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Technical and Scale Efficiency of Traditional Medicine Hospitals and General Hospitals in Inner Mongolia, China

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Abstract

The purpose of this study was to measure the technical and scale efficiency of 128 general hospitals and 69 traditional medicine hospitals, estimating the possible factors influencing the efficiency of both general hospitals and traditional hospitals in Inner Mongolia Region, China. In the first part, Input-orientation Data Envelopment Analysis (DEA) was employed to compute TE and SE of both general hospitals and traditional medicine hospitals. In the second part, ordinary least square (OLS) was used to determine the factors that affect the efficiency. The DEA analysis showed 86.7% of general hospitals and 66.7% of traditional medicine hospitals were run inefficiently in 2011. In both types of hospital, the average variable return to scale (VRS) and technical efficiency scores were about 50% and 60%, respectively. The pattern in most general and traditional medicine hospitals for scale inefficiency was increasing returns to scale.

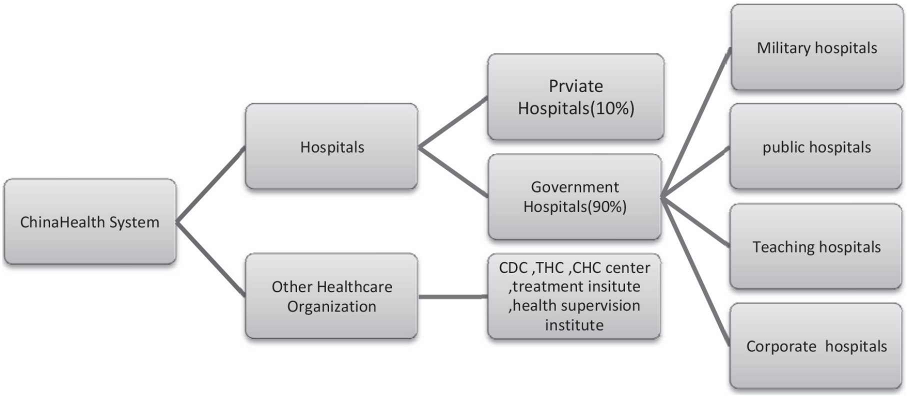
Keywords: Technical Efficiency, Scale Efficiency, General Hospital, Traditional Medicine Hospital, Data Envelopment Analysis, China

1. Introduction

1.1 China Healthcare System

Since the major victory won in combating SARS in 2003, the whole healthcare system in China has taken a great change, until now China's health care sector has made remarkable achievements, as well as health science and technology level have rapidly risen. A health service system coving both urban and rural residents has come into being; the disease prevention and treatment capacity has been continuously strengthened. China's health system is made up of hospitals, nursing homes, health centers, outpatient clinics, community health service centers, maternal and child care stations, and centers for disease control. There are two types of institutions: medical and other medical institutions are licensed to diagnosis and treat diseases. Other institutions include public health agencies (such as centers for disease control), blood stations, and teaching and training institutes. Along with deepening the health care system reform, the healthcare service are primarily based on the government managed the hospitals, and almost 90% of the public hospitals under the leadership of Ministry of Health or Health Bureaus of local governments at provincial or county level. (Figure 1)

Figure 1 Structure of the China Health System

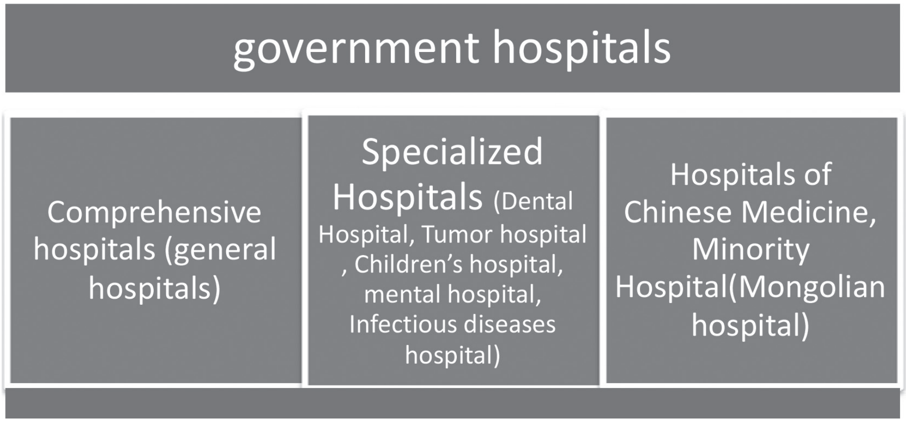


Sources: "Ministry of Health, China, 2010"

Hospital is the main healthcare provider in China; it plays a great important role in the reform of Chinese healthcare system**.** The main functions of public hospital in China are save lives, prevent and cure diseases, and it is also the core of attaining government objectives for health and social stability. The Chinese government established the mechanism of labor division and work coordination between urban hospital and community health service institutions. The essential functions and responsibilities of these public hospitals contain the following aspects:

First is to providing regular medical services; second is to providing preventive health care, rehabilitation, and health education; third is to responding to public health accidents; forth is to supporting other government missions; and last is to conducting medical education and research What is more, there are many ways to distinct the hospitals in china**,** from the classes' perspective; According to functions, tasks and scopes of services it can be divided into the following classes. (Figure 2)

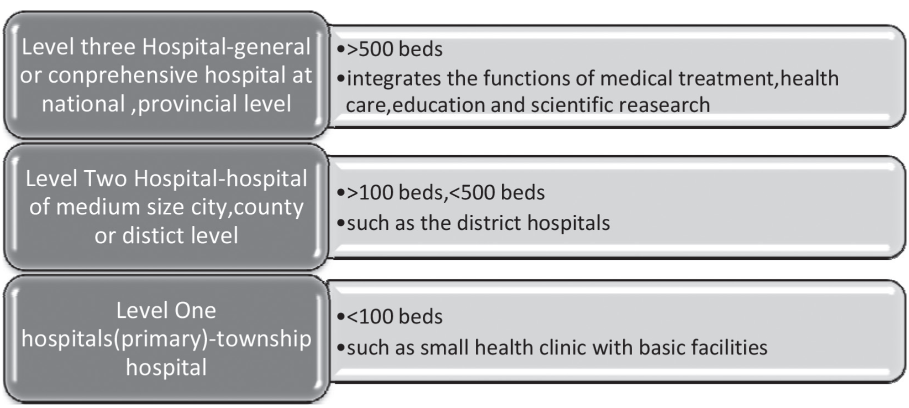
Figure 2 Classes of the Government Hospitals in China



Sources: "Ministry of Health, China, 2010"

According to the levels of the hospitals, different classifications have different hospital level**;** there are mainly three levels of hospitals as follows (figure 3):

Figure 3 Levels of the Hospitals in China



Sources: "Ministry of Health, China, 2010"

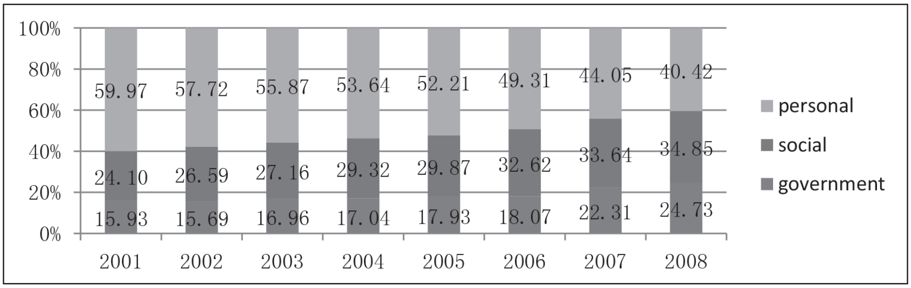
1.2 The Main Health System Problems in China

Like many other counties, now china's health system is facing a great pressure to using the limited resources to provide a high quality service .When government implemented the healthcare reform since 2009, there were many issues which required a thorough and comprehensive view to face and solve. The mainly problems are as followed:

1.2.1 Still Have A Severe Lack of Access to Affordable Healthcare in Many provinces

Due to the different economic levels in different provinces and autonomous regions in China, there is still a significant portion of China's urban and rural population without access to affordable healthcare. Especially, the rural residents are hard hit, many of the rural population are not able to afford professional medical treatment, and most of them indicated that they have not been hospitalized despite having been told they need to be. At the same time, for urban areas, this situation is not much better than the rural areas, along with more and more rural residents come to urban cities to find a job and live in the past two decades, there are also many urban residents find medical treatment prohibitively expensive. Healthcare expenditures, along with actual government funding, have been increasing steadily over the past decades, but the main part of health expenditure is still the out-of –pocket. As illustrated in Figure 4, the percentage of out-of-pocket health expenditures is the main resource of healthcare expenditure.

Figure 4 Healthcare Expenditures by Source of Payment



Sources: "National Bureau of Statistic of China"

1.2.2 Inefficiency Use of Healthcare Resources

The second problem is that current healthcare resources are often not allocated and used effectively by the segments of population that need them most. Hospitals as the main health care provider in China have played an important role in the utilization of health care resources. Although from 2003, the Central Government of China and Ministry of Health have embarked on a series of reforms to the hospitals**,** the variations of the geographic environments, demographic structure and other factors can lead to different results. This imbalance allocated of hospitals resources results in inefficiencies in the supply and demand of healthcare services. A disproportionate amount of China's healthcare resources have traditionally been concentrated on larger and big hospitals, particularly those in urban areas. This can be reflected in the number of hospital beds and healthcare personnel in rural and urban areas (Table 1).

Table 1 Distribution of Healthcare Beds and Personal in Urban Area and Rural Area (Per 1000 population)

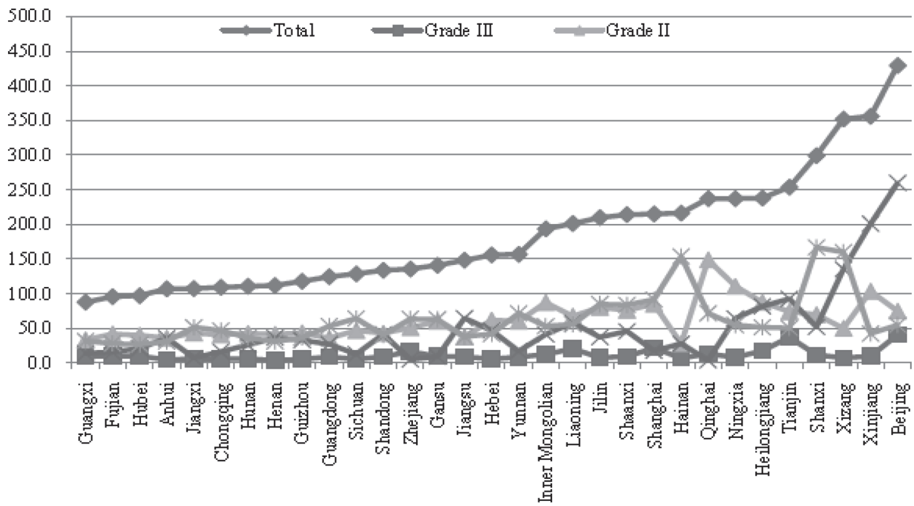
	1980	1990	2000	2003	2009
Number of beds					
Urban	4.47	4.18	3.49	3.67	4.31
rural	1.48	1.55	1.50	1.50	1.93
Number of health professions					
Urban	8.03	6.59	5.17	4.84	6.03
Rural	1.81	2.15	2.41	2.19	2.46

Sources: "National Bureau of Statistic of China"

From the above figure, we can see that most of beds and professions are allocated around the urban areas, however, two thirds of population in China are peasants and living in the rural area. Meanwhile, since the reforms of the hospitals have carried out, they got some unintended consequence; for instance, many hospitals have expanded infrastructure and high-technology equipment in a chaotic way. This results in a serious of no effective utilization situation and imbalance in the growth and distribution of hospital facilities.

Although in china now some provinces' and cities' economy grow quickly, such as Inner Mongolia, the number of hospitals are not that many than other provinces and regions, from figure 6, we can see that Beijing has five times more hospitals per capita than Inner Mongolia, and Inner Mongolia is in the Grade III level, but the economy growth No.1 in 2009.

Figure 6 Hospitals per 10 million Populations, by Province and Administrative Level



Source: World Bank of Fixing the Public Hospital System in China, 2010

What is more, some of inefficiency in resource utilization is mainly by the patients who are more likely to use larger and big hospitals in urban areas. Such disparity leads to "expensive medical bills and difficult access to quality medical services" issue in China in recent years. From the observation, we can see there is a long queue in the big and larger hospitals, and the most of small hospitals have to depend on the government support to survival.

1.2.3 Shortfall of High-quality Patient Care

There is common acknowledgement among healthcare system stakeholders that the quality of patient care has been compromised in China. This is reflected in three aspects: first aspect is the hospitals loss of focus on patient care, due to the financial pressures and without clear and strict government guidelines, lots of hospitals have lost the core competency of providing high-quality clinical care; second aspect is that most professionals are in low quality, there are more professionals in this time than before, however, current training and experience of healthcare personnel is relatively weak, more important is that there is no uniform definition exists to document the required qualifications of healthcare personnel, particularly in rural areas the problem of inconsistent and low quality of healthcare workers is a sever issue. The last aspect is the relative departments are unable to monitor the level of care, although almost 90% hospitals are managed by the government, the monitoring is a difficult part for the MoH, because the health system is quite complex as well as the provision and regulation of health service delivery is largely decentralized and managed by many of different stakeholders, including the MoH, provincial and city governments, military and so on. In conclusion, significant improvements are very necessary to solve these problems, especially in less developed place in China, such as Inner Mongolia. With respect to this issue, it is necessary to consider the situation individually.

1.2.4 Less Developed of Traditional Medicine Hospital

What is more, according to the "National health plan and priorities" (WHO, 2007), China government supports the development of Traditional Chinese Medicine and fostering a modern TCM industry, as traditional medicine development in China, there is more and more disease can be cured by traditional medicine, it is not only has a good treatment effect, but also reduce the cost of healthcare providers and patients, for example, chronic disease and prevention of disease. China is the only one country in the world where Western Medicine and Traditional Medicine are practiced alongside each other at every level of the healthcare system. Such as Traditional Chinese medicine has its own theoretical and practical way to the treatment of disease, which has already developed over thousands of years, therefore, they account for around 40% of all health care delivered in China now. As the importance of traditional medicine development in China, the current government policy of expansion of traditional hospitals' facilities and manpower is being questioned because many hospitals using traditional Chinese medicine are underutilized and depend on government subsidies for survival. Improve the traditional hospitals efficiency is also an important part for developing and improving the traditional medicine.

All in all, the efficiency of these hospitals′ to be an important point for the policy makers and the process of monitor .From a managerial perspective, understanding the structure of hospitals and their inefficiency in utilizing resources is crucial for making health care policies and budgeting decisions. So improve the efficiency of hospitals not only take much conveniences to the residents but also relieve the pressure of "expensive medical bills and difficult access to quality medical services".

1.3 Scope of the Study

Inner Mongolia Autonomous Region locates in the North part of China and as the third-largest subdivision of China spanning about 1,200,000 km^2 (463,000 sq. mi) of China's total land area. It has a population of about 24 million as of 2009. The economy has taken a great change since twentieth century in Inner Mongolia. In 2009 the GDP growth got the first one compared with other provinces and cities in the country.

So the problems are generated by two main factors. On one hand, due to the development of the economy, most of people in Inner Mongolia are now living in a better life. When people have a rising material well-being, their demand of other aspects will increase as well, the health service in special. Although the government of Inner Mongolia has also been implemented various hospital reforms to improve efficiency in health care, as the greater people expectations for access to health services, and limits on the availability of health workers and government funding to support these higher expected levels of service. Quantifying the current level of inefficiency in the hospital system helps provide insight into the degree to which these pressures could be met by a more effective use of resources.

On the other hand, through these years there hardly can find any study on the efficiency of the hospitals in Inner Mongolia region.

What is more, compared with the other provinces and cities, Inner Mongolia as the minority autonomous region, they have their own traditional medicine which already developed for hundred years. The development of the traditional Chinese medicine and traditional minority medicine has become a new popular trend for the sake of implementing the policy of "*Notice of the State Council on Issuing the Plan on Recent Priorities in Carrying out the Reform of Health Care System*" concept (Ministry of health, 2009). In Inner Mongolia Autonomous Region, the main type of the hospital is general hospital, it will be one of the research objectives in this study, and the other objective is traditional medicine hospital.

In conclusion, this study would focus on 197 observations, they were all the second level hospitals that distributed in 12 cities in Inner Mongolia region and the secondary cross-section data which was collected in 2011 from these hospitals in Inner Mongolia region was used**.**

2. Literature Review

Most papers related to the methods to measure the technical efficiency and scale efficiency of firms' ether on the parametric or on the non-parametric approach, and there were also some papers used both of the methods. These two kinds of approaches were shown in the following concept.

2.1 Parametric Frontier Approach

Parametric frontier function needs the definition of a specific functional from for the technology and for the inefficiency error term and it can be divided into two ways: One is the deterministic model, another is stochastic model.

2.1.1 Deterministic Frontier Production Function

The deterministic frontier production function model envelope all the observations, identifying the distance between the observed production and the maximum production, and it is defined by the frontier and the current technology level. For example, we assume the level of technology is given of the sample firms, the most interest thing is ascertaining the highest output got using the best practice technique at firm level. The output can be shown through the production function, which can be called the frontier production function (FPF), may estimate in a many ways, for example, one input and one output of a DMU, or two inputs and one output of a DMU and so forth

2.1.1.1 Stochastic Frontier Production Function (SFA)

Stochastic model has the capacity of capture the efforts from outside beyond the control of the analysis unit errors in the observations and in the measurement of output are also be considered in this model**.**

2.1.1.2 Non-Parametric Approach

Non-parametric approach does not require the specification of any particular functional from to describe the efficiency frontier or envelopment surface. (Luis, Juan, 2000).

The Data envelopment analysis (DEA) is the main non-parametric approach herein. DEA is a linear programming measurement which identifies the relationship between inputs to a production process (resources used in a hospital) and the outputs of that process. (Charnes, Cooper and Rhodes, 1978).

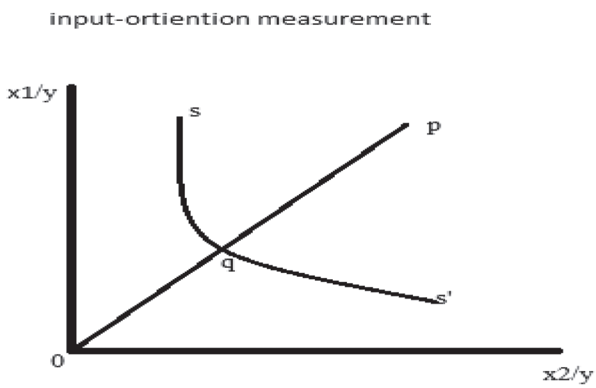
2.2 Input and Output-orientated Measurement

For the DEA approach, there are mainly two different measurements: input-orientated measures and output-orientated measures.

2.2.1 Input-orientated Measures

The input-orientated measures address on the question: "by how much can input quantities be proportionally reduced without changing the output quantities produced?" For this question a simple example relative to firms which used two inputs to produce a single output, under the assumption of constant returns to scale is given. Due to the unit isoquant of fully efficient firm, represented by SS′ in figure 7. if a given firm uses quantities of inputs. Defined by point S, to produce a unit of output, the technical inefficiency of the firm can be represented by the distance QS, which is the amount by which all inputs could be proportionally reduced without a reduction in output. This also can be written in percentage terms by the ratio QS/OS, and the technical efficiency equal to one minus QS/OS. It will take a value between zero and one, as well as provides and indicator of the degree of technical inefficiency of the firm. The value of one indicates the firm is fully technical efficient (Coelli, 1996).

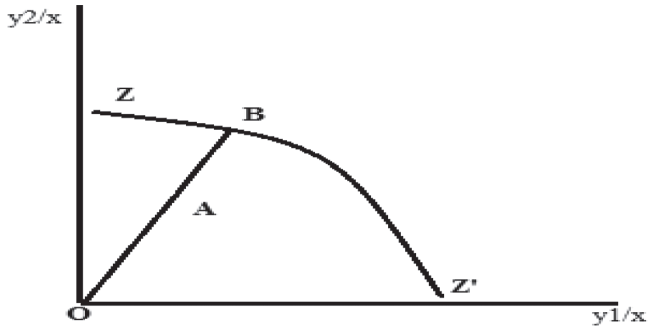
Figure 7 Input-orientation Measurement



2.2.2 Output-orientated Measures

In contrast to the input-orientated measures, the output-orientated measure focus on the "by how much can output quantities be proportionally expanded without affecting the input quantities used?" same like the input-orientated measure, a simple example can be given in this measures, for example, a firm could produce two outputs and use a single input, under the constant return to scale, form figure 8, we can see the line ZZ′ is the unit production possibility curve and the point A represented a inefficient firm, we can see that the inefficient firm point A, lies below the curve in this case because ZZ′ assumes the upper bound of production possibilities. From the figure 8 the distance AB represents technical inefficiency. That is, the amount by which outputs could increase without requiring extra inputs. Hence a measure of output-orientated technical efficiency equal to 0A/0B (Coelli, 1996).

Figure 8 Output-orientation Measurement



2.3 DEA Models

For DEA, there are also have different models: at first, Charnes, Cooper and Rhodes (1978) created the input-oriented and output-oriented DEA models which is assumed in the constant return to scale (CRS), and few years later Banker, Chanes and Cooper (1984) introduced this models assuming variable return to scale (VRS) referring to changing the economic scale for both input and output oriented.

2.3.1 The Constant Returns to Scale DEA Model

Assume there are N firms or DMU′s contain K inputs and M outputs, respectively, and there are two matrixes, one is X involving K*N input matrix, and the other one is M*N output matrix, Y. for the i-th DMU there are represented by the vectors x_i and y_i, respectively.DEA is aimed to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or below the production frontier (Hollingsworth, 1999).

The Charnes, Cooper, and Rhodes introduced the ratio DEA. The ratio of all outputs over all inputs is used to measure the relative efficiency of the firms. This model is used to be as the reduction of the multiple-output/multiple-input situation for each DMU. In the mathematic way, it can be expressed as:

$$\mathrm{Max}H_{\mu,\nu} = (\textstyle\sum_r \mu_r y_{r0})/(\sum_i \nu_i \chi_{i0}) \tag{2.1}$$

where μ is an M*1 vector of output weights and ν is the K*1 vector of input weights.

To looking for the appropriate weight, we can through the mathematic ways:

$$Max_{\mu,\nu}\left(\frac{\mu' y_i}{\nu' x_i}\right)$$

$$\text{Subject to} \quad \mu' y_j/\nu' x_i \leq 1, \text{j} = 1, 2, 3, 4\ldots\ldots \text{j}$$

$$\mu, \nu \geq 0 \qquad (2.2)$$

from the above equation, we can calculate the μ and ν, the under the constraint that all efficiency measures must be less than or equal to one. However, there will be a problem with this ratio formulation is that it has an infinite number of solutions, for the sake of avoiding this problem, we can impose the constraint $\nu' x_i = 1$, which provide:

$$Max_{\mu,\nu}(\mu' y_i)$$

$$\text{Subject to} \qquad \nu' x_i = 1,$$

$$\mu' y_i - \nu' x_i \leq 0, \text{j} = 1, 2, 3\ldots\ldots, \text{N},$$

$$\mu, \nu \geq 0 \qquad (2.3)$$

This form is regarded as multiplier form of the linear programming problem. What is more, a new kind of form can be brought out when using the duality in the linear programming, which is called the envelopment form, expressed in the following mathematic formulation:

$$Min_{\theta,\lambda}\,\theta$$

$$\text{Subject to} \qquad -y_i + \text{Y}\lambda \geq 0$$

$$\theta \text{Xi} - \text{X}\lambda \geq 0,$$

$$\lambda \geq 0 \qquad (2.4)$$

This envelopment form involves fewer constraints than multiplier form, and this is generally the popular one to be used. The value of θ will be the efficiency score for the i-th DMU and according to the Farrell (1957) definition, it meet the θ≤1, when it equal to 1, it means that a point on the frontier and hence a technically efficient. (Coelli, 1996)

For the constant returns to scale DEA model, Cooper, Seiford, and Zhu (2004) proposed that it can be applied into the input and output-oriented versions, in the following table 2 and 3 shows the mathematic expression of the two different measurements, each in the form of a pair of dual linear programs

Table 2 Constant Returns to Scale DEA Model in Input-oriented

Input-oriented	
Envelopment model	Multipliers model
$Min_{\theta} - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{i=1}^{s} s_r^+)$	$\text{Max } z = \sum_{r=1}^{s} \mu_r y_{r0}$
Subject to	Subject to
$\sum_{j=1}^{n} x_{ij} + s_i^- = \theta x_{i0}$, i = 1,2,...m;	$\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$
$\sum_{j=1}^{n} y_{rj} - s_r^+ = y_{r0}$, $r = 1,2,3...s$;	$\sum_{i=1}^{m} v_i x_{i0} = 1$
$\lambda_j \geq 0$, j = 1,2,3,...n	$\mu_r, v_i \geq \lambda > 0$

Table 3 Constant Returns to Scale DEA Model in Output-Oriented

output-oriented	
Envelopment model	Multipliers model
$Min_{\rho} + \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{i=1}^{s} s_r^+)$	$Max_P = \sum_{r=1}^{m} v_r x_{r0}$
Subject to	Subject to
$\sum_{j=1}^{n} x_{ij} + s_i^- = x_{i0}$, i = 1,2,...m; $\sum_{i=1}^{m} v_i x_{ij}$	$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} \mu_r y_{rj} \geq 0$
$\sum_{j=1}^{n} y_{rj} - s_r^+ = \rho y_{r0}$, $r = 1,2,3...s$;	$\sum_{i=1}^{m} \mu_i y_{i0} = 1$
$\lambda_j \geq 0$, j = 1,2,3,...n	$\mu_r, v_i \geq \varepsilon > 0$

2.3.2 The Variable Returns to Scale Model DEA (VRS)

Due to the imperfect competition, constraints on finance, etc. such reasons may lead to the DMU to be not operating at optimal scale. So Banker, Charns and Cooper (1984) advised that an extension of the CRS DEA model to express variable returns to scale situation. In the CRS specification when some of DMUs are not operating at the optimal scale, will lead to measures of TE which are confound by the scale efficiencies (SE), and the VRS specification will permit the calculation of TE devoid of these SE impacts.

The VRS can be account for through the CRS linear programming by adding the convexity constraint: $N1'\lambda=1$

$$
\begin{aligned}
& Min_{\theta,\lambda}\,\theta, \\
\text{Subject to} \quad & -y_i + Y\lambda \geq 0 \\
& \theta Xi - X\lambda \geq 0, \\
& N1'\lambda = 1 \\
& \lambda \geq 0
\end{aligned}
\tag{2.5}
$$

This approach forms a convex hull of interesting planes which envelop the data points more tightly than the CRS conical hull and thus provide technical efficiency scores which are greater than or equal to those obtained using the CRS model.

Then, under variable return to scale assumption, it is common to decompose measures technical efficiency into component measures of *purely technical efficiency, congestion, and scale efficiency.*

Scale Efficiency through DEA calculation, we can get the CCR score and BCC scores of a DMU, and we can use $_{CCR}$ and $_{BBR}$ represent the two kind of scores, respectively. The scale efficiency is defined by

$$\mathbf{SE} = {}_{CCR}/{}_{BBR} \tag{2.6}$$

SE is not greater than one. From above concept we can calculate the

$$\mathbf{TE} = \text{pure technical eff.} \times \text{scale eff.}$$

From the economist or the manager perspective, the economic decision-making process can fail in two different ways. “The whole core of economic theory is concerned with the first of these-the marginal revenue products of some or all factors might be unequal to their marginal costs. If this is true the allocative decision is said to be inefficient. The second source of failure is the technical production function-a failure to produce the greatest possible output from a given set of inputs means the technical decision is inefficient” (Coelli, 1996).

2.4 Regression Analysis Used in DEA

There are also many ways to do the regression analysis, for example, Standard multiple regressions but it need to assume the normal and homoscedastic distribution of the disturbance and the dependent variable; and in the case of a limited dependent variable, the expected errors will not equal zero. Hence, standard regression will lead to a biased estimate. While, Logit models can also be used if the DEA scores are converted to abinary variable such as efficient/inefficient. However, the converting of scores < 1 to a categorical variable results in the loss of valuable information; consequently Logit is not recommended as a technique for exploring health care problems with DEA. At the same time, perhaps someone think that the Tobit model can also be used whenever there is a mass of observations at a limiting value. This truly works well with DEA scores which contain both a limiting value (health care providers: whose DEA scores are clustered at 1) and some continuous parts (health care providers: whose DEA scores fall into a wide variation of strictly positive values < 1). No information is lost and a Tobit model fits nicely with distribution of DEA scores as long as there are enough best practice providers. But, there are real have some limitations, for example, if in a sample of 200 providers less than 5 were on the frontier, a Tobit model would not be suitable.

3. Result and Discussion

3.1 Results

3.1.1 Descriptive Statistic of Technical Efficiency Scores and Scale Efficiency Scores of Both General Hospital and Traditional Hospital

3.1.1.1 Descriptive Statistic of Technical Efficiency Scores and Scale Efficiency Scores

Descriptive statistic of technical efficiency score and traditional efficiency score of DEA, both general hospital and traditional hospital showed the number, mean, minimum, maximum, 25th percentiles, 75th percentile in the following table. The mean of general hospital TEVRS is lower than the traditional hospitals'. The TEVRS and SE score of traditional hospital in 25^{th} and 75^{th} percentiles and minimum were higher than the general hospitals'

Table 4 Descriptive of General Hospital and Traditional Hospital VRSTE and SE

Descriptive statistic	General hospital		Traditional hospital	
	VRSTE	SE	VRSTE	SE
Number	128	128	69	69
mean	0.538	0.922	0.685	0.905
minimum	0.149	0.137	0.173	0.490
maximum	1	1	1	1
Percentile25th	0.36	0.91	0.42	0.86
Percentile75th	0.69	0.98	1	0.99

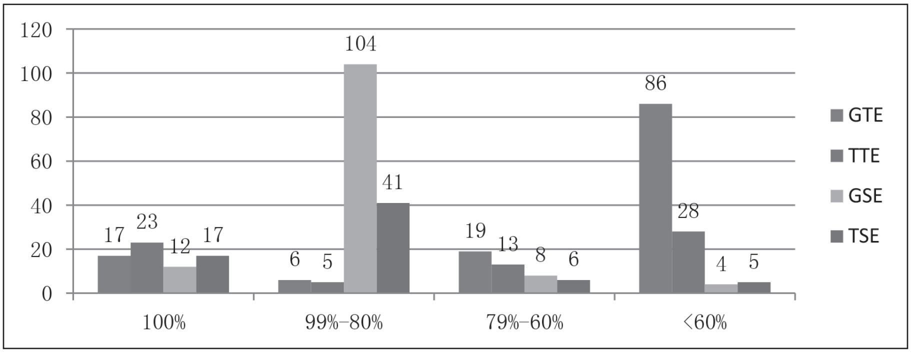
3.1.1.2 Ranking of Efficiency Level

The frequency of technical efficiency and scale efficiency level in both general hospital and scale hospital were showed in the table 5. For the general hospital, only 17 (13.3%) hospitals were technical efficient since they had a relative technical efficiency score of 1, and most of them, out of 128 general hospitals, 86 hospitals (62.7%) technical efficient score even below 0.6, its almost 4 times larger than the efficient DMUs, and the left hospitals (14.8%) efficient score between 0.9999 and 0.6. on the contrary, the traditional hospital, out of the 68 hospitals, 23 (33.3%) were technical efficient and they got the 1 efficient score, among the inefficient hospital, 5 hospitals (7.2%) had the TE score between 99%-80%. 13 hospitals (18.8%) had efficiency score among 60%-79%, and 28 hospitals (40.6%) had the score less than 60%. Figure 9 showed the distribution of the efficiency level of both general hospitals and traditional hospitals.

Table 5 Ranking of the Two Type's Hospital Efficiency Level

Level efficiency	General hospital				Traditional hospital			
	TE number	%	SE Number	%	TE number	%	SE number	%
100%	17	13.3	12	9.4	23	33.3	17	24.6
99%-80%	6	4.7	104	81.3	5	7.2	41	59.4
79%-60%	19	14.8	8	6.3	13	18.8	6	8.7
<60%	86	67.2	4	3.1	28	40.6	5	7.2

Figure 9 Distribution of Hospital by Level of Efficiency



3.1.1.3 Pattern of Scale Inefficiency of DEA, Both General Hospital and Traditional Hospital

From the following table 6, showing the frequency of pattern of scale inefficiency, decreasing return to scale indicated that unit cost increase as output increase and thus the hospital was too large for the volume of activities that it runs. On the contrary, a hospital with increasing to scale meant, unit cost decrease as outputs increase, which was relatively small for its scale of operations. From the scale inefficiency pattern of the hospital, it could give some good implications to the manager and policy makers. So from the DEA results of the pattern of scale inefficiency of general hospital was same as the traditional hospital, both type of hospitals' the frequencies of increasing return to scale pattern were higher than the frequencies of decreasing return to scale pattern in general hospital.

Table 6 Frequency of Pattern of Scale Inefficiency of Both General Hospital and Traditional Hospital

items	General Hospital Pattern of Scale inefficiency				Traditional Hospital Pattern of Scale inefficiency			
	--	irs	Drs	Total	--	irs	drs	Total
Frequency	14	77	37	128	18	38	13	69
%	11	60	29	100	26	55	19	100

Note: irs = increasing return to scale drs=decreasing return to scale

3.1.1.4 Excess Inputs and Shortfall Outputs

The technical efficiency scores implied the extent to which all the inputs have to be reduced in order to get 100% efficiency for the inefficient DMUs, so from the DEA calculated slacks which specify the amount by which an input or output should be increased in order for the unit to become efficient .the DMU produced on the efficient frontier define the best practice and thus could be treated as the models to the inefficient DMUs, the result of DEA can identify the efficient hospitals that as the comparators for the inefficient ones. And the inefficient ones should learn from the efficient ones by observing their production process, the efficient frontier and the slack variables for each of the inefficient hospitals were given in the table. The information provided the magnitudes by which specific inputs per inefficient hospitals should reduce. Table 7 showed the summary of the excess inputs used by inefficient hospitals for the output the produced. The same categories of inputs were selected for both the general hospital and traditional hospital, so the inefficient of general hospital could become efficient hospital by reducing the current inputs such as the number of beds, number of physicians, number of nurse, and the area of the hospitals by1163, 663, 1186 and 2096110.95, at the same time, for the same variables of the traditional hospitals should reduce by 502, 81,154 and 75214 individually.

Table 7 Inputs Reductions Needed to Make Both Types Inefficient Hospital Efficient

Variables	General	Hospital	Traditional	Hospital
	Actual	Excess	Actual	Excess
No. of beds	26383	1163	7204	502
No. of physicians	10731	663	3540	81
No. of nurse	10882	1186	2284	154
area of the hospital	2096110.95	28611	573726.17	75214

Table 8 showed the magnitude of output slacks for the inefficient hospitals. This indicated that the if inefficient hospitals become to efficient hospitals they should improve their current outputs of outpatients visits, average length of bed days, number of emergency visits and number of inpatient surgeries for the general hospitals and outpatients visits, average length of bed days, number of emergency visits for the traditional hospitals.

Table 8 Total Outputs Needed to Increase to Make the Inefficient Traditional Hospital and General Hospitals Efficient

Variables	General Hospital		Traditional Hospital	
	Actual	Excess	Actual	Excess
Outpatient visits	9185711	48536	3615291	78732
Average of bed days	1187	270	685	83
Emergency visits	983944	103	33094	40986
Inpatient surgeries	246478	19153		

Through looked the input slacks and output slacks information of these hospitals', manager and policy makers can make strategies to improve the access of hospital service and invest the capital of the hospital.

3.1.1.5 Descriptive of Different Cities and League Cities

Because of the data came from 12 cities and league cities in Inner Mongolia, and there were also many external factors that may be influence the hospital efficiency, form the following table, we can see that the mean of technical and scale efficiency in different were quite different. most of general hospitals in 12 cities the average technical efficiency score were under 0.5, the range was from 0.405 to 0.738, and the average of scale efficiency were all over 0.9.

The traditional hospitals in 12 cities have higher average technical efficiency score than general hospital. In Chi Feng city the average of traditional hospital VRSTE was the lowest, below 0.5. on the contrary, the average of each cities' traditional hospital scale efficiency was lower than general hospitals' at the same city, and the traditional hospital scale efficiency in BaoTou city was 0.793 lower than others (Table 9).

Table 9 Different Cities and League Cities Hospital VRCES and SE

Name of City	General Hospital			Traditional Hospital		
	Number of Hospital	Mean		Number of Hospital	Mean	
Hohhot city	8	VRSTE	SE	3	VRSTE	SE
BaoTou city	11	0.424	0.941	5	1	0.935
Chi Feng city	13	0.467	0.920	12	0.796	0.793
Tong Liao city	9	0.429	0.919	9	0.403	0.933
Erdos city	10	0.563	0.921	7	0.591	0.932
Wu Lan Cha Bu city	11	0.738	0.947	6	0.759	0.848
Hulunbuir League City	34	0.405	0.939	9	0.723	0.832
A Meng League City	3	0.545	0.902	2	0.633	0.922
Xing an League City	5	0.539	0.944	5	0.793	0.997
Xi linguo le League City	12	0.454	0.950	7	0.740	0.862
Bayannaoer League City	7	0.664	0.904	3	0.934	0.953
Wuhai city	5	0.591	0.953	1	0.703	0.953
		0.656	0.908		1	1

3.1.2 OLS of General Hospital and Traditional Medicine Hospital Scale Efficiency

Most independent variables of SE scores significantly correlated to general hospital dependent variables only geographic location (GL) insignificantly correlated to SE scores because p-value were more than 0.05 as Table 10,. R-square value (R^2) of this equation was low ($R^2 = 0.265367$) because the selected explanatory variables may be not the good independent variables for the dependent variables. From the probability F-statistic = 0.0000 meaning this equation was linear statistical model. For the traditional medicine hospital, the number of bed, outpatient-visits –physician's ratio and the dummy variable geographic location have an impact on the scale efficiency on the traditional hospital. R-square value (R^2) of this equation was low ($R^2 = 0.219724$) since the selected explanatory variables may be not the appropriate independent variables for the dependent variables. From the probability F-statistic = 0.00286 meaning this equation was linear statistical model.

Table 10 Result of Ordinary Least Square of Both General Hospital and Traditional Hospital Scale Efficiency

	General hospital				Traditional hospital			
Variable	Coefficient	Std.Error	t-Statis	Prob.	Coefficient	Std.Error	t-Statis	Prob.
C	0.9933	0.0345	28.772	0.00	0.8499	0.0516	16.471	0.00
B	-0.0002	4.56E-05	-5.1045	0.00	-0.0003	0.0001	-2.0604	0.04
OPPR	5.65E-05	1.63E-05	3.4725	0.00	4.57E-05	2.03E-05	2.2547	0.02
BEDDA								
Y	-0.0089	0.0037	-2.3664	0.01	0.0058	0.0041	1.4227	0.15
L	0.0238	0.0238	1.0018	0.31	-0.0771	0.0357	-2.1581	0.03
R-squared = 0.2654					R-squared = 0.2197			
F-statistic = 11.10765					F-statistic = 4.5056			
Prob (F-statistic) = 0.00					Prob (F-statistic) = 0.00			

From the hypnosis, the variable outpatient-visit-Physicians ratio (OPPR) which was expected to have a positive correlation to SE score of both general hospital and traditional medicine hospital, the OLS result showed that the OPPR have an impact on both types hospitals and it was a kind of positive relationship.

From the hypnoses, the number of beds should have an positive effect on the hospital scale efficiency of both types hospital, but, the result of the OLS reversely different as we expected, the coefficient of the variable were negative sign, they had a negative relationship with the scale efficiency of general hospital and traditional hospital.

The average of bed days represented the utilization of the bed in the hospital; it was expected to have a positive relationship with the general hospital and traditional medicine hospital. However, the OLS result indicated that this variable had a negative sign of the coefficient and insignificant in the traditional medicine hospital scale efficiency equation.

For the dummy variable geographic location, it was expected to have a positive relationship with the dependent variable, however, it was insignificant for the general hospital scale efficiency and had a reverse relationship with the tradition al hospital, and it meant that in the city region the scale efficiency decreased.

3.1.2.1 The Comparison between IRS Group and DRS Group in General Hospital

From the DEA result, we can see that the patterns of inefficiency in 77 of 128 general hospitals were increasing return to scale, which means that the output in at relatively low levels, and 37 of 128 general hospitals were decreasing return to scale, which stands for the output of these hospitals were in relatively high levels. According to the result of OLS of general hospital, from the whole picture there were 4 of 6 factors affecting the technical efficiency score and 3 of 4 factors affecting the scale efficiency score, for the sake of finding more details, this study would identify the influence between the increasing return to scale group and decreasing return to scale group of general hospitals.

Table 11 OLS of IRS group and DRS group of general hospital technical efficiency

	Increasing return to scale group				Decreasing return to scale			
Variable	Coefficient	Std.Error	t-Statis	Prob.	Coefficient	Std.Error	t-Statis	Prob.
C	0.3334	0.0758	4.3934	0.00	0.3757	0.1903	1.9742	0.05
BP	-0.0146	0.0294	-0.4987	0.62	0.0743	0.0350	2.1226	0.04
NP	0.0158	0.6446	0.2453	0.81	-0.1482	0.1180	-1.255	0.21
OPP	0.1047	0.0418	2.4998	0.01	0.0046	0.0524	0.0877	0.96
PS	9.0311	5.1012	1.7703	0.08	7.5827	7.5827	1.1303	0.93
BC	-2.87E-06	2.34E-06	-1.2273	0.22	-7.42E-06	-7.42E-06	-0.0422	0.26
Location	-0.0691	0.0453	-1.5247	0.13	0.0804	0.0704		0.26
R-squared = 0.15					R-squared = 0.21			
Number of observation = 77					Number of observation = 37			
F-statistic = 2.16					F-statistic = 1.37			

According to the table 11, the other-personal physician ratio were significant in the increasing return to scale group, however, insignificant in the decreasing return to scale, it meant that these two factors could influence the hospital technical efficiency of the increasing return to scale group; meanwhile, from the OLS result, the bed-physician ratio was significant in the decreasing return to scale group and insignificant in the increasing return to scale group, so the bed-physician ratio affect the general hospital in the decreasing to scale group; for other factors that nurse-physician ratio, number of physicians in form of square ,bed occupancy and the geographic location were insignificant in neither IRS group and DRS group in this study.

For the general hospital scale efficiency can also be composed by the IRS group and DRS group, from the OLS result of IRS group and DRS group (table 12), we can see that, the factors number of beds, the average of bed day were significant in both IRS group and DRS group, it meant that these two factors had an impact on the hospitals scale efficiency no matter the pattern was IRS or DRS, then from the value of the outpatient-physician ratio in both group, the increasing return to scale group was influenced by the OOPR and decreasing return to scale group was not. The geographic location never had an effect on the IRS group and DRS group.

Table 12 OLS of IRS and DRS of General Hospital Scale Efficiency

	Increasing return to scale group				Decreasing return to scale			
Variable	Coefficient	Std.Error	t-Statis	Prob.	Coefficient	Std.Error	t-Statis	Prob.
C	0.6571	0.0497	13.2103	0.00	1.2618	0.085	14.829	0.00
BEDS	0.0004	0.0001	3.6768	0.00	-0.0003	6.45E-05	-5.4158	0.00
OPPR	0.0001	2.19E-05	4.8160	0.00	2.77E-05	4.66E-05	0.5937	0.55
BEDDAY	0.0166	0.0052	3.1462	0.00	-0.0298	0.0063	-4.6966	0.00
Location	-0.0468	0.0230	0.4248	0.67	0.089	0.049	1.8158	0.07
R-squared = 0					R-squared = 0.61			
Number of observation = 77					Number of observation = 37			
F-statistic = 10.65					F-statistic = 12.91			

In conclusion, according to the above parts, we can see that the pattern of inefficiency hospitals can be divided into two groups: IRS group and DRS group. To find the factors that effect on these two groups' hospitals, this study used OLS to identify the influence, from OLS results, for the technical efficiency of these two groups general hospitals, 4 of 6 factors were insignificant in both two group hospitals, and OPP was significant in IRS group and BP was significant in DRS group. In scale efficiency, the number of bed and average of bed day influence these two group hospitals, and the OPPR was insignificant in the DRS group, the geographic location did not have influence on these two group hospitals' scale efficiency.

3.1.2.2 The Comparison between IRS Group and DRS Group in Traditional Medicine Hospital

The same way was use for the traditional medicine hospital, from table 12, we can find that only the bed-physician ratio was significant in the increasing return to scale group, other variables were insignificant, meanwhile, in the decreasing return to scale group, none of these were significant.

Table 13 OLS of IRS Group and DRS Group of Tradition Medicine Hospital Technical Efficiency

	Increasing return to scale group				Decreasing return to scale			
Variable	Coefficient	Std.Error	t-Statis	Prob.	Coefficient	Std.Error	t-Statis	Prob.
C	0.5259	0.1191	4.4147	0.00	0.4772	0.3801	1.2554	0.25
BP	0.057	0.0185	3.0683	0.00	0.2795	0.1178	2.3707	0.05
NP	-0.0884	0.140	-0.6018	0.55	-0.6763	0.3455	-1.9576	0.09
OPP	0.014	0.043	0.3278	0.75	-0.0273	0.1579	-0.1730	0.86
PS	15.185	8.0816	1.8789	0.07	32.747	27.104	1.2081	0.27
BC	-0.0003	0.0007	-0.4515	0.65	0.0009	0.0007	1.3471	0.23
Location	-0.1635	0.0886	-1.8463	0.07	-0.0413	0.1538	-0.2682	0.79
R-squared = 0.46					R-squared = 0.54			
Number of observation = 38					Number of observation = 13			
F-statistic = 4.52					F-statistic = 1.18			

According to table 13, in the increasing return to scale group the number of beds and the outpatient-physician ratio factors had an impact on the hospitals scale efficiency, the other two factors were insignificant. However, in the decreasing return to scale group, none of the factors were significant.

Table 14 OLS of IRS and DRS of Traditional Medicine Hospital Scale Efficiency

	Increasing return to scale group				Decreasing return to scale			
Variable	Coefficient	Std.Error	t-Statis	Prob.	Coefficient	Std.Error	t-Statis	Prob.
C	0.8665	0.0738	11.7277	0.00	0.7828	0.3268	2.3955	0.04
BEDS	-0.001	0.0002	-4.6006	0.00	-0.0001	0.0004	-0.3823	0.71
OPPR	7.73E-05	3.01E-05	2.5713	0.01	0.0021	0.0193	0.1110	0.91
BEDDAY	0.0026	0.007	0.3695	0.71	-2.69E-06	0.0001	-0.0262	0.97
Location	-0.0468	0.0468	-0.936	0.35	-0.2141	0.1573	-1.3614	0.21
R-squared = 0.47					R-squared = 0.54			
Number of observation = 38					Number of observation = 13			
F-statistic = 4.52					F-statistic = 1.18			

From the above concept, we can see that most of these factors were significant no matter for the increasing to scale group hospitals or decreasing to scale group hospitals in this study.

This study provided a brief condition of the efficiency of general hospital and traditional hospital in Inner Mongolia, from the DEA results, we can see that the average constant return to scale technical efficiency score of both general hospital and traditional hospitals were 0.495, 0.625 with S.D. of 0.237, 0.288, respectively; the average variable return to scale technical efficiency score were 0.538 and 0.685 with S.D. 0.244 and 0.285, the average scale efficiency score were 0.922 and 0.905 with S.D. 0.122 and 0.129. These results figure that the level of technical and scale efficiency of the both the general hospital and traditional hospitals are very low. The traditional hospital had a slightly higher average technical efficiency score, more than 9% gained constant return to scale technical efficiency, about 33% and 24% got variable return to scale technical efficiency and scale efficiency, respectively.

In conclusion, the technical and scale efficiency score of both general hospital and traditional hospital in Inner Mongolia region were very low, all above concepts could provide a lot very useful information to the policy maker in health sector and managers of the hospital to enhance the inefficient regional hospital in proper direction by run the inefficient regional hospitals, through the appropriate way to assign the resources to the inefficient hospitals.

3.1.3 Analysis of Determinates of Both General Hospitals and Traditional Hospital

This study use the same determinates for the general hospital and traditional hospital, form the result of the regression analysis, we can see that bed-physician ratio, other personal-physician ratio, number of physician in the form of square were positive correlated to the variable return to scale technical efficiency score, only nurse-physician ratio negatively correlated to variable return to scale technical efficiency score, and the bed occupancy and geographic location were insignificant to the variable return to scale technical efficiency score, on the contrary, for the traditional hospital, only other personal-physician ratio was significant and positive correlated to variable return to scale technical efficiency score, other variables were insignificant to the variable return to efficiency score.

For the scale efficiency, the same determinates, such as number of beds, out-patient-physicians ratio, the average of bed days and geographic location were used to the general hospital and traditional hospital, from the OLS result, number of bed, outpatient-physician ratio and average of bed day were significant and only outpatient-physician ratio was positive correlated to the scale efficiency score of the general hospital, the dummy variable geographic location was insignificant.

However, for the traditional hospital scale efficiency score, the average of bed day was insignificant, and the other three variables were significant, and the outpatient-physician ratio was positive correlate with the scale efficiency score, the number of bed and geographic location were negative correlated with the scale efficiency of the traditional hospital scale efficiency score.

All in all, the policy maker and managers of the hospitals could reduce the number of bed, the average of bed day and increase the outpatient-physician ratio improve the general hospital scale efficiency, for the traditional hospital could reduce the number of bed, increase the outpatient-physician ratio to improve the traditional hospital scale efficiency, what' more, for the traditional hospital, the geographic location had a negative correlated to the efficiency, so the location had impact on the traditional hospital.

3.2 Recommendation

From the result of this study, we can see it is not as good as we expected before, the average of constant return to scale technical efficiency, the variable return to scale technical efficiency and the scale efficiency were very low both in traditional medicine hospital and general hospital, so there are some implications and recommendations can be derived:

1. There are lots of general hospitals and traditional hospital had the low level of technical efficiency, so it is better to use the resources related to the human resource and capital resource in the secondary level hospitals in

Inner Mongolia, such as number of doctors, number of nurse.

2. Most of hospitals are increasing pattern of scale, so the policy maker should consider the education of medicine; provide lots of professional test to enhance the quality of the professionals, meanwhile the policy makers also enhance the management of the hospital.

3. Most medical students, in Inner Mongolia, prefer to stay in the big and advanced cities and do not go to the district and township hospitals because they cannot get well work environment and good salaries, so from this perspective, policy maker can offer more good conditions to the professionals to avoiding brain drain.

4. The government and policy makers should balance the development of general hospital and traditional medicine hospital according to the characteristics of both types of hospital; make these two types of hospital mutual cooperation, promotion and common development.

5. Efficiency monitoring and benchmarking. if the Ministry of Public Health sets the national policy in the hospital reform in different level and classifications, the hospital efficiency monitoring and benchmarking should be routinely measured and reported yearly, or every two or three years. This is sensitive issue for inefficient hospitals so the reports in other words or in the classified groups such as good, moderate, fair, poor depending on the levels of efficiency scores.

The broadest conclusion to be extracted from the analysis relates to the data used in the analysis. The empirical approach used in this paper, as discussed in earlier sections, is not without flaws: the data is just one year data. In despite of those flaws, DEA when used carefully, can be used to guide resource allocation in multiple output production units, as long as the data used in the analysis is representative of the production process and can be compared to appropriate peer production units. The data used in this paper suffers on both of the preceding points; therefore, it is necessary that general hospitals and traditional hospitals across the Inner Mongolia region should be encouraged and develop data warehousing systems, so that future research on this topic can be conducted.

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