Original Study

Measuring the efficiency among secondary and university pulmonary hospital clinics in Greece

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Key words:
- pulmonary clinics
- efficiency measurement
- hospital
- DEA
- Greece

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SUMMARY. BACKGROUND: The need for efficient use of healthcare resources intensifies in times of economic recession and budgetary constraints. **AIM:** The scope of this study is to measure the efficiency among secondary and university pulmonary clinics operating in two public hospitals located in different geographical regions in Greece. **MATERIAL & METHODS:** The method of analysis used is the Data Envelopment Analysis (DEA). Efficiency models were developed using as inputs the medical and nursing staff and the number of beds in use, and as outputs the number of visits to outpatient clinics, the number of patients and the hospitalisation days, in 2012. **RESULTS:** The comparative analysis of the university clinics in the two hospitals indicated that both are operating fully efficiently. Out of the 11 secondary clinics, nine (9) showed a positive efficiency, out of which seven (7) were fully efficient achieving the maximum score. Regarding the comparison of all pulmonary secondary and university clinics, positive results were observed, with seven (7) out of the thirteen (13) clinics achieving efficient scores. Out of these, four (4) clinics, three in the secondary hospital of the 1st region and one in the university hospital of the 2nd region were fully efficient, scoring is 1.00. **CONCLUSIONS:** Ensuring efficiency gains with evidence-based studies from the hospitals' or/and clinics' perspective, using technical performance measurement tools such as DEA, is contributing to a better assessment of health systems performance. ***Pneumon 2014, 27(1):31-36.***

INTRODUCTION

At a time of cuts in public expenditure and the on-going evaluation for the restructuring of public services, hospitals' efficiency assessment and the optimisation of services have been targeted as priority in Greece. Measuring efficiency may be used to analyse the feasibility of a policy of which the

main objective will be to streamline the use of available resources. The assessment is an integral and important part of the planning, organisation and management process of each service or health system (Geitona, 2001). Greece is currently facing a financial crisis which imposes a need to assess the performance of the NHS hospitals.

The field of economics provides a variety of methodological tools for the analysis of efficiency. A widely used mathematical method which evaluates the efficiency is the Data Envelopment Analysis (DEA) (Hollingsworth 2003, 2008). The purpose of this study is to assess the efficiency among university and secondary pulmonary clinics operating in two public hospitals in Greece in the year 2012, by applying DEA methodology. The findings of such studies can provide information to hospital managers and policy makers on efficient and not efficient performance of the clinics or hospitals.

METHOD - MATERIAL

Literature review

Efficiency

Efficiency assessment is based on the Pareto optimisation, i.e. how can an organisation or a health system achieve the desired objectives for given resources (Chacholiades, 1990). Thus, efficiency measurement is the main tool for controlling the allocation of human and financial resources (Farrell, 1957). The degree of utilisation of the available resources have to meet the demand for the health services and to ensure the efficiency of health services (Farrell, 1957; Brown and Popkin 1962; Lovell, 1993; Grosskopf, 1993; Hollingsworth 2003 and 2008). Efficiency can be understood in the context of how human resources are using the available technology to produce one unit of output compared to the existing capacity of beds (Ganley and Cubbin, 1992; Palmer and Torgerson, 1999). The measurement of efficiency is related to the measurement of productivity. In the provision of health services, the study of productivity focuses on the production of health output by the use of the resources of the system (Yfantopoulos, 2003), whereas efficiency includes the assessment of the overall organisation of the production process; this contributes to improving basic economic, administrative and clinical parameters (Hollingsworth, 2008). Therefore, the use of both concepts can be considered appropriate as an assessment tool in the health sector as well, given that the provision of health services includes social implications and characteristics of a public or semi-public good (Greenwald and Stiglitz, 1992).

This study evaluated the technical efficiency defined as the achievement of a specified quantity of health product (e.g. a specific number of patients examined) using the minimum input to physical units (e.g. with the minimum use doctors or nurses), or the maximum quantity of product using a given quantity of inputs (Fare, Grosskopf and Lovell, 1985; Norman and Stoker, 1991; Ganley and Cubbin, 1992). The technical efficiency measures the extent of achieving the greatest possible number of services with the available resources in a hospital. The aim is to assess whether a hospital or a clinic can offer the maximum number of diagnosis, treatment, teaching, research and other services, building upon the existing buildings and machinery, human resources and the available materials (Ganley and Cubbin, 1992).

DEA

DEA is based on the analysis of the activities of an organisation or service and is reported in the international literature as the most popular technique to measure efficiency (Emrouznejad and Thanassoulis 1997; Seiford, 1996, Cook and Seiford, 2009). It is a non-parametric methodology, which uses less limiting assumptions and qualifies as conclusive (deterministic) since explicit probabilistic cases are not made clear (Charnes et al, 1994). DEA measures the level of efficiency of an organisation with the Resolution Linear equations, which allow for either maximum outputs or minimum inputs. If the results of the analysis reveal that a hospital or a clinic is not efficient, this means it can improve efficiency either by reducing the outputs, by using an input — oriented model, or by increasing the outputs with the use of the output-oriented model. Charnes, Cooper and Rhodes (1981) define efficiency according to the selected model orientation:

I. On an output oriented model, the DMU (decision making unit) may not be efficient if for each increase of the production level there is no increase in input or vice versa.

II. On an input oriented model, the DMU cannot be efficient if for each reduction of input there is no reduction of output.

DEA is used in models for measuring the efficiency of multiple inputs and outputs, such as multiple health units. DEA does not assume the existence of a relationship between the inputs and outputs of a production process of products or services (Athanassopoulos, 1995; Podinovski and Athanassopoulos, 1998; Podinovski, 2004; Prezerakos et al, 2007). The inputs and outputs may be expressed in completely different units of measurement. It is used for

measuring the "relative" efficiency, i.e. efficiency of a unit in relation to other comparable units. In cases where a unit may improve performance and becomes efficient, relative efficiency of the other unit does not change. The best score of DEA is 1.00 and more than 0.90 can be considered a fully efficient operation of the unit under evaluation.

Methodology

This study aims to measure the efficiency of pulmonary clinics in hospitals between two public hospitals located in different geographical regions. The method of analysis used is the DEA. The DEA model used was output oriented with constant returns to scale (CRS). Display of the border efficiency can be supported by the hypothesis of CRS. Charnes, Cooper and Rhodes, (1978) proposed the DEA model inputs calibrated to assuming fixed efficiency (CRS). The CRS assumption is appropriately used when the DMU operate at the optimum scales. The indicators used as inputs were the medical doctors, the nursing staff and the number of beds. Outputs involved the number of visits to outpatient care, the number of patients and the number of hospitalisation days for the year 2012. In particular, 3 models were created, the first one was performed by using the university pulmonary clinics, the second by using the secondary clinics and third by using all the pulmonary clinics (secondary and university).

Data was collected from clinics of the hospitals. In the two hospitals of the two regions 11 pulmonary secondary clinics and two university clinics were assessed. The total number of beds was 469, out of which 64 are university beds. The number of medical doctors was 62 consultants and 134 doctors getting their specialty in the field, out of which 11 consultants and 23 doctors getting their specialty were working for the university clinics. The number of nurses was 190, out of which 33 were working in the university clinics.

Regarding the outputs used for the secondary pulmonary clinics for 2012, the total number of hospitalised patients was 17.314, accounting for 115.788 hospitalisation days and 8.327 patients seeking outpatient care. Concerning university pulmonary clinics for all hospital admissions for 2012, 4.270 were hospitalised patients; 24.315 were the hospitalisation days and 5.745 were patients seeking outpatient care.

Results

The number of medical and healthcare personnel remained stable over the period under analysis. Differences were observed in the outputs with regards to the patients examined in the outpatient care for the year 2012. When comparing the two university pulmonary clinics, little difference was observed in the efficiency outcomes. In particular, the model has shown that the university clinic of the hospital of the 2nd region achieved a top score of 1.00 with a fully efficient operation compared to the corresponding university hospital of the 1st region which was very close to a fully efficient performance (Figure 1). The results of the analysis indicated that the better performance of the university pulmonary clinic of the 2nd region is linked to the use of human resources working for the clinic (Table 1). It should be noted that the measurements were obtained by observing the ratio between the available human resources and the visits to outpatient care or the number of hospitalised persons and/or days hospitalisation.

Regarding the internal comparative results of the secondary pulmonary clinics of the hospital in the 1st region, nine (9) out of eleven (11) showed positive efficiency (0.90 to 1.00) out of which seven (7) were fully efficient achieving the highest score 1.00 (Figure 2). However, there were two (2) clinics which showed inefficiencies (<0.90) due to lack of rational use of their inputs. Given the great experience of the provision of health care of clinics of the hospital in the 1st region, it is possible to improve inefficiencies, either by finding another model of allocating the available human resources – e.g. making staff available to more than one clinic - or/and by admitting the patients to the pulmonary clinics of the same hospital that have the most available resources at the time, such as available beds and/or staff.

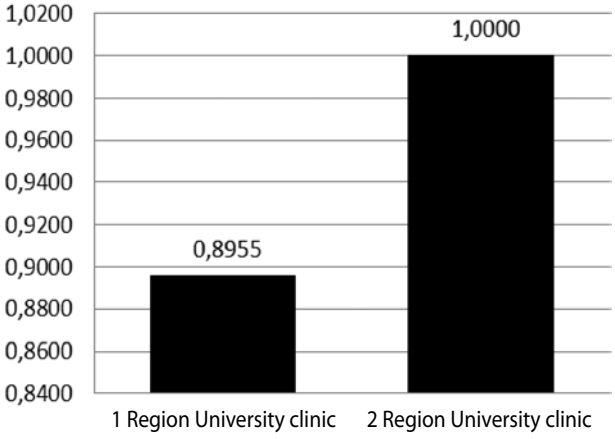

FIGURE 1. Efficiency of university pulmonary clinics.

TABLE 1. Proportion of patients per medical and nursing staff of pulmonary university clinics

Hospitals in different Regions	No of patients per doctors consultants	No of patients per doctor including consultants and getting their specialty	No of patients per doctor (including all medical and nursing staff)	No of out-patient patients (including all medical and nursing staff)
Region 1	343	104	55	48
Region 2	466	169	77	152

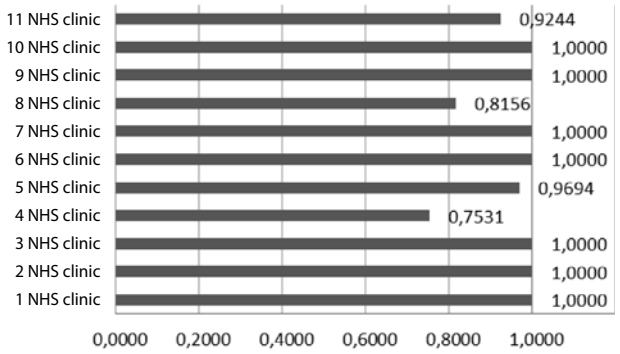

FIGURE 2. Efficiency of secondary pulmonary clinics.

With respect to the comparison of all pulmonary clinics (secondary and university), positive results were shown, with seven (7) out of the thirteen (13) clinics operating efficiently. Out of these, four (4) clinics - i.e. the university pulmonary clinic of hospital of the 2nd region and three secondary pulmonary clinics of the hospital of the 1st region – were fully efficient by scoring 1.00 (Figure 3).

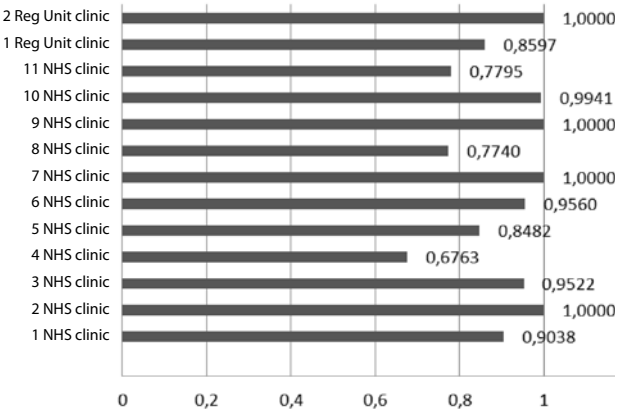

FIGURE 3. Efficiency of secondary and university pulmonary clinics.

Discussion — Conclusions

The benchmarking of pulmonary clinics aims to reveal the factors which contribute to efficient or inefficient behaviours. Decision and policy makers can evaluate public hospitals through empirical analysis of measuring the efficiency of the clinics. The main conclusion drawn from this analysis is that most of the pulmonary clinics under study operate efficiently. This finding is of great importance, because it shows on the one hand, that patients' health needs in both regions are efficiently met, and on the other hand demonstrates that the allocation of the human and financial resources is handled efficiently. It can be assumed that the efficient use of human resources may be the leading factor affecting efficiency, due to the fact that it really affects the outputs, such as the number of admitted patients in the outpatient wards and the number of hospitalisation days. With regards to the inefficient clinics, there is an important need for changes aimed at the efficient operation of pulmonary clinics. This could be achieved by increasing the outputs parallel to the increase of inputs, as has been already suggested by the Charnes, Cooper and Rhodes (1981).

The small dominance of the university hospital of the 2nd region over the hospital of the 1st region , confirms that the location of the clinic efficiently covers the needs of the relevant demand for tertiary care in the region. However, it could be argued that the existence of a single university hospital in the 2nd region, is attracting the population compared to the university clinic of the 1st region and therefore has an impact on its efficiency. The analysis of the data shows that this claim is not the case, because despite the high demand for outpatient care in the university hospital of the region, only a small number of cases have been hospitalised. This study can provide an evidence-based picture of the efficient use of human resources, the high level of efficiency of the university clinic and could simultaneously provide a model for proper management of fully efficient patients flow.

This study is the first empirical attempt to measure the efficiency of pulmonary clinics (university and secondary hospitals) between two different health regions in Greece. The fact that the use of the DEA model was based on detailed data of the health regions may be considered as a comparative advantage in relation to

the respective Greek studies. The selection of one year evaluation (2012) could be considered a methodological limitation, especially in view of the economic crisis coincidence. Moreover, this could reasonably refer to findings with important research outcomes, since a comparative analysis would provide a possible impact for greater availability of financial resources, which are linked to the human resources and health technology. It could be mentioned that additional data – such as indicators for evaluating the quality of the health services provided and the personalised healthcare linked to the scarce resources – would have been of added value to the outcomes of this study. However, the absence of relevant analytical data at a clinical and hospital level in the country, remains the major barrier of conducting such a study. Also, an additional methodological limitation could be indicated regarding the design of the third model of the analysis, i.e. running DEA for evaluating the efficiency of the university and the secondary clinics together; this is due to the fact that the diversity of the additional roles of the university clinics (educational, research scope and the specialised nature of the work) may have led to differentiation of the results. However, the results of the present analysis indicated that the clinics were not affected by the diversity of the type of hospitals, since seven (7) clinics were efficient, four (4) were fully efficient scoring 1.00, out of which one (1) was a university clinic and three (3) were secondary clinics.

It should be noted that the conclusions of this study are similar with the findings of other studies carried out in Greece (Maniadakis et.al, 2007; Androutsou et al. 2012; Geitona et al. 2013). Although the abovementioned studies have identified clinics with the highest efficiency scores (score = 1.00), inefficient clinics scoring less than 0.90 were also presented, and it was proposed that reallocation of resources combining reforms aiming at fiscal consolidation may achieve excellent performance of the clinics and hospitals as a whole.

The efficiency was measured in this paper as an evaluation model and does not concern the choice and accuracy of diagnoses and/or treatments or even the degree of patient satisfaction by the health services providers. It was a mathematical model assessing the efficient way of using the resources available without evaluating the quality of the clinical outcomes and patient satisfaction of the treatment.

Given the unfavourable economic situation and the lack of an evaluation of the administrative procedures in the country, there is an apparent need to introduce innovative managerial tools in public hospitals. In particular, in the context of implementing the proposed measures, the need for reforms aimed at achieving efficiency, effectiveness and social justice is vital. Therefore, the introduction of systematic performance techniques and processes, such as the DEA, can be the way forward, and is recently being explored as an option by the World Health Organisation (WHO). In the coming years techniques using evaluations with additional criteria of efficiency, clinical efficacy, cost effectiveness, quality of life and quality health services indicators, can attribute to more efficient providers and health care systems.

Comparative analysis as this one can result in the assessment, redesign and restructuring of health services, allocation and investment of the human resources to achieve the maximum capacity at clinical level, and the maximum use of resources available. Studies as these can form the bases for structuring reforms which aim at saving resources, such as the recent ministerial proposals on merging public hospitals. Therefore, the measurement of efficiency plays a very important role for the evaluation of the management of resources and the policy interventions in health. At a regional level, the assessment of the hospitals and in particular of clinics on an annual basis, can contribute to the creation of epidemiological, clinical and socio-economic data necessary for the assessment of the performance of the health units. Such data can strengthen the development of a national strategic plan for public health with efficient public health services.

In conclusion, the study revealed that this empirical analysis and in particular the comparative assessment of the efficiency of clinics and hospitals, can be a key component of an overarching regional policy framework. Simultaneously, it is confirmed that the use of such techniques can prove to be a modern, reliable and transparent evaluation tool, not only for the public health facilities but also for the whole public administration.

The economic crisis is a challenge for health, leading to increased demand and reduced resources for health care sectors. Therefore, similar studies may become an evidence based tool for maintaining and improving health care providers' performance.

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