Analysis of Operational Efficiency and Changing Trends of Clinics in Beijing (Postprint)

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Abstract

Background The number of clinics in Beijing has grown rapidly; however, clinics face serious issues such as physician shortage, low service quality, and weak regulatory oversight. Objective To investigate the operational efficiency of Beijing' s clinics and its changing trends, providing a reference for the rational allocation of medical resources in clinics. Methods Data Envelopment Analysis (DEA) and the Malmquist Index model were employed to measure the static and dynamic efficiency of Beijing' s clinics from 2013 to 2020. Input indicators included building floor area, number of on-duty staff, and total expenses; output indicators included number of patient visits and total revenue. Results From 2013 to 2020, the comprehensive technical efficiency and pure technical efficiency values of clinics exhibited a fluctuating downward trend, while scale efficiency showed a fluctuating upward trend. Medical aesthetic clinics had the lowest comprehensive technical efficiency, and urban clinics demonstrated higher comprehensive technical efficiency than suburban clinics. Clinic efficiency improved from 2013 to 2015, but declined from 2015 to 2020, indicating efficiency regression. Conclusion The overall efficiency of Beijing' s clinics is relatively low, with technical efficiency being particularly low; there are certain inadequacies in resource inputs for clinics, and efficiency varies across different categories and regions. Recommendations Strengthen personnel training in clinics, encourage physicians from large hospitals to establish clinics at the primary care level to improve diagnostic and treatment capabilities; enhance internal and external regulatory capacity of clinics, and formulate more detailed supporting measures for clinic establishment.

Full Text

Preamble

Analysis of Clinic Operation Efficiency and its Changing Trend in Beijing

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Abstract

Background: The number of clinics in Beijing is growing rapidly, but clinics suffer from serious problems such as a lack of physicians, lower quality of service, and weak supervision.

Objective: To explore the clinic operation efficiency and its change trend in Beijing, and to provide reference for rational allocation of clinic medical resources.

Methods: Data Envelopment Analysis (DEA) and Malmquist index model were used to estimate the static and dynamic efficiency of clinics in Beijing from 2013 to 2020. The input indicators selected were building area, number of working staff, and total cost, while the output indicators selected were number of patient visits and total income.

Results: From 2013 to 2020, the comprehensive technical efficiency and pure technical efficiency showed a fluctuating decreasing trend, while scale efficiency showed a fluctuating increasing trend. The comprehensive technical efficiency of medical aesthetic clinics was the lowest, and the comprehensive technical efficiency of urban clinics was higher than that of suburban clinics. Clinic efficiency improved from 2013 to 2015, but decreased from 2015 to 2020.

Conclusion: The overall efficiency of clinics in Beijing is not high, with low technical efficiency. There is a certain shortage of clinic input resources, and there are certain differences in clinic efficiency across different categories and regions. It is suggested to strengthen the training of clinic personnel and encourage doctors in large hospitals to set up clinics at the grassroots level to improve the level of clinic diagnosis and treatment; strengthen the internal and external supervision capacity of clinics, and formulate more detailed supporting measures for the establishment of clinics.

Keywords: Clinic; Operation efficiency; DEA; Malmquist index model; Beijing

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Introduction

Clinics are an essential component of the primary healthcare service system, primarily providing outpatient diagnosis and treatment services for common and frequently occurring diseases, as well as some family doctor contract services [1]. In 2015, Beijing proposed encouraging qualified medical personnel to open clinics or practice individually in communities [2], a policy aimed at promoting the rational mobility of health technicians, diverting outpatient volume from large hospitals, and ultimately alleviating the problem of "difficulty in seeing a doctor" for residents. In 2019, the state promulgated the "Guiding Opinions on Carrying Out Pilots to Promote the Development of Clinics"[3] and the "Notice on Issuing Opinions on Promoting the Sustained, Healthy and Standardized Development of Social Medical Institutions" [4]. As an indispensable part of social medical institutions, clinics have thus obtained new development opportunities. From 2009 to 2019, the number of clinics in Beijing increased from 1,757 to 2,934, and clinic service volume grew from 3.553 million to 4.132 million visits. Although the number of clinics in Beijing is growing rapidly, clinics face serious problems such as a shortage of physicians, lower service quality, and weak supervision [5].

Currently, domestic research mostly uses qualitative case analysis and quantitative descriptive analysis to study the current status of clinic quantity and scale configuration in different regions and categories [6], but no studies have been seen on efficiency evaluation of clinics.

Methods

2.1 Data Collection

This study took clinics in Beijing from 2013 to 2020 as the research subjects. Data were obtained from Beijing' s health statistical reports from 2013 to 2021, including basic clinic information, personnel information, financial status, and medical service provision. Inclusion criteria: clinics opened in Beijing from 2013 to 2020 that reported complete data for one year or more. Exclusion criteria: clinics with missing values and illogical data, such as those showing sudden surges followed by drops in input volume. When analyzing the static efficiency of clinics for each year, the clinics constituted an unbalanced panel dataset with a total of 3,945 decision-making units (DMUs). When analyzing the changing trend of clinic resource allocation efficiency from 2013 to 2020, the 16 administrative districts of Beijing were used as DMUs.

2.2 Research Methods

Data Envelopment Analysis (DEA) is a non-parametric analytical method that uses linear programming to handle multiple input and output evaluation indicators to assess the relative efficiency of decision-making units. The comprehensive technical efficiency measured can be decomposed into pure technical efficiency and scale efficiency. Pure technical efficiency reflects the management capability and technical level of decision-making units, while scale efficiency reflects the resource allocation level of decision-making units [7]. Through literature review, input indicators were considered to include three aspects: material, human, and financial resources. Combined with indicator availability, this study selected the following input indicators: building area (square meters), number of staff on duty (persons), and total cost (thousand yuan) [8-10].

Since most clinics are for-profit institutions, the output indicators selected were: number of patient visits (person-times) and total income (thousand yuan) [11-12]. When using the DEA method, the number of decision-making units should be at least three times the sum of input and output variables [13], thus this study meets the conditions for using the DEA method.

To further understand the changing trend of efficiency, this study adopted the Malmquist index model to calculate the dynamic changes in total factor productivity between years. Total factor productivity represents the additional production efficiency achieved under given input levels of various production factors, which can be decomposed into technical progress and technical efficiency change. Technical progress refers to achieving more output with the same input combination through technological advancement, while technical efficiency change refers to releasing the potential of existing technology to a greater extent by increasing coordination among various resource elements under current technical levels [14]. Technical efficiency change can be further decomposed into pure technical efficiency change and scale efficiency change. Based on the policy encouragement orientation, Beijing' s clinics are in a state of rapid quantitative growth and internal scale expansion. Therefore, when calculating efficiency, an input-oriented variable returns to scale model was selected.

2.3 Statistical Methods

This study collected clinic-related data from Beijing' s health statistical reports from 2013 to 2021. Data were organized using Excel, and basic clinic characteristics were described using frequency, mean, and percentage. MaxDEA 7 statistical software was used to evaluate clinic operation efficiency, employing Data Envelopment Analysis and Malmquist index models to conduct static and dynamic efficiency analyses. The aim was to understand the operation efficiency, resource input utilization, and output conditions of Beijing' s clinics against the backdrop of rapid development, providing empirical evidence for optimizing resource allocation and improving operation efficiency in Beijing' s clinics.

Results

2.1 Clinic Distribution

In 2020, there were 1,078 clinics in urban areas and a total of 1,298 clinics in suburban areas in Beijing. Among them, Chaoyang District, Changping District, and Shunyi District ranked top three in clinic numbers, with 477, 401, and 275 clinics respectively. Fengtai District, Mentougou District, and Tongzhou District ranked at the bottom, each with fewer than 30 clinics (see Table 1).

2.2 Clinic Categories and Input-Output Indicators

From 2013 to 2020, the most numerous category of clinics in Beijing' s medical market was general clinics, followed by traditional Chinese medicine (TCM) (comprehensive) clinics and dental clinics. In 2015, the number of dental clinics surpassed that of TCM (comprehensive) clinics, ranking second. In terms of quantity trends, general clinics, TCM (comprehensive) clinics, dental clinics, and medical aesthetic clinics increased year by year, with medical aesthetic clinics showing the largest average annual growth rate of 23.70%. The number of other clinics decreased year by year, with an average annual growth rate of -2.85% (see Table 2).

Note: Other clinics include integrated TCM-Western medicine clinics, ethnic medicine clinics, mental health clinics, and other clinics.

From 2013 to 2019, the building area, number of staff on duty, and total costs of Beijing' s clinics showed an increasing trend. However, in 2020, affected by the COVID-19 pandemic, although clinic input indicators continued to show an upward trend, clinic outputs decreased significantly compared to 2019. When classified by clinic category, general clinics had the highest input-output indicator values, followed by dental clinics. When classified by region, clinics in urban Beijing had higher input-output than those in suburban areas (see Table 3).

Note: Values in the table are means.

2.3 Static Efficiency Analysis

A summary analysis of the static efficiency of Beijing clinics from 2013 to 2020 revealed that comprehensive technical efficiency and pure technical efficiency showed fluctuating decreasing trends, while scale efficiency showed a fluctuating increasing trend. Among these, 2014 had the highest efficiency values, with comprehensive technical efficiency at 0.314, pure technical efficiency at 0.533, and scale efficiency at 0.654. Due to the impact of the COVID-19 pandemic, 2020 had the lowest comprehensive technical efficiency at only 0.142. From 2013 to 2020, the number of clinics with increasing returns to scale each year exceeded 90% of the total clinics for that year, indicating that the growth rate of outputs was higher than that of inputs for most clinics [15].

When clinics were classified by category, medical aesthetic clinics had the lowest

mean comprehensive technical efficiency at 0.156, while other clinics had the highest mean at 0.197. In terms of pure technical efficiency, traditional Chinese medicine (TCM) (comprehensive) clinics had the highest mean, while medical aesthetic clinics had the lowest. In terms of scale efficiency, medical aesthetic clinics had the highest, while TCM (comprehensive) clinics had the lowest mean. When classified by region, urban clinics had higher comprehensive technical efficiency and scale efficiency than suburban clinics, but lower pure technical efficiency (see Table 4).

2.4 Dynamic Efficiency Analysis

A summary analysis of the dynamic efficiency of Beijing clinics from 2013 to 2020 showed that only in 2013-2014 and 2014-2015 did the total factor productivity index exceed 1, indicating efficiency improvement. Specifically, the technical efficiency change index was greater than 1 in 2013-2014, while the technical progress index was greater than 1 in 2014-2015. In subsequent years, clinic efficiency experienced varying degrees of regression, with the most severe regression occurring in 2019-2020, likely due to the impact of the COVID-19 pandemic, which created operational difficulties for clinics.

When comparing efficiency changes across clinic categories, only other clinics had a total factor productivity index greater than 1, indicating efficiency improvement from 2013 to 2020. All other clinic categories had total factor productivity indices less than 1, representing efficiency regression. Decomposing clinics with total factor productivity indices less than 1 revealed that, except for TCM (comprehensive) clinics and dental clinics where technical efficiency remained unchanged, all other clinics experienced regression in both technical efficiency and technical progress. Urban clinics had a total factor productivity index greater than 1, indicating efficiency improvement, while suburban clinics experienced efficiency regression (see Table 5).

Discussion

3.1 Growth in Clinic Quantity and Scale in Beijing, but Low Overall Efficiency

Driven by national and Beijing municipal policy encouragement [16], the number of social medical institutions in Beijing has grown rapidly. As a component of social medical institutions, research results show that both the number and input scale of Beijing' s clinics increased year by year from 2013 to 2020. As a first-tier city, Beijing residents have relatively high consumption levels and are more accepting of the comfortable and private diagnostic and treatment services provided by clinics, which may also have contributed to the development of Beijing' s clinics [17]. However, the overall efficiency of clinics is low. From 2013 to 2020, the mean comprehensive technical efficiency of clinics was less than 0.2. Decomposing comprehensive technical efficiency into pure technical efficiency and scale efficiency reveals that both efficiency levels were less

than 50%, with pure technical efficiency lower than scale efficiency on average. This indicates more serious deficiencies in technical level performance and internal management of clinics. The possible reasons are that clinic talent and technology lag far behind hospitals [18] and clinic management methods are backward [19], unable to meet the rapid development of clinics. This study recommends strengthening clinic personnel training to improve diagnostic and treatment levels. Doctors from large hospitals should be encouraged to open clinics at the grassroots level [2], with supporting policies formulated to ensure high-quality resources from large hospitals flow down to clinics. Simultaneously, more general practitioners should be trained and deployed to clinics, and clinic personnel should be incorporated into national education and training plans [17] to smooth their development pathways, thereby improving the overall diagnostic and treatment level of clinics.

3.2 Differences in Efficiency Across Clinic Categories and Regions

Research results show that efficiency varies across different clinic categories and regions. Other clinics had the highest comprehensive technical efficiency, while medical aesthetic clinics had the lowest at only 0.156. From 2013 to 2020, medical aesthetic clinics experienced the largest growth in numbers. The possible reason is that medical aesthetics has become a popular service item, and opening medical aesthetic clinics yields quick profits [20]. Therefore, driven by huge profits and lacking sufficient regulatory basis or means to supervise their economic operations [21], phenomena such as unlicensed practice, cross-specialty practice, and false advertising are widespread in the medical aesthetic clinic market. Clinic internal management measures are also lacking. Similar phenomena exist in popular clinic markets such as TCM and dental clinics [22].

Therefore, the authors recommend strengthening internal and external regulatory capacity for such clinic markets. Internally, clinics should actively explore "modern management systems," hire professional management personnel responsible for clinic operations, and regularly conduct standardized training for medical staff. Externally, the clinic filing system should be improved, a unified clinic personnel information system can be established, and regulatory and early warning mechanisms for physician mobility should be perfected, along with a clinic "blacklist" mechanism to achieve unified standardized management of clinics.

When classified by region, urban clinics in Beijing had higher comprehensive technical efficiency than suburban clinics, and urban clinic efficiency improved compared to suburban clinics. The possible reasons are that urban residents have higher consumption levels and medical resource allocation favors urban areas, making urban residents more willing to seek medical care at clinics [23]. Based on this, suburban clinics can also explore effective group development to achieve scale, avoid individual operation, and thereby improve resource utilization efficiency [16].

3.3 Insufficient Operational Inputs for Beijing Clinics

Research results show that although clinic scale efficiency showed an upward trend from 2013 to 2020, the overall level of scale efficiency remained low. However, the proportion of clinics with increasing returns to scale exceeded 90% each year, indicating that current inputs in Beijing' s clinics are being relatively fully utilized. The cause of low scale efficiency is the small scale of clinics and insufficient input in human, financial, and material resources. Analyzing the reasons for the generally small scale of current clinics, the authors believe possible causes include the external objective environment of clinics and the subjective choices of clinic operators. Regarding the external objective environment, Beijing has many large hospitals that gather more high-quality medical resources in terms of human, financial, and material resources. From the perspective of the entire health system, clinic institutions are relatively marginalized [24]. Studies have found that TCM clinics suffer from a shortage of young physicians, with phenomena such as gaps in health technical personnel and uneven quality [25, 26]. For clinic operators, smaller clinics have lower risk, require less investment in management and operation, and are less likely to face investment failure [27]. For clinics currently experiencing low scale efficiency but increasing returns to scale, establishing "clinic alliances" or "clinic groups" could be considered to expand clinic scale [28], integrate high-quality resources, reduce operational risks, and ultimately enhance clinic competitiveness.

3.4 Recommendations for Formulating or Improving Clinic-Related Policies to Promote Sustainable Development

The overall efficiency of Beijing' s clinics is not high, there is insufficient input of health resources, and efficiency varies significantly across different clinic categories. Building on current clinic policies that mostly call for and encourage clinic establishment, this study recommends formulating more supporting safeguard and regulatory policies for opening clinics, while implementing policies tailored to local conditions according to different clinic categories. The study found that Beijing' s clinic efficiency in 2014 was 0.314, which represented a significant improvement compared to the previous and following years. The possible reason is that in 2014, Beijing promulgated the "Beijing Social Capital Medical Institution Guide"and the "2014 Notice of Beijing Municipal Health and Family Planning Commission on Adjusting the Management of Class B Large Medical Equipment Configuration in Medical Institutions Established by Social Capital" [29], which detailed the processes for social capital to establish medical institutions and standardized the management policies for social medical institutions. These policies clarified relevant details for opening clinics on the basis of encouraging clinic access, thereby improving clinic operation efficiency. Currently, most clinic policies focus on calling for and encouraging clinic establishment, but have not formulated detailed policies on the specific content of the clinic opening process, leading to a "wild growth" phenomenon in clinics [30]. Based on this, more supporting safeguard and regulatory policies for opening

clinics should be formulated on top of the policy "encouragement" level, such as including clinics opened by doctors from large hospitals within the scope of medical insurance designated institutions, or formulating category-specific policies according to clinic types, with different business scopes for different categories of clinics and qualifications for doctors suitable for opening clinics.

3.5 Limitations of This Study

Regarding the selection of DEA evaluation indicators, domestic scholars have chosen different health resource indicators. Due to data availability, this study could not further decompose the number of staff on duty in the input indicators into medical technical personnel and non-medical technical personnel, nor could it decompose the treatment volume in the output indicators into outpatient and inpatient service volumes. In the future, the research team will further explore the data, refine the input-output indicators, and conduct analyses.

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