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The Effect of Lean Six Sigma Implementation, Information Technology Utilization, and Bed Capacity on Length of Inpatient Stay at Karya Medika Hospital, Bantar Gebang, Bekasi, in 2025

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Abstract

The Length of stay is a crucial indicator in hospital service systems. This study aims to analyze the influence of Lean Six Sigma implementation, the use of information technology, and bed capacity on the length of stay at RS Karya Medika Bantar Gebang. The research method used is a quantitative approach with a descriptive analytical design. Data were collected through questionnaires and analyzed using univariate, bivariate, and multivariate tests. The univariate analysis results show that the majority of respondents are aged 20-35 years (59.00%), female (64.10%), and work as nurses (56.40%). Bivariate analysis using Pearson correlation test shows that Lean Six Sigma implementation has a strong relationship with length of stay (r = 0.855, p = 0.000), the use of information technology has a very strong relationship (r = 0.906, p = 0.000), and bed capacity also has a strong relationship (r = 0.838, p = 0.000). Multivariate analysis results using multiple linear regression indicate that Lean Six Sigma implementation (β = 1.583, p = 0.000) and the use of information technology (β = 0.954, p = 0.043) significantly affect the length of stay, while bed capacity (β = 0.505, p = 0.243) does not have a significant effect. The regression model used has an R value of 0.944 and an R Square value of 0.892, indicating that 89.2% of variations in length of stay can be explained by the three independent variables. The conclusion of this study is that Lean Six Sigma implementation and the use of information technology significantly contribute to reducing the length of stay, while bed capacity does not have a direct impact. Therefore, hospitals are advised to further optimize the implementation of Lean Six Sigma and information technology to improve service efficiency.

Keywords: Length of Stay, Lean Six Sigma, Information Technology, Bed Capacity, Hospital Efficiency

Abstrak

Lama rawat inap merupakan indikator penting dalam sistem pelayanan rumah sakit. Penelitian ini bertujuan untuk menganalisis pengaruh penerapan Lean Six Sigma, penggunaan teknologi informasi, dan kapasitas tempat tidur terhadap lama rawat inap di RS Karya Medika Bantar Gebang. Metode penelitian yang digunakan adalah pendekatan kuantitatif dengan desain deskriptif analitik. Data dikumpulkan melalui kuesioner dan dianalisis menggunakan uji univariat, bivariat, dan multivariat. Hasil analisis univariat menunjukkan bahwa mayoritas responden berusia 20-35 tahun (59,00%), berjenis kelamin perempuan (64,10%), dan memiliki profesi sebagai perawat (56,40%). Analisis bivariat menggunakan uji korelasi Pearson menunjukkan bahwa penerapan Lean Six Sigma memiliki hubungan kuat dengan lama rawat inap (r = 0.855, p = 0.000), penggunaan teknologi informasi memiliki hubungan sangat kuat (r = 0.906, p = 0.000), dan kapasitas tempat tidur juga memiliki hubungan kuat (r = 0.838, p = 0.000). Hasil analisis multivariat dengan regresi linier berganda menunjukkan bahwa penerapan Lean Six Sigma (β = 1.583, p = 0.000) dan penggunaan teknologi informasi (β = 0.954, p = 0.043) berpengaruh signifikan terhadap lama rawat inap, sedangkan kapasitas tempat tidur (β = 0.505, p = 0.243) tidak berpengaruh signifikan. Model regresi yang digunakan memiliki nilai R sebesar 0.944 dan R Square sebesar 0.892, yang menunjukkan bahwa 89,2% variasi dalam lama rawat inap dapat dijelaskan oleh ketiga variabel independen. Kesimpulan dari penelitian ini adalah penerapan Lean Six Sigma dan penggunaan teknologi informasi berkontribusi signifikan dalam mengurangi lama rawat inap, sedangkan kapasitas tempat tidur tidak memiliki dampak

langsung. Oleh karena itu, rumah sakit disarankan untuk lebih mengoptimalkan penerapan Lean Six Sigma dan teknologi informasi guna meningkatkan efisiensi pelayanan.

Kata Kunci: Lama Rawat Inap, Lean Six Sigma, Teknologi Informasi, Kapasitas Tempat Tidur, Efisiensi Rumah Sakit

INTRODUCTION

Lean Six Sigma (LSS) has been proven to enhance operational efficiency and service quality in the global healthcare sector. In the United States, the implementation of LSS reduced patient waiting times by up to 30% and improved hospital workflow (Nave, 2021). In the United Kingdom, hospitals adopting LSS experienced a 25% reduction in length of stay through resource optimization (Smith et al., 2022). Furthermore, the utilization of health information technology, such as Electronic Medical Records (EMR) and Hospital Management Systems (HMS), has been shown to reduce medical errors and accelerate clinical decision-making (Johnson & Jones, 2022). Adequate bed capacity also plays a role in reducing hospital operational burdens (Brown et al., 2023).

In Indonesia, operational efficiency in hospitals remains a challenge. The average length of stay is 5.2 days, higher than Malaysia's 3.8 days (Ministry of Health RI, 2023). Bed Occupancy Rates (BOR) often exceed the WHO ideal threshold of 60%–85%, with some hospitals reaching 90% (Ministry of Health RI, 2023). Although LSS adoption is still limited, hospitals such as RSUP Dr. Sardjito have successfully reduced patient waiting times by up to 40% after LSS implementation (Handayani et al., 2022). The use of health information technology has also increased following the enactment of Ministry of Health Regulation No. 24 of 2022 on Electronic Medical Records, although its adoption is still hindered by infrastructure, staff training, and funding limitations, especially in remote areas (Susanti & Rahman, 2023). Bed capacity distribution is also uneven, with dominance in urban areas (Ministry of Health RI, 2023).

RS Karya Medika Bantar Gebang has experienced a surge in inpatient numbers from 2,298 cases in 2021 to 5,805 cases in 2023. The average length of stay has reached 5.5 days, exceeding the ideal target of 4–5 days. Although the hospital has implemented a Hospital Management Information System (SIMRS), its utilization has not been optimal. Bed capacity is also often insufficient during patient surges (RS Karya Medika Bantar Gebang, 2023). If these challenges are not addressed, the hospital risks increased patient complaints, reduced satisfaction, and rising operational costs (Brown et al., 2023).

Previous studies have mostly focused on LSS implementation to reduce waiting times in emergency departments or to improve outpatient clinic efficiency. Research integrating LSS, information technology, and bed capacity in relation to length of stay is still limited in Indonesia (Handayani et al., 2022). Therefore, this study offers a holistic approach to analyze the effect of LSS implementation, information technology utilization, and bed capacity on inpatient length of stay at RS Karya Medika Bantar Gebang. With increasing patient numbers, LSS-based solutions, health information technology, and effective bed capacity management are expected to provide applicable strategic recommendations and contribute to the development of hospital management in Indonesia (Susanti & Rahman, 2023).

RESEARCH PROBLEM

RS Karya Medika Bantar Gebang has seen an increase in inpatient numbers from 2,298 cases in 2021 to 5,805 cases in 2023. This surge has resulted in limited bed capacity and an increased average length of stay of 5.5 days, exceeding the ideal target of 4–5 days.

Although the hospital has implemented a Hospital Management Information System (SIMRS) and electronic medical records,

integration and utilization remain suboptimal. This impacts operational efficiency, increases hospital costs, and potentially lowers patient satisfaction.

As a solution, the implementation of Lean Six Sigma can help reduce waste and improve workflow efficiency. This study examines the integration of Lean Six Sigma, information technology, and bed capacity management to enhance inpatient service efficiency and provide strategic recommendations for the hospital.

RESEARCH OBJECTIVE

The objective of this study is to analyze the influence of Lean Six Sigma implementation (X1), information technology utilization (X2), and bed capacity (X3) on length of inpatient stay (Y) at RS Karya Medika Bantar Gebang, in order to improve operational efficiency and the quality of inpatient care at the hospital.

RESEARCH METHOD

This research is a quantitative study with a cross-sectional design, analyzing the influence of Lean Six Sigma implementation (X1), information technology utilization (X2), and bed capacity (X3) on length of inpatient stay (Y) at RS Karya Medika Bantar Gebang. The research sample consisted of the entire population of medical and healthcare personnel (39 individuals), including doctors, nurses, and midwives, using a total sampling technique. Data were collected using a Likert-scale questionnaire distributed both directly and online. Multivariate analysis was conducted using multiple linear regression to test the simultaneous effect of the independent variables on length of stay.

RESEARCH RESULTS

1. Lean Six Sigma Implementation (X1)
The majority of respondents (66.7%) stated that the hospital routinely conducts analysis to identify and eliminate waste in service processes. A total of 64.1% of respondents agreed that Lean Six Sigma implementation helps reduce variation in inpatient service processes, while 61.5% stated that the hospital uses tools such as DMAIC to improve service quality. Although most healthcare workers agree with LSS implementation, 23.1% remained neutral regarding training programs related to this method.

2. Information Technology Utilization (X2)
Most respondents (64.1%) agreed that the Hospital Management Information System (SIMRS) facilitates inpatient data management, while 61.5% agreed that Electronic Medical Records (EMR) accelerate medical decision-making. In addition, 56.4% of respondents believed that the hospital information system helps reduce administrative errors, and 66.7% stated that information technology facilitates patient status monitoring.

3. Bed Capacity (X3)
A total of 56.4% of respondents assessed that the hospital's bed capacity is adequate, but 64.1% acknowledged difficulties in handling patient surges due to limited capacity. Moreover, 66.7% of respondents stated that bed capacity affects patients' length of stay.

4. Length of Stay (Y)
As many as 64.1% of respondents stated that the hospital's length of stay still exceeds the ideal target. Meanwhile, 56.4% said that accelerating medical processes can help reduce length of stay, and 64.1% agreed that adequate bed capacity can speed up inpatient care processes.

Univariate Analysis Results

Tabel 1
Tabel Hasil Univariat

Variablw	Mean	Standar Deviasi
Lean Six Sigma (X1)	3.89	0.72
Information Technology (X2)	3.95	0.68
Bed capacity (X3)	3.76	0.74
Length of stay (Y)	4.02	0.71

The univariate analysis results indicate that the mean scores for all variables were relatively

high, suggesting that most respondents gave positive assessments of the variables studied.

Bivariate Analysis Results (Pearson Correlation)

Tabel 2
Tabel Pearson Correlation

Variable	Pearson Correlation	P-value
Implementation of Lean Six Sigma (X1) → Length of stay (Y)	0.855	0.000
Information technology utilization (X2) → Length of stay (Y)	0.906	0.000
Bed capacity (X3) → Length of stay (Y)	0.838	0.000

The Pearson correlation results indicate a very strong and significant relationship between the implementation of Lean Six Sigma, the use of information technology, and bed capacity with the length of patient hospitalization.

Multivariate Analysis Results (Multiple Linear Regression)

1. Simultaneous Regression Analysis

Table 3 Simultaneous Regression

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1424.744	7	203.535	36.504	0.000
Residual	172.846	31	5.576		
Total	1597.590	38			

The regression model was significant with F = 36.504, p = 0.000, indicating that the independent variables collectively have a significant effect on the length of hospital stay.

2. Partial Regression Analysis

Table 4 Partial Regression Analysis Table

Variable	Koefisien Beta	Standar Error	t-value	Sig.
Constant	3.611	2.761	1.308	0.200
Implementation of Lean Six Sigma (X1)	1.583	0.400	3.954	0.000
Information technology utilization (X2)	0.954	0.451	2.114	0.043
Bed capacity (X3)	0.505	0.424	1.191	0.243

The implementation of Lean Six Sigma (β = 0.567, p = 0.000) was the most significant variable in reducing the length of hospital stay, followed by the use of information technology (β = 0.273, p = 0.043). Bed capacity had no significant effect (p = 0.243).

3. Coefficient of Determination

Table 5 Coefficient of Determination Table

Model	R	R Square	Adjusted R Square	Std. Error
1	0.944	0.892	0.867	2.361

The model has an R^2 value of 89.2%, indicating that the independent variables explain 89.2% of the variability in patients' length of stay.

DISCUSSION

1. Respondent Characteristics

This study aims to analyze the effect of Lean Six Sigma implementation, information technology use, and bed capacity on patient length of stay at Karya Medika Bantar Gebang Hospital in Bekasi in 2025. Based on the research findings, the majority of respondents were aged between 20 and 35 years (59.00%), with a higher proportion of female healthcare workers (64.10%) compared to male healthcare workers (35.90%). Most respondents were nurses (56.40%), followed by doctors (28.20%) and midwives (15.40%). Based on years of experience, over half of the healthcare workers had 1-5 years of experience (51.30%), while 23.10% had 5-10 years of experience, and 25.60% had worked for over 10 years. These characteristics indicate that the majority of healthcare

workers in this hospital are still in the early stages of their careers, which may impact the implementation of innovations and the effectiveness of new systems such as Lean Six Sigma, as well as the adoption of information technology in patient care.

The implementation of Lean Six Sigma in healthcare is based on the concepts of efficiency and waste reduction to improve the quality of care. George (2003) explains that Lean Six Sigma focuses on optimizing workflows and eliminating activities that do not add value for patients, thereby reducing length of stay. Additionally, Davis' (1989) Technology Acceptance Model (TAM) theory supports this research, as healthcare workers' acceptance and use of information technology can enhance administrative efficiency and accelerate clinical decision-making. Another influencing factor is bed capacity, which is related to the Hospital Capacity Management theory, where optimal bed availability can affect patient admission and discharge processes as well as overall length of stay.

Previous studies support the findings of this research. A study by Smith et al. (2020) in the Journal of Healthcare Management shows that the implementation of Lean Six Sigma in hospitals can reduce length of stay by up to 30% by improving service efficiency. Another study by Chakraborty & Sharma (2021) in the International Journal of Medical Informatics highlights how the use of information technology in hospitals accelerates administrative processes, improves diagnostic accuracy, and supports bed capacity management. Meanwhile, research by Jones et al. (2019) in Hospital Administration Review found that effective bed capacity management can reduce patient waiting times and improve healthcare efficiency, thereby directly impacting the duration of hospital stays.

This study contributes new insights by analyzing how the simultaneous application of Lean Six Sigma, information technology use, and bed capacity influence patient length of stay in hospitals. Unlike previous studies that tend to discuss these factors separately, this study integrates all three aspects to provide a more comprehensive understanding. Additionally, this study focuses on healthcare staff in hospitals, who are a key factor in the implementation of efficiency policies. Thus, this study provides new insights into how the combination of efficiency strategies and technology can improve hospital service quality and optimize resource utilization.

Based on the research findings, it can be concluded that the implementation of Lean Six Sigma, the use of information technology, and bed capacity play a significant role in determining the length of hospital stays for patients. The majority of healthcare workers participating in this study were in the productive age group, with nurses dominating as the primary profession. This indicates that the implementation of efficiency systems such as Lean Six Sigma and information technology heavily depends on the readiness and involvement of healthcare workers in system changes. With better bed management, hospital operational efficiency can be improved, positively impacting patient care duration. Therefore, hospitals need to continue developing strategies to optimize the use of technology and apply efficiency principles in healthcare services to improve the quality and effectiveness of inpatient care.

2. The Application of Lean Six Sigma (X1) and Its Impact on Length of Hospital Stay (Y)

Based on the questionnaire results, the majority of respondents agreed that hospitals routinely conduct analyses to identify and eliminate waste in service processes, with 66.7% agreeing and 15.4% strongly agreeing. The use of Lean Six Sigma tools such as DMAIC (Define, Measure, Analyze, Improve, Control) also received positive responses, with 61.5% of respondents agreeing, and 15.4% strongly agreed, although 17.9% remained neutral. Regression analysis results show that the application of Lean Six Sigma has a significant effect on the length of hospital stay ($p = 0.000$), where the more optimal its application, the greater the efficiency in services that can reduce the duration of patient hospitalization.

The Lean Six Sigma method, which focuses on waste reduction and efficiency improvement, has been proven to accelerate patient care flow and optimize hospital resources. This finding is supported by research by Improta et al. (2018) which showed a reduction in hospital stay duration by up to 25% through workflow improvements. Costa et al. (2020) also found that eliminating non-value-added activities increased service efficiency and reduced bed occupancy.

In a theoretical context, this research aligns with Womack and Jones' (1996) Lean concept, which emphasizes the elimination of non-value-added activities in healthcare. Graban's (2016) Lean Healthcare model also shows that hospitals applying Lean principles tend to have more effective systems in handling patients and reducing waiting times and length of hospital stay.

This research provides a new contribution by analyzing how the application of Lean Six Sigma, the use of information technology, and bed capacity simultaneously affect the length of patient hospital stay. Unlike previous research that discussed these factors separately, this study integrates these three aspects to gain a more comprehensive understanding. In addition, this research was conducted in Indonesia, which is still in the development stage of Lean Six Sigma, thus providing new insights related to challenges and opportunities in its application.

Based on the research results, the effective application of Lean Six Sigma can reduce the length of patient hospital stay by optimizing healthcare service flow. By increasing efficiency in work processes and reducing waste, healthcare professionals can provide faster and more targeted care. Therefore, hospital management needs to consider implementing Lean Six Sigma more broadly, by ensuring training for healthcare professionals and technological support that supports operational efficiency.

3. The Use of Information Technology (X2) and Its Effect on Length of Hospital Stay (Y)

As many as 64.1% of respondents stated that HMIS facilitates patient data management, and 61.5% agreed that EMR accelerates medical decision-making. Regression results show that information technology has a significant effect on the length of hospital stay ($p = 0.043$). The implementation of digital systems increases administrative efficiency, reduces medical errors, and accelerates coordination among healthcare professionals.

Davis' (1989) Technology Acceptance Model (TAM) theory states that technology adoption depends on perceived ease of use and usefulness. Buntin et al. (2011) also emphasized that information technology improves service quality and hospital operational efficiency. A study by Kruse et al. (2018) showed that electronic medical record systems can accelerate clinical decision-making, while Menachemi & Collum (2011) found that the application of technology in hospital management can reduce medical errors and accelerate patient discharge processes.

This research integrates Lean Six Sigma, information technology, and bed capacity in the analysis of hospital efficiency, providing a new perspective in the context of hospitals in Indonesia which are still in the digital transformation stage. While previous research tended to examine these factors separately, this study connects the three aspects simultaneously to gain a more comprehensive understanding.

Lean Six Sigma and information technology have been proven to reduce the length of hospital stay by increasing hospital operational efficiency.The implementation of integrated information systems and healthcare personnel training are important factors in service optimization.

4. Bed Capacity (X3) and its Effect on Length of Stay (Y)

As many as 56.4% of respondents stated that the hospital's bed capacity was adequate, but there were still 17.9% who were neutral and

10.3% who disagreed regarding the smooth flow of services. Regression results showed that bed capacity did not significantly affect the length of stay (p = 0.234). Although beds were available, other factors such as the efficiency of medical services and administrative systems were more decisive in determining the duration of patient care.

The Hospital Bed Management Theory by Bagust et al. (1999) states that bed capacity is important, but the efficiency of its use is more decisive. Queuing Theory (Kendall, 1953) also emphasizes that patient flow management is more crucial than simply increasing capacity. Studies by Blay et al. (2017) and Kuntz et al. (2015) show that hospitals with more beds do not always have shorter lengths of stay, especially if patient management is not optimal.

This research integrates Lean Six Sigma, information technology, and bed capacity in the analysis of hospital efficiency, providing a new perspective in the context of hospitals in Indonesia which are still in the digital transformation stage. While previous research tended to examine these factors separately, this study connects the three aspects simultaneously to gain a more comprehensive understanding.

Lean Six Sigma and information technology have been shown to reduce the length of stay by increasing hospital operational efficiency, while bed capacity does not have a significant effect on the duration of stay. The implementation of integrated information systems and optimization of patient management are key factors in improving the efficiency of hospital services.

CONCLUSION

Based on the research results, the application of Lean Six Sigma and the use of information technology have been proven to have a significant effect in reducing the length of patient stay, while bed capacity does not have a direct significant impact. Lean Six Sigma helps improve the efficiency of service flow and optimize resources, while information technology accelerates administration and medical decision-making. Hospital management needs to focus on operational efficiency strategies and digital transformation to improve the effectiveness of inpatient services rather than just increasing bed capacity.

SUGGESTIONS

RS Karya Medika Bantar Gebang needs to optimize the implementation of Lean Six Sigma through training for medical personnel and improving workflows to increase the efficiency of inpatient services. In addition, the integration of information technology must be strengthened, especially in the use of electronic medical records (EMR) and more integrated hospital management systems to accelerate patient administration. Although bed capacity does not significantly affect the length of stay, better bed management is still needed to optimize patient flow and avoid overcapacity. Regular evaluation and monitoring of the implementation of Lean Six Sigma and information technology also need to be carried out to maintain their effectiveness. Further studies are suggested to include more hospitals with longitudinal methods to measure the long-term impact of the implementation of Lean Six Sigma and information technology on the length of patient stay and to consider additional variables such as the quality of medical services and referral systems.

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