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Clinical pathways in patients with ischaemic stroke: Estimating mean length of stay and hospital costs

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Abstract

Background: Effective and efficient healthcare services have become one of the priorities in the global health system, including in Indonesia. In an effort to improve quality and efficiency of care, various initiatives have been implemented by hospitals, one of which is the application of Clinical Pathways (CP). A Clinical Pathway is a systematic approach designed to provide evidence-based guidelines in managing patients with specific conditions, with the goal of improving quality, efficiency, and patient safety.
Purpose: To analyze the effectiveness of clinical pathways on length of stay (LOS) and its implications for hospital costs in ischemic stroke patients.
Method: This quantitative, analytical, observational study used a cross-sectional approach. Data collection was conducted retrospectively using secondary data from patient medical records, Clinical Pathway documents, and the Hospital Information System (SIMRS). This included all inpatients with ischemic stroke treated by the Social Security Administration at Hermina Hospital Solo during 2024. The sample size was determined using the Slovin formula with a 5% margin of error, resulting in a sample of 170 respondents.
Results: Regression analysis showed that CP significantly affects LOS, with a regression coefficient indicating that increased adherence to CP can reduce LOS. LOS also has a significant effect on hospital costs, with a positive regression coefficient, meaning the longer the LOS, the higher the hospital cost. However, CP does not have a direct effect on hospital costs. Path analysis revealed an indirect effect of CP on hospital costs through LOS, indicating that improved CP adherence can reduce hospital costs by shortening LOS.
Conclusion: That higher adherence to CP can shorten LOS and indirectly lower hospital costs. Hospital management is expected to conduct regular socialization, evaluation, and monitoring of CP implementation to achieve optimal service efficiency and cost control.

Keywords: Clinical Pathway; Hospital Cost; Ischemic Stroke; Length of Stay; Social Security Administration.

INTRODUCTION

Effective and efficient healthcare services have become one of the priorities in the global health system, including in Indonesia. In an effort to improve quality and efficiency of care, various initiatives have been implemented by hospitals, one of which is the application of Clinical Pathways (CP). A Clinical Pathway is a systematic approach designed to provide evidence-based guidelines in managing patients with specific conditions, with the goal of improving quality, efficiency, and patient safety (Vanhaecht, Panella, Van Zelm, & Sermeus, 2010). CP serves as a tool to reduce variations in clinical practice, ensure that medical procedures are carried out according to established standards, and minimize errors that may occur during the treatment process (Bai, Man, Hong, Li, Shi, & Bian, 2022).

In addition, the implementation of CP is also an important part of hospital accreditation standards in Indonesia, conducted by the Hospital Accreditation Commission. This accreditation aims to ensure that

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hospitals can provide quality services in accordance with applicable guidelines. Thus, the implementation of CP is a strategic step in efforts to improve service quality and compliance with the standards set by the accreditation body. In this context, hospitals adopting CP are expected to meet accreditation requirements as well as deliver better clinical outcomes for patients, while also improving cost efficiency.

The relevance of Universal Health Coverage (UHC) in Indonesia is crucial in realizing equitable and sustainable access to healthcare. UHC is a guarantee provided by the state to ensure that all Indonesians receive the healthcare they need without being burdened by excessive costs (World Health Organization, 2015). This system also supports the sustainability of healthcare financing by reducing reliance on out-of-pocket payments and improving efficiency in health financing management. Therefore, hospitals, as an integral part of the healthcare system, must be able to provide efficient and high-quality services, including in managing costs and treatment duration.

INA-CBG's (Indonesia Case Base Groups) claims are a package-based payment mechanism within the National Health system, implemented to ensure transparency and efficiency in financing hospital healthcare services. In this system, payments for medical services are made based on specific diagnostic groups with fixed rates, adjusted to the patient's clinical condition and the procedures performed (Zou, Li, Zhou, & Liao, 2020).

Stroke is one of the diseases with a significant impact both clinically and economically, being a leading cause of death and disability in many countries, including Indonesia. Stroke patients generally require intensive and prolonged care, leading to a higher Length of Stay (LOS) compared to many other medical conditions. The prolonged duration of care has a direct impact on hospital costs. Inpatient and treatment costs for stroke patients are often very high, creating financial pressure on hospitals and affecting their financial sustainability (Girotra, Lekoubou, Bishu, & Ovbiagele, 2020). In the context of the National Health Insurance system, INA-CBG's claims for stroke patients also pose a major challenge, as stroke falls under the category of High Cost, High Risk, High Volume (HCHRV). This means that although it occurs frequently, its treatment costs are very high and the risks for patients are significant. CP can also help improve clinical outcomes for patients by ensuring that they receive timely care aligned with evidence-based medical protocols (Runnacles, Roueché, & Lachman, 2018).

The high LOS and hospital costs for stroke patients not only place financial strain on hospitals, but also highlight the importance of CP implementation (Lucas-Noll, Clua-Espuny, Lleixa-Fortuno, Gavalda-Espelta, Queralt-Tomas, Panisello-Tafalla, & Carles-Lavila, 2023). The impact of CP on hospital costs has been discussed in various studies. CP implementation allows hospitals to manage resources more efficiently and reduce unnecessary expenses, such as repeated procedures or inappropriate treatments. (Huang, Ju, Chang, Reddy, & Velmurugan, 2017), in their study on CP implementation in South Korea, revealed that hospitalization costs for stroke patients could be reduced by around 12–15% after CP adoption. This cost reduction occurs because CP decreases variation in medical procedures and ensures that patients undergo only the necessary care, in line with evidence-based guidelines (McLachlan, Kyrimi, Dube, Hitman, Simmonds, & Fenton, 2020).

Studies at several hospitals in Indonesia have demonstrated the effectiveness of implementing clinical pathways for stroke patients. Research at Dr. Sardjito Hospital, Yogyakarta, found that CP reduced length of stay (LOS) by 12% through standardized, evidence-based care and minimizing unnecessary procedures (Raharjo & Pinzon, 2020). Similarly, another study reported a 15% reduction in LOS, with CP improving coordination between medical teams, accelerating clinical decision-making, and reducing variability in treatment duration (Iroth, Ahmad, & Pinzon, 2016). Furthermore, at Prof. Dr. RD Kandou Provincial General Hospital in Manado, CP reduced hospital costs by 10% by minimizing unnecessary medications, reducing the use of expensive medical equipment, and optimizing resource allocation—while maintaining quality of care and improving cost-effectiveness (Paat, Kristanto, & Kalalo, 2017).

A cost analysis of CP implementation found that it resulted in cost savings of 15-18% for stroke patients. Standardization of care ensures that only truly necessary procedures are performed, reducing repeated diagnostic testing and inappropriate interventions. Furthermore, the use of a more

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organized care pathway helps reduce reliance on more expensive hospital resources, thereby lowering total costs per patient (Agus, Suratri, & Fajarwati, 2021).

Hermina Solo Hospital is part of the Hermina Hospital Group network and was established on August 21, 2014, on Jalan Kolonel Sutarto, Jebres, Surakarta City, Central Java. As the 20th branch of the Hermina Group, this hospital was initially known for its superior maternal and child healthcare services. However, along with developments and community needs, Hermina Solo Hospital continues to transform into a general hospital with increasingly comprehensive and modern services. Since 2014, Hermina Solo Hospital has officially partnered with the Social Security Administering Agency for Health, so that all National Health Insurance participants can access services at this hospital.

Entering 2024, Hermina Solo Hospital is further strengthening its commitment to developing superior services, one of which is by introducing an integrated stroke service program. This service includes early screening, acute phase management, and post-stroke rehabilitation. The development of stroke services is a response to community needs and aligns with the Ministry of Health's service priorities, as stroke remains one of the highest burdens of disease in Indonesia. Ischemic stroke was also among the top five diagnoses with the highest number of inpatients at Hermina Solo Hospital in 2024 with 375 patients. The LOS for stroke patients varied at Hermina Solo Hospital, with the longest inpatient stay being 30 days in 2024.

Hermina Solo Hospital has 30 beds in the adult intensive care unit (ICU) and a staff of 54 nurses. The patient-to-nurse ratio for the ICU is one nurse for every four patients, while for the ICU, it is one nurse for every two patients. Stroke patients are categorized as ICU patients, but if they are on a ventilator, they are categorized as ICU patients. Ischemic stroke is a complication of underlying chronic diseases such as hypertension and diabetes mellitus. This increases the risk of worsening in the first 24 hours and the possibility of systemic complications (e.g., respiratory failure, heart problems, or infection). Therefore, stroke patients are treated in the intensive care unit from the first day of treatment at Hermina Solo Hospital. Complete supporting examinations—such as CT scans and laboratory assessments—are performed to confirm the diagnosis, monitor stroke progression, and anticipate further deterioration. Ischemic stroke management at Hermina Solo Hospital adheres to the standardized Ischemic Stroke Clinical Pathway (CP), ensuring selective, efficient, and evidence-based assessments and interventions. This ensures optimal cost control without sacrificing service quality, while minimizing unnecessary variations in medical procedures.

The implementation of the ischemic stroke Clinical Pathway (CP) is one of the CPs evaluated by the Hermina Solo Hospital Quality Team as a priority service. The evaluation is conducted monthly, taking a sample of all stroke patients each month, and then reporting it to the director quarterly. The Quality Team's evaluation indicates that of the 55 mandatory points in the Clinical Pathway (CP) aligned with the Ischemic Stroke PPK, six points are selected for monitoring. There has been a decline in CP implementation compliance, reaching 87.72% in the first quarter of 2024, then dropping to 81.93% in the fourth quarter of 2024. The lowest compliance rate was recorded in May, at 73.68%. While numerous studies document the positive impact of CP implementation on LOS and hospital costs, several gaps remain in the existing literature, particularly in the context of CP implementation in Indonesia.

RESEARCH METHOD

This quantitative, analytical, observational study used a cross-sectional approach. Data collection was conducted retrospectively using secondary data from patient medical records, Clinical Pathway documents, and the Hospital Information System (SIMRS). This included all inpatients with ischemic stroke treated by the Social Security Administration at Hermina Hospital Solo during 2024.

The primary focus of this study was to determine the effect of Clinical Pathway implementation on two important variables in hospital services: Length of Stay (LOS) and hospital costs. Furthermore, this study also examined the effect of length of stay on hospital costs, given that length of stay is a component that logically and empirically contributes to total healthcare costs.

The population in this study was 297 stroke patients hospitalized with a maximum hospitalization period of 7 days (according to the duration of

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inpatient CP treatment) and a CP score >70%. Meanwhile, the sample size was determined using the Slovin formula with a 5% margin of error, resulting in a sample of 170 respondents. The sample inclusion criteria were stroke patients treated by the Social Security Administration with the ICD-10 code 'I63' and complete medical record data, including length of stay (LOS) and total hospital costs. Meanwhile, exclusion criteria included patients diagnosed with stroke who were not included in the rehospitalization category and patients who were still alive at the end of the hospitalization period.

In the research process, the clinical pathway is the result of evaluating the implementation of mandatory items in the Ischemic Stroke Clinical Pathway, calculated as a percentage (%) for each patient. Length of Stay (LOS) measures the length of a patient's hospital stay. LOS is an indicator of the efficiency of hospital services from the implementation of the clinical pathway. Hospital costs are measured through the total hospital costs incurred during patient care. This variable is used to assess the economic impact of the implementation of the clinical pathway and the duration of patient hospitalization. This study used medical record data and interviews using a checklist questionnaire with patients. Furthermore, the data were analyzed univariately to distribute respondent data in the form of age and gender and bivariate analysis of simple linear regression.

RESEARCH RESULTS

Table 1. Distribution of Respondent Characteristics (N=170)

Variable	Results
Age (n/%)	
(Mean±SD)(Range)(Years)	(62±11.22)(35-65)
< 40	2/1.2
40 – 45	7/4.1
45 – 50	19/11.2
50 – 55	19/11.2
55 – 60	30/17.6
> 60	93/54.7
Gender (n/%)	
Male	86/50.6
Female	84/49.4

Based on table 1. Most of the respondents were aged >60 years, as many as 93 respondents (54.7%) and were male, as many as 86 respondents (50.6%).

Table 2. Results of Simple Linear Regression Analysis Test

Variabel	R Square	Uji ANOVA (F)	Siq	Unstandardized B	t
LOS to Hospital Cost	0.225	48.811	<0.001	0.325	6.986
Clinical Pathway (CP) and Hospital Cost	0.001	0.167	0.683	-0.025	-0.409

Based on Table 2, the length of stay (LOS) variable significantly affects hospital costs. The coefficient of determination (R^2) of 0.225 indicates that 22.5% of the variation in patient care costs can be explained by the length of stay (LOS), while the remainder is influenced by other variables outside this model. The ANOVA test for model significance produced an F value of 48.811 with a significance value <0.001, indicating that this regression model is statistically significant and suitable for use. In

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addition, the regression coefficient for the LOS variable is positive at 0.325 with a t-value of 6.986. A significance value <0.001 indicates that each additional unit of LOS increases hospital costs by 0.325 units. Thus, there is a positive and significant relationship between patient length of stay and total hospital costs. These results confirm that the longer a patient is hospitalized, the greater the costs required to complete the care episode.

Based on the results of a simple linear regression analysis to assess the direct effect of CP on Hospital Costs, an R-squared value of 0.001 was obtained, indicating that only 0.1% of the variation in treatment costs can be explained by the CP variable. The remaining 99.9% is explained by other variables not included in this model. The results of the ANOVA test show a calculated F value of 0.167 with a significance value of p = 0.683 (> 0.05). This indicates that the regression model is not significant. The regression coefficient table shows a value of -0.025, indicating that increasing CP compliance slightly reduces costs, but the effect is very small. The direct effect of CP on hospital costs shows a negative coefficient of 0.025 with a significance value of 0.683, indicating that CP reduces hospital costs, but is not statistically significant. The indirect effect of CP on hospital costs through LOS is -0.0757, meaning that every 1 unit increase in CP compliance results in a 0.0757 unit decrease in hospital costs indirectly through a decrease in LOS.

Overall, this model suggests that higher adherence to clinical pathways leads to shorter LOS, which tends to lower hospital costs. LOS serves as a mediator explaining the relationship between adherence to clinical pathways and hospital costs.

DISCUSSION

The results of this study and data analysis regarding the effect of Clinical Pathway (CP) on Length of Stay (LOS) and its implications for Hospital Cost show significant results in the relationship between Length of Stay (LOS) and Hospital Cost. However, the relationship between Clinical Pathway (CP) and Length of Stay (LOS) is not significant, nor is the relationship between CP and Hospital Cost, either directly or indirectly through the LOS variable. The descriptive results of this study show a positive trend, namely that increased compliance with CP tends to reduce LOS and make it more uniform, with a smaller standard deviation. Statistically, through a simple linear regression test, there is a significant effect of increased CP compliance on the reduction of patient LOS.

Similar results were found in a study using a scoping review method that included six studies (2017–2023) from several hospitals in Asia (including Japan, Indonesia, and China). This study showed that CP implementation consistently had a significant impact on reducing patient length of stay, with only one study showing no significant effect (p = 0.868). Overall, this review strengthens the conclusion that CP can improve inpatient care efficiency by reducing length of stay, provided it is implemented with adequate socialization, training, and periodic evaluation to ensure compliance and effectiveness (Ristiyana, Jati, & Arso, 2023).

Conversely, a study with different results was conducted at Dr. Sardjito Hospital using a quasi-experimental model on 100 acute ischemic stroke patients, comparing before and after CP implementation. This study emphasized that the complexity of medical problems and the variability of stroke patients' conditions are major barriers to CP's success in improving outcomes. Many complex issues arise during care, resulting in suboptimal patient outcomes even after CP implementation. The results of the study showed no significant difference in clinical outcomes, as measured by NIHSS scores, between the CP and non-CP groups (p = 0.06) (Atriawan, Sutarni, & Paryono, 2022).

A study of six hospitals in Indonesia over the past five years found that CP implementation is often suboptimal, resulting in a lack of impact on service quality. Several factors were identified as contributing to this, including a lack of socialization and training of staff involved in CP implementation, low staff compliance due to a lack of ownership, time constraints, and a lack of awareness of the importance of completing CP forms. Furthermore, the absence of standard operating procedures (SOPs) and dedicated CP teams in several hospital units (Thahirah, Rachmawaty, & Erfina, 2023).

A similar situation occurred in this study at Hermina Solo Hospital, where understanding of CP was limited to the head of the ward, head of the installation, hospital quality division, and medical service manager. Not all healthcare professionals understood the importance of CP in ischemic stroke

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patient care. CP results were not socialized to healthcare professionals and were only used as administrative data for hospital accreditation. Therefore, socialization, monitoring, and regular evaluation are needed to maintain and enhance the use of CP for ischemic stroke patients at Hermina Solo Hospital.

Furthermore, both descriptive and statistical analyses yielded similar results: an increase in length of stay (LOS) was directly proportional to an increase in hospital costs. This finding is consistent with a previous study conducted on 129,444 ischemic stroke patients and 15,525 hemorrhagic stroke patients, which found that LOS was a major determinant of increased hospitalization costs. The effect of total length of stay (LOS) on hospitalization costs was 0.795 for ischemic stroke patients and 0.754 for hemorrhagic stroke patients, indicating a strong and significant correlation between LOS and costs (Su, Pan, Zhao, Chen, Wang, Lu, & Liang, 2022). For each additional day of hospitalization, hospital costs increased significantly, even after controlling for other factors such as hospital level, severity (CCI), surgical intervention, discharge status, and payment system. Cost components that increased included room/accommodation, medications and supporting treatments, medical services (doctors/nurses), diagnostic examinations (laboratory/radiology), and intensive care costs in case of complications or additional interventions.

A similar study of 24 inpatients with ischemic stroke under the National Health Insurance found a significant association between length of stay (LOS) and direct medical costs ($p = 0.006$). The longer the stay, the higher the medical costs. In this study, the costs of rooms, medications, medical services, and diagnostic/laboratory examinations were the components that increased the most with the length of LOS in inpatients with ischemic stroke. This pattern is consistent with many national and international studies: the longer the stay, the higher the total costs, particularly from daily room costs, medications, and medical services (Rahmadani, Supadmi, & Sudibyo, 2023). The same is true at Hermina Hospital Solo, where additional days of stay increase hospital costs—including room costs, medications, medical services, and diagnostics. Consequently, Hermina Hospital Solo monitors the length of stay for National Health Insurance patients, with 3 days for general care and 5 days for intensive care.

The descriptive results of this study show that although compliance with CP increased, the average hospital cost also increased. However, this increase in cost was accompanied by a reduction in standard deviation, meaning that costs became more controlled and consistent. This indicates that CP implementation with high compliance does not necessarily reduce costs absolutely but improves efficiency and cost predictability. Statistically, CP implementation did not have a direct significant effect on Hospital Cost, but it had an indirect significant effect through the LOS variable. LOS acts as a mediator explaining the relationship between CP compliance and hospital cost.

CP adherence has the potential to reduce hospital costs for stroke patients, but the effect was not statistically significant in this study (Arhin, Oteng-Abayie, & Novignon, 2023). The researchers recommend optimizing CP implementation, accompanied by regular monitoring, and conducting multivariable analysis to isolate the influence of other dominant clinical factors on hospital costs in stroke patients. Identified factors include clinical variations/complications in ischemic stroke cases, not all of which can be standardized by CP, and other cost components (medications, diagnostics, interventions) that remain high even with CP adherence. CP reduces room costs but does not affect total costs because other components increase. To control costs outside the room, Hermina Solo Hospital implemented several measures: replacing symptomatic injectable drugs with oral medications for inpatients, limiting the use of Social Security Administration drugs outside the formulary, and requiring management approval for high-cost or repeated diagnostic tests to control hospital costs.

In contrast, a study with differing results used a systematic literature review of 129 articles, 15 of which met the inclusion criteria, to assess the effectiveness and efficiency of CP in hospital healthcare financing. The results showed that CP implementation reduced hospital costs. CP improves hospital spending efficiency by helping standardize management, reducing unnecessary interventions, and improving clinical and non-clinical resource management (Firmansyah & Bakhtiar, 2022).

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This study explicitly showed that hospital costs for stroke patients were more strongly influenced by LOS as a mediator than directly by management interventions such as CP. Clinical pathways and management policies did not directly reduce hospital costs but did so indirectly through reduced LOS. The study's findings highlight that LOS is a major factor directly increasing hospital costs in ischemic and hemorrhagic stroke patients. CP is not the sole determinant of hospital costs; if LOS is not reduced, cost-efficiency gains tend to be minimal or insignificant (Su et al., 2022).

CONCLUSION

Clinical Pathway (CP) implementation resulted in an average compliance score of 83.5%, an average length of stay (LOS) of 4.5 days, and an average hospital cost of IDR 16,197,435 in ischemic stroke patients. Each 1-unit decrease in CP reduces the length of stay by 0.233 units of LOS. Length of Stay (LOS) significantly impacts hospital costs for ischemic stroke patients. Each 1-unit increase in LOS increases hospital costs by 0.325 units. Clinical Pathway (CP) does not directly impact hospital costs, but indirectly through Length of Stay (LOS) as an intermediary variable in ischemic stroke patients. Each 1-unit increase in CP compliance reduces 0.0757 units of hospital costs indirectly through decreased LOS.

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