

RESEARCH ARTICLE

Clinical Pathway Implementation and Hospital Outcomes Among Bronchopneumonia Patients Under the JKN System in Indonesia

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ABSTRACT

Introduction: Under Indonesia's National Health Insurance (JKN) system, hospitals are expected to improve efficiency while maintaining quality of care. Clinical pathways (CPs) are widely implemented to standardize patient management, but evidence regarding their association with hospital outcomes among bronchopneumonia patients remains limited. This study examined the association between CP implementation and hospital outcomes under the JKN system.

Methods: A retrospective analytic study with a cross-sectional design was conducted using secondary data obtained from medical records of 113 JKN inpatients diagnosed with bronchopneumonia at Pertamina Brain and Heart Hospital Biringkanaya Makassar, Indonesia. CP implementation was classified as compliant or non-compliant based on documented adherence to the established clinical pathway. Hospital outcomes included length of stay (LOS), hospital cost efficiency, quality of care, and patient recovery. Data were analyzed using chi-square tests, Mann-Whitney U test, and multivariable binary logistic regression adjusted for age group and sex.

Results: After adjustment for age group and sex, clinical pathway compliance remained independently associated with shorter length of stay (AOR = 15.23; 95% CI: 5.74-40.41; $p < 0.001$) and greater hospital cost efficiency (AOR = 18.36; 95% CI: 6.77-49.83; $p < 0.001$). Clinical pathway compliance was also significantly associated with compliance with documented clinical service standards (OR = 140.800; 95% CI: 17.814-1112.876; $p < 0.001$). Median hospital treatment costs differed significantly between the compliant and non-compliant groups (Mann-Whitney U test, $p < 0.001$). No significant association was observed between clinical pathway compliance and patient recovery outcomes ($p = 0.250$).

Conclusion: Clinical pathway compliance was independently associated with shorter LOS, greater hospital cost efficiency, and better adherence to documented clinical service standards. These findings support the role of clinical pathways in promoting standardized and efficient hospital care under Indonesia's JKN system.

Keywords: Clinical Pathway; LOS; Hospital Cost; Quality of Care; JKN

INTRODUCTION

Hospitals play an essential role in ensuring the delivery of effective, efficient, and high-quality healthcare services. Improving organizational performance increasingly requires the adoption of standardized systems and evidence-based management approaches that support healthcare quality and efficiency (1). Increasing healthcare demands, rising treatment costs, and limited healthcare resources have encouraged hospitals to adopt standardized approaches to improve service efficiency and clinical outcomes (2,3). In modern healthcare systems, hospitals are increasingly required to balance cost containment with quality improvement while maintaining patient safety and organizational performance (4,5). Under prospective payment systems, healthcare facilities are also expected to optimize resource utilization and improve operational efficiency through evidence-based and standardized care processes (6,7).

In Indonesia, the implementation of the National Health Insurance (*Jaminan Kesehatan Nasional / JKN*) introduced the Indonesia Case-Based Groups (INA-CBGs) reimbursement mechanism, whereby hospitals receive fixed payments based on diagnosis groups rather than actual treatment expenditures (6,8). Although this payment system aims to improve cost efficiency and service standardization, discrepancies between hospital expenditures and INA-CBGs reimbursement remain a challenge for healthcare facilities (6,9). Uncontrolled variations in clinical practice may contribute to prolonged hospitalization, increased treatment costs, inefficient service delivery, and suboptimal healthcare quality (2,10,11). Standardization of care processes is therefore considered an important strategy to strengthen hospital governance, accountability, and service consistency in healthcare delivery (3,5,12).

One strategy commonly implemented to improve service efficiency and standardize patient management is the use of clinical pathways (CPs). Clinical pathways are structured multidisciplinary care plans designed to standardize patient management for specific diagnoses within a defined treatment period (6,13). Clinical pathway implementation aims to reduce unnecessary variations in clinical practice, improve adherence to evidence-based care, optimize healthcare resource utilization, and strengthen healthcare quality through coordinated multidisciplinary management (2,14). Previous studies have reported that CP implementation may reduce *length of stay* (LOS), lower hospital treatment costs, improve healthcare quality, and support more efficient hospital management (15–18). In addition, standardized service models such as clinical pathways may contribute to value innovation in hospitals by improving efficiency while maintaining quality and service consistency (19).

Length of stay is frequently used as an indicator of hospital efficiency because prolonged hospitalization increases healthcare costs and resource utilization (6,9,10). Likewise, hospital treatment cost is closely related to financial sustainability under the INA-CBGs reimbursement system (8,13). In addition, quality of care reflects adherence to clinical standards and consistency of patient management, making it an important indicator of healthcare performance and patient safety culture in hospitals (3,20,21). Effective CP implementation also depends on organizational support, professional commitment, leadership, and compliance among healthcare providers, particularly nurses, who play an important role in ensuring continuity and consistency of patient care (21,22). However, several studies identified barriers to CP implementation, including low compliance among healthcare providers, incomplete documentation, limited monitoring systems, and inadequate institutional support, which may contribute to service variation and reduced efficiency of healthcare delivery (23–25). In addition, effective leadership and organizational commitment play important roles in supporting quality improvement initiatives, enhancing staff adherence to standardized procedures, and strengthening overall hospital performance (26).

Bronchopneumonia remains one of the leading causes of hospitalization and contributes substantially to healthcare utilization and treatment costs in Indonesia (2). Patients with bronchopneumonia frequently require prolonged inpatient treatment, multiple diagnostic procedures, and intensive pharmacological management, potentially increasing variations in clinical practice and hospital expenditures (16,27,28). At Pertamina Brain and Heart Hospital Biringkanaya Makassar, bronchopneumonia cases are associated with relatively high treatment costs and variable *length of stay*, making this condition relevant for evaluating the implementation of clinical pathways. Furthermore, strengthening standardized care approaches may support hospital resilience and improve healthcare service continuity in managing high-burden diseases (29).

Previous studies have demonstrated that clinical pathway implementation is associated with improved hospital outcomes, including shorter length of stay, lower treatment costs, and better adherence to standardized clinical care (4,24). However, several important knowledge gaps remain. First, evidence regarding the implementation of clinical pathways among bronchopneumonia patients within Indonesia's National Health Insurance (JKN) system is still limited, particularly in the context of the INA-CBGs reimbursement mechanism where hospital efficiency and cost containment are critical (10,30). Second, most previous studies have evaluated hospital outcomes separately, whereas studies simultaneously examining length of stay, hospital cost efficiency, quality of care, and patient outcomes within a single analytical framework remain scarce, particularly in referral hospitals (17,20). Finally, limited evidence is available regarding whether the observed associations between clinical pathway implementation and hospital outcomes remain consistent after accounting for differences in patient characteristics. Addressing these gaps is important for strengthening the evidence supporting clinical pathway implementation in routine hospital practice. Therefore, this study aimed to analyze the association between clinical pathway implementation and hospital outcomes, including *length of stay*, hospital treatment cost, quality of care, and patient outcomes among bronchopneumonia patients under the JKN system at Pertamina Brain and Heart Hospital Biringkanaya Makassar, Indonesia.

METHODS

Research Type

This study employed a retrospective observational analytic study with a cross-sectional approach using secondary data obtained from hospital medical records. The study aimed to analyze the association between clinical pathway implementation and hospital outcomes, including length of stay (LOS), hospital treatment cost, quality of care, and patient outcomes among bronchopneumonia patients under the National Health Insurance (*Jaminan Kesehatan Nasional / JKN*) system.

Population and Sample/Informants

The population in this study consisted of all inpatients diagnosed with bronchopneumonia and registered as JKN participants at Pertamina Brain and Heart Hospital (RSOJ) Biringkanaya Makassar during the study period.

A total sampling technique was used in this study. All patients who met the inclusion criteria were included in the analysis. The inclusion criteria were: (1) patients diagnosed with bronchopneumonia, (2) registered as JKN participants, and (3) having complete medical record and clinical pathway documentation. Patients with incomplete medical records or missing clinical pathway forms were excluded from the study. A total of 113 patients fulfilled the eligibility criteria and were included in the final analysis.

Because this study aimed to evaluate clinical pathway implementation in routine hospital practice, all eligible bronchopneumonia patients were included regardless of age. To account for potential heterogeneity across age groups, age group was included as an adjustment variable in the multivariable logistic regression analyses.

Research Location

The study was conducted at Pertamina Brain and Heart Hospital (RSOJ) Biringkanaya Makassar, Indonesia, a referral hospital that has implemented clinical pathways as part of hospital quality improvement and service standardization programs.

Instrumentation or Tools

The instruments used in this study included medical records review sheets, clinical pathway documentation forms, and hospital financial records. These instruments were used to collect data regarding patient characteristics, clinical pathway implementation status, length of stay (LOS), hospital treatment cost, quality of care, and patient recovery.

Clinical pathway implementation was assessed through a structured review of bronchopneumonia clinical pathway documentation based on the hospital's standardized clinical pathway. Compliance was categorized as compliant when at least 75% of the required clinical pathway components were completed and non-compliant when compliance was less than 75%. The evaluated components included patient assessment, diagnostic examinations, pharmacological management, supportive therapy, patient monitoring, discharge planning, and completion of mandatory clinical documentation according to the hospital bronchopneumonia clinical pathway.

The dependent variables included length of stay (LOS), hospital treatment cost, quality of care, and patient recovery. LOS was categorized into 1–6 days and 7–14 days according to the hospital clinical pathway standard for bronchopneumonia management. Hospital treatment cost was categorized as efficient when the actual hospitalization cost did not exceed the corresponding INA-CBG reimbursement and inefficient when the actual hospitalization cost exceeded the INA-CBG reimbursement. Quality of care was categorized as standard-compliant or non-compliant according to hospital service quality indicators documented in the medical records. Patient recovery was categorized into recovered and not recovered according to discharge status.

Age group and sex were included as potential confounding variables in the multivariable analyses because both variables may influence hospitalization duration and treatment costs among bronchopneumonia patients.

Data Collection Procedures

Data were collected retrospectively using hospital medical records, clinical pathway forms, and hospital financial records. Data collected included patient demographic characteristics, clinical pathway implementation status, length of stay, hospital treatment cost, quality of care indicators, and patient recovery.

Clinical pathway implementation was assessed through structured review of patient management documentation based on the hospital clinical pathway standards for bronchopneumonia.

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 24. Descriptive statistics were used to summarize patient characteristics and study variables. Categorical variables were presented as frequencies and percentages, whereas continuous variables were summarized using as means, standard deviation (SD), median, and interquartile range (IQR).

Bivariate analysis was conducted to determine the association between clinical pathway implementation and hospital outcomes. The chi-square test or Fisher's exact test was used to assess associations between categorical variables, as appropriate. Odds ratios (ORs) with 95% confidence intervals (CI) were calculated to determine the strength of associations. Hospital treatment costs were assessed for normality using the Shapiro–Wilk test. Because the cost data were not normally distributed, hospital treatment costs between the compliant and non-compliant clinical pathway groups were compared using the Mann–Whitney U test. To control for potential confounding, multivariable binary logistic regression analysis using the

Enter method was performed for the outcomes of length of stay and hospital cost efficiency. Clinical pathway implementation was entered as the primary independent variable, whereas age group and sex were included as adjustment variables because both factors are clinically relevant and were available in the study dataset. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. Model performance was evaluated using the Hosmer–Lemeshow goodness-of-fit test, Nagelkerke R^2 , and overall classification accuracy. A two-sided p -value of <0.05 was considered statistically significant.

Ethical Approval

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Public Health, Hasanuddin University with approval number 106/UN4.14.1/TP.01.02/2025. Patient confidentiality and anonymity were maintained throughout the study by removing personal identifiers from all collected data.

RESULTS

Characteristics of the Study Participants

As shown in Table 1, a total of 113 bronchopneumonia patients registered under the National Health Insurance (JKN) system were included in this study. Most patients were in the early elderly age group (45–65 years) (27.5%), followed by toddlers aged 1–5 years (26.5%). Female patients constituted 56.6% of the study population, while males accounted for 43.4%. Regarding hospitalization class, the majority of patients were admitted to Class I wards (61.1%), whereas only a few were treated in intensive care units (0.9%) and isolation rooms (4.4%).

Table 1. Baseline Characteristics of Bronchopneumonia Patients (n=113)

Variable	Category	n (%)
Age Group	Toddler (1–5 years)	30 (26.5)
	Children (5–11 years)	16 (14.2)
	Adolescents (12–25 years)	11 (9.7)
	Adults (26–45 years)	12 (10.6)
	Early elderly (45–65 years)	31 (27.5)
	Late elderly (>65 years)	13 (11.5)
Sex	Male	49 (43.4)
	Female	64 (56.6)
Inpatient Class	Intensive Care	1 (0.9)
	Intensive / Class III	2 (1.8)
	Isolation	5 (4.4)
	Class I	69 (61.1)
	Class II	19 (16.8)
	Class III	17 (15.0)

Distribution of Hospital Outcome

Table 2 presents the distribution of hospital outcome variables among the 113 bronchopneumonia patients included in this study. More than half of the patients (50.4%) experienced a length of stay of 7–14 days, while 49.6% were hospitalized for 1–6 days. Based on the comparison between the actual hospitalization cost and the corresponding INA-CBG reimbursement, 57.5% of patients were categorized as having inefficient hospital costs, whereas 42.5% were classified as cost-efficient. Regarding quality of care, 69.9% of patients were classified as non-compliant with hospital service standards, while 30.1% met the established standards. Nearly all patients (97.3%) were discharged with recovered status, whereas only 2.7% were categorized as not recovered.

Table 2. Distribution of Hospital Outcomes among Bronchopneumonia Patients

Outcome Variable	Category	n (%)
Length of Stay	1–6 days	56 (49.6)
	7–14 days	57 (50.4)
Hospital Cost Efficiency	Efficient	48 (42.5)
	Inefficient	65 (57.5)
Quality of Care	Standard-compliant	34 (30.1)
	Non-compliant	79 (69.9)
Patient Recovery	Recovered	110 (97.3)
	Not recovered	3 (2.7)

Comparison of Hospital Treatment Costs According to Clinical Pathway Implementation

Hospital treatment costs were not normally distributed in either clinical pathway group according to the Shapiro–Wilk test (both $p < 0.001$). Therefore, differences in hospital treatment costs were analyzed using the Mann–Whitney U test. As presented in Table 3, patients managed according to the clinical pathway had lower hospital treatment costs than those managed without clinical pathway compliance. The median hospital treatment cost was IDR 4,608,895 (IQR: IDR 732,758) in the compliant group and IDR 7,441,683 (IQR: IDR 4,551,438) in the non-compliant group. This difference was statistically significant (Mann–Whitney U = 635.5, Z = -5.370, $p < 0.001$).

Table 3. Comparison of Hospital Treatment Costs According to Clinical Pathway Implementation

Clinical Pathway Implementation	n	Mean $\pm$ SD (IDR)	Median (IQR) (IDR)	p-value*
Non-compliant	65	8,644,654 $\pm$ 4,245,132	7,441,683 (4,551,438)	<0.001
Compliant	48	5,633,437 $\pm$ 3,032,622	4,608,895 (732,758)	

*Mann–Whitney U test

Association between Clinical Pathway Implementation and Hospital Outcomes

Table 4 presents the bivariate associations between clinical pathway implementation and hospital outcomes. Clinical pathway implementation was significantly associated with length of stay (LOS), hospital cost efficiency, and quality of care (all $p < 0.001$). Patients managed according to the clinical pathway were more likely to have a shorter LOS (OR=15.313; 95% CI: 5.946–39.431), efficient hospital costs (OR=16.512; 95% CI: 6.485–42.042), and standard-compliant quality of care (OR=140.800; 95% CI: 17.814–1112.876) than those in the non-compliant group. No significant association was found between clinical pathway implementation and patient recovery ($p = 0.250$).

Table 4. Bivariate Association between Clinical Pathway Implementation and Hospital Outcomes

Variables	Category	Compliant n (%)	Non-Compliant n (%)	p-value	OR (95% CI)
Length of Stay (LOS)	< 1 week	40 (71.4)	16 (28.6)	<0.001	15.313 (5.946–39.431)
	1–2 weeks	8 (14.0)	49 (86.0)		
Hospital Cost	Efficient	37 (77.1)	11 (22.9)	<0.001	16.512 (6.485–42.042)
	Inefficient	11 (16.9)	54 (83.1)		
Quality of Care	Standard-compliant	33 (97.1)	1 (2.9)	<0.001	140.800 (17.814–1112.876)
	Non-compliant	15 (19.0)	64 (81.0)		
Patient Recovery	Recovered	45 (93.8)	65 (100)	0.250	NA
	Not recovered	3 (6.3)	0 (0)		

Data are presented as n (%). P-values were obtained using Pearson's chi-square test or Fisher's exact test, as appropriate. OR = odds ratio; CI = confidence interval. NA = odds ratio could not be estimated because one cell contained zero observations.

To account for potential confounding, multivariable binary logistic regression analyses were subsequently performed for length of stay and hospital cost efficiency after adjustment for age group and sex.

Multivariable Binary Logistic Regression Analysis of Hospital Outcomes

Table 5 presents the results of the multivariable binary logistic regression analyses for length of stay and hospital cost efficiency after adjustment for age group and sex. Clinical pathway compliance remained independently associated with both shorter length of stay and hospital cost efficiency after adjustment. In contrast, age group and sex were not significantly associated with either outcome ($p > 0.05$). Both regression models demonstrated acceptable goodness of fit according to the Hosmer–Lemeshow test, indicating that the models adequately fit the observed data.

Table 5. Multivariable Binary Logistic Regression Analysis of Factors Associated with Length of Stay and Hospital Cost Efficiency

Variable	Length of Stay AOR (95% CI)	p	Hospital Cost Efficiency AOR (95% CI)	p
Clinical pathway	15.23 (5.74–40.41)	<0.001	18.36 (6.77–49.83)	<0.001
Age	Adjusted	0.770	Adjusted	0.870
Sex	Adjusted	0.771	Adjusted	0.571
Model Performance			LOS	Cost
Hosmer–Lemeshow			0.785	0.710
Nagelkerke R ²			0.427	0.447
Accuracy			78.8%	80.5%

AOR = adjusted odds ratio; CI = confidence interval. Models were adjusted for age group and sex.

DISCUSSION

This study examined the association between clinical pathway implementation and hospital outcomes among bronchopneumonia patients under the National Health Insurance (JKN) system at Pertamina Brain and Heart Hospital Biringkanaya Makassar. The findings demonstrated that clinical pathway compliance was significantly associated with shorter length of stay (LOS), greater hospital cost efficiency, and better quality of care. Furthermore, the associations with LOS and hospital cost efficiency remained statistically significant after adjustment for age group and sex using multivariable logistic regression analysis. However, no statistically significant association was observed between clinical pathway implementation and patient recovery outcomes.

These findings suggest that adherence to clinical pathways may support hospital efficiency and standardization of patient management, particularly in healthcare systems operating under bundled reimbursement mechanisms such as INA-CBGs (6,8,9). Clinical pathway implementation may facilitate multidisciplinary coordination, reduce unnecessary variation in clinical practice, and promote more efficient use of healthcare resources (11,12). These findings are consistent with previous evidence indicating that standardized clinical management and structured care processes can improve organizational performance, care coordination, and service efficiency (1). Nevertheless, the observed associations should be interpreted with caution because patient outcomes may also be influenced by disease severity, comorbidities, nutritional status, treatment intensity, and other patient-specific clinical characteristics that were not fully captured in this study (16,23).

From a health systems perspective, the findings of this study reinforce the importance of standardized clinical management in strengthening service quality, hospital governance, and operational efficiency. Clinical pathways should therefore be viewed not merely as administrative instruments, but as structured quality improvement mechanisms that facilitate evidence-based practice, interdisciplinary coordination, and more efficient healthcare delivery (6,11,26). In addition, pathway-based care may contribute to value innovation and organizational improvement by promoting service consistency and more efficient resource utilization within hospitals (19). However, given the retrospective cross-sectional design of this study, the findings should be interpreted as demonstrating associations rather than causal relationships.

Interpretation of Key Findings

This study demonstrated that clinical pathway implementation was independently associated with shorter length of stay (LOS) and greater hospital cost efficiency after adjustment for age group and sex. Patients whose management complied with the clinical pathway were also more likely to receive care that met the hospital's documented clinical service standards. However, no statistically significant association was observed between clinical pathway implementation and patient recovery outcomes. These findings indicate that adherence to clinical pathways was associated primarily with improvements in hospital care processes and operational efficiency rather than direct clinical outcomes.

The shorter LOS observed among patients managed according to clinical pathways suggests that standardized patient management may improve service efficiency by reducing unnecessary variation in clinical decision-making, facilitating timely diagnostic evaluation, promoting appropriate treatment selection, and supporting more effective discharge planning (15,18). Clinical pathways are designed to coordinate multidisciplinary care and reduce unnecessary variations in treatment, thereby supporting more efficient inpatient management (2,14,31). The persistence of this association after adjustment for age group and sex further suggests that the relationship was not explained solely by differences in patient demographic characteristics. Nevertheless, deviations from the clinical pathway should not automatically be interpreted as inappropriate care. In routine clinical practice, individualized management may be necessary for patients with severe bronchopneumonia, multiple comorbidities, complications, or other complex clinical conditions requiring deviation from standardized protocols. Therefore, although pathway compliance was associated with shorter hospitalization, these findings should not be interpreted as implying that all pathway deviations represent poor-quality clinical practice.

With respect to hospital treatment costs, patients managed according to the clinical pathway were more likely to experience efficient hospital expenditures than those whose management did not comply with the pathway. This finding may reflect more efficient utilization of healthcare resources through standardized diagnostic procedures, medication use, and clinical interventions (12,25). Under the INA-CBGs reimbursement system, where hospital reimbursement is predetermined according to diagnosis-related groups rather than actual expenditure, efficient resource utilization is particularly important for maintaining hospital financial sustainability (8,9). The multivariable analysis demonstrated that the association between clinical pathway compliance and hospital cost efficiency remained statistically significant after adjustment, supporting the potential contribution of standardized clinical management to more efficient hospital resource utilization (7,19).

Regarding quality of care, patients managed according to the clinical pathway were more likely to receive care that complied with the hospital's documented clinical service standards. This finding indicates better adherence to standardized clinical processes and greater consistency in patient management (20). However, the quality-of-care indicator used in this study was derived from documented compliance with clinical service standards recorded in medical records. Consequently, some conceptual overlap between clinical pathway compliance and quality-of-care assessment cannot be completely excluded. Therefore, the observed association should be interpreted primarily as reflecting improved adherence to standardized care processes rather than demonstrating a direct improvement in overall clinical effectiveness. Institutional support, healthcare worker commitment, leadership, and patient safety culture remain essential factors influencing successful implementation of clinical pathways and continuous quality improvement initiatives (21,22).

No statistically significant association was found between clinical pathway implementation and patient recovery outcomes. This finding should be interpreted cautiously because almost all patients were discharged in a recovered condition, resulting

in limited variability of the outcome measure. Consequently, the study may have had limited statistical power to detect meaningful differences in recovery between groups. In addition, recovery among bronchopneumonia patients is influenced by multiple clinical factors beyond pathway adherence, including disease severity, comorbidities, nutritional status, immune response, treatment intensity, and timeliness of treatment initiation (16). Therefore, while clinical pathways appear to support more efficient and standardized care processes, they should not be interpreted as the sole determinant of patient recovery, particularly in a clinically heterogeneous patient population.

Comparison with Previous Studies

The findings of this study are consistent with previous research demonstrating that clinical pathway implementation is associated with improved hospital efficiency and greater adherence to standardized clinical practice. A systematic review by Rotter et al. reported that clinical pathways reduced length of stay, enhanced multidisciplinary coordination, and promoted compliance with evidence-based treatment protocols among hospitalized patients (2). Similar findings have also been reported in hospital-based studies showing that standardized care pathways reduce unnecessary variation in patient management, facilitate more timely clinical decision-making, and contribute to shorter hospitalization and lower treatment costs (10,15). The persistence of these associations after adjustment for age group and sex in the present study further supports the robustness of the observed relationship, although causal inference cannot be established because of the observational study design.

The significant association between clinical pathway implementation and hospital cost efficiency observed in this study is also consistent with previous evidence indicating that structured clinical management can improve resource utilization and reduce unnecessary healthcare expenditures (15,30). Standardization of diagnostic procedures, medication use, clinical monitoring, and discharge planning may contribute to more efficient utilization of hospital resources while maintaining adherence to recommended clinical practice (12,25). These findings are particularly relevant within prospective payment systems such as INA-CBGs, where hospitals receive predetermined reimbursement according to diagnosis-related groups rather than actual expenditure (3,18). Consequently, implementation of clinical pathways may support financial sustainability by reducing unwarranted variation in clinical management while improving operational efficiency (7).

The association between clinical pathway implementation and quality of care observed in this study is also in agreement with previous reports demonstrating improved adherence to clinical standards following pathway implementation (17,20,24). Clinical pathways facilitate multidisciplinary collaboration, promote consistency in clinical decision-making, and strengthen quality assurance processes within hospitals (3,21). However, the quality-of-care indicator in the present study was primarily based on documented compliance with hospital clinical service standards. Therefore, the observed association should be interpreted as reflecting improved adherence to standardized care processes rather than definitive evidence of improved overall clinical effectiveness. Organizational commitment, managerial support, leadership, and a strong patient safety culture remain important determinants of successful clinical pathway implementation and sustained quality improvement (22,26).

Unlike several previous studies reporting improvements in clinical outcomes following pathway implementation (4,16), this study did not identify a significant association between clinical pathway implementation and patient recovery. This discrepancy may be explained by the limited variability of the outcome, as nearly all patients were discharged in a recovered condition. In addition, recovery among bronchopneumonia patients is influenced by multiple clinical factors, including disease severity, underlying comorbidities, nutritional status, immune response, and treatment intensity, many of which were not available in the retrospective medical record data (23). Differences in patient characteristics, hospital settings, and operational definitions of clinical outcomes across studies may also contribute to the variation in findings. These considerations suggest that standardized clinical pathways should be integrated with individualized clinical assessment to optimize patient management while acknowledging that recovery is determined by multiple interacting clinical factors.

Limitations and Cautions

Several limitations should be considered when interpreting the findings of this study. First, this study employed a retrospective design using secondary medical record data, which is inherently dependent on the completeness and accuracy of clinical documentation. Incomplete or inconsistent recording of clinical pathway forms and medical records may have resulted in misclassification of pathway compliance status (documentation bias), thereby influencing the observed associations.

Second, the study was conducted in a single referral hospital, which may limit the generalizability of findings to hospitals with different patient populations, organizational structures, service capacities, and levels of clinical pathway implementation systems. Consequently, caution should be exercised when applying these findings to other healthcare settings.

Third, although multivariable logistic regression was performed to adjust for age group and sex, residual confounding cannot be excluded. Several clinically important variables, including bronchopneumonia severity, underlying comorbidities, nutritional status, complications, treatment intensity, and socioeconomic characteristics, were not comprehensively available in the retrospective dataset and therefore could not be incorporated into the regression models. Patients with greater clinical complexity may have been more likely to deviate from the clinical pathway while simultaneously experiencing longer hospitalization and higher treatment costs. Accordingly, the findings should be interpreted as demonstrating associations rather than causal effects of clinical pathway implementation.

Finally, the strong association observed between clinical pathway implementation and quality of care should be interpreted with caution. The quality-of-care indicator was primarily derived from documented compliance with hospital clinical service standards, which may partially overlap conceptually with the assessment of clinical pathway compliance. This overlap, together with the limited variability of several outcome categories, may have contributed to the large odds ratio and wide

confidence interval observed for this outcome. Future studies should incorporate more independent indicators of healthcare quality, such as guideline-concordant antibiotic therapy, complication rates, readmission, patient safety indicators, or patient-reported outcomes, to provide a more comprehensive evaluation of the impact of clinical pathway implementation.

Recommendations for Future Research

Future studies are recommended to employ prospective or multicenter study designs to improve generalizability and establish stronger causal inference regarding the impact of clinical pathway implementation on hospital outcomes (17,18). Further research should also include more comprehensive clinical variables, such as disease severity, comorbidity burden, nutritional status, patient adherence to treatment, and healthcare provider compliance, to better understand factors influencing patient outcomes. Future research should employ prospective cohort or multicenter study designs to improve the generalizability of findings and provide stronger evidence regarding the association between clinical pathway implementation and hospital outcomes (17,18). Future studies should also incorporate more comprehensive clinical variables, including disease severity, comorbidity burden, nutritional status, treatment intensity, complications, and baseline clinical status, to enable more robust adjustment for potential confounding factors and improve the validity of outcome assessment.

In addition, future evaluations of clinical pathway implementation should include more independent indicators of healthcare quality, such as appropriateness of antibiotic therapy, adherence to diagnostic recommendations, complication rates, readmission, patient safety indicators, and patient-reported outcomes. These measures would provide a more comprehensive assessment of clinical effectiveness beyond documentation-based compliance and help distinguish process quality from patient outcomes.

Qualitative and mixed-methods studies exploring barriers and facilitators to clinical pathway implementation among healthcare professionals are also recommended to better understand factors influencing pathway adherence, multidisciplinary collaboration, organizational support, leadership, and patient safety culture (21,22). Furthermore, evaluating the long-term clinical, organizational, and economic impact of clinical pathway implementation across different hospital settings would contribute to strengthening evidence-based hospital management, value innovation, and healthcare efficiency within Indonesia's National Health Insurance (JKN) system (19,29).

CONCLUSION

This study examined the association between clinical pathway implementation and hospital outcomes among bronchopneumonia patients under Indonesia's National Health Insurance (Jaminan Kesehatan Nasional/JKN) system. Clinical pathway compliance was independently associated with shorter length of stay and greater hospital cost efficiency after adjustment for age group and sex. Patients managed according to the clinical pathway were also more likely to receive care that complied with the hospital's documented clinical service standards. However, no statistically significant association was observed between clinical pathway implementation and patient recovery outcomes. These findings suggest that adherence to clinical pathways is associated with improved hospital efficiency and greater consistency of standardized clinical care within the INA-CBGs reimbursement system, although the observed relationships should be interpreted as associative rather than causal.

The findings should be interpreted in light of the study's retrospective design, reliance on secondary medical record data, and single-center setting, which may limit generalizability and leave the possibility of residual confounding. Future multicenter prospective studies incorporating more comprehensive clinical variables and independent indicators of healthcare quality are warranted to further evaluate the role of clinical pathway implementation in improving hospital performance and patient care.

DECLARATIONS

Author contributions: All authors made substantial contributions to this study. Y.P. was responsible for the conceptualization, study design, data collection, data analysis, interpretation of findings, manuscript drafting, and revision. N.B.N. and I.I. contributed through academic supervision, methodological validation, critical review of the manuscript, and guidance throughout the research process. A.I.S. and F.R. contributed to methodological evaluation, critical manuscript review, and final revision of the manuscript. All authors reviewed and approved the final version of the manuscript for publication.

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Declaration of Generative AI And AI-Assisted Technologies in the Writing Process: The authors wish to declare that, during the preparation of this manuscript, generative artificial intelligence (AI) tools, including ChatGPT (OpenAI), were employed exclusively to support language refinement, improve clarity, readability, and the overall quality of academic writing. All research concepts, study design, data collection, statistical analyses, interpretation of findings, and conclusions are entirely the independent work of the authors, with no involvement of AI tools in scientific analysis, data interpretation, or academic decision-making.

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