

Development of a Multiprofessional Collaboration Evaluation Index System for Family Doctor Teams: Postprint

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Date: 2024-09-10T00:00:00+00:00

Abstract

Background: Effective multi-professional collaboration within family doctor teams is crucial for meeting residents' increasingly complex health needs and delivering high-quality integrated health services; however, scientifically feasible evaluation tools for team-based multi-professional collaboration are currently lacking. Objective: To develop an evaluation indicator system for multi-professional collaboration in family doctor teams based on the Four-Dimensional Collaboration Model (D'Amour Model), thereby providing empirical evidence for the continuous development of family doctor teams and their multi-professional collaboration. Methods: The indicator system was initially constructed through literature analysis, policy induction, and semi-structured interviews. From April to June 2023, a modified Delphi method was employed to conduct two rounds of expert consultation with 24 experts, and the evaluation indicator system was finalized based on the consultation results. The analytic hierarchy process-entropy weight method comprehensive weighting approach was used to determine indicator weights. Results: The effective response rates for both rounds of consultation were 100.00% (24/24). The expert authority coefficients were 0.874 and 0.885, respectively, and the Kendall coordination coefficients were 0.157 ($\chi^2 = 166.005$, $P < 0.05$) and 0.146 ($\chi^2 = 151.145$, $P < 0.05$), respectively. The final evaluation indicator system for multi-professional collaboration in family doctor teams comprised 5 first-level indicators, 11 second-level indicators, and 27 third-level indicators with their respective weights. The weights for the first-level indicators "Shared Goals and Vision," "Internalization," "Governance," "Standardization," and "Incentive" were 0.1267, 0.1904, 0.2913, 0.1180, and 0.2754, respectively. Conclusion: The developed evaluation indicator system for multi-professional collaboration in family doctor teams demonstrates strong scientificity and operability, holding theoretical and practical significance for enhancing team-based multi-professional collaboration.

Full Text

Construction of an Evaluation Index System for Inter-professional Collaboration in Family Doctor Teams

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Abstract

Background: Implementing effective inter-professional collaboration within family doctor teams is essential for meeting residents' increasingly complex health needs and delivering high-quality integrated care. However, scientifically sound evaluation tools for assessing inter-professional collaboration in Chinese family doctor teams are currently lacking. **Objective:** To develop an evaluation index system for inter-professional collaboration in family doctor teams based on the Collaboration Four-Dimensional Model (D'Amour Model), providing empirical evidence for the continuous development of family doctor teams and their inter-professional collaboration. **Methods:** An initial index system was established through literature analysis, policy review, and semi-structured interviews. From April to June 2023, a two-round expert consultation was conducted with 24 experts using the modified Delphi method, and the evaluation index system was finalized based on the consultation results. The weights of the indices were determined using a combined weighting method of Analytic Hierarchy Process (AHP) and Entropy Weight Method. **Results:** The effective response rate for both rounds of expert consultation was 100.00% (24/24). The expert authority coefficients were 0.874 and 0.885, respectively, and the Kendall coordination coefficients were 0.157 ($\chi^2=166.005$, $P<0.05$) and 0.146 ($\chi^2=151.145$, $P<0.05$), respectively. The final evaluation index system for inter-professional collaboration in family doctor teams comprised 5 first-level indicators, 11 second-level indicators, 27 third-level indicators, and their corresponding weights. The weights for the first-level indicators "Shared Goals and Vision," "Internalization," "Governance," "Formalization," and "Incentive" were 0.1267, 0.1904, 0.2913, 0.1180, and 0.2754, respectively. **Conclusion:** The constructed evaluation index system for inter-professional collaboration in family doctor teams demonstrates strong scientific validity and operational feasibility, offering both theoretical and practical significance for enhancing inter-professional collaboration within family doctor teams.

Keywords: family practice; family doctor team; inter-professional collaboration; modified Delphi method; analytic hierarchy process; entropy weight method; combined weight method; indicator system

1. Background and Methods

1.1 Theoretical Framework and Index Pool Development

1.1.1 Theoretical Framework: The D'Amour Model The D'Amour Model analyzes inter-professional collaboration in primary healthcare systems through four dimensions and ten indicators. Two of these dimensions—Shared Goals and Vision, and Internalization—concern interpersonal relationships, while Formalization and Governance concern the organizational environment that influences collective action. These four dimensions are interrelated and mutually influential. The model has been validated across various collaborative settings, including teams, organizations, and health service networks [11]. Chinese scholar Tang Wenxi et al. [12] added an “Incentive” dimension to the original model through literature review, expert consultation, and stakeholder interviews, creating an adjusted D'Amour Model (Figure 1 [Figure 1: see original paper]) more suitable for China's healthcare system. This study adopts the adjusted D'Amour Model as its initial theoretical framework.

1.1.2 Establishing the Index Pool Three approaches were used to develop the initial index pool. First, **literature analysis** was conducted by searching Chinese databases (CNKI, Wanfang, VIP) using Chinese keywords including “family doctor team,” “general practice team,” “family doctor,” “collaboration,” and “cooperation,” and international databases (PubMed, Web of Science) using English keywords such as “inter-professional collaboration,” “multi-professional collaboration,” “multidisciplinary collaboration,” “teamwork,” “collaboration,” “team-based,” and “primary care” from January 2000 to February 2023. Second, **policy review** examined policy documents and research reports on family doctor teams from the National Health Commission website. Third, **semi-structured interviews** were conducted using purposive sampling with six family doctor teams from Guangzhou's Huangpu District to qualitatively investigate inter-professional collaboration. Based on literature, policy documents, and qualitative findings, combined with expert opinions through repeated discussions and screening, a preliminary evaluation index system for inter-professional collaboration in family doctor teams was established, comprising 5 first-level indicators, 11 second-level indicators, and 29 third-level indicators.

1.2 Expert Consultation

1.2.1 Delphi Consultation Process The expert consultation questionnaire consisted of four parts: (1) questionnaire instructions including study introduction, completion guidelines, main content, and deadline; (2) expert basic information form covering gender, age, education, professional title, institution, and work experience; (3) family doctor team inter-professional collaboration evaluation index consultation form using a 5-point Likert scale for importance

rating, with a modification comment section for expert suggestions; and (4) self-assessment forms for index familiarity and judgment basis. Familiarity was rated as very unfamiliar (0), unfamiliar (0.25), neutral (0.50), familiar (0.75), or very familiar (1.00) [13]. Judgment basis included theoretical analysis, practical experience, domestic/international literature reference, and subjective judgment, quantified as large, medium, or small (theoretical analysis: 0.3/0.2/0.1; practical experience: 0.5/0.4/0.3; literature reference: 0.1/0.1/0.1; subjective judgment: 0.1/0.1/0.1).

1.2.2 Expert Selection Using purposive sampling, 24 experts were selected from universities, research institutes, and primary healthcare institutions in Beijing, Guangdong, Shandong, Tianjin, Zhejiang, Hubei, and Jiangsu. Researcher inclusion criteria were: (1) engaged in primary healthcare services, family doctor team, or inter-professional collaboration research; (2) bachelor's degree or higher; (3) intermediate professional title or higher; and (4) voluntary participation. Practitioner inclusion criteria were: (1) familiar with family doctor team practice or ≥ 5 years of work experience in family doctor teams; and (2) voluntary participation. While 15-50 experts are generally recommended for Delphi studies [14], this study included 24 experts based on practical considerations.

Two rounds of expert consultation were conducted. In April 2023, the first-round questionnaire was distributed. After collection, indices were screened based on importance mean score >3.5 , coefficient of variation $<25\%$, and full-score ratio $>20\%$ [15]. Expert suggestions were discussed with research team members, leading to index deletion, modification, and addition. The revised questionnaire was then used for the second round, where experts were provided with first-round results for reference and asked to re-rate the modified indices. After the second round, the index system was finalized based on screening criteria and expert opinions.

1.3 Weight Determination

1.3.1 Analytic Hierarchy Process (AHP) As a subjective weighting method, AHP first established a hierarchical structure model based on the index system, including the target decision layer, first-level index criterion layer, second-level index criterion layer, and third-level index alternative layer. Experts were then invited to conduct pairwise comparisons of indices at the same level to determine relative importance using Saaty's 1-9 scale [16]. Finally, single-level and total-level ranking weights were calculated with consistency testing.

1.3.2 Entropy Weight Method This objective weighting method assigns weights based on the effective information provided by objective data. When an index has smaller information entropy, greater dispersion, and provides more information, its weight is larger, and vice versa [17]. Based on the constructed index system, survey questionnaires and field observation record forms were de-

veloped. A multi-stage random sampling method was used: first, Guangzhou's 11 districts were stratified by family doctor team development effectiveness into four layers, with one district randomly selected from each layer (Haizhu, Yuexiu, Huangpu, Zengcheng); then one primary healthcare institution was randomly selected from each district; finally, two teams were randomly selected from each institution as survey objects.

1.3.3 Combined Weighting Method Following the principle of combining subjective and objective approaches, the weighting results from AHP and Entropy Weight Method were integrated using the additive synthesis formula [18]: $x = (h + z)/2$, where x is the combined weight of index i , h is the subjective weight from AHP, and z is the objective weight from Entropy Weight Method.

Data were organized using Excel 2019 and analyzed using SPSS 26.0. Categorical data were expressed as frequency and percentage. Expert participation was reflected by questionnaire response rate and percentage of experts providing suggestions, with 60% considered high participation. Expert authority was measured by the authority coefficient ($Cr = (Ca + Cs)/2$, where Ca is judgment coefficient and Cs is familiarity coefficient), with $Cr > 0.70$ indicating high authority. Expert opinion coordination was measured by Kendall's coordination coefficient (W), where higher W indicates better coordination. AHP was performed using Yaahq12.7 software, with random consistency ratio (CR) < 0.10 considered acceptable. Entropy weights were calculated using Excel 2019 to obtain objective weights.

2. Results

2.1 Expert Characteristics

Among the 24 experts, 15 were female (62.50%), 16 were 39 years old (66.67%), 15 held doctoral degrees (62.50%), 10 had intermediate professional titles (41.67%), and 10 had 6-10 years of work experience (41.67%). Sixteen experts were from domestic universities and research institutes (66.67%), and eight were from primary healthcare institutions (33.33%). Details are shown in Table 1 .

2.2 Expert Participation

In both rounds, 24 questionnaires were distributed and 24 valid questionnaires were returned (100.0% response rate). The rates of experts providing suggestions were 66.67% and 33.33%, respectively, indicating high expert participation.

2.3 Expert Authority

In the two rounds, the familiarity coefficients (Cs) were 0.823 and 0.844, judgment coefficients (Ca) were both 0.925, and authority coefficients (Cr) were 0.874 and 0.885, respectively, demonstrating high expert authority.

2.4 Expert Opinion Coordination

For third-level indices, Kendall's coordination coefficients (W) were 0.157 ($\chi^2=166.005$, $P<0.05$) and 0.146 ($\chi^2=151.145$, $P<0.05$) in the two rounds, indicating high consistency among experts and strong reliability of the index system.

2.5 Index Screening Results

In the first round, first-level indices had importance scores of 4.50-4.92, variation coefficients of 0.057-0.169, and full-score ratios of 87.50%-100.00%. Second-level indices scored 4.46-4.88, with variation coefficients of 0.069-0.162 and full-score ratios of 87.50%-100.00%. Third-level indices scored 4.00-4.92, with variation coefficients of 0.057-0.231 and full-score ratios of 62.50%-100.00%. Based on screening criteria, expert suggestions, and team discussions, indices were modified as follows: (1) Two second-level indices ("assessment" and "performance distribution") were deleted, while two ("external incentive" and "internal incentive") were added. Four second-level indices were revised: "patient-centered" to "people-centered," "mutual familiarity" to "interpersonal interaction," "normative tools" to "collaborative norms," and "information exchange" to "normative support system." (2) Five third-level indices were deleted ("meeting patient needs," "support from other organizations," "existence of normative tools," "use of normative tools," "application of assessment results"), five were added ("conflict management," "collaboration's enhancement of individual service capacity," "collaboration's enhancement of team service capacity," "service norms," "management norms"), and nine were revised.

In the second round, first-level indices scored 4.58-4.88, with variation coefficients of 0.069-0.143 and full-score ratios of 91.67%-100.00%. Second-level indices scored 4.29-4.88, with variation coefficients of 0.069-0.175 and full-score ratios of 83.33%-100.00%. Third-level indices scored 4.00-4.92, with variation coefficients of 0.057-0.243 and full-score ratios of 79.17%-100.00%. Based on screening criteria, expert opinions, and discussions, further adjustments were made: one third-level index ("goal rationality") was deleted, and three third-level indices were revised ("team communication" to "non-professional knowledge exchange," "information sharing" to "information support," and "fairness of performance evaluation results" to "matching compensation with effort").

After two rounds of consultation, the final evaluation index system for inter-professional collaboration in family doctor teams was established, comprising 5 first-level indicators, 11 second-level indicators, and 27 third-level indicators (Table 2).

2.6 Index Weight Results

The AHP-Entropy Weight Method combination yielded the following first-level indicator weights: “Shared Goals and Vision” (0.1267), “Internalization” (0.1904), “Governance” (0.2913), “Formalization” (0.1180), and “Incentive” (0.2754). Among second-level indicators, the top three combined weights were “Leadership” (0.1580), “External Incentive” (0.1451), and “Internal Incentive” (0.1303). Among third-level indicators, the top three were “Team Leader Stability” (0.0980), “Collaboration’s Enhancement of Team Service Capacity” (0.0766), and “Performance Evaluation System Completeness” (0.0614). All judgment matrices in AHP had corrected CR values < 0.10 , meeting consistency requirements (Table 3).

3. Discussion

3.1 Scientific Validity of the Evaluation Index System

This study employed multiple scientific methods to ensure validity. First, the adjusted D’Amour Model served as the theoretical framework, incorporating core indicators from domestic and international inter-professional collaboration evaluations in primary healthcare systems, such as “organizational support” and “time and space” from Reeves et al.’s conceptual model [19], “role clarity” and “shared decision-making” from the Collaborative Practice Assessment Tool (CPAT) [8], “goal consistency” and “informal communication” from the Assessment of Interprofessional Team Collaboration Scale (AITCS) [9], and “team composition” from Ma Wenhan et al. [20]. Elements from the Primary Care Team Dynamics Scale (PCTDS), Team Climate Inventory (TCI), and trust theory were also integrated. Semi-structured interviews further analyzed the processes, barriers, and facilitators of inter-professional collaboration in Chinese family doctor teams, ensuring the initial index pool’s scientific rigor, purposefulness, and representativeness. Second, the modified Delphi method was used to screen indices, with strict expert selection criteria based on authority, representativeness, and diversity, yielding 24 qualified experts from seven provinces. Quality control measures including concept explanations and clear instructions resulted in high expert participation, authority, and opinion coordination, demonstrating the experts’ credibility and the index system’s scientific validity. Finally, the combined weighting method integrated subjective and objective approaches, avoiding subjective bias from expert 固有思维 while compensating for Entropy Weight Method’s limitation of ignoring intrinsic index importance [21], resulting in more accurate and reasonable weights.

3.2 Content and Weight Analysis

In “Shared Goals and Vision,” the weights of “Shared Goals” and “People-Centered” were similar. Shared goals and people-centered vision have long

been considered the cornerstone of inter-professional collaboration [22], as teams with people-centered shared goals can set clear directions and generate positive collaborative dynamics and coordinated actions. “Internalization” emphasizes “Interpersonal Interaction,” as frequent and sustained interaction among members forms the foundation of inter-professional collaboration. Through formal/informal communication and professional training, members understand each other’s capabilities, roles, and contributions, developing interpersonal relationships that foster mutual trust and dependence. Within “Interpersonal Interaction,” “Professional Knowledge Sharing” had the highest weight. As emphasized by The Lancet Commission, professionals often lack effective teamwork capabilities [23], suggesting that inter-professional training can enhance collaborative skills, knowledge, and culture. In “Governance,” “Leadership” carried substantial weight. Previous research shows that collaboration among team members is often driven by leaders who communicate collaborative goals and vision, clarify role divisions, and coordinate conflict resolution [24-25]. “Team Leader Stability” proved more important than “Team Leader Capability,” as stability ensures consistent team structure, work methods, and content, allowing collaboration to continue without members needing to expend energy on re-familiarization and adaptation. In “Formalization,” “Collaborative Norms” had higher weight, as standardized documents like service guidelines and team work plans facilitate orderly collaboration. In “Incentive,” “External Incentive” slightly outweighed “Internal Incentive.” Current incentives for family doctor teams primarily rely on external material rewards [26], and research indicates that without external incentives, structural measures like team formation and collaborative norms alone cannot foster genuine collaboration [12]. Within “External Incentive,” “Performance Evaluation System Completeness” had high subjective and objective weights, reflecting that performance evaluation is a crucial prerequisite for ensuring fair and transparent material incentives.

3.3 Significance and Application

Family doctor teams serve as the fundamental unit of primary healthcare systems, acting as residents’ “health gatekeepers.” Effective inter-professional collaboration within these teams is key to meeting complex health needs and delivering high-quality integrated services. However, whether substantive “collaboration” exists among team members and whether they provide truly coordinated, continuous, and comprehensive services remains unclear. This index system serves three purposes: First, it enables quantitative, objective, and accurate measurement and evaluation of inter-professional collaboration in Chinese family doctor teams, providing intuitive and comprehensive understanding of current collaboration status. Second, it facilitates deeper research on family doctor team collaboration, helping construct an evidence chain between “family doctor team model—inter-professional collaboration level—health outcomes” to explore how team service models exert their effects. Third, it promotes inter-professional collaboration practice by identifying weak links and deficiencies in team collaboration processes, enabling improvement through evaluation.

This study combined multiple qualitative and quantitative methods to develop a scientifically sound and applicable evaluation index system for inter-professional collaboration in family doctor teams, providing an effective tool for policymakers to advance team collaboration and professional integration. However, limitations exist. First, semi-structured interviews and Entropy Weight Method were conducted only in Guangdong Province. As family doctor team operations vary across provinces, factors affecting inter-professional collaboration may differ, limiting sample representativeness. Second, family doctor team development is an evolving process, making this index system applicable only to the current stage. Future revisions, adjustments, and improvements to index content, weights, and scoring criteria will be needed as practice develops.

Author Contributions: ZHENG Caiyun was responsible for study design and implementation, data collection and analysis, and manuscript writing. WU Shuanger was responsible for literature review and data collection. YU Ganquan was responsible for policy review, data collection, and organization. WANG Xin was responsible for study implementation and feasibility analysis, quality control, and manuscript review.

Conflict of Interest: The authors declare no conflict of interest.

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Received: 2023-11-10; Revised: 2024-07-31

Edited by: WANG Shiyue

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.