Effect of Collaborative Governance on Medical and Nursing Service Combination: An Evaluation Based on Delphi and Entropy Method

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Research

**Keywords:** Medical and nursing care combination, Pension services, Collaborative supply, Index construction, Evaluation of synergistic effect

**DOI:** https://doi.org/10.21203/rs.3.rs-704236/v1

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Effect of collaborative governance on medical and nursing service combination: An evaluation based on Delphi and Entropy Method

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Abstract

[Background] Improved of synergies on medical and nursing services can help governments to optimize the allocation of medical resources, however, an appropriate evaluation method is critical for an appropriate decision process in this regard.

[Method] To assess medical and nursing service combination (MNSC) at regional level, this study applied a 5-dimension evaluation index composed by 28 basic response areas related to the MNSC development status in China determining its respective weight through Delphi and entropy method.

[Result] This empirical exercise analyzed the MNSC supply system by interviewing 9 head of medical and nursing institutions and 11 healthcare-related government personnel during August of 2020 in Xinxiang City, Henan province, P.R China. Results showed that (1) public satisfaction with the fees charged by Medical and Nursing service Institutions (MNSI); (2) Medicare and supply services policy publicity; (3) external financing situation of MNSI; (4) medical staff professional quality; (5) medical facilities and supply of MNSI; and (6) recognition level of the development plan of MNSI scored the highest effect on the synergy of MNSC supply among the assessed factors.

[Conclusion] These results showed that an evaluation based on Delphi and Entropy Method can effectively integrate the opinions of experts and related institutions to evaluate synergies on medical and nursing service supply.

Keywords: Medical and nursing care combination; Pension services; Collaborative supply; Index construction; Evaluation of synergistic effect.

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1. Introduction

Given a context of sustained population aging [1], providing appropriate healthcare support for elderly is becoming increasingly challenging, especially when the contradiction caused by the separation of medical care and nursing care is becoming increasingly prominent as the post-medical follow up period is longer on senior ages, requiring a sustained long-term professional care. The traditional healthcare model seems to be unable to provide an appropriate set of services as the separation between health and nursing services suggests that medical treatment and off-clinic eldercare is clearly defined, ignoring a comprehensive perspective as opportunities for synergies.

Although medical institutions can provide qualified treatment, chronic conditions, major diseases, and disabilities related to this segment require longer term nursing support. Medical services may struggle to meet the daily needs associated to higher age, even more, without articulation of nursing services support in terms of prevention and illness identification, hospital services may experience case saturation with all problems associated to “filled hospital beds” phenomena. Medical and Nursing Service Combination (MNSC) can effectively integrate prevention and treatment with effect on healthcare sustainability for senior citizens contributing to address one of the main challenges that healthcare sectors around the world are trying to solve [2].

For the case of China, despite having a notable development during the latest decades, MNSC has started late in contrast to developed countries in Europe and the United States and still have problems that require to be addressed, for example medical and nursing service system is still behind on service fragmentation and synergies development, medical and nursing resource distribution presents great difference between regions and institutions [3]. Further articulation of government, capital, hospitals, eldercare institutions, patients and other related actors are fundamental for synergy development and service improvements for MNSC [4].

MNSC collaborative supply refers to coordination and cooperation among subjects in a shared network to develop an interdependent and structured supply structure intended to maximize service satisfaction to ultimately increase public trust and confidence. Nowadays researchers have applied theory of synergy on local and international scenarios [5,6] to study regional medical resources [7], public health services [8], retirement pension service supply [9], combination of medical and nursing services [10]. However, existing research have been mainly focused on theoretical construction of collaborative supply mechanisms of combined medical care and eldercare services, having just few studies on index system development to measure the synergy within MNSC in different regions from a practical view. As previously mentioned, combined service supply may be determinant to increase elder population life quality, and an appropriate evaluation mechanism on synergies for each specific context is urgently needed by academic and industry to continue developing solutions at theoretical and practical level.

By determining MNSC as object of study, this empirical exercise considered relevant literature, expert interviews, and the status development of MNSC in China to construct an evaluation index system that assess the synergistic effect of MNSC service supply applying it to the specific case of Xinxiang city, Henan province in China. The following sections of this paper will explain the construction of the mentioned evaluation index (Title 2), the construction of the evaluation model for MNSC (Title 3), the empirical application (Title 4), and its respective conclusions and discussions (Title 5).
2. Evaluation Index Construction for MNSC Supply.

Based on Rainbow Model[11,12], there are 3 denominations for institutions that compose MNSI: (1) medical institutions within eldercare institutions [9]; (2) medical institutions that provide eldercare-related services [13]; and (3) institutions that provide medical and nursing services in accordance with a cooperation agreement between eldercare and medical. In this last case medical institutions send medical personnel to eldercare institutions in a regular basis to provide medical services, establishing at the same time a green channel to facilitate senior citizens access to medical treatment, on regard to nursing services of rehabilitation and convalescence, these are responsibility of the eldercare institution [13], resulting in a two-way referral care model [14,15].

Setting an evaluation index system to assess the effect of synergistic supply of medical and nursing services should be able to integrate basic theoretical basis with principles of scientific and reasonable evaluation index system construction, as well as the actual context and background of the MNSC development in China. This research shows that the collaborative development of medical and nursing service system not only depends on synergies within the MNSC system and supply of medical staff, but it is also related to policy environment, social environment, and stakeholder system of MNSC [16]. Consistent with these elements, this study has developed an evaluation index for MNSC supply in China based in five dimensions: (1) policy environment supply system, (2) social environment supply system, (3) professional network supply system, (4) medical care supply system and stakeholder system from the perspective of synergetic theory. Details for each dimension are described as follows:

2.1. Policy environment supply system.

Mainly refers to relevant government functional departments and medical institutions involved in policy development and resources environment, this group includes government departments, more specifically includes Health and Family Planning Commission, Office of Aging, Ministry of Civil Affairs, Ministry of Finance, Development and Reform Commission, Health Insurance Bureau among others related [17]. In the Chinese context these institutions usually own strong authority within their own jurisdictions, although interdependent, these are also coordinated and each department play a clearly defined role guiding the development and application of MNCS supply [18]. This dimension considers their role on policy formulation, promotion, y implementation as well as related aspects of relevant government departments of MNSC in China.

2.2. Social environment supply system.

Social environment is defined by the surrounding environment for each MNSI, as the social support cannot be overseen in the process of service construction and development as some related factors may influence the development of MNSI. Related factors include (1) relevant insurance system in combination with healthcare, as well of the development of eldercare and medical services in China is currently carried out through regulations and issuance of some province-level regulations and policy documents [19]; (2) legal system related to MNSC, defined as the basic warranty for development of MNSC; (3) market development mechanism construction, the development degree of MNSI and its market mechanisms are closely related [20]. (4) MNSI and its external financing situation, as MNSC
requires constant financial support, funding constrains determine the pace and sustainability of institution construction and expansion [21]; (5) Last and relevant is the supervision mechanism for MNSI, the government as the main body of macro-control oversees the supervision of the whole process of MNSC supply system guaranteeing the stable operation of the project [22,23].

2.3. Professional network supply system.

This index refers to the grade of guarantee of eldercare environment, facilities and equipment that ensures coverage of seniors’ security needs[24]. This study also evaluates the grade of synergy in MNSI professional network supply system in China by combining (1) supply of basic materials and equipment, like facilities and equipment, (2) standardization of medical and nursing institutions, (3) degree of information construction in MNSI, and (4) management efficiency of MNSI.

2.4. Medical care supply system.

This index refers to specific service providers in MNSI including doctors, nursing professionals, rehabilitation doctors, chefs, and staff for other related services. They generally have knowledge and professional skills, considered direct embodiment of MNSI quality. They perceive the direct effects of policy implementation and are also the core of MNSC supply system [25]. This factor is determinant for assurance of safety of the attended senior patients and impact the quality of life. This study included this element into the evaluation index for synergies within MNSI.

2.5. Stakeholders’ system.

It refers to stakeholders direct and indirectly related to MNCS that reflect the degree of development and the contextual situation of MNCS, among the various actors, it includes elder community, seniors’ families, relevant experts, public, and media, etc., mentioned collectively in this study as “the public”. Given the extent and complexity of their relationship, the stakeholder system is large and complex, their effect is less evident, and the level of dependency is limited.

As MNSC needs the support of the factors previously mentioned, its recognition and feedback provided by the public complete the overall picture. This actor plays an indispensable role in promotion and development of MNSC [26].

Having explained the 5-set dimensions within the index set for synergy assessment on eldercare MNSC in China, each first level and second level index have been described in table 1 as follows.

| Primary Index                              | Weight | Secondary Index                                                                 | Weight |
|--------------------------------------------|--------|-------------------------------------------------------------------------------|--------|
| 1. Coordination of policy environment supply system | 0.176  | 1.1 Degree of construction of relevant policies of MNSC                        | 0.019  |
|                                            |        | 1.2 Policy promotion of MNSC                                                   | 0.019  |
|                                            |        | 1.3 Policy implementation in the promotion of MNSC                             | 0.090  |
|                                            |        | 1.4 Support of government policies to medical and nursing institutions          | 0.018  |
|                                            |        | 1.5 Relaxation and efficiency of government policy on the establishment of MNSI | 0.030  |
3. Method: Evaluation Model Construction for MNSC service supply.

3.1 Index weight value determination.

To calculate the weight of evaluation indicators there are multiple methods that generally, can be divided into 3 categories: (1) qualitative evaluation; (2) Quantitative assessment; (3) Qualitative and quantitative analysis. The first one belongs to subjective evaluation methods, where it results are related to the evaluator’s perspective, its inference and analysis reflect the lens of his/her knowledge and practical experience. This type of evaluation may be criticized by lack of an objective and reasonable scientific basis[27]. Quantitative evaluation is based on historical data related to the research object as well as certain and accurate data analysis software, it has strong objectivity when supported by a large amount of sample data [28]. The qualitative and quantitative method quantifies the subjective evaluation criteria and express it as numerical values. This method combines the advantages of qualitative and quantitative methods [29].

Considering that MNSC healthcare in China is still in development stage, it is still difficult to collect enough objective data, thus, an entirely quantitative method may not be entirely appropriate. In combination with the defined setting of evaluation indicators, this study used Delphi method to integrate various expert subjective scores and entropy method of objective calculation to determine the weight for each index as component of the evaluation of synergies on MNSC in China.

This empirical exercise applied a 5-level Likert questionnaire (For details please refer to attachment 1) where experts were asked to rate the importance of each index according to their own practical experience and theoretical knowledge where 1 represents the lowest importance to (from 1 as the least importance to 5 as the greater...
importance). Then, with the collected data, after applying the reliability and validity tests, entropy weighting method was used to calculate the weight value for each evaluation index. Details on the calculation process is described below.

First, under the assumption that the MNSC service supply is assessed through \(m\) index and \(n\) samples, then the original data matrix \(X = (x_{ij})_{m \times n}\) is standardized according to (1).

### Positive Indicators
\[
x_{ij}^* = \frac{x_{ij} - \min x_i}{\max x_i - \min x_i} + 1
\]

### Negative Indicators
\[
x_{ij}^- = \frac{\max x_i - x_{ij}}{\max x_i - \min x_i} + 1
\]

Where \(x_{ij}^*\) is the standardized value for \(j\)th index for the \(i\)th sample for \(i = 1, 2, \ldots, n\) and \(j = 1, 2, \ldots, m\)

Secondly, by using (2) the indicator proportion \(P_{ij}\) is calculated for each \(i\) object under each \(j\) index.

\[
P_{ij} = \frac{x_{ij}^*}{\sum_{i=1}^{n} x_{ij}^*}
\]

Then, according to the definition of information / entropy, \(E_j\) was calculated for \(j\)th index according to (3).

\[
E_j = -k \sum_{i=1}^{n} p_{ij} \ln(p_{ij})
\]

Where \(k > 0; \ k = \frac{1}{\ln(n)}\) and \(E_j \geq 0\)

The difference coefficient \(G_j\) is calculated through equation (4). Greater its value means a greater determinacy of the overall evaluation and smaller entropy.

\[
G_j = \frac{1 - E_j}{m - E_e}
\]

Where \(E_e = \sum_{j=1}^{m} E_j; \ 0 \leq G_j \leq 1; \ \sum_{j=1}^{m} G_j = 1\)

Then, the weight of each evaluation index is calculated according to (5)

\[
W_j = \frac{G_j}{\sum_{j=1}^{m} G_j}
\]

### 3.2 Measurement model construction to measure synergy within MNSC supply.

The synergistic or coordination level of MNSI supply system refers to the consistency degree among service supply subsystems: policy environment, social environment, professional network, production and stakeholder among process development and improvement. This construction is based on the system synergy degree measurement model developed by [30] and the respective procedure is described as follows.
Firstly, the order degree for each subsystem is calculated as \( S = \{ S_1, S_2, S_3, S_4, S_5 \} \) where \( S_i \ i \in [1, \ldots, 5] \), represents each index or service supply subsystem as follows:

\[ S_1: \text{Policy Environment} \quad S_2: \text{Social Environment} \quad S_3: \text{Professional network} \quad S_4: \text{Production} \quad S_5: \text{Stakeholder} \]

For each subsystem \( S_i \), \( e_{ij} \) represents the parameter corresponding to each subsystem where \( j \in [1, \ldots, n] \), \( n \geq 1 \), \( \beta_{ij} \leq e_{ij} \leq \alpha_{ij} \) being \( \alpha_{ij} \) and \( \beta_{ij} \) the upper and lower limits of the sequence parameter \( e_{ij} \) at the system critical point.

In this study, the order parameter of each subsystem is the corresponding secondary evaluation index in the evaluation system of collaborative supply of MNSC in China. For example, the policy environment supply subsystem (N=5), and its corresponding five secondary evaluation indexes are used as its order parameters \( e_{ij} \), to obtain the system order degree \( u_i(e_{ij}) \) according to (6) as follows:

\[
u_i(e_{ij}) = \begin{cases} e_{ij} - \beta_{ij}, & j \in \text{Positive Index} \\ \alpha_{ij} - e_{ij}, & j \in \text{Negative Index} \\ \alpha_{ij} - \beta_{ij}, & \end{cases} \]

Where \( u_i(e_{ij}) \in [0,1] \) and represents the contribution of the order parameter \( e_{ij} \) to it respective subsystem. Higher values for \( u_i(e_{ij}) \) imply higher contribution.

The measure model of order degree of the \( S_i \) subsystem \( u_i(S_i) \) was constructed by linear weighting method as described in (7) as follows:

\[
u_i(S_i) = \sum_{j=1}^{n} w_j u_i(e_{ij}), w_j \geq 0, \sum_{j=1}^{n} w_j = 1 \]

Where \( w_j \) represents the weight for each order parameter. Higher values for \( S_i \) means a higher order of the subsystem \( S_i \).

Assuming an initial order degree for the set of supply subsystems (policy environment, social environment, professional network, production, and stakeholder) in a \( t_0 \) moment: \( u_1^0(S_1), u_2^0(S_2), u_3^0(S_3), u_4^0(S_4), u_5^0(S_5) \). Then after a certain period it will evolve to \( t_1 \) moment to a new order degree \( u_1^1(S_1), u_2^1(S_2), u_3^1(S_3), u_4^1(S_4), u_5^1(S_5) \). Afterwards, the synergy of the system \( SE \) (coordination degree) is calculated as described in (8):

\[
SE = \theta \sqrt{\prod_{i=1}^{5} [u_i^1(S_i) - u_i^0(S_i)]} \]

Where \( i \in \{1,2,3,4,5\} \), \( \theta \in [0,1] \), and

\[
\theta = \frac{\min_i[u_i^1(S_i) - u_i^0(S_i) \neq 0]}{\max_i[u_i^1(S_i) - u_i^0(S_i) \neq 0]} \]
A higher value of SE means higher degree of combination for MNSC supply in the investigated area. As the data collected for this study in this area of research has no change in time, the subsystem set of $t_1$ can be used for reference [7]. This empirical exercise defined the MNSC system service in China as described in (9) as follows:

$$SE = \theta \sqrt{\prod_{i=1}^{5} [u_i^1(S_i)_{ij}]}$$

Where

$$\theta = \frac{\min[u_i^1(S_i_{ij})]}{\min[u_i(S_i_{ij})]}$$

Finally, the grading definition for MNSC is based on actual literature [7, 31, 32], also considering expert suggestions, and interviewed personnel during the field investigation period. The respective grading standard for MNSC in China is described in table 2:

| Synergy Grade | SE Value | Interpretation |
|---------------|----------|----------------|
| Optimal       | $0.8 \leq SE \leq 1$ | The service system shows the highest level of synergy, high efficiency is expected. |
| High          | $0.6 \leq SE < 0.8$ | There is good collaborative effect and high synergy, the service supply system is expected to run effectively. |
| Average       | $0.4 \leq SE < 0.6$ | The system collaborative effect is not significant, its synergy level has potential for further optimization. |
| Low           | $0.2 \leq SE \leq 0.4$ | The system collaborative effect is weak, its synergy is low and there is greater field for optimization initiatives. |
| Lowest        | $0 \leq SE \leq 0.2$ | The lowest synergy reflects a very weak collaborative effect among the service system, optimization is an evident need. |

4. Result: Empirical analysis of synergy assessment of MNSI in China

4.1 Data Sources

4.1.1 Index Evaluation
The study supporting the index set development for the relevant service subsystems applied a structured questionnaire (available in appendix 2) to 9 head of MNSI and 11 healthcare-related government personnel during August of 2020, during the field investigation, the data collection instrument was applied personally with each one of the interviewed professionals. After data screening 82.6% of the answers were valid. Details on the sample for the interview is described in table 3.

Table 3. Interviewed personnel description.
4.1.2 Empirical Analysis (Professionals)

Subsequently, the evaluations index set for MNSC supply was empirically assessed by applying the specific questionnaire (available in appendix 3) survey to managers, medical staff, and senior service customers in 4 MNSI in Xinxiang City (Henan province, P.R China). From 181 collected questionnaires, 172 were valid to an effectivity rate of 95%, descriptive statistics is described in Table 4.

Table 4. Descriptive Statistics for the empirical assessment on Professional Staff

| Subject                  | Option                      | Quantity | Proportion |
|--------------------------|-----------------------------|----------|------------|
| Work Unit                | MNSC                        | 8        | 42.11%     |
|                          | Government related sector   | 11       | 57.89%     |
| Gender                   | Male                        | 12       | 63.16%     |
|                          | Female                      | 7        | 36.84%     |
| Years Engaged in Position| Under 1 year                | 0        | 0%         |
|                          | 1-5 years                   | 1        | 5.26%      |
|                          | 5-10 years                  | 3        | 15.79%     |
|                          | 10-20 years                 | 9        | 47.37%     |
|                          | More than 20 years          | 6        | 31.58%     |
| Age                      | Under 35 years of age       | 3        | 15.79%     |
|                          | 36-45 years of age          | 3        | 15.79%     |
|                          | 46-65 years of age          | 12       | 63.16%     |
|                          | More than 65 years of age   | 1        | 5.26%      |

4.1.3 Empirical Analysis (Users)

To determine the evaluation given by the stakeholders to MNSC synergy degree, an additional survey application (available in appendix 4) was applied to the public as an online questionnaire through www.wjx.cn by obtaining a total of 245 responses, that after validation check resulted in 153 valid responses with an effectivity rate of 62.45%, descriptive statistics is described in table 5.
Table 5. Descriptive Statistics for the empirical assessment on Service Users

| Subject        | Option          | Quantity | Proportion |
|----------------|-----------------|----------|------------|
| Gender         | Male            | 72       | 47.37%     |
|                | Female          | 80       | 52.63%     |
| Age            | Under 35 years old | 46     | 30.26%     |
|                | 36-45 years old | 26       | 17.11%     |
|                | 46-65 years old | 77       | 50.66%     |
|                | More than 65 years old | 3  | 1.97%     |
| Highest degree | College and below | 63    | 41.45%     |
|                | Undergraduate course | 42    | 27.63%     |
|                | Master          | 28       | 18.42%     |
|                | Doctor          | 19       | 12.5%      |
| Place of residence | Eastern China      | 95  | 62.5%     |
|                | Central China   | 57       | 37.5%      |

4.2 Index Weight Identification

4.3.1 Subsystem order degree and synergistic effect.

By following formulas (6) and (7), sample data collected information from five different perspectives: (1) Healthcare government departments, (2) senior management personnel of MNSI, (3) medical personnel, (4) service users, and (5) the public; as well as the weight of the evaluation index for the effect of collaborative supply of medical and nursing services. The order degree for each subsystem within the evaluation of synergies on MNSC supply was calculated and described in Table 6.

Table 6. Subsystem Order degree in synergies on MNSC supply for this exercise.

| Primary Index                                      | Order Degree | Secondary Index                                                                 | Parameter Contribution |
|----------------------------------------------------|--------------|---------------------------------------------------------------------------------|------------------------|
| 1. Coordination of policy environment supply system | 0.600        | 1.1 Degree of construction of relevant policies of MNSC                        | 0.063                  |
|                                                    |              | 1.2 Policy promotion of MNSC                                                    | 0.065                  |
|                                                    |              | 1.3 Policy implementation in the promotion of MNSC                              | 0.296                  |
|                                                    |              | 1.4 Support of government policies to medical and nursing institutions          | 0.068                  |
|                                                    |              | 1.5 Relaxation and efficiency of government policy on the establishment of MNSI| 0.108                  |
| 2. Synergy degree of social environment supply system | 0.521        | 2.1 How far is the insurance system related to MNSC?                            | 0.051                  |
|                                                    |              | 2.2 Degree of legal system construction related to MNSC                        | 0.033                  |
|                                                    |              | 2.3 Construction degree of market development mechanism on MNSC                | 0.049                  |
|                                                    |              | 2.4 External financing of MNSI                                                  | 0.338                  |
|                                                    |              | 2.5. Construction of supervision mechanisms for MNSI                           | 0.05                   |
| 3. Collaboration of professional network supply system | 0.664        | 3.1 What is the supply of facilities and equipment in MNSI?                     | 0.051                  |
|                                                    |              | 3.2 Standardization of MNSI                                                     | 0.111                  |
|                                                    |              | 3.3 Degree of informatization construction of MNSI                            | 0.096                  |
|                                                    |              | 3.4 Management efficiency of MNSI                                               | 0.156                  |
|                                                    |              | 3.5 Convenience of the seniors to obtain medical care services                 | 0.108                  |
|                                                    |              | 3.6 Satisfaction of senior population on MNSI                                  | 0.054                  |
| 4. Collaboration                                    | 0.635        | 4.1 Availability of medical and support professionals                          | 0.047                  |
The synergistic degree of the composite system of MNSC supply is mainly affected by the order degree of each subsystem. As seen in Table 6, the order degree for (3) professional network supply and (4) medical care supply system is relatively high scoring 0.664 and 0.635 respectively. The order degree of policy environment supply system and social environment supply system is in the middle, which is 0.60 and 0.521, respectively. The order degree of stakeholder system is the lowest, which is 0.496.

The parameter contribution also has impact on the synergistic degree of its respective MNSC subsystem. As seen from Table 6, (4.3) professional quality of medical staff, (2.4) external financing of integrated care institutions, and (1.3) Policy implementation in the promotion of MNSC contribute at around 0.3. However, low contribution is also present in various cases, to mention some, (5.4) Fairness and accessibility of MNCS for the public's enjoyment scored 0.029, (2.2) Degree of legal system construction related to MNSC with 0.033; (4.6) Satisfaction of medical staff on their remuneration with 0.036; and (5.1) Public awareness of MNSI with 0.040. These results indicate that the local government and MNSI would need to strengthen related supervision mechanisms, popularize the scope of the MNSI, recheck the salary calculation method and treatment of medical staff, as well as strengthen the publicity strategy of the MNSI among the public.

The order degree of each subsystem is influenced by its corresponding order parameter contribution degree. In the case of (1) policy supply system, the contribution of (1.1) Degree of construction of relevant policies of MNSC (0.63); (1.2) Policy promotion of MNSC (0.65), and (1.4) Support of government policies to medical and nursing institutions (0.68) their summed scores are less than (1.3) Policy implementation in the promotion of MNSC (0.296). These results show that policy implementation has the greatest impact on the order degree of the mentioned supply subsystem.

In the social environment supply subsystem (0521), the contribution of (2.2) Degree of legal system construction related to MNSC (0.033); scored the lowest, while the contribution of (2.2) Degree of legal system construction related to MNSC, while (2.4) External financing of MNSI scored the highest (0.338). These results mean that the external financing situation of the MNSI is determinant to the degree of synergy in this subsystem. Faced with the huge demand of eldercare in China, is expected to social capital to be willing to be invested in the development in these institutions.

For the professional network supply subsystem (0.664), (3.6) Satisfaction of senior population on MNSI contribution degree was relatively low (0.054) while the contribution degree of other order parameters is close to or above 0.1. It can be interpreted that to improve the order degree of the professional network supply system, it may be necessary to spend more resources on service for seniors, intended to improve
their satisfaction levels.

In medical supply subsystem association, (4.6) medical personnel salary satisfaction (0.036), (4.2) health care professionals, (4.1) Availability of medical and support professionals (0.047) such as (4.4) medical staff training and examination mechanism (0.046) showed low level of contribution degree, in contrast, (4.3) Professional quality of medical staff (0.327) contribution is high and almost equal to the medical supply system. In this case, to improve the order of medical supply system, it may be necessary to improve multiple sub variables such as the remuneration of medical staff, increase the supply of medical staff, establish an appropriate training and assessment mechanism for the medical staff within MNSI or departments, improve the professional skills of medical staff, and improve their working environment.

Lastly, on the stakeholder supply subsystem, (5.4) Fairness and accessibility of MNCS for the public's enjoyment (0.029), (5.5) Satisfaction of the public towards the waiting time to access MNCS (0.041); and (5.1) Public awareness of MNSI (0.040) showed relatively lower contribution, and (5.6) Public satisfaction with the fees charged by MNSI (0.164) showed the highest contribution. These results showed that the from the view of the main stakeholders’ subsystem fee charges in public satisfaction is a key factor. To raise institutions’ satisfaction of stakeholders, institutions may need to increase the public awareness and recognition through relevant knowledge diffusion, improve the public perception of fairness, reduce the waiting time.

### 4.3.2 Analysis of supply system synergy degree

By putting the calculation of the order degree for each subsystem in different regions into Equation (9), it can be concluded that the degree of synergy of the complex system of MNCS supply in the investigated region is 0.256, which is in a low level of synergy. As mentioned previously, this value reflects that, synergistic supply of medical and nursing services is still in the primary stage of development, having a not evident synergistic supply effect, not conducive to promoting the development of medical and nursing services in China. Therefore, the synergistic system of medical and nursing services in China has ample area to improvement.

Through the above-mentioned subsystem order analysis, it can be seen that the main reason for the low synergy of the combination of medical and nursing service supply system is that the influence of stakeholder system order is greater, through field research found that the policy promotion in various regions on regard to medical and nursing service supply is not high, resulting in lower public awareness of the of MNSI, in this research, there were individuals who have never even heard of medical and nursing integration, even more, various members of the public believe that the combination of medical
and nursing integration for the general public is still far to be a reality, given the difficulty to access such services. In addition, because the combination of health care is still in the initial stage of development in China, the construction of the relevant legal system is still being perfectioned.

5. Discussion

5.1 Research Conclusions

In the complexity within the MNSC system of Chinese MNSI, the goal of each subsystem is intended to contribute to the general service supply system. The evaluation indexes affecting the synergy of MNSC supply in China were developed by generating a base from existing literature, and the specific construction was developed after two rounds of expert interviews and consultations about the synergy level of MNSC supply in China, after running the empirical exercise, it was possible to establish a valid 5-dimension and 28 subdimensions index set to assess the proposed object of study.

By comparing and analyzing existing evaluation index weight calculation methods, the combination of Delphi and entropy method was the election to determine the index weight of each subsystem within the evaluation of synergistic effect of MNSC supply in China. Through the calculation results of the evaluation index weight of the synergistic effect of MNSC, it is possible to determine the following factors to be considered when attempting to increase the synergy level within MNSIs’ service supply: (1) Service charges of MNSI; (2) Implementation of government policies in the process of promoting the MNSC; (3) Actively and effective social capital guide to medical and nursing industry investment ultimately to improve the external financing situation of the MNSI; (4) Improve the professional quality of medical staff; and (5) Strengthen the supply of medical facilities and medical staff in MNSI.

After analyzing the data form field investigation, empirical assessment and software data analysis to determine the contribution degree for each order parameter and the overall synergy level of each subsystem to the MNCS supply in Xinxiang City, it was possible to conclude that that the order degree of professional network supply system and medical and nursing supply system is relatively high; the order degree of policy environment supply system and social environment supply system showed average values; while the order degree of stakeholder system was the lowest. According to the collaborative supply effect of MNSC survey section, the collaborative supply of MNSC in Xinxiang City of China is still incipient in terms of collaborative form, and its collaborative supply effect is not evident, not conducive to promoting further development of MNSC in China.

5.2 Research Contributions

Current domestic and international studies on MNSC mainly focused on connotation, types, development status and difficulties, local pilots from the perspectives of medicine, demography, gerontology, management, among others. Related studies on MNSC in China are relatively scarce. From the perspective of synergetic, this study explored the synergetic nature of the medical and nursing integration service supply system, composed by (1) policy environment, (2) social environment, (3) professional network, (4) medical personnel, (5) medical and nursing stakeholders, broadening the
research perspective on the medical and nursing service integration.

Based in the situation and objectives of MNSC supply in China, based on relevant literature and the suggestions of consulted experts, this research constructed an evaluation index system for the synergistic effect of service supply on integrated medical and nursing care services, based on 5 first-level indicators and 28 second-level indicators, tested on an empirical exercise in China and appliable on related samples.

On methodology, by using Delphi and entropy value method for index weight calculation, this research proposed a mechanism to assess the synergy of medical and nursing service supply key factors to help government a mechanism to promote way to MNSI to increase their effectiveness, integrating an appropriate use of resources, to enhance the efficiency of medical and nursing service supply.

This study is a first step that limited the evaluation index system assessment of synergistic supply effect of MNSC to the range of Xinxiang City. It means that this study needs to be testes on wider range and alternate samples.

Declarations

Ethics approval and consent to participate

Data used in this article comes from the specific questionnaire (available in appendix 3) survey to managers, medical staff, and senior service customers in 4 MNSI in Xinxiang City (Henan province, P.R China), which was own ethics approval and consent to participate.

Consent for publication

Not applicable.

Availability of data and materials

The data of this study is confidential. If necessary, please contact the author.

Competing interests

The authors declare that they have no competing interests. No conflict of interest exits in the submission of this manuscript, and manuscript is approved by all authors for publication. This work was original research that has not been published previously, and not under consideration for publication elsewhere. The authors listed have approved the manuscript that is enclosed.
Funding
National Planning Office of Philosophy and Social Science, Award number: 17ZDA121, Recipient: Yansui Yang.

Authors’ contributions
YSY, BQC are the joint first authors, who contributed equally to the manuscript. YSY and BQC conceived and designed the study. BQC searched literature, YSY and BQC analyzed data. YSY and BQC wrote the first draft of the manuscript. YSY, BQC, and GABL modified the manuscript and language, YSY and BQC reviewed the manuscript. All authors critically revised the manuscript and approved the final version.

Acknowledgements
We thank the managers, medical staff, and senior service customers in 4 MNSI in Xinxiang City (Henan province, P.R China) for applying the specific questionnaire survey. We thank the students who participated in the survey for their cooperation. We thank all volunteers and staff involved in this research.

Competing interests
The authors declare that they have no competing interests. No conflict of interest exits in the submission of this manuscript, and manuscript is approved by all authors for publication. This work was original research that has not been published previously, and not under consideration for publication elsewhere. The authors listed have approved the manuscript that is enclosed.

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