

Evaluation of Health Resource Allocation Efficiency of Community Health Service Institutions of China in 2019 based on DEA

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Abstract: In the process of deepening the reform of medical and health system, community health service institutions have developed well, but there are still some problems, therefore, we analyzed the allocation of health resources in community health service institutions. Based on the theory and method of data envelopment analysis (DEA), this paper made a horizontal analysis on the allocation of health resources in community health service institutions of China in 2019. The results showed that there are differences in the allocation of health resources among community health service institutions in the east, middle and the west of China, all regions should rationally allocate health resources, innovate the management mechanism of community health service institutions, rely on the strength of medical partnerships, carry out technological innovation, and improve the quality and ability of medical staff at the basic level.

1 INTRODUCTION

Community health service institutions, as the main body of primary medical and health service system, is the first line of defense for residents' health. With the gradual improvement of people's living standards, people pay more attention to their physical health, and people's health needs become diversified, which brings severe challenges to the resource allocation of community health service institutions. The reasonable resource allocation would influence the efficient use of resources and meet the needs of patients effectively. And the allocation and utilization rate of health resources directly affect the quality of medical services provided to residents and the satisfaction of patients. Therefore, it is necessary to research on the allocation efficiency of health resources in community health service institutions, and how to promote the optimization of the allocation of resources in community health service institutions. Based on the open data of 2020 and using the DEA method, this paper analyzed of the allocation efficiency of health resources in 2019 of community health service institutions in China, summarized the present situation and existing problems of health resources allocation in community health service

institutions, and put forward relevant suggestions to the problems.

2 DATA AND METHODOLOGY

Based on data from the 2020 China Health Statistics Yearbook, this paper analyzed the health resource allocation efficiency of community health service institutions in 31 provinces, municipalities and autonomous regions of China in 2019 by DEA. The statistical analysis method is DEA statistical analysis method, which included the CCR model and BCC model. This paper researched the efficiency of health resource allocation in community health service institutions using the BCC model (Yao 2021).

3 RESEARCH INDICATORS

After analyzing the present situation and configuration characteristics of medical and health resources in our community health service institutions, the number of institutions, the number of beds and the number of health technicians were selected as input indexes, and the number of visits and the utilization rate of beds were selected as the output indexes.

4 RESULTS

The specific data of health resource input and output of 31 provinces, autonomous regions and municipalities directly under the central government in 2019 was showed in Table 1 according to China Health Statistics Yearbook 2020. And the input and output data in Table 1 were put into BCC model to obtain the health resource allocation efficiency analysis of community health service institutions in 2019 using the DEAP2.1 (Table 2). In addition, according to China Health Statistics Yearbook 2020, we divided the 31 provinces, autonomous regions and municipalities directly under the central government into east, central and west areas of China. Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan are the eastern area; Shanxi, Jilin, Heilongjiang,

Anhui, Jiangxi, Henan, Hubei and Hunan are the central regions; Inner Mongolia, Chongqing, Sichuan, Guangxi, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang are the western regions. The BCC model could calculate the overall technical efficiency (TE), which can be further decomposed into scale efficiency (SE) and pure technical efficiency (PTE), that is $TE = SE * PTE$. The results in table 2 showed that the allocation of health resources were relatively effective in the community health service institutions of Beijing, Shanghai, Zhejiang, Hainan, Qinghai, and Ningxia in 2019 according to the DEA analysis. The returns to scale remained unchanged, and the TE, PTE and SE were all 1, which illustrated that the health resources in these six regions have been fully utilized, and the resource allocation is reasonable and effective. The six regions were all located in east and west area of China.

Table 1: Health resources input and output in community health service institutions in 31 provinces, autonomous regions and municipalities in 2019.

Area	Output		Input		
	Number of visits	Hospital bed utilization rate (%)	Number of institutions	Number of beds	Number of health technicians
Beijing	59974362	34.2	340	4879	32818
Tianjin	19552600	17.7	124	2435	8285
Hebei	7891873	39.3	343	13552	16745
Shanxi	4378641	29.8	230	4379	11896
Inner Mongolia	4823180	22.4	334	4863	12117
Liaoning	10677454	24.6	398	7437	15847
Jilin	5165843	28.3	228	3450	7900
Heilongjiang	6929932	28.3	459	6771	12263
Shanghai	85823561	85.2	321	15827	31397
Jiangsu	80158069	54.6	563	22720	48414
Zhejiang	105578894	41.8	479	8426	37990
Anhui	16970843	38.6	380	8188	18853
Fujian	18191671	34.9	228	4001	12994
Jiangxi	4539998	31.2	179	3875	7736
Shandong	25209712	44.6	567	18594	37265
Henan	17111648	45.6	468	12504	22226
Hubei	17446667	57.2	353	15996	21205
Hunan	12856480	58.6	370	15469	18803
Guangdong	112960327	47.1	1136	9340	51100
Guangxi	8844937	53.1	173	2672	8466
Hainan	1056743	37.3	49	1187	3264
Chongqing	8630411	71.2	203	9928	11842
Sichuan	26723522	65.3	433	12133	20578

Guizhou	5702169	39.7	264	5356	11520
Yunnan	5688416	50.5	197	5201	9097
Tibet	136860	-	9	135	225
Shaanxi	6335799	31.2	265	3692	11189
Gansu	3845766	49.7	209	4286	8677
Qinghai	880029	40.8	36	1536	2531
Ningxia	1281457	17.8	36	427	2703
Xinjiang	5739060	39.5	187	8186	9036

Table 2: Health resource allocation efficiency of community health service institutions in 2019.

Provinces	TE	PTE	SE	Returns to scale	Relative effectiveness
Beijing	1.000	1.000	1.000	No change	Effective
Tianjin	0.904	0.919	0.984	Increment	Invalid
Hebei	0.276	0.278	0.995	Increment	Invalid
Shanxi	0.291	0.295	0.985	Increment	Invalid
Inner Mongolia	0.235	0.243	0.968	Increment	Invalid
Liaoning	0.300	0.306	0.981	Increment	Invalid
Jilin	0.415	0.422	0.982	Increment	Invalid
Heilongjiang	0.303	0.309	0.981	Increment	Invalid
Shanghai	1.000	1.000	1.000	No change	Effective
Jiangsu	0.601	0.601	0.999	Increment	Invalid
Zhejiang	1.000	1.000	1.000	No change	Effective
Anhui	0.403	0.405	0.996	Increment	Invalid
Fujian	0.620	0.622	0.996	Increment	Invalid
Jiangxi	0.412	0.419	0.985	Increment	Invalid
Shandong	0.278	0.279	0.996	Increment	Invalid
Henan	0.353	0.354	0.998	Increment	Invalid
Hubei	0.405	0.477	0.849	Decline	Invalid
Hunan	0.385	0.507	0.760	Decline	Invalid
Guangdong	0.967	1.000	0.967	Decline	Weak effectiveness
Guangxi	0.826	1.000	0.826	Decline	Weak effectiveness
Hainan	1.000	1.000	1.000	No change	Effective
Chongqing	0.559	1.000	0.559	Decline	Weak effectiveness
Sichuan	0.579	0.695	0.834	Decline	Invalid
Guizhou	0.354	0.354	0.998	Increment	Invalid
Yunnan	0.502	0.694	0.723	Decline	Invalid
Tibet	0.219	1.000	0.219	Increment	Invalid
Shaanxi	0.385	0.388	0.991	Increment	Invalid
Gansu	0.473	0.711	0.666	Decline	Invalid
Qinghai	1.000	1.000	1.000	No change	Effective
Ningxia	1.000	1.000	1.000	No change	Effective
Xinjiang	0.439	0.441	0.996	Increment	Invalid

The data also showed that there were three regions with weak-form efficiency of DEA: Guangdong, Guangxi and Chongqing, including one province in the east, one autonomous region and one municipality directly under the central government in the west. The PTE of these three regions was 1, the SE was less than 1 with decreasing returns to scale, and the slack variable was 0. The PTE was 1, which reflected that in 2019, at the current technical level, the community health service institutions in these three regions were efficient in the use of input resources. The main reasons for their failure to achieve comprehensive efficiency were ineffective scale, excessive input and oversized scale of health resources. With the increase of input, the added value of output dwindled continuously. And the output growth rate of health resources was lower than the input growth rate, resulting in resource redundancy and difficulty in coordination. Therefore, the focus should be placed on how to give better play to the scale efficiency.

The other 22 provinces, municipalities directly under the central government and autonomous regions saw inefficiency, with 5 provinces and 1 municipality in the east, 8 provinces in the central China, and 5 provinces as well as 3 autonomous regions in the west. The returns to scale in provinces of Hubei, Hunan, Sichuan, Yunnan and Gansu were declining, combined with a relatively low pure technical efficiency. Consequently, we should think about how to effectively improve the output from the technical level, such as innovating the management mode of medical institutions and learning the management mode of Grade III hospitals to improve the management level and the resource utilization rate. The increasing returns to scale of the other 17 provinces, municipalities and autonomous regions showed that increasing input can create a certain value, and the output still increased with the increase of input.

Overall, in 2019, the average TE of health resources input and output of community health service institutions in 31 provinces, municipalities and autonomous regions was 0.564, the average PTE was 0.636, and the average SE was 0.911; the mean values of technical efficiency, pure technical efficiency, and scale efficiency of 11 provinces and municipalities in the east were 0.722, 0.728, and 0.993 respectively; the mean values of technical efficiency, pure technical efficiency, and scale efficiency of the 8 provinces in the central China were 0.371, 0.399 and 0.942 respectively; the mean values of technical efficiency, pure technical efficiency, and scale efficiency of the 12 western provinces, municipalities and autonomous regions were 0.548,

0.711 and 0.815 respectively. It showed that the mean values of technical efficiency and pure technical efficiency of the central region was the lowest, while average scale efficiency of the western region was the lowest. From the perspective of rational resource allocation, the east and the west of China witnessed the efficiency and weak-form efficiency of DEA, and the average TE of the east and the west was higher than that of the central area. It can be seen that the rational allocation of resources of the eastern and western regions is better, while the central region need to be strengthened in this regard. Therefore, attention should be paid to the combining the health resources allocation with the reality. It is also very essential to invest health resources scientifically based on the health demand.

5 DISCUSSIONS AND SUGGESTIONS

5.1 Allocating Medical Resources of Community Health Service Institutions based on Local Conditions

we should comprehensively analyze the local medical and health demands so as to carry out reasonable resource allocation suiting local conditions, for economically developed regions and central regions, we should strengthen the integration of medical treatment, medical insurance and medicines supply at the grass-roots level, guiding residents to choose to see a doctor in community health service institutions and improving the overall utilization of medical resources; whereas in economically underdeveloped regions, we should be more concerned about improving the quality of diagnosis and treatment, purchasing advanced medical devices, strengthening the training of professional and technical personnel, and introducing high-level and high-quality talents(Tian 2021).

5.2 Innovating Management Mechanism and Improving Management in Community Health Service Institutions

Community health service institutions can rely on the strength of the medical treatment partnerships, learning the management experience of superior hospitals in it, innovating management mechanism

and improving management in community health service institutions. At the same time, community health service institutions should optimize the personnel structure, reduce the burden of grass-roots medical personnel, perfect the personnel salary system, emphasize that personal salary should be linked to actual labor and contribution, and formulate a reasonable and effective incentive mechanism to improve the enthusiasm of grass-roots medical workers.

5.3 Carrying out Technological Innovation by Relying on the Strength of the Medical Treatment Partnerships

Strengthening the cultivation of high-quality talents and improving the output level. In addition to controlling input and avoiding redundancy caused by excessive input, we should improve the output quality, strengthen the construction of high-quality talents in community health service institutions, introduce talents equipped with medical and management skills in hospital management, optimize personnel structure, strengthen skill training for medical personnel, and improve the medical level of community health service institutions (Zhang 2019).

5.4 Strengthening the Construction of Information Platform and the Management of Health Archives

Community health service institutions should strengthen the construction of information platform, improve the three-tiered health service network, and set up information sharing to carry out up-down referral quickly and effectively, and finally improve the efficiency of medical services and the utilization efficiency of medical resources. In the meantime, the protection of patient information, the security protection index of information system, and the network supervision should also be strengthened to prevent patient information leakage, and effectively protect the rights and interests of patients (Hao 2020).

5.5 Strengthening the Cultivation of High-quality Talents and Improving the Output Level

In addition to controlling input and avoiding redundancy caused by excessive input, we should improve the output quality, strengthen the

construction of high-quality talents in community health service institutions, introduce talents equipped with medical and management skills in hospital management, optimize personnel structure, strengthen skill training for medical personnel, and improve the medical level of community health service institutions, so as to improve the efficiency of medical services (Zhang 2019). With the development of information technology, in order to provide talent guarantee for the information construction of community health service institutions, these institutions should continuously update the advanced medical information system. Meanwhile, they should also make efforts on the introduction and training of information technology talents.

5.6 Perfecting the Personnel Salary System and Formulating a Scientific and Effective Incentive Mechanism

Belonging to grass-roots medical institutions, community health service institutions suffer from some long-term problems like talent shortage and outflow. Because of the unreasonable and unfair salaries of medical personnel, the limited career growth space, and the difficulty of reflecting their personal value, it is difficult for community health service institutions to retain medical talents with a low willingness to obtain employment in them. Therefore, we should perfect the personnel salary system, improve the salary of grass-roots medical personnel, formulate scientific and reasonable performance evaluation indicators within the organization, and emphasize that personal salary should be linked to actual labor and contribution, so that medical personnel feels their contribution being paid. The infrastructure construction of community health service institutions should be strengthened to create a good medical practice environment for medical personnel. At the same time, the promotion of professional titles should be inclined to the grass-roots level, and render relevant favorable policies to community health service institutions to encourage medical personnel to improve their work enthusiasm and willingness to work there.

5.7 Strengthening the Integration of Medical Treatment, Medical Insurance and Medicines Supply and Enhancing the Service Capacity of Community Health Service Institutions

In terms of medical insurance, we should gradually improve the quota management of medical insurance expenses of grass-roots medical and health institutions. Combined with the actual situation and the social and economic level of different regions, we should greatly improve the total standard of medical insurance and the quota standard per case, improve the reasonable over-expenditure compensation mechanism of medical insurance, truly implement and improve the total reimbursement system of medical insurance, and provide policy preferences to community health service institutions (Liu 2020).

6 CONCLUSIONS

Through the detailed analysis of the data, we can find that there are some problems in the resource allocation of community health service institutions, mainly the unbalanced resource allocation in different regions and the unreasonable internal resource allocation in some regions. In order to better meet people's needs and ensure the health of the whole people, we should pay attention to the allocation of health resources and solve the problems in time. To improve these problems, we should comprehensively analyze the local medical and health demands so as to carry out reasonable resource allocation suiting local conditions, innovating management mechanism and improving management in community health service institutions, carrying out technological innovation by relying on the strength of the medical treatment partnerships. Also we can strengthen the construction of information platform and the management of health archives, perfect the personnel salary system and formulating a scientific and effective incentive mechanism, perfect the personnel salary system and formulating a scientific and effective incentive mechanism, strengthen the integration of medical treatment, medical insurance and medicines supply and enhance the service capacity of community health service institutions.

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