Team / Emory University, Atlanta, USA), 30 physicians would be required in each cohort. For robustness, we included 70 physicians from other bases who had been rotating in the surgical department.[8]

Cohorts

A total of 30 resident physicians were admitted to the general surgical residency training base (RT cohort; structured residency training program), and a total of 70 resident physicians were admitted to other bases and had been rotating in the surgical department (SDR cohort; rotating in the surgical department). In a structured residency training program, resident physicians spent a longer period of 1–2 years studying. Resident physicians rotating in the surgical department spent 1–2 months there during the study. In addition to training at the general surgical residency training base or rotating in the surgical department,

Table 1. Comparative studies on teaching/training for physicians in different specialties and settings

Study	Publication year	Country/region	Sample size, n	Sample	Age [years]	Type of teaching/training	Duration of teaching/training	Main conclusions
Network meta-analysis, Ye et al.[6]	2025	China	5,004	internal medicine residents	not reported	1. Traditional teaching; 2. Integration of problem-based learning teaching with WeChat; 3. Case-based learning teaching with WeChat; 4. Team-based learning teaching with WeChat; 5. Integration of problem-based learning with case-based learning teaching	not reported	The integration of problem-based learning teaching with WeChat, case-based learning teaching with WeChat, and integration of problem-based learning with case-based learning teaching had a better impact on the performance of internal medicine residents.
Systematic review and meta-analysis, Zhang et al.[7]	2018	China	1,487	radiology education	not reported	Integration of problem-based learning teaching	not reported	Integration of problem-based learning teaching was more effective in radiology education.
Randomized controlled trial, Jiang et al.[8]	2025	China	70	assistant general practitioner trainees	22 (22–23)	1. Integration of problem-based learning teaching; 2. Integration of problem-based learning	1 year	Integration of problem-based learning and case-based learning teaching methods positively influenced the clinical thinking skills of assistant general practitioner trainees.
Randomized trial, Peng et al.[9]	2023	China	60	surgery training students	>18	1. Single mode of lecture-based learning; 2. Problem-based learning; 3. Simulation-based learning	18 months	Simulation-based learning with problem-based learning can effectively improve the theoretical knowledge and clinical skills of students.
Trial, Lin et al.[10]	2025	China	380	oral general course students	19–22 (20.60 ±1.10)	1. Traditional teaching methods; 2. Multidisciplinary team combined with a flipped classroom teaching model	1 semester	A multidisciplinary team combined with a flipped classroom teaching model had beneficial effects on the clinical thinking and practical ability of students.
Randomized trial, Ying[11]	2025	China	102	general surgery residents	20–27	1. Traditional teaching; 2. Problem-based learning teaching combined with case-based learning teaching; 3. Problem-based learning teaching	15 months	The combination of the problem-based learning teaching model and the case-based learning teaching model had a better impact on the performance of general surgery residents.
Narrative review, Mokhtari et al.[12]	2024	real-world global observational literature	49 studies	undergraduate medical students and residents in research	not reported	Structured mentoring programs and advanced training systems	1–2 semesters	Improving evidence-based medical practice is important.

Categorical variables are presented as frequencies with percentages in parentheses. Normally distributed continuous variables are presented as mean ± standard deviation (±SD). Non-normally distributed continuous variables are presented as median (Q1–Q3).

resident physicians were free to use WeChat v. 8.0.40 (Tencent Holdings Ltd., Shenzhen, China) to communicate with each other and their mentors. There was 1 mentor for every 5 doctors, who was trained and had at least 3 years of surgical experience at the institute. The training sessions lasted 3–4 h per day and were held 6 days per week, with 1 day off per week.

Outcome measures

The theoretical skills scores

The theory examination paper

At the end of the training, theoretical knowledge was assessed. The theoretical examination paper was

standardized, and the closed-book examination was organized by Minhang Hospital.[11] One 180-min paper contained 200 multiple-choice questions covering all subjects taught at the graduate level and in the training course. One-third of a mark was deducted for each incorrect answer in the test. The examination was supervised by 3 investigators (H.M., Q.C., and Z.Z.). A score of 49 points or less on the theoretical examination paper constituted failure.

Objective score test

Case analysis and clinical practice (e.g., medical record writing, physical examination, and basic theoretical knowledge) were scored from 0 to 100. A higher score indicated better performance.[1] Basic theoretical knowledge included mastery, non-mastery, and general knowledge. A score of 49 points or less in any of the parameters was considered a failure in the objective score test.

Practical skills scores

Teaching quality was assessed by analyzing improvements in the interest of the enrolled resident doctors, knowledge consolidation, literature search and learning, clinical thinking skills, and resident doctor–patient communication ability. Yes/no questions were administered by researchers to the resident doctors. "Yes" was considered an improvement, and "no" was considered no improvement.[1]

Satisfaction of resident doctors

Resident doctors' satisfaction was assessed after completion of the course based on the prescribed format of the institute (4-point scale). It was graded as 0 – dissatisfied, 1 – partially satisfied, 2 – satisfied, and 3 – fully satisfied. Not all surveys are available in translated form, and institutions are not willing to disclose them at present.

Clinical benefits of training resident doctors

The clinical benefits of training resident doctors were evaluated as a function of the benefit scores. Benefit scores for the training of resident doctors were calculated from the risk of failure among resident doctors in any of the theoretical skill scores, as expressed in Equation 1. The risk related to theoretical skill scores was defined by a calculation involving the theoretical skill scores obtained by resident doctors (Equation 2). The benefit score of resident doctor training is the area above the curve for the adopted training, and the working area is the area under the curve (AUC) for the adopted training. For all adopted training methods, a score of 49 points or less in any theoretical skill score of resident doctors was considered a failure.[12,13]

$$\mathrm{Risk}_{\mathrm{fail}} = \frac{\mathrm{S}_{\mathrm{ts}}}{\mathrm{S}_{\mathrm{ts}} + 50} \quad (1)$$

where

$\mathrm{Risk}_{\mathrm{fail}}$ – risk of failure of the resident doctor;

S_{ts} – score in any of the theoretical skills.

$$\text{Beneficial score} = \frac{\mathrm{RD}_{\mathrm{passed}}}{\mathrm{RD}_{\mathrm{total}}} - \left(\frac{\mathrm{RD}_{\mathrm{fail}}}{\mathrm{RD}_{\mathrm{total}}} \times \mathrm{Risk}_{\mathrm{fail}}\right) \quad (2)$$

where

$\mathrm{RD}_{\mathrm{passed}}$ – number of resident physicians who passed all theoretical assessments;

$\mathrm{RD}_{\mathrm{total}}$ – total number of resident doctors in that cohort;

$\mathrm{RD}_{\mathrm{fail}}$ – number of resident physicians who failed at least one theoretical assessment.

Statistical analyses

InStat v. 3.01 (GraphPad Software, San Diego, USA) was used for statistical analyses. Categorical variables, normally distributed continuous variables, and non-normally distributed continuous variables are presented as frequencies with percentages in parentheses, mean ± standard deviation (SD), and median with Q1–Q3 in parentheses, respectively. CalculatorSoup® (CalculatorSoup, LLC, Ashland, USA) was used to calculate quartile values. The Kolmogorov–Smirnov test was used to check the normality of continuous variables. Bartlett's test was used to check the homogeneity of SDs of normally distributed continuous variables. An unpaired t-test with or without Welch correction was used for normally distributed continuous variables, and the Mann–Whitney test was used for non-normally distributed continuous variables. The χ^2 and Fisher–Freeman–Halton tests were used for categorical variables. All results were considered significant if $p < 0.05$.

Results

Study population

During the study period (from January 15, 2020, to May 15, 2025), a total of 100 resident physicians received training at Minhang Hospital, either at the general surgical residency training base or through rotation in the surgical department. After completion of training, data on theoretical scores (theoretical examination scores and objective scores), practical skill scores (teaching quality), and satisfaction among 100 resident physicians were included in the analyses for the study. The flow diagram of the cross-sectional study is presented in Fig. 1.

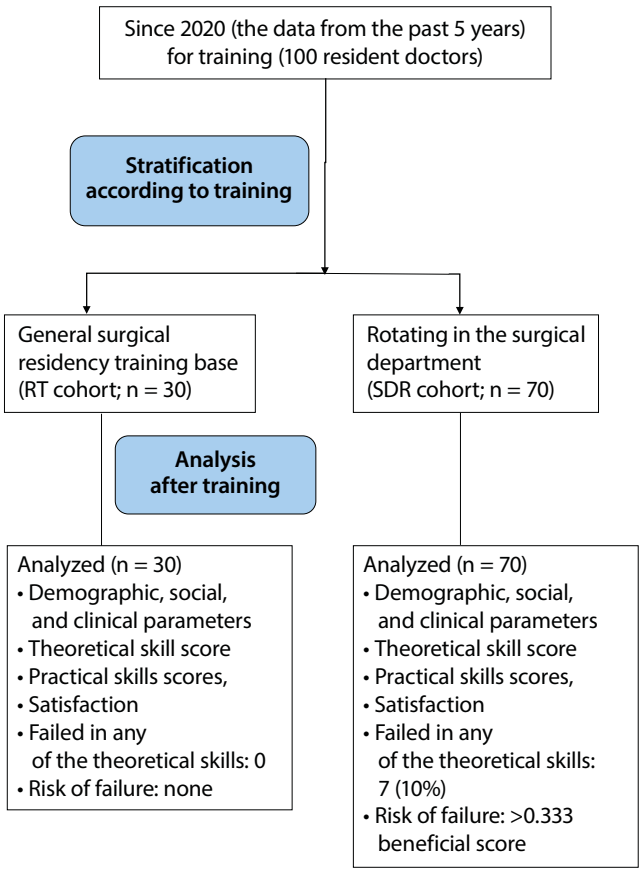


Fig. 1. Flow diagram of the cross-sectional study. Green indicates good outcomes. Red indicates worse outcomes

Demographic, social, and clinical parameters

Resident physicians had a male-to-female ratio of 3 : 2. The age range was 23–25 years. Most were Han Chinese and from urban or suburban areas. Details of the demographic, social, and clinical parameters of resident physicians included in the analyses are presented in Table 2.

Outcome measures

The theoretical skills scores

Six (9%) resident physicians and 1 (1%) resident physician from the SDR cohort failed the theoretical examination paper and the basic theoretical knowledge component, respectively. A total of 7 (10%) resident physicians from the SDR cohort failed at least 1 theoretical skill assessment. None of the resident physicians from the RT cohort failed any theoretical skill assessment. The number of resident physicians who failed any theoretical skill assessment did not differ significantly between the SDR and RT cohorts ($p = 0.099$, relative risk (RR) = 1.476, 95% confidence interval (95% CI): 1.283–1.699, Fisher's exact test; the difference in failure rates was not statistically significant).

Scores on the theoretical examination paper, case analysis scores, medical record writing scores, physical examination scores, and basic theoretical knowledge scores of resident physicians from the RT cohort were better than those of resident physicians from the SDR cohort. Details of the theoretical skill scores of resident physicians included in the analyses are presented in Table 3.

Practical skills scores

Among the practical skills, improvement in interest and knowledge consolidation were significantly greater among resident physicians in the RT cohort than among those in the SDR cohort. Furthermore, literature search and learning, clinical thinking skills, and resident

Table 2. Demographic, social, and clinical parameters of resident doctors enrolled in the analyses

Parameter	Category	RT	SDR	p-value	df	test value	95% CI
Training	–	general surgical residency training base	rotation in the surgical department	–	–	–	–
Resident physicians	–	30	70	–	–	–	–
Sex	male	18 (60.0%)	43 (61.4%)	0.893 (χ^2 test)	1	0.018	0.521–1.765
	female	12 (40.0%)	27 (38.6%)				
Age [years]		23 (23–24)	23 (24–23)	0.175 (Mann–Whitney test)	N/A	872	N/A
Ethnicity	Han Chinese	26 (87.0%)	64 (91.0%)	0.732 (Fisher–Freeman–Halton test)	N/A	0.648	0.316–1.649
	Mongolian	3 (10.0%)	5 (7.0%)				
	Tibetan	1 (3.0%)	1 (2.0%)				
Birthplace	urban	18 (60.0%)	45 (64.0%)	0.161 (Fisher–Freeman–Halton test)	N/A	0.556	0.275–1.123
	rural	7 (23.0%)	5 (7.0%)				
	suburban	5 (17.0%)	20 (29.0%)				

95% CI – 95% confidence interval, calculated using the Katz approximation; df – degrees of freedom; N/A – not applicable; RT – residency training; SDR – surgical department rotation. Categorical and non-normally distributed continuous variables are presented as frequencies with percentages in parentheses and medians (Q1–Q3), respectively. CalculatorSoup® (CalculatorSoup, LLC) was used to calculate quartile values. Test value: χ^2 statistic for the χ^2 test, relative risk for Fisher's exact test, and Mann–Whitney U statistic for the Mann–Whitney U test. All results were considered significant if $p < 0.05$.

Table 3. The theoretical skills scores of resident doctors enrolled in the analyses

Skill/domain	Assessment	RT	SDR	p-value	df	test value	95% CI
Training	–	general surgical residency training base	rotation in the surgical department	–	–	–	–
Resident physicians	–	30	70	–	–	–	–
Theoretical examination	theory examination paper [marks]	69.1 ±1.97	58.73 ±4.74	<0.001 (unpaired t-test with Welch's correction)	97	15	−11.704 to −9.039
Theoretical skills	case analysis score	57.67 ±3.17	55.73 ±1.31	0.003 (unpaired t-test with Welch's correction)	33	3	−3.156 to −0.720
Clinical practice	medical record writing score	58.7 ±2.14	55.59 ±2.75	<0.001 (unpaired t-test)	98	6	−4.232 to −1.996
	physical examination score	59 (56–62)	55 (54–58)	<0.001 (Mann–Whitney U test)	N/A	530	N/A
	basic theoretical knowledge score	58 (56–59)	56 (53–58)	0.016 (Mann–Whitney U test)	N/A	731	N/A

95% CI – 95% confidence interval, calculated using the Katz approximation; df – degrees of freedom; N/A – not applicable; RT – residency training; SDR – surgical department rotation. Normally distributed and non-normally distributed continuous variables are presented as mean ± standard deviation (±SD) and median with Q1–Q3 in parentheses, respectively. CalculatorSoup® (CalculatorSoup, LLC) was used to calculate quartile values. Test value: Mann–Whitney U statistic for the Mann–Whitney U test and Welch's approximate t for the unpaired t-test with Welch's correction. A score of 49 points or less in any theoretical skill score of resident physicians was considered a failure. All results were considered significant if $p < 0.05$.

Table 4. The practical skills of resident doctors enrolled in the analyses

Skill/measure	RT	SDR	p-value	df	Test statistic	95% CI
Training	general surgical residency training base	rotation in the surgical department	–	–	–	–
Resident physicians	30	70	–	–	–	–
Interest (number of "yes" responses)	21 (70.0%)	30 (43.0%)	0.023	1	5.153	1.141–4.405
Knowledge consolidation effect (number of "yes" responses)	20 (67.0%)	28 (40.0%)	0.026	1	4.962	1.131–4.150
Literature search and learning (number of "yes" responses)	19 (63.0%)	28 (40.0%)	0.054	1	3.701	1.037–3.659
Improvement in clinical thinking skills (number of "yes" responses)	18 (60.0%)	27 (39.0%)	0.079	1	3.078	0.991–3.392
Resident physician–patient communication ability (number of "yes" responses)	17 (57.0%)	25 (36.0%)	0.085	1	2.973	0.988–3.301
Resident physicians' satisfaction	2 (1–2)	1 (1–1)	<0.001	N/A	415	N/A

95% CI – 95% confidence interval, calculated using the Katz approximation; df – degrees of freedom; N/A – not applicable; RT – residency training; SDR – surgical department rotation. Categorical and non-normally distributed continuous variables are presented as frequencies with percentages in parentheses and median with Q1–Q3 in parentheses, respectively. CalculatorSoup® (CalculatorSoup, LLC) was used to calculate quartile values. The χ^2 test was used for statistical analysis of categorical variables, and the Mann–Whitney U test was performed for non-normally distributed continuous variables. "Yes" was considered an improvement, and "no" was considered no improvement. All results were considered significant if $p < 0.05$.

physician–patient communication ability were improved among resident physicians in the RT cohort compared with those in the SDR cohort, but the differences were not statistically significant. Details of the practical skills evaluation of resident physicians included in the analyses are presented in Table 4.

Satisfaction of resident doctors

Satisfaction with training was higher among resident physicians in the RT cohort than among resident physicians in the SDR cohort. Details of the comments on the assumption tests used in the study are presented in Table 5.

Clinical benefits for the training of resident doctors

Resident physicians in the SDR cohort had benefit scores ranging from 0.833 to 0.900, and those in the RT cohort had benefit scores ranging from 0 to 1 for practical training after medical graduation. However, below a benefit score of 0.833, resident physicians in the SDR cohort were at risk of failing any theoretical test evaluation. In contrast, resident physicians in the RT cohort had no risk of failure in any theoretical test evaluation. The graphical presentation of the clinical benefits of training resident physicians is presented in Fig. 2. Details of the clinical benefits of training resident physicians are presented in Table 6.

Table 5. Comments about the assumptions' tests adopted in the study

Variable	Subcategory	Adopted test, results, and authors' description of the statistical test used
Categorical variables	2 × 2 table, 3 × 2 table	Fisher's exact test or χ^2 test. The χ^2 test was performed for sample sizes >5 and a total sample population ≥40. A χ^2 test with Yates' correction was performed if any individual sample was less than 10. Yates' correction is designed for continuity. Fisher's exact test was performed only if n ≤ 90. Otherwise, the χ^2 test of independence was performed. Fisher's exact test was performed if there were fewer than 6 elements in the contingency table per group. The total sample size might be large, but if 1 category contained few elements, the correct test was Fisher's exact test. For tables larger than 2 × 2, Fisher–Freeman–Halton tests were preferred.
	large tables	A χ^2 test of independence, when all expected values were greater than 1, or a χ^2 test for trend was performed.
Continuous variables	normality	The Kolmogorov–Smirnov test was preferred because n > 50.
	homogeneity of variances	Bartlett's test was used to check the homogeneity of variances.
	age [years]	Both columns failed the normality test ($p < 0.001$ for both comparisons). Therefore, a 2-tailed Mann–Whitney U test was performed.
Theoretical skills	theory examination paper [marks]	Both columns passed the normality test ($p = 0.058$ and $p > 0.1$ for the Kolmogorov–Smirnov test). In Bartlett's test, $F = 5.787$ and $p < 0.001$. This test suggests that the difference between the 2 SDs is extremely significant. Since the t-test assumes populations with equal SDs, we should consider transforming the data (reciprocal or log transformation), selecting a nonparametric test, or selecting the alternative Welch t-test. Therefore, a 2-tailed unpaired t-test with Welch correction was performed.
	case analysis score	Both columns passed the normality test ($p > 0.1$ and $p = 0.072$ for the Kolmogorov–Smirnov test). In Bartlett's test, $F = 5.869$ and $p < 0.001$. This test suggests that the difference between the 2 SDs is extremely significant. Since the t-test assumes populations with equal SDs, we should consider transforming the data (reciprocal or log transformation), selecting a nonparametric test, or selecting the alternative Welch t-test. Therefore, a 2-tailed unpaired t-test with Welch correction was performed.
Clinical practice	medical record writing score	Both columns passed the normality test ($p > 0.1$ for both comparisons for the Kolmogorov–Smirnov test). In Bartlett's test, $F = 1.655$ and $p = 0.067$. This test suggests that the difference between the 2 SDs is not significant. Therefore, a 2-tailed unpaired t-test was performed.
	physical examination score	One column failed the normality test ($p > 0.1$ and $p = 0.046$ for the Kolmogorov–Smirnov test). Therefore, a 2-tailed Mann–Whitney U test was performed.
	basic theoretical knowledge score	One column failed the normality test ($p = 0.072$ and $p = 0.034$ for the Kolmogorov–Smirnov test). Therefore, a two-tailed Mann–Whitney U test was performed.
Satisfaction of resident doctors	–	Both columns failed the normality test ($p < 0.001$ for both comparisons for the Kolmogorov–Smirnov test). Therefore, a 2-tailed Mann–Whitney U test was performed.

SD – standard deviation.

Discussion

During the study period, resident physicians either received surgical residency training or rotated in surgical department-based training. In the current context, with the increasing demand for doctors, continuing education is especially important for them.[1] Therefore, after graduation, medical graduates should receive clinical training. Since 2015, new doctors in China admitted to professional master's degree programs in clinical medicine have been required to participate in certified resident training.[14]

A total of 7 (10%) resident physicians from the SDR cohort failed at least 1 theoretical skill assessment. In addition, benefit scores below 0.833 among resident physicians from the SDR cohort were associated with a risk of failure. Qualified medical graduates should have theoretical knowledge and clinical practice skills.[1] The traditional education model has certain limitations.[12] This leads to a gap between theoretical skills and practical skills. Resident physicians may become confused when they face serious clinical conditions.[15] Since 1949, China has made many changes to develop its medical education system and now has a complex range of medical degrees.[16]

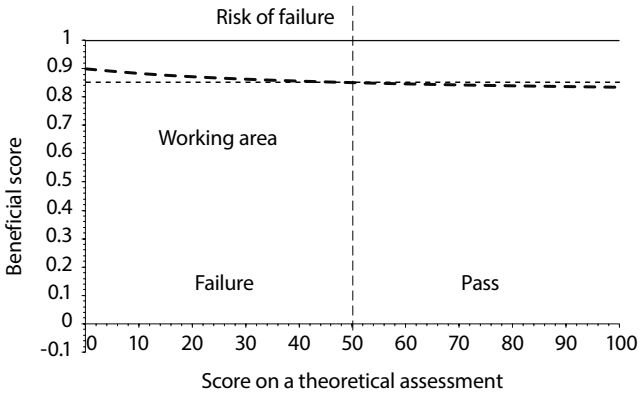


Fig. 2. Graphical presentation of the clinical benefits of training resident doctors. The straight horizontal line at the top represent RT cohort (n = 30) and dashed/plain curve running just below the top line represent SDR cohort (n = 70)

RT – residency training; SDR – surgical department rotation.

Table 6. The clinical benefits of the training of resident doctors

Parameter/Variable		Cohorts	
		RT	SDR
Training		general surgical residency training base	rotation in the surgical department
Resident physicians		30	70
Passed all theoretical assessments		30	63
Failed all theoretical assessments		0	7
Score in any theoretical skill assessment	**Risk of failure**	**Benefit score**	
0	0	1	0.9
10	0.17	1	0.88
20	0.29	1	0.87
30	0.38	1	0.86
40	0.44	1	0.86
50	0.5	1	0.85
60	0.55	1	0.85
70	0.58	1	0.84
80	0.62	1	0.84
90	0.64	1	0.84
100	0.67	1	0.83
Clinical benefit (beneficial score)		0–1	0.900 to 0.833
Risk of failure (beneficial score)		none	<0.833

A score below 50 on any theoretical assessment was considered a failure. RT – residency training; SDR – surgical department rotation.

The current situation of the medical education system in China has been worsened by the mismatch between clinical ability and promotion, as well as inadequate remuneration.[14] The surgical residency training base had better effects than rotation in the surgical department based on the overall performance of the resident physicians.

Among practical skills, improvement in clinical thinking skills and resident physician–patient communication ability did not differ significantly between the 2 cohorts (Fisher's test failed to prove a difference in the number of failures between the 2 cohorts). This is not the same as proving that failure rates are equal. The small sample size is responsible for this. Enhancing the precision and accuracy of practical skills measurements reduces variability in the data, making it easier to detect true effects.

Limitations of the study

The limitations of the study include its cross-sectional design and lack of a trial. The sample size is small. The sample size was calculated based on the final score outcomes, not the number of questions in the administered questionnaires. Outcomes such as "teaching quality" or "interest in promotion" were not measured using multiple methods (e.g., survey instruments or scoring rubrics). Other limitations include the single-institution design, lack of long-term follow-up, and potential observer bias in subjective assessments. Furthermore, not all surveys are available in translated form, and institutions are not willing to disclose them at present, which weakens the emphasis on the scoring system.

Conclusions

New students admitted to professional master's degree programs in clinical medicine in China are required to participate in certified resident training. The surgical residency training base had better effects than rotation in the surgical department based on the overall performance of the resident physicians. The study contributes to the global discussion on postgraduate medical education and surgical training reform.

Data Availability Statement

Data sharing does not apply to this article, as all data are already included in the manuscript.

Consent for publication of personal information

Not applicable.

Use of AI and AI-assisted technologies

Not applicable.

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