Investigating the Financial Performance of Universities of Medical Science and Health Services in Iran, Using Data Envelopment Analysis

Amir Ashkan NASIRIPOUR [1] , Abbas TOLOIE-ASHLAGHY [2] , Seyed Jamaleddin TABIBI [3] , Mohammad Reza MALEKI [3] , *Hassan Abolghasem GORJI [1,4]

1. *Dept. of Health Services management, School of Management and Economic, Science and Research Branch, Islamic Azad university (IAU), Tehran, Iran*
2. *Dept. of Industrial Management, School of Management and Economic, Science and Research Branch, Islamic Azad university (IAU), Tehran, Iran*
3. *Dept. of Health Services Management, School of Health Management and Information Sciences, Tehran University of Medical Sciences, Tehran, Iran*
4. *Research Center for Health Services Management, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran*

*Corresponding Author: Tel: +989122567591, E-mail: hgorji@tums.ac.ir

Abstract

Background: Universities of Medical Science and Health Services (UMSHS$_s$) are among the main organizations in Iran's health-care section. Improving their efficiency in financial resource management through creating an appropriate coordination between consumption and resources is strategically vital. Investigating the financial performance as well as ranking the Iranian UMSHS$_s$ is the research objective.

Methods: The study is of descriptive and applied type. The study population includes the UMSHS$_s$ of Iran (n=42) among which 24 UMSHS$_s$ are selected. DEA is used with the aim to model and assess the financial performance including 4 inputs and 3 outputs. Also, linear regression is applied to determine the effectiveness of the applied indices as well as the level of the financial performance. Data are obtained from the Budgeting Center in the Ministry of Health and Medical Education, during 2010 mainly through forms designed based on the available balance sheets.

Results: The average score of financial performance assessment for UMSHS$_s$ based on the DEA of input-oriented data is 0.74, assuming a constant scale of DEA-CRS. Thus, approximately 25% of the studied UMSHS$_s$ have maximum relative performance and totally, there is about a 30% capacity to increase the financial performance in these UMSHS$_s$.

Conclusion: Most Iranian UMSHS$_s$ do not have high financial performance. This can be due to problems in financial resource management especially in asset combining. Therefore, compilation and execution of a comprehensive program for organizational change and agility with the aim to create a kind of optimized combination of resources and assets is strongly recommended.

Keywords: Financial performance, Technical efficiency, Managerial efficiency, Scale efficiency, Iran

Introduction

Nowadays, a global competition through vast cultural, social, and economic changes leads to remarkable changes in governmental structures, namely in replacing the traditional twentieth-century patterns of government administration with modern government administration (1). Modern government administration is an international phenomenon the impact of which is evident in various countries including England and the US (2).

On the other hand, reformation in health system is one of the fundamental and pioneering strategies and policies in different countries, considering the two following main bases:

- Structure reformation and decentralization
- Reformation of income-outcome financial systems (3, 4).

Accordingly, the financial system as the second feature affecting the reformation in addition to keeping a track of self-organization feature, and decentralization, as the first essential basis of health system reformation acting as a motivating force and the backbone for reformation both require comprehensive consideration (5, 6). It is mentioned, financial function is one major functions of health system (stewardship, resource generation, health financing and service provision); improving and transplanting of this function in UMSHS$_s$ is critical point and issue for health system reformation (5).

On the other hand, in most middle-income countries, more than 5% of the GDP and 5% to10% of the total governmental costs is allocated to health section (7). Without an appropriate infrastructure for effective deployment of resources, especially financial ones, the effectiveness and efficiency assessment and monitoring of such resources will not be possible, and even a permanent increase in financial credits for this section cannot be useful in removing the system's problems (8).

Therefore, efforts for reformation in financial management and responsiveness in governmental section has launched in Australia since 2000, with shifting their accounting method from cash to accrual as the most basic step derived from the reformation of financial management in governmental section (2). While in Iran, several major problems in health and medication affairs as one of the governmental parts pose to hinder the emergence of reformation; to mention a few, these problems can be counted: issues in cash registration and financial record of receptions and payments, as well as in registration of buying assets and properties, weakness in preparing financial reports and in preparing financial sheets, and ambiguity in real performance of the budget (9). Among the most important priorities of health section for achieving financial optimal management system, one can consider the following: devoting credit at the time of creating or approving a cost, implementing the effective internal controls, integrating and standardizing the processes, activity-based budgeting, budget-controlling and analyzing the deviation from project, reforming the organizational structure, and homogenizing the data (9, 10).

In Iran, the Ministry of Health and Medical Education (MHME) is the governmental organization in charge of public health administration for formulating and establishing the policies and strategies, general monitoring, directing and developing the national health proceedings (10). Among the problems, there is a profound lack of powerful communication system in our information technology in this field; moreover, the available information about human, logistic, and financial resources and budget in the existing financial systems in Iran's public health section is not comprehensive, and this, by itself, leads to a weakness in information-based decision-making (8). Thus, it seems that a reform in financial system of MHME as well as an implementation of a modern financial system is absolutely essential.

Furthermore, the importance of implementing a reform in modern financial system of health section is officially confirmed regarding the existing defections in our traditional system and consider-

ing the emphasis of governmental documents such as Plan Four in Iran's Development Act, financial and transactional regulations of UMSHS$_s$ nationwide, and the legislations of governmental administration in service-providing section (11).

Thus, since the MHME is responsible for financial management of more than 40 UMSHS$_s$, about 600 public hospitals, and 4000 urban and rural medical centers nationwide (12), the reform in financial management of the country's health system has started.

To achieve more effective use of public resources, cash accounting is proved not to be appropriate for implementing the government plans (10), nor does it provide the required information; thus, the MHME has started to reform its accounting system from cash accounting into accrual, as the first step towards creating an efficient financial information base for decision-making in asset combination and financial resources management (13). This first phase has been accomplished in 2010 and UMSHS$_s$ of the country are now able to present their financial sheets based on accrual accounting.

Still, the performance analysis and the assessment of these financial sheets is a vital step to be taken in order to make feasible the process of decision-making regarding the mentioned issues; for this reason, this study aimed to investigate the financial performance of UMSHS$_s$ over the country using Data Envelopment Analysis.

Materials & Methods

The present study is of descriptive, periodical, and applied type, regarding method, time, and objectives, respectively conducted in 2012. In addition, it is of quantitative type, using financial sheets of Iran's UMSHS$_s$; the research method applied is DEA.

In order to implement the model for financial performance assessment based on DEA, all UMSHS$_s$ of the country were selected as our research population (n=42) Considering the accrual-accounting report in the form of financial sheets, and the correctness and deficiency of financial information,

24 UMSHS$_s$ were selected, and the remaining 18 were excluded from the population (10 did not present their financial reports in accrual form, 5 provided incomplete information, and 4 lacked the reliability in their financial information).

In line with the policies for reducing the costs and for avoiding resources wasting, the DEA method was applied to all input data; the financial performance of the studied UMSHS$_s$ was calculated in EMS software based on CCR model and BCC input; and finally, a complete ranking (AP model) was performed.

In conducting the DEA, the inputs included X1=current assets, X2=constant assets, X3=public budget, and X4=operational costs, while the outputs included Y1=cash flow of operation, Y2= operational income, and Y3= cash surplus/deficit rate.

The Input-oriented CCR:

$$\text{Min} \quad \theta$$
$$\text{S.t} \quad \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io}$$
$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro}$$

The Input-oriented BCC:

$$\text{Min} \quad \theta$$
$$\text{s.t} \quad \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io}$$
$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro}$$
$$\sum_{j=1}^{n} \lambda_j = 1$$

$\lambda \geq 0$ / i= 1,2,...,m / r=1,2,...,s / j=1,2,...,n

Data collection for to the determined indices of financial sheets including the balance sheets, income and cost, consumptions, resources, and cash flow was conducted based on the reports of 2010 provided by each UMSHS for the Budgeting Center at the MHME. Linear regression is applied in order to determine the effectiveness of the applied indices as well as the level of the financial performance.

Results

The numbers in input-output indices model are in 1000 billion Rls. As represented in Table 1: In *inputs* part, the average of "current assets" without DEA ratio was 1.209, the minimum rate of which belonging to UMSHS$_s$ *no. 20* and *no. 48*, and the maximum rate being that of UMSHS$_s$ *no. 13*; the average of "fixed assets" was 2.919, the minimum of which belonging to UMSHS$_s$ *no. 35* and *no. 48*, and the maximum rate being that of UMSHS$_s$ *no. 37*; and finally, the average of "public budget" was 6.147, the minimum rate of which belonging to UMSHS$_s$ *no. 31* and *no. 48*, and the maximum rate being that of UMSHS$_s$ *no. 7*; The average of "op-

erational costs" was 0.780, the minimum rate of which belonging to UMSHS$_s$ *no. 48* and the maximum rate being that of UMSHS$_s$ *no. 13*.
And in output part, the average of "cash flow" resulted from the operation was 0.383, the minimum rate of which belonging to UMSHS$_s$ *no. 48*, and the maximum rate being that of UMSHS$_s$ *no. 33*; the average of "operational income" was 0.859, the minimum rate of which belonging to UMSHS$_s$ *no. 20* and *no. 48,* and the maximum rate being that of UMSHS$_s$ *no. 13*; the average of "cash surplus/deficit" was 0.223, the minimum of which belonging to UMSHS$_s$ no. 30 and no. 48 and the maximum rate being that of UMSHS$_s$ *no. 10*.

Table 1: Rate of model indices without DEA

University No.	Inputs				Outputs		
	X1	X2	X3	X4	Y1	Y2	Y3
2	0.344	2.785	0.506	0.284	0.085	0.341	2.338
3	0.257	2.582	0.459	0.43	0	0.417	2.292
7	2.127	0.308	30.808	2.069	1.08	2.503	1.833
8	0.364	0.933	0.725	0.415	0.805	0.416	2.286
10	0.459	0.256	1.935	0.86	0.34	0.176	2.972
11	0.774	2.611	1.273	0.752	0.014	0.93	2.094
13	5.903	9.212	3.164	3.24	0.863	3.248	2.278
14	0.369	0.517	0.623	0.286	0.385	0.361	2.212
19	0.312	0.452	0.246	0.186	0.083	0.171	2.302
20	0.094	0.359	0.229	0.059	0.04	0.056	2.292
21	0.332	0.189	0.499	0.328	0.105	0.336	2.28
23	1.278	0.474	0.839	1.882	0.272	1.769	2.4
25	0.235	3.246	0.478	0.377	0.17	0.384	2.42
30	1.738	7.319	2.269	1.811	0.24	2.338	1.806
31	0.114	2.728	0.164	0.171	0.027	0.133	2.325
32	0.399	4.091	1.547	0.792	0.117	0.848	2.269
33	0.396	0.13	0.505	0.804	1.458	0.959	2.132
34	0.171	0.141	0.341	0.146	0.048	0.16	2.274
35	0.095	0.02	0.243	0.174	0.102	0.269	2.192
37	0.998	10.404	1.718	1.171	0.116	1.472	1.972
39	0.716	2.518	1.001	0.466	0.183	0.679	2.061
41	1.198	0.266	1.543	0.629	0.488	0.783	2.132
44	0.267	0.063	0.437	0.254	0.029	0.211	2.331
45	0.288	1.347	0.469	0.191	0.013	0.203	2.276
48	0.094	0.02	0.164	0.059	0	0.056	1.806
Minimum	0.094	0.02	0.164	0.059	0	0.056	1.806
Maximum	5.903	10.404	30.808	3.24	1.458	3.248	2.972
Average	1.209	2.919	6.147	0.78	0.383	0.859	0.223

Results of implementing the model of input-oriented DEA financial ratios:

As illustrated in Table 2, the technical efficiency average of AP DEA for UMSHS$_s$ of the country was 1.21, with the managerial efficiency of 1.63, and the average of scale efficiency being 0.74; the technical efficiency average of DEA for these UMSHS$_s$ was 0.84, with the managerial efficiency of 0.98, and the average of scale efficiency being 0.85. In other words, based on the results of DEA model and by assuming DEA-VAR, the capacity of the efficiency promotion in Iran's UMSHS$_s$

without any increase in costs and with application of the same inputs was about 16%. Among all studied UMSHS$_s$, 6 UMSHS$_s$ (16.66%) had maximum technical efficiency of DEA (1 and above), 17 UMSHS$_s$ (70.83%) ranged from 0.5 to 1, and one UMSHS (4.61% of all population) had an efficiency less than 0.5.

According to results of the AP model of DEA in 2010, the maximum technical efficiency belonged to Kerman UMSHS (5.56) while the minimum was that of Markazi UMSHS (0.38).

Table 2: Results of the simple model without input-oriented DEA ratio of Iran's UMSHS$_s$ during 2010

	UMSHS$_s$ Name	Efficiency AP-DEA			Efficiency DEA		
No.	Kerman	Technical	Managerial	Ratio	Technical	Managerial	Ratio
1		5.56	Big	-	1	1	1
2	Jiroft	3.25	3.36	0.97	1	1	1
3	Gonabad	2.48	2.62	0.95	1	1	1
4	Dezful	1.47	1.79	0.82	1	1	1
5	Qazvin	1.11	1.28	0.87	1	1	1
6	Eastern Azerbaijan	1.11	7.37	0.15	1	1	1
7	Kohkilouyeh & Boyerahmad	0.98	0.99	0.99	0.98	0.99	0.99
8	Fassa	0.96	1.12	0.86	0.96	1	0.96
9	Rafsanjan	0.95	1.1	0.86	0.95	1	0.95
10	Golestan	0.94	1.08	0.87	0.94	1	0.94
11	Ahvaz Jondishapour	0.87	1.7	0.51	0.87	1	0.87
12	Sistan & Baluxhestan	0.85	1	0.85	0.85	1	0.85
13	Mazandaran	0.81	0.98	0.83	0.81	0.98	0.83
14	Hamedan	0.8	0.94	0.85	0.8	0.94	0.85
15	Shahid Beheshti	0.79	Big	-	0.79	1	0.79
16	Kashan	0.78	1.07	0.73	0.78	1	0.78
17	Guilan	0.75	1.05	0.71	0.75	1	0.75
18	Fars	0.74	Big	-	0.74	1	0.74
19	Semnan	0.73	0.83	0.88	0.73	0.83	0.88
20	Zabol	0.7	1.22	0.57	0.7	1	0.7
21	Qum	0.7	0.83	0.84	0.7	0.83	0.84
22	Karaj	0.69	1.33	0.52	0.69	1	0.69
23	North Khorasan	0.66	0.98	0.67	0.66	0.98	0.67
24	Markazi	0.38	Big	-	0.38	1	0.38
Minimum		0.38	0.38	0.83	0.46	0.38	0.38
Maximum		5.56	5.56	7.37	0.75	1	1
Average		1.21	1.21	1.63	0.74	0.84	0.85
Standard deviation		1.11	1.11	1.49	0.14	0.16	0.05

Linear regression was applied in order to determine the effectiveness of the applied indices as well as the level of the financial performance of

the Iranian UMSHS$_s$; the results are demonstrated in Table 3. In this case, among the indices of simple model without the ratio in input-oriented

DEA, by constant scale, only two indices of cash flow resulted from "operation" and "current asset" showed 18.8% and 16% of the efficiency of the studied UMSHS$_s$, respectively.

Table 3: results of the linear regression between the indices and the financial performance rate of the UMSHS$_s$

Model No	Model/Ratio	Modified R	Rate of changes
1m	cash flow resulted from "operation"	0.188	0.188
2m	1m + current assets	0.348	0.160

P<0.05

Discussion

The study showed that there is generally a high cash volume in Iranian UMSHS$_s$ which is owing to the cash created by government at the end of each financial year. However, these UMSHS$_s$ do not have satisfactory situation in comparison with other fields regarding their financial activity (deficit/surplus, charges recovering period, and charges paying period) and return (return of assets, return of budget, and gross return of assets).

Based on the results of input-oriented DEA, about one fifth of these UMSHS$_s$ had high performance and most of them (about three fifths) showed unsatisfactory financial performance.

Results obtained from the findings of linear regression test in various models proved that the constant assets index and the return of assets had the most significant impact on financial performance. Then, the combined index of activity return and cash flow had the most significant impact. Makoee et al. study also verified the impact of these indicators on the financial performance (14). Thus, the method of combining the assets with the resources of the UMSHS$_s$ allocated to the defined missions is a key point in improving the financial performance of the UMSHS$_s$.

According to the obtained results, a decrease in the amount of the current and constant assets, dependency on public budget and operational costs should be achieved in order to increase the financial performance and, accordingly, the return of assets. Of course, UMSHS$_s$ have to perform effectively in line with their missions in order to increase the return of assets and the activity index. In other words, the quality of services presented in line with the defined missions should be increased so as to have an increase in profit and effectiveness cost.

Thus, through a logical decrease of the assets volume of the UMSHS$_s$, along with creating an appropriate combination of productive assets, it would be possible to simultaneously decrease the operational costs (especially constant costs) and increase the incomes. Applying these efforts would be supported by the Neo public Management theory in which productivity improvement has been highlighted (15).

To achieve agility in an organization through the above-mentioned objectives, special consideration should be given to implementation of administrative reform in financial-administrative system of the UMSHS$_s$. One of the important required steps would be to change the infrastructures of the UMSHS$_s$ toward decentralization in order to manage their resources and assets more efficiently and effectively. Therefore, developing the cooperative structure of hospitals and a true autonomy of UMSHS$_s$' subunits is recommended.

Conclusion

Currently, most Iranian UMSHS$_s$ do not have high financial performance. This can be due to problems in financial resource management especially in asset combining. Therefore, compilation and execution of a comprehensive program for organizational change and agility with the aim to create a kind of optimized combination of resources and assets is strongly recommended.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or fal-

sification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

References

1. Van Der P, Hoek M (2005). From Cash to Accrual Budgeting and Accounting in the Public Sector: The Dutch Experience. *Public Budgeting & Finance Journal,*25(1): 32-55

2. Connolly C, Hyndman N (2006). The Actual Implementation of Accruals Accounting: Caveats Form a Case within the UK Public Sector. *Accounting, Auditing & Accountability Journal,* 9(2): 272-290.

3. Abouhalaj M, Kazemian M, Ramezanian M (2008*). Achievements, challenges, and perspectives of financing system in health and medication in Iran.* Reports of the Office for Budgeting and Financial Planning at the Ministry of Health and Medical Education, I.R. Iran.

4. Davari M, Haycox A, Walley T *(2005).* Health Care Challenges in Iran. *Iranian J Publ Health,*34: 30-31.

5. The World Health Organization report 2000-*Health systems, improving performance* (2000). World Health Organization, Geneva.

6. Jafari Sirizi M (2009). *The autonomy levels and the patterns of organizational structure reform in district and educational hospitals in Tehran and suggesting the corrective model.* Dissertation for PhD in health ser-

vice management, Tehran University of Medical Sciences [In Persian].

7. Davari M, Haycox A, Walley T (2012).The Iranian Health Insurance System; Past Experiences, Present Challenges and Future Strategies. *Iranian J Publ Health*, 41(9): 1-9.

8. Hafezi R, Abolhallaje M, Ramezanian M (2009). Designing New Financial Management System in Health Sector of Islamic Republic of Iran. *Iran J Publ Health*, 38(1):173-178.

9. Abolhalaj M, Ramazanian M (2011). The experience of Iranian Ministry of Health and Medical Education in health new financial reform. *Health Economics*, 1(1):83-92[In Persian].

10. Babajani J, Madadi A (2009). The possibility of change in accounting system and financial reporting in Iranian public universities. *Accounting and auditing investigations*,16(56):3-20 [In Persian].

11. Damari B, Delavari A, Vosoogh Moghadam A (2007). *Policy document: the review of stewardship in health care system and suggesting interventions.* Coordination assistance of Ministry of Health and Medical Education.

12. Abolhalaj M, Kazemian M, Ramazanian M (2007). *Policy document: the review of health finance system and suggesting the interventions.* The coordination assistance of Ministry of Health and Medical Education [In Persian].

13. Abolhalaj M (2010). *Change principals in public financial system. The first phase: change from cash to accrual accounting.* Sarnevesht Sazan Press [In Persian] .

14. Makooei A, Sajadi SJ (2008). Relative Evaluation of Homogenous Corporations based on Financial Criteria using DEA Method: A Case Study of Automobile Corporations. *Economic Research*, 8 (29): 227-57. Available at: http://www.ensani.ir/storage/Files/20120318131303-1001-18.pdf [in Persian]

15. Duggan M (2004). Does contracting out increase the efficiency of government programme? Evidence from Medicaid HMOs. *Journal of Public Economics*, 88, 2549-72.