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The Efficiency of Clinical Departments in Medical Faculty Hospitals: A Case Study Based on Data Envelopment Analysis

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***Abstract*—**The debts of university hospitals have been increasing recently in Turkey. Thus, they should use their financial resources effectively. The aim of this study is to analyze the technical activities of departments at Adnan Menderes University, Training and Research Hospital, Aydın, Turkey. Data were obtained from the statistical records in 2014. Activities were evaluated with Data Envelopment Analysis (DEA), which is a nonparametric method that allows the use of more than one input and output at the same time. The study comprised three sections. In the first section, expenditure, package deficiencies, and Social Security Institution (SSI) deductions were defined as inputs and income was defined as the output. The Banker, Chames, and Cooper (BCC) model, which aims to minimize inputs, was used in this section. "Orthopedics" was found to be the most effective department. In the second section, faculty members, research assistants, room numbers of policlinics, and bed numbers in services were defined as the inputs; the total number of policlinic patients, total number of patients allocated bed, and income were defined as outputs. In this section, the outcome-focused Charnes, Cooper, and Rhodes (CCR) model, which aims to maximize outcomes, was used. "Emergency" and "Child and Adolescent Psychology" were found to be the most efficient departments. In the third section, faculty members, research assistants, room numbers of policlinics, and bed numbers in services were defined as the inputs; the total number of policlinic patients, total number of patients allocated beds, total operation numbers, and income were defined as outputs. In this section, the CCR model was again used. "Thoracic Surgery" was defined as the most efficient department. At the end of the analyses, reference rates were defined for the inefficient departments.

***Keywords*—**Turkey, Adnan Menderes University, Clinical departments, Health information systems, Data envelopment analysis, Efficiency

I. INTRODUCTION

In recent years, as has been observed in a number of industries, efficiency, productivity, and quality have gained increasing attention from administrations in terms of study. The effective utilization of scarce resources has become a core research subject with a view to enhancing hospital management activities. Owing to its great influence in this area, the Transformation in Health Service Program (THP) has been applied in the Turkish health system since 2003 [1]. Numerous radical reforms have been undertaken since the introduction of Health Transformation Program in 2003 [2, 3]. The most important problems of the healthcare system in Turkey before 2003 were related to access, equality, quality, and efficiency [3]. With the new system, successful regulations have been put in place in relation to health insurance and access to healthcare services, inequalities and inadequacies have been eliminated, and health outcomes have been improved. Thus, Turkey has become an exemplary country in the area of health reform [4, 5].

In addition to their core purpose of providing health services to the public, medical faculty hospitals (MFHs) serve some other purposes. One of these is to supply high-quality and low-cost health services to those potentially in need of such services based on principles of productivity and efficiencies [6]. This target is especially important for MFHs to maintain their research, application, and training activities. In recent years, the costs of hospital services have increased significantly throughout most of the world. Although vast resources are reserved for hospital services globally, it is necessary to develop the resources available and ensure the efficient utilization of resources to increase hospital productivity [7].

Considering that the majority (about 85%) of income of MFHs in Turkey is supplied from their floating capital in comparison to other public hospitals and that they are not by government subsidized, the need to evaluate the efficiency of service clinics, reduce service costs, and increase productivity for hospital administrations is evident. MFHs in Turkey are administered in a similar manner to private, government-

subsidized hospitals. Accordingly, in addition to their own scarce resources, as they can use the income gained in exchange for their services paid for by the government (Declaration on Health Application "SUT" – www.SSI.gov.tr), optimal utilization of these limited resources has become a prominent issue. MFHs collect almost all of their income from the Social Security Institution (SSI). In doing so, hospitals encounter obligatory withholdings and package losses as prescribed by the SUT (www.SSI.gov.tr). Thus, the income collected by MFHs can sometimes be fall below their expenditure for the relevant health service and many MFHs in Turkey declare losses in their end-of-year financial statements.

In this study, conducted to seek solutions to the financial problems of MFHs, the aim was to analyze and compare the efficiency of clinical departments at MFHs with a view to supporting the decision-making process of hospital administrations, ensuring the optimal utilization of available resources, and making optimal investments by means of data envelopment analysis (DEA).

A. Health Care and Data Envelopment Analysis

With regard to the use of resources by hospitals, it is necessary to compare outputs and total data for the estimation of organizational efficiency and productivity [8]. Scherman [9] DEA to evaluate technical productivity and emphasized that the use of this method by hospital administration acquired useful results compared to other methods. Andes *et al.* (2002) also proposed the use of DEA by hospital departments, which are required to undertake measurements to increase their efficiency and ensure more efficient use of their individual resources [10].

Hospitals requiring high expertise, such as MFHs (serving as part of a medical school), have high cost efficiency. Such hospitals serve large groups of people [11]. The greater the level of expertise, the higher the quality of health outcomes required [5]. A study on this has revealed that hospitals specialized in certain fields perform remarkably better than other hospitals. They are not only cost efficient but are also more effective [12]. Moreover, studies have shown that training- and research-oriented hospitals face higher costs than other hospitals [5].

Around the world, it can be observed in the health industry especially that DEA is one of the methods most frequently used to evaluate hospital efficiency, productivity, and financial performance [13]. With the use of DEA, the increases in efficiency that will be attained can be specified by assigning different input–output levels [14].

DEA has been used to compare and contrast the technical productivity of hospitals in Turkey [5]. This technique also provides information concerning the quantity of outputs that should be increased and the quantity of inputs that should be decreased. The findings of a survey carried out on this topic indicate differences in the technical productivity of hospitals affiliated with the Ministry of Health [15]. In particular, it has been emphasized that while university and hospital management make all the necessary investments in medical faculty hospital departments (clinics, human resources, and others), the productivity levels of individual clinics are an important factor in the decision-making process.

B. Data Envelopment Analysis

DEA is a method used for the evaluation of performance of various institutions, such as hospitals, universities, and banks [16]. Performance measurement is conducted to ensure the efficient use of limited resources. Performance levels can be determined based on productivity. Productivity is defined as the proportion of inputs to the outputs of a system; higher rates are desirable as result of these measurements. When a group of departments is considered, a productivity limit can be set; accordingly, the efficiencies of relevant individual departments can be assessed based on this predetermined limit [17].

DEA is an approach that enables the evaluation of the relative efficiency of a decision-making unit (DMU) through the inclusion of multiple inputs and outputs [18]. In the hospital setting, DMUs comprise combinations of clinical departments with the same inputs and outputs, and they have a flexible structure [19]. This method draws on mathematical programing that can handle multiple inputs and outputs, eliminating limitations in the number of such inputs and outputs. This approach, which focuses on limits rather than central tendency measures, is a nonparametric method with no underlying assumptions [16, 18]. The performance values of departments vary in the range of 0–1 in this method, and refer to a degree of efficiency. Departments found to be effective can be investigated comparatively [19]. DEA is capable of determining the inefficient use resources and rates of inefficient departments [17]. In addition, departments that can be role models for inefficient departments can be described [20].

DEA can be conducted based on the Charnes–Cooper–Rhodes (CCR) and Banker–Charnes–Cooper (BCC) models. The CCR and BCC methods can be differentiated from each other based on the assumption of returns to scale. The CCR method assumes fixed returns to scale. That is, according to this method, an increase in an input will result in a proportional increase in the respective output. However, in the BCC method, it is assumed that inputs do not affect outputs in the same proportion [21]. The CCR and BCC methods can be applied as input- or output-focused models. Input-focused DEA aims to minimize input levels based on adequate output levels. Output-focused DEA seeks to increase outputs without the need for more inputs [19].

II. METHOD

A. Type of Research

The research is relational in nature. In such types of research, the relations between two or more variables are evaluated without interfering with these variables [22]. Similarly, in this research, efficiency measurement is conducted based on the existing relations between input and output variables.

B. Population and Sampling

In this research, clinical departments within the Adnan Menderes University Hospital were selected as the population. Detailed information concerning the 43 clinical departments is provided in Appendix 1.

The research was conducted on different variables and different clinic departments by means of three different models. In the first model, 40 out of the 43 clinical departments were used to confer the homogeneity that should be met in DEA. In the second and third models, internal and surgical clinical departments were investigated individually; moreover, clinical department not fulfilling the condition of homogeneity were excluded from the study. The clinical departments included in each model are summarized in Table 1.

Table 1. Clinical Departments Included in the Research

SN	Model 1	Model 2	Model 3
1	Emergency	Emergency	Anesthesia
2	Family Practice	Pediatric Allergy	Neurosurgery
3	Anesthesia	Pediatric Endocrinology	Pediatric Surgery
4	Neurosurgery	Pediatric Gastroenterology	General Surgery
5	Pediatric Allergy	Pediatric Diseases	Thoracic Surgery
6	Pediatric Surgery	Pediatric Hematology and Oncology	Ophthalmic Diseases
7	Pediatric Endocrinology	Pediatric Cardiology	Gynecological Diseases
8	Pediatric Gastroenterology	Pediatric Nephrology	Cardiovascular Surgery
9	Pediatric Diseases	Pediatric Neurology	Otorhinolaryngology
10	Pediatric Hematology and Oncology	Pediatric and Adolescent Psychiatry	Orthopedics
11	Pediatric Cardiology	Neonatology	Plastic Surgery
12	Pediatric Nephrology	Dermatology	Urology
13	Pediatric Neurology	Endocrinology	
14	Pediatric and Adolescent Psychiatry	Infection	
15	Neonatology	Physical Medicine and Rehabilitation	
16	Dermatology	Gastroenterology	
17	Endocrinology	General Internal Medicine	
18	Infection	Pulmonary Diseases	
19	Physical Medicine and Rehabilitation	Hematology	
20	Gastroenterology	Immunology-Rheumatology	
21	General Surgery	Cardiology	
22	General Internal Medicine	Nephrology	
23	Thoracic Surgery	Neurology	
24	Pulmonary Diseases	Oncology	
25	Ophthalmic Diseases	Psychiatry	
26	Hematology		
27	Immunology-Rheumatology		
28	Gynecological Diseases		
29	Cardiovascular Surgery		
30	Cardiology		
31	Otorhinolaryngology		
32	Nephrology		
33	Neurology		
34	Nuclear Medicine		
35	Oncology		
36	Orthopedics		
37	Plastic Surgery		
38	Psychiatry		
39	Radiology		
40	Urology		

From Table 1, it can be observed that the Genetic, Pathology, and Forensic Medicine clinical departments were excluded from the first model. These clinical departments are not subject to obligatory SSI withholdings or package loss due to the nature of their services. In the second model, several internal medicine departments were excluded, namely the Genetic, Nuclear Medicine, Pathology, Radiology, Forensic Medicine, and Family Practice clinical departments. As these clinical departments do not provide services and (except the Radiology department) they do not accept polyclinic patients, they were excluded to ensure homogeneity in the study. In the third model, all surgical departments were included.

C. Data Collection

The data sets were built based on information obtained from the Adnan Menderes University Hospital in 2014. There were three separate data sets in the research. The first included the "Expenditure," "SSI Withholding" and "Package Loss" variables; the second and third data sets differed in terms of the inclusion of the "Number of Surgical Operations" variable (only in the third set). Besides the inclusion of this variable in the third set, both data sets included "Expenditure," "Number of Faculty Members," "Number of Assistant," and "Number of Rooms in Polyclinics," and "Number of Beds in Service" as inputs; "Number of Patients in Polyclinics," "Number of Inpatients," and "Income" were included as output variables. The input and output variables included in each data set are summarized in Appendix 2.

The first model includes 40 DMUs, with 4 input and output variables; the second model incorporates 25 DMUs, with 8

input and output variables; the third model encompasses 12 DMUs, with 9 input and output variables. According to Boussofiane *et al.* (1991), to ensure the reliability of the study, the minimum number of DMUs for *m* inputs and *n* outputs is m+n+1 [23] (Erpolat, 2011). Thus, the number of DMUs used in the study was adequate.

D. Data Analysis

The data obtained were analyzed in EMS 1.3 software. The input-oriented BCC method was used for the first model, and the output-oriented CCR method, which seeks the maximization of outputs using same amount of inputs and relies on the assumption of fixed returns, was used in the second and the third models.

III. FINDINGS

The study investigated the efficiency of clinical department using three different models composed of different inputs, outputs, and DMUs. The results for the first (BCC) model, which aims to minimize inputs while maintaining the same output level and assumes variable returns, are summarized in Table 2.

Table 2. Results for Model 1

SN	DMU	Score (%)	Criteria
1	**Orthopedics**	**Big**	**1**
2	**Oncology**	**231.00**	**0**
3	**Hematology**	**100.79**	**0**
4	Neurosurgery	63.42	1 (.08), 5 (.92)
5	**Anesthesia**	**592.06**	**9**
6	Cardiovascular Surgery	57.10	5 (.52), 10 (.48)
7	Emergency	63.29	5 (.48), 10 (.52)
8	General Surgery	54.27	5 (.45), 10 (.55)
9	Cardiology	56.00	5 (.31), 10 (.69)
10	**Radiology**	**436.26**	**25**
11	Neurology	57.12	10 (.72), 30 (.28)
12	Pediatric Neonatology	72.86	10 (.72), 30 (.28)
13	Physical Medicine and Rehabilitation	58.86	10 (.70), 30 (.30)
14	Nephrology	56.07	10 (.49), 30 (.51)
15	Pulmonary Diseases	50.23	10 (.48), 30 (.52)
16	Gastroenterology	60.55	10 (.46), 30 (.54)
17	Nuclear Medicine	88.70	10 (.53), 30 (.47)
18	Urology	51.73	10 (.40), 30 (.60)
19	Gynecological Diseases	47.34	10 (.37), 30 (.63)
20	Otorhinolaryngology	65.61	10 (.34), 30 (.66)
21	Ophthalmic Diseases	77.50	10 (.31), 30 (.69)
22	Endocrinology	62.04	10 (.28), 30 (.72)
23	Plastic Surgery	53.19	10 (.18), 30 (.82)
24	Infection	40.23	10 (.13), 30 (.87)
25	Immunology-Rheumatology	46.93	10 (.12), 30 (.88)
26	Pediatric Allergy	59.84	10 (.10), 30 (.71), 40 (.19)
27	Pediatric Diseases	51.65	5 (.06), 30 (.72), 37 (.22)
28	Pediatric Hematology and Oncology	50.41	10 (.17), 30 (.25), 37 (.01), 40 (.57)
29	Pulmonary Surgery	39.08	10 (.13), 30 (.38), 40 (.49)
30	**Psychiatry**	**127.75**	**23**
31	Pediatric Nephrology	54.22	10 (.04), 30 (.77), 40 (.19)
32	Dermatology	52.27	30 (.81), 37 (.19)
33	General Internal Medicine	41.47	5 (.01), 30 (.61), 37 (.38)
34	Pediatric Neurology	64.31	10 (.09), 30 (.03), 37 (.65), 40 (.22)
35	Pediatric Surgery	37.96	10 (.03), 30 (.50), 40 (.48)
36	Pediatric Endocrine	87.57	5 (.02), 37 (.49), 39 (.49)
37	**Pediatric and Adolescent Psychiatry**	**246.46**	**7**
38	Pediatric Cardiology	90.40	5 (.00), 37 (.56), 39 (.44), 40 (.01)
39	**Pediatric Gastroenterology**	**111.62**	**2**
40	**Family Practice**	**420.36**	**8**

From Table 2, it can be observed that Orthopedics, Oncology, Hematology, Anesthesia, Radiology, Psychiatry, Pediatric and Adolescent Psychology, Pediatric Gastroenterology, and Family Practice were found to be relatively effective. The most effective clinical department was Orthopedics (Big); the least efficient was Pediatric Surgery (37.96%). For ineffective clinical departments, reference effective clinical departments were identified. Accordingly, Orthopedics was referenced to 1 clinical department, Anesthesia to 9, Radiology to 25, Psychiatry to 23, Pediatric and Adolescent Psychology to 7, Pediatric Gastroenterology to 2, and Family Practice to 8. Thus, to enhance the efficiency of Pediatric Surgery (lowest efficiency), it will be necessary for this clinical department to take as its reference Radiology (3%), Psychiatry (50%), and Family Practice (48%). To bring clinical departments with efficiency levels below 100% up to an efficient level, the necessary reduction rates in inputs and increment rates in outputs are presented in Appendix 3.

When the results regarding increments in outputs and reductions in inputs are considered, to enhance the efficiency of Pediatric Surgery, a relatively inefficient clinical department, it would be necessary to reduce SSI withholding by 90.69%. To enhance the efficiency of Cardiovascular Surgery and bring it up to the desired level, it would be necessary to increase income by 0.02% and to reduce expenditure by 0.01%, package loss by 22.64%, and SSI withholding by 65.93%.

In model 2, concerning internal medicine clinical departments, the input was "Total Number of Patients in Polyclinics," and the outputs were "Total Number of Inpatients" and "Income." The results of the CCR method used in model 2, which aims to maximize outputs and

employs the assumption of fixed returns, are summarized in Table 3.

Table 3. Results for Model 2

SN	DMU	Score (%)	Criteria
1	**Emergency**	**0.00**	**5**
2	**Pediatric Allergy**	**99.28**	**2**
3	**Pediatric Endocrine**	**91.99**	**1**
4	Pediatric Gastroenterology	122.44	2 (.01), 7 (.15), 13 (.14)
5	**Pediatric Diseases**	**83.35**	**0**
6	Pediatric Hematology and Oncology	106.79	8 (.53), 20 (.02), 24 (.07)
7	**Pediatric Cardiology**	**89.80**	**1**
8	**Pediatric Nephrology**	**60.36**	**4**
9	**Pediatric Neurology**	**98.59**	**0**
10	**Pediatric and Adolescent Psychiatry**	**0.00**	**3**
11	**Neonatology**	**74.24**	**5**
12	**Dermatology**	**30.93**	**5**
13	**Endocrinology**	**60.47**	**4**
14	Infection	141.12	1 (.13), 10 (.02), 11 (.29), 12 (.22), 19 (.01)
15	Physical Medicine and Rehabilitation	106.33	1 (.28), 10 (.16), 11 (.17), 12 (.40), 13 (.24), 19 (.11)
16	Gastroenterology	101.51	11 (.14), 13 (.54), 19 (.15)
17	General Internal Medicine	117.52	3 (.60), 8 (.74), 12 (.09)
18	Pulmonary Diseases	123.63	1 (.16), 2 (.20), 8 (.35), 11 (.30), 12 (.09), 19 (.10)
19	**Hematology**	**64.51**	**6**
20	**Immunology-Rheumatology**	**76.06**	**2**
21	Cardiology	106.94	1 (.12), 8 (1.22), 19 (.23), 20 (.38), 24 (.16)
22	**Nephrology**	**60.50**	**0**
23	Neurology	118.91	1 (.12), 10 (.34), 11 (.55), 12 (.02), 13 (.57), 19 (.06)
24	**Oncology**	**30.48**	**2**
25	**Psychiatry**	**72.46**	**0**

As can be seen in Table 3, a number of clinical departments were found to be relatively effective, as follows: Emergency, Pediatric Allergy, Pediatric Endocrinology, Pediatric Diseases, Pediatric Cardiology, Pediatric Nephrology, Pediatric Neurology, Pediatric and Adolescent Psychology, Neonatology, Dermatology, Endocrinology, Hematology, Immunology-Rheumatology, Nephrology, Oncology, and Psychiatry. The most effective clinics were Pediatrics and Adolescent Psychology (0.00), and Emergency (0.00); the least efficient was Infection (141.12%). For inefficient clinical departments, reference efficient clinical departments were identified. Hence, Emergency was referenced to 5 departments, Pediatric Allergy to 2, Pediatric Endocrinology to 1, Pediatric Cardiology to 1, Pediatric Nephrology to 4, Pediatric and Adolescent Psychology to 3, Neonatology to 5, Dermatology to 5, Endocrinology to 4, Hematology to 6, Immunology-Rheumatology to 2, and Oncology to 2. Thus, to bring Pulmonary Diseases (the second least effective department relatively) to an efficient level, it would be necessary for it to reference Emergency (16%), Pediatric Allergy (20%), Pediatric Nephrology (35%), Neonatology (30%), Dermatology (9%), and Hematology (10%). Appendix 4 presents the necessary reductions in inputs and increments in outputs to bring clinical departments with efficiency levels below 100% to the required level.

Considering the results regarding outputs necessitating increment and inputs necessitating reduction, to bring Infection (the least efficient department relatively) to an efficient level, it would be necessary to reduce the "Number of Faculty Members" by 2.37% and to increase the "Total Number of Patients in Polyclinics" by 95.78%. To bring General Internal Medicine to a relatively efficient level, it would be necessary to reduce the "Number of Faculty Members" by 0.35%, the "Number of Assistants" by 19.63%, and the "Number of Beds in Service" by 4.48%; while increasing "Income" by 49.24%.

The results for model 3, conducted by means of the output-oriented CCR method, which aims to maximize outputs, are presented in Table 4.

Table 4. Results for Model 3

S.N	DMU	Score (%)	Criteria
1	**Anesthesia**	**62.84**	**0**
2	**Neurosurgery**	**40.22**	**0**
3	Pediatric Surgery	103.69	6 (.14), 8 (.08), 12 (.03)
4	**General Surgery**	**87.67**	**0**
5	**Thoracic Surgery**	**0.00**	**0**
6	**Ophthalmic Diseases**	**31.32**	**2**
7	Gynecological Diseases	105.52	6 (.13), 9 (.30), 12 (.75)
8	**Cardio Vascular Surgery**	**19.57**	**1**
9	**Otorhinolaryngology**	**62.65**	**1**
10	**Orthopedics**	**56.04**	**0**
11	**Plastic Surgery**	**88.33**	**0**
12	**Urology**	**71.38**	**2**

It can be observed that Anesthesia, Neurosurgery, General Surgery, Thoracic Surgery, Ophthalmic Diseases, Cardiovascular Surgery, Otorhinolaryngology, Orthopedics, Plastic Surgery, and Urology were relatively effective. The most effective clinic was Thoracic Surgery (0.00); the least effective clinic was Gynecological Diseases (105.52%). Effective references were determined for inefficient clinical departments. Accordingly, Ophthalmic Diseases was referenced to 2 department, Cardiovascular Surgery to 1, Otorhinolaryngology to 1, and Urology to 2. To bring Gynecological Diseases (the most inefficient department) up to an efficient level, it would be necessary for it to refer to Ophthalmic Diseases (13%), Otorhinolaryngology (75%), and Urology (30%). To bring clinical departments with an efficiency level in excess of 100% to an effective level, necessary reduction rates in inputs and increments in outputs are summarized in Appendix 5.

According to appendix 5, to bring Gynecological Diseases (the most inefficient department) to an efficient level, it would necessary to reduce "Expenditure" by 0.01%, the "Number of Faculty Members" by 0.55%, the "Number of

Assistants" by 2.30%, and the "Number of Beds in Service" by 15.32%, as well as increasing the "Total Number of Surgical Operations" by 28.64% and "Income" by 89.71%. To bring Pediatric Surgery (the second most inefficient department) to an efficient level, it would be necessary to decrease the "Number of Faculty Members" by 2.52%, the "Number of Assistants" by 0.15%, and the "Number of Beds in Service" by 3.52%, and to increase "Income" by 48.04%.

IV. RESULTS

In this study, the efficiency of clinical departments of an MFH was estimated by means of DEA, extensively applied in the health industry. Based on three different perspectives, all clinical departments were taken into consideration. In the first model, which employed the BCC model and used "Expenditure," "Package Loss," and "SSI withholding" as inputs, and "Income" as the output, it is important to note that Orthopedics (Big) was the most effective department and Pediatric Surgery (37.96%) was the least effective department. The analysis applied across the hospital revealed the need for the optimization of input–output factors in each clinical department, and especially the need to investigate the most inefficient clinical departments in relation to effective clinical departments.

Based on this investigation, it must be emphasized that the input and output factors of efficient departments can provide good examples for other departments because the rules apply to all departments in MFHs as mandated by the Ministry of Health. In addition, the results reveal that hospital administrations need to make amendments to input variables at the hospital level, rather than outputs. For instance, to bring the efficiency of Pediatric Surgery up to an acceptable level, SSI withholding must be reduced by 90.69% and to develop the efficiency of Thoracic Surgery so that it is at an acceptable level, SSI withholding must be reduced by 29.47%. Moreover, to do the same for Cardiovascular Surgery, income must be increased by 0.02% and expenditure must be reduced by 0.01%, package loss by 22.64%, and SSI withholding by 65.93%. Viewed in terms of the management model, inputs are the process components concerning which managers can predominantly use their administrative functions.

In model 2, considering the analyses conducted on internal medicine clinical departments using the output-oriented CCR method, aiming to maximize "Total Polyclinics," the "Number of Patients," the "Total Number of Inpatients," and "Income," it was determined that the most effective clinical departments were Pediatric and Adolescent Psychology (0.00) and Emergency (0.00); the least efficient department was Infection (141.12%). To bring the Infection clinical department up to an acceptable efficiency level, it must look to Neonatology and Dermatology as reference departments (29% and 22%, respectively). In addition, the fact that it is necessary to decrease the "Number of Faculty Members" by 2.37% and to increase the "Total Number of Patient in the Polyclinic" by 95.78% to increase efficiency to an acceptable level directly concerns the decisions of hospital managers. Consequently, all these results suggest that efficient clinical departments provide services to more patients with fewer personnel in comparison with the Infection clinic.

In the final approach, the analysis conducted on Surgical Medicine by means of the output-oriented CCR method, considered the need to maximize "Total Polyclinic" numbers, "Number of Patients," "Total Number of Inpatients," "Total Number of Surgical Operations," and "Income." According to the results, it was determined that the most effective department was Thoracic Surgery (0.00%), and the most inefficient department was Gynecological Diseases (105.52%). To increase the efficiency of Gynecological Diseases to an acceptable level, it must take Urology as reference (75%). To bring its efficiency levels within an acceptable level with respect to its relations between inputs and outputs, it was observed that would be necessary to decrease the "Number of Beds" by 15.32% and increase the "Total Number of Surgical Operations" and "Income" by 28.64% and 89.71% respectively. A reduction in the "Number of Beds" would mean that the department would perform more surgical procedures using fewer beds and would collect more income from its services. These results constitute significant data that can be used to support the decision-making process of hospital management and potentially university administration boards.

V. DISCUSSION

Increases in the expenses of the health sector have compelled hospitals to evaluate their levels of efficiency. Hospitals could take precautions by identifying the inputs to be reduced and outputs to be increased [24]. An important point in increasing the financial performance of hospitals is not wasting resources. In this regard, in their study of public and private hospitals, Erdoğan and Yıldız (2015) indicated that sufficient staff should be employed, fixed expenses should be tracked, stocks should be managed, and the costs of raw materials should be reduced. Moreover, they suggested that patient satisfaction should be attained, income-generating treatment units should be established, and staff should be trained [25]. The results of this study are analogous with those of Erdoğan and Yıldız's (2015) study. According to the findings, the number of staff should be decreased in certain departments and expenditures, package loss, and deductions should be reduced.

As with the comparison of hospitals, departments can be compared, and thus managers can generate strategies for improvement [24]. At this point, it is significant that hospital managers have the necessary knowledge and skills to interpret the financial data. Furthermore, hospitals should carry out constant analysis and reports to define their future financial outlook [25]. DEA could be used in this decision-making

process. However, it should be borne in mind that DEA provides a relative figure and does not offer absolute efficiency criteria/measures.

VI. CONCLUSION

The reliability of parametric and non-parametric efficiency estimators is important for decision-making processes within the framework of health policy. Researchers and policymakers must be aware of the limitations of these techniques used for measuring productivity in the health industry, drawing on massive amounts of data. However, these studies can be a valuable resource in providing evidence for international comparison of policy if conducted rigorously [13].

In today's world, the effective allocation of scarce resources is of great importance. This study provides insights and essential information for MFH hospital managers and policymakers. As suggested in Girginer *et al.* (2015), the findings of this research could contribute to enhancing the efficiency of hitherto inefficient clinical departments [26]. Taking the significance of this subject for MFHs and health policies, particularly given the scarcity of resources, into consideration, measures establishing the efficiency of individual clinical departments will ultimately provide information on the overall efficiency of the hospital concerned. This will make it possible to consider the overall efficiency of the health industry as a whole. In studies conducted on clustered hospitals in different countries and in different geographical regions, DEA has exhibited variations in findings [27]. This study can be further expanded by territorial and country-wide research based on a clustering approach for clinical departments and local hospitals. The results of the study can be confirmed by applying the reasoning adopted here to different hospitals. Moreover, guidance for structuring the general health policies of countries must be investigated.

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