

Performance Assessment of Health Organization in Thi Qar Province Using CCR Model

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Abstract

This paper presents a comprehensive evaluation of the relative efficiency of healthcare organizations in Thi Qar Province by considering their inputs and outputs. The study employs the CCR model, developed by Charnes, Cooper, and Rhodes, to provide insights into organizational performance. The assessment of seven hospitals reveals varying levels of efficiency among them. Four hospitals achieved a remarkable relative efficiency of 100%, indicating their optimal utilization of resources to achieve the desired outcomes. Conversely, the remaining four hospitals exhibited lower efficiencies, ranging from 59% to 79%. The study emphasizes the potential for the improvement in the inefficient hospitals' performance. By reducing inputs, such as optimizing resource allocation and minimizing wastage, these organizations can enhance their efficiency levels and overall effectiveness. Furthermore, the findings suggest that the underperforming hospitals can learn from the reference units that have achieved full efficiency. Analyzing the practices and strategies implemented by the highly efficient hospitals can serve as benchmarks for the inefficient units, enabling them to adopt similar approaches and improve their own efficiency.

Keywords: Performance assessment, relative efficiency, health organizations, Data envelopment analysis

تقييم أداء المؤسسات الصحية في محافظة ذي قار باستخدام نموذج CCR
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المستخلص

في هذا البحث ، تم استخدام طريقة غير معلمية تعتمد على تقنية البرمجة الخطية التي قدمها (Charnes, Cooper and Rhodes) والتي تعتبر احد نماذج تحليل مغلف البيانات ذات الحجم الثابت والمعروف باسم نموذج CCR وكوبر لقياس الكفاءة النسبية للمنظمات الصحية في محافظة ذي قار بالاعتماد على المدخلات والمخرجات لكل منظمة صحية. تتكون دراسة الحالة من سبعة مستشفيات مع أربعة مدخلات وثلاثة مخرجات. وأظهرت الدراسة أن الكفاءة النسبية لأربعة مستشفيات تصل إلى 100% بينما تصل كفاءة أربعة مستشفيات أخرى إلى 59% و 61% و 73% و 79%. بناءً على نموذج CCR ، نستنتج أن الوحدات غير الفعالة يمكنها تحسين أدائها عن طريق تقليل مدخلاتها والاستفادة من الوحدات المرجعية التي وصلت إلى الكفاءة الكاملة.

الكلمات المفتاحية : تقييم الاداء ، الكفاءة النسبية ، المنظمات الصحية ، تحليل مغلف البيانات

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معلومات البحث

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Introduction

Efficient and effective healthcare systems are essential for the well-being of communities and the provision of quality care. Evaluating the performance of health organizations is a crucial step in identifying areas for improvement and optimizing resource utilization. This paper focuses on the performance assessment of health organizations in Thi Qar Province, employing the CCR (Charnes, Cooper, and Rhodes) model as a comprehensive evaluation framework. The objective of this study is to analyze the relative efficiency of health organizations in Thi Qar Province by considering both inputs and outputs. The CCR model is a non-parametric approach which is based on linear programming that enables a comprehensive assessment of organizational performance. By incorporating multiple inputs and outputs, it provides a holistic perspective on the efficiency of healthcare organizations. More details about linear programming problems and its applications we refer to [1],[2] ,[3],[4],[5],[6] and [7]. Identifying the inefficient hospitals presents

an opportunity for improvement. By focusing on reducing inputs, such as optimizing resource allocation and minimizing wastage, these organizations can enhance their efficiency levels and overall performance. Such improvements would contribute to better patient care, increased cost-effectiveness, and the optimization of scarce healthcare resources. In addition, the study emphasizes the potential benefits of benchmarking. By analyzing the practices and strategies employed by highly efficient hospitals, underperforming organizations can learn from their successful counterparts and adopt similar approaches to enhance their own efficiency.

CCR model

Charnes, Cooper, and Rhodes presented constant return to scale known as (CCR) model.

The mathematical models for output- oriented CCR (CCR.O) and input- oriented CCR (CCR.I) are illustrated in the Table 1 as in [7],[8],[9],[10] and [11] as follows:

Table (1): Formulation of CCR Model

(CCR-O)	(CCR-I)
$\text{Min } (\pi . x^{j*})$ <p>S.t.</p> $(\pi . x^j) - (\delta . y^j) \geq 0 \quad ,j=1,\dots,n :$ $(\delta . y^{j*}) = 1:$ $\Pi, \delta \geq 0 .$	$\text{Max}(\delta . y^{j*})$ <p>S.t.</p> $(\delta . y^j) - (\pi . x^j) \leq 0 \quad ,j=1,\dots,n :$ $(\pi . x^{j*}) = 1$ $\Pi, \delta \geq 0$

Case Study

The performance assessment of health organizations in Thi Qar Province, utilizing the CCR model, provides valuable insights into the relative efficiency of these institutions. In this

paper, we calculate the relative efficiency of 8 hospitals in Thi Qar Province by using CCR model with (number of employees, number of doctors, number of medical devices, number of hospital beds)

as inputs and (number of medical patients) as outputs . The input and output data examinations , number of inpatients, number of are illustrated in Table 2 and Table 3 as follows:

Table (2): Input Data

Hospital Name	First input	Second input	Third input	Fourth input	Year
Al-Hussein Teaching Hospital	5102	530	3076	400	2020
	5089	563	3200	220	2021
Nasiriyah Heart Center	1800	105	688	124	2020
	1606	112	680	124	2021
Al Haboubi General Hospital	1990	194	597	124	2020
	2006	199	542	124	2021
Bint Al Huda Maternity Hospital	2153	125	1093	154	2020
	2164	132	1102	154	2021
Mohammed Al Mousawi Hospital	1202	37	257	133	2020
	1249	35	259	133	2021
Al Rifai General Hospital	533	104	360	169	2020
	608	110	400	154	2021
Shatrah General Hospital	1809	98	1353	169	2020
	2222	89	1213	160	2021
Souq Al-Shuyoukh General Hospital	1920	102	688	285	2020
	1961	105	600	222	2021

Table (3): Output Data

Hospital Name	First output	Second output	Third output	Year
Al-Hussein Teaching Hospital	460215	10405	12948	2020
	602676	10915	25356	2021
Nasiriyah Heart Center	75163	4562	8351	2020
	132602	6322	17430	2021
Al Haboubi General Hospital	65714	7087	52638	2020
	57952	10490	71439	2021
Bint Al Huda Maternity Hospital	35465	7087	42638	2020
	40663	11012	51445	2021
Mohammed Al Mousawi Hospital	130757	9330	17615	2020
	83960	2713	23977	2021
Al Rifai General Hospital	140778	10988	128323	2020
	138876	14910	141431	2021
Shatrah General Hospital	164015	12768	120482	2020
	172658	10564	105353	2021
Souq Al-Shuyoukh General Hospital	130691	6071	84119	2020
	127601	6322	87453	2021

Mathematical Formulation

We formulate the CCR model which is based on input and output that illustrated in Table 2 and Table 3 by using the following computational procedure:

Step1: Construct the objective function for the given decision making unit as ratio between the output and input.

Step2: Construct the constraints based on the remaining decision making units as ratio between

the output and input and this ratio is less than or equal 1.

Step3: Solve this model as linear programming model by using WINQSB solver,

Step4: Repeat steps1-3 for all decision making units.

Results

Based on the mathematical formulation of CCR model and by using WINQSB solver, we obtain

The efficiency of the all hospitals as illustrated in the Table (4) as follows:

Table (4): Hospitals Efficiency

Hospital Name	2020- Hospitals Efficiency	2021- Hospitals Efficiency
Al-Hussein Teaching Hospital	1	1
Nasiriyah Heart Center	0.60	0.89
Al Haboubi General Hospital	0.80	0.87
Bint Al Huda Maternity Hospital	0.62	0.70
Mohammed Al Mousawi Hospital	1	1
Al Rifai General Hospital	1	1
Shatrah General Hospital	1	1
Souq Al-Shuyoukh General Hospital	0.73	0.75

Conclusions

1-Relative Efficiency Evaluation: The research examines the relative efficiency of healthcare organizations in Thi Qar province by considering both inputs and outputs. The CCR model allows for a comprehensive assessment of organizational performance.

2-Efficiency Disparities: Among the seven hospitals studied, four hospitals achieved a relative efficiency of 100%. This implies that these hospitals are utilizing their resources optimally to produce the desired outcomes. However, the remaining four hospitals exhibited lower efficiencies, with ratings of 59%, 61%, 73%, and 79%.

3-Potential for Improvement: The study highlights that the inefficient hospitals have room for improvement in terms of their performance. By reducing their inputs, such as optimizing

resource allocation or minimizing wastage, these organizations can enhance their efficiency levels.

4-Benchmarking for Improvement: The findings suggest that inefficient units can learn from the reference units that have already attained full efficiency. By analyzing the practices and strategies implemented by the highly efficient hospitals, the underperforming organizations can adopt similar approaches to improve their own efficiency.

In conclusion, the CCR model-based assessment reveals disparities in the relative efficiency of health organizations in Thi Qar Province. By identifying inefficient units and promoting benchmarking practices, this study provides valuable insights for improving the overall performance of healthcare organizations in the region

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