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Developing a Homogeneous Training Evaluation System for Multi-Campus Hospital Resident Physicians: A Delphi-AHP Study

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Research Article

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Abstract

Background

Standardized training of residents is the core way for medical graduates to grow into qualified clinicians. However, with the rapid popularization of the multi-Campus model in public hospitals, the consistency of training management, teaching quality and assessment standards between different hospitals is facing severe challenges. At present, there is still a lack of effective tools to systematically evaluate the homogeneity of multi-hospital training. The purpose of this study is to construct a set of evaluation index system for homogeneous training of residents in multi-campus hospital, to quantitatively identify the differences in training between hospitals, and to provide scientific basis for improving training quality and management refinement.

Methods

Through literature retrieval, policy text analysis and focus group interviews, the framework of evaluation index system is preliminarily constructed. The Delphi method was used to conduct two rounds of consultations with 22 experts specializing in the field of resident training management and research. The analytic hierarchy process was used to calculate the weight of indicators at all levels and conduct consistency tests.

Results

The effective recovery rate of the two rounds of expert consultation questionnaires was 100%, the expert authority coefficient was 0.964, the *Kendall's W* was 0.213 and 0.227 ($P < 0.001$), and the *CV* was 0.12 ± 0.03 and 0.074 ± 0.041, respectively. The final index system includes 4 first-level indicators (management system homogeneity degree 0.285, service ability homogeneity degree 0.205, service quality homogeneity degree 0.205, training quality homogeneity degree 0.305) and 16 second-level indicators. The weights of all levels of indicators pass the consistency test ($CR < 0.1$). Based on the index weight, the scoring and evaluation criteria of the evaluation index are further established.

Conclusion

The index system constructed in this study has high scientificity and reliability. It can quantify the homogenization target into comparable difference indicators, and comprehensively cover key dimensions such as management, service and training. It provides a measurement tool and empirical basis for the homogenization evaluation and high-quality development of multi-campus hospital residential training.

1 Background

The standardized training of residents (hereinafter referred to as " resident training ") is the only way for medical graduates to grow into qualified clinicians, and it is also the core link of medical education after graduation[1,2].Since China launched the resident training system in 2014, the system has developed rapidly. At present, tens of thousands of resident standardized training trainees (hereinafter referred to as " residents ") receive standardized training in more than 1000 training bases across the country every year[3].The fundamental goal of the resident training system is to ensure that all residents can obtain the same clinical ability and professional quality after completing the training.This principle is called training homogeneity or equivalence in the field of medical education[4].As a direct participant and training object of resident training,the quality and homogenization level of resident training is directly related to the overall improvement of the quality and medical service ability of future clinicians.

In recent years,the organizational structure of public hospitals in China has undergone profound changes.In order to cope with the increasing demand for medical services, alleviate the shortage of space resources and expand the accessibility of high-quality medical services, the multi-campus hospital development model has been accelerated nationwide[5]. According to statistics, in the past ten years, the number of tertiary public hospitals with two or more hospital districts has increased significantly[6].The hospital management model is shifting from intensive management of a single hospital district to collaborative governance of multiple hospital districts.The management coordination and quality consistency between the main hospital district and the branch hospital district has become an urgent problem to be solved[7]. For residents who rotate multi-campus hospita, whether the management requirements, teaching arrangements and assessment standards they receive in different hospital areas are consistent is directly related to the homogeneity of their training experience and the final training quality.

The national policy level has attached great importance to this challenge. The " Notice of the National Health Commission on Regulating the Management of Public Hospital Branch Areas " issued in 2022 (No.7 National Health Medical Development) clearly requires that public hospitals must take the main hospital area and the branch area as a unified whole for evaluation and evaluation, emphasizing the realization of unity in medical resource allocation, operation management and quality standards[8]. This policy orientation highlights the importance of homogeneous operations in all functional areas of hospitals, including clinical diagnosis and treatment, administration, and medical education.As the future talent reserve of the hospital, whether the management requirements, service ability and service quality of the residents in the multi-campus hospital interval are consistent has become the core content of evaluating the overall training quality and homogenization level of the hospital[9]. International experience shows that clinical networks, as an innovative strategy, have been used to improve medical continuity and team communication in large multi-campus hospital institutions[10].However, there is still a lack of systematic tools for homogenization assessment of residency training.

Training homogenization covers multiple dimensions in medical education, including curriculum standardization, clinical exposure equivalence, consistency of supervision quality, and comparability of evaluation methods[11,12].Studies have shown that differences between different training environments may lead to measurable differences in the clinical competence of residents, especially in the case of significant differences in institutional resources, patient populations, or supervision arrangements[13].Research on distributed medical education models not only reveals the potential of multi-campus hospital training in enhancing community participation, but also points out the continuing challenges of ensuring comparability of educational experiences in different locations[14].In the field of specialist training, homogenization education has become an important issue. Some studies have explored the homogenization training of specialists in the member units of the hospital group, and identified practical challenges such as inconsistent teaching levels and limited teaching resources[15]. The issue of whether curriculum homogenization is sufficient to ensure clinical competence has also attracted academic attention. There is evidence that the implementation of clinical training faces unique challenges and requires inter-agency collaborative response[16].These studies all point to a common problem: how to systematically evaluate the degree of homogenization of residents in multi-campus hospital training.

The evaluation of the homogenization of resident training in multi-campus hospital districts has unique methodological challenges, which makes it different from traditional training quality evaluation. Traditional quality assessment usually sets an absolute performance threshold to measure the performance of a single training program or trainees[17],while homogeneity assessment requires cross-hospital comparison to quantify the differences in the process and results of resident training between the main hospital area and the branch hospital area[18].This difference is conceptually significant : homogenization focuses on reducing inter-hospital variation rather than maximizing absolute performance, so a measurement framework for capturing inter-hospital differences needs to be specifically designed. Some studies have explored the definition of equivalence in medical education, and found that when the effect size of inter-hospital differences reaches Cohen 's d = 0.57, educators tend to think that there is substantial non-equivalence between different training sites. A study of the Shanghai residency training system found that hospital types and university affiliations could not explain the variation in the improvement of residents ' self-reporting ability, indicating that well-designed training programs can be used as a cross-agency ' balancer ' when properly implemented[19].However, at present, there is still a lack of mature tools that can systematically evaluate the equivalence degree of resident multi-campus hospital interval training in China, which restricts the scientific and refined management of resident training homogenization in multi-campus hospital hospitals to a certain extent.

Based on the above background, this study is devoted to constructing a set of evaluation index system suitable for the homogeneous training of residents in multi-campus hospitals.Based on the experience of international multi-campus hospital training evaluation, this study combines Delphi method and analytic hierarchy process[20], combs the indicators related to the homogenization of resident training through literature review, revises them through focus group interviews, and then reaches consensus

through multiple rounds of expert consultation. Finally, an evaluation framework covering four dimensions of management system, service ability, service quality and training quality is formed. The weight of each index is determined by the analytic hierarchy process, and on this basis, the scoring standard and evaluation grade based on the percentile system are established, and the management goal of " homogenization" is transformed into a quantitative difference index that can be directly compared between different districts. This evaluation system aims to provide diagnostic tools for multi-campus hospital hospitals to identify the weak links in the management of resident training, provide decision-making basis for residential training supervision and connotative high-quality development, and also provide reference measurement tools and case references for the homogeneity evaluation of resident training quality in multi-campus hospitals in Guangxi and even in the whole country.

2 Methods and materials

2.1 Index system construction process

In this study, ' resident physician ', ' quality of standardized training for resident physicians ', ' multi-campus hospital homogenization ' were used as keywords to search CNKI, Web of Science and other professional knowledge databases at home and abroad, as well as the post-graduate medical education website of Chinese Medical Doctor Association. The retrieved 19 policy texts and 98 core journal literatures were systematically analyzed, and the relevant indicators for evaluating the quality of resident physician training and the homogenization evaluation methods of multi-campus hospitals in hospitals were sorted out[21–29], and the applicable indicators for the evaluation of homogeneous training of resident physicians in multi-campus hospitals were preliminarily constructed. By means of focus group interviews and expert discussions, the evaluation indicators were adjusted and modified by means of focus group interviews and expert discussions with the leaders of the management and teaching colleges, the heads of the teaching departments, the heads of the professional bases and the full-time managers of the resident training hospitals and the multi-campus hospital training hospitals, and the framework of the evaluation index system for the homogeneous training of resident doctors in multi-campus hospital areas consulted by Delphi experts was formed.

2.2 Delphi consultation process

Delphi method, as a common qualitative decision-making method, is widely used in education, medical and other industries[30]. In this study, we fully considered the training coverage and operation difficulty of the residential training area. According to the selection criteria of Delphi consulting experts[31],we selected 22 experts and scholars with rich practice, management and research experience in the related fields of residential training in Guangxi and other provinces and cities to conduct Delphi consultation. The inclusion criteria of experts are as follows: more than 5 years engaged in residential training management and research work; bachelor degree or above; deputy senior and above titles; the unit has a multi-campus hospital training for residents; interested in this study and a high degree of cooperation. Two rounds of expert consultation were carried out in the form of online questionnaire and offline

discussion. Experts were invited to score the importance, familiarity and judgment basis of the indicators according to the scoring criteria. Finally, the evaluation index system of homogeneous training of residents in multiple hospitals was determined according to the feedback of experts. Detailed results are presented in Table 1.

Table 1
Quantitative table of importance, familiarity and judgment basis influence degree

Importance	***Value***	***Familiarity(Cs)***	***Value***	***Judgment basis (Ca)***	***Influence degree***		
					Large	***Medium***	***Small***
Very important	5	Very familiar	1.0	Practical experience	0.3	0.2	0.1
Important	4	More familiar	0.8	Theoretical analysis	0.5	0.4	0.3
General	3	Generally familiar	0.6	Reference materials	0.1	0.1	0.1
Unimportant	2	Less familiar	0.4	Intuitive feeling	0.1	0.1	0.1
very unimportant	1	Very unfamiliar	0.2	-	-	-	-

2.3 Evaluation index weight calculation

Analytic hierarchy process(AHP)[32] is a combination of qualitative and quantitative weight determination method for multi-objective complex problems. The essence is to establish a hierarchical structure and determine advantages based on logical and numerical consistency[33]. According to Saaty (1 ~ 9 scale method), the judgment matrix of pairwise comparison of indicators at all levels of homogenization training evaluation for residents in multi-campus hospital areas was constructed. By scoring the importance of each indicator, the weights of indicators at all levels were calculated and the consistency test was completed. When the consistency ratio $CR < 0.1$, it shows that the judgment matrix of homogenization training evaluation indicators for residents in multi-campus hospital areas meets the consistency requirements, and the obtained weighting results are credible.

2.4 Statistical analysis

The double independent entry method was used to complete the entry and verification of Delphi expert consultation data using Excel 2019. SPSS 25.0 software was used for statistical description, analysis and test of the data, and the test level was $\alpha=0.05$. SPSSPRO software was used to calculate the weight of indicators at all levels, and the consistency test was carried out. Finally, the evaluation index determined by the Delphi method is combined with the weight calculated by the AHP to construct a complete evaluation index system and evaluation criteria for the homogeneous training of residents in multi-campus hospital areas.

3 Results

3.1 Basic information of experts

Among the 22 experts who participated in the consultation, there were 8 males (36.36%) and 14 females (63.64%). The age was concentrated in 46–55 years old (50%);18(81.82%) had master 's degree or above; there were 22 people (100%) with deputy senior and above professional titles; the working years of residential training were concentrated in 5 to 10 years (68.18%), with the shortest time of 6 years and the longest time of 16 years.Most of the occupational categories were full-time management personnel (81.82%). Detailed results are presented in Table 2.

Table 2
Basic situation of experts(n = 22)

Basic information	N	Composition ratio (%)
Age group(years)		
35~45	9	40.91
46~55	11	50
>55	2	9.09
Gender		
Male	8	36.36
Female	14	63.64
Education		
Doctor	4	18.18
Master of Science	14	63.64
Undergraduate	4	18.18
Title		
Jung-senior	13	59.09
Vice-senior	9	40.91
Working years (years)		
5~10	15	68.18
>10	7	31.82
Occupational category		
Resident training full-time management personnel	18	81.82
Resident training professional base person in charge	4	18.18

3.2 Reliability analysis of expert opinion

The reliability results of expert opinions include three aspects: the degree of expert positivity, the degree of expert authority and the degree of coordination of expert opinions[34]. The effective recovery rate of the two rounds of consultation questionnaires was 100%, and the positive coefficient of the experts was greater than 70%, indicating that the experts participating in the consultation had a high degree of enthusiasm for this study.

The degree of expert authority is measured by the expert authority coefficient (*Cr*), which is the arithmetic average of the familiarity coefficient (*Cs*) and the judgment basis coefficient (*Ca*). It is

generally believed that the research results have high reliability when *Cr* > 0.7. The Cr value of expert consultation in this study was (0.973 + 0.955)/2 = 0.964, indicating that the expert authority was high and the consultation results were reliable.

The degree of coordination of expert opinions reflects whether there is a big difference in the evaluation of each indicator by experts. It is usually expressed by Kendall's coordination coefficient (*Kendell's W*) and variation coefficient (*CV*). The *Kendell's W* coefficients of the two rounds of expert consultation were 0.213 and 0.227, respectively, and the P values were less than 0.001, which was statistically significant. The coefficient of variation decreased from 0.12 ± 0.03 in the first round to 0.074 ± 0.041 in the second round. The CV of each index in the two rounds of consultation was less than 0.25, indicating that the experts opinions on the index tended to be coordinated and the evaluation index was desirable.Detailed results are presented in Table 3.

Table 3
The coordination degree of expert opinions and the range of coefficient of variation ($\bar{x} \pm s$)

Consultation rounds	*Kendall's W*	χ^2	*P*	*CV*
First round	0.213	51.448	<0.001	0.12 ± 0.03
Second round	0.227	94.899	<0.001	0.074 ± 0.041

3.3 Modification and determination of evaluation index

The framework of the evaluation index system for the homogenization training of resident doctors in multi-campus hospital areas initially proposed in this study includes three first-level indicators, such as the degree of homogenization of service ability, the degree of homogenization of service quality, and the degree of homogenization of training quality, as well as nine second-level indicators, such as the difference in the ratio of teachers and students, the difference in the ratio of full-time managers to residents, the difference in the compliance rate of teaching activities, the difference in the satisfaction of residents ' living allowance, the difference in the satisfaction of teachers ' qualification performance, the difference in the attendance rate of residents in teaching activities, the difference in the annual assessment pass rate, the difference in the pass rate of the first examination of medical practitioners, and the difference in the pass rate of the final examination of residential training. When the difference between the evaluation indexes of the main hospital area and the branch hospital area is 0, it indicates that the training quality of the resident doctors in the multi-campus hospital area is consistent. The more the evaluation indexes with a difference of 0, the higher the homogenization degree of the resident doctors in the multi-campus hospital area.

In the first round of expert consultation, the mean value of the importance assignment of each index ranged 4.182~4.909, the coefficient of variation ranged 0.06~0.166, and the full score ranged 31.8%~90.9%. According to the experts scoring of the importance and feasibility of the indicators, the

evaluation index boundary value is screened and the expert opinions are fully considered, and the important indicators that are not considered in the evaluation index system framework are added. The adjustment of the evaluation index is as follows: the second-level indicators are uniformly modified to increase the ' between hospital campuses ' ; the first-level index increases the homogeneity degree index of the evaluation management system, and integrates the difference of the unification rate of the institutional documents, the difference of the compliance rate of the use of the information system, the difference of the implementation rate of the coordination mechanism, and the difference of the consistency rate of the supervision and evaluation into the second-level index. In the degree of homogeneity of service ability, the difference in the proportion of teaching hours between hospitals is included in its secondary indicators; in the degree of homogenization of service quality, the difference in the timely rate of resident complaint handling between hospital sections was included in its secondary indicators; in the degree of homogeneity of training quality, the difference in the passing rate of the completion examination of the residential training is modified to the difference in the passing rate of the first examination of the residential training completion examination between the hospital, and the difference in the completion rate of the rotation plan between the hospital is included in its secondary indicators.

In the second round of expert consultation, the mean value of the importance assignment of each index ranged 4.5~5, the coefficient of variation ranged 0~0.114, and the full score ranged 45.5%~100%. After two rounds of expert consultation, the mean of each index was more than 3.5 points, the full score rate was more than 20%, the coefficient of variation was less than 0.25[35], and it was lower than the boundary value of 0.115. The experts opinions tended to be consistent, and the consultation was terminated. The evaluation index system of homogeneous training of residents in multi-campus hospital areas formed after the second round of expert consultation was used as the final version.

3.4 Determination of evaluation index weight

AHP was used to construct the hierarchical structure model of the evaluation index system for the homogeneous training of residents in multi-campus hospital areas. The indexes were compared in pairs to form five comparative judgment matrices, including one first-level index judgment matrix and four second-level index judgment matrices. The results show that the CR values of each layer of indicators are less than 0.1, and the consistency test is passed, that is, the weight distribution of each index is reasonable, and the weight of the evaluation index is finally determined. Among the first-level indicators, the degree of homogeneity of training quality has the highest weight, which is 0.305. Among the second-level indicators, the difference in consistency rate of supervision and evaluation between hospital campuses (0.293), the difference in compliance rate of educational activities between hospital campuses (0.281), the difference in resident satisfaction with living allowances between hospital campuses (0.278), and the difference in first-attempt pass rate of the medical licensing examination between hospital campuses (0.274) are the highest second-level indicator weights in their corresponding first-level indicators. The comprehensive weight of the difference in consistency rate of supervision and evaluation between hospital campuses in the degree of homogenization of the management system and

the difference in first-attempt pass rate of the medical licensing examination between hospital campuses in the degree of homogenization of the training quality is the highest, both of which are 0.084, indicating that they are the two core indicators in the evaluation index system of the homogenization training of residents in multi-campus hospital areas.Detailed results are presented in Table 4.

Table 4
Evaluation index system and index weight of homogeneous training of resident doctors in multi-campus hospital area

First-level indicators	Weight	Second-level indicators	Weight	Comprehensive weight
1 The degree of homogeneity of management system	0.285	1.1 The difference in uniformity rate of institutional documents between hospital campuses	0.257	0.073
		1.2 The difference in compliance rate of information system usage between hospital campuses	0.208	0.059
		1.3 The difference in implementation rate of coordination mechanisms between hospital campuses	0.242	0.069
		1.4 The difference in consistency rate of supervision and evaluation between hospital campuses	0.293	0.084
2 The degree of homogenization of service capabilities	0.205	2.1 The difference in proportion of teaching hours by clinical faculty between hospital campuses	0.275	0.056
		2.2 The difference in clinical faculty-to-resident ratio for residency training between hospital campuses	0.231	0.047
		2.3 The difference in ratio of full-time administrative staff to residents between hospital campuses	0.213	0.044
		2.4 The difference in compliance rate of educational activities between hospital campuses	0.281	0.058
3 The degree of homogeneity of service quality	0.205	3.1 The difference in timeliness rate of resident complaint handling between hospital campuses	0.229	0.047
		3.2 The difference in resident satisfaction with living allowances between hospital campuses	0.278	0.057
		3.3 The difference in satisfaction of residency training faculty with performance incentives between hospital campuses	0.254	0.052

First-level indicators	Weight	Second-level indicators	Weight	Comprehensive weight
		3.4 The difference in resident attendance rate at educational activities between hospital campuses	0.239	0.049
4 The degree of homogeneity of training quality	0.305	4.1 The difference in completion rate of rotation plans between hospital campuses	0.258	0.079
		4.2 The difference in pass rate of annual assessments between hospital campuses	0.207	0.063
		4.3 The difference in first-attempt pass rate of the medical licensing examination between hospital campuses	0.274	0.084
		4.4 The difference in first-attempt pass rate of the residency training completion assessment between hospital campuses	0.261	0.080

3.5 Evaluation index assignment and evaluation criteria

The evaluation index system of homogeneous training of residents in multi-campus hospital areas is evaluated by scoring method. According to the weight determined by each index, the weight is converted into a hundred-point system for scoring. The evaluation criteria refer to the criteria of ' Evaluation Index of Resident Standardized Training Base (2024 Edition) '. The evaluation score < 70 points is considered to be different in the training of residents in multi-campus hospital areas, 70 points ≤ evaluation score < 80 points is considered to be basically homogeneous in the training of residents in multi-campus hospital areas, and the evaluation score ≥ 80 points is considered to be homogeneous in the training of residents in multi-campus hospital areas.Detailed results are presented in Table 5.

Table 5
Scoring table of evaluation indexes for homogeneous training of resident doctors in multi-campus hospital areas

First-level indicators	Score values	Second-level indicators	Score values	Score
1 The degree of homogeneity of management system	29	1.1 The difference in uniformity rate of institutional documents between hospital campuses	7	
		1.2 The difference in compliance rate of information system usage between hospital campuses	6	
		1.3 The difference in implementation rate of coordination mechanisms between hospital campuses	7	
		1.4 The difference in consistency rate of supervision and evaluation between hospital campuses	9	
2 The degree of homogenization of service capabilities	20	2.1 The difference in proportion of teaching hours by clinical faculty between hospital campuses	6	
		2.2 The difference in clinical faculty-to-resident ratio for residency training between hospital campuses	4	
		2.3 The difference in ratio of full-time administrative staff to residents between hospital campuses	4	
		2.4 The difference in compliance rate of educational activities between hospital campuses	6	
3 The degree of homogeneity of service quality	20	3.1 The difference in timeliness rate of resident complaint handling between hospital campuses	4	
		3.2 The difference in resident satisfaction with living allowances between hospital campuses	6	
		3.3 The difference in satisfaction of residency training faculty with performance incentives between hospital campuses	5	
		3.4 The difference in resident attendance rate at educational activities between hospital campuses	5	
4 The degree of homogeneity of training quality	31	4.1 The difference in completion rate of rotation plans between hospital campuses	8	

First-level indicators	Score values	Second-level indicators	Score values	Score
		4.2 The difference in pass rate of annual assessments between hospital campuses	6	
		4.3 The difference in first-attempt pass rate of the medical licensing examination between hospital campuses	9	
		4.4 The difference in first-attempt pass rate of the residency training completion assessment between hospital campuses	8	
Total score			100	

4 Discussion

4.1 The significance of the construction of evaluation index system

Under the background that the development of multi-campus hospital areas has become a strategic choice for the high-quality development of large public hospitals, ensuring the homogeneous training of residents in different hospital areas is a key link to ensure the quality of medical personnel training and improve the overall medical service ability[10,36]. However, there is still a lack of systematic research tools on how to scientifically and objectively evaluate the degree of homogenization of the quality of multi-campus hospital residential training. This study uses Delphi method and AHP to construct an evaluation index system for homogeneous training of residents in multi-campus hospital areas, including 4 first-level indicators and 16 second-level indicators. It explores the quantification of the management goal of 'homogenization' as a measurable and comparable difference index. It provides a scientific basis for multi-campus hospital hospitals to identify the weak links of residency training management, residency training supervision and precise implementation of connotative high-quality development. It also provides measurement tools and reference indicators for hospitals in other regions to carry out research on homogeneous evaluation of residency training quality in multi-campus hospital areas.

4.2 Scientific analysis of the construction of evaluation index system

This study follows the standardized process of index system construction, and comprehensively uses qualitative and quantitative research methods to ensure the scientificity of the research process and the reliability of the results. In the early stage of the construction of the evaluation index system, through systematic literature search and policy text analysis, combined with focus group interviews, the initial indicators were revised at the practical level to make the indicators more suitable for the actual situation

of multi-campus hospital management evaluation[4,9,16,37]. In the selection of Delphi consultation experts, the selected 22 experts have rich experience in residential training management and research. The analysis of the consultation data shows that the expert's authority coefficient, enthusiasm, familiarity, and coordination of opinions are good. It can be considered that the expert consultation results are scientific and the results are credible. In the selection of weight calculation methods, the consistency ratios of the five judgment matrices constructed by the AHP are all less than 0.1, indicating that the experts have good logical consistency in the judgment of index importance, and the calculated weight distribution is reasonable and reliable[7,20,38].

4.3 Content analysis of evaluation index system

The evaluation index system finally determined in this study includes 4 first-level indicators and 16 second-level indicators, which basically cover all dimensions of evaluating the homogenization of residential training. From the perspective of weight distribution, the index weight of ' degree of homogeneity of training quality ' is the highest (0.305), which is fully consistent with the ultimate goal of training qualified clinicians, and the homogeneity of training quality is usually regarded as the fundamental standard to measure the success or failure of multi-campus hospital training. Among the secondary indicators, the weight of ' the difference in first-attempt pass rate of the medical licensing examination between hospital campusesl ' (comprehensive weight 0.084) and ' the difference in first-attempt pass rate of the residency training completion assessment between hospital campuses ' (comprehensive weight 0.080) are prominent. These two indicators are key indicators of training quality and can directly reflect whether the theoretical and clinical capabilities of residents in different hospital areas are homogeneous. The weight of ' the degree of homogeneity of the management system ' ranks second (0.285), and its secondary index ' the difference in consistency rate of supervision and evaluation between hospital campuses ' (0.293, comprehensive weight 0.084) is also one of the highest comprehensive weights in the entire index system, which confirms that the consistency of the supervision and evaluation is to ensure that the rules and regulations and teaching activities are fully implemented in each hospital[3,8,18,39]. The weight of ' homogeneity of service ability ' (0.205) and ' homogeneity of service quality ' (0.205) is juxtaposed third. The former focuses on the equalization of resident training resource input and process execution, such as ' the difference in compliance rate of educational activities between hospital campuses ' (0.281) and ' the difference in proportion of teaching hours by clinical faculty between hospital campuses ' (0.275). The latter pays more attention to the experience and feelings of students, among which ' the difference in resident satisfaction with living allowances between hospital campuses ' (0.278) has the highest weight.This shows that ensuring the reasonable treatment of residents and improving their satisfaction are important incentive factors for stabilizing the resident team and stimulating their training motivation. It is also an indispensable humanistic care for the homogeneous training of resident training[15,40].

4.4 Innovative analysis of the evaluation index system

This study quantifies ' homogenization ' by ' difference ', and constructs a scoring standard and evaluation system based on the percentile system, which breaks through the limitation of absolute

evaluation of the quality of resident training in a single hospital in the past. The management goal of ' homogenization ' is transformed into the relative difference of each index in different hospitals, which makes the evaluation results more intuitive and operational, and facilitates the practical application of multi-campus hospital hospitals in hospital self-evaluation. At the same time, the research content focuses on the homogenization of resident training in multi-campus hospital hospitals. At present, there are few systematic evaluation studies on the quality of resident training in multi-campus hospital hospitals at home and abroad. The evaluation index system covering four dimensions of management system, service ability, service quality and training quality constructed in this study improves the research content in this field. In addition, indicators with the characteristics of management process, such as the difference in consistency rate of supervision and evaluation between hospital campuses and the difference in uniformity rate of institutional documents between hospital campuses, are included in the index design. Compared with the traditional evaluation system based on outcome indicators, it also emphasizes the basic role of process management and institutional guarantee in homogeneous training. In the result analysis, two core evaluation indicators, the difference in consistency rate of supervision and evaluation between hospital campuses and the difference in first-attempt pass rate of the medical licensing examination between hospital campuses, are also identified, which provides a key starting point for the homogeneous management of residential training in multi-campus hospital hospitals.

5 Limitations

The evaluation index system of homogeneous training of resident doctors in multi-campus hospitals constructed in this study is still in the stage of academic exploration. Due to the large differences in medical resources and the development level of residential training in different regions, whether each index has wide representativeness and applicability in other provinces and cities may also need to be adjusted according to the local actual situation. The availability of evaluation index data and the operability of the evaluation process need to be tested in practice. In the future, the empirical evaluation of resident homogenization training will be carried out based on specific multi-campus hospital hospitals, and the evaluation index system will be optimized according to the empirical results.

6 Conclusion

Based on Delphi method and AHP, this study constructed a set of evaluation index system for homogeneous training of resident doctors in multi-campus hospital areas, including 4 first-level indicators and 16 second-level indicators. After two rounds of expert consultation, the results show that the index system has high scientificity and reliability, and the weight distribution is reasonable. The core indicators are ' the difference in consistency rate of supervision and evaluation between hospital campusess ' and ' the difference in first-attempt pass rate of the medical licensing examination between hospital campuses '. The system quantifies the homogenization goal with ' difference ', covering key dimensions such as management, service and training, and provides scientific and operable tools and empirical basis for the quality evaluation and homogenization management of residential training in multi-campus hospital hospitals.

Abbreviations

resident training
The standardized training of residents
residents
resident standardized training trainees
AHP
Analytic hierarchy process

Declarations

Ethics approval and consent to participate

The study was approved by People's Hospital of Guangxi Zhuang Autonomous Region and Guangxi Academy of Medical Sciences (No:KY-KJT-2023-206). Informed consent was obtained from all individual participants included in this study. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Competing interests

The authors declare no competing interests.

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Author Contribution

Ruida Zhang:Writing-original draft preparation.Qiaoying Wei:Visualization.Chen Lv:Conceptualization.Yuxueyun Li:Formal analysis and investigation. Qinji Liao:Formal analysis and investigation.Haiyan Luo:Methodology.Kun Ye:Supervision.Dongfeng Wu:Formal analysis and investigation.Shenglin Liang: Writing-review and editing

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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