



UNIVERSIDADE CATÓLICA PORTUGUESA

Are KPIs Effective in Measuring Business Performance in the Healthcare Sector?

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Business Analytics

by

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Resumo

Numa época marcada por exigências crescentes de eficiência, qualidade e responsabilidade, os indicadores-chave de desempenho (KPI) surgiram como ferramentas essenciais na avaliação e gestão do desempenho empresarial, oferecendo às organizações de cuidados de saúde informações valiosas sobre as suas operações e resultados. No entanto, no complexo panorama da gestão dos cuidados de saúde, a eficácia dos KPI na medição exacta do desempenho empresarial continua a ser objeto de escrutínio e investigação.

Este estudo abre uma análise abrangente da utilização de KPIs no setor dos cuidados de saúde, pretendendo descobrir os pormenores da sua aplicação, eficácia e alinhamento com os objectivos estratégicos. Com base numa meticulosa revisão da literatura que abrange várias perspectivas, complementada por opiniões de gestores de cuidados de saúde através de um questionário estruturado, esta investigação explora as definições fundamentais de KPI, a sua importância na gestão dos cuidados de saúde e das várias categorias e tipos predominantes no sector.

Os resultados analíticos esclarecem até que ponto os KPIs contribuem para a eficiência operacional, o alinhamento estratégico e a qualidade do serviço em contextos de cuidados de saúde. Os resultados sublinham a importância dos KPIs na promoção de melhorias e na revelação de áreas críticas de desenvolvimento na gestão dos cuidados de saúde. Além disso, a análise de regressão fornece conclusões perspicazes sobre a influência de vários fatores na implementação efectiva e na percepção da eficácia dos KPIs.

Palavras-chave: Indicadores Chave de Desempenho, Desempenho Empresarial, Indústria da Saúde, Gestão Hospitalar, Medição de Desempenho

Abstract

In a time marked by increasing demands for efficiency, quality, and accountability, Key performance indicators (KPIs) have emerged as essential tools in the evaluation and management of business performance, offering healthcare organizations valuable information about their operations and results. However, in the complex landscape of healthcare management, the effectiveness of KPIs in accurately measuring business performance remains the subject of scrutiny and investigation.

This study opens a comprehensive exploration of the use of KPIs in the healthcare sector, intending to discover the details of their application, effectiveness, and alignment with strategic objectives. Based on a meticulous literature review covering various perspectives, complemented by opinions from healthcare managers and stakeholders through a structured questionnaire, this research navigates through the fundamental definitions of KPIs, their importance in healthcare management, and the various categories and types predominant in the sector.

The analytical findings illuminate the degree to which KPIs contribute to operational efficiency, strategic alignment, and service quality in healthcare settings. The results underscore the importance of KPIs in driving improvements and revealing critical areas for development in healthcare management. Additionally, the regression analysis provides insightful revelations about the influence of various factors on the effective implementation and perceived effectiveness of KPIs.

Keywords: Key Performance Indicator, Business Performance, Healthcare Industry, Hospital Management, Performance Measurement

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List of Abbreviations

KPI – Key Performance Indicator

MLR – Multiple Linear Regression

PnR – “Position and Role” survey question

YofE – “Years of Experience” survey question

FamKPI – “How familiar are you with the concept of Key Performance Indicators (KPIs)?” survey question

EffKPI – “How effective do you believe KPIs are in measuring the business performance of the hospital?” survey question

SelKPI – “How are KPIs selected in your hospital? (Check all that apply)” survey question

CustKPI – “To what extent do you believe KPIs need to be customized to suit the unique challenges and goals of the healthcare industry?” survey question

CurUseKPI – “To what extent are KPIs currently utilized in your hospital's management practices?” survey question

SuffKPI – “Do you believe the following KPIs are sufficient to comprehensively measure business performance? Wait Time of Patients; Indoor Air Quality; Average Length of Stay; Cost per Case; Patients Satisfaction Score; Hospital Readmission Rate; Employee Turnover Ratio; Bed Occupancy Rate” survey question

Chapter 1

Introduction

1.1. General Framework

In the ever-evolving landscape of the healthcare industry, the pursuit of excellence and efficiency has become compatible with the effective management of Key Performance Indicators (KPIs). These measurable metrics serve as navigational markers for healthcare institutions, guiding them through the complexities of patient care, resource utilization, financial sustainability, and overall operational performance. As healthcare systems face the challenges of a dynamic environment, the need to critically evaluate the effectiveness of KPIs in measuring business performance has taken on a pivotal role.

This thesis aims to explore the strong relationship between KPIs and business performance within the healthcare sector. Drawing inspiration from the diverse perspectives presented in contemporary literature, we delve into the various dimensions of KPIs — from their definition and importance to their categorization and types in various healthcare contexts and areas. As healthcare organizations navigate unprecedented challenges, the strategic alignment and tailored selection of KPIs emerge as pivotal and must-have components for sustainable success.

1.2. Objectives and Research Methodology

The goals of this study are threefold. Firstly, we aim to comprehensively assess and analyse the landscape of KPIs in healthcare, examining their definition, significance, and diverse perspectives offered by scholars in the field. Secondly, the focus extends to categorizing KPIs within the healthcare framework, and understanding how these indicators align with various perspectives such as financial, customer/patient, quality, employee-related, utilization of resources, and operational domains. Lastly, we aspire to investigate the critical need for the customization of KPIs following the specific context and goals of hospitals and healthcare institutions.

To achieve these objectives, a structured research methodology is implemented. The literature review serves as the foundation, offering a panoramic overall view of existing knowledge and insights. Afterward, a detailed questionnaire is designed, intending to engage healthcare managers and decision-makers. This qualitative approach aims to extract real-world experiences, challenges, knowledge, and successes encountered by healthcare institutions in their utilization of KPIs. By combining theoretical frameworks with practical experiences, this research seeks to contribute valuable insights that can inform and enhance the strategic use of KPIs in healthcare settings.

1.3. Macrostructure

The structure of this work has been carefully designed to facilitate a thorough understanding of the subject matter. It is divided into 6 primary chapters.

Chapter 2, the Literature Review, sets the theoretical framework for understanding what KPIs are, their importance, what type of KPIs are most commonly used in healthcare organizations, and which category of KPIs they belong to.

Chapter 3, Problem Definition and Research Questions, identifies the specific challenges and research gaps that this study aims to address. It also describes the main research questions that we strive to answer, providing a clear direction for the study.

Chapter 4, the Research Method, describes the approach adopted for data collection and analysis. It elaborates on the choice of methodology, highlighting its adequacy for this study and the measures taken to assure the integrity and reliability of the results.

Chapter 5, Experimental Results, presents the findings from the research. It includes a thorough analysis and interpretation of the results, relating them to the research questions and objectives outlined in Chapter 3.

Finally, Chapter 6, Conclusions, summarizes the research findings, elucidates their relevance to healthcare management, and proposes directions for future investigation. In addition, it offers actionable insights for decision-makers and practitioners, presenting potential approaches to enhance quality management within healthcare environments.

Chapter 2

Literature Review

2.1. Definition of KPIs and their Importance in the Healthcare Sector

As defined by Koumparouli (2013), KPIs are reference points used to measure a company's development, performance, or position. They can be financial or non-financial, short or long-term, strategic, departmental, or corporate.

In alignment with Koumparouli's (2013) perspective, Velimirovic (2010) defines KPIs as financial and non-financial indicators used by organizations to evaluate and reinforce their success in accomplishing long-term objectives. It emphasizes the importance of selecting appropriate indicators for the measurement and appraisal of organizational performance. In addition, this paper emphasizes the critical role of KPIs in providing a quantitative and qualitative expression of organizational results. It also emphasizes that KPIs enable effective organizations to express their success through numerical values, thereby facilitating the understanding, adjustment, and improvement of business across all departments.

Examining the common grounds between both authors on defining KPIs, both stress the dual nature of KPIs, acknowledging their financial and non-financial dimensions. Additionally, both highlight the importance of strategic alignment, emphasizing the need for indicators that align with long-term organizational objectives. While Koumparouli (2013) primarily emphasizes the

diverse temporal and hierarchical scopes of KPIs, Velimirovic (2010). accentuates the nuanced selection and expression of these indicators as integral components in organizational performance measurement. Despite nuanced differences in their emphasis, the collective insights from these scholars contribute to a comprehensive understanding of the multifaceted role that KPIs play in evaluating and enhancing organizational success.

Building on these perspectives, Hristov (2019) states that the selection of KPIs to include should be correlated with organizational strategic objectives, significant and effective to represent and explain the value creation process, and reliable, comprehensive, consistent, and comparable.

The paper also suggests that incorporating sustainability dimensions within corporate strategy would allow strategic alignment to gain competitive advantage and therefore create sustainability value. This means that companies should not only consider traditional financial metrics when setting KPIs, but also environmental and social metrics that reflect the company's impact on the planet and society.

Regarding healthcare, range of studies underscores the importance of key performance indicators (KPIs) in this sector. Burlea-Schiopoiu (2020) emphasizes the need for KPIs to evaluate, monitor, and control critical factors in healthcare, particularly during a crisis such as the COVID-19 pandemic for example.

The importance of KPIs in the healthcare sector lies in their ability to provide managers and employees with valuable insights for decision-making and performance improvement. The identification of specific KPIs allows healthcare facilities to focus on key areas that impact patient care, operational efficiency, and overall sustainability. For instance, the study identifies clusters of KPIs related to human factors such as clinical errors, infection rate, and medication

errors, and technical elements including laboratory test time, location of the facility, and sufficient air. Also, the use of KPIs in the healthcare sector facilitates strategic decision-making and crisis management. By measuring and tracking performance through KPIs, healthcare facilities can identify areas for improvement, set targets, and implement strategies to enhance patient care, operational efficiency, and employee well-being.

Behrouzi (2014) highlights the role of KPIs in evaluating the performance of healthcare accreditation programs and in strategic management and performance measurement, respectively. This study emphasizes the crucial role of KPIs in improving the performance and efficiency of the health sector.

2.2. KPIs Types and Categories in Healthcare

Categorizing Key Performance Indicators in healthcare is crucial for several reasons. Firstly, it allows healthcare facilities to prioritize focus areas and allocate resources accordingly. By grouping KPIs into categories, healthcare managers can identify the most critical areas that require attention and develop strategies to improve performance. Secondly, it facilitates benchmarking and performance comparison. By grouping KPIs into categories, healthcare facilities can compare their performance against industry standards and best practices. Thirdly, categorizing KPIs in healthcare facilitates communication and reporting in a way that healthcare managers can communicate their performance to stakeholders clearly and concisely. This enables stakeholders to understand the performance of healthcare facilities and make informed decisions (Burlea-Schiopoiu & Ferhati, 2020).

2.2.1. Operational KPIs

2.2.1.1. Waiting Time of Patients

This KPI measures the time a patient must wait before receiving care. Shorter wait times often indicate more efficient care delivery and higher patient satisfaction. Excessively long waits can lead to poor patient outcomes and dissatisfaction. Robinson et al., (2020) emphasize the impact of prolonged wait times on patient satisfaction, staff morale, and overall clinic efficiency. By measuring and shortening cycle time, the aim is to enhance patient experience, staff satisfaction, and patient access, ultimately improving the quality of care provided. Bleustein et al., (2014) add that satisfaction scores are more sensitive to time spent in the exam room than in the designated waiting room. By analysing the relationships between wait times and various satisfaction measures, healthcare providers can better understand the importance of minimizing wait times to enhance patient satisfaction and improve the overall care experience.

2.2.1.2. Indoor Air Quality

Indoor air quality is a critical KPI in the healthcare sector, as it directly impacts the health and well-being of patients and staff. Poor indoor air quality can lead to respiratory problems, allergies, and other health issues, which can compromise patient care and employee productivity. Therefore, healthcare facilities need to monitor and control indoor air quality through KPIs such as sufficient air conditioning and ventilation (Burlea-Schiopoiu & Ferhati, 2021). In addition, Leung & Chan (2006) emphasize the importance of effective engineering systems, including ventilation and filtration, to maintain superior Indoor Air Quality in critical areas such as operating theatres and isolation rooms. By implementing recommended Indoor Air Quality monitoring

methods and mitigation measures, healthcare facilities can prioritize Indoor Air Quality as a key indicator of a safe and healthy environment for all occupants.

2.2.1.3. Average Length of Stay

The average length of stay is a crucial KPI in hospital management. As highlighted by Baek et al., (2018), this KPI serves as an indicator of the efficiency of hospital operations and patient care. The research provides insights into the factors influencing Length of Stay, including departmental variations and medical conditions associated with longer stays.

2.2.2. Financial KPIs

2.2.2.1. Cost per Case

Cost per case is a critical KPI in evaluating hospital financial performance, as discussed by Alexander, Weiner, and Griffith (2006). The study examines the impact of quality improvement practices on cost per case, finding that higher proportions of hospital staff and senior managers on quality improvement teams are associated with lower average cost per case over the study period. Additionally, the research explores the influence of quality improvement intensity, including the number of guidelines employed by the hospital and the emphasis on quality improvement, on average cost per case. These findings highlight the significance of effective quality improvement implementation in influencing cost per case as a KPI in hospital financial performance.

2.2.3. Patient Experience

2.2.3.1. Patient Satisfaction Score

Patient satisfaction is a crucial KPI for evaluating the quality of healthcare services. Baruah et al., (2016) emphasize the significance of patient satisfaction as a multidimensional aspect and a vital indicator for measuring the success of doctors and hospitals. The study accentuates the importance of assessing patient satisfaction to identify areas of deficient services and improve overall organizational performance, stating that "assessing satisfaction in patients is a simple and easy way to point out areas of deficient services". Additionally, the article highlights the impact of patient satisfaction on clinical outcomes, patient retention, and the delivery of quality healthcare, noting that "patient satisfaction affects clinical outcomes, patient retention, and medical malpractice claims". Baruah et al., (2016) also discuss the use of patient satisfaction surveys as a quality improvement tool, emphasizing that "healthcare regulators shifted towards a market-driven approach of turning patient satisfaction surveys into quality improvement tool for overall organizational performance". Bleustein et al., (2014) add that, by analysing patient satisfaction scores, healthcare providers can gain valuable insights into the effectiveness of care delivery and the overall patient experience. This underscores the importance of prioritizing patient satisfaction as a KPI to drive improvements in healthcare delivery and enhance the quality of care provided.

2.2.4 Quality

2.2.4.1. Hospital Readmission Rate

Halfon et al., (2006) support the use of the potentially avoidable hospital readmission rate as a routine indicator of hospital care quality by addressing limitations of usual measures and providing evidence of its validity as a KPI. The article emphasizes the importance of identifying potentially avoidable readmissions and detecting readmissions in other hospitals as essential conditions for using the readmission rate as a KPI. The study's findings suggest that the hospital readmission rate, particularly the potentially avoidable readmission rate, can serve as a valuable KPI for monitoring the quality of the discharge process, especially in the context of resource constraints.

2.2.5. Employee Related

2.2.5.1. Employee Turnover Ratio

Collini et al., (2015) emphasize the significant threat that turnover poses to the mission of creating a healing environment for patients and the financial stability of healthcare organizations. By understanding the mediating effects of employee engagement on turnover, healthcare organizations can better assess and address factors such as interpersonal respect, diversity climate, and mission fulfillment that contribute to turnover rates. Therefore, while Collini et al., (2015) do not directly focus on the employee turnover ratio as a KPI, its findings underscore the importance of considering turnover rates and employee engagement in healthcare management practices to create a more supportive and effective work environment. Collins et al., (2015) add that by tracking and

analysing employee turnover rates, healthcare managers can gain valuable insights into the stability of their workforce, identify areas for improvement in employee retention strategies, and assess the overall health of the organization. Monitoring the employee turnover ratio allows healthcare facilities to make informed decisions to address turnover challenges, enhance employee morale, increase productivity, and reduce recruitment and termination costs.

2.2.6. Resource Utilization

2.2.6.1. Bed Occupancy Rate

Bed occupancy is a crucial KPI in hospital management, as highlighted by Jones (2015). The author emphasizes the impact of high bed occupancy on patient care and safety, stating that "bed occupancy above 85% leads to increased risk of hospital-acquired infection, serious errors, staff consumption of antidepressants, and higher mortality". It also discusses the relationship between bed occupancy and hospital mortality, indicating that sudden and large step-increases in all-cause mortality can affect emergency medical admissions and average occupancy, ultimately contributing to overall mortality rates. This underscores the significance of monitoring bed occupancy as a KPI to ensure patient safety and quality of care in healthcare facilities.

Chapter 3

Problem Definition and Research Questions

3.1. Problem Definition

The healthcare industry is a dynamic and critical sector that demands continuous evaluation and improvement. As organizations strive for better performance, the utilization of KPIs has become indispensable. KPIs serve as vital benchmarks, allowing healthcare facilities to gauge their performance across various dimensions. However, the effectiveness of these KPIs in truly measuring business performance remains a subject of scrutiny.

Effectively measuring business performance in healthcare is more than a matter of routine evaluation, it's an essential element for delivering high-quality patient care, ensuring operational efficiency, and maintaining financial stability. The importance of this problem is underlined by the multifaceted nature of the healthcare ecosystem, where success depends on a sensitive balance between clinical outcomes, patient satisfaction, and financial stability.

3.1.1. Existing Gaps and Challenges

A comprehensive review of existing literature reveals that there are critical gaps and challenges in the current approach regarding KPIs usage in healthcare. Different measurement methodologies and perspectives on success, and the need for strategic alignment with organizational objectives appear as current themes. These gaps do not only hinder an accurate assessment of

business performance, but also complicate the ability to derive actionable insights for continuous improvement.

3.2. Research Questions

The research questions that are addressed in this dissertation are presented in Table 1.

Research Questions	Objectives
Are Hospital Managers (or similar roles of management) familiar with the concept of KPIs?	Assess the overall effectiveness of KPIs in providing accurate measurements of business performance within healthcare organizations.
To what extent do Hospital Managers (or similar roles of management) use KPIs in their current hospital's management practices?	Analyse the extent of KPI utilization among Hospital Managers.
To what extent are KPIs effective in accurately measuring business performance in the healthcare industry?	Evaluate the effectiveness of KPIs in providing measurements of business performance in the healthcare industry.
How well-aligned are current KPIs in healthcare organizations with their strategic objectives?	Assess the level of alignment between existing KPIs and the strategic objectives of healthcare organizations.
What challenges exist in ensuring strategic alignment between organizational goals and chosen KPIs?	Identify the challenges faced by healthcare organizations in selecting and aligning KPIs with their organizational goals.

Research Questions	Objectives
How do KPIs influence decision-making processes within healthcare organizations?	Investigate the impact of KPIs on decision-making processes in healthcare organizations.
To what extent do healthcare organizations adapt KPIs to their specific contexts and goals?	Analyse the extent to which healthcare organizations customize and adapt KPIs to their specific contexts and goals.
In the eyes of healthcare managers, what improvements can be made in the use of KPIs for better business performance measurement?	Gather insights from healthcare managers to identify areas of improvement in the current utilization of KPIs, to elevate their effectiveness in measuring business performance.
Do the KPIs identified in the literature review adequately cover the diverse aspects of business performance in healthcare, or are additional indicators necessary?	Evaluate whether the KPIs identified in the literature review cover the diverse aspects of business performance in healthcare, or not.
If healthcare managers identify a need for additional KPIs, what specific indicators do they consider relevant and why?	Identify specific KPIs that healthcare managers believe are relevant and necessary for a comprehensive evaluation of business performance in healthcare, and explore the reason behind their choices.

Table 1 - Research questions and objectives

Chapter 4

Research Method

4.1. Method Definition

4.1.1. Research Design

The research adopts a quantitative approach to gather empirical data from healthcare managers or similar roles within healthcare organizations. A structured questionnaire is employed to collect responses, enabling the quantification of opinions and perceptions regarding the use and effectiveness of KPIs in measuring business performance.

4.1.2. Data Collection Method

A comprehensive questionnaire is developed based on insights from the literature review and the research questions formulated in Chapter 3. The questionnaire is designed to capture information about the utilization, alignment, and perceived impact of KPIs within healthcare organizations.

The questionnaire was distributed electronically to a targeted sample of healthcare managers across various healthcare organizations between February to March 2024. The electronic distribution allows for efficient data collection while ensuring anonymity and confidentiality of responses.

The population of interest comprises healthcare managers or individuals in similar managerial roles within healthcare organizations, encompassing hospitals, clinics, and healthcare service providers.

4.2. Regression Analysis

Sykes (1993) explains Regression Analysis as a statistical methodology utilized to examine the relationships between variables. The primary objective is often to understand the causal impact of one variable on another—for example, assessing how a price increase affects demand or the influence of money supply changes on inflation rates. By collecting data on relevant variables and applying regression methods, researchers estimate the quantitative impact of causal variables on the influenced variable, as well as the statistical significance of these relationships, which indicates the confidence level in the true relationship being close to the estimated one.

4.2.1. Multiple Linear Regression Model

The Multiple Linear Regression (MLR) Model is a statistical technique used to predict the outcome of a dependent variable based on the values of two or more independent variables. This method is particularly useful when the dependent variable is influenced by several factors, making it a versatile tool for analysing the interplay between different variables (Uyanik, et al., 2013).

Multiple linear regression analysis is carried out in this study using Microsoft Excel's Data Analysis tool.

This type of regression analysis enables the simultaneous examination of multiple independent factors' impact on the dependent variable, as well as the exploration of the connections between these factors and various predictor variables.

Therefore, this model is employed to enhance understanding of how KPIs are currently used within healthcare organizations. The multiple linear regression model provides a dependable statistical approach to analyse the relationship between this factor and several independent variables.

4.2.2. P-value

The p-value, a statistical measure ranging from 0 to 1, helps interpret the likelihood that research findings are due to chance. As described by O'Brien et al., (2015), a p-value below 0.05 usually indicates a statistically significant difference, suggesting evidence against the null hypothesis. However, it's critical to note that a p-value doesn't confirm absolute truth or clinical relevance. Misinterpretations of p-values, such as viewing a high p-value as evidence for the null hypothesis or treating $p < 0.05$ as an absolute marker of significance, can lead to flawed conclusions. O'Brien et al., (2015) emphasize the importance of viewing the p-value as one of several tools in research evaluation, advocating for its use in context with other study elements to ensure robust and accurate interpretations of data.

4.2.3. Significance F

The F-statistic tests whether the regression model significantly fits the data better than a model with no predictors. If the p-value of the F-statistic is less than the significance level, the model is considered a better fit. The F-test of overall significance is crucial for determining whether all predictor variables in a regression model are jointly significant. While individual predictor variables

may not be significant on their own, the F-test can reveal their collective significance in the model (Sureiman & Mangera, 2020).

Chapter 5

Experimental Results

In this section, we present the outcomes obtained from our experimental investigations. We first provide an overview of the dataset, detailing its characteristics, followed by a descriptive analysis of the data gathered through the questionnaire, and lastly, we present the results and conclusions from our data exploration, utilizing various techniques such as correlation and regression analysis.

5.1. Dataset Characterization

The questionnaire was made via Google Forms, with 14 questions in total. A total of 50 answers were collected and then examined and analysed.

5.2. Descriptive Analysis

This chapter presents a descriptive analysis of the data collected through the questionnaire administered to healthcare managers regarding the utilization and effectiveness of KPIs in measuring business performance within the healthcare industry. The analysis aims to provide a comprehensive overview of the respondents' perceptions, practices, and experiences related to KPIs, offering insights into the current landscape of KPI utilization in healthcare management.

Figure 1 shows that the role of Department Manager made up almost half of the respondents, with Chief Executive and Hospital Manager representing 23% and 20% of the respondents, respectively. 12% of the respondents were in other types of management roles.

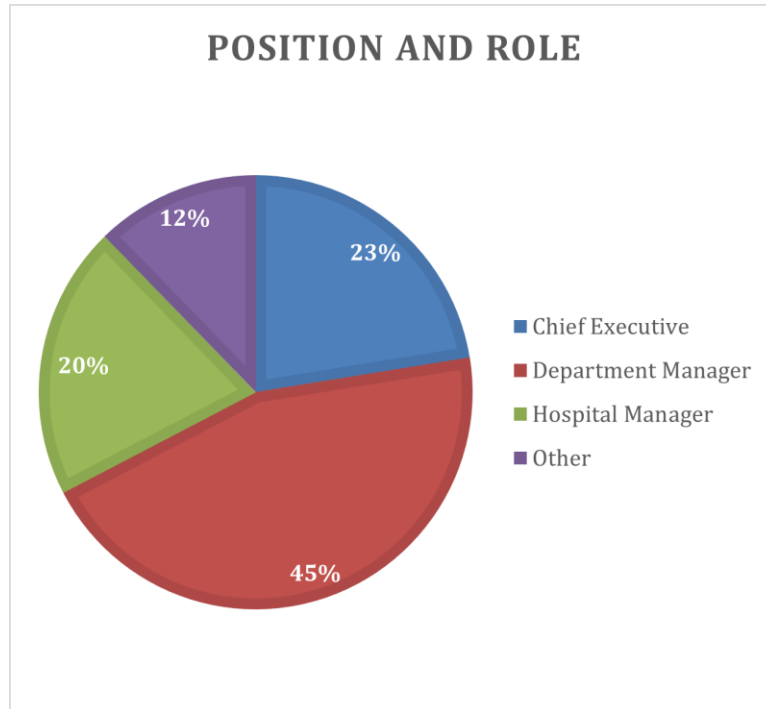


Figure 1 - Position and Role of the Respondents

Figure 2 shows the different years of experience of the respondents. As we can see by the chart, most of the answers came from respondents with more than 10 years of experience in management roles in the healthcare sector. Next came respondents with 5 to 10 years of experience, with 27%, and lastly, respondents with less than 5 years of experience represented only 8% of the responses.

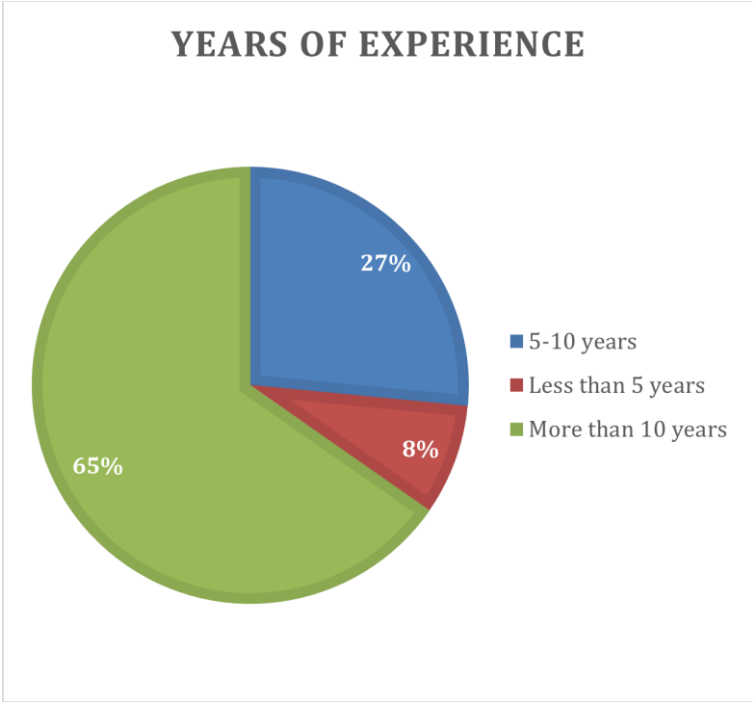


Figure 2 – Respondents' Years of Experience

By analysing Figure 3, we can see that most of the respondents were already very familiar with the concept of KPIs, and 20% of them were somewhat familiar. Only 4% of the respondents were not familiar with the concept of KPIs.

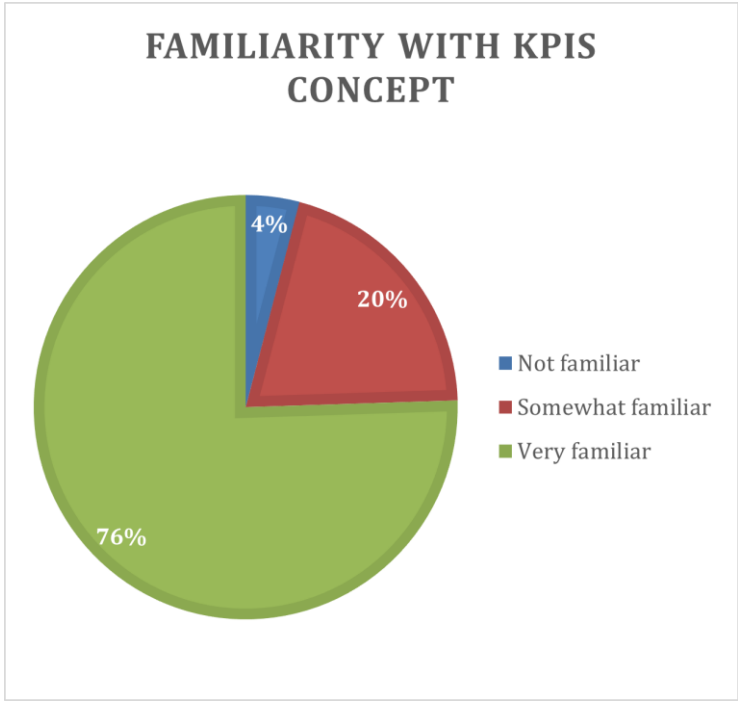


Figure 3 – Respondents' Familiarity with the KPIs concept

As shown in Figure 4, the average usage of KPIs is 1.86. Since 'Extensively' is the first category and 'Not at all' is the last, corresponding from 1 to 4 in that order, a mean of 1.86 suggests that, on average, respondents are between 'Extensively' and 'Moderately' in terms of KPI usage.

The standard deviation is 0.808. This indicates the amount of variation or dispersion of KPI usage from the mean. A lower standard deviation would suggest that most responses are close to the mean, while a higher standard deviation would indicate more spread-out responses. In this context, a standard deviation of 0.808 shows a moderate to high level of variation in the responses.

It seems that within the healthcare sector, as per the responses, KPIs are generally used to a moderate or extensive degree, with minimal or no usage being less common. This could suggest an acknowledgment of the importance of KPIs in performance measurement but also indicates room for increased adoption or more effective use.

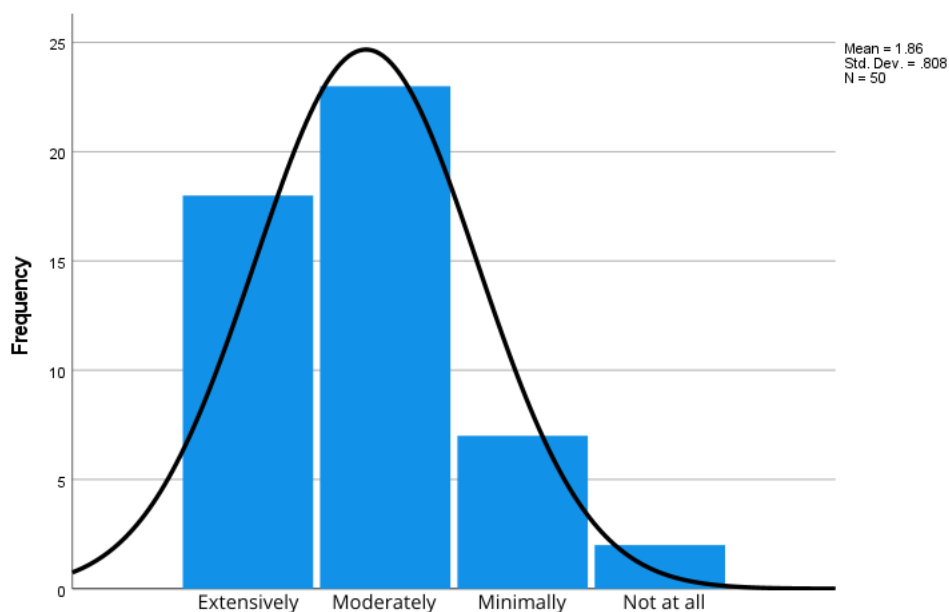


Figure 4 - Current use of KPIs in Respondents' Organization

Figure 5 represents responses about the sufficiency of KPIs listed in the literature review for business performance measurement.

The results imply a prevailing sentiment among respondents that the KPIs listed in the literature for business performance measurement in the healthcare sector may not be sufficient, with just a few respondents thinking otherwise. This could indicate a gap between the theoretical KPIs proposed in the literature and the practical needs or expectations of professionals in the field.

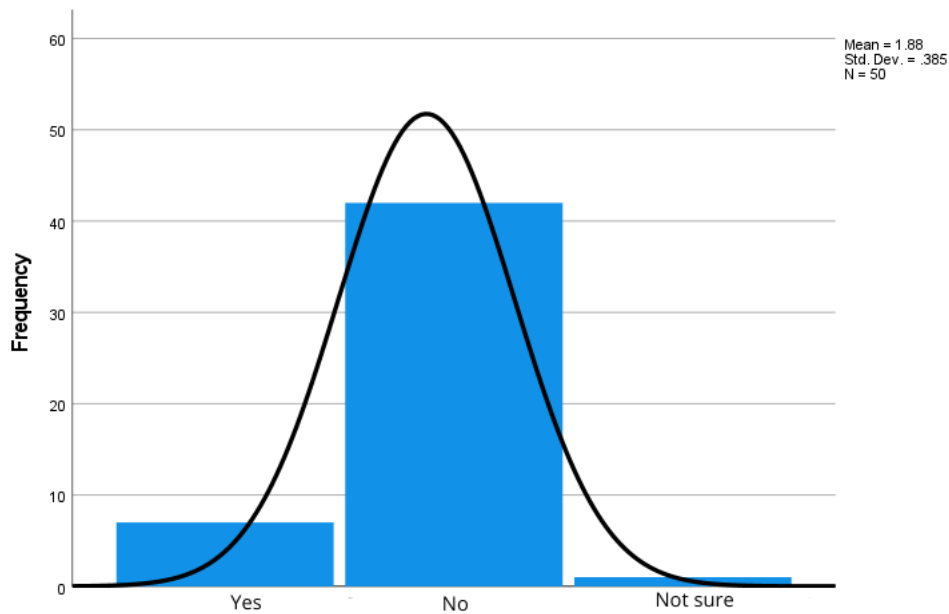


Figure 5 – Distribution of answers to the question related to the sufficiency of KPIs listed in the Literature Review for business performance measurement

Figure 6 represents responses to a question about the perceived effectiveness of KPIs in measuring business performance. The responses are categorized into five options: very effective, somewhat effective, neutral, somewhat ineffective, and very ineffective.

The mean score is 1.58, which, based on the ordering of responses, suggests that the average perception leans towards KPIs being between 'very effective' and 'somewhat effective'. This indicates a generally positive view of KPI effectiveness among the respondents.

The standard deviation is 0.673. This is a relatively small value, showing that responses are quite close to the mean, indicating a lower level of disagreement among the respondents about their perceptions of KPI effectiveness.

The chart suggests that among the respondents, there is a tendency to view KPIs as effective tools for measuring business performance, with most responses clustering around 'somewhat effective' and 'very effective'. This positive assessment of KPIs could reflect a belief in their utility and relevance in the healthcare sector.

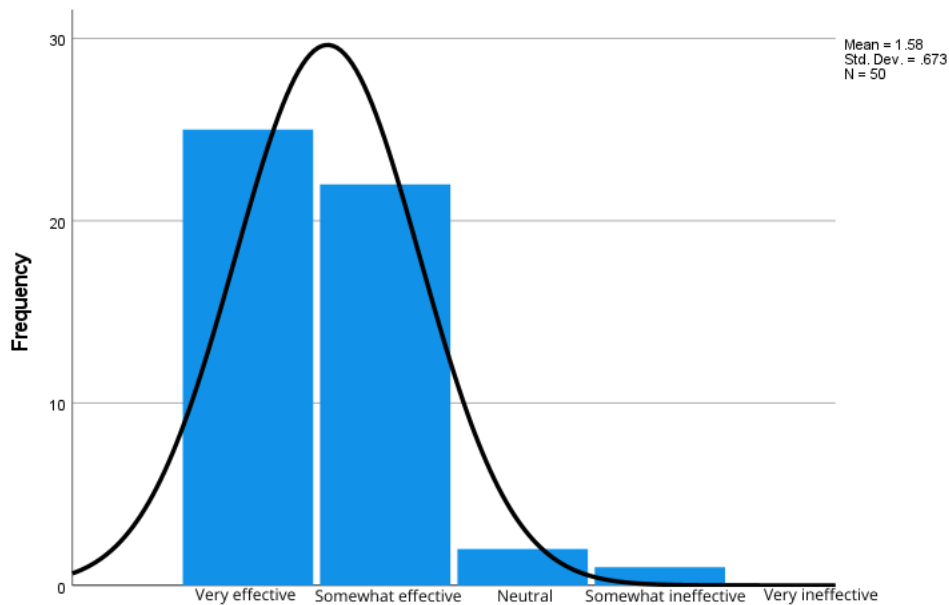


Figure 6 – Distribution of answers to the question related to KPIs effectiveness in measuring business performance

Figure 7 represents responses to how KPIs are selected in healthcare organizations, with several categories ranging from 'Aligned with industry standards' to 'Not applicable'. The categories are encoded numerically from 1 to 8, corresponding to specific criteria used for selecting KPIs.

The highest frequency falls on the category labelled 6, which corresponds to KPIs being 'Aligned with industry standards, Tailored to hospital-specific goals, Regulatory requirements'. This suggests that many organizations select their KPIs based on a combination of factors that include industry standards, customization for specific organizational goals, and regulatory compliance.

The next highest categories are '4' and '2', suggesting that a significant number of organizations also rely on either a combination of industry alignment and specific goal tailoring or just specific goal tailoring, respectively.

Categories '3', '5', and '7' have fewer responses, which involve regulatory requirements alone or in combination with other factors.

The '1' (aligned with industry standards only) and '8' (not applicable) categories have the least frequency, indicating these are less common as sole criteria for KPI selection.

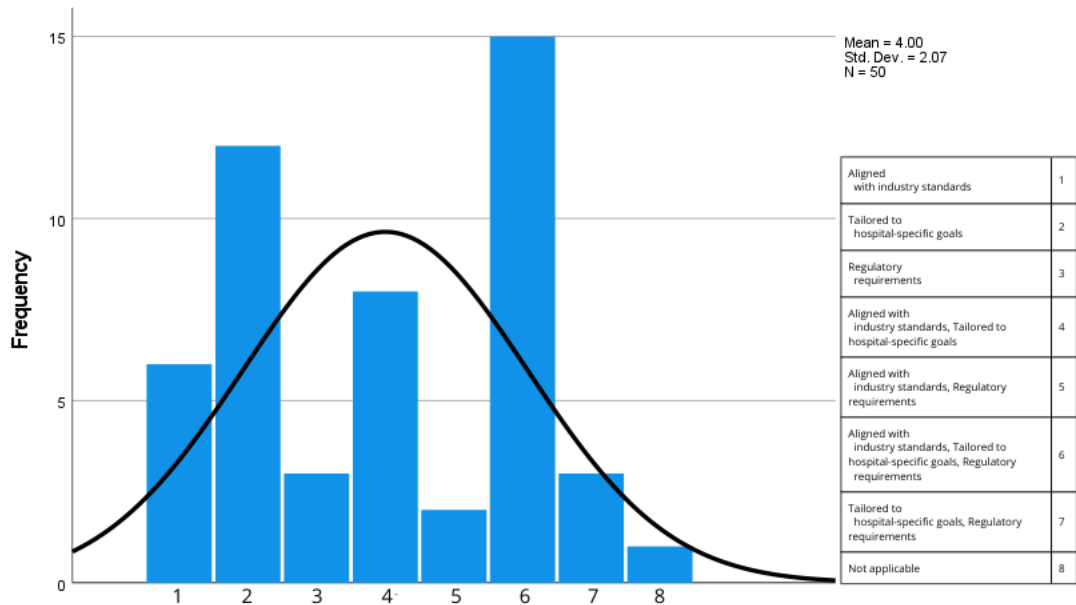


Figure 7 – Distribution of answers to the question “How are KPIs selected in your Healthcare organization?”

Figure 8 represents responses regarding the necessity of KPI customization to suit specific organizational challenges and goals in the healthcare sector.

Based on this distribution, it can be interpreted that there is a consensus among respondents that KPIs require customization, with most respondents indicating a preference for moderate to high customization. This suggests that there may be an understanding within the healthcare sector that KPIs should be tailored to meet the unique demands and objectives of each organization.

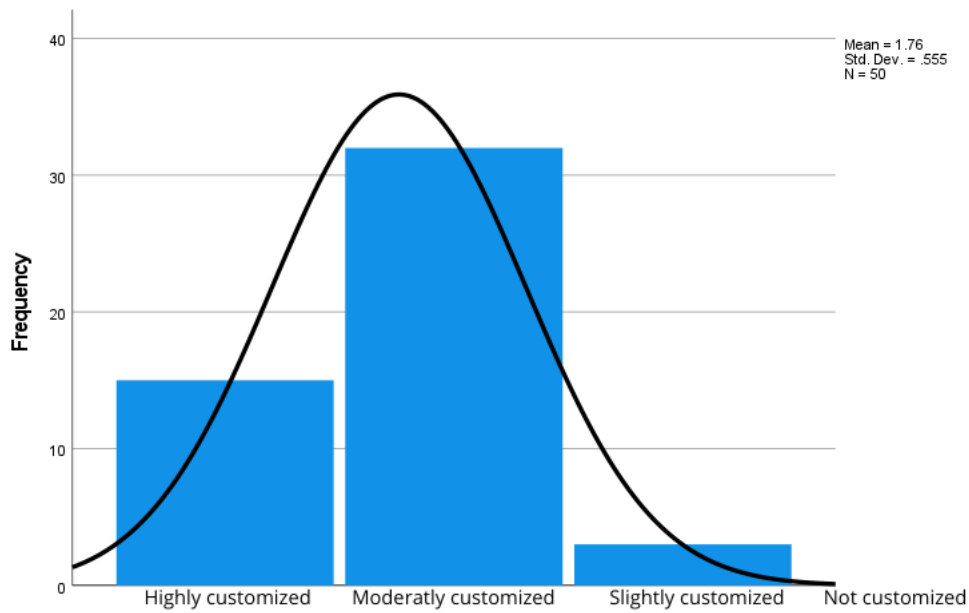


Figure 8 – Distribution of answers to the question related to the necessity of KPI customization to suit specific organization challenges and goals

In Figure 9, the bar chart illustrates the frequency of mentions of various challenges encountered in implementing KPIs in hospital management, as reported by survey respondents.

The results suggest that concerns about the quality of data are the most common when implementing KPIs in hospital management, followed by resistance to change. Besides that, it's also possible to conclude that many challenges involving Data were mentioned.

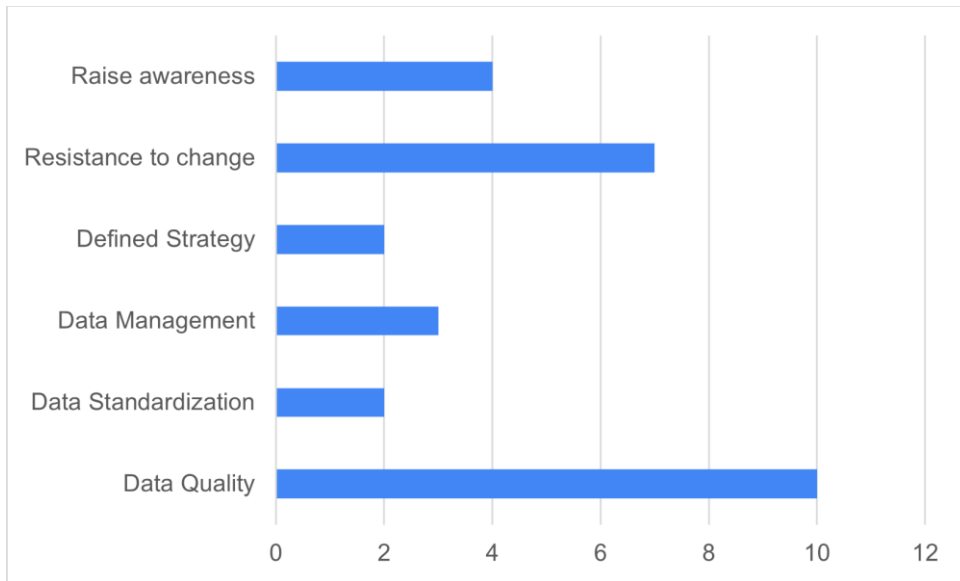


Figure 9 – Answers to the question “What challenges, if any, have you encountered in implementing KPIs in hospital management?”

Figure 10 shows the frequency of specific benefits associated with the implementation of KPI in hospital performance, as mentioned by survey respondents.

The “Improved management; Controlling; Strategy” was mentioned 8 times, which indicates that KPIs are highly regarded for improving management practices, providing better control, and helping in strategic planning. Followed by that we have “Efficiency; Effectiveness”, “Understanding of performance” and “Clarity; Transparency”, with 5, 4, and 3 mentions, respectively. That suggests that KPIs are seen as an instrument that improves performance and contributes to a better understanding of it, more clearly and transparently. “Process optimization” and “Monitorization” are also mentioned as benefits of KPIs in overall performance.

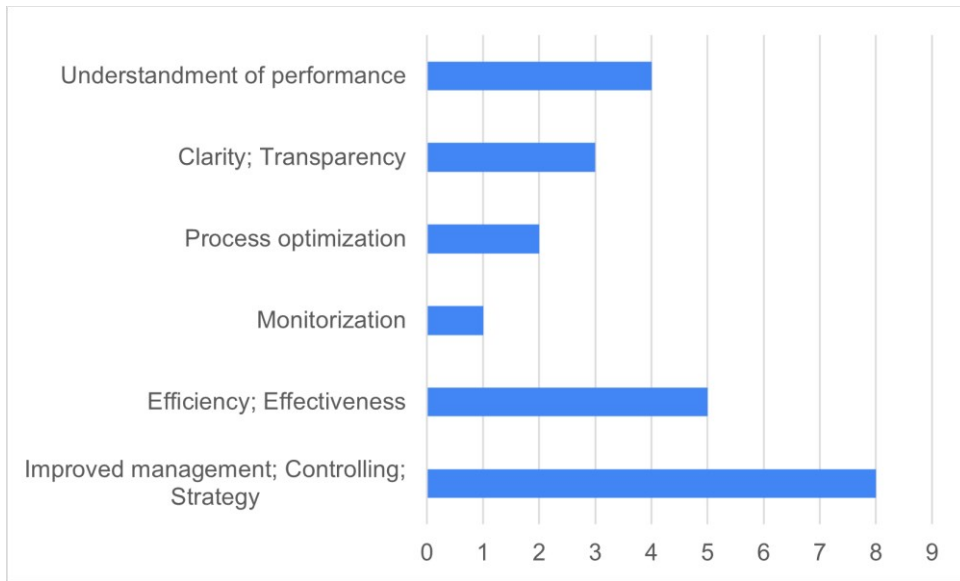


Figure 10 – Answers to the question “In your opinion, what specific benefits have KPIs brought to your hospital’s overall performance?”

Figure 11 shows the frequency of certain terms mentioned by respondents when asked about potential improvements for better business performance measurement using KPIs in healthcare.

Overall, the chart suggests that there is a desire among the respondents to improve data collection practices, customize KPIs to specific needs, and provide more management training, with a focus on increasing awareness and transparency in KPI-related processes. Standardization, while seen as less of a priority compared to the other areas, is still noted as an area for improvement.

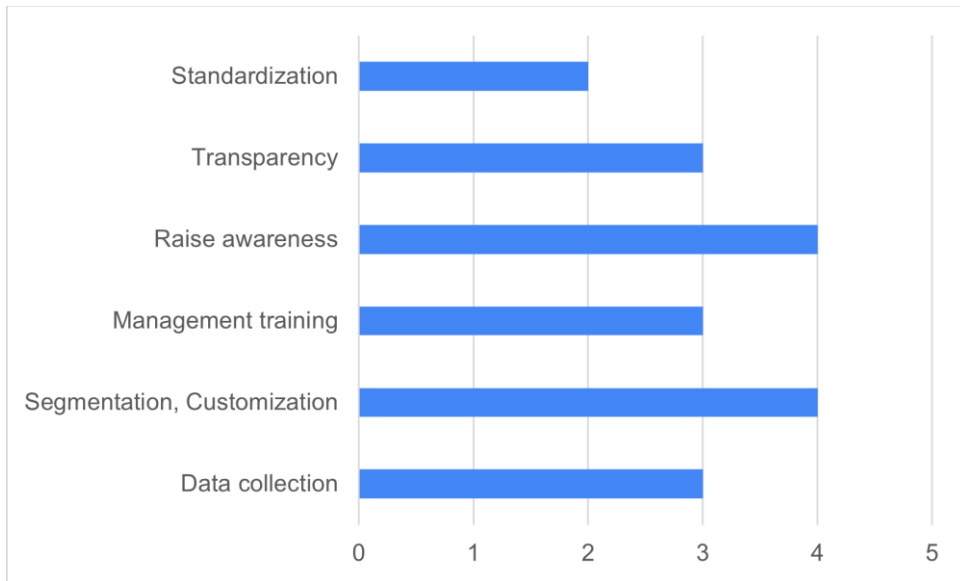


Figure 11 – Answers to the question “In your opinion, what improvements can be made in the use of KPIs for better business performance measurement in healthcare?”

Figure 12 indicates the frequency with which certain terms were mentioned by respondents when asked about specific areas or trends in healthcare management where KPIs could have a more significant role in the future.

The data suggest that respondents believe KPIs will become increasingly important in financial incentives, service quality, and integrating new technologies in healthcare management, with growing trends like digitalization and sustainability also being areas of potential KPI application.

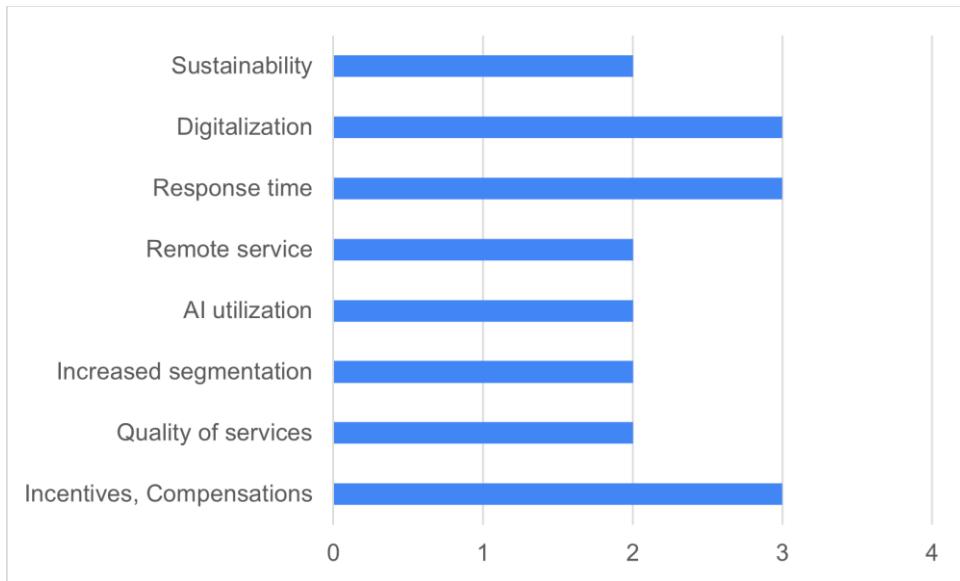


Figure 12 – Answers to the question “Are there specific areas or trends in healthcare management where you believe KPIs could play a more significant role in the future?”

5.3. Statistical Analysis and Discussion

The correlation coefficients between the different pairs of variables in our data are displayed in this correlation matrix, which shows the correlation coefficients between various factors related to KPIs. The factors include role, experience, familiarity with KPIs, KPI current use, sufficiency, effectiveness, selection, and customization.

The correlation coefficient values range from -1 to 1. A value of 1 indicates a perfect positive correlation, -1 indicates a perfect negative correlation, and 0 indicates no correlation. Positive values suggest a direct relationship, whereas one variable increases, the other tends to increase. Negative values suggest an inverse relationship, whereas one variable increases, the other tends to decrease.

Correlations between the different factors are presented in the correlation matrix below as Table 2, which are “Position and Role” survey question (PnR), “Years of Experience” survey question (YofE), “How familiar are you with the concept of Key Performance Indicators (KPIs)?” survey question (FamKPI), “To

what extent are KPIs currently utilized in your hospital's management practices?" survey question (CurUseKPI), "Do you believe the following KPIs are sufficient to comprehensively measure business performance? Wait Time of Patients; Indoor Air Quality; Average Length of Stay; Cost per Case; Patients Satisfaction Score; Hospital Readmission Rate; Employee Turnover Ratio; Bed Occupancy Rate" survey question (SuffKPI), "How effective do you believe KPIs are in measuring the business performance of the hospital?" survey question (EffKPI), "How are KPIs selected in your hospital? (Check all that apply)" survey question (SelKPI), and "To what extent do you believe KPIs need to be customized to suit the unique challenges and goals of the healthcare industry?" survey question (CustKPI).

Factors	PnR	YofE	FamKPI	CurUse KPI	SuffKPI	EffKPI	SelKPI	CustKPI
PnR	1							
YofE	-0,17	1						
FamKPI	0,39	0,05	1					
CurUseKPI	0,42	0,24	0,56	1				
SuffKPI	0,25	0,04	0,17	0,21	1			
EffKPI	0,23	0,01	0,33	0,42	0,20	1		
SelKPI	0,21	-0,25	0,09	-0,13	-0,05	-0,22	1	
CustKPI	-0,16	0,00	0,02	0,11	0,15	0,16	-0,05	1

Table 2 - Correlation between different factors

By analysing the correlations between the different factors presented in Table 2, it's possible to see that 'FamKPI and 'CurUseKPI' have a strong positive correlation (0.562). This suggests that respondents who answered positively on their familiarity with KPIs tended to respond positively to the question of to what extent they currently use KPIs.

While interpreting this matrix, it's important to consider that correlation does not imply causation. A high or low correlation between two factors does not necessarily mean that one causes the other. Other factors may be involved, and these relationships can only suggest possible areas for further investigation.

5.3.1. Regression Analysis

Model 1

This analysis will aim to understand how six variables (PnR, YofE, FamKPI, EffKPI, SelKPI, CustKPI) influence the variable CurUseKPI, that being the current use of KPIs on the healthcare organization of the respondent. As per the Equation:

$$\text{CurUseKPI} = -0.67 + 0.28\text{PnR} + 0.3\text{YofE} + 0.57 \text{FamKPI} + 0.2\text{EffKPI} - 0.05 \text{SelKPI} + 0.17\text{CusKPI}$$

The following regression statistics are provided in Table 3:

- The Multiple R value is 0.71, which suggests moderately strong positive correlations between the CurUseKPI dependent variable, and all the independent variables combined.
- The R Square value is 0.51. This means that approximately 51% of the variability in the dependent variable can be explained by the factors in this model.
- Adjusted R Square value is 0.44. This is a more accurate measure of the strength of the model, as it adjusts for the number of predictors in the model. A value of 0.44 is still a good number, indicating that the model explains 44% of the dependent variable.
- A Standard Error of 0.61 is a measure of the average difference between the predicted and actual CurUseKPI.

Regression Statistics	
Multiple R	0.71
R Square	0.51
Adjusted R Square	0.44
Standard Error	0.61

Regression Statistics	
Observations	50

Table 3- Regression statistics for CurUseKPI as a dependent variable

Based on the values from Table 4, the F statistic is 7.33, with a corresponding Significance F of just 0.00002, which tells us that the variables together are statistically significant in predicting CurUseKPI, as the p-value is less than 0.05. This means that the combined effect of the independent variables on CurUseKPI is not due to random chance.

ANOVA					
	df	SS	MS	F	Significance F
Regression	6	16.19	2.7	7.33	0.00002
Residual	43	15.83	0.37		
Total	49	23.02			

Table 4 - ANOVA for CurUseKPI as a dependent variable

In Table 5, we can examine how the variables are related.

The Intercept coefficient is -0.67. This means that when all the independent variables are equal to zero, the expected value of the dependent variable would be -0.67.

As for the independent variables:

- PnR, YofE, and FamKPI all have p-values below 0.05, indicating that they're statistically significant at the 95% confidence level. The other three independent variables have a p-value above 0.05, which indicates that they are not statistically significant at the 95% confidence level.
- FamKPI coefficient value is 0.57, which means that for every one-unit increase in PnR, CurUseKPI is expected to increase by 0.57 units. This indicates that the more familiarity the respondent had with KPIs, the

more he was likely to answer positively when asked about his current use of KPIs in his healthcare organization.

- YofE coefficient value is 0.3, which means that for every one-unit increase in YofE, CurUseKPI is expected to increase by 0.3 units. This means that the more years of experience the respondent had, the more he was likely to answer positively when asked about his current use of KPI in his healthcare organization.
- The PnR coefficient value is 0.28, which means that for every one-unit increase in PnR, CurUseKPI is expected to increase by 0.28 units.

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	-0,67	0,62	-1,08	0,29	-1,91	0,57	-1,91	0,57
PnR	0,28	0,11	2,59	0,01	0,06	0,50	0,06	0,50
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
YofE	0,30	0,14	2,11	0,04	0,01	0,59	0,01	0,59
FamKPI	0,57	0,19	3,08	0,00	0,20	0,95	0,20	0,95
EffKPI	0,20	0,15	1,35	0,18	-0,10	0,49	-0,10	0,49
SelKPI	-0,05	0,05	-1,15	0,26	-0,15	0,04	-0,15	0,04
CusKPI	0,17	0,16	1,03	0,31	-0,16	0,49	-0,16	0,49

Table 5 – MLR results for CurUseKPI as a dependent variable

In conclusion, Model 1 finds PnR, YofE, and FamKPI variables as significant predictors of CurUseKPI, explaining a solid portion of the. Variation. The rest of the variables have p-values above 0.05, indicating their effects on CurUseKPI are not statistically significant.

Model 2

This analysis will aim to understand how six variables (PnR, YofE, FamKPI, CurUseKPI, SelKPI, CustKPI) influence the variable EffKPI, that being the effectiveness of KPIs on the healthcare organization of the respondent. As per the Equation:

$$\text{EffKPI} = -1.04 + 0.08\text{PnR} - 0.1\text{YofE} + 0.22 \text{FamKPI} + 0.21\text{CurUseKPI} - 0.08 \text{SelKPI} + 0.16\text{CusKPI}$$

The following regression statistics are provided in Table 6:

- The Multiple R value is 0.51, which suggests moderate positive correlations between the EffKPI dependent variable and all the independent variables combined.
- The R Square value is 0.26. This means that approximately 26% of the variability in the dependent variable can be explained by the factors in this model, suggesting that many factors that influence EffKPI are not captured in the model.
- Adjusted R Square value is just 0.16. A value of 0.16 further indicates that the model explains a small portion of the variance in EffKPI.
- A Standard Error of 0.62 is a measure of the average difference between the predicted and actual EffKPI.

Regression Statistics	
Multiple R	0.51
R Square	0.26
Adjusted R Square	0.16
Standard Error	0.62
Observations	50

Table 6 - Regression Statistics for EffKPI as a dependent variable

Based on the values from Table 7, the F statistic is 2.52, with a corresponding Significance F of just 0.035, which tells us that the variables together are statistically significant in predicting EffKPI, as the Significance F is less than 0.05. This means that the combined effect of the independent variables on EffKPI is not due to random chance.

ANOVA					
	df	SS	MS	F	Significance F
Regression	6	5.78	0.96	2.52	0.035
Residual	43	16.40	0.38		
Total	49	22.18			

Table 7 - ANOVA for EffKPI as a dependent variable

As Table 8 indicates, none of the independent variables have a P-value less than 0.05, which is the conventional cutoff for statistical significance. This would suggest that none of the variables have a statistically significant impact on EffKPI. However, it's essential to consider the following:

- The CurUseKPI has a p-value of 0.184, which is close to 0.05, so it might be of interest in a larger sample or different context.
- P-values are a function of the effect size and the sample size. A larger sample might find even small effects to be significant.

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	1.04	0.61	1.69	0.10	-0.20	2.28	-0.20	2.28
PnR	0.08	0.12	0.68	0.50	-0.16	0.32	-0.16	0.32
YofE	-0.10	0.15	-0.69	0.49	-0.41	0.20	-0.41	0.20
FamKPI	0.22	0.21	1.06	0.29	-0.20	0.63	-0.20	0.63
EffKPI	0.21	0.15	1.35	0.18	-0.10	0.51	-0.10	0.51
SelKPI	-0.08	0.05	-1.72	0.09	-0.17	0.01	-0.17	0.01
CusKPI	0.16	0.17	1.00	0.32	-0.17	0.50	-0.17	0.50

Table 8 - MLR results for EffKPI as dependent variable

Chapter 6

Conclusions

6.1. General Conclusions

The research embarked on a comprehensive analysis of KPIs within the healthcare industry, aiming to elucidate their effectiveness and importance in measuring business performance. Through an extensive literature review and a robust analysis of questionnaire responses from healthcare management professionals, it has been determined that KPIs are integral tools for strategic decision-making, operational efficiency, and improving the quality of service delivered. The evidence suggests that KPIs, when carefully selected and effectively utilized, can significantly influence management practices, leading to improved patient care and optimized organizational performance. However, the data also underscores a critical need for the customization of KPIs to the unique challenges and objectives of healthcare institutions, indicating a move away from one-size-fits-all metrics.

Regarding the Regression Analysis, An examination of multiple linear regressions was carried out in Excel. The simultaneous investigation of the impact of numerous independent factors on the two dependent variables was made possible by this kind of regression analysis. Our two models aimed to learn more about the current use of KPIs in healthcare institutions, as well the managers' perspective on how efficient they are in measuring business performance.

In this analysis, several regression tables were examined, illustrating the degree of influence that various variables have on the dependent variables

'CurUseKPI' and 'EffKPI'. These variables included 'PnR', 'YofE', 'FamKPI', 'SelKPI', 'CusKPI', 'CurUseKPI' (on Model 2), and 'EffKPI' (on Model 1).

The analysis showed that the influence of these variables on the dependent were statistically significant in both models, as the p-value was above 0.05.

6.2. Theoretical Contributions

This study contributes to the theoretical understanding of performance measurement by reinforcing the significance and benefits of aligning KPIs with strategic objectives within healthcare management. It also expands on the importance of data quality and the need for KPIs to evolve alongside technological advancements in healthcare. The study bridges theoretical knowledge with empirical data, offering a unique perspective on the pragmatic challenges and benefits associated with KPI usage in the healthcare sector.

6.3. Managerial Implications and Recommendations

Findings from this research hold practical implications for healthcare managers. They underscore the necessity for continuous KPI refinement to ensure they reflect the dynamism of healthcare management. It is recommended that healthcare organizations invest in training programs to raise awareness and enhance the understanding of KPIs among staff, and also invest in management training for KPI understanding and usage. Additionally, there is a clear need for investing in digitalization and AI to leverage data analytics for more accurate and real-time performance measurement. Managers should consider these tools as indispensable allies in the quest for operational excellence.

6.4. Limitations and Future Research

The limitations of this study arise from the sample size and the homogeneity of the respondents. Future research should consider a more diverse pool of healthcare institutions and possibly a longitudinal study to assess the evolution of KPI effectiveness over time.

Additionally, the study presents an opportunity to delve into the effects of innovative technologies on the formulation and application of KPIs. Given the rapid evolution in healthcare services, especially in response to global challenges like the COVID-19 pandemic, further investigations could evaluate how KPIs are adapted for use in healthcare crisis management and emergency protocols.

References

Koumparoulis D, (2013). Key Performance Indicators (KPI): A Commentary. International Journal of Management Sciences IJMS. https://www.academia.edu/5080617/Key_Performance_Indicators_KPI_A_Commentary

Velimirovic, Dragana & Velimirovic, Milan & Rade, Stanković. (2011). Role and importance of key performance indicators measurement. Serbian Journal of Management. DOI: 10.5937/sjm1101063V

Hristov & Chirico, (2019). The Role of Sustainability Key Performance Indicators (KPIs) in Implementing Sustainable Strategies. Sustainability. doi:10.3390/su11205742

Burlea-Schiopoiu A, Ferhati K (2020). The Managerial Implications of the Key Performance Indicators in Healthcare Sector: A Cluster Analysis. Healthcare (Basel). doi: 10.3390/healthcare9010019. PMID: 33375693; PMCID: PMC7823544.

Behrouzi, Farshad & M Shaharoun, Awaluddin & Ma'aram, Azanizawati. (2014). Applications of the balanced scorecard for strategic management and performance measurement in the health sector. Australian health review. DOI: 10.1071/AH13170

Robinson J, Porter M, Montalvo Y, et al. Losing the wait: improving patient cycle time in primary care. BMJ Open Quality. doi:10.1136/bmjoq-2019-000910

Baek, Hyunyoung & Cho, Minsu & Kim, Seok & Hwang, Hee & Song, Minseok & Yoo, Sooyoung. (2018). Analysis of length of hospital stay using electronic health records: A statistical and data mining approach. PLOS ONE. 13. e0195901. DOI: 10.1371/journal.pone.0195901.

Alexander, Jeffrey & Weiner, Bryan & Griffith, John. (2006). Quality improvement and hospital financial performance. Journal of Organizational Behaviour. DOI: 10.1002/job.401

Baruah, Minoti & Dawka, Kaveeta & Kataki, Amal. (2016). Patient satisfaction: a tool for quality control. International Journal of Community Medicine and Public Health. 1215-1218. 10.18203/2394-6040.ijcmph20161387.

Halfon, P., Egli, Y., Pêtre-Rohrbach, I., Meylan, D., Marazzi, A., & Burnand, B. (2006). Validation of the Potentially Avoidable Hospital Readmission Rate as a Routine Indicator of the Quality of Hospital Care. Medical Care, 44(11), 972–981. <http://www.jstor.org/stable/41219551>

Collini, Stevie & Guidroz, Ashley & Perez, Lisa. (2013). Turnover in health care: The mediating effects of employee engagement. Journal of nursing management, 23. DOI:[10.1111/jonm.12109](https://doi.org/10.1111/jonm.12109)

Jones R (2016) Bed occupancy and hospital mortality. British Journal of Healthcare Management 22(6): 380-381. https://www.hcaf.biz/2016/Bed_Mortality.pdf

Bleustein, Clifford & Rothschild, David & Valen, Andrew & Valatis, Eduardas & Schweitzer, Laura & Jones, Raleigh. (2014). Wait Times, Patient Satisfaction

Scores, and the Perception of Care. *The American journal of managed care*. 20. 393-400. PMID: 25181568.

Leung, M & Chan, A. Control and management of hospital indoor air quality. *Med Sci Monit*. 2006. 12(3): SR17-23.

Alan O. Sykes (1993). *An Introduction to Regression Analysis*. Coase-Sandor Institute for Law & Economics Working Paper No. 20.

Kaya Uyanık, Gülden & Güler, Neşe. (2013). A Study on Multiple Linear Regression Analysis. *Procedia - Social and Behavioral Sciences*. 106. 234–240. DOI:10.1016/j.sbspro.2013.12.027

O'Brien, S.F., Osmond, L. and Yi, Q.-L. (2015), How do I interpret a p value?. *Transfusion*, 55: 2778-2782. <https://doi.org/10.1111/trf.13383>

Sureiman, Onchiri & Mangera, CallenMoraa. (2020). F-test of overall significance in regression analysis simplified. *Journal of the Practice of Cardiovascular Sciences*. 6. 116. DOI: 10.4103/jpcs.jpcs_18_20

Appendix

The questionnaire used to collect data for this research includes the following questions:

Survey questions	
Section	Question
Demographic Information	What is your current position at the hospital?
	How many years of experience do you have in healthcare management?
KPI Usage in Hospital Management	How familiar are you with the concept of Key Performance Indicators (KPIs)?
	To what extent are KPIs currently utilized in your hospital's management practices?
	Do you believe the following KPIs are sufficient to comprehensively measure business performance? Wait Time of Patients Indoor Air Quality Average Length of Stay Cost per Case Patients Satisfaction Score Hospital Readmission Rate Employee Turnover Ratio Bed Occupancy Rate
	If you indicated that additional KPIs are needed for a more comprehensive assessment of business performance, please specify which KPIs you believe

	would be relevant in the context of hospital management.
Effectiveness of KPIs	How effective do you believe KPIs are in measuring the business performance of the hospital?
	What challenges, if any, have you encountered in implementing KPIs in hospital management?
	In your opinion, what specific benefits have KPIs brought to your hospital's overall performance?
KPI Selection and Tailoring	How are KPIs selected in your hospital? (Check all that apply)
	To what extent do you believe KPIs need to be customized to suit the unique challenges and goals of the healthcare industry?
Recommendations and Future Considerations	In your opinion, what improvements can be made in the use of KPIs for better business performance measurement in healthcare?
	Are there specific areas or trends in healthcare management where you believe KPIs could play a more significant role in the future?
Additional Comments	Please use this space to provide any additional comments or insights regarding the use of KPIs in hospital management.

Table 9 - Survey Questions