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Clinical Pathway Compliance, Length of Stay, and Cost Efficiency among Inpatients at Marsudi Waluyo Hospital

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ABSTRACT

Hospitals are under increasing pressure to improve service quality while maintaining financial sustainability under Indonesia's National Health Insurance (JKN) reimbursement system. Clinical Pathway (CP) implementation and Length of Stay (LOS) are considered important strategies for improving cost efficiency, yet their financial impact remains inconsistent across healthcare settings. Previous studies have primarily examined the influence of Clinical Pathway implementation on service quality or Length of Stay separately. In contrast, evidence regarding the combined effects of Clinical Pathway compliance and Length of Stay on hospital cost efficiency, particularly in Type D hospitals, remains limited. This study aimed to analyse the effects of Clinical Pathway compliance and Length of Stay on cost efficiency among inpatients at Marsudi Waluyo Hospital, Malang Regency, using Gross Profit Margin (GPM) as the indicator of cost efficiency. A quantitative study with an observational, analytic, and retrospective design was conducted using secondary data from medical records, Clinical Pathway forms, hospital information systems, billing records, and casemix data. The study included 361 inpatient care episodes selected through total sampling. Multiple linear regression was employed to examine the relationships among variables, and bootstrap analysis with 1,000 resamples was applied to enhance the robustness of the estimates. Clinical Pathway compliance significantly affected Gross Profit Margin ($\beta = -0.341$, $p = 0.029$), while Length of Stay also showed a significant negative effect ($\beta = -10.385$, $p < 0.001$). Simultaneously, both variables significantly influenced Gross Profit Margin ($F = 30.800$, $p < 0.001$), explaining 14.7% of its variance ($R^2 = 0.147$). Length of Stay demonstrated a stronger influence on cost efficiency. This study also contributes empirical evidence on hospital cost efficiency in a Type D hospital and provides practical guidance for hospital managers in developing evidence-based cost-control strategies.

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1. INTRODUCTION

In recent years, hospitals have faced increasing pressure to improve service quality while simultaneously controlling costs, particularly within the National Health Insurance (Jaminan Kesehatan Nasional/JKN) financing system. In practice, however, these efforts are often constrained by various challenges, especially the burden of service costs and the need to improve limited facilities further. This challenge becomes even more complex in hospitals serving patients under the JKN scheme, where cost control is highly critical. This issue becomes more relevant when associated with the dynamics of Indonesia's healthcare financing system. Based on data from the National Social Security Council (DJSN) in 2024, as reported by CNN Indonesia, there is a projected budget deficit for BPJS Kesehatan during the August September 2025 period. Furthermore, government policy, as set out in the Minister of Health Regulation No. 3 of 2023 concerning INA-CBGs tariffs, also presents its own challenges for hospitals. Marsudi Waluyo Hospital continues to face challenges in achieving its targeted cost efficiency. This is reflected in financial performance indicators, particularly Gross Profit Margin (GPM) and Cost of Goods Sold (COGS), which have not shown optimal results since 2022. The targeted Gross Profit Margin of ≥20% has not been achieved; in 2022, the actual Gross Profit Margin was only 13.24%.

The implementation of Clinical Pathways aims to improve patient safety, reduce Length of Stay, enhance service quality, and minimise clinical risks [1], [2], [3], [4]. In addition, Clinical Pathways improve patient satisfaction while optimising resource utilisation and service costs [3]. In the literature, Clinical Pathways are also referred to as Critical Care Pathways, Caremaps, Anticipated Recovery Pathways (ARPs), Multidisciplinary Pathways of Care (MPC), and Care Protocols. However, the terms Clinical Pathways and Integrated Care Pathways are the most commonly used in healthcare practice [4]. According to national quality indicators, adherence to Clinical Pathways should reach at least 80%. This highlights that healthcare providers' compliance is a crucial factor in the successful implementation of Clinical Pathways. Several previous studies have examined the impact of Clinical Pathway implementation and adherence on service cost efficiency. The findings indicate that the application of Clinical Pathways, combined with high adherence, can reduce treatment costs, as observed in cases of acute ischemic stroke [5] and acute coronary heart disease among JKN patients [6].

Adherence to Clinical Pathways (CP) is closely associated with cost efficiency, particularly through the control of Length of Stay and improvements in service quality [7], [8], [9], [10]. Patients who receive care in accordance with Clinical Pathways tend to recover more quickly, as the care provided follows proven, standardised procedures [11]. This finding is supported by Siddique et al. [12], who demonstrated that implementing Clinical Pathways significantly reduces hospitalisation duration, particularly among high-risk patients. Furthermore, the study emphasises that success in reducing Length of Stay is strongly influenced by healthcare providers' adherence to Clinical Pathways, ultimately resulting in overall cost savings [12]. Another study by Aladin et al. [13] also found that hospitals consistently implementing Clinical Pathways experienced significant reductions in both Length of Stay and treatment costs, including among patients undergoing cesarean section procedures.

Based on secondary hospital data over the past three years (2023 2025), although the level of Clinical Pathway adherence at Marsudi Waluyo Hospital has exceeded the national quality indicator standard, reaching 97.48% in 2023, 97.21% in 2024, and 93.41% in 2025, there are still fluctuations from year to year. This condition indicates that the implementation of Clinical Pathways has been generally well executed; however, continuous evaluation is still necessary to maintain service consistency and to optimally support cost efficiency. This also suggests that the implementation of Clinical Pathways in practice continues to face various challenges, both in terms of healthcare providers' adherence and supporting system factors.

Length of Stay (LOS) is an important indicator in assessing the efficiency of hospital services [14], [15], [16], [17], [18]. The longer the duration of patient care, the higher the costs incurred by the hospital and the National Health Insurance (JKN) financing system. This situation highlights that controlling the length of Stay is a highly critical aspect in improving service efficiency. According to the author, the length of Stay is influenced not only by the patient's clinical condition but also by the consistency with which service standards, including Clinical Pathways (CP), are implemented. Therefore, optimal implementation of Clinical Pathways is expected to serve as a strategy to reduce Length of Stay while simultaneously controlling service costs.

Furthermore, based on the hospital's financial data, a discrepancy was identified between the actual service costs (*Real Cost/RITL*) and the INA-CBGs claim tariffs received. In several cases, the actual costs exceeded the reimbursed tariffs, resulting in an unfavourable margin for the hospital. This condition indicates that cost efficiency in service delivery has not yet been fully achieved.

In the context of national health policy, challenges related to cost efficiency have become increasingly complex, particularly with the revision of INA-CBGs tariffs through Minister of Health Regulation No. 3 of 2023, as well as the projected budget deficit of BPJS Kesehatan [19]. These policy changes require hospitals to adapt their service financing to be more effective. According to the author, this situation further emphasises the importance of optimising resource management and improving adherence to established service standards, including the Clinical Pathway. Without systematic improvement efforts, financial pressures on hospitals are likely to intensify amid the ongoing growth in healthcare demand.

Based on the problems outlined and supported by previous research, the author considers adherence to the Clinical Pathway and Length of Stay as important factors that may influence hospital cost efficiency. Therefore, this study aims to analyse the effects of adherence to the Clinical Pathway and Length of Stay (LOS) on cost efficiency among inpatients at Marsudi Waluyo Hospital, a type D hospital.

2. METHODS

This study employed a quantitative approach, using an observational-analytic design with a retrospective method. The study was conducted at Marsudi Waluyo Hospital, Malang Regency, using secondary inpatient data from January 1 to December 31, 2025. The population comprised all inpatient care episodes of JKN participants during the study period. The unit of analysis was the inpatient care episode, and a total sampling technique was applied. A total of 361 inpatient care episodes that met the inclusion criteria, including complete medical records, Clinical Pathway documentation, billing data, and INA-CBGs information, were included in the analysis, while records with incomplete data were excluded.

Secondary data were obtained from medical records, Clinical Pathway forms, the Hospital Information System (SIMRS), billing records, and casemix data. The independent variables were Clinical Pathway compliance and Length of Stay (LOS). In contrast, the dependent variable was cost efficiency measured by Gross Profit Margin (GPM), calculated as the difference between INA-CBGs reimbursement and actual hospital costs relative to INA-CBGs reimbursement. Clinical Pathway compliance was measured as the percentage of completed Clinical Pathway components, while LOS was defined as the number of hospitalisation days from admission to discharge.

Data were analysed using descriptive statistics and multiple linear regression. Classical assumption tests, including normality, multicollinearity, heteroscedasticity, autocorrelation, and influential case analyses, were performed before regression. Because violations of normality and heteroscedasticity were identified, the regression estimates were strengthened using the bootstrap method with 1,000 resamples. Statistical significance was established at $p < 0.05$. Ethical approval and institutional permission were obtained from Marsudi Waluyo Hospital, and all patient data were anonymised to ensure confidentiality.

3. RESULTS AND DISCUSSION

This section presents the findings of the statistical analyses, including sample characteristics, descriptive statistics, assumption testing, multiple linear regression, and bootstrap estimation to examine the effects of Clinical Pathway compliance and Length of Stay on Gross Profit Margin.

Description of Numerical Research Variables

Table 1. Descriptive Statistics of Research Variables

No	Variable	N	Mean	Median	Std. Deviation	Minimum	Maximum
1	Age (tahun)	361	59.46	60.00	12.81	20.00	95.00
2	*Length of Stay*/LOS (day)	361	4.46	4.00	1.53	2.00	12.00
3	Compliance CP (%)	361	91.30	100.00	13.03	40.00	100.00
4	*Gross Profit Margin*/GPM (%)	361	-15.41	-23.18	39.87	-81.03	254.48
5	INA-CBGs (Rp)	361	4,441,554.57	4,398,500.00	1,377,650.94	1,240,800.00	9,649,300.00
6	Rates RS (Rp)	361	7,683,668.14	6,561,300.00	3,933,880.18	2,098,050.00	24,514,550.00
7	Real Cost (Rp)	361	6,146,934.52	5,249,040.00	3,147,104.14	1,678,440.00	19,611,640.00

Source: Processed secondary data, 2026

Based on Table 1, the average age of patients is 59.46 years with a median of 60.00 years. The average Length of Stay (LOS) is 4.46 days with a median of 4.00 days. The Gross Profit Margin shows an average of -15.41%, a median of -23.18%, a minimum of -81.03%, and a maximum of 254.48%. The negative average Gross Profit Margin indicates that, in general, there is cost pressure in a number of cases, where the real cost tends to exceed the reimbursement received in several care episodes.

The average INA-CBGs value is IDR 4,441,554.57, while the average real cost is IDR 6,146,934.52. The gap between claim tariffs, hospital tariffs, and real costs is an important factor in interpreting Gross Profit Margin, as it is influenced not only by Clinical Pathway adherence but also by cost structure, length of Stay, case severity, and resource utilisation during patient care. The descriptive statistics indicate that Clinical Pathway compliance was relatively high (mean = 91.30%), whereas the average Length of Stay was 4.46 days. Despite the high level of Clinical Pathway compliance, the average Gross Profit Margin remained negative (-15.41%), indicating that inpatient services generated costs exceeding the reimbursement received under the INA-CBGs payment system. The comparison between actual hospital costs and INA-CBGs tariffs further demonstrates persistent financial pressure on inpatient services.

Normality Test

Variable Normality Test

Table 2. Results of the Kolmogorov-Smirnov Normality Test

Variable	**Statistic**	**df**	**Sig.**	Conclusion
GPM	0,092	361	0,000	Not Normal
LOS	0,223	361	0,000	Not Normal
Adherence	0,393	361	0,000	Not Normal

Source: Processed SPSS Output, 2026

All numerical variables have a significance value of 0.000, which is less than 0.05. Thus, Gross Profit Margin, Length of Stay, and Clinical Pathway adherence are not normally distributed. However, given the sufficiently large sample size, regression analysis can still be conducted, with primary attention given to the model residuals and further strengthened using the bootstrap method.

Residual Normality Test

Based on Table 3, the significance value of the standardised residuals is 0.000, which is less than 0.05, indicating that the model residuals are not normally distributed. Therefore, the regression results in this study are strengthened using the bootstrap method with 1,000 samples to ensure that significance testing and confidence intervals are more robust to violations of the normality assumption.

Table 3. Results of the Residual Normality Test

Variable	**Kolmogorov Smirnov Statistic**	**df**	**Sig.**	**Conclusion**
Standardized Residual	0.089	361	0.000	Residuals not normal

Source: Processed SPSS Output, 2026

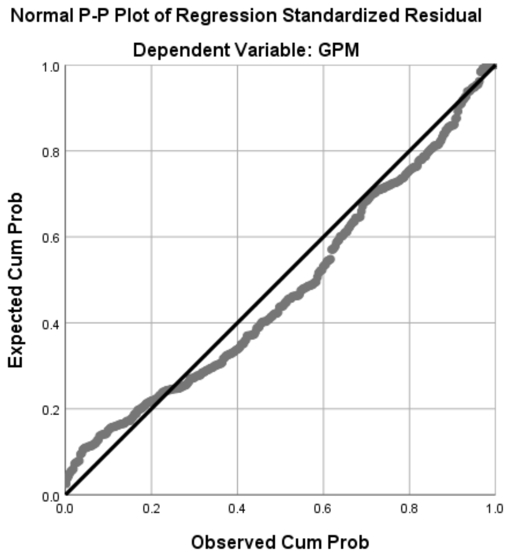

Figure 1. Normal P P Plot of Residuals
Source: Processed secondary data, 2026

Based on Figure 1, the residual points appear to follow a diagonal line, though slight deviations are observed in the tails of the distribution. This suggests that the residuals visually approximate a normal distribution; however, further reinforcement through the bootstrap approach remains necessary, as the statistical test indicates a p-value below 0.05.

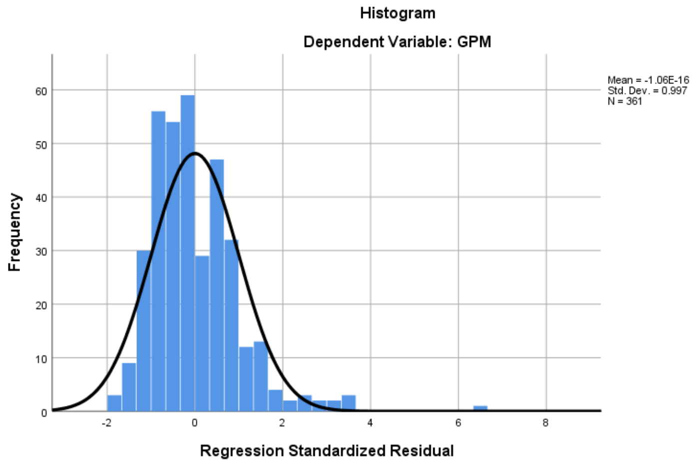

Figure 2. Normal Histogram of Residuals
Source: Processed secondary data, 2026

Based on Figure 2, the histogram of standardised residuals displays a distribution that visually approximates a bell-shaped curve, or a normal distribution. Most residual values are concentrated around zero, with a relatively balanced spread on both the left and right sides. This indicates that the regression residuals visually follow a normal distribution.

However, a slight deviation is still observed in the tails of the distribution, particularly on the right, indicating the presence of several residual values that exceed the majority of the data. This condition is consistent with the results of the residual normality test, which show a significance value below 0.05, suggesting that the residuals are not yet fully normally distributed.

Multicollinearity Test

Table 4. Results of the Multicollinearity Test

Variable	Tolerance	VIF	Conclusion
Clinical Pathway Adherence	0.928	1.078	No multicollinearity
Length of Stay (LOS)	0.928	1.078	No multicollinearity

Source: Processed SPSS Output, 2026

Based on Table 4, the results of the multicollinearity test indicate that all variables have Tolerance values greater than 0.10 and VIF values less than 10. The Clinical Pathway adherence variable has a Tolerance value of 0.928 and a VIF value of 1.078, while the Length of Stay variable also has a Tolerance value of 0.928 and a VIF value of 1.078. These values indicate that there is no strong linear relationship among the independent variables in the regression model.

Thus, it can be concluded that the regression model used in this study does not exhibit symptoms of multicollinearity. Therefore, Clinical Pathway adherence, Length of Stay, inpatient class, and age are appropriate to be included simultaneously in the multiple linear regression analysis.

Heteroscedasticity Test

The heteroscedasticity test is conducted to determine whether the variance of residuals is constant across all observations. The test in this study is performed using the Glejser test.

Table 5. Results of the Glejser Test

Variable	B	Std. Error	t	Sig.
Constant	45.858	8.332	5.504	.000
Clinical Pathway Adherence	-.091	.076	-1.191	.235
Length of Stay (LOS)	-2.731	.652	-4.186	.000

Source: Processed SPSS Output, 2026

The results of the Glejser test indicate that the Clinical Pathway adherence variable has a p-value of 0.235, which is greater than 0.05, indicating no heteroscedasticity. In contrast, the Length of Stay variable has a significance value of 0.000, which is less than 0.05, indicating heteroscedasticity in the regression model.

Thus, the regression model does not fully meet the assumption of homoscedasticity, as indicated by the Glejser test. However, visual examination through the scatterplot does not reveal a strong heteroscedasticity pattern, and the regression analysis in this study has been strengthened using the bootstrap method to ensure more robust coefficient estimates against violations of classical assumptions.

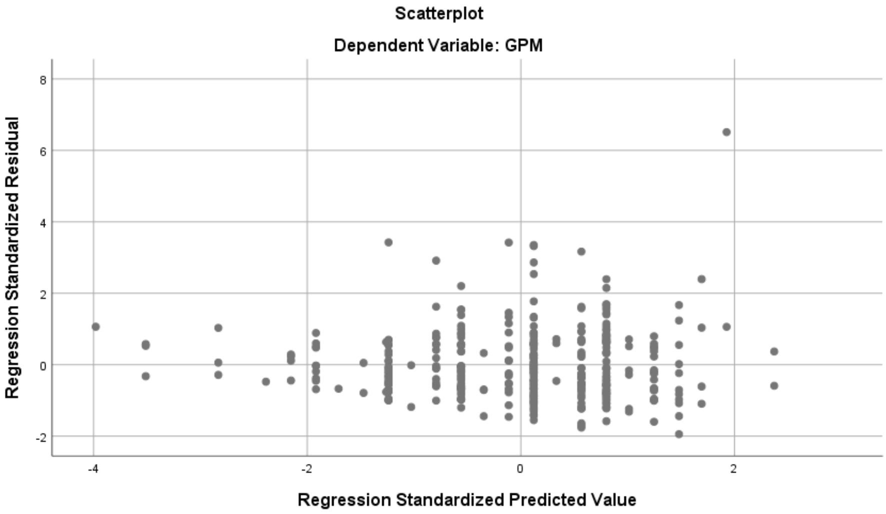

Figure 3. Residual Scatterplot
Source: Processed SPSS Output, 2026

Heteroscedasticity is examined using a scatterplot of standardised predicted values (ZPRED) versus standardised residuals (ZRESID). Based on Figure 3, the scatterplot shows that the residual points are dispersed around the zero line and do not form a clear pattern, such as a funnel, an expanding shape, or a wave-like shape. Visually, this indicates that there is no strong evidence of heteroscedasticity in the regression model.

However, since the Glejser test indicates the presence of heteroscedasticity in the Length of Stay variable, the regression results are further strengthened using the bootstrap method to ensure that the coefficient estimates are more robust to violations of classical assumptions

Outlier and Influential Case Examination

Table 6. Results of Outlier and Influential Case Examination

Indicator	Minimum	Maximum	Mean	Std. Deviation	Conclusion
Standardized Residual	-1,96407	6,56875	0,0000000	0,99442893	Indication of residual outliers due to the maximum value exceeding ±3
Cook's Distance	0,00000	0,18569	0,0028089	0,01057932	No dominant influential cases (max < 1)
Centered Leverage Value	0,00219	0,10306	0,0110803	0,00983458	Some relatively high leverage values, but not influential due to Cook's Distance < 1

Source: Processed SPSS Output, 2026

The results of the outlier and influential case examination indicate that the standardised residuals range from -1.96407 to 6.56875. The maximum value exceeds the general threshold of ±3, indicating the presence of potential residual outliers in the regression model.

However, the maximum Cook's Distance value of 0.18569 remains below the threshold of 1. This indicates that although some cases exhibit extreme residuals, they do not exert a dominant influence on the overall regression model. In other words, the detected outliers are not classified as influential cases that significantly alter the model results.

In addition, the maximum Centred Leverage Value of 0.10306 indicates the presence of observations with relatively higher leverage than other data points. Nevertheless, since the Cook's Distance remains below 1, these cases are not considered to have excessive influence on the model.

Thus, the data can still be used in the regression analysis. To ensure the robustness of the findings, a sensitivity analysis was conducted by comparing regression results before and after excluding residual outlier cases. This step was taken to ensure that the study's conclusions are not overly dependent on a single or a few extreme observations.

Autocorrelation Test

Table 7. Results of the Autocorrelation Test

Model	Durbin-Watson	Conclusion
1	1,775	No indication of serious autocorrelation

Source: Processed SPSS Output, 2026

Based on Table 7, the Durbin-Watson value is 1.775. This value falls within the acceptable range of 1.5 to 2.5, indicating no serious autocorrelation in the regression model. Thus, the assumption of residual independence can be considered reasonably satisfied.

Multiple Linear Regression Analysis

Table 8. Results of Multiple Linear Regression Analysis

Variable	B	Std. Error	Beta	t	Sig.
Constant	62.020	16.861		3.678	.000
Compliance	-.341	.155	-.111	-2.195	.029
LOS	-10.385	1.323	-.398	-7.848	.000

Source: Processed SPSS Output, 2026

The results of the multiple linear regression analysis show Gross Profit Margin (GPM) as the dependent variable, with Clinical Pathway adherence and Length of Stay (LOS) as independent variables. The constant 62.020 indicates that when both Clinical Pathway adherence and LOS are zero, the Gross Profit Margin is estimated to be 62.020. However, this constant is primarily mathematical and does not necessarily have direct clinical significance.

The resulting multiple linear regression equation is as follows:

$$\mathbf{Y = \alpha + \beta 1X1 + \beta 2X2 + \varepsilon}$$

***Gross Profit Margin* = 62,020 - 0,341(Compliance) - 10,385(LOS)**

The equation indicates that both Clinical Pathway adherence and Length of Stay (LOS) have coefficients affecting Gross Profit Margin. The coefficient value of Clinical Pathway adherence is -0.341, meaning that each one-point increase in Clinical Pathway adherence is associated with a decrease in Gross Profit Margin by 0.341 points, assuming Length of Stay (LOS) remains constant. The significance value of adherence is 0.029, which is less than 0.05; therefore, Clinical Pathway adherence has a significant effect on Gross Profit Margin.

Furthermore, the coefficient value of Length of Stay (LOS) is -10.385, indicating that each additional one-day increase in LOS tends to reduce Gross Profit Margin by 10.385 points, assuming Clinical Pathway adherence remains constant. The significance value of LOS is 0.000, which is less than 0.05; thus, Length of Stay has a significant effect on Gross Profit Margin.

Based on the Standardised Coefficients (Beta), Length of Stay (LOS) has a Beta of -0.398, while Clinical Pathway adherence has a Beta of -0.111. This indicates that the length of Stay has a stronger effect on Gross Profit Margin compared to Clinical Pathway adherence. Therefore, Length of Stay is the more dominant variable in explaining variations in Gross Profit Margin (GPM) in inpatient care episodes.

Overall, these findings indicate that the longer the Length of Stay (LOS), the lower the Gross Profit Margin tends to be. This occurs because a longer hospital stay increases the hospital's real costs, while INA-CBG's tariffs are package-based and do not necessarily increase in proportion to the length of hospitalization. Meanwhile, the negative direction of Clinical Pathway adherence should be interpreted cautiously, as adherence does not reflect only cost efficiency but may also indicate more comprehensive service delivery, including examinations, treatments, and procedures in accordance with clinical standards, which still incur service costs.

Multiple Linear Regression Analysis with Bootstrap

Table 9. Results of Bootstrap for Coefficients

Bootstrap for Coefficients							
			Bootstrap[a]				
						95% Confidence Interval	
Model		B	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
1	(Constant)	62.020	-.229	19.299	.001	25.184	102.566
	Compliance	-.341	.000	.163	.032	-.658	-.029
	LOS	-10.385	.051	1.424	.001	-13.355	-7.669
a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples							

Source: Processed SPSS Output using bootstrap with 1,000 samples, 2026

The results of the multiple linear regression using the bootstrap method indicate that Clinical Pathway adherence has a bootstrap significance value of 0.032, with a 95% confidence interval ranging from -0.658 to -0.029. Since the significance value is less than 0.05 and the confidence interval does not cross zero, it can be concluded that Clinical Pathway adherence has a significant effect on Gross Profit Margin.

The coefficient for Clinical Pathway adherence is -0.341, indicating a negative influence. This means that every one-point increase in Clinical Pathway adherence tends to be associated with a decrease in Gross Profit Margin by 0.341 points, assuming that Length of Stay remains constant. This negative direction suggests that increased adherence to the Clinical Pathway in this study does not always lead to higher margins, as adherence may also reflect more comprehensive implementation of examinations, therapies, medications, and procedures in accordance with clinical standards.

Furthermore, Length of Stay has a bootstrap significance value of 0.001, with a 95% confidence interval ranging from -13.355 to -7.669. Since the significance value is less than 0.05 and the confidence interval does not cross zero, it can be concluded that the length of Stay has a significant effect on Gross Profit Margin.

The coefficient for Length of Stay is -10.385, indicating a negative influence. This implies that each additional day of Length of Stay tends to reduce Gross Profit Margin by 10.385 points, assuming Clinical Pathway adherence remains constant. This result suggests that the longer a patient is hospitalized, the lower the Gross Profit Margin tends to be. This condition may occur because an extended Length of Stay increases the real cost of services, while INA-CBGs tariffs are package-based and do not always increase in proportion to the length of hospitalization.

Thus, the bootstrap results reinforce the findings of the multiple linear regression, indicating that Clinical Pathway adherence and Length of Stay have significant negative effects on Gross Profit Margin. The bootstrap method used in this study aims to strengthen regression coefficient estimates, given that classical assumption tests indicated deviations from normality and heteroscedasticity.

Partial t-Test

Based on Table 8, the Clinical Pathway adherence variable has a t-value of -2.195 and a p-value of 0.029. Since this significance value is less than 0.05, it can be concluded that Clinical Pathway adherence has a significant effect on Gross Profit Margin. The coefficient value indicates that an increase in Clinical Pathway adherence in this research model tends to be associated with a decrease in Gross Profit Margin.

Furthermore, the length of Stay has a t-value of -7.848 with a significance value of 0.000. Since this significance value is less than 0.05, it can be concluded that the length of Stay has a significant effect on Gross Profit Margin. The coefficient direction indicates that the longer the Length of Stay, the lower the Gross Profit Margin tends to be.

Based on the Standardised Coefficients (Beta), Length of Stay has a Beta of -0.398, while Clinical Pathway adherence has a Beta of -0.111. Since the absolute Beta value of Length of Stay is greater than that of Clinical Pathway adherence, Length of Stay is the more dominant variable in influencing Gross Profit Margin.

These findings indicate that inpatient Length of Stay makes a greater contribution to changes in Gross Profit Margin than Clinical Pathway adherence. This may occur because the longer a patient is hospitalised, the higher the hospital's actual costs, whereas INA-CBG tariffs are package-based and do not necessarily increase with longer hospital stays.

Simultaneous F-Test

Table 10. Results of the Simultaneous F-Test

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	84011.987	2	42005.993	30.800	.000[b]
Residual	488255.346	358	1363.842		
Total	572267.333	360			

Source: Processed SPSS Output, 2026

Based on Table 10, the calculated F-value is 30.800 with a significance value of 0.000. Since the significance value is less than 0.05, it can be concluded that Clinical Pathway adherence and Length of Stay simultaneously have a significant effect on Gross Profit Margin. The F-test results indicate that both independent variables jointly have a significant influence on Gross Profit Margin. Thus, the regression model can be used to explain the effects of these two independent variables on Gross Profit Margin, although its explanatory power remains limited.

The Regression Sum of Squares value of 84,011.987 represents the amount of variation in Gross Profit Margin that the regression model explains. Meanwhile, the Residual Sum of Squares value of 488,255.346 indicates the variation in Gross Profit Margin that cannot be explained by Clinical Pathway adherence and Length of Stay. Therefore, although the regression model is statistically significant, other factors outside the model still influence Gross Profit Margin, such as INA-CBGs tariffs, real costs, diagnostic factors, medical severity levels, supporting examinations, medications, medical devices, comorbidities, and patient case complexity.

In conclusion, the F-test results show that Clinical Pathway adherence and Length of Stay simultaneously have a significant effect on Gross Profit Margin.

Coefficient of Determination

Table 11. Results of the Coefficient of Determination Test

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate	Model
1	.383[a]	.147	.142	36.93023%	1

Source: Processed SPSS Output, 2026

Based on the results of the coefficient of determination test presented in Table 11, the R value is 0.383. This value indicates that the relationship between the independent variables, Clinical Pathway adherence and Length of Stay, and the dependent variable, Gross Profit Margin, falls within the low-to-moderate range.

The R Square value of 0.147 indicates that Clinical Pathway adherence and Length of Stay can explain 14.7% of the variation in Gross Profit Margin. Meanwhile, the remaining 85.3% is explained by other factors outside this research model, such as INA-CBGs tariffs, real costs, diagnostic complexity, severity level, supporting examinations, medication usage, medical equipment, comorbidities, inpatient class, and other healthcare financing components.

The Adjusted R-Square value of 0.142 indicates that after adjusting for the number of variables in the model, the explanatory power of Clinical Pathway adherence and Length of Stay on Gross Profit Margin is 14.2%. This value is not significantly different from the R-Square, suggesting that the model’s ability to explain variation in Gross Profit Margin remains limited. However, since the F-test results indicate a significant simultaneous effect, the model can still be used to statistically explain the relationships among variables, albeit with careful interpretation, as the contributions of Clinical Pathway adherence and Length of Stay to Gross Profit Margin are relatively limited.

The Std. error of the Estimate value of 36.93023 reflects the average prediction error of the model in estimating Gross Profit Margin. This indicates that there is still considerable variation in Gross Profit Margin beyond what is explained by Clinical Pathway adherence and Length of Stay. Therefore, although the regression model is statistically significant, the results of this study should be interpreted cautiously, as factors beyond the research model also influence Gross Profit Margin.

Thus, it can be concluded that Clinical Pathway adherence and Length of Stay explain 14.7% of the variation in Gross Profit Margin, while the remaining 85.3% is influenced by other factors not examined in this model.

Strengthening Regression Estimation Using Bootstrap

Based on the results of the classical assumption tests, the residuals of the regression model are not fully normally distributed. In addition, the Glejser test indicates heteroscedasticity in the Length of Stay variable. Therefore, the regression analysis in this study is strengthened using the bootstrap method with 1,000 samples. The use of bootstrap aims to obtain coefficient estimates, significance values, and confidence intervals that are more robust against violations of normality and heteroscedasticity assumptions. Thus, the test results do not rely solely on the assumption of normally distributed residuals but are reinforced through a resampling approach. The results of the regression analysis using the bootstrap method are presented in Table 9.

4. CONCLUSION

This study examined the effects of Clinical Pathway compliance and Length of Stay (LOS) on hospital cost efficiency, measured by Gross Profit Margin (GPM), among inpatient care episodes at Marsudi Waluyo Hospital. The findings indicate that both Clinical Pathway compliance and LOS significantly influence Gross Profit Margin, with LOS demonstrating the stronger effect. These results suggest that efficient inpatient management, particularly by controlling hospitalization duration while maintaining adherence to standardized clinical care, plays an important role in improving hospital financial performance under the INA-CBGs reimbursement system. This study contributes to the growing evidence on hospital cost efficiency by simultaneously examining Clinical Pathway compliance and LOS in a Type D hospital within Indonesia's JKN financing system. The findings have practical implications for hospital managers by highlighting the importance of strengthening Clinical Pathway implementation, optimising discharge planning, and continuously monitoring hospitalisation costs to improve financial sustainability without compromising service quality.

Several limitations should be acknowledged. The study was conducted in a single hospital using retrospective secondary data, included only two explanatory variables, and relied on Gross Profit Margin as a proxy for cost efficiency. In addition, the sample was dominated by patients with diabetes mellitus, and potential confounding factors, such as disease severity, comorbidities, inpatient class, medical procedures, medication costs, diagnostic support costs, and INA-CBGs categories, were not included in the regression model. Therefore, the findings should be interpreted with caution. Future studies are recommended to incorporate broader clinical and financial variables, including disease severity, INA-CBGs groups, comorbidities, inpatient class, medical procedures, medication and diagnostic costs, readmission rates, and clinical outcome indicators. Multi-center studies involving different hospital types would also improve the generalizability of the findings and provide a more comprehensive understanding of factors influencing hospital cost efficiency.

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