Efficiency of Health Centres Groups (ACES) in Lisbon and Tagus Valley: An approach with Data Envelopment Analysis

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December 5, 2012

Abstract

In the past few years, the Portuguese Primary Health Care has suffered many developments. An example of particular importance is the creation of the ACES. However, given the current situation of our country, there is an extra need to evaluate the ACES productive behavior, i.e., its efficiency, and also its quality and equity. In this research, based on data envelopment analysis (DEA), the main objective was to evaluate the efficiency of the 22 ACES of Lisbon and Tagus Valley, with data from 2009 and 2010. 4 DEA models: medicine, nursing, global and global with total costs, were applied with three different orientations, used in connection with both constant and variable returns to scale. To study the horizontal equity based on the NUTS III, the efficiency and the percentage of patients without a designated doctor were evaluated regarding the 5 NUTS III. These tests suggest that there is no evidence of relevant differences in efficiency and percentage of patients without a designated doctor, concluding that there is horizontal equity regarding the NUTS III. Moreover, the ratio between the complaints and the total activity was used to study the quality of services. Finally, an order-m analysis was used to examine the influence of environmental variables on the efficiency, which might reflect differences in the efficiency of primary care organization. This research reveals that, with a better usage of the available resources, there is room for efficiency improvement of ACES, maintaining their quality and equity.

Keywords: Data envelopment analysis (DEA), Health Centres Groups (ACES), Primary Health Care, Order-m, Quality, Equity of access

1 Introduction

The healthcare is one of the most important areas for the citizens and where the countries spend more resources. In 2009 it was estimated that the waste of financial resources with the Portuguese Health System was about 25% of the amount allocated to health [1]. Furthermore, it has been observed an increase on health expenses, both public and private. The growth rate of these expenses even exceeded the growth rate of the GDP [2]. These situations have created a constant concern about the sustainability of the Portuguese health system, and it becomes necessary to promote the efficiency, by adapting the management of financial resources.

Despite the fact that the Portuguese health care model is still very dependent on the secondary and differentiated care, the idea that health care systems based on a solid structure of Primary Health

Care (PHC) are more cost-effective is, nowadays, fairly pacific [3]. Due to this fact, the Portuguese Primary Health Care has suffered many developments. Additionally, given the current situation of our country, there is an extra need to evaluate the ACES productive behavior, and particularly, its efficiency. As stated by Jacobs et al. [4], the efficiency study of health institutions must be a central objective and accordingly, Data Envelopment Analysis (DEA) might be an extremely useful tool for estimating the PHC efficiency and, for the case of this particular paper, the efficiency of Health Centres Groups(ACES).

The analysis of hospital efficiency has been studied by many authors, nationally and internationally. However, the efficiency of PHC has not been a significant priority. Actually, in the performed literature survey, only a few papers regarding PHC efficiency were found, including: Huang and McLaughlin [5], Pinillos and Antoñanzas [6], Linna et al. [7], Akazili et al. [8], Kirigia et al. [9], Amado and Santos [10], Sebastian and Lemma [11], Halsteinli et al. [12] and Nuti et al. [13]. A common feature of most of these studies is the variables that are chosen. In terms of inputs, the most frequent are human resources and expenditures. Concerning the outputs, the most adopted are the different kinds of consultations related to the PHC. Nevertheless, while the older studies were only focused on efficiency, the latest ones also take into account the factors that affect efficiency.

This paper aims to contribute to a better understanding of the current reality of PHC, by applying DEA, in order to establish a comparison between the ACES of Lisbon and Tagus Valley (LVT) and identify the most efficient ones. Another objective is to evaluate the quality and equity of these PHC providers.

The rest of the paper is organised as follows. The current situation of Portuguese Primary Health Care is described in Section 2. Section 3 introduces DEA and the order-m analysis and Section 4 discusses some methodological issues and presents the case study results, regarding efficiency, equity of access and quality. Finally, the concluding remarks summarise the main results.

2 The Portuguese Primary Health Care

The PHC is a conceptual model which refers to disease prevention, health promotion, population health, and community development within a holistic framework, with the aim of providing essential community-focused health care. In Portugal, the reform initiated in 2005 was probably one of the most important ones taking place in the public health sector in Portugal. The main objectives of this reform were to improve accessibility, efficiency, quality and continuity of care.

A big change regarding the restructuring of PHC is the foundation of the ACES. The ACES consist on aggregations of resources and management structures and are composed by different functional units. Their mission is to ensure the provision of PHC in a particular geographic area, enhancing the health gains accomplished by Familiar Health Units (USF) and providing better management structures. Also, the development of epidemiological surveillance activities, the research on health and the control and evaluation of results are inherent to the ACES's mission.

Normally, each ACES is composed by 5 types of functional units (see Table 1). Other functional units might be considered, if the Health Regional Administration(ARS) decides so [14].

The geographic limitation of ACES should take into account geodemographic factors such as the number of residents (which should be between 50 000 e 200 000), the population structure, the aging index and the accessibility to the hospital of reference (Decreto-Lei no. 28/2008, 28th February).

Table 1: The 5 types of functional units that compose the ACES [14]

Functional Unit	Description
Familiar Health Unit (USF)	Individual and Family Care Unit. Promotes the formation of multidisciplinary teams, comprised by doctors, nurses and administrative staff. It allows a closer relationship with users through constant and personalized contact.
Personalized Health-care Unit (UCSP)	Individual and Family Care Unit. In terms of dimension, it is similar to an USF. However, USFs are regulated by specific legislation, whereas this units are bounded to rules approved by the Clinic Council.
Community Care Unit (UCC)	Providing care to groups with special needs and community interventions. It operates in the community and is capable of mobilizing skills inherent to other functional units, to provide health care through specific interventions.
Public Health Unit (USP)	Population, environmental and public health. It is responsible for the planning and divulgation in public health. It is also in charge of epidemiological surveillance and manages population-wide programs in the domains of prevention, health promotion and protection.
Shared Assistential Resources Unit (URAP)	It provides and enhances specific support and advice to the functional units and health projects of each ACES. Its mission is to support the former functional units.

3 Data Envelopment Analysis

3.1 Overview

DEA is a non-parametric and multi-factorial linear programming technique. It is used with the aim of evaluating the efficiency of the Decision Making Units (DMUs), by analysing the optimal combinations between inputs and outputs, *i.e.* between consumed resources and the resulting services or goods. This methodology optimizes each individual observation and builds a production frontier, constituted by the efficient DMUs [15].

When applying this technique, several factors must be taken into account: (1) selection of DMUs; (2) selection of inputs and outputs; (3) the model (constant returns to scale (CRS) or variable returns to scale (VRS)) and the orientation (for inputs, outputs or non-oriented); (4) slacks; (5) evaluation of the model quality (6) the exogenous variables (also called environmental); among other models. Factors (1), (2), (3) and (6) will be discussed in a more detailed way below [4].

3.2 Selection of DMUs, Inputs and Outputs

The DMUs must be homogeneous, *i.e.* they must develop the same tasks, have the same objectives and autonomy on decision making. Regarding the variables to be used, criteria of uniqueness and completeness are generally used. In other words, inputs must be mutually exclusive and, by themselves, must influence all and only the outputs considered in the sample. Furthermore, although there is no analytical proof, Banker et al. [16] recommend that the number of DMUs in analysis must be, at least, three times the number of variables, *i.e.* $\#\text{DMUs} \geq 3(\#\text{inputs} + \#\text{outputs})$.

3.3 Model and Orientation

The DEA methodology allows the development of several models. Choices regarding the type of return to scale and the orientation must be made in agreement with the production process that is being analysed (see Table 2).

Table 2: Mathematical formulation of the different models and orientations [15]

Orientation	CRS	VRS
Inputs	$Minimize\ \theta - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+)$ subject to 1a. $\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta^* x_{i0}$ with $i = 1, ..., m$ 2a. $\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{r0}$ with $r = 1, ..., s$ 3. $\lambda_j \geq 0$ with $j = 1, ..., m$	$Minimize\ \theta - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+)$ subject to 1a, 2a, 3 and 4. $\sum_{j=1}^{n} \lambda_j = 1$ with $r = 1, ..., s$
Outputs	$Maximize\ \phi - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+)$ subject to 1b. $\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = x_{i0}$ with $i = 1, ..., m$ 2b. $\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = \phi y_{r0}$ with $r = 1, ..., s$ 3. $\lambda_j \geq 0$ with $j = 1, ..., m$	$Maximize\ \phi - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+)$ subject to 1b, 2b, 3 and 4. $\sum_{j=1}^{n} \lambda_j = 1$ with $r = 1, ..., s$
Non-oriented	$\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+$ subject to 1c. $\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = x_{i0} \quad i = 1, ..., m$ 2c. $\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{r0} \quad r = 1, ..., s$ 3. $\lambda_j \geq 0 \quad j = 1, ..., m$	$\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+$ subject to 1c, 2c, 3 and 4. $\sum_{j=1}^{n} \lambda_j = 1$ with $r = 1, ..., s$

Regarding the type of technology, the most widely used approaches are CRS and VRS. As the name suggests, CRS deals with constant returns to scale, *i.e.* a variation of the inputs induces a proportional variation of the outputs. On the other hand, VRS replaces the axiom of proportionality between inputs and outputs by the axiom of convexity. This feature makes VRS more flexible than CRS and assures that each DMU is only compared with others of equivalent size [17]. While CRS model determines the technical efficiency (TE), VRS determines the pure TE. The ratio between ET and pure ET provides a measure of the scale efficiency (SE).

Regarding the orientation, a model can be input-oriented, output-oriented or non-oriented. The most appropriate orientation depends on the subject of study, by considering the characteristics of the DMUs and the chosen data.

The input orientation is used when the managers have more control on the inputs and intend to emphasize the reduction of excessive inputs, in order to improve efficiency. On the other hand, the output-oriented model is used if the managers have more control on the outputs, for instance, by controlling the reputation or the quality of service. Finally, in the non-oriented model it is considered to be possible to reduce the inputs and simultaneously increase the outputs.

3.4 The Environmental Variables: Order-m Methodology

The environmental variables are exogenous factors that cannot be classified as input or output but affect the efficiency and not controlled by the DMU management. It is extremely important to take into account these variables. If not, incorrect conclusions might be drawn. Although there is no agreement on the best technique to be used, in this study is used the recent method of order-m. This method was proven to be less sensitive to outlier values and able to overcome the deterministic nature of traditional non-parametric techniques.

According to order-m methodology, the production process can be described by the joint probability measure of (X, Y), on space $\Re_+^p \times \Re_+^q$: $H_{XY}(x, y) = \mathsf{Prob}(X \leq x, Y \geq y)$.

The likelihood function can be decomposed into two, according to Bayes rule and then, the efficiency can be computed. [1] [18].

$$H_{XY}(x, y) = \mathsf{Prob}(X \leq x|Y \geq y)\mathsf{Prob}(Y \geq y) = F_{X|Y}(x|y)S_Y(y) \tag{1}$$

$$\theta(x, y) = \mathsf{inf}\{\theta|F_{X|Y}(\theta x|y) > 0\} = \mathsf{inf}\{\theta|H_{XY}(\theta x, y) > 0\} \tag{2}$$

$$\hat{\theta}(x, y) = \mathsf{inf}\{\theta|\hat{F}_{X|Y}(\theta x|y) > 0\} \tag{3}$$

$$\hat{\theta}_{m,n}(x, y) = \int_0^\infty (1 - \hat{F}_{X|Y,n}(ux|y))^m \mathsf{d}u \tag{4}$$

with $\hat{F}_{X|Y,n}(ux|y) = \frac{\sum_{i=1}^{n} I(X_i \leq ux, Y_i \geq y)}{\sum_{i=1}^{n} I(Y_i \geq y)}$ and $I(k)$ is the indicator function that take the value $I(k) = 1$ when k is true or $I(k) = 0$ otherwise.

The inclusion of exogenous variables can easily be done by limiting the production process to a given value of the exogenous variable.

$$H_{XY}(x, y) = \mathsf{Prob}(X \leq x|Y \geq y, Z = z)\mathsf{Prob}(Y \geq y|Z = z) = F_{X|Y,Z}(x|y, z)S_{Y|Z}(y|z) \tag{5}$$

$$\hat{\theta}_m(x, y|z) = \int_0^\infty (1 - \hat{F}_{X|Y,Z,n}(ux|y, z))^m \mathsf{d}u \tag{6}$$

where $\hat{F}_{X|Y,Z,n}(ux|y, z) = \frac{\sum_{i=1}^{n} I(X_i \leq ux, Y_i \geq y)K(\frac{(Z - Z_i)}{h})}{\sum_{i=1}^{n} I(Y_i \geq y)K(\frac{Z - Z_i}{h})}$, h is the bandwidth and $K(\bullet)$ is the kernel function.

In order to analyse the influence of the exogenous variable on the production process, a non-parametric smoothed regression of the ratios between the order-m conditional efficiencies and the unconditional efficiencies is applied. If the regression has a positive slope, the exogenous variable has a negative effect on the production process because the environmental variable acts like an "undesirable" output to be produced, requiring the usage of more inputs [19].

4 Case Study: Performance Evaluation

4.1 Methodological Issues

The data used in this study refers to the activity of the ACES during the years 2009 and 2010 and was obtained from many contacts with ARS, ARS activity reports and the report of the Project SimCidadão.

It is important to stress that in the activity reports some information was not available. Due to this fact, this data had to be estimated by using a direct proportion based on averages of the available data. Table 3 shows the variables used as inputs and outputs, as well as the environmental variables.

[1] In this study, only the formulation for input orientation is addressed, because this is the orientation that is applied to the study of environmental variables influence.

Furthermore, is important to describe the working models:

Model I (Medicine) It includes all the ACES' medical services. The input used was $x1$ and the outputs were $y1$, $y2$, $y3$ and $y4$;

Model II (Nursing It includes all the ACES' nursing services. The input adopted was $x2$ and the outputs were $y6$, $y7$, $y8$ and $y9$;

Model III (Global) This model aims to include all the ACES' services. The input used were $x1$, $x2$ and $x3$ and the outputs were $y5$, $y10$, $y11$;

Model IV (Global with total costs) Model similar to Model III. However, the input used was $y4$ (total costs), instead of human resources. The outputs used were $y5$, $y10$, $y11$.

Table 3: Inputs and Outputs used in the DEA models to measure efficiency and environmental variables

Inputs	**Outputs**	**Environmental Variables**
$x1$: doctors' working hours $x2$: nurses' working hours $x3$: administrative staff's working hours $x4$: total costs	$y1$: number of adult health consultations $y2$: number of speciality consultations $y3$: number of urgency consultations (SAP, CATUS) $y4$: number of home visits by the doctor $y5$: total number of consultations $y6$: number of group education sessions $y7$: number of consultations by the nurse $y8$: number of injections, vaccinations, curatives and other treatments $y9$: number of home visits by the nurse $y10$: total number of nursing $y11$: total number of public health activities	$EV1$: Population $EV2$: Population density $EV3$: Percentage of patients aged greater than or equal to 65 years $EV4$: Mortality Rate $EV5$: Percentage of patients without designated doctor $EV6$: Distance to the nearest hospital $EV7$: Purchasing power

4.2 Efficiency

In the previous chapter the importance of choosing the return to scale and the model orientation was addressed. In this study both technologies to scale in connection with input orientation and output orientation and the non-oriented model were used in order to compare the results from each approach. The results were very similar and, therefore only the input-oriented results are shown. The direction of economies of scale and the environmental variables are studied after a general analysis of the CRS, VRS and Scale efficiency (see Table 4).

By analysing Table 4, some comments can be made:

- ACES 17 (Oeste Norte) is one of the most efficient. In fact, Model I (CRS) is the only model that does not provide an unitary efficiency. Besides, this ACES is one of the most common benchmarks, *i.e.* a best practice for the other ACES;

- ACES 2 and 11 are the least efficient. In fact, these ACES have poor results regarding the contractualization.

- For the chosen variables, the model with the lowest efficiency is Model II (Nursing);

- A general improvement of the efficiency between 2009 and 2010 can be observed. One of the possible reasons is the start-up of 10 new USFs. Also, 2009 was the first year of operation of the ACES and it is likely that they were not as organized as in 2010. Despite this, the improvement was not as large as it could have been, due to restrictions imposed by the Stability and Growth Pact.

Table 4: Efficiency results for 2009 and 2010 - input orientation

	Model I		Model II		Model III		Model IV
Dimension	22	22	22	22	22	22	22
Year	2009	2010	2009	2010	2009	2010	2010
θ_{CRS} average	0.793	0.816	0.764	0.769	0.913	0.935	0.918
min θ_{CRS}	0.581	0.569	0.469	0.465	0.761	0.817	0.745
DMU with min θ_{CRS}	2	2	21	11	11	11	2
Number of efficient DMUs (CRS)	4	6	5	6	8	8	6
DMUs with $\theta_{CRS} > 95\%$	4	6	6	7	9	11	12
DMUs with $\theta_{CRS} < 60\%$	2	1	5	3	0	0	0
Most common benchmarks (CRS)	22	22	17	17	17	17	8
θ_{VRS} average	0.852	0.857	0.839	0.849	0.944	0.961	0.928
min θ_{VRS}	0.585	0.595	0.581	0.520	0.775	0.835	0.754
DMU with min θ_{VRS}	11	2	21	15	11	15	2
Number of efficient DMUs (VRS)	7	8	8	7	11	13	9
DMUs with $\theta_{VRS} > 95\%$	9	8	8	9	13	15	12
DMUs with $\theta_{VRS} < 60\%$	1	1	1	1	0	0	0
Most common benchmarks (VRS)	15	13 e 22	5	17	17	13 e 17	14
θ_{Scale} average	0.935	0.954	0.905	0.903	0.968	0.972	0.990
min θ_{Scale}	0.722	0.783	0.690	0.622	0.837	0.848	0.960
DMU with min θ_{Scale}	15	17	9	9	12	5	9
Number of DMUs with SE = 1	4	6	5	6	8	8	7
DMUs with $\theta_{Scale} > 95\%$	11	17	8	10	17	17	22
DMUs with $\theta_{Scale} < 60\%$	0	0	0	0	0	0	0

Although not featured on the previous table, ACES 21 had a large increment in the nursing efficiency. This might be due to the remodeling of one of ACES' USF and the start-up of 3 new USF between 2009 and 2010. The results regarding the direction of the economies of scale are shown in Table 5.

By observing Table 5, it can be seen that regarding Model I, more than half of the ACES are working with decreasing returns to scale, *i.e.* they are operating above the optimal scale.

ACES 1 and 3 always present decreasing returns to scale for Model I. Actually, both ACES are serving a population over the theoretical limit of 200 000. Probably the effect of diseconomies of scale would decrease if the 3 ACES of the Lisbon area (Lisboa Norte, Lisboa Oriental and Lisboa Central) were splitted into 4. On the other hand, in Model II (nursing), more than 50% of the ACES have increasing returns to scales. This means that the nursing in these ACES is operating below the optimal scale.

Table 5: General statistics of the economies of scale - input orientation

	Model I		Model II		Model III		Model IV
Dimension	22	22	22	22	22	22	22
Year	2009	2010	2009	2010	2009	2010	2010
$\Sigma\lambda_{CRS}$ average	1.393	1.310	0.753	0.829	0.857	0.945	0,9418
max $\Sigma\lambda_{CRS}$	3.506	2.941	1.137	1.284	1.123	1.488	1,3158
DMU with max $\Sigma\lambda_{CRS}$	3	3	1	16	21	11	16
Number of DMUs with $\Sigma\lambda_{CRS} > 1$	14	12	2	4	3	6	6
min $\Sigma\lambda_{CRS}$	0.862	0.941	0.362	0.486	0.473	0.518	0.523
DMU with min $\Sigma\lambda_{CRS}$	12	5	9	9	9	5	9
Number of DMUs with $\Sigma\lambda_{CRS} < 1$	4	4	15	12	11	8	10
Number of DMUs with $\Sigma\lambda_{CRS} = 1$	4	6	5	6	8	8	6

The last step regarding the efficiency is to determine the influence of some environmental variables on the efficiency. Table 6 summarizes the results obtained.

Table 6: Influence of the exogenous variables studied on efficiency.

Variable	**Influence**
Population	The efficiency decreases with the increase of the population. This result is in agreement with the suggestion made before, about splitting the 3 ACES of Lisbon into 4.
Population density	The results show that there is no influence on efficiency.
% of patients aged greater than or equal to 65 years	According to the results obtained, there is a negative influence of this variable on the efficiency. In fact, aging leads to significant rises in needs for community and social care. Consequently, the efficiency decreases due to the increasing of the costs associated with aging.
Mortality rate	Mortality shows no influence on efficiency. Avoidable mortality could have been used instead. However, this data was not available.
% of patients without designated doctor	Once again, this variable shows no influence on the efficiency, maybe because of the reorganization of some of the functional units of the ACES, namely USFs and UCSPs.
Distance to the nearest hospital	Distance has a positive influence on the efficiency. This is not surprising as when the hospital is located further away from the population, more patients will go to PHC.
Purchasing power	This variable as a negative influence on the efficiency. Actually, patients with higher purchasing power tend to have health insurance and use less the PHC. Furthermore, patients with less purchasing power cannot afford private health care and they need to resort to PHC.

4.3 Equity of access

An important study regarding the PHC is the analysis of the horizontal equity, which is concerned with fairness or justice in the treatment of cases and measures whether patients from different groups have similar access to the services they equally need [10].

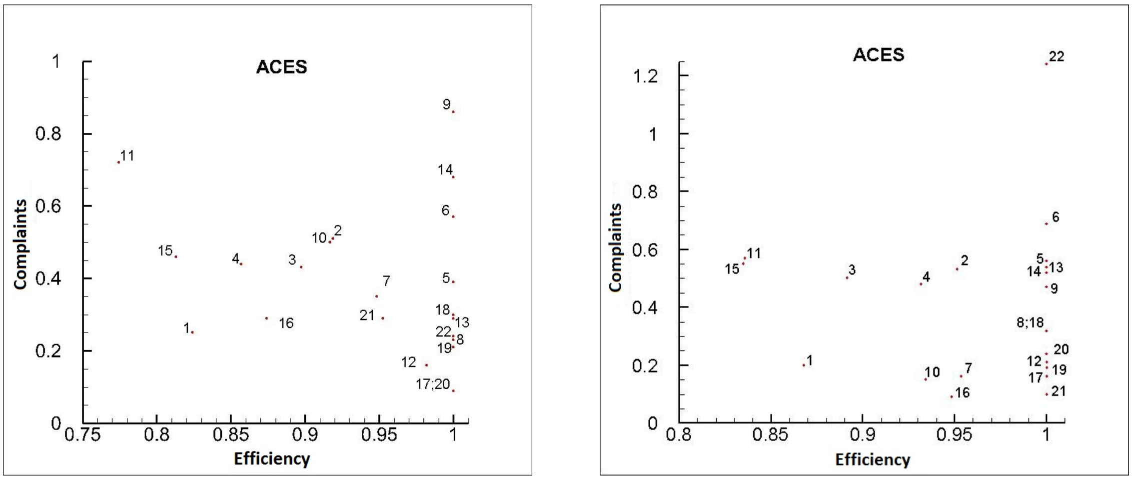
In order to analyze the horizontal equity of access regarding the NUTS III we studied the relationship between the NUTS III and (1) the efficiency and (2) the percentage of patients without a designated doctor. To test the hypothesis of relevant differences in equity, we used the non-parametric Kruskal-Wallis test, with multiple comparisons.

Both tests suggest that there is no evidence of relevant differences, and consequently there is horizontal equity regarding the NUTS III. In fact, despite some demographic inequalities, all the municipalities have healthcare facilities. In addition, the USFs can also contribute to improve equity because one of their main goals is to have a close contact with the population [20].

4.4 Quality

Additionally to to the efficiency and the equity of access, it is also of utmost importance to evaluate the quality of the services provided. According to Fornell [21], the patients' level of satisfaction on the PHC is very important to track the quality of the service. Therefore, this analysis uses the ratio between complaints and total of ACES' activities. This data is reported in [22] and is a good indicator of the patient's level of satisfaction.

Figure 1 shows the trade-offs between the VRS efficiency and the ratio addressed above, for both years 2009 and 2010.



(a) 2009 **(b)** 2010

Figure 1: Trade-offs between efficiency and complaints

Figure 1, presented above, shows a large number of complaints in Grande Lisboa and Península de Setúbal. However, this behavior might be a consequence of patients? higher expectations. Also, in Figure 1 some particular results should be noticed. There is a higher incidence of complaints for ACES Algueirão e Rio de Mouro (9) in 2009 and for ACES Lezíria II (22) in 2010. Regarding ACES Lezíria II (22), an increase of about 200% was recorded, comparing with 2009. This increase may be due to the lack of doctors and the excess work load of the doctors working in this ACES. The reason why in ACES Algueirão e Rio de Mouro (9) there was a higher incidence of complaints is probably the same. In fact, this is the ACES with higher average number of patients per doctor.

ACES Cascais (11) and Arco Ribeirinho (15) can be found in the region of high complaints and low efficiency, for both years. The high level of complaints of ACES 15 may be related to the average waiting time for a consultation in a UCSP, which is typically greater than the average waiting time in a USF.

Finally, ACES Oeste Norte (17) presents one of the highest patient levels of satisfaction. This ACES in one of the benchmarks used for most ACES, as mentioned in Section 4.2. This idea is corroborated by observing Figure 1 and also by the fact that the average number of patients per doctor is low. It should, therefore, be taken as a benchmark regarding PHC.

It is important to stress that the rate of complaints is only an indicative measure of the patients? satisfaction. The rate of complaints can be used as a guideline to satisfaction and quality, but satisfaction surveys would have been better in our view. ARS was trying to elaborate these surveys. However, up to date they are suspended as a result of the current economic conditions.

5 Conclusion

Taking into account the pressure to decrease costs with healthcare, the efficiency analysis of PHC is of paramount importance. However, besides the problems with data acquisition, evaluating PHC is still a difficult task. Nonetheless, during this analysis, some important conclusions were drawn.

In terms of efficiency, in the big picture, there was a general improvement of the efficiency between 2009 and 2010. It was found that nursing was the service with lowest scores. In particular, ACES Oeste Norte (17) was scored as one of the most efficient and a unit to be used as a benchmark. On the other hand, ACES Lisboa Oriental (2) and Cascais (11) were scored as the least efficient. With regard to the return to scale, it would be a good policy to split the 3 ACES from Lisbon (Lisboa Norte, Lisboa Oriental and Lisboa Central) into 4.

Regarding equity of access, the objectives of ensuring equal opportunity to all the patients and the allocation of resources and services in a fair, consistent and inclusive manner appears to be working well, at least according to the two tests performed.

Concerning quality versus efficiency, the ACES which can more successfully combine both are ACES Zêzere (20), Ribatejo (21) and also ACES Oeste Norte (17), previously referred to as a benchmark. On the other hand, the most problematic cases are ACES Cascais (11) and Arco Ribeirinho (15), both located in the region of high complaints and low efficiency. Other examples of problematic cases are ACES Algueirão e Rio de Mouro (9) and Lezíria II (22). These ACES are efficient only because they have a low level of human resources and because of that, they receive massive complaints. As previously mentioned, satisfaction surveys regarding PHC are, at least for the time being, suspended. We intend to include them in this study as soon as they become available.

Finally, regarding the exogenous variables, the distance to the nearest hospital has a positive influence on efficiency. On the other hand, the order-m test showed that the purchasing power, the percentage of patients aged greater than or equal to 65 years and the population affect negatively efficiency.

In order to strengthen this study, it should be repeated with more information and more robust data in the future, for instance, it would be important to include more data regarding costs and also regarding health results, such as prevention and control of diabetes. Nevertheless, despite some difficulties, this study reveals that there is room for improving the efficiency of ACES with a better usage of the available resources, maintaining quality and equity.

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