Relationship Between Operational, Economic, and Financial Efficiencies and User Satisfaction at the Health Centers of Praia City

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Abstract. This study aims to contribute to a better understanding of the current state of Primary Health Care, specifically in terms of efficiency and user satisfaction at 8 Health Centers in Praia City, Cape Verde, observed in 2017, 2018, 2020 and 2021. The Data Envelopment Analysis (DEA) model with input orientation and Constant Returns of Scale (CRS) is used to measure operational efficiency, and the income to expenditure ratio is used to measure economic and financial efficiency. User satisfaction is assessed using a questionnaire survey involving 408 respondents. The results indicate that 8 Decision-Making Units (DMUs) are operationally efficient. Regarding economic and financial efficiency, the ratios observed were generally higher than 1 in the different Health Centers analyzed. The satisfaction results show that most users are satisfied with the organization and services provided by the Health Centers. However, some improvements are needed in all the categories evaluated. A positive association between operational efficiency and the economic and financial efficiency ratio stands out as a result of comparing the different types of efficiency. Operational efficiency shows a negative relationship with the dimensions of satisfaction related to organization, service process, medical and nursing services, but this relationship is only statistically significant for the service process.

Keywords: Efficiency · DEA · Primary Health Care · Survey · Satisfaction

1 Introduction

When analyzing the health sector from an economic and operational perspectives, all the decisions made by managers or agents linked to the sector must be considered. It is relevant to study the health sector because of its growing importance in developed economies and because it deals with human lives [1]. It is a sector with high expenditure, and the percentage of the budget of the Ministry of Health of Cape Verde for 2021 was 10,93%, representing an increase of 2,22% compared to 2020. For example, the Health Authority of Praia City, responsible for managing the Health Centers, recorded 65.788.582,00

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escudos as expenditure in 2021 [2]. For these and other reasons, it is essential to analyze whether the health system produces efficiently or wastes resources. Efficiency is the relationship between what has been produced and what could be produced using the same available resources, i.e., maximizing the relationship between inputs and outputs. Following this line of reasoning, an organization is considered efficient when it obtains a certain level of results with a considerable degree of quality, using a minimum combination of resources [3–5]. Similarly, the organization's efficiency can be closely linked to its productivity since its definition involves inputs and outputs [6].

Many studies have analyzed hospital efficiency, although the various stakeholders have not prioritized the efficiency of Health Centers. In Portugal, there are few studies evaluating efficiency in Health Centers. As far as we know, there is no record of such studies in Cape Verde.

Efficiency can be categorized as economic, allocative and technical. Based on the seminal definitions of Farrel [7], technical efficiency consists of producing the maximum amount of output from a given amount of input (output-orientation) or, conversely, producing a given output with a minimum amount of input (input-orientation) so that when a company is technically efficient, it operates on its production frontier. Economic efficiency is seen in Farrel's [7] perspective as being a broader efficiency, and for an organization to be classified as economically efficient, it must meet three fundamental criteria: maximize profit, minimize costs, and maximize customer satisfaction with the organization's products or services.

For this study, the Data Envelopment Analysis (DEA) technique is used, which has a non-parametric nature that does not require the definition of a functional form in the relationship between inputs and outputs, relating these variables through the comparative measurement of the efficiency of Decision-Making Units (DMUs) using the best practices units as a reference. Therefore, DEA enables the assessment of the relative efficiency of production units using multiple inputs and outputs, mediated by the definition of an empirical production function defined as the efficiency frontier [3, 4, 8, 9]. The DEA model, initially introduced by Charnes et al. [10], allows each unit to be evaluated against constant returns to scale (CRS) frontier, which means that for each change in the value of inputs in a DMU, there will be an equal change in outputs. The model introduced by Banker et al. [11] has variable returns to scale (VRS), which makes it possible to accommodate different sizes of DMU. This means that a unit is evaluated against a frontier with variable returns to scale, distinguishing between technical and scale efficiency.

Another critical issue in assessing the performance of health centers involves knowing user satisfaction, which is seen as a fundamental aspect of any health unit, leading to quality care [12]. The National Health Service (SNS) Health Centers serve as the primary entry point for users into the system. Chaves et al. [12] show that the concept of satisfaction extends beyond a simple feeling of liking or disliking. In healthcare, it relates to various factors, particularly users' past experiences with health services, and is reflected in their overall well-being.

Assessing user satisfaction in the health sector is different and unique from other sectors, as it requires a more targeted approach to users and the professionals who provide care, as measuring user satisfaction is complex. This complexity is justified because

health services deal directly with human lives, and users often find it challenging to understand the complexity of the technologies used to provide care [13]. A widely used way of measuring satisfaction beyond the questionnaire is by analyzing user complaints, which most health systems consider to be a good direct indicator of user satisfaction.

In addition to this introduction, which describes the main concepts, this paper is organized into three more sections. The following section presents the methodology used in this research, such as the selection of the DMUs and variables to be used, the DEA models, and the selection of the study samples. Afterwards, the analysis of the results is presented, starting with a general analysis and then addressing the more specific issues with the results obtained from the two models used to analyze efficiency and assessment satisfaction. This section also presents the results of comparing the efficiency assessment with those obtained from the satisfaction evaluation. The last section presents the main conclusions, suggestions, and recommendations for future developments.

2 Methodology, Data Collection and Sample

This study uses the DEA technique to assess the operational efficiency of Health Centers in Praia City, Cape Verde. In addition, users' satisfaction with the different Health Centers will be assessed and compared with their operational and economic performance. The data of Health Centers were preprocessed in Excel, and RStudio version 4.4.1 was used to run the DEA models to assess the operational efficiency of the Health Centers.

The DEA technique enables efficiency measurement by identifying the Health Centers that serve as benchmarks and should be models for inefficient Health Centers. Another important advantage of the DEA is that it can work simultaneously with multiple inputs and outputs. Furthermore, another advantage of the DEA is that it allows a group of benchmarks to be identified for each inefficient DMU that corresponds to a group of units with best practices [14].

The most appropriate model should be determined by the characteristics of the process of transforming inputs into outputs of the DMUs. Thus, for this study, we used two models, the Charnes, Cooper and Rhodes (CCR) model [10] and the Banker, Charnes and Cooper (BCC) model [11], since the Health Centers, which are the DMUs, have different dimensions related to the regional dimension, as can be seen from the distribution of the population, among other characteristics [15].The input orientation model is best suited to this study, as managers can control the resources which are limited. As emphasized by Dyson et al. [14], the choice of model orientation depends on managers' ability to control resources and the production process. Since the input orientation allows managers to have greater control over resources, emphasis is placed on reducing inputs for a given level of services provided, aiming to increase efficiency [16].

This study intends to evaluate the operational and economic efficiency of the Health Centers in Praia City for the years 2017, 2018, 2020 and 2021. These data were obtained from the Health Authority of Praia City between January and March 2024. The data for 2019 was not published, according to the Health Authority, due to the COVID-19 pandemic. As a result, it was only possible to work in the four years mentioned. Thus, the annual activity reports and the financial data of the Health Authority were used. The Health Authority of Praia City manages the Health Centers located in Ponta d'Água

(PD), Fazenda (FZ), Achada Santo António (ASA), Achada Grande Trás (AGT), and Tira Chapéu (TC), owning their coverage area.

Based on the literature review, data availability and relevance to the research, three inputs were selected to assess the operational efficiency of Health Centers: number of doctors (N_MED), number of nurses (N_ENF), and number of beds (N_CM) and three outputs: number of outpatient appointments (C_EXT), number of general medical appointments (CCG) and number of nursing appointments and treatments (C_ENF_C). Total revenue was selected as the input and total expenditure as the output to assess economic and financial efficiency. The data can be seen in Table 1.

Table 1. Identification of variables (inputs and outputs)

Operational efficiency		Economic and financial efficiency	
Inputs	Outputs	Input	Output
No. of doctors No. of nurses No. of beds	No. of outpatient appointments No. of general medical appointments No. of nursing appointments and treatments	Total revenue	Total expenditure

The sample for the satisfaction assessment was calculated based on the data collected by the Health Authority for 2020, using data from the population of Praia City, which comprises all the users of the five Health Centers. According to the statistical procedure, a sample of 408 respondents was obtained and distributed proportionally among the five Health Centers. Thus, 89, 48, 119, 48, and 104 responses were collected from the TC, ASA, FZ, AGT, and PD centers, respectively. The questionnaire survey allows for measurement of satisfaction using a 5-point Likert scale, where users select a value from 1 to 5 based on their level of satisfaction, which 1 means 'very little', 2 'little', 3 'reasonable', 4 'good' and 5 'very good', with 6 used for situations that are not applicable.

3 Results

3.1 Data Analysis

Analyzing the descriptive statistics of the data on operational efficiency, there were no major changes in the first 3 years, either in terms of inputs or outputs, with the most significant change occurring from 2020 to 2021, where there were increases in both the input and output variables, as can be seen in Table 2.

The economic and financial efficiency analysis was carried out based on the ratio of revenue to expenditure, in which most of the Health Centers obtained a value greater than 1, indicating that their revenue is greater than their expenditure. In the first 2 years, the FZ Health Center had the highest ratio, and the PD Health Center had the lowest ratio. In the last two years, the TC Health Center had the highest ratio and the AGT Health Center had the lowest ratio, as shown in Table 3.

Table 2. Descriptive statistics for the indicators used to assess operational efficiency.

Inputs				Outputs		
Year 2017	N_MED	N_ENF	N_CM	C_EXT	CCG	C_ENF_C
Minimum	4	5	2	2398	9321	3758
Maximum	7	10	4	4791	19958	18317
Average	4,80	6,40	3,00	3732,40	13732,20	9582,40
Standard deviation	1,304	2,191	1,000	860,541	4446,772	5492,128
Year 2018						
Minimum	4	5	2	1788	6055	4982
Maximum	7	10	5	2801	19618	14917
Average	4,80	6,40	3,20	2248,20	13871,40	10781,60
Standard deviation	1,304	2,191	1,304	404,665	4936,059	4011,409
Year 2020						
Minimum	4	5	2	541	3630	3224
Maximum	6	12	5	3993	11321	13398
Average	4,60	8,00	3,20	1754,00	7523,20	7193,60
Standard deviation	0,894	2,550	1,304	1427,809	3515,932	4194,131
Year 2021						
Minimum	4	7	2	433	946	8450
Maximum	8	15	6	11858	15301	17078
Average	5,00	9,80	3,80	4583,40	8294,40	11801,80
Standard deviation	1,732	3,347	1,483	4567,616	5723,302	3447,640

As a first step, the efficiency of the DMUs was analyzed for each year, and the BCC and CCR models with input orientation were applied. As explained above, this analysis mainly seeks to construct an efficient frontier, which will comprise the DMUs with the best practices, where an efficiency score is assigned to each DMU, based on its distance from the frontier. With these results, the efficient and inefficient DMUs are identified, enabling the determination of the benchmarks for each inefficient Health Center and serving as models for the inefficient ones to reach the efficiency frontier. Table 4 shows the results of the operational efficiency analysis based on the CCR model and input orientation.

In general, analyzing the 5 Health Centers over the 4 years corresponding to the 20 DMUs, it was observed that 40% of the DMUs are operationally efficient based on the CCR model and input orientation. The average and standard deviation of the operational efficiency of each Health Center over the 4 years were also analyzed, followed by an analysis of all 5 Health Centers by year. The results indicate that 3 Health Centers were efficient in 2017 and 3 in 2018. In 2020, none of the 5 Centers were efficient, and in 2021, only 2 were efficient. These results can be seen in the Fig. 1.

Table 3. Economic and financial data for Health Centers of Praia City.

		TC	ASA	FZ	AGT	PD
2017	Revenue	6054821	7172372	4425375	5255737	3994442
	Expenditure	6023062	6872372	1593633	4432389	3994925
	Ratio	1,005	1,044	2,777	1,186	0,999
2018	Revenue	6054821	7172372	4425375	5255737	4425375
	Expenditure	6023062	6872372	1593633	4432389	4432389
	Ratio	1,005	1,044	2,777	1,186	0,998
2020	Revenue	5013062	5845515	7721887	4556719	4556719
	Expenditure	4764518	5772382	9285048	6092226	4764518
	Ratio	1,052	1,013	0,832	0,748	0,956
2021	Revenue	8274932	5845515	21295986	4556719	5573580
	Expenditure	5321250	5772382	22053795	6092226	5436795
	Ratio	1,555	1,013	0,966	0,748	1,025

Table 4. Results of operational efficiency with the CCR model.

DMU	2017	2018	2020	2021	Mean	Standard deviation
TC	100%	100%	89,98%	100%	97,50%	4,34%
ASA	96,95%	100%	67,58%	60,19%	81,18%	17,52%
FZ	100%	100%	61,50%	100%	90,38%	16,67%
AGT	97,31%	66,02%	45,00%	46,13%	63,62%	21,17%
PD	100%	86,12%	34,45%	69,10%	72,42%	24,50%
Mean	98,85%	90,43%	59,70%	75,08%		
Standard deviation	1,41%	13,34%	19,16%	21,62%		

Operational efficiency was also analyzed using the BCC model. However, the results show that almost all DMUs are efficient, which prevents the use of the BCC model. Thus, when comparing each DMU with similar units in terms of scale, almost all DMUs are efficient. The results of the DEA can be biased when the sample size is small [17]. In such cases, there is a trend for almost all DMUs to appear efficient, as a larger number of inputs and outputs reduces the discrimination of the efficiency score among the DMUs [14].

Based on the CCR model, we can compare the results between the variables of the efficient DMUs and the inefficient DMUs, as can be shown in the Fig. 2. The N_MED and N_ENF inputs have a higher average in the benchmarks than in the inefficient DMUs.

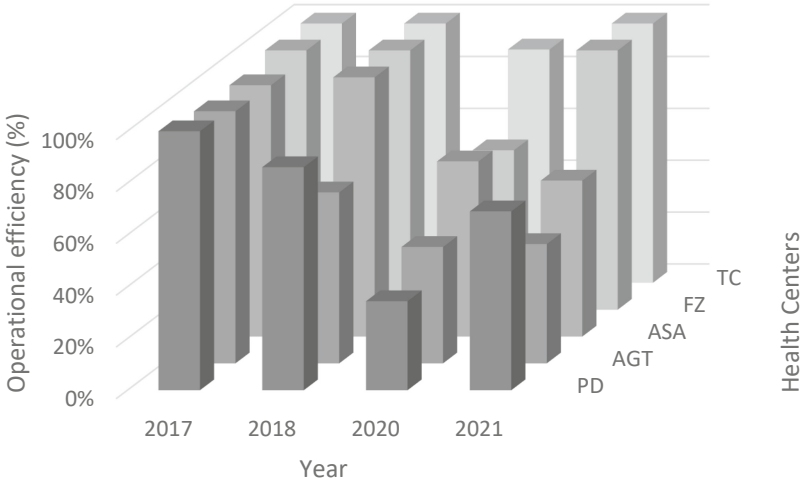


Fig. 1. Evolution of the efficiency of Health Centers over the 4 years.

In comparison, the N_CM input has a higher average in the inefficient DMUs than in the benchmarks. When analyzing the outputs, it can also be seen that the benchmark DMUs' averages are higher than those of the inefficient DMUs. These results show that inefficient units can readjust their capacity in terms of beds and possibly manage their human resources better to achieve a high level of service closer to that of efficient units.

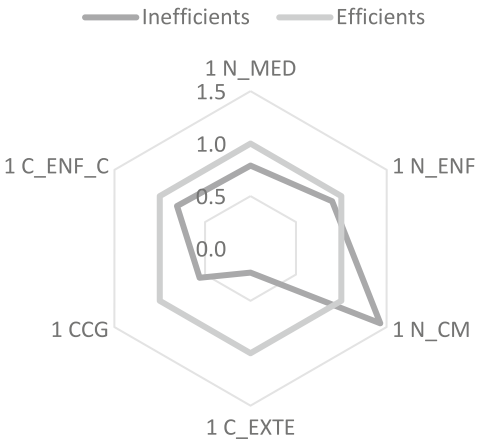


Fig. 2. Comparison of the average variables between efficient and inefficient DMUs.

The results of the evaluation of user satisfaction were based on 408 valid responses, which guarantees the necessary sample. Most respondents were female, representing 73% of 408 valid questionnaires. The predominant age was between 20 and 59 years

old; 66% had a minimum of secondary school, and 94% had come to the Health Center for an appointment. These results can be seen in Table 5.

Regarding the satisfaction evaluation of the Health Centers, the following aspects were analyzed: the general organization of the centers, the service process at the Health Centers, the medical services provided at each of the centers, and the nursing services. Finally, a question was asked to assess the satisfaction concerning the general organization of the Health Centers from years 2017 to 2021. The result of Cronbach's alpha coefficient is 0,91, considering the items that assess the four dimensions of satisfaction (organization, service process, medical and nursing services). This value indicates excellent internal consistency among the variables in the scale [18].

The Kruskal-Wallis test is also used to assess the equality of median satisfaction levels across the five Health Centers, with respect to the four dimensions of service such as organization, service process, medical services and nursing services. Significant differences in satisfaction levels were observed among Health Centers for each service dimension (at the 0,01 level) shown in Table 6 and Table 7.

Regarding the users' evaluation of the general organization of health Centers, the average of the users' responses shows that almost all centers obtained an average above 4, which is good because most users are satisfied with this organization as shown in Table 6. On the question of satisfaction with the service process at the Health Centers, the ASA, FZ, AGT and PD Health Centers obtained an average above 3, as presented in Table 6, which means that users are not dissatisfied with the service process, but it needs to be improved.

When analyzing the minimum values, some users from TC, ASA, and FZ Health Centers rated the service process as very poor, which means that these users are dissatisfied with the service at these Centers. The TC Health Center, on the other hand, had the worst evaluation among the Health Centers.

According to the data presented in Table 7, it can be seen in the evaluation of user satisfaction with the medical services provided in each of the centers, that TC Health Center received the worst evaluation, with an average of 2,77, which shows that users are not satisfied, and a minimum of 1, which means that there is a group of users who are dissatisfied with this service. The other four Health Centers obtained an average above 3, which means that a good proportion of users are satisfied with the medical services. Lastly, evaluating user satisfaction with nursing services, the ASA, FZ, AGT, and PD Health Centers obtained an average above 3, showing that users are not dissatisfied but want improvements. However, when analyzing their minimum values, the TC Health Center had the worst evaluation since a group of users said they were dissatisfied with these services, owning an average of 2,77.

3.2 Results Discussion

When comparing the results, the TC Health Center was operationally efficient and had the highest economic efficiency ratio. It also had one of the best averages regarding user satisfaction with the organization. However, this center had the worst ratings in the other three dimensions: satisfaction with service, medical and nursing services. On the other hand, the AGT Health Center was the worst in terms of efficiency, as it has the lowest average in operational and economic efficiency. Its users are only satisfied

Table 5. Characterization of the sample.

Health Center		TC	ASA	FZ	AGT	PD	Total
Age	< 19 years old	2%	0%	7%	4%	5%	4%
	20 to 39 years old	29%	23%	39%	46%	39%	36%
	40 to 59 years old	63%	73%	52%	50%	55%	57%
	> 60 years old	6%	4%	2%	0%	1%	2%
Total		100%	100%	100%	100%	100%	100%
Gender	Male	40%	31%	23%	27%	20%	27%
	Female	60%	69%	77%	73%	80%	73%
Total		100%	100%	100%	100%	100%	100%
Education level	No qualifications	9%	6%	3%	8%	5%	6%
	Primary school	6%	15%	8%	23%	13%	12%
	Secondary school	67%	54%	75%	58%	64%	66%
	University	18%	25%	14%	10%	17%	17%
Total		100%	100%	100%	100%	100%	100%
Reason for visiting the Health Center	Urgency	3%	6%	3%	4%	0%	3%
	Appointment	96%	90%	92%	92%	98%	94%
	Treatment	1%	4%	6%	4%	1%	3%
	Other	0%	0%	0%	0%	1%	0%
	Total	100%	100%	100%	100%	100%	100%
Sample size		89	48	119	48	104	408

with how it is organized, as it was assessed as reasonable in the other dimensions. Therefore, responsible managers should better evaluate how their resources are allocated and utilized. In this way, they can improve operating practices compared to benchmarks and control costs, increasing the economic and financial efficiency ratio.

The users who frequent the Health Centers the most were female (72%). This percentage can be explained by women playing an essential role in the family and community [19].

When analyzing the overall satisfaction data of the Health Centers, in terms of organization and service, it can be said that the centers are doing a good job, as they record a good average in terms of the satisfaction of their users. Organizing services is essential when assessing their quality [20]. However, the service issue did not receive as good rating as the organization evaluation, given that most users consider that the Health Centers provide reasonable service, as the average for most Centers was above 3. According to Santos et al. [21], some fundamental aspects are often seen as barriers between users and Health Centers, leading to dissatisfaction. These include accessibility issues such as location, opening hours and other aspects that frequently cause users to miss appointments and subsequently give the Health Center a low rating.

Table 6. Satisfaction with the organization and service of the Health Center.

Satisfaction with the general organization of Health Centers					
Health Centers	TC	ASA	FZ	AGT	PD
Mean	4,13	4,03	3,91	4,15	4,18
Standard deviation	0,670	0,490	0,488	0,495	0,375
Maximum	5	5	5	5	5
Minimum	2	3	2	3	2
Satisfaction with the service process at Health Centers					
Health Centers	TC	ASA	FZ	AGT	PD
Mean	2,91	3,35	3,31	3,61	3,41
Standard deviation	0,711	0,572	0,437	0,535	0,370
Maximum	4	5	4	4	4
Minimum	1	1	1	2	2

Table 7. Satisfaction with medical and nursing services.

Satisfaction with medical services					
Health Centers	TC	ASA	FZ	AGT	PD
Mean	2,77	3,64	3,62	3,81	3,81
Standard deviation	0,584	0,654	0,510	0,580	0,341
Maximum	5	5	5	5	4
Minimum	1	2	2	2	3
Satisfaction with nursing services					
Health Centers	TC	ASA	FZ	AGT	PD
Mean	2,77	3,60	3,42	3,24	3,28
Standard deviation	0,670	0,650	0,416	0,530	0,331
Maximum	5	5	5	4	4
Minimum	1	2	2	2	2

Users' satisfaction with the medical services was considered satisfactory, with an average score above 3. On the other hand, user satisfaction with the services provided by the nurses was lower, as most respondents rated the services as reasonable, with an average score slightly above 3. According to Santos et al. [21], health professionals are important in determining users' satisfaction with Health Centers.

Concerning the association between efficiency and satisfaction, Table 8 shows the Spearman correlation coefficients between operational efficiency, the economic and

financial efficiency ratio, and the dimensions of satisfaction (organization, service process, medical services and nursing services).

According to the correlation analysis shown in Table 8, it can be seen that operational efficiency shows a strong (absolute score from 0,71 to 0,90 [22]) negative correlation [18] with user satisfaction regarding medical services and also with the Health Center's service process, implying that the more satisfied users are with medical care and services, the lower the average operational efficiency will be, and vice versa. However, this correlation is only statistically significant for satisfaction in the service process. There is also a positive correlation between operational efficiency and the economic and financial efficiency ratio, which shows that the more efficient the Health Center is at an operational level, the higher its economic and financial efficiency ratio will be and vice versa. However, this correlation is not statistically significant. It is also worth noting that there is a very strong (absolute score higher than 0,9 [22]), positive, and statistically significant correlation between user satisfaction with the Health Center's service process and the doctors' service. The Spearman correlation coefficients shown in Table 8 are based on the average of each satisfaction item, calculated from the average of the answers to the questions used to assess each item. Thus, there is only one observation for each Health Center, i.e. five observations.

Table 8. Spearman correlation test of variables.

Variables	EFOP	EFEC	SO	SA	SSM	SSE
EFOP	1,000	0,564	−0,410	−0,872*	−0,789	−0,154
EFEC		1,000	0,200	−0,600	−0,462	−0,300
SO			1,000	0,600	0,667	−0,500
SA				1,000	0,975**	0,100
SSM					1,000	0,154
SSE						1,000

Notes: 1) * The correlation is significant at the 0,1 level (two-sided). 2) ** The correlation is significant at the 0,01 level (two-sided). 3) Definition of variables: operational efficiency (EFOP), economic and financial efficiency (EFEC), satisfaction in the organization (SO), satisfaction in service process (SA), satisfaction in medical services (SSM), and satisfaction in nursing services (SSE)

4 Conclusion

This study evaluates the efficiency of the Health Centers in Praia City using the DEA technique, focusing on operational, economic and financial efficiency. In addition, users' satisfaction with the Health Centers in Praia City was evaluated. The DEA technique assessed the operational efficiency using the CCR model and input orientation.

The results obtained show that 8 out of the 20 DMUs are efficient. Therefore, the 8 efficient DMUs are considered the benchmarks, which should serve as a model for

inefficient Health Centers to improve their practices. When comparing the results of the benchmarks with the other inefficient DMUs, it was found that the inputs N_MED and N_ENF have a higher average in the benchmarks than in the inefficient DMUs, and the input N_CM has a higher average in the inefficient DMUs than in the benchmarks. When analyzing the outputs, it can be noted that the averages of efficient DMUs are higher than those of inefficient DMUs. The conclusion that can be drawn is that inefficient units can benefit from adjusting their capacity in terms of beds and eventually improving personnel management to achieve a level of services closer to the level observed in efficient units.

The economic and financial efficiency was evaluated with a single input and a single output. The results showed that the FZ Health Center had the best performance in the first two years, while the TC Health Center ranked highest in the last two. The PD Health Center had the lowest performance in the first two years, while the AGT Health Center ranked lowest in the last two. This shows that the Health Centers with the worst rates must improve their policies regarding obtaining revenue and controlling expenses to improve their economic and financial efficiency rates.

Regarding user satisfaction, all Health Centers had a reasonable and acceptable average, except the TC Health Center, which had the lowest average satisfaction. However, there is still much to improve regarding user satisfaction and efficiency. The Health Centers must work more effectively to optimize available resources and ensure the provision of quality services to users.

Additionally, it would be valuable to extend the analysis to all Health Centers in the country, which would provide a much broader sample and more discriminating results in terms of efficiency. Furthermore, it could be important to compare the country's islands to identify which is the best prepared in terms of management, organization of Health Centers, and user satisfaction.

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