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Cost Effectiveness and Resource Allocation

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Analysis on the individual and allocation efficiencies of health resources in China: 2008–2021

Qinpu Liu[1*] and Li Zhou[1]

Abstract

Background The contradictions between the insufficient supply of health services and the growing healthcare demand in China is still prominent. It is necessary to study the changes of China's main health resource individual and allocation efficiencies in recent years for improving the health services in China.

Methods Data were collected from the National Data published on the website of the National Bureau of Statistics of the People's Republic of China and the Statistical Bulletin on the Development of Healthcare in China. The "Proportion Weight Method (PWM)" was used to establish some simple models of health resource efficiency under the multi-input and multi-output conditions for analyzing the health resource efficiencies. PWM is an objective valuation method to determine the weight of the indicators based on their own values. It means that the weight of one indicator is equal to the proportion of this indicator's value in all related indicators' values. If one indicator has larger proportion in all, it shows that this indicator plays a more important and effective role than others in representing or distinguishing its unit among all decision making units (DMUs).

Results It was found that the efficiency of health institution of China showed an increasing trend from 0.77 in 2008 to 0.91 in 2021, with the largest value of 1.0 in 2019 and an average of 0.89, while the efficiencies of health personnel, health expenditure and health institution beds all showed downward trends from 1.0 in 2008 to 0.71, 0.26, 0.58 in 2021 respectively, with averages of 0.89, 0.54 and 0.79. The health resource allocation efficiency showed a slight downward trend from 0.99 in 2008 to 0.92 in 2021, with the average of 0.95.

Conclusion The health resource allocation efficiency in China is overall at a high level with a downward trend, which is mainly due to the rapid declines of health expenditure efficiency and health institution bed efficiency. The models of health resource individual and allocation efficiencies established in this study are simple and practical, which are convenient to adopt targeted measures to upgrade the efficiency of resource allocation.

Keywords Healthcare, Healthcare facility, manpower and services, Individual and allocation health resource efficiencies, Integrated output/input coefficient

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Background

Health services depend on health resources. The equity and efficiency of health resource allocation not only affects the health level of residents, but also plays an important role in the sustainable development of the public health undertakings [1]. Since the founding of People's Republic of China, especially after carrying out the reform and opening up policy in 1978, China's medical and health services have made remarkable achievements and people's health has significantly improved. It can be divided into three periods for the changes of medical and health services in China over the past 70 years [2]. In the first period of 1949–1978, China implemented the planned economy system, the government took the greatest responsibility for public healthcare [3], which was easy to produce some problems, such as the inactive participation of medical institutions and staff, poor service quality, and low operational efficiency. The second stage was from 1979 to 2009 when China carried out the market economy, the government reduced its financial investment in hospitals and increased the autonomy of public hospitals that could operate on their own [3, 4]. Although medical service quality and operational efficiency of public hospitals improved, the medical expenses rapidly increased, resulting in being expensive and difficult for residents to see doctors [2]. The third stage was from 2009, when the Chinese government conducted a new healthcare reform program aiming to establish and improve a basic medical and health system by 2020, which tries to provide safe, effective, convenient and inexpensive medical and health services for urban and rural residents [5]. The past more than 10 years have witnessed the great progress of the new health reform, such as the deepening reforms on health facilities and public hospitals, the zero mark-up policy on drug sales, and full coverage of basic insurance among urban and rural residents [6]. However, the contradiction between the insufficient supply of health services and the growing demand for them is still prominent. The existing health resources and services are struggling to meet the needs of rapid economic development and the aging population [7, 8]. Optimizing the allocation of health resources and meeting people's health needs is the key to achieving universal access to basic health services [9]. How to improve the allocation efficiency of health resources is one of the important topics in China's healthcare reform and development [10].

At present, research on the efficiency of health resource inputs and service outputs at home and abroad mainly includes two types: one is the traditional parametric model based on the production frontier theory, i.e., Stochastic Frontier Analysis (SFA); the other is the non parametric model, Data Envelopment Analysis (DEA) [11]. SFA is an effective method for cost efficiency measurement of "multi-input, single-output". DEA meets the requirements of "multi-input and multi-output" for measurements of the technical efficiency of health resource allocation, requires less indicators, and is not affected by the dimension of indicators [12]. Different models based on DEA have been widely used to assess the efficiency of healthcare sectors in China and abroad [13]. For example, input-oriented CCR-DEA model was used to study the efficiency of several hospital health centers in Greece, and the efficiency of intensive care units was valued with the BCC-DEA model in Iran [2, 14]. Xu et al. [15] selected some relevant data of 31 provinces in China in 2018 and used the Three-stage DEA model to measure the health resource efficiency. It was found that after excluding the impact of environmental factors and random noise, the comprehensive technical efficiency of health resource allocation in China increased from 0.859 to 0.893. Chen and Cao [16] used the Three-stage DEA model to investigate the efficiency of health resource allocation in 31 provinces in China from 2013 to 2016. They found that after removing the interference of environmental factors and random noise, the average efficiency of health resource allocation over the four years was 0.545, 0.570, 0.574 and 0.572, respectively. Liang and Huang [17] used BCC-DEA and Malmquist models to evaluate the efficiency of China's health resource allocation from 2009 to 2019. The results showed that the average comprehensive efficiency of China's health resource allocation during this period was 0.998, which was generally at a good level. Zhang et al. [12] used DEA and SFA to evaluate the technical efficiency and cost efficiency of China's health resource allocation from 2004 to 2013, and found that the technical efficiency of China's health resource allocation has been continuously improved over the past 10 years, with the average of 0.997, and the cost efficiency value is only 0.69.

The studies illustrated above on the health resource efficiency used relatively complex methods, few of which analyzed both the allocation efficiency and individual efficiency of health resources. Particularly, using traditional DEA method to analyse the technical efficiency of health resource allocation failed to distinguish the efficiency in different decision making units (DMUs) with value of 1. Referring to the concept of "Relative Productivity Proportion Weight" (RPPW), which means that the weight of one resource's relative-productivity is equal to its proportion in the sum of relative-productivities of all resources involved, put forward by Liu et al. [18], this paper established some simple models to investigate the changes of China's health resource individual and allocation efficiencies from 2008 to 2021 under "multi-input and multi-output" conditions to provide some suggestions for improving China's health service efficiency.

The main innovations and practical applications of this study are as follows:

1. This study found out that China's health resource allocation efficiency(HRAE) is at a high level with a slight downward trend, which results from the fact that the increasing speed of the integrated output coefficient was lower than that of the integrated input coefficient. The rapid decreasing of both the total health expenditure and the health institution bed efficiencies plays an important role for the downward trend of HRAE in view of individual health resource efficiency. It provides a new perspective and method to understand the mechanism of change trend in China's health resource allocation efficiency.
2. Compared with DEA method, the models designed in this study are simpler and more practical. They could effectively reflect not only the difference of health resource allocation efficiency in different years, but also the difference of individual health resource efficiencies which affect the former. It is convenient to adopt targeted measures to upgrade the efficiency of health resource allocation, and also can be used for other fields efficiency studies.

Methods

Data source

The data used in this study were from the National Data published on the website of the National Bureau of Statistics of the People's Republic of China [19] and the Statistical Bulletin on the Development of Healthcare in China in 2021 issued by the National Health Commission of the People's Republic of China [20]. All of these data are publicly accessible.

Indicators of health resource efficiency assessment

The indicators of evaluating health resource efficiency include two parts: health resource input indicators and health service output indicators. Considering representation, stability, and independence, healthcare facility, manpower and finance investments are deemed to be important input variables in the delivery of health services [21], The input indicators selected in the current study consist of the number of health institutions (NHI) which include hospitals, grassroots health institutions, professional public health institutions and others, the number of health personnel (NHP) which includes doctors, nurses and others in the health institutions, the total health expenditure (THE), and the number of health institution beds (NHIB). Among them, NHI and NHIB represent facility, NHP and THE represent manpower and fiance, respectively. Because the health services in the health institutions are mainly for outpatients and inpatients, such indicators as the number of diagnosed and treated people (NDTP), the number of inpatients (NI), and the utilization rate of beds (URB) in health institutions were selected for health services outputs.

Models

Integrated output coefficient (IOC)

Based on the conception of "Relative Productivity Proportion Weight (RPPW)" put forward by Liu et al. [18]. a brief concept of Proportion Weight Method (PWM) is adopted. PWM means that the weight of one indicator is equal to the proportion of this indicator's value in all related indicators' values. It is an objective valuation method to determine the weight of the indicators based on their own values. If one indicator has larger proportion in all, it shows that this indicator plays a more important and effective role than others in representing or distinguishing its unit among all decision making units (DMUs). Since the health resource allocation efficiency of China measured in this paper belongs to the integrated efficiency of multiple inputs and multiple outputs, the weighted average value of multiple outputs, which is called the Integrated Output Coefficient (IOC), needs to be calculated first by using the PWM, making the multiple outputs into one integrated output. The measurement of IOC is based on the value of each health service output indicator which is obtained by normalization of original data according to the maximum. The formula of IOC is given as:

$$IOC = \sum O_i^2 / \sum O_i \qquad (i = 1,\ 2,\ \cdots,\ j) \quad (1)$$

where IOC is the integrated output coefficient; j is the number of outputs, $j = 3$ in this study; O_i represents the normalized values of the three output indicators of NDTP, NI, URB in this study, respectively.

Similarly, Integrated Input Coefficient (IIC) can be calculated when the output indicators (O_i) in the formula (1) are replaced by input indicators (I_i). The formula is as follows:

$$IIC = \sum I_i^2 / \sum I_i \qquad (i = 1,\ 2,\ \cdots,\ k) \quad (2)$$

where k is the number of inputs, $k = 4$ in this study.

Health resource productivity (HRP)

Health resource productivity refers to the ratio of the IOC value of health services outputs to the value of one health resource input, which is obtained by normalization of its original data according to the maximum. The normalized value of one input indicator, i.e. NHI, NHP, THE, or NHIB, is expressed as I_i. The formula of health resource productivity (HRP) is given as:

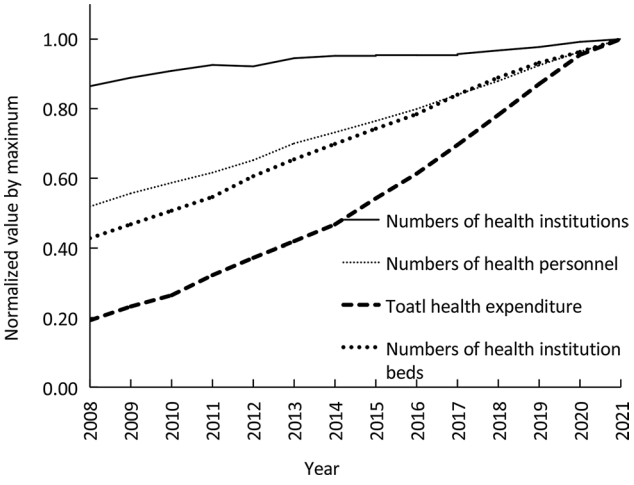

Fig. 1 Change trends of four health resource inputs in China from 2008 to 2021

$$HRP_i = IOC/I_i \qquad (i = 1,\ 2,\ \cdots,\ m) \qquad (3)$$

where HRP_i represents the health resource individual productivity; m is the number of inputs, $m = 4$ herein.

Health resource efficiency (HRE)

HRP is a kind of efficiency of health resources, but its values are probably greater than 1. In order to set the range of HRE between 0 and 1, the values of HRP are proceeded by maximum normalization to get relative health resource productivity, which is called Health Resource Efficiency (HRE). HRE represents the individual efficiency of health resources, it can be obtained by the following formula:

$$HRE_i = HRP_i/HRP_{imax} \qquad (4)$$

where HRE_i refers to the individual efficiency of health institutions, health personnel, total health expenditure, and health institution beds, respectively; in this study. $HRP_{i\max}$ represents maximum value among HRP_i.

Health resource allocation efficiency (HRAE)

Similar to the technical efficiency (TE) in DEA, HRAE indicates the ability of various resource inputs to reach the best proportion for the maximum output. It is measured by the *1/n* power of the proportion weighted average of health resource individual efficiency based on PWM. The formula is given as follows:

$$HRAE = \sqrt[n]{\sum HRE_i^2 / \sum HRE_i} \qquad (5)$$

where *HRAE* represents the health resource allocation efficiency; $n = 4$ herein. Like TE, the HRE and HRAE in this study are relative efficiency, their values are between 0 and 1.

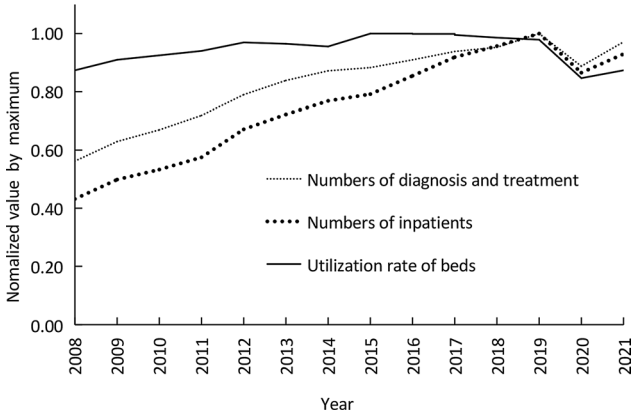

Fig. 2 Change trends of three health service outputs in China from 2008 to 2021

Results

Changes of health resource inputs and health service outputs in China from 2008 to 2021

According to statistics, the numbers of health institutions, health personnel, total health expenditure, and health institutions beds in China during 2008–2021 increased from 0.89 million, 7.25 million, CNY (Chines Yuan) 1.45 trillion, and 4.04 million in 2008 up to 1.03 million, 13.98 million, CNY 7.56 trillion, and 9.45 million, growing up by 15.7%, 92.8%, 420.1%, and 133.9%, respectively. According to the normalized values of the original data by the maximum, four resource inputs showed the different growing trends (Fig. 1). The value of health institutions was growing slowly from 0.86 in 2008 up to 1.0 in 2021, while the total health expenditure was increasing rapidly from 0.19 in 2008 up to 1.0 in 2021, and faster after 2015. The weighted average of the normalized value of the four resource inputs, i.e. the integrated input coefficient (IIC), increased by 62% from 0.62 in 2008 up to 1.0 in 2019.

The output of health services also showed different degrees of growth. The number of diagnoses and treatments, the number of inpatients and the utilization rate of beds in health institution increased from 4.90 billion, 114.83 million, and 74.60% in 2008 up to 8.72 billion, 265.96 million, and 83.60% in 2019, growing up by 77.9%, 131.6%, and 12.1%, respectively. Among them the number of inpatients increased the fastest, the utilization rate of beds in health institution increased the slowest and decreased year by year after 2015 (Fig. 2). Compared with the previous year, the outputs of these three health services in 2020 decreased significantly by 11.2%, 13.5%, and 13.5%, respectively, due to the breakout of the COVID-19 (Corona Virus Disease 2019) epidemic, and all rebounded in 2021. The weighted average of the normalized value of

the three health service outputs, i.e. the integrated output coefficient (IOC), increased by 37% from 0.68 in 2008 up to 0.93 in 2021.

Changes of the health resource individual efficiencies in China from 2008 to 2021

The individual efficiencies of four health resource inputs in China from 2008 to 2021 were obtained according to Eqs. (1), (3), and (4), which are shown in Fig. 3. As mentioned above, the individual efficiency of health resources is a relative value, which represents the relative difference of one health resource input efficiency among the studied period. The changes of health resource individual efficiencies are subject to the changes of their relationships with the integrated output coefficients. The efficiency of health institutions showed an increasing trend from 0.77 in 2008 up to 1.0 in 2019 and declined later, with the average of 0.89. This is because the growth rate of the number of health institutions was far lower than that of the integrated output of health services (i.e. IOC). However, the efficiencies of health personnel, total health expenditure, and health institution beds were the highest in 2008, and showed a downward trend since then (Fig. 3), falling from 1.0 down to 0.71, 0.26, and 0.58 in 2021, with averages of 0.89, 0.54, and 0.79, respectively. Since the total health expenditure increased at the fastest speed in this period, its efficiency also decreased the fastest.

Change of health resource allocation efficiency in China from 2008 to 2021

Based on the individual efficiency of four health resources, their allocation efficiency, that is HRAE, is calculated according to Eq. (5). The results showed that over the past 14 years, HRAE in China changed from 0.988 in 2008 to 0.917 in 2021, with the lowest value of 0.906 in 2020 and an average of 0.951, indicating that China's health resource allocation efficiency is at a high level with a slight downward trend (Fig. 4). Figure 4 shows that the declining trend of the health resource allocation efficiency results from the fact that the increasing speed of the integrated output coefficient was lower than that of the integrated input coefficient. The rapid decreasing of individual efficiencies of the total health expenditure and the health institution bed plays a important role for the downward trend of HARE. It is evident that this result follow the law of marginal diminishing effect, which means that under certain conditions, the value of return is high at the beginning of inputs, but it will decrease as time goes on. In this study, the return is health services represented by integrated output coefficient, and the input is health resources represented by integrated input coefficient. The health resource allocation efficiency can be improved by rational allocation of health resources,

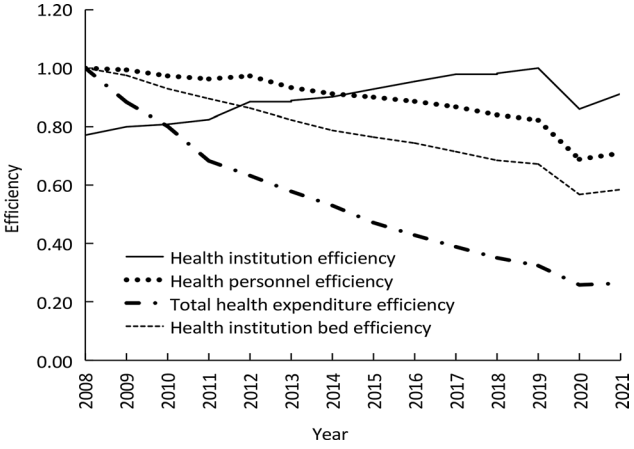

Fig. 3 Change trends of individual efficiencies of four health resource inputs in China from 2008 to 2021

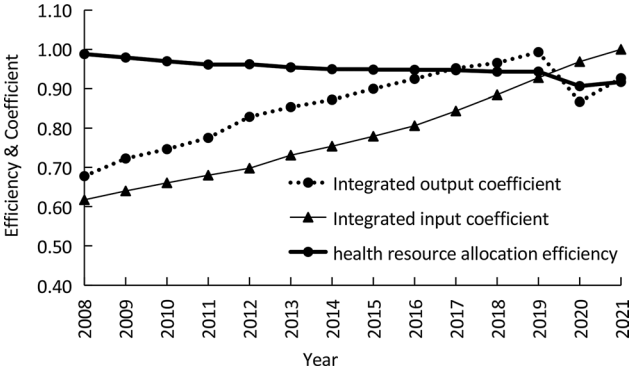

Fig. 4 Change of health resource allocation efficiency in China from 2008 to 2021

high quality health services, and innovation, so as to minimize the affect of marginal diminishing effect.

In order to prove the feasibility of the health resource allocation efficiency model formulated in this study, the same input and output data of China's health resources from 2008 to 2021 were processed using the Data Envelopment Analysis (DEA) method. The technical efficiency (TE) values obtained by the traditional DEA are very closed to the HRAE of this study (Fig. 5). The average efficiency values of the two ways are 0.987 and 0.951, respectively, with an average relative error of 3.6%. The correlation coefficient of the two group values is 0.739 at the 0.01 level of significance. However, it can be seen that the downward trend of HRAE in this study is more obvious than TE by the DEA method. Particularly, the technical efficiencies corresponding to the 10 years when the values are equal to 1 in the DEA analysis, are, on the contrary, clearly distinguished with the present study. In fact, owing to the shortcomings that there are usually some DMUs technical efficiencies equal to 1 in the traditional DEA analysis [11, 22], some scholars have proposed a concept of super efficiency DEA to improved it

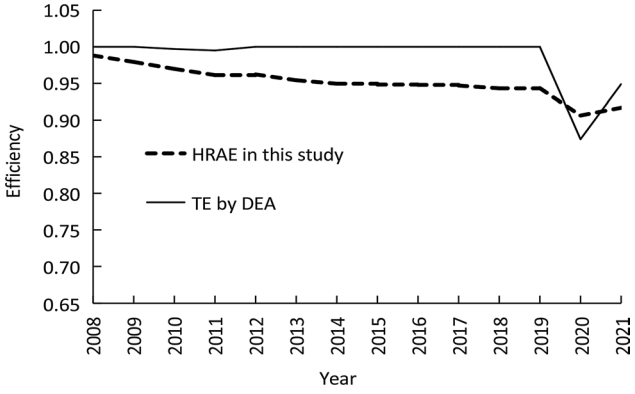

Fig. 5 Comparison of change of the health resource allocation efficiency (HRAE) from 2008 to 2021 in this study with that of the technical efficiency (TE) calculated by DEA method

[23, 24]. As the integrated growth rate of outputs is lower than the integrated growth rate of inputs in China from 2008 to 2021, the health resource allocation efficiency inevitably declines. Therefore, the health resource allocation efficiency obtained in this study reveals the situation of China's healthcare development. Compared with DEA method, the models designed in this study are simpler and more practical. They could effectively reflect not only the difference of health resource allocation efficiency in different years, but also the difference of individual health resource efficiencies which affect the former. Moreover, the process of calculation with these models is easier. First IOC model is used to integrate the three health service outputs into one integrated output by using the PWM method, then HRE model is used to calculate individual efficiencies of the four health resource inputs, respectively. Finally, summing up the 4 HREs by using the method of PWM, the comprehensive efficiency, i.e. health resource allocation efficiency (HRAE), is obtained. In a word, the models deal with the complicated efficiency problem of multi-input multi-output by using a simple weighted average method. In addition, it is convenient to adopt targeted measures in the perspective of individual resource efficiency for improving the integrated efficiency of health resource allocation. Another interesting fact is that the value of n in the formula (5) affects the mean of HRAE and the correlation coefficient between the HREA in this study and TE by DEA method. The greater the value of n, the closer the mean of HRAE to that of TE, and the higher the correlation coefficients between HRAE and TE (Table 1). How to select the value of n appropriately needs to be studied in the future.

Discussion

This study indicates that the average allocation efficiency of health resources at present in China is 0.951, which is at a high level as a whole, similar to the result of 0.997 investigated by Zhang et al. [12], except for the new finding of this study that there was a downward change, especially during the period of Covid-19 epidemic. It is well known that a new healthcare reform program was carried out in China since 2009, various policies were implemented, which stimulated enormous investments in public and private hospitals, resulting in their facility and manpower insufficient utilization. In 2020, the peak year of Covid-19 epidemic, Chinese government at all levels invested huge manpower, material, and financial resources to deal with it, and many patients would rather stay at home than go to hospital to see doctors, leading to the lowest health resource efficiency. The decline of the health resource allocation efficiency is firstly related to the rapid increase of health expenditure. Therefore, controlling the increase of health expenditure can effectively improve the efficiency of health resource allocation. There are many reasons for the rapid growth of medical and health costs, in which there are some reasonable and unreasonable factors. The reasonable factors result from the development of the national economy that promotes the growth of total health costs. The rapid economic development in China, on the one hand, provides more funds for the development of the medical and health fields, and gives rise to the medical insurance system covering the whole population. On the other hand, the incomes of residents have increased with the continuous growth of the social economy, resulting in the increasing demand for health services, which will lead to the increase of the medical and health expenditure of residents [25]. The unreasonable factors of medical expenditure exist mainly in excessive dispensing medicine, excessive inspection, excessive treatment, etc. in the hospitals and medical institutions. Practices of medical insurance system in developed countries have proved that the rapid growth of medical expenses is not conducive to the sustainable development of medical insurance, so effective measures must be taken to control it. It is suggested to take the following ways: First, clarifying the government's responsibility in establishing a sustainable government health investment mechanism. The government should invest more financial funds in public healthcare, and spend more on "preventing disease" [26], making the health resources flow from the medical

Table 1 The means of HRAE under the different n in the formula (5) and correlation coefficients(CC) between HRAE in this study and TE by DEA method

n	1	2	4	6	8	10	Mean of TE by DEA
Mean of HRAE	0.821	0.905	0.951	0.967	0.975	0.980	0.987
CC	0.711	0.730	0.739	0.742	0.744	0.745	

treatment field to the disease prevention and healthcare field, from large busy medical institutions to community health services, and from urban area to countryside. Second, improving the medical security system and fully evaluating the rationality of medical security financing and expenditure structure. Third, strictly controlling and reducing false high drug prices, and correcting unhealthy tendencies in the pharmaceutical industry, such as medical staffs' receiving rebate of drugs, false drug advertisement. Fourth, strengthening the supervision and management of medical insurance institutions and hospitals to control and reduce health costs for improving health resource efficiency.

The fast increasing of hospital bed number in various medical and health institutions, which has resulted in the low utilization of hospital beds, is another reason for the low efficiency of health resource allocation. Among the past 14 years in China, there were 11 years when the utilization rate of beds (URB) in health institutions was lower than 85%, only three years URB at 85%. The URB in the last five years decreased significantly, reaching 72.3% in 2020. It is generally believed that 85%-93% of the hospital bed utilization rate is reasonable. The low utilization rate indicates that there are many hospital beds free; much higher utilization rate means the burden of the hospital beds is too heavy, and there is not enough time for the disinfection of them, easily leading to hospital infection. The temporary extra beds will affect the ward management, which may have adverse effects on the medical quality [27]. The utilization rate of hospital beds in China has a large room for improvement, especially in the rural area and urban community hospitals. It is suggested that the public authorities should allocate the limited health resources to the areas with high potential of efficiency, curb the blind expansion of hospitals, and allocate hospital bed resources reasonably. According to the regional economic development level, population structure and different needs, and health and disease conditions, the medical institutions at different levels should be rationally distributed. Comprehensive regulations and managements should be carried out in terms of personnel, beds, equipment and funds. New medical and health resources should focus on weak medical areas such as countryside and urban communities, to improve the utilization rate of beds in grass-roots hospitals which have very low value of health resource allocation efficiency [28], and reduce the pressure on beds in large hospitals. More attention should be paid to optimizing the investment structure of medical and health resources, improving the efficiency of health resource allocation, and realizing the gradual transformation of medical institutions from scale and quantity to quality and efficiency, so that the limited health resources can serve the public's health fairly, reasonably and efficiently to achieve the greatest possible social benefits.

Although this study has attempted to select the indicators justifiable and used some new models to analyze the time-series changes of China's health resource individual and allocation efficiencies from 2008 to 2021, there are still some limitations as follows: First, the indicator of the health institutions was not further subdivided into hospitals, grassroots health institutions, professional public health institutions and others, and the health personnel not into doctors, nurses and others. So it is not possible to identify which institution or personnel plays major roles in the individual and allocation efficiencies of health resources. In the future studies, additional indicators could be employed for detail analysis. Second, it could be seen that different selection of n in the model (5) will affect the results. The greater the value of n, the closer the mean of HRAE by this model to that of TE by the method of EDA. We have no theoretical reason now to explain how to select the more appropriate value of n. Third, all of three output indicators in this study are quantitative ones. In fact, the outputs of health services are diverse and complex in terms of quality and quantity while consuming the same amount of health resources. If the output of health services is measured only by the production quantity, it cannot truly reflect the relationship between the output of health services and the input of health resources [29]. In the future's research on the efficiency of health resource allocation, it is necessary to select appropriately some quality indicators of health service output, such as patient mortality, infection rate, average hospital stay, etc., to make the evaluation results more comprehensive and reasonable.

Conclusion

The "proportion weight method (PWM)" was used in this work to establish some simple models to analyze the time-series changes of China's health resource individual and allocation efficiencies from 2008 to 2021. The results showed that:

Comprehensively, the growth rate of health service outputs is lower than that of health resource inputs in China during the period studied because the integrated output coefficient (IOC) increased by 37% from 0.68 to 0.93, and the integrated input coefficient (IIC) increased by 62% from 0.62 to 1.0. The first two inputs growing fast are total health expenditure and health institutions beds, increased by 420.1% and 133.9%, respectively. The health resource allocation efficiency shows a slight downward trend within the high values of 0.90 to 1.0, at the average of 0.95. The reason for the downward trend mainly results from the rapid declines of health expenditure efficiency and health institution bed efficiency. Therefore, it is necessary to control the increase of health expenditure

and improve the utilization rate of beds, especially in grass-roots hospitals for changing the downward trend of health resource allocation efficiency in China.

Models about health resource efficiency established in this work are simple and practical, which are convenient to measure the health resource allocation efficiency and identify the individual health resource efficiency, so as to adopt targeted measures to upgrade the efficiency of resource allocation.

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Author contributions
QL designed the study and wrote the manuscript. LZ collected the data. The final version submitted for publication was read and approved by all authors.

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Data availability
The data that support the findings of this study are available from the following two links: https://data.stats.gov.cn/easyquery.htm?cn=C01. http://www.nhc.gov.cn/.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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