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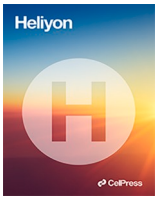

Research article

Resolving conflict and promoting coordination for an integrated old-age healthcare service system in China: GMCR-AHP based decision analysis approach

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ABSTRACT

China faces a healthcare challenge due to its aging population, necessitating an integrated old-age healthcare system considering multiple stakeholders' interests. Conflict and inequality may arise from varying stakeholder interests. This study develops a conflict resolution strategy for the coordination of stakeholders involved in the old-age healthcare service system, promoting harmonization and minimizing conflict to establish an equitable system meeting elderly needs. It contributes to a robust healthcare system for comprehensive, quality care. The focus of the study is to identify relevant stakeholders and decision-makers involved in developing an integrated old-age healthcare service system and explore a feasible solution through stakeholder analysis using the Mitchell score-based technique and stakeholder theory. Decision-makers' preferences are estimated using the Analytic Hierarchy Process (AHP). Solution strategies are developed through multiple stability concepts within the graph model for conflict resolution (GMCR). The conflict resolution analysis based on the integrated AHP-GMCR approach reveals that the development of an integrated old-age healthcare system is feasible by addressing potential conflicts among the stakeholders. Considering the current predicament of comprehensive medical services in China, governments should distribute authority, simplify procedures, and improve the insurance system. Furthermore, medical institutions should explore funding options, expand services, and enhance accessibility. Elderly individuals should prioritize healthy aging and seek suitable healthcare providers. Stakeholder participation is crucial for effective implementation. These recommendations enable China to advance integrated elderly care successfully, addressing challenges posed by the aging population.

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1. Introduction

The growing proportion of the elderly population, coupled with an increasing number of mentally disabled individuals and empty-nesters in Chinese society, has highlighted the need for an integrated old-age healthcare services system and targeted medical treatment [1–3]. Meeting the varied needs of the elderly is challenging as they depend solely on children or family members [4,5]. This makes the development of an integrated social support and old-age healthcare system crucial [6,7]. However, it is essential to develop an integrated system for elderly and aged citizens that considers China's specific national conditions, emphasizing a long-term perspective [3,8,9]. While China has experienced marvelous economic growth and development, progress has been made in integrated elderly healthcare.

However, existing systems face various challenges, including policy system fragmentation, inadequate supportive policies, lack of relevant laws and regulations, unclear institutional positioning, inconsistent linkages between medical and nursing organizations, inefficient resource allocation, imbalances in service supply and demand, and unfair competition among institutions [10–12]. Implementing a policy that combines medical care with nursing involves the interest of multiple stakeholders. Successful implementation must involve the active participation and coordination of all stakeholders, ensure smooth progress, and address potential difficulties that may arise during the implementation process. Establishing a win-win relationship among all stakeholders is of utmost importance. To achieve this, it is vital to understand the demands and concerns of each stakeholder, clarify their dilemmas, and establish a coordination mechanism that effectively balances conflicts and aligns the interests of all parties involved in integrated elderly care.

The present study aims to develop a decision analysis strategy to deal with the conflict that evolved in developing and providing integrated healthcare to the aged population due to conflicting interests and inequalities among the relevant stakeholders in China. For this purpose, the authors put this conflict into perspective and developed an integrated decision analysis approach by integrating the Mitchell score-based approach, AHP, and GMCR. Furthermore, the authors identified the relevant stakeholders and decision-makers (DMs) and traced their interests related to healthcare services to the aged population. Because the preferences of the DMs play an indispensable role in determining the outcomes of a decision-making problem, Mitchell score-based and AHP methods were used to generate the ranking of the strategies. Moving further, these preferences have been used to examine conflict and trace solution strategies for the development of an integrated healthcare service system in China. The GMCR-AHP framework presents the findings of conflict forecasting and process analysis in this domain, establishing mechanisms to coordinate medical needs and relevant subject interests. This analysis offers more detailed guidelines and insights for decision-making in developing an integrated elderly care system in China.

2. Background

2.1. Literature review

In 2005, Chinese scholars introduced the concept of integrating medical and nursing care, emphasizing the need for continuous care. This concept was first proposed to develop nationally integrated medical and nursing care. However, several challenges have emerged during the initial implementation phase, including overlapping responsibilities among authorities, unclear boundaries of responsibility, service misalignment, and widespread illegal practices within nursing care institutions [11,13]. Through exploration and efforts, progress has been made in China's integrated elderly care system. Three main models have emerged: pension-type combinations, community-based care, and home-based care [14]. However, issues such as inconsistent service quality, inadequate matching of supply and demand, and lack of supportive policies have become new obstacles impeding the advancement of integrated medical and nursing care services [15,16].

The studies have identified a disparity between supply and demand in the integrated care system, attributed primarily to coordination and governance difficulties among different departments, misalignment of demand targeting, and low engagement from service providers [12,17]. Existing studies have focused on three main aspects of this supply-demand discrepancy: first, the spatial distribution of elderly care resources is imbalanced, with insufficient overall supply and underutilized resources, particularly in community-based care services [18,19]; second, the high-end elderly care industry has developed rapidly, while the development of small- and medium-sized care institutions lags, resulting in an imbalance between service demands and supply [20,21]; Third, the regional distribution of elderly care services is highly influenced by economic disparities, with economically developed areas experiencing robust supply and demand, while economically underdeveloped areas face weaker supply and demand [22–24]. Furthermore, scholars have emphasized that the integration of medical and elderly care exacerbates the structural contradiction between the supply and demand of medical services, necessitating the exploration of new medical care models [11].

Currently, inadequate integration between medical and nursing resources encompasses the consolidation and reallocation of these resources as well as the management system and operational mechanisms. This issue fundamentally involves the interests of relevant departments, groups, and individuals [25]. The researchers explored the collaboration among multiple stakeholders in an integrated medical-support pension model. They emphasized that the government should not be the sole actor and that market forces alone cannot drive the development of this model. Instead, a multifaceted operational mechanism that fosters participation and integrates interests should be established [26]. Utilizing the IDEA strategic model, four coordination mechanisms were defined for providers in integrated medical and supported care based on the dimensions of "relationship" and "interest" [27,28]. This approach systematically analyzed how coordination can be achieved among multiple providers in integrated medical and support care for the elderly [29]. By employing game analysis and considering the government, medical institutions, and enterprises in the western region of China, one

study pointed out that practical cooperation among the government, hospitals, and social enterprises is essential in the face of challenges related to systems, resources, and information. With government policy guidance, these stakeholders should promote resource sharing, healthcare services, talent exchanges, and scientific and technological advancements. This collaborative approach explores the unique characteristics of the Western regions' integrated medical and elderly care models [6,30].

Chinese academics have actively investigated merging medical and aged care models. The focus of this study has evolved from a limited to a broader perspective, resulting in more significant insights and some research outputs. Numerous studies have addressed obstacles to implementing integrated medical and aged care, highlighting concerns such as limitations in the growth of medical and elderly care firms and supply and demand mismatches. Researchers from many viewpoints have presented numerous remedies and proposals, recognizing that integrating medical resources is critical for developing medical and senior care integration. However, measuring stakeholders' willingness and preferences remains challenging, and further studies on building multi-stakeholder cooperation mechanisms for integrated medical and nursing care are needed. Therefore, research in these areas must be strengthened.

2.2. Theoretical basis

Stakeholder theory originated in the 1930s and defines stakeholders as groups or individuals who can impact or are affected by the achievement of organizational goals [31–33] introduced stakeholder theory to the health field; since then, it has gained widespread application and demonstrated its relevance. In the Chinese context, stakeholder theory has been utilized in various areas including health policy research, health institution management, and medical and health reform [34,35]. This theory emphasizes the presence of multiple stakeholders who can be examined from different perspectives. These stakeholders have a direct connection with policy implementation or goal attainment. They may share risks, bear costs, supervise, or impose constraints on implementing policies or achieving objectives [32]. Considering the stakeholder theory approach, this study analyzes the relationship between medical care and relevant stakeholders from multiple angles, clarifying their interdependencies and laying the groundwork for conflict analysis modeling.

Conflicting interests among stakeholders within an integrated nursing care setting can give rise to inconsistent conflicts in their game behavior [34]. Obtaining preference data for the game becomes challenging, and establishing alignment among various stakeholders is crucial to advancing their interests. Therefore, there is a need to employ precise data and decision-making methods to address minor conflicts. The GMCR offers such an approach, drawing from classical game theory and partial game theory [36]. In a decision-analysis problem, it is important to consider all DMs and their preferences. GMCR provides this liberty to DMs while putting the decision problem into perspective and making it possible to reach a feasible solution [37,38]. It enables the modeling and resolution of conflict problems, providing decision-makers with practical and scientifically grounded solutions. The GMCR method exhibits the benefits of a flexible modeling framework that combines qualitative and quantitative analyses. It replaces the utility value approach with a relative order, reducing the information required for the decision maker's preferences [39]. In comparison, classical game theory is more convenient and adaptable, whereas conflict resolution methods [40] are widely used in various domains involving conflicts related to energy and water resources [41,42], market competition, and military contexts [39].

3. GMCR

The GMCR can be defined as $V = \{N, S, P, G\}$, where N $(N \geq 2)$ represents a finite and non-empty set encompassing all decision-makers involved in the conflict. 'S' denotes a non-empty set consisting of all feasible states. 'P' represents the preference information of the decision-makers, and 'G' signifies the decision-maker's state transition graph model [36,43,44]. GMCR resolves conflict problems by analyzing the conflict context, identifying decision-makers and their strategies, eliminating infeasible states, determining feasible states and their transitions, analyzing preference information, and conducting stability analysis to derive global equilibrium solutions. The stability analysis outcomes can provide decision-makers with valuable support in navigating conflict-resolution processes.

In GMCR theory, preference [37,38,45,46] refers to the pros and cons of the states obtained by DMs according to their own desired goals and judgment of conflicts. We express the simple preference structure of decision-maker I as follows: $P = \{\sim_i, \succ_i\}$, "$\succ$ "and "$\sim$" represent information about a DMs' preferences for different states, respectively. For example, for any two possible states $s, q \in S$, $s \succ_i q$ denotes for decision maker i, the state 's' is better than state q, $q \succ_i s$ said state q is better than state 's',' $s \sim_i q$ denotes for decision maker i, states is equivalent to state q. For any two feasible states $s, q \in S$, the following properties are satisfied [47]:

First property: $\succ_i$ satisfies the asymmetry. For $s, q \in S$, both $s \succ_i q$ and $q \succ_i s$ cannot be true.

Second property: $\sim_i$ satisfies the reflexivity and symmetry. For $s, q \in S$, $s \sim_i s$ is true and is called reflexivity.

If $s \sim_i q$, so $q \sim_i s$, called symmetry.

Third property: $\{\sim_i, \succ_i\}$ satisfies the completeness. For , $q \in S$, $s \succ_i q$, $s \sim_i q$, and $q \succ_i s$ must satisfy one of them.

At the same time, $s \succeq_i q$ is the same thing as either $s \succ_i q$ or $s \sim_i q$, and $s \prec_i q$ is the same thing as $q \succ_i s$.

The four basic stability types commonly used in GMCR are Nash stability, General Metarational stability (GMR), Symmetric Metarational stability (SMR), and Sequential stability (SEQ). To facilitate the calculation, using the logical definitions of the conflict analysis diagram model, Xu et al. [48,49] presented four matrix definitions of basic stability.

Definition 1. **Nash stability (Nash):** Let N be the decision-maker set, S be the feasible state set for the DM $i \in N$ and state $s \in S$, if $R_i^+(s) = \varphi$, and state is the state of Nash for decision maker i, written as $s \in S_i^{Nash}$.

Definition 2. General Metarational stability (GMR): Let N be the decision-maker set, S be the feasible state set, for DM $i \in N$ and state $s \in S$, for any $s_1 \in R_i^+(s)$, at least state $s_2 \in R_{N-\{i\}}(s_1)$ exists, so that state $s \geq_i s_2$ is true, so for DM i, state S is called GMR, written as $s \in S_i^{GMR}$.

Definition 3. Symmetric Metarational stability (SMR): Let N be the decision maker set, S be the feasible state set, for DM $i \in N$ and state $s \in S$, for any $s_1 \in R_i^+(s)$,at least state $s_2 \in R_{N-\{i\}}(s_1)$ exists, so that state $s \geq_i s_2$ is true, and for any $s_3 \in R_i(s_2)$, meet $s \geq_i s_3$, so for decision maker i, state S is called SMR, written as $s \in S_i^{SMR}$.

Definition 4. Sequence stability (SEQ): Let N be the decision-maker set, S be the feasible state set, for DM $i \in N$ and state $s \in S$, for any $s_1 \in R_i^+(s)$, at least state $s_2 \in R_{N-\{i\}}^+(s_1)$ exists, so that state $s \geq_i s_2$ is true, so for DM i, state S is called SEQ, written as $s \in S_i^{SEQ}$.

4. Conflict analysis modeling solution

4.1. Conflict background analysis

China transitioned to an aging society in 1999, and this demographic shift has persisted for over 20 years. To address the challenges posed by the aging population, the combined medical and elderly care model has emerged as an integral approach. This integration has played a vital role in alleviating the pressures associated with an aging society and in advancing elderly care services in China. However, the current state of policy implementation presents several challenges. First, relevant government departments must fulfill their roles effectively. Numerous government bodies are involved in the medical sector, serving people and their interests in various capacities [50,51]. However, in their operations, it becomes challenging for them to avoid pursuing their interests and adopting strategies that favor the establishment of specific institutions, referred to as "keep institutions." These institutions tend to impede the timely examination and approval of qualifications and fail to provide timely feedback, resulting in ineffective problem-solving. While coordination may exist among departments such as the Commission on Aging, more administrative powers within its internal institutions are needed to ensure their ability to address complex issues that impact the integration of medical and pension resources [3]. This situation also affects the success or failure of medical policies and significantly affects the market's enthusiasm for providing medical nursing services. Moreover, integrated care for the elderly weakens the links with necessary reforms. The current combination of government-dominated institutions relies on something other than market operations, as China's social governance mechanisms tend to follow a top-down approach [52]. Consequently, the participation of stakeholders beyond the immediate government departments could be higher and more active, leading to a limited expression of their interests [53].

Third, there is a need for more enthusiasm for cooperation among medical institutions. Extensive healthcare facilities focus primarily on providing routine medical services. Owing to the scarcity of medical resources, these institutions face high service costs. Furthermore, the nature of welfare-oriented medical care limits its ability to generate substantial profit. As a result, large medical institutions need more initiative and enthusiasm to promote policies related to combined medical care and nursing. Most primary healthcare institutions are publicly funded and lack performance incentive mechanisms. Additionally, the elderly, as a demographic group, are more susceptible to medical disputes and associated with lower profits. Consequently, primary medical and health institutions demonstrate limited enthusiasm for catering to the needs of elderly patients and resist the integration of medical care with nursing.

Fourth, there is a misalliance between supply and demand for integrated care for the elderly. With the government's policy of combining medical and nursing care, many small pension institutions have ventured to establish medical facilities. However, their limited capacity and funding constraints hinder their ability to address complex medical issues, such as hospitalization. This lack of clarity regarding the role of medical care exacerbates resource waste. Additionally, integrating high-end medical services into large pension institutions contributes to resource inefficiencies due to the high fees.

Fifth, it is challenging to translate the individual needs of the elderly into social needs. Nursing services in medical institutions are driven by economic considerations, which result in high costs. Consequently, many elderly individuals with limited financial resources cannot afford these services and are reluctant to bear the burden of high charges. Moreover, medical institutions cannot recover costs through medical insurance reimbursement or basic annuities, which are insufficient to alleviate economic pressure or transform the individual needs of the elderly for medical nursing services into a societal need. This leads to a surplus of available beds, wasting institutional resources and diminishing social welfare. Such outcomes are considered a deviation from the original intention of the policy of combining medical and nursing care, hindering its progress [25].

Sixth, issues are related to low and unequal coverage of long-term care insurance policies. These policies aim to address the nursing care needs of disabled and elderly individuals and to alleviate the challenges they and their families face. However, the actual implementation of these policies extends only to urban and rural residents. Moreover, assessment standards vary significantly from location to location, resulting in severe inequalities and inefficient utilization of medical insurance funds, even posing a risk of overdrafts.

Seventh, the traditional concepts of aging and family play a significant role. Many elderly individuals strongly adhere to traditional beliefs that place the responsibility of caring for their children. Consequently, they are unwilling to accept services from pension institutions including medical care facilities. This mindset discourages governments from fully implementing policies that combine medical and nursing care.

Integrated care for the elderly involves various stakeholders with diverse demands that have yet to converge into a consensus for the implementation process. This situation poses a dilemma in this field. Constructing a comprehensive mechanism for combined

medical and nursing care is essentially a process of balancing the interests of all stakeholders [25]. Therefore, it is imperative to seek an optimal strategy that effectively balances all relevant parties' interests and ensures the successful and efficient implementation of the best policy.

4.2. Definition of integrated care for the elderly with stakeholders and the analysis of interest demand

While developing an integrated care system for the elderly, several vital stakeholders play crucial roles, including the government, medical institutions, pension institutions, representative elderly groups, and families [25,54]. The government encompasses various departments such as the National Development and Reform Commission (NDRC), Ministry of Civil Affairs and Social Security (MOCA), Ministry of Finance (MOF), Ministry of Human Resources and Social Security (MOHRSS) (The People Club Department), National Health Commission (NHC), Ministry of Land and Resources, Ministry of Housing and Urban-Rural Development, Elders' Office, Bureau of Traditional Chinese Medicine, Commission on Aging (COA), and Office of Aging. By applying stakeholder theory, this study employs the Mitchell scoring method to classify stakeholders involved in the integrated care system for the elderly. The stakeholders were grouped into three categories. We have classified DMs into three groups, including defined stakeholders, prospective stakeholders, and potential stakeholders. Moreover, each type of grouping is a set of DMs with the same properties but different numbers. Then, we assign scores to any type of decision-maker from four aspects, including legitimacy, urgency, power, and position. It is obvious that the assignment of scores to a certain aspect is not a specific numerical value, but is described using different levels of language.

Government departments are responsible for implementing medical care and catering to aging citizens, including the NDRC, MOCA, MOF, MOHRSS, NHC, COA, and Office of Ageing. Prospective stakeholders include medical institutions at all levels, pension institutions, representative elderly groups, and families. Potential stakeholders include health products and drug manufacturers, sellers of auxiliary devices, commercial insurance companies, and other for-profit organizations. While some entities may fulfill multiple functions and assume multiple roles, for clarity, this study focuses on analyzing the primary roles of stakeholders, as outlined in Table 1. The research data in this article mainly comes from public information, such as government announcements, research reports, etc. [25,51,54].

The attitudes of various stakeholders towards integrating medical and nursing care policies are pivotal in either facilitating or impeding policy implementation. Stakeholders' positions and attitudes are influenced by their interest in and satisfaction with policy execution. As the guardian of citizens' rights and interests, the government assumes the roles of policymakers, promoters, and overseers in the combination of medical and elderly care. The government aims to alleviate the pressure of an aging population and foster the integration of medical and elderly care resources through comprehensive policy measures. Whether driven by safeguarding citizens' rights and interests or by enhancing the utilization of social resources, government departments generally support policies that integrate medical and nursing care.

Medical institutions and pension service providers are direct providers of integrated medical and nursing care. As profit-oriented entities, medical institutions and pension service providers seek to maximize their benefits. They strive to secure favorable policies and financial subsidies while also attempting to increase the pricing of medical services as recipients and ultimate beneficiaries of medical care services. The elderly and their families aspire to fulfill the needs of the elderly population by advocating for the policy of combining medical and nursing care, which ensures continuous and high-quality medical services.

Potential stakeholders, such as drug manufacturers, auxiliary device manufacturers, and commercial insurance institutions, primarily aim to gain a larger market share and augment their profits by implementing relevant policies. This perspective is detailed in Table 2, which highlights the interests and motivations of these stakeholders.

Table 1
Definition of stakeholders in the integrated care for the elderly policy.

Type	Stakeholders	Legitimacy	Urgency	Power	Position
Defined stakeholders	the NDRC	strong	strong	strong	support
	the Ministry of Civil Affairs	strong	strong	strong	support
	the Ministry of Finance	strong	strong	strong	support
	the Ministry of Human Resources and Social Security	strong	strong	strong	support
	the National Health Commission	strong	strong	strong	support
	the Commission on Aging and the Office of Aging	strong	strong	strong	support
Prospective stakeholders	medical institution	strong	medium	a little bit stronger	General support
	Pension agency	strong	a little bit stronger	a little bit stronger	Very supportive
	Elderly people and their families	strong	strong	medium	support
Potential stakeholders	Health products and pharmaceutical manufacturers	medium	weak	weak	Generally, oppose
	Vendors of ancillary equipment products	medium	weak	weak	General support
	Commercial insurance institution	medium	weak	weak	General support

Table 2
Analysis of interest demands of related subjects in combination with medical care.

Type	Stakeholders	Interest orientation or needs
Defined stakeholders	NDRC	Planning old-age care services and formulating relevant policies to alleviate the pressure of the aging population, promote resource allocation and service connectivity, and improve the overall level of social welfare.
	Ministry of Civil Affairs	To supervise and manage the elderly care services; to formulate plans, policies, and standards for the construction of the elderly care system and organize their implementation, to meet the medical and nursing needs of the elderly to the greatest extent.
	Ministry of Finance	Manage old-age service subsidies, coordinate the budget and allocation of medical benefits, and reasonably control the expenditure of medical care finance and medical insurance expenses.
	The Ministry of Human Resources and Social Security	To draw up development plans and mobility policies for medical care professionals, verify the access and reimbursement standards for pension payments and medical insurance reimbursement, and promote the rational flow and effective allocation of medical care professionals, pension funds, and medical insurance funds.
	the National Health Commission	To supervise and manage the audit of elderly care quality and health qualification to ensure the quality of medical care services.
	the Commission on Aging and the Office of Aging	Coordinate with all departments to effectively promote medical care.
Prospective stakeholders	Medical institution	Revenue maximization.
	Pension agency	Maintain the good operation of the organization, increase the number of services, and strive for more preferential policies and financial subsidies with the government to improve economic benefits.
	Elderly people and their families	Access to affordable, quality, safe, and accessible medical care
Potential stakeholders	Health products and pharmaceutical manufacturers	Increase the supply of healthcare products and medicines for the elderly, expand the sales market, and increase income.
	Vendors of ancillary equipment products	Promote the use of auxiliary equipment for the elderly, increase market share, and increase profits.
	Commercial insurance institution	More people will be included in the insurance scheme to benefit more from the combination of medical care and nursing care.

5. The analysis

5.1. Analysis of decision makers and their strategies

In the context of the implementation challenges faced in combining medical and nursing care, the term "Decision Maker" (DM) refers to individuals or groups who can make decisions independently. A conflict event requires the presence of at least two DMs with distinct interests. This study identified three primary stakeholders as decision-makers in the conflict surrounding the combination of medical and nursing care. These stakeholders included the government (DM1), medical care and nursing institutions (DM2), and the elderly group (DM3). The interrelationships among these DMs are illustrated in Fig. 1. Considering the conflict's backdrop, each DM has three strategy choices available, as outlined in Table 3.

5.2. Feasible state and state transition diagram construction

The conflict diagram model consists of three DMs and nine strategies. Table 4 presents the selection status of each strategy using "Y"

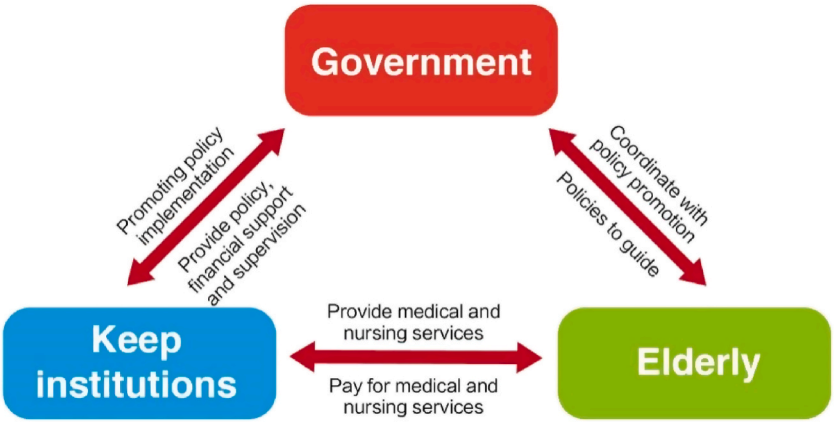

Fig. 1. Relationship diagram of each decision subject.

Table 3
Decision makers and their strategies.

DM	Strategy
Government (DM1)	① Break through the institutional dilemma of the hierarchical organization structure and strengthen the coordination and cooperation among various departments. Streamlining administration, delegating power, and optimizing the examination and approval process of medical care institutions. ② Improving the medical insurance system and establishing and improving long-term care insurance. ③ To maintain the status quo.
Medical care and nursing institutions (DM2)	④ Building a medical and nursing complex and increasing the supply of middle-end medical and nursing services to meet the needs of the public. ⑤ Broaden the channels of financing and enrich the sources of funds. ⑥ Pursue economic benefits and blindly increase the charging standards of medical care services.
Elderly (DM3)	⑦ Purchase of medical care services (purchase of long-term care insurance). ⑧ Because of the high fees for choosing ordinary pension institutions. ⑨ Change the traditional concept of old-age care, and strengthen the awareness of healthy aging.

Table 4
Feasible states.

DM	Option	State															
DM1	①	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	②	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	③	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N
DM2	④	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
	⑤	N	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y
	⑥	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N
DM3	⑦	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N	Y	Y
	⑧	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N
	⑨	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
States/Strategies		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16

Notes: DM1(Decision Make 1): government; DM2(Decision Make 2): Medical care institution; DM3(Decision Make 3): The elderly.

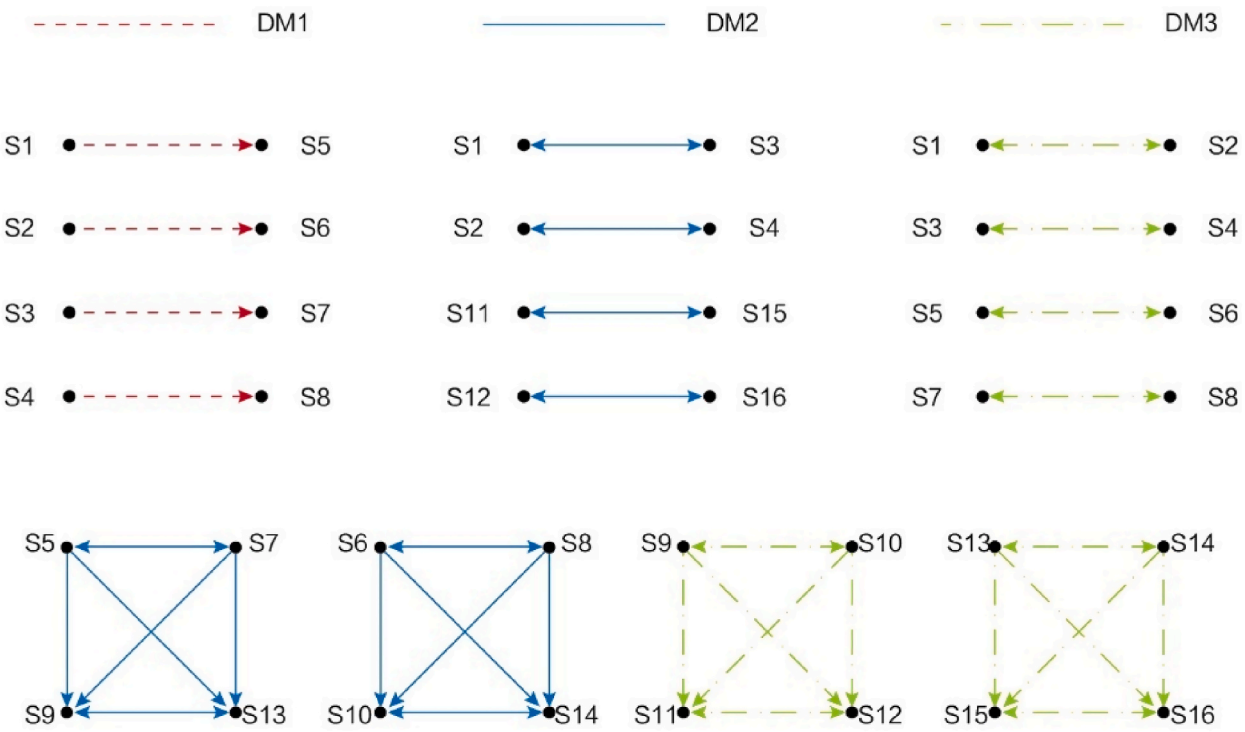

Fig. 2. State transition diagram model.

to indicate the selection, "N" for non-selection, and "-" for strategies that can be either selected or not. The strategies selected by all decision makers form various permutations and combinations, represented by feasible and infeasible states in the graphical model (e.g., —Y—N——YY—). In this study, there are nine options, resulting in a theoretical total of 29 states that reflect the conflicting outcomes of decision-maker strategies.

However, in reality, certain strategies may contradict or depend on one another, rendering some of the 29 states impossible or infeasible. The infeasible states must be identified and eliminated. For instance, the elderly population can only choose either strategy ⑦ or strategy ⑧, making the state (————————YY—) invalid. By incorporating a rejection state and utilizing GMCR II software, it is possible to eliminate the remaining 16 possible states, as shown in Table 4.

In some cases, DMs may modify their strategies to safeguard their interests or expedite conflict resolution. However, while some DMs retain their strategies, this change from one DM alters the conflict dynamics and transitions the current state to a different state. This phenomenon is known as a state transition. For instance, if the government (DM1) and medical care institutions (DM2) maintain their previous strategies while the elderly population (DM3) adopts a new strategy to shift from traditional pension concepts and emphasize the importance of healthy aging, the conflict may transition from state S1 to state S2.

The feasibility states of the conflict and the state transitions of the decision makers are represented by a comprehensive directed graph called the graph model (Fig. 2). This model illustrates a three-state transition diagram for each decision-maker. Feasible and infeasible states are depicted as solid black dots in the graph. Sixteen feasible states exist within the state transition graph model. The arrows indicate the direction of transition from the initial state to the accessible state. A single arrow represents one-way transfer, whereas a double arrow indicates reversible state transition. Different line types correspond to different DMs in the model.

5.3. Policymakers' preferences and strategy statements

The Analytical Hierarchy Process (AHP) [55–57] is a practical decision-making method that enables the evaluation of multiple schemes or objectives. It effectively integrates qualitative and quantitative analyses, thereby facilitating a hierarchical and quantitative decision-making process. Using the AHP method, decision indicators were structured into a hierarchical model, expert ratings were collected, and judgment matrices were constructed. This article is a preference evaluation of six different strategies in conflict problems and the evaluation criteria are based on the preference criteria of the decision-maker's background and status. We evaluate the six strategies based on the individual criteria of DMs. The YAahp software was utilized to compute and finalize hierarchical rankings, along with conducting tests for consistency. The derived ranking of strategy weights is showcased in Table 5, offering a definitive basis for decision-making grounded in the AHP methodology.

5.4. Stability analysis to find equilibrium solution

Conflict stability refers to a decision maker's behavioral pattern in a conflict situation. When a player does not transition unilaterally to a better state at a particular point, that state is considered stable for that decision-maker. If a state exists that is stable for all decision-makers, it is considered a conflict equilibrium solution. Table 6 shows that under GMR, SMR, and SEQ, the ultimate equilibrium points are S2, S4, S6, S8, S12, and S16. Under the Nash equilibrium, S16 is the ultimate equilibrium point. It is generally believed that a solution that satisfies the Nash equilibrium, GMR, SMR, and SEQ simultaneously is a global equilibrium solution [43,44,49,58]. Therefore, in this conflict event, the global equilibrium solution is State 16 (YYNYYNYNY).

This solution implies that the government needs to overcome the institutional dilemma posed by bureaucratic organizational structures. It should enhance coordination and cooperation among various departments, streamline administration, delegate power, optimize the qualification approval process for medical care institutions, and improve the medical insurance system. Such governance structure could be developed by adopting ICT technologies in the governance structure. Cordella and Tempini [59] support this adoption by suggesting e-government and organizational change in bureaucracy in public service delivery. Furthermore, shared

Table 5
Decision strategy weight ranking.

Strategy	DM1		DM2		DM3	
	Weight	Sorting	Weight	Sorting	Weight	Sorting
①	0.1281	4	0.2400	2	0.0741	6
②	0.0516	7	0.1200	4	0.2222	2
③	0.0814	6	0.0400	8	0.0370	7
④	0.2053	1	0.1097	5	0.2308	1
⑤	0.0987	5	0.0421	7	0.0769	5
⑥	0.0237	9	0.0482	6	0.0256	9
⑦	0.1941	2	0.2462	1	0.1938	3
⑧	0.0344	8	0.0308	9	0.0365	8
⑨	0.1826	3	0.1231	3	0.1031	4

These results conclude the preferences of the DMs as follows.
The government**:** ④>⑦>⑨>①>⑤>③>②>⑧>⑥
Medical care institutions**:** ⑦>①>⑨>②>④>⑥>⑤>③>⑧
Old age group**:** ④>②>⑦>⑨>⑤>①>③>⑧>⑥

Table 6
Stability analysis results.

Decision makers	Strategy	S2	S4	S6	S8	S12	S16
DM1	①	N	N	Y	Y	Y	Y
	②	N	N	Y	Y	Y	Y
	③	Y	Y	N	N	N	N
DM2	④	N	N	N	N	Y	Y
	⑤	N	Y	N	Y	N	Y
	⑥	Y	Y	Y	Y	N	N
DM3	⑦	N	N	N	N	Y	Y
	⑧	Y	Y	Y	Y	N	N
	⑨	Y	Y	Y	Y	Y	Y
R							☑
GMR		☑	☑	☑	☑	☑	☑
SMR		☑	☑	☑	☑	☑	☑
SEQ							☑

Notes: DM1(Decision Make 1): government; DM2(Decision Make 2): Medical care institution; DM3(Decision Make 3): The elderly. R: Nash Stability; GMR: General Metarational stability; SMR: Symmetric Metarational stability; SEQ: Sequential Stability.

decision-making could be productive in dealing with the issues related to complex needs of older people [60]. Additionally, the establishment and improvement of long-term care insurance should go beyond just maintaining the status quo. This findings is also supported by the findings of [61,62]. Medical and nursing institutions should adopt a strategy for forming consortia, increasing the availability of middle-end medical and nursing facilities to meet public needs, diversifying financing channels, and enriching funding sources. They need to prioritize the provision of quality care rather than solely pursuing economic benefits or indiscriminately raising charges. The elderly population should consider purchasing medical care services and long-term care insurance while also challenging traditional pension concepts and actively promoting awareness of healthy aging. Instead of opting for conventional pension institutions with high fees, they should explore alternatives as outlined in Table 6.

5.5. Analysis of conflict evolution path

Table 7 presents the optimal evolution path of the conflict event, following the principles of resource conservation, from initial state S1 (NNYNNYNYN) to equilibrium state S16 (YYNYYNYNY). The arrows indicate unilateral strategy changes by DMs, leading to state transitions. In response to the conflict and dilemma, the government, serving as the policy maker, implementer, and regulator of the medical-care integration policy and the representative and protector of people's interests, takes an active leadership role.

The government breaks through hierarchical organizational structures and enhances coordination among various departments. It streamlines administration, delegates power, optimizes the qualification approval process for medical institutions, and improves the

Table 7
Conflict evolution path.

Decision makers	Strategy	Initial state		Transition state		Transition state		equilibrium state
DM1	①	N	→	Y		Y		Y
	②	N	→	Y		Y		Y
	③	Y	→	N		N		N
DM2	④	N		N	→	Y		Y
	⑤	N		N	→	Y		Y
	⑥	Y		Y	→	N		N
DM3	⑦	N		N		N	→	Y
	⑧	Y		Y		Y	→	N
	⑨	N		N		N	→	Y
The number of states		S1		S5		S13		S16

Notes: DM1(Decision Make 1): government; DM2(Decision Make 2): Medical care institution; DM3(Decision Make 3): The elderly.

systems of medical and long-term care insurance, moving the state from S1 to S5. Simultaneously, medical and nursing institutions abandoned their blind pursuit of economic benefits and established a consortium of medical and nursing institutions.

By increasing the availability of middle-end medical and nursing facilities to cater to public needs, they broaden their financing channels and diversify their funding sources. This transition progressed from S5 to S13. In response to the changes made by the government and medical institutions, the elderly gradually alter their traditional notions of endowment, strengthen their awareness of healthy aging, and choose to purchase medical services. This prompts the transition from state S13 to state S16, ultimately reaching a global equilibrium.

In this state, conflicts among the decision-makers are resolved, maximizing the interests of all parties involved. An equilibrium situation can be achieved by navigating through conflicts.

5.6. Limitations of research

The limitation of this study lies in the complexity of conflict and promoting coordination for an integrated old-age healthcare service system in China. However, the decision-maker options summarized by existing graph models may be too vague, resulting in discrepancies between the analysis results and the actual situation. This is also a major research direction in the future, how to characterize the fuzzy preference relationships of decision-makers within graph models.

5.7. Comparative analysis between GMCR and existing consensus creation methods

(1) As shown in original GMCR definitions, it includes two different stages: modeling and analysis. Considering the shortcomings of the current preference ranking methods in the analysis stage, this paper first considers using AHP to obtain each DM's preference ranking methods over all states. In other words, quantitative consensus creation methods such as AHP and other quantitative consensus creation methods are just used to determine DM's real preference ranking in the modeling stage of GMCR. As for quantitative consensus creation tools, their effects are also the same. Thus, compared with existing research methods, the proposed method in this paper not only has the advantages of GMCR but also has the advantages of consensus creation tools.

(2) Compared to other quantitative existing consensus creation, the proposed method in this paper can be used to model and analyze real-life conflict. However, quantitative existing consensus creation is just used to rank all states for each DM in the framework of GMCR. Thus, the proposed method is more professional and scientific in handling conflicts. Particularly, to resolve conflict and promote coordination for an integrated old-age healthcare service system in China, this paper first uses the quantitative existing consensus method called AHP to determine the preference in the framework of GMCR.

6. Conclusions and future works

6.1. Research conclusions

Achieving a global equilibrium solution for resolving conflicts in integrated care for the elderly and promoting its development requires coordinated efforts from multiple stakeholders, including government departments, medical institutions, elder care institutions, and the elderly. Market regulation and collaboration among these entities are crucial. Government departments should enhance coordination and cooperation among different departments, streamline administrative processes, delegate power effectively, and optimize the examinations and approval procedures of medical care institutions. Additionally, improvements in the medical insurance system and the establishment and enhancement of long-term care insurance are essential priorities. Medical and pension service institutions should collaborate actively by forming medical and nursing associations. This collaboration enables them to increase the availability of middle-end medical and nursing care services, aligning with the needs of the public. These institutions need to diversify their construction and operational channels while enriching their funding sources. It is equally crucial for them to avoid arbitrary fee increases and to focus on providing quality care. The elderly population plays a significant role in this regard. They should actively work towards transforming the traditional concepts of elderly care. By strengthening their awareness of healthy aging, they can generate demand for medical care services and overcome the challenges of combining medical and nursing care. By collectively addressing these aspects, stakeholders can contribute to resolving conflicts and dilemmas in integrated care for the elderly, paving the way for successful development and implementation.

Compared with existing research methods, the method proposed in this article quantitatively analyzes conflict and promoting coordination for an integrated old-age healthcare service system in China, the research process is simple and effective, and the research conclusions are more reliable. The research results of this article can be directly and effectively applied to obtaining solutions to real-life conflicts.

(1) Promote coordination and cooperation to break through the institutional difficulties of the bureaucratic organizational structure.

Creating a scientific and practical institutional mechanism is crucial for the successful implementation of integrated care for the elderly. The current fragmented management approach with limited authority and overlapping responsibilities must be addressed by mobilizing cooperative enthusiasm among all departments. This requires breaking through hierarchical organizational structures and

striving for a balanced interest among departments. To truly serve the people and achieve the strategic objectives of a healthy China and an aging population, superficial efforts must be replaced by substantive cooperation between pension services and medical institutions. Consideration of stakeholders' appeals and requirements is essential for meaningful collaboration. Each department should clearly understand its responsibilities, and delineate its powers and obligations within the integrated mechanism. Collaboration and efficiency principles should guide the optimization of powers and responsibilities, ensuring clear boundaries and avoiding conflicts. A guided responsibility system should be established to allow government departments to collaborate, seek appropriate powers and responsibilities, and find a balance among themselves. Legal norms related to elderly policies, such as qualification examination and approval of medical institutions, healthcare, supervision, law enforcement powers, and ownership responsibilities, should be clarified to establish robust legal safeguards with distinct boundaries. Implementing these measures will establish a robust institutional framework that enables efficient and effective integrated healthcare for the elderly while upholding legal standards and fostering collaboration among all relevant departments.

(2) Simplification of administrative procedures, empowered decision-making, and enhancement of the qualification inspection and approval process for medical care institutions

The role of the government in the approval, management, and supervision of healthcare institutions is important for an effective and efficient healthcare service system. For this purpose, the government should focus on streamlining the policies and their objectives to formulate administrative structure, delegate power, introduce rules and regulations, and optimize the services. In this regard, the government should ensure the participation and engagement of the social and healthcare institutions including medical facility centers, pension and insurance institutions, and community centers. Furthermore, the facilitation of coordination of the institutions, and grading of referral systems along information-sharing platforms would add to the efforts to develop an integrated old-age healthcare service system. The responsibilities of the stakeholders need to be defined. These stakeholders include financing, land planning, taxation and subsidies, fees, availability of beds, and demographic databases of the aged population.

Simplifying transactions and leveraging the strengths of different institutions will enhance resource integration. Additionally, the government should strengthen its supervision while streamlining administrative processes and delegating power. This ensures that institutions combining medical and nursing care can fulfill their roles effectively, focusing on medical functions and ensuring the quality of life and dignity of the elderly. By implementing these measures, the government can establish a robust framework that promotes efficiency, coordination, and accountability in integrated care. This will lead to improved healthcare services and higher quality of life for the elderly.

(3) Improve the medical insurance system and establish and improve long-term care insurance

Enhancing the medical insurance system and establishing comprehensive long-term care insurance can positively affect the elderly population. These measures can reduce economic burden, increase willingness to seek combined medical and nursing care, and stimulate overall consumption. They also attract social capital and market forces, expand funding sources for medical care institutions, and relieve the financial strain on the government. On the demand side, focusing on improving care for disabled and elderly individuals is crucial. It involves scientifically evaluating care needs and adjusting the eligibility criteria for long-term care insurance. Similar to those implemented in Beijing and Shanghai, standardized evaluation requirements can serve as models for other regions. On the supply side, expanding the scope of long-term care insurance services to cover both urban and rural residents helps bridge the urban-rural gap and ensure equitable access to care. Balancing in-home and institutional care within the insurance framework is also essential. While institutional care provides standardized regulations and better-quality care, it is necessary to address the short-term financing challenges faced by medical care institutions and the government. Standards, careful transition ratios, and speed must be established. Leveraging social and market forces is therefore crucial. Encouraging commercial insurance institutions to offer diverse long-term care insurance options helps to share the burden and meet the diverse pension needs of the population. This approach provides a range of choices that cater to different preferences and requirements, thus alleviating pressure on the government.

(4) To build medical and nursing consortiums and increase the middle-end supply to meet the needs of the public.

Ensuring the effective advancement of integrated care for the elderly population requires addressing their needs, adhering to supply-side reform principles, and optimizing strategies. The supply of integrated care services should cater to the diverse requirements of the elderly, including different age groups, disabilities, chronic illnesses, and general health needs. One approach is to enhance the integration of medical and nursing care services and to expand their availability. This can be achieved by integrating medical care into existing pension services, incorporating pension care into existing medical services, or establishing collaborative models between medical and pension institutions. Transforming general hospitals into comprehensive pension service centers and developing new medical institutions within elder care facilities can promote resource efficiency and cater to specific needs. Prioritizing the demands and preferences of the elderly is crucial. Considering their ability to pay, health conditions, and personal preferences helps optimize resource allocation. It involves reducing low- and high-end services and increasing the availability of middle-end integrated care options that align with public demand. By aligning supply with these factors, the development of integrated care services can be more efficient and responsive to the needs of the elderly population. Addressing the specific needs of the elderly population and optimizing the supply of integrated care services ensures that the development of this field is in line with their requirements and contributes to their overall well-being. This promotes efficient resource allocation and enhances the quality and accessibility of

integrated care services for the elderly population.

(5) Strengthening awareness of healthy aging and stimulating potential demand for medical and nursing services

The influence of traditional culture has shaped the perception that supporting the elderly is primarily the responsibility of intergenerational relationships, thus impacting the utilization of institutional elder care services. Proactive measures are necessary to promote a broader understanding of support for the elderly. A clear definition of the target population, focusing on the elderly population, is crucial. Promotional efforts should consider the level of acceptance and employ emotionally compelling messages. Using vivid examples and diverse formats can effectively convey the importance of medical and elderly care concepts, enhancing engagement and understanding among the elderly. Governments can facilitate the development of community-based integrated care models. In rural areas, existing grassroots medical institutions, such as township health centers and village clinics, can be tailored to meet the specific needs of the aging population. In urban areas, community health service institutions, such as elderly day-care centers and home care services, play a crucial role in providing comprehensive support for the elderly, enabling them to maintain their quality of life at home. By actively addressing cultural perspectives and employing targeted promotion strategies, societal attitudes toward elder care can be reshaped. This encourages the adoption of integrated care approaches that cater to the needs and preferences of the elderly.

6.2. Future research prospects

MAMCA (multi-attribute and multi-criteria analysis) [63] was created specifically for stakeholder groups with different objectives, motivations, and information. At the same time, consensus creation is a less subjective method, does not need further stakeholder participation but requires more mathematical calculations. However, these two preference acquisition methods have not yet been considered in the theoretical framework of graph models. Thus, in future research work, these two types of methods can be considered in the graph model framework to obtain preferences.

Data availability

Data will be made available on request.

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CRediT authorship contribution statement

Yang Kong: Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Xue-Wei Liu:** Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Qian-Qian Cui:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Haiyan Xu:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation. **Sharafat Ali:** Writing – original draft, Visualization, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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