

Analysis of Prevention and Control Effect in Post-epidemic Era based on DEA Analysis

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Abstract

Based on how to achieve high-efficiency allocation of medical resources in various regions and accurately prevent and control the epidemic situation in the post-epidemic era, this paper uses data envelopment analysis (DEA) to establish an evaluation model to compare the utilization of medical resources in Jilin, Shanghai and Wuhan in 2019 and 2020, and analyzes the epidemic prevention and control effects of these three regions, finding out the shortcomings and defects in medical resource allocation and epidemic prevention and control, and making suggestions for achieving high-efficiency allocation of medical resources, accurately preventing and controlling the epidemic situation and ensuring people's life safety in the post-epidemic era.

Keywords

COVID-19 Epidemic; Medical Resources; Data Envelopment Analysis Method; Epidemic Prevention.

1. Introduction

COVID-19 epidemic has become the most important health threat in the world since it broke out in Wuhan, Hubei Province, China in 2020. It is the most serious infectious disease pandemic in the world since the 1918 pandemic. All countries in the world have taken active measures to protect people's lives. In 2021, the epidemic situation in China was basically under control, but in March 2022, the epidemic situation occurred repeatedly in Shanghai and Jilin, and people's lives were threatened again. Shanghai and Jilin established shelter hospitals and implemented measures such as city closure to actively respond. Epidemic prevention and control is a challenge to all regions. All regions actively prevent the spread of the epidemic by making use of early basic medical resources and later epidemic prevention and control measures (such as nationwide "city closure", etc.). The basic medical level determines the benchmark mortality level of countries without any intervention measures in the face of COVID-19 epidemic, and the intervention measures of COVID-19 epidemic determine the impact of intervention measures on virus mortality [1]. Therefore, it is particularly important to achieve high-efficiency allocation of medical resources in various regions and make accurate prevention and control in the post-epidemic era.

2. Literature Review

Wu Jiebiao et al. (2020) used DEA model to evaluate the efficiency of COVID-19 epidemic prevention and control in 14 countries around the world. The results showed that the efficiency of medical resource allocation in China was DEA effective epidemic prevention and control, and the efficiency of medical resource allocation in European countries was generally low, while that in Japan and South Korea was relatively high, and the redundancy of medical resource allocation in Russia was the highest [1]. Liu Xu et al. (2020) used data envelopment analysis (DEA) to calculate the efficiency, and evaluated the operation efficiency of each ward in Huoshenshan Xinguan Pneumonia Hospital. It was found that the pure technical efficiency of

each ward in Huoshenshan Hospital was generally high, which affirmed the effectiveness of emergency medical management. The scale efficiency results verified the allocation principle of "early enough" of power pumping group, which provided decision-making basis for optimizing the allocation of medical resources and improving the efficiency of emergency management [2]. Wang Shuai et al. (2022) used data envelopment analysis (DEA) to analyze the efficiency of medical and health resources in China from 2000 to 2019, and concluded that the current allocation efficiency of medical and health resources needs to be improved, and the professional quality and ability of health personnel need to be improved [3]. Wang Junhao et al. (2021) pointed out that the rational allocation of medical and health resources among medical and health institutions at different levels is the key to promote the reform of graded diagnosis and treatment, and the outbreak of COVID-19 epidemic situation has highlighted the problems of lack of resources and insufficient service capacity of primary medical and health institutions in China [4].

3. Analysis of Medical Resource Efficiency

3.1. Data Sources

The research data come from the statistical yearbooks of Wuhan City, Shanghai City and Jilin Province in Hubei Province in 2020 and 2021, and the data obtained by consulting the statistical yearbooks.

3.2. Research Methods

Data envelopment analysis (DEA) is a method of operational research and research on economic production boundary. This method is generally used to measure the production efficiency of some decision-making departments. The basic idea is to comprehensively analyze the input and output data of production decision-making units, get the relative indexes of each efficiency, and then sort all the efficiency indexes to determine the relatively effective decision-making units. At the same time, the projection method can be used to point out the reasons why DEA is not effective or DEA is effective, and the direction and degree that should be improved, so as to provide management decision-making information for managers. The data envelopment analysis (DEA) method is used to make an empirical study. The input indicators are the number of health institutions, health technicians and beds in health institutions in each region, and the output indicators are the number of bed turnover and bed utilization rate. The medical resource allocation in 2019 and 2020 in three regions is empirically analyzed, and some reasonable suggestions are put forward to realize the optimization of medical resource allocation and epidemic prevention and control.

3.3. Index Setting

Table 1. Basic data

		Number of health institutions (one)	Health technicians (people)	Number of beds in health institutions (10,000)	Turnover times of hospital beds (times)	Bed utilization rate (%)
Shanghai	2019	5610	213300	154600	32.2	93.55
	2020	5905	226400	161500	25.76	82.83
Wuhan	2019	6497	141724	96357	35.7	90.03
	2020	6446	139956	93834	23.26	65.65
Jilin province	2019	22178	188257	170582	25.4	69.73
	2020	25626	212140	173143	18.8	56.16

This paper selects five indicators, namely, the number of health institutions, health technicians, the number of beds in health institutions, the number of bed turnover and the utilization rate of beds. The data obtained from statistical yearbooks of various regions are sorted out as follows.

3.4. Empirical Research

Set up 6 decision-making units, and use Matlab software to write codes for dea efficiency analysis. The results are as follows:

Table 2. Efficiency result

region	age	efficiency
Shanghai	2019	1
	2020	0.8435
Wuhan	2019	1
	2020	0.7488
Jilin province	2019	0.5831
	2020	0.4167

According to the output results of the model, the production efficiency of six decision-making units can be obtained: in 2019, Shanghai and Wuhan were DMU effective, with a score of 1; in 2020, Shanghai, Wuhan, Jilin and Jilin provinces were DMU inefficient, with scores of 0.8435, 0.7488, 0.5831 and 0.0.

It can be concluded that in 2019, the allocation efficiency of medical resources in Shanghai and Wuhan was high, while in 2020, Shanghai, Wuhan, Jilin and Jilin provinces were low. The outbreak of COVID-19 in 2020 posed a great challenge to Chinese medical care, and the allocation efficiency of medical resources in various regions decreased in 2020 compared with that in 2019. Therefore, it can be improved in terms of health institutions, health technicians, number of beds, etc., and regional coordination of medical resources should be carried out among hospitals in the city and among cities in the province to prevent redundancy and shortage of medical resources. After the outbreak, Shanghai, Wuhan and Jilin also established a shelter hospital, actively allocating medical resources, transferring and rescuing COVID-19 patients, and ensuring people's life safety.

4. Analysis of Epidemic Prevention Effect

After a large-scale outbreak of the epidemic in Shanghai, all kinds of epidemic prevention measures were taken immediately, such as city closure, home isolation, daily nucleic acid testing, establishment of shelter hospital, etc., and COVID-19 epidemic prevention and control management was strictly implemented. There was a situation of poor logistics and lack of materials in Shanghai. After the outbreak of the epidemic in Jilin Province, various regions also actively prevented the epidemic, among which Changchun City and Jilin City had a serious epidemic during this period, and measures such as city closure, nucleic acid detection, establishment of shelter hospital, etc. were also implemented. Once COVID-19 positive patients were found, they were immediately sent to isolation and treatment, and followed up. Wuhan, as the first outbreak area in 2020, has been actively preventing and controlling the epidemic, and its epidemic prevention and control effect is good in 2022. Looking at the contents of prevention and control in Shanghai, Wuhan and Jilin, all regions have strengthened the medical investigation in COVID-19, attached importance to the nucleic acid detection of foreign imports, immigrants and imported goods, strengthened the monitoring and investigation of local epidemic situation, and made real-time reports on the epidemic situation. Among them, people

and places related to confirmed cases in key regions have focused on investigation and disposal, and all regions have strengthened the monitoring and risk assessment of epidemic situation, paid close attention to the development trend of global epidemic situation, and dynamically adjusted the prevention and control strategies and measures, which can achieve scientific, accurate, efficient and standardized emergency treatment of COVID-19 epidemic situation.

5. Suggestions

5.1. Do a Good Job in the Allocation of Medical Resources and Improve the Quality of Medical Personnel

Medical resources are the basic guarantee for people's life safety, and the rational allocation of medical resources among different medical and health institutions in different regions is the key to achieve high-efficiency health protection and high-efficiency epidemic prevention and control. From the empirical research of Shanghai, Jilin and Wuhan selected in this paper, it is found that the allocation of medical and health resources is not efficient and reasonable, and it needs to be improved. To realize the rationalization of medical resources and high efficiency of services, it is necessary to coordinate medical resources, but also to improve the professional ability of medical and health institutions. It is the medical staff who are in direct contact with patients. Therefore, it is also meaningful to strengthen the educational strength, improve the professional quality of medical staff, increase the number of people who have obtained relevant certificates, and ensure both quantity and quality.

5.2. Promote the Development of New Formats of Internet Plus Medical Care

With the development of Internet, the efficiency of medical treatment can be improved through the development and opening of online service functions, so as to achieve convenient and intelligent medical treatment. At present, Internet medical treatment is developing rapidly, which continuously optimizes the allocation of medical resources and provides a lot of convenience for people to seek medical treatment. Therefore, it is also very important to promote the development of new formats of Internet plus medical treatment, comprehensively promote digital hospitals, and deeply promote the digital transformation of hospitals.

5.3. Implement Epidemic Prevention and Control

Besides medical resources, prevention and control measures are the main factors to ensure people's life safety, and they can't be slackened in the post-epidemic era. All trades and professions need to stick to their posts and do a good job in epidemic prevention, and epidemic prevention propaganda workers need to actively publicize the knowledge of epidemic prevention and control to the masses. Market supervision departments, emergency management departments and other departments should strengthen the supervision of imported food, ensure the safety of materials, and postal departments should do a good job in express delivery and preventive disinfection, etc. Workers in all trades need to closely combine epidemic prevention with work to comprehensively and meticulously ensure people's life safety. At the same time, all localities need to continue to strengthen the closed-loop management of immigration personnel, prevent and control local cases, prevent and control epidemic situation in medical institutions, promote vaccination and prepare for emergency response of epidemic situation, dynamically adjust prevention and control strategies and measures, and make adequate preparations for the uncertainty and complexity of epidemic situation.

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References

- [1] Wu Jiebiao, Dong Yu. Evaluation of COVID-19 epidemic prevention and control efficiency based on DEA model [J]. chinese journal of medical library and information science, 2020,29(12):7-16.
- [2] Liu Xu, Guo Yufeng, Yu Boyang, Tang Bihan, Zhang Lulu, Liu Bin. Analysis of medical resource allocation efficiency of Huoshenshan Hospital based on DEA [J]. Journal of Hospital Management of PLA, 2020,27(04):301-304.
- [3] Wang Shuai, Luo Juan, Ma Wendi, Li Shuai, Hu Jing. DEA-based analysis of the input efficiency of national medical and health resources [J]. China Medical Management Science, 2022,12(03):47-50.
- [4] Wang Junhao, Jia Wanwen. Analysis on the allocation and utilization efficiency of medical and health resources in China [J]. Finance and Trade Economics, 2021,42(02):20-35.