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Analyzing Hospital Efficiency in Golestan Province: A Four-Year Study Using the Pabon Lasso Model

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Abstract

The efficiency of hospitals has been a persistent concern in the domains of healthcare and medicine. A significant approach to assessing the performance and efficiency of various hospitals is the Pabon Lasso model. This model is designed to evaluate hospital performance with a high degree of accuracy and offers a graphical representation for simultaneously comparing multiple hospitals. This descriptive cross-sectional analysis seeks to assess the performance of 26 hospitals in Golestan province from 2019 to 2022, which has not been previously investigated. These hospitals include both public and private institutions associated with Golestan University of Medical Sciences. Data were collected from the registration records of the Hospital Statistics and Information System for the designated period. Our findings indicate that the average occupancy rate in Golestan province stands at 64%, varying by hospital type. University hospitals exhibit an occupancy rate of 59%, whereas Social Security hospitals show a significantly higher rate of 90%, reflecting a robust demand for their services. Additionally, private hospitals report an occupancy rate of 66%. While a four-year timeframe may not be adequate for drawing definitive conclusions, and given the absence of certain external factors influencing occupancy rates, health policymakers in Golestan Province can utilize the insights derived from this study. The results can also support decision-making processes and enhance health policies and programs within the province. Furthermore, by employing the data and analyses provided in this study, stakeholders can achieve a more comprehensive understanding of the healthcare system's strengths and weaknesses, thereby fostering improvements in healthcare services in Golestan Province.

Keywords: Bed occupancy, Bed turnover, Efficiency, Hospitalization, Pabon Lasso Model, Length of stay

Introduction

The operational definition of hospital efficiency pertains to its ability to provide high-quality services to patients while effectively managing resources and costs. In essence, efficiency signifies that a hospital can achieve the maximum level of services with the least expenditure of resources and costs, or conversely, maintain a specific level of services with a defined amount of resources and costs (1-2). This concept is of significant importance for the health system of any nation, particularly for government-operated hospitals, which often encounter limitations in financial and human resources. In Iran, as the population continues to grow and age, the demand for healthcare services is increasing. Consequently, hospitals that operate efficiently are better equipped to meet this rising demand and prevent potential crises within the healthcare system. Efficient hospitals can not only provide timely and effective care but also ensure that resources are allocated wisely, thereby enhancing overall healthcare delivery and sustainability (2-6). Thus, these hospitals can serve and manage a larger number of patients with greater efficiency. This ability is especially crucial in times of crisis, including pandemics or natural disasters. Enhanced efficiency indicates the effective use of resources, resulting in reduced expenses and better access to healthcare services. For instance, by minimizing the average length of stay (ALOS) and maximizing bed occupancy rates, hospitals can provide care to more patients without requiring additional resources. Therefore, in recent decades, the evaluation of hospital performance has gained increasing importance due to the limitations imposed by finite resources (7-8). This is particularly relevant as hospitals play a crucial role in delivering care during emergencies, often operating under the pressures of various external factors. Hospitals account for a significant portion of the financial resources and human capital within the healthcare system (9-11). Research conducted by the World Bank indicates that public hospitals consume approximately 50% to 80% of the total expenditures in the healthcare sector. In developed countries, this percentage is lower than 40%, while in developing nations, it surpasses 80%. Unfortunately, in developing countries, hospital expenditures are linked to facilities that function at only 50% of their potential capacity (9-12). Therefore, assessing hospital performance is highly beneficial and will contribute significantly to achieving health sector objectives (12-14). Hospital performance has been evaluated across various dimensions, including efficiency, productivity, quality, and accessibility (12). One of the primary objectives pursued by numerous nations is the enhancement of their healthcare systems, focusing on both the quality of services and their operational efficiency (14-17). The evaluation of hospital performance or efficiency can serve a strategic function within healthcare organizations by facilitating the optimal allocation of resources to achieve desired outcomes (18-21). Hospitals are typically assessed based on their bed count and occupancy rates. The total number of beds reflects the hospital's capacity for patient accommodation, while the Bed Occupancy Rates (BOR), which measure the percentage of occupied beds, serve as a crucial metric for assessing hospital efficiency and effectiveness (20-21). Bed occupancy rates provide hospital administrators with insights into the utilization of hospital capacity. A high occupancy rate may suggest a strong demand for hospital services, but it can also create strain on available resources and services. Thus, a low occupancy rate may indicate suboptimal resource utilization. In addition to the BOR, the Bed Turnover Rate (BTR) and the Average Length of Stay (ALOS) serve as practical metrics for assessing hospital efficiency (5-8). Consequently, the total number of beds, their occupancy rates, and the average length of patient stays are crucial for the effective management and strategic planning of healthcare services, ultimately leading to improved productivity and quality of service in hospitals (7-8). Therefore, utilizing all three indicators concurrently in the assessment of hospital

performance can yield more accurate insights, whereas relying on any single indicator may lead to misleading conclusions (19-23). The Pabon Lasso model has been used as a graphical tool in evaluating the performance of hospitals and their various departments over the past few decades (24). This model is particularly valuable for comparing the efficiency of multiple hospitals as well as evaluating different departments in a hospital unit (24-25). This model is based on three key performance indicators such as the average level of bed occupation, bed circulation, and the average duration of the patient's residence. According to these three indicators, hospitals are classified into one of the four districts in the Pabon Lasso chart. This classification allows hospital managers to evaluate their efficiency in terms of relevant situations and thus make better decisions to improve performance and productivity. Using the Pabon Lasso model can help identify the strengths and weaknesses of hospitals, improve the quality of service and increase patient satisfaction (18, 23-25). A variety of studies have investigated hospital efficiency and assessed the previously mentioned indicators, while further research has looked into the elements affecting these three metrics. However, the efficiency of hospitals in Golestan province is still unclear, as it has not been previously examined using the Pabon Lasso model, which could serve as a suitable instrument for additional analysis (16, 25-29). The purpose of this study is to employ the Pabon Lasso model to evaluate performance indicators and to identify strategies that could assist regional hospitals in Golestan province in enhancing their performance from 2019 to 2023. Specifically, this study offers policymakers a practical assessment of the current situation and proposes a strategy aimed at maximizing the effective use of existing healthcare resources.

Methods

Study design

This retrospective cross-sectional study analyzed data from 26 hospitals, including governmental and non-governmental institutions associated with Golestan University of Medical Sciences. The information was obtained from the registration records of the Hospital Statistics and Information System (Avab) covering the period from 2019 to 2023. The selection of 2019 to 2023 appears to have been a deliberate decision aimed at capturing a critical period of transformation or progress relevant to the research subject. This timeframe may include significant events, trends, or changes in the field that are essential for understanding the current situation. For example, it could encompass the impact of the COVID-19 pandemic, technological advancements, or policy changes that have occurred during these years. Monthly statistics on hospitalized patients are recorded by these hospitals. We performed a paired t-test, F-test (Fisher), ANOVA tables, and Chi-Square test with a significance level of 0.05 in its entirety. The analysis was conducted using SPSS version 23 software.

Pabon Lasso Model

The Pabon Lasso model (PLM) is a crucial tool for assessing hospital performance, illustrating the relationships between Bed Occupancy Rate (BOR), Bed Turnover (BTO), and Average Length of Stay (ALOS) (11-12, 24). To evaluate hospitals based on how long they maintain an efficient operational status, we employed the Pabon Lasso methodology. The Pabon Lasso model emphasizes the connection between hospital resources, patient outcomes, and efficiency. It highlights how this model can be used to identify areas for improvement in hospital operations. Based on the model's findings, we recommend strategies for optimizing resource allocation. These could include adjusting staffing levels, redistributing medical equipment, or enhancing training programs to ensure that resources are utilized efficiently and effectively.

Formulas

The study's three main indicators are the average length of stay in hospitals (ALOS) which indicates the percentage of beds occupied in a

hospital and can help assess the hospital's admission capacity; bed occupancy rate (BOR) which refers to the number of times the beds used for new patients over a given period of time and may indicate the efficiency of the beds; and bed turnover rate (BTR) which indicates the duration. They were determined using the following equations (12):

$$\text{ALOS} = \frac{\text{Total length of stay in the given year}}{\text{Total number of discharges (including deaths) in the given year}}$$

$$\text{BOR} = \frac{\text{Total inpatient days in the given year}}{\text{Total inpatient bed days in the given year}} \times 100$$

$$\text{BTR} = \frac{\text{Total number of discharges (including deaths) in the given year}}{\text{Average bed count in the given year}}$$

ALOS indicates the mean duration of hospitalization for patients. BOR reflects the average number of beds being used during a specific period, and BTR assesses the number of patients treated per bed within a set timeframe. The evaluation of hospital performance and efficiency was carried out using the Pabon Lasso model (PLM) (24), which is based on specific indicators. The PLM offers a simple diagrammatic tool that allows for quick assessment of hospital performance, making it accessible for the majority of hospital administrators.

Quadrant classification

According to the PLM framework, the relationship between ALOS, BOR, and BTR can be categorized into four distinct quadrants. Table 1 presents the classification of efficient and inefficient hospitals (10-13). It illustrates low occupancy, low turnover, and prolonged stays in Quadrant I; low occupancy, high turnover, and brief stays in Quadrant II; high occupancy, high turnover, and short stays in Quadrant III; and high occupancy, low turnover, and extended stays in Quadrant IV. When a hospital's conditions are assessed to be in the first quadrant, it is deemed inefficient. Conversely, if the conditions are found to be in the third quadrant, the hospital is considered efficient (11-13).

Table 1. Analysis of hospital efficiency using the Pabon Lasso model, divided into four distinct quadrants

Quadrant	The status of indicators	Interpretation of hospital efficiency
I **(Not Efficient)**	Low BOR Low BTR Long Stay	High number of beds, low demand for inpatient services, lack of efficiency, lack of proper management, and lack of motivation in staff and doctors, people prefer to choose another hospital.
II	Low BOR High BTR Short Stay	Low need to expand the hospital or create a new hospital in the place of additional bed capacity, unnecessary hospitalization of patients, relative efficiency for maternity hospitals, and short length of stay.
III **(Efficient)**	High BOR High BTR Short Stay	Good efficiency, low unused beds, good geographical distribution and utilization, proper organization of beds.

IV	High BOR Low BTR Long Stay	Unnecessary and long-term hospitalizations, the lack of technology required for immediate diagnosis and treatment, the frequency of chronic diseases, psychiatric centers and the elderly are included in this group.

Furthermore, hospitals located in Quadrant IV are expected to care for patients with long-term hospitalizations, leading to decreased resource efficiency and increased expenses. This situation may arise due to the prevalence of chronic illnesses, resulting in prolonged hospital stays and subpar service delivery. These four categories help identify and evaluate the utilization of hospital resources, enhancing understanding of the facilities and capabilities within these institutions. By pinpointing facilities that underutilize their potential, strategies can be developed to improve resource efficiency. While these findings may have some inaccuracies, they can assist policymakers in making more informed decisions in this area. Improving hospital productivity and efficiency not only enhances patient care quality but also leads to cost savings and improved resource management. By utilizing accurate data and thorough analysis, hospitals can identify strengths and weaknesses and implement continuous improvement programs to enhance services and facilities, ultimately increasing patient satisfaction and treatment outcomes. Additionally, by streamlining processes and reducing resource waste, hospitals can establish a more sustainable and efficient model for delivering healthcare services. To evaluate hospital performance indicators and enable comparisons among hospitals, we analyzed average patient stay duration, bed occupancy rates, and bed turnover rates using t-tests and Fisher's tests. Since patient stay length and bed turnover rates cannot be directly compared across different usage types and hospital departments, we implemented the Pabon Lasso model to evaluate hospital efficiency concerning these metrics based on their usage types. This model involved designating one variable as X and another as Y from the coordinate tables. Hospitals were evaluated based on their monthly performance at the efficient point (optimal efficiency), and a chi-square test was subsequently conducted at a significance level of 0.05.

Results

In this study, a total of 26 hospitals in Golestan province were analyzed. These hospitals consisted of 17 (66%) public academic hospitals, 2 (7%) non-academic public hospitals (social security hospitals), 6 (23%) private hospitals, and 1 (4%) hospital affiliated with other institutions. Together, these hospitals provide a total of 3,256 beds. Of these beds, 2,506 (77%) are designated for university use, 280 (8.6%) are allocated to social security organizations, 41 (1.3%) are associated with other non-governmental organizations, and 429 (13.1%) are in private facilities. The analysis was conducted using SPSS software version 23.

Table 2. Four-year hospital indicators in Golestan province hospitals based on ownership type and utilization type

	Hospitals	indicators	2019	2020	2021	2022
ownership	public academic	Average Length of Stay	3	3	3	3
		Bed turnover rate	5	4	4	5
		Inpatient bed occupancy ratio	66	52	57	61
	Social security	Average Length of Stay	2	3	3	2
		Bed turnover rate	7	7	7	8
		Inpatient bed occupancy ratio	70	70	85	81

	Private	Average Length of Stay	1	1	1	1
		Bed turnover rate	10	11	11	11
		Inpatient bed occupancy ratio	66	62	68	65
type of use	General	Average Length of Stay	2	3	3	2
		Bed turnover rate	7	6	6	7
		Inpatient bed occupancy ratio	66	57	63	63
	Specialized	Average Length of Stay	4	4	3	3
		Bed turnover rate	3	2	3	4
		Inpatient bed occupancy ratio	82	51	61	82

Table 2 presents a comparison of various indicators, including the average length of stay, bed turnover, and bed occupancy rate across hospitals. The initial section categorizes hospitals based on ownership type, while the subsequent section distinguishes them by usage type from 2019 to 2022. The data indicates that university hospitals have a longer average length of stay compared to social security and private hospitals. Conversely, private hospitals exhibit a higher bed turnover rate than both social security and university hospitals. Additionally, social security hospitals maintain a higher average bed occupancy rate than their private and university counterparts. In the analysis of the second segment of Table 2, it is noted that specialized care has a longer average length of stay than general care. Furthermore, general hospitals demonstrate a higher bed turnover rate than specialized hospitals, whereas specialized hospitals have a greater bed occupancy rate compared to general hospitals. The data has been thoroughly compared, establishing a statistical correlation between hospital ownership (university, social security, and private) and the second segment concerning hospital usage type (specialized and general). The hospital indicators (bed occupancy rate, average length of stay, and bed turnover) were analyzed independently over four years utilizing the F-test (Fisher) and ANOVA tables, while the second segment was assessed using the t-test. The findings across all scenarios indicated a significant level, with a p-value of less than 0.05.

Table 3 displays data on hospitals categorized by their bed capacity whitin a study or report. The table evaluates hospitals based on the number of beds they have. The comparison indicators show that patient stays in hospitals with over 200 beds have consistently been longer over each four-years, while the turnover rate is higher in hospitals with fewer than 200 beds. However, the bed occupancy rate in hospitals with more than 200 beds is also higher. This analysis was conducted using the t-test statistical method, demonstrating statistical significance over each four years with a P-value of less than 0.05. During the research phase, an additional element that emerged was the impact of the COVID-19 pandemic on hospitals and treatment facilities. The findings presented in Table 3 illustrate the differences between the periods influenced by the presence of COVID-19 and those that were not.

Table 3. Four-year hospital indicators in Golestan province based on bed capacity

		Indicators	2019	2020	2021	2022
Active beds	Beds< 200	Average Length of Stay	2	3	2	2
		Bed turnover rate	7	6	6	7
		Inpatient bed occupancy ratio	65	56	62	63
	Beds>200	Average Length of Stay	4	5	5	4
		Bed turnover rate	4	3	4	5
		Inpatient bed occupancy ratio	82	64	73	79

Table 4. Four-year hospital indicators in Golestan province based on the Corona and non-Corona periods

	Hospitals	indicators	Corona	Non-Corona
ownership	public academic	Average Length of Stay	3	3
		Bed turnover rate	4	5
		Inpatient bed occupancy ratio	56	63
	Social security	Average Length of Stay	2	2
		Bed turnover rate	7	8
		Inpatient bed occupancy ratio	75	81
	Private	Average Length of Stay	1	1
		Bed turnover rate	11	11
		Inpatient bed occupancy ratio	65	65
type of use	General	Average Length of Stay	1	2
		Bed turnover rate	7	6
		Inpatient bed occupancy ratio	61	64
	Specialized	Average Length of Stay	0	3
		Bed turnover rate	3	4
		Inpatient bed occupancy ratio	65	82

Furthermore, Table 4 shows a significant decline in both the bed occupancy rate and the bed turnover index during the COVID-19 pandemic, while the average length of stay has mostly remained stable. The observed changes are statistically significant, highlighting the significant impact of COVID-19 on hospitals ($P < 0.05$).

Table 5. Frequency and percentage of hospitals categorized by the number of months within the year, assessing efficient and inefficient areas over a four-year in Golestan province. This data is further segmented by ownership, type of use, and the number of active beds.

	Hospitals	indicators	2019		2020		2021		2022	
			n	%	n	%	n	%	n	%
Ownership	Public academic	no efficiency	161	78.9	190	93.1	192	89.7	179	83.3
		efficiency	43	21.1	14	6.9	22	10.3	36	16.7
	Social security	no efficiency	11	45.8	22	91.7	24	100	14	58.3
		efficiency	13	54.2	2	8.3	0	0	10	41.7
	Private	no efficiency	24	40	28	46.7	20	33.3	22	36.1
		efficiency	36	60	32	53.3	40	66.7	39	63.9
Type of use	General	no efficiency	184	66.7	225	81	223	78	203	70.5
		efficiency	92	33.3	51	18	63	22	85	29.5
	Specialized	no efficiency	29	80.6	29	80.6	26	72.2	28	75.7
		efficiency	7	19.4	7	19.4	10	27.8	9	24.3
Active beds	Beds <200	no efficiency	184	66.7	226	77.5	223	78	203	70.5
		efficiency	92	33.3	51	22.5	63	22	85	29.5
	Beds >200	no efficiency	24	100	24	100	24	100	24	100
		efficiency	0	0	0	0	0	0	0	0

Table 5 shows that private hospitals demonstrate higher efficiency, as measured by the Pabon Lasso index, for more months over the analyzed four-year period. Social security

hospitals follow in efficiency, while university hospitals are positioned at the bottom. The observed differences are statistically significant (P <0.05). Additionally, data from the COVID-19 pandemic, indicate that hospitals treating these patients experienced increased admission and bed occupancy rates, potentially affecting their operational efficiency. The data presented in Table 6 reveals a significant impact of the COVID-19 pandemic on hospital efficiency. Overall, there was a 10% decrease in the number of hospitals during the pandemic. This decline was most pronounced in public hospitals, followed by academic institutions, with private hospitals experiencing a relatively minor impact (P <0.05). We conducted a paired t-test to compare the index status before and after the coronavirus outbreak.

Table 6. Frequency and percentage of hospitals located in the efficient region, categorized by ownership, type of use, and number of beds of Corona and Non-Corona hospitals in Golestan province

	Hospitals	indicators	Non- Corona		Corona	
			n	%	n	%
Ownership	public academic	no efficiency	291	42.9	387	57.1
		efficiency	73	65.2	39	34.8
	Social security	no efficiency	44	38.3	71	61.7
		efficiency	22	75.9	7	24.1
	Private	no efficiency	59	42.8	79	57.2
		efficiency	73	48.7	77	51.3
Type of use	General	no efficiency	342	41.8	477	58.2
		efficiency	153	59.3	105	40.7
	Specialized	no efficiency	52	46.4	60	53.6
		efficiency	15	45.5	18	54.5
Active beds	Beds<200	no efficiency	350	41.9	486	58.1
		efficiency	168	57.7	123	42.3
	Beds>200	no efficiency	44	46.3	51	53.7
		efficiency	0	0	0	0

Figure 1 illustrates the Pabon Lasso diagram showing the efficiency of hospitals in Golestan province from 2019 to 2022. This chart is based on the Pabon Lasso model used in the research. The chart is divided into four distinct regions. According to the Pabon Lasso framework, a region is considered efficient if it is above the average bed occupancy rate and below the average length of patient stay. Over the four years studied, all 26 hospitals were evaluated monthly for efficiency. The chart shows that hospitals highlighted in black are in the efficient region. Additionally, it is clear from the chart that private sector hospitals are in the efficient region, suggesting that private sector hospitals in Golestan province demonstrate higher efficiency compared to public hospitals.

Discussion

Golestan province is home to 26 hospitals, which collectively provide 2,725 active hospital beds. The average monthly occupancy rate for these facilities, calculated over a four year, from the beginning of 2019 to the end of 2022, stands at 64%. Additionally, the average bed turnover rate is 6.7, while the average length of hospital stay is 3.02 days. The hospital efficiency rate, derived from these three metrics, is 23% for the province, based on the months classified as efficient. Notably, there is a statistically significant variation in this efficiency based on hospital ownership; 52% of the hospitals are privately owned, 26% are affiliated with social security, and 14% are university hospitals, as observed over the four months. Furthermore, a significant difference is evident when comparing the months before and after the onset of the COVID-19 pandemic. In 2019, the efficiency

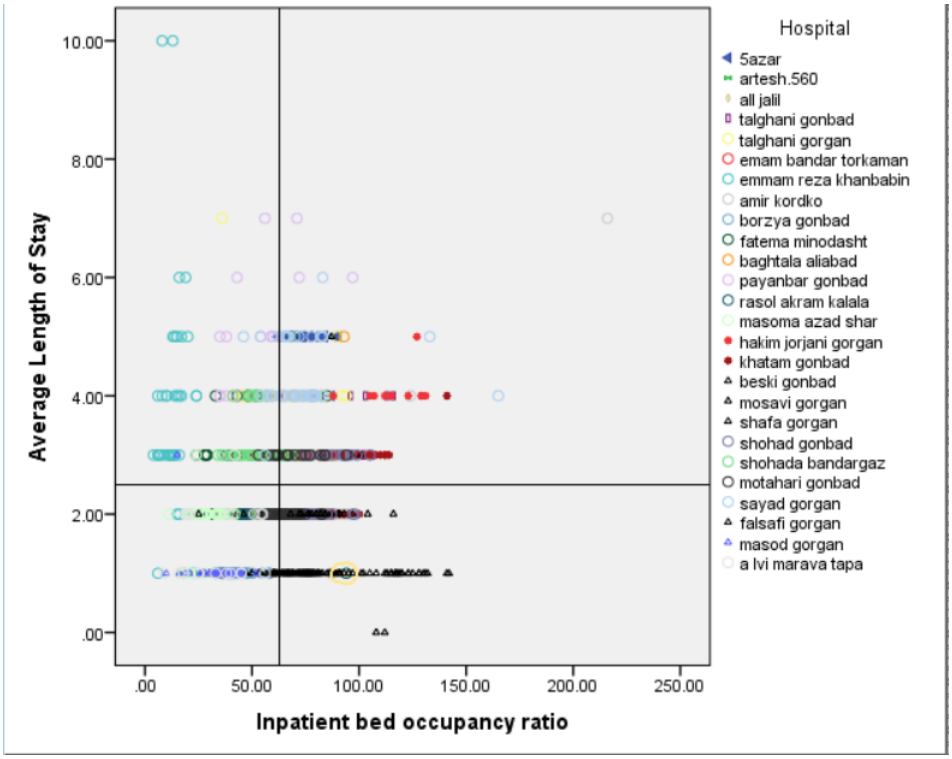

Figure 1. Pabon Lasso diagram for the efficiency of hospitals in Golestan province in 4 years from 2019 to 2022

index for hospitals was 30 %, which decreased to 17 % in 2020, then rose to 20 % in 2021, and finally reached 27 % in 2022. Our findings showed that university hospitals frequently serve as referral centers for intricate cases, implying that they tend to receive patients referred from other institutions rather than admitting a large number of patients directly. Conversely, social security hospitals may experience a steadier flow of patients owing to their function in delivering essential healthcare services to the broader community. Additionally, the financial frameworks and reimbursement systems for university hospitals can vary considerably from those of social security hospitals, which may benefit from more reliable funding sources, resulting in consistent patient admissions. In a research conducted by Hashemian et al. in Isfahan, 2017 (5), 20.9% of the centers were located within the limits of the Pabon Lasso. Our analysis, derived from the Pabon Lasso diagram (Figure 1), indicates that over the past 48 months in Golestan province, 23% (291 months in the hospital) were situated within this area. In addition, the efficiency of hospitals in Golestan province was recorded at 30% in 2018. Nevertheless, this percentage fell to 17% in 2019 due to the impact of the coronavirus pandemic. In previous years, the efficiency levels were recorded at 20% in 2014 and 27% in 2011. A research conducted by Dargahi et al. (7) as an evaluation of the performance of Tehran University of Medical Sciences hospitals based on the Pabon Lasso model: a five-year trend study, the results showed that the studied hospitals were located in the three regions of the Pabon Lasso diagram at the end of the five-year period, which indicated the optimal performance of these hospitals in this period. Further, a research investigation carried out by Kaousi et al. (23) assessed the performance of hospitals utilizing the Pabon Lasso model at Lorestan University of Medical Sciences. The findings revealed that among the 14 hospitals examined, only 5 were classified as Pabon Lasso hospitals. Specifically, in our analysis, 14% of academic

hospitals, 20% of social security hospitals, and 52% of private hospitals fell within the Pabon Lasso parameters.

Bastani et al. (9) performed a performance analysis of the educational treatment hospitals affiliated with Shiraz University of Medical Sciences, examining the period before and after the implementation of the Health Transformation Plan. Utilizing the Pabon Lasso model, their findings revealed that in 2013, before the plan's implementation, 14% of the 14 hospitals assessed were categorized in the first quadrant, indicating poor efficiency, while 28% were classified in the third quadrant, reflecting good efficiency. In 2014, after the implementation of the Health Transformation Plan, 21% of hospitals were in the first quadrant, and 21% were in the third quadrant. According to the paired t-test, only the percentage of bed occupancy before and after the plan showed significant differences. Overall, the performance indicators of hospitals affiliated with Shiraz University of Medical Sciences were not in a desirable condition compared to the standards. After the implementation of the Health System Transformation Plan, changes occurred in the situation of the hospitals. One of the key aspects addressed in this study is that the study period coincided with the COVID-19 pandemic, a factor that has not been previously examined in similar research. This unique timing presents an opportunity to explore how the pandemic may have influenced the outcomes and variables of interest in the study. The unprecedented nature of the COVID-19 crisis likely affected various aspects of life, including health behaviors, access to healthcare, and social interactions, which could have significant implications for the findings. Our analysis based on the Pabon Lasso model, which examines the interplay between hospital resources, patient outcomes, and operational efficiency, reveals that the COVID-19 pandemic emerged as a critical factor during the research phase, particularly impacting hospitals and treatment facilities. This indicates that the pandemic significantly influenced healthcare operations, patient care, and the allocation of resources. Furthermore, the mention of Table 3 suggests that the study incorporates quantitative or qualitative data that highlights the disparities in performance or conditions of hospitals and treatment facilities during the COVID-19 pandemic compared to periods without its presence. These variations may include several factors, such as patient admission rates, treatment outcomes, resource utilization, staffing difficulties, and the overall delivery of healthcare. Perform a comprehensive evaluation of resource usage in healthcare facilities to pinpoint inefficiencies. Adopt a data-informed strategy to optimize resource allocation, guaranteeing that high-demand sectors are sufficiently supported. Employ predictive analytics to anticipate patient admissions and modify staffing and resource allocations as needed, especially during peak periods or public health crises. As a result, our findings indicate that social security hospitals are functioning at or near full capacity, with an occupancy rate of 90%. This may reflect an increased demand for services within that sector. In contrast, university hospitals exhibit the lowest occupancy rate at 59%, suggesting they may have greater capacity for specialized care or are underutilized relative to social security facilities. The overall average occupancy rate stands at 64%, implying that there are still unoccupied beds in the province's hospitals. While this could be viewed as a favorable development for patient access, it also prompts inquiries regarding the allocation of patients across various hospital types.

Conclusion

Hospitals play a crucial role in the healthcare system, accounting for a significant portion of the overall health system budget. As a result, there is a constant focus on improving efficiency and enhancing patient services. This research suggests that the increasing occupancy rates in social care hospitals may indicate an urgent need for additional funding or expansion to meet the growing demand for services. On the other hand, the decreasing occupancy rates in university

hospitals may indicate that the same facilities are not being fully utilized.

Hospitals cater to diverse populations, which can greatly affect their occupancy rates. The classification of a hospital—whether it be a university hospital, community hospital, or specialized institution—plays a significant role in determining these rates. University hospitals typically handle more complex cases and specialized treatments, resulting in lower occupancy rates compared to community hospitals that offer a wider array of general services and may admit a larger number of patients. Additionally, hospitals that serve as referral centers for specialized care may experience fluctuating occupancy rates based on the number of referrals they receive. In contrast, hospitals catering to a more general patient population may maintain more stable occupancy levels. By taking these factors into account the conclusion, one can gain a more thorough understanding of the factors that contribute to variations in occupancy rates among hospitals. This comprehensive analysis not only enhances the conclusion but also provides valuable insights for stakeholders looking to address occupancy challenges and improve healthcare delivery. Furthermore, university hospitals often focus on specialized services and research, which may limit the range of cases they manage. In contrast, social security hospitals generally offer a broader spectrum of general healthcare services, resulting in higher occupancy levels. The excessive number of patients in Social Security hospitals may be attributed to extensive insurance coverage, affordability, accessibility, and a lack of alternative healthcare options. Improved allocation of resources and increased capacity in public hospitals could alleviate this problem. Patients admitted to university hospitals may experience extended lengths of stay due to the intricacy of their conditions and the nature of the treatments administered. This can lead to lower turnover rates when compared to social security hospitals, which may emphasize faster discharges. A more thorough analysis is required to comprehensively understand the dynamics at play and the specific elements influencing demand in social security hospitals, including socioeconomic factors, healthcare policies, and regional health needs. To strengthen the conclusion by providing actionable outcomes and offering specific suggestions for improving hospital efficiency, it is suggested that hospitals adopt lean methodologies. This approach aims to optimize operations, minimize waste, and improve patient flow by mapping processes, identifying bottlenecks, and continuously refining workflows. This breakdown should provide a clearer picture of the hospital situation in Golestan province, including how different types of hospitals are utilized and the overall capacity available for patient care. Occupancy rates can inform healthcare planning and resource allocation. High occupancy rates in social care hospitals may require additional budget or expansion, while lower rates in academic hospitals may suggest a need for marketing or outreach efforts to attract more patients. Understanding these occupancy rates is crucial for managing patient flow, ensuring access to emergency care, and developing long-term healthcare strategies within the province. Additionally, hospitals can improve efficiency and reduce administrative expenses by carefully analyzing patient conditions to predict optimal discharge times, as well as continuously monitoring and assessing bed availability and intelligently allocating resources. Additionally, tracking visitor numbers, patient satisfaction, bed occupancy rates, and refining strategies based on data will contribute to cost reduction and the attraction of new patients, thus optimizing bed occupancy levels. The COVID-19 pandemic has profoundly impacted the utilization of healthcare services in hospitals, resulting in the cancellation of admissions and elective procedures, while also requiring the reallocation of hospital resources to prioritize COVID-19 patients. Numerous studies referenced in this research have examined the pandemic's effects on hospital performance, indicating that the outbreak has affected hospitalization rates, average bed occupancy, length of stay, and emergency admissions.

Limitations and suggestions

A significant limitation of this study is that some hospitals may not have updated their daily registration systems, which restricts access to accurate data. It is recommended that hospitals take steps to ensure access to precise and reliable data. Such data is essential for conducting comprehensive analyses and assessments, ultimately leading to improved decision-making, better patient care, and more effective hospital operations.

Abbreviations and symbols

Average Length Of Stay = ALOS
Bed Occupancy Rate=BOR
Bed Turnover Rate=BTR
Pabon Lasso Model=PLM

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Journalism Ethics considerations

The study received approval from the Ethics Committee of Golestan University of Medical Sciences, assigned the ethics code (IR.GOUMS.REC.1402.329).

Competing interests

None declared.

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