

Analysis of the Current Research Status and Optimization Paths of Health Resource Allocation in China

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Abstract

Objective To systematically review the prominent problems existing in the field of health resource allocation in China, so as to provide a reference for optimizing resource layout. **Methods** The literature research method was adopted to summarize and analyze relevant studies from four dimensions: spatial layout, operational efficiency, talent team, and external environment. **Results** There are problems in health resource allocation in China, such as imbalanced spatial layout, low operational efficiency, structural shortage of the talent team, and insufficient dynamic adaptability. **Conclusion** It is necessary to establish a dual-dimension allocation standard based on population and geography, improve regional coordination and counterpart assistance mechanisms, promote the transformation towards efficiency improvement and technology-driven development, take multiple measures to strengthen talent team construction, and enhance the dynamic adaptability to changes in the external environment.

Keywords

Allocation of health resources; Equity; Configuration efficiency.

1. Introduction

The allocation of health resources is directly related to the fundamental guarantee of universal health and serves as a key support for the efficient operation of the healthcare system. Reasonable resource layout can continuously improve the accessibility and equity of medical services. It can also effectively maintain public health security, further enhancing the well-being of people's livelihood in society as a whole. The "Healthy China 2030" Planning Outline clearly states the need to coordinate health resource allocation between urban and rural areas and across regions. It aims to promote the expansion of high-quality medical resources and achieve a balanced layout, gradually narrowing the service gap between different regions and between urban and rural areas. The National Health Plan of the "14th Five-Year" further emphasizes the need to improve the allocation system of medical and health resources. It requires appropriately tilting resources towards the grassroots level, remote areas, and underdeveloped regions, so that more people can enjoy high-quality health services nearby. This series of policies introduced at the national level highlights the strategic position of health resource allocation. It also points out the direction for optimizing resource layout and improving service efficiency in the new era. Based on this, this paper comprehensively analyzes various problems in the field of health resource allocation in China from four dimensions: spatial distribution, operational efficiency, talent structure, and external environment. It also proposes targeted optimization paths to provide theoretical references for government departments to scientifically develop health plans and promote the balanced distribution of high-quality medical resources.

2. Current Status of Health Resource Allocation Research in China

2.1. Imbalanced Spatial Distribution and Multiple Deficiencies in Fairness

2.1.1. Severe Discrepancy between Population-based and Geographic-based Equity

For a long time, the planning and allocation of health resources in China have been primarily based on population size. Consequently, while resource allocation generally demonstrates good equity when measured by population statistics, fairness measured by geographic area lags significantly behind. Wang et al. calculated that in 2021, the equity of human resource allocation in national specialized public health institutions was relatively high when calculated by population, with a Gini coefficient of only 0.1002; however, when calculated by geographic area, the Gini coefficient rose to 0.6706, indicating a substantial disparity between the two metrics [1]. Ni et al.'s analysis of primary medical and health institutions in China reached a similar conclusion. The Gini coefficient based on population distribution shows absolute equity, while the Gini coefficient based on geographic area indicates severe inequity [2]. This phenomenon is particularly prominent in the western region. Li et al. pointed out that the Gini coefficient for health human resource allocation by geographic area in the western region is generally above 0.6, showing obvious gaps in resource distribution [3]. Liu et al.'s research on Qinghai Province further supports this point. The Gini coefficient of medical accessibility in this province is as high as 0.6546, revealing severe inequality in the geographic accessibility of medical services for residents [4]. It can be said that this allocation model, relying solely on the single dimension of population, ensures relative balance in per capita ownership at the macro level. However, at the geospatial level, it causes problems such as oversized service radii and many inconveniences for people in remote areas when accessing medical services.

2.1.2. Regional Differentiation with an East-High, West-Low Gradient

Judging from the overall regional distribution, China's medical and health resources show obvious spatial clustering characteristics. The eastern region has clear advantages in resource allocation, while the central and western regions are relatively disadvantaged. Feng et al. reported that in 2022, the density index of grassroots health human resources in eastern China was 2.3490. This value was 1.96 times that of the central region and 3.03 times that of the western region. Furthermore, the gap between Shanghai, which had the highest value, and the Tibet Autonomous Region, which had the lowest, reached 42.44 times [5]. Such disparities are not limited to inter-provincial comparisons but are also evident within provinces. For example, in remote areas such as the ethnic minority regions of Sichuan and the three prefectures of southern Qinghai, the level of resource allocation has long remained low. The imbalance in the distribution of high-quality medical resources is even more pronounced. Sun et al.'s research shows that from 2017 to 2021, the concentration of high-quality medical resources in China was highest in the east, followed by the central region, and lowest in the west. The contribution rate of inter-group differences was as high as 73.86%, meaning the resource gap between different regions is the key cause of inadequate equity in overall allocation [6]. Tang et al. further pointed out that this Matthew effect allows areas with sufficient resources to continuously accumulate more advantages over time, while areas with scarce resources will gradually be marginalized [7].

2.2. Low Operational Efficiency and Imbalanced Input-Output Structure

2.2.1. Overall Low Efficiency and Obvious Regional Differentiation

From a national perspective, the efficiency of health resource allocation in grassroots and rural areas is generally low. Gao et al.'s research shows that in 2020, in China's rural medical and health sector, very few provinces achieved a good match between input and output, and most areas had underutilized resources [8]. Xu et al.'s analysis of primary medical and health institutions also shows that nearly half of the provinces invested a lot of human and material

resources in primary care, but the output of service volume failed to keep up. This indicates a certain degree of resource waste during utilization [9]. Even in economically developed coastal areas, Sun et al. found that the overall operational efficiency of health resources still has considerable room for improvement and has not reached an ideal state [10]. It is worth noting that insufficient management capacity and low technical levels are two prominent shortcomings restricting efficiency improvement. Gao et al. found that the low efficiency in rural areas is largely related to lagging management levels and weak technical service capacities [8]. The situation in Shanxi Province also confirms this. Chang et al. believe that most cities in Shanxi have invested heavily in resources, but the actual output is unsatisfactory. This reflects that there is still large room for improvement in local institutional operation and medical service capacities [11]. This phenomenon indicates that simply increasing resource input cannot be effectively translated into actual service outputs. The improvement of the “soft power” of resource allocation is imminent.

2.2.2. Insufficient Technological Progress Constraints Sustained Efficiency Improvement

Judging from the results of dynamic analysis, multiple studies point to a common problem: slow technological progress has become an important factor restricting efficiency improvement. Duan et al.'s research found that from 2011 to 2020, the overall utilization efficiency of health resources in ethnic areas of Sichuan Province did not increase but decreased. One key reason is that technological progress failed to keep up with actual demands [12]. Zhang et al.'s analysis of the Inner Mongolia Autonomous Region also shows that the operational efficiency of health resources in this region during the same period was not ideal, and progress at the technical level was relatively limited [13]. Fan et al.'s research on Shandong Province reached a similar conclusion. The performance of many local cities in technological innovation was unsatisfactory, affecting the growth of overall efficiency [14]. Yu et al.'s analysis using a three-stage DEA model further confirmed this judgment. From 2013 to 2020, technological progress in China's grassroots medical and health sector was generally slow, and resource operational efficiency showed a downward trend [15]. These research results collectively indicate one point: the past practice of mainly relying on increased investment and scale expansion has become increasingly limited in effectiveness. The real driver for the continuous improvement of resource allocation efficiency relies on technological innovation and progress.

2.3. Structural Shortage in the Talent Team and Prominent Allocation Contradictions

2.3.1. Imbalanced Doctor-to-Nurse Ratio and a Large Shortage of Nursing Personnel

Although the doctor-to-nurse ratio in China has improved in recent years, a significant gap remains when compared to developed countries and WHO recommended standards. Li et al. pointed out that in 2017, the domestic doctor-to-nurse ratio was 1:1.12, which is lower than the globally accepted standard of 1:2 and represents an even larger disparity compared to the level of 1:4 in some developed countries [3]. This issue is particularly prominent in grassroots and rural areas. Liu et al. found that the doctor-to-nurse ratio in grassroots medical and health institutions in Inner Mongolia was only 1:1.09, with the number of nurses being 22.6% below the national standard [16]. An analysis of Shandong Province by Song et al. also showed a doctor-to-nurse ratio of 1:0.9, with a provincial average of only 2.93 registered nurses per 1,000 population [17]. The shortage of nursing staff results from a combination of multiple factors. On one hand, it is influenced by the traditional concept of valuing doctors over nurses. On the other hand, the high intensity of daily work, low salary levels, and insufficient professional identity among nurses collectively contribute to a serious loss of nursing talent. Gong et al.'s research in Hainan Province also confirmed this point. The doctor-to-nurse ratio is still far from

the WHO minimum ideal value of 1:2, and the problems of low professional identity and high turnover among nurses need to be resolved urgently [18].

2.3.2. Talent Agglomeration in Developed Regions Leading to Grassroots Hollowing

There is a significant imbalance in the allocation of health human resources in China. Specifically, high-quality health human resources continue to concentrate in large medical institutions and regions with high economic development levels. Data from Li et al. show that the growth rate of practicing (assistant) physicians in hospitals is significantly higher than that in primary medical and health institutions [3]. In Jiangsu Province, Xu et al. found that the concentration of health human resources from highest to lowest is Southern Jiangsu > Central Jiangsu > Northern Jiangsu. There is an excess of health human resources in Southern Jiangsu, while Central and Northern Jiangsu experience relative shortages [19]. Health human resources are relatively surplus in economically developed areas, whereas economically lagging areas and primary medical institutions face severe talent shortages. Zhang et al.'s research in Jiangxi Province also confirmed that core cities have an obvious siphon effect on surrounding areas, further exacerbating the loss of health human resources in these peripheral regions [20]. Duan et al. pointed out that ethnic areas generally face practical dilemmas in talent team construction involving training, recruitment, and retention. They predicted that by 2025, the number of practicing (assistant) physicians per 1,000 population in ethnic areas of Sichuan Province would be only 2.41, a figure 0.44 lower than the provincial planning target [12].

2.4. Complex External Environmental Influences and Insufficient Dynamic Adaptability

2.4.1. New Challenges to Equity Arising from the Development of the Digital Economy

Although the rapid development of the digital economy has brought numerous benefits to medical and health services, it simultaneously carries the potential to further exacerbate existing inequities in resource allocation. Empirical research by Li et al. demonstrates that the development of the digital economy tends to indirectly cause a certain degree of decline in the equity of health resource allocation through three pathways: elevating regional economic development levels, improving public education levels, and widening income gaps among residents. This impact is most prominent in the central region, followed by the western region, and is less evident in the eastern region [21]. This shows that in areas with a low level of digital economic development, the digital divide may further amplify the existing resource allocation gap. However, it is worth noting that this effect of exacerbating inequity will gradually weaken as the level of digital economic development continuously improves. In other words, after the digital economy reaches a relatively mature stage, its inclusive characteristics will slowly emerge. This is more conducive to alleviating inequity in resource allocation, rather than making the problem more serious.

2.4.2. New Challenges to Resource Allocation Posed by Changes in Population Structure

The continuous acceleration of population aging has actually put forward new requirements for health resource allocation. Yang et al.'s research found that in regions with severe aging, such as Liaoning and Heilongjiang, the medical resources provided to the elderly population are relatively insufficient [22]. Tang et al. also pointed out that the degree of aging in the southeast coastal areas is continuously deepening, which has led to a significant increase in local medical service demand. However, the existing resource layout in Southwest and North China is difficult to meet this new demand [7]. This contradiction between demand growth and supply lag reminds relevant parties to make dynamic adjustments to resource allocation strategies according to changes in population structure. In addition, Huang et al. argued that population mobility also has an important impact on resource allocation. The acceleration of urbanization has led to a decrease in the rural permanent population, resulting in a "hollowing-

out” phenomenon in some areas, and the utilization rate of grassroots medical resources has also declined [23]. Under the background of large-scale population mobility, how to achieve the dynamic adaptation of resources is an issue requiring continuous attention and research.

3. Analysis of Optimization Paths for Health Resource Allocation in China

3.1. Improving the Spatial Distribution of Resources to Enhance Service Equity and Accessibility

3.1.1. Establishing a Dual-Dimension Resource Allocation Standard Based on Population and Geography

It is necessary to break the traditional model of distributing health resources solely based on population size. Geographic area should be incorporated into the core indicators of resource allocation, and a two-dimensional collaborative accounting system should be established by combining factors such as service radius, residents’ medical accessibility, and traffic conditions [24]. For vast and sparsely populated areas such as the west, plateaus, and mountainous areas, the proportion of resource allocation in the geographic dimension should be moderately increased. This shortens the coverage radius of grassroots medical services. By adding mobile medical stations and township touring diagnostic points, the barriers to medical access caused by geographic space can be compensated. For densely populated areas, the allocation standard per 1,000 population remains the dominant standard. In addition, a dynamic monitoring mechanism for health resource equity at the provincial level should be established. It should synchronously calculate the allocation differences across population and geographic dimensions, thereby avoiding imbalances caused by a single-indicator orientation.

3.1.2. Improving Regional Coordination and Counterpart Assistance Mechanisms

In view of the gradient gap in resource allocation among the eastern, central, and western regions, it is necessary to establish a cross-regional collaborative allocation mechanism for health resources. At the macro level, financial investment and policy support for the central and western regions, ethnic areas, and remote counties should be increased. By building sub-centers of national regional medical centers, organizing high-quality hospitals to carry out counterpart assistance, and arranging regular expert stationing, the resource shortcomings in the western region can be gradually addressed [25]. At the provincial level, for areas with large gaps in resource allocation within the province, a pairing assistance system can be implemented. Medical institutions in areas with surplus resources are required to provide designated support to areas with scarce resources, and the actual effectiveness of such assistance should be incorporated into the hospital performance appraisal system [26].

3.2. Improving Resource Allocation Efficiency and Promoting the Transformation of Development Modes

3.2.1. Transitioning from Scale Expansion to Quality Improvement and Efficiency Enhancement

In view of problems such as low comprehensive technical efficiency and widespread input redundancy, the allocation mode of health resources should be gradually transitioned from incremental expansion to stock optimization. For those areas experiencing decreasing returns to scale, it is necessary to strictly control the total volume of health resource input. The focus should be placed on internal structural adjustment, compressing duplicated beds and institutions, and diverting redundant health technical personnel to scarce positions or resource-deficient areas [27]. For areas experiencing increasing returns to scale, the input of key resources can be moderately increased. However, management capacity should be improved synchronously to avoid simultaneous investment and waste [28]. In addition, a dynamic monitoring mechanism for health resource allocation efficiency should be established.

The input-output efficiency of various regions and institutions should be regularly evaluated, and efficiency indicators should be included in the health work assessment system of local governments [29].

3.2.2. Driving Efficiency Improvement Through Technological Progress

Insufficient technological progress has to a certain extent constrained the growth of total factor productivity; therefore, promoting technological innovation in relevant fields has reached a critical stage. In terms of hardware configuration, it is necessary to increase financial support for equipment renewal and the introduction of advanced technologies in grassroots medical institutions, promoting and applying more practical and mature technologies to actual grassroots operations. In terms of human resources, continuing education and professional competence training for medical technical personnel should be strengthened, with a particular focus on enhancing the technical capabilities of grassroots general practitioners and nursing staff. Furthermore, the in-depth application of "Internet + Medical Health" should be actively promoted to vigorously develop digital medical services such as telemedicine, artificial intelligence-assisted diagnosis, and electronic health records. Regions with suitable conditions can attempt to establish regional medical technology sharing platforms to enable the sharing and utilization of large-scale medical equipment and technical resources among different institutions [30].

3.3. Strengthening the Talent Team to Resolve Structural Shortage Contradictions

3.3.1. Taking Multiple Measures to Solve the Problem of Nursing Personnel Shortage

To address the predicament of a severely imbalanced doctor-to-nurse ratio and a large shortage of nursing personnel, comprehensive measures should be taken across the three links of training, utilization, and retention [31]. In the training link, the enrollment scale for nursing majors should be expanded, tuition fees reduced or exempted for students applying for nursing majors, and appropriate living subsidies provided; in ethnic and remote areas, targeted training plans for nursing personnel can be implemented [32]. In the utilization link, the position allocation of nursing personnel should be optimized to reduce the burden of non-nursing work, allowing nurses to return to their professional nursing duties. In the retention phase, the remuneration of nursing staff should be effectively improved, and a performance distribution mechanism matching work intensity and technical difficulty should be established. Career development channels for nursing staff should be broadened, with preference given in professional title evaluation and further training. The nursing work environment should be improved to reduce occupational burnout and lower the turnover rate.

3.3.2. Guiding the Flow of Health Human Resources to Grassroots and Underdeveloped Areas

To reverse the current phenomenon where high-quality health human resources are excessively concentrated in big cities and large hospitals, an institutionalized guidance mechanism is required. In the talent training link, free medical training programs oriented towards rural areas should be continuously implemented, enrollment quotas appropriately increased, and employment guidance and management improved to encourage trained medical students to return to work at the grassroots level. In the talent utilization link, the management and employment models for grassroots health personnel should be optimized so that staff in township and village-level medical institutions can enjoy the same treatment as employees in county-level hospitals in terms of staffing establishment guarantees and position promotion, thereby reducing the worries of grassroots talent. In the policy incentive link, medical personnel who voluntarily choose to work in remote or relatively harsh areas should be provided with higher position subsidies and one-time settlement fees, as well as conveniences

such as priority promotion in professional title evaluation. Furthermore, a system should be established for doctors from urban upper-level hospitals to regularly visit grassroots level for consultations and assistance, making grassroots service experience a necessary condition for doctors to be promoted to professional titles, thereby using the system to drive high-quality medical talent to actively move down to the grassroots frontline [33].

3.4. Adapting to Changes in the External Environment and Enhancing Dynamic Adaptive Capacity in Resource Allocation

3.4.1. Guiding the Digital Economy Towards an Inclusive Direction

The continuous development of the digital economy acts as a double-edged sword for health resource allocation; the key lies in whether this development trend can be guided to evolve in a direction more conducive to fairness. On one hand, it is necessary to accelerate the construction of a national unified medical and health information platform, strive to break the issue of data silos, and enable high-quality medical resources to achieve digital sharing within a larger scope [34]. On the other hand, in remote and impoverished areas, priority should be given to completing the layout of telemedicine-related infrastructure. Through the "Internet + Medical" approach, local residents can be enabled to obtain diagnosis and treatment services from higher-level hospitals relatively conveniently.

3.4.2. Dynamically Adjusting Allocation to Adapt to Changes in Population Structure

Facing the trend of increasingly severe population aging, it is necessary to incorporate geriatrics, rehabilitation nursing, home-based medical care, and long-term care into the priority areas for health resource allocation [35]. In regions with high aging levels, the allocation of geriatric beds and rehabilitation beds should be moderately increased, and the construction of geriatrics departments and nursing homes should be strengthened. Furthermore, dynamic adjustments to the grassroots resource layout should be made in combination with the overall trend of population mobility. In cities with population inflow, community health service stations should be appropriately added, while in areas with population outflow, resource integration and layout optimization should be carried out to avoid unnecessary resource waste [36]. In addition, an attempt can be made to establish a resource demand early warning mechanism based on a population prediction model, so as to make more forward-looking planning arrangements for resource allocation.

4. Conclusion

Based on the four dimensions of spatial layout, operational efficiency, talent team, and external environment, this article systematically reviews the research status and outstanding problems in the field of health resource allocation in China. The research shows that the current allocation of health resources in China is fair in the population dimension but unbalanced in the geographical dimension. The east-west gradient differentiation remains obvious. In terms of efficiency, a bottleneck exists with low overall operational efficiency and slow technological progress restricting the improvement of total factor productivity. Regarding the talent team, it faces a structural shortage involving an imbalanced doctor-to-nurse ratio and grassroots talent hollowing. Meanwhile, external environmental changes such as the digital economy and population aging have posed serious challenges to the dynamic adaptability of resource allocation. To address these problems, this paper proposes the following optimization paths. First, establish a two-dimensional collaborative accounting system for population and geography. Also, improve the cross-regional coordination and counterpart assistance mechanism to perfect the spatial layout and service accessibility. Second, promote the transformation of resource allocation from scale expansion to quality and efficiency improvement. Technological progress and digital applications should drive the improvement

of operational efficiency. Third, take multiple measures to strengthen talent team construction. This will solve the shortage of nursing staff and the dilemma of grassroots talent retention, guiding high-quality resources to the grassroots. Fourth, guide the digital economy to evolve towards inclusiveness. Establish a dynamic adjustment mechanism based on population structure changes to enhance the adaptability of resource allocation to external environment shifts. Moving forward, government departments should further strengthen top-level design. Integrating these paths into the formulation and implementation of health policies will promote the high-quality, balanced, and sustainable development of China's medical and health resources.

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