WHIOCE PUBLISHING PTE. LTD.
PROVIDING
FIRST-CLASS SCIENTIFIC INFORMATION
FOR TOP SCHOLARS

2025 Volume 10, Issue 4
Advances in Precision Medicine
ISSN: 2424-9106 (Online)
ISSN: 2424-8592 (Print)

# Trends in Hospitalization Costs for COPD Patients: A Policy Coordination Perspective

**Xuege Qiao[1], Yin Wang[1], Jiajia Zhao[1], Xiaoyan Wang[2], Zhong Lv[1]***

[1]Dongyang Hospital Affiliated to Wenzhou Medical University, Zhejiang 322100, China

[2]Dongyang People's Hospital, Zhejiang 322100, China

**Author to whom correspondence should be addressed.*



**Abstract:** *Objective:* To investigate the impact of integrating clinical pathways with Diagnosis-Related Groups (DRG) from a policy synergy perspective on hospitalization costs, healthcare efficiency, and cost structure for patients with chronic obstructive pulmonary disease (COPD), and to explore pathway optimization strategies adapting to the DRG 2.0 grouping policy, thereby enhancing the efficiency of medical insurance fund utilization. *Methods:* Using a tertiary hospital in Jinhua City as a case study, 7,015 medical insurance patients with a primary diagnosis of COPD admitted between 2020 and 2024 were selected. Interrupted Time Series Analysis (ITSA) and Structural Variation Analysis were employed to assess trends in hospitalization costs and other indicators. *Results:* Total hospitalization costs exhibited a significant short-term decrease ($p$ = 0.003). Laboratory and examination costs decreased both in the short and long term (all $p < 0.05$). However, antimicrobial medication costs demonstrated a long-term upward trend ($p$ = 0.007). Length of stay (LOS) decreased by 0.29 days in the short term. Western medications (contribution rate: 29.19%) and comprehensive medical services (contribution rate: 24.98%) were identified as key factors driving structural changes. *Conclusion:* Effective synergy between DRG and clinical pathways can reduce total hospitalization costs and shorten LOS for COPD patients, while optimizing cost structures. However, close attention must be paid to the unreasonable increase in antimicrobial medication costs. "Value-based healthcare" may represent a future trend for achieving a win-win scenario for cost control and healthcare quality.

**Keywords:** Clinical pathway; DRG 2.0; Chronic obstructive pulmonary disease (COPD); Value-based healthcare

***Online publication:*** December 20, 2025

## 1. Foreword

In July 2024, the National Healthcare Security Administration issued the "Notice on Issuing the Diagnosis-Related Groups (DRG) Payment Version 2.0 Classification Scheme and Deepening Related Work" [1]. Compared to the Version 1.1 classification scheme, the new scheme introduces significant adjustments to grouping rules, classification criteria, and payment methods, while also imposing stricter requirements on internal medical insurance fund management within public hospitals.

Under this new policy framework, clinical pathways now assume new responsibilities in optimizing resource utilization and enhancing grouping accuracy. Effectively integrating clinical pathways with DRG systems to enhance cost management efficiency represents the key to solving the challenges of refined hospital management. This study examines the impact of clinical pathway coordination policies on inpatient costs using COPD inpatients at a tertiary hospital in Jinhua City (Hospital D) as a case study [2,3].

## 2. Research data and methods

### 2.1. Study population and data sources

This study selected data from patients discharged from Hospital D with primary diagnoses of "Chronic Obstructive Pulmonary Disease with Acute Exacerbation" or "chronic obstructive pulmonary disease with acute lower respiratory tract infection" (ICD-10: J44).

#### 2.1.1. Inclusion criteria

Cases belonging to DRG groups ET21 or ET23 without surgical procedures and meeting criteria for the COPD clinical pathway.

#### 2.1.2. Exclusion criteria

Cases with hospital stays shorter than 3 days or longer than 40 days, and cases readmitted within short intervals. A total of 7,015 cases were ultimately included: 949 pre-intervention and 6,066 post-interventions [4,5].

### 2.2. Research methods

This study employed a quasi-experimental design using interrupted time series analysis (ITSA), constructing a segmented linear regression model to evaluate the implementation effects of clinical pathway optimization [6]. The basic model equation is:

(1) $Yt = \beta0 + \beta1 \cdot time + \beta2 \cdot intervention + \beta3 \cdot time\ after\ intervention + \varepsilon t$.

(2) β2 represents the instantaneous change slope, i.e., the estimated level change in the target outcome caused by the intervention; β3 represents the long-term change slope, i.e., the estimated trend changes in the target outcome caused by the intervention.

This study used length of hospital stay, number of hospitalizations, and various medical costs as dependent variables. June 2021 was designated as the intervention point. Considering the impact of centralized procurement policies, the fifth and eighth batches of centralized procurement (December 2021 and March 2023) were selected as policy change points. Controls distinguished between the epidemic period and peak period. Sensitivity analysis was conducted by varying the order of autocorrelation to validate robustness. The Durbin-Watson test diagnosed residual autocorrelation, and Prais-Winsten methods were applied for refitting and correction. Statistical analysis was conducted using Stata 18 software, with $p < 0.05$ indicating significant differences.

## 3. Evaluation of clinical pathway optimization effects

### 3.1. Descriptive analysis

After clinical pathway optimization, the average length of hospital stays for COPD patients decreased from 8.10 days to 7.40 days. Total hospitalization costs fell from ¥9,208.30 to ¥7,830.90. The cost structure exhibited a "four decreases and one increase" pattern: medication costs dropped; the proportion of medical services increased; laboratory & imaging costs decreased in absolute terms; however, antimicrobial drug costs increased from ¥227.20 to ¥348.40. (See **Table 1**)

**Table 1.** Distribution of key indicators before and after clinical pathway optimization at Hospital D

| Indicator (day/yuan) | Before intervention (0) | After intervention (1) | Standard deviation (SD) |
|---|---|---|---|
| Healthcare utilization | | | |
| Length of stay (days) | 8.1 | 7.4 | 0.6 |
| Number of admissions | 6.9 | 6.7 | 0.8 |
| Costs (Yuan) | | | |
| Total cost | 9208.3 | 7830.9 | 786.9 |
| Drug cost | 2302 | 1575.8 | 180 |
| Antibiotic drug cost | 227.2 | 348.4 | 265.2 |
| Medical service cost | 2043.6 | 1948.6 | 42.6 |
| Laboratory & imaging cost | 4672.2 | 4139.3 | 383.4 |
| Consumable cost | 190.4 | 167.2 | 243.7 |

## 3.2. ITSA analysis results

Discrete time series analysis reveals: From the perspective of medical efficiency, optimizing the diagnosis and treatment process during the initial intervention phase moderately improved efficiency, with a short-term downward trend in patient hospitalization days (β2 = 0.29, $p = 0.01$). However, a long-term upward trend emerged (β3 = 0.07, $p = 0.02$). Hospital D's clinical pathway optimization measures reduced unnecessary hospitalizations by reinforcing tiered diagnosis and treatment concepts, showing declining trends in both short-term (0.99 fewer cumulative hospitalizations, $p < 0.01$) and long-term (0.31 fewer, $p < 0.01$) periods. Non-urgent hospitalization demand was significantly suppressed during the COVID-19 peak, resulting in markedly reduced admission rates.

Regarding cost control, Hospital D's clinical pathway optimization measures reduced total inpatient costs in the short term by ¥694.73 ($p = 0.003$), though the long-term trend was non-significant. The implementation of the fifth batch of centralized procurement had a substantial impact on inpatient costs. Medical service costs showed a short-term downward trend, decreasing by ¥89.47 ($p = 0.008$), but exhibited a long-term upward trend with an average monthly increase of ¥41.20 ($p < 0.01$). This indicates that during the initial phase of clinical pathway optimization, certain over-treatment behaviors were standardized, while subsequent optimization of cost structures allowed the value of medical professionals' technical labor to be reflected. Clinical pathway optimization reduced unnecessary laboratory tests and imaging examinations. Combined with the impact of the fifth batch of centralized procurement policies, laboratory and imaging costs for COPD patients decreased by 442.4 yuan in the short term ($p = 0.01$) and showed a long-term downward trend, with costs decreasing by 72.5 yuan ($p = 0.03$). Medical consumables costs showed a short-term downward trend due to the optimization's control over high-value consumables, decreasing by 46.5 yuan ($p = 0.003$). Notably, the intervention exerted a long-term upward effect on both antimicrobial drug costs and nursing fees, with trend slopes increasing by 25.86 ($p = 0.007$) and 10.89 ($p = 0.03$), respectively. This may be related to the complex underlying conditions of COPD patients. (See **Table 2**)

**Table 2.** Regression analysis of policy intervention effects on healthcare efficiency and cost control

| Indicator | | Variable | Coefficient | *t*-value | *p*-value |
|---|---|---|---|---|---|
| Healthcare efficiency | | | | | |
| | Length of stay | β1 | -0.04 | -1.66 | 0.11 |
| | | β2 | -0.29 | -2.7 | 0.01 |
| | | β3 | 0.07 | 2.38 | 0.02 |
| | | Policy1 | -0.64 | -4.08 | < 0.001 |
| | | Policy2 | -0.98 | -3.09 | 0.002 |
| | | Phase1 | -0.44 | -3.03 | 0.002 |

**Table 1 (Continued)**

| **Indicator** | | **Variable** | **Coefficient** | ***t*-value** | ***p*-value** |
|---|---|---|---|---|---|
| | Number of admissions | β1 | 0.38 | 7.37 | < 0.001 |
| | | β2 | -0.99 | -4.61 | < 0.001 |
| | | β3 | -0.31 | -5.57 | < 0.001 |
| | | Policy1 | -0.94 | -4.6 | < 0.001 |
| | | Policy2 | -0.9 | -2.33 | 0.02 |
| | | Phase1 | -1.97 | -11.07 | < 0.001 |
| | | Phase2 | -2 | -5.39 | < 0.001 |
| Cost control | | | | | |
| | Total cost | β1 | -86.84 | -2.1 | 0.036 |
| | | β2 | -694.73 | -3.11 | 0.002 |
| | | β3 | 56.28 | 1.19 | 0.24 |
| | | Policy1 | -637.23 | -3.35 | < 0.001 |
| | | Phase1 | 738.8 | 3.19 | 0.001 |
| | | Phase2 | 1561.51 | 4.12 | < 0.001 |
| | Medical service cost | β1 | -27.25 | -3.41 | < 0.001 |
| | | β2 | -89.47 | -2.8 | 0.005 |
| | | β3 | 41.2 | 4.55 | < 0.001 |
| | | Policy1 | -126.95 | -2.8 | 0.005 |
| | | Policy2 | -305.46 | -3.65 | < 0.001 |
| | Drug cost | Policy1 | -265.16 | -3.66 | < 0.001 |
| | | Phase1 | 566.05 | 2.5 | 0.012 |
| | | Phase2 | 759.84 | 3.16 | 0.002 |
| | Consumable cost | β1 | 2.91 | 0.56 | 0.58 |
| | | β2 | -46.5 | -3.19 | 0.001 |
| | | β3 | -2.35 | -0.43 | 0.67 |
| | Laboratory & imaging cost | β1 | 44.57 | 1.28 | 0.21 |
| | | β2 | -442.4 | -3.54 | < 0.001 |
| | | β3 | -72.25 | -1.92 | 0.055* |
| | | Phase2 | 744.08 | 3.46 | < 0.001 |
| | Antibiotic drug cost | β1 | -10.95 | -1.42 | 0.16 |
| | | β2 | 29.22 | 0.63 | 0.53 |
| | | β3 | 25.86 | 0.3 | < 0.001 |
| | | Policy1 | 24.52 | 0.56 | 0.58 |
| | | Policy2 | 161.56 | 1.16 | 0.25 |
| | | Phase1 | -25.54 | -0.52 | 0.61 |
| | | Phase2 | 405.85 | 3.22 | 0.001 |
| | Nursing fee | β1 | -9.38 | -2.02 | 0.043 |
| | | β2 | -8.73 | -0.65 | 0.52 |
| | | β3 | 10.89 | 2.32 | 0.02 |
| | | Policy1 | -17.06 | -2.12 | 0.034 |
| | | Policy2 | -29.83 | -2.09 | 0.037 |

Notes:

Significance levels are indicated by *p*-values in bold.* denotes marginal significance ($p < 0.1$).

Variable names (e.g., β1, Policy1, Phase1) correspond to the terms defined in the regression model.

## 4. Analysis of changes in hospitalization cost structure for COPD patients at hospital D from 2022 to 2024

As demonstrated earlier, the overall per-admission total hospitalization costs for COPD patients at Hospital D showed a downward trend from 2020 to 2024. We will further analyze the changes in the cost structure using the structural change method [7].

Structural change analysis showed that the overall degree of change in per-visit total hospitalization costs from 2021 to 2024 reached 15.99. The structural variability was highest between 2021 and 2022 (11.02) and lowest during 2022–2023 (6.52). From 2021 to 2024, the largest fluctuations in the cost structure occurred in comprehensive medical services, diagnostics, treatments, and Western pharmaceuticals. These four categories collectively contributed 89.2% to the total variation, with Western pharmaceuticals accounting for the highest proportion (29.19%).(See **Table 3** and **4**)

**Table 3.** Structural variation in healthcare costs by category (2021–2024) (%)

| Category | 2021–2022 | 2022–2023 | 2023–2024 | Cumulative (2021–2024) |
|---|---|---|---|---|
| General medical services | 1.64 | 0.5 | 1.86 | 4 |
| Diagnostic services | -3.92 | 2.66 | -1.86 | -3.12 |
| Therapeutic services | 1.99 | -1.57 | 2.06 | 2.48 |
| Rehabilitation services | 0.05 | -0.02 | 0.3 | 0.34 |
| Traditional Chinese Medicine (TCM) services | 0.03 | 0.06 | 0.18 | 0.27 |
| Western Medicines | -1.38 | -0.19 | -3.1 | -4.67 |
| Chinese Materia Medica | -0.01 | 0.01 | 0.02 | 0.02 |
| Blood and blood products | 1.18 | -0.7 | -0.09 | 0.4 |
| Medical consumables | 0.61 | -0.77 | 0.66 | 0.5 |
| Other | -0.2 | 0.02 | -0.02 | -0.2 |
| Degree of structural change (Absolute structural value = ASV) | 11.02 | 6.52 | 10.14 | 15.99 |

**Table 4.** Contribution of different cost categories to structural change in inpatient COPD costs at Hospital D, 2021–2024 (%)

| Cost treatment | 2021–2022 | 2022–2023 | 2023–2024 | Cumulative (2021–2024) |
|---|---|---|---|---|
| General medical service | 14.86 | 7.65 | 18.32 | 24.98 |
| Diagnostic service | 35.61 | 40.82 | 18.35 | 19.54 |
| Therapeutic service | 18.10 | 24.16 | 20.27 | 15.49 |
| Rehabilitation service | 0.49 | 0.30 | 2.97 | 2.10 |
| Traditional Chinese Medicine (TCM) service | 0.26 | 0.99 | 1.77 | 1.71 |
| Western medicines | 12.48 | 2.97 | 30.55 | 29.19 |
| Chinese Materia Medica | 0.08 | 0.19 | 0.18 | 0.14 |
| Blood and blood product | 10.71 | 10.69 | 0.85 | 2.48 |
| Medical consumables | 5.57 | 11.89 | 6.47 | 3.10 |
| Other | 1.83 | 0.35 | 0.25 | 1.27 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |

## 5. Discussion and reflections

Overall, since 2020, the targeted pathway optimization measures implemented by Hospital D have yielded certain results. These measures have reduced patient hospitalization costs while effectively controlling the unreasonable growth of laboratory and imaging examination expenses, thereby enhancing the labor value and sense of fulfillment among medical staff. However, attention should be paid to the noticeable increase in antimicrobial drug costs for COPD patients, which exhibits a long-term upward trend. The inappropriate use of antimicrobials can lead to heightened viral resistance, posing significant challenges to clinical treatment and patient finances. Therefore, future research should further analyze the root causes of this issue and implement timely intervention measures.

### 5.1. Stricter antibiotic management for COPD patients

Based on the above analysis, it is necessary to embed an intelligent antibiotic management module within COPD clinical pathway management. This involves adding tiered medication review rules to the electronic medical record system to achieve a closed-loop management process of "prescription-review-feedback". This includes:

Pre-emptive alerts: When prescriptions exceed the guidelines outlined in the "COPD Antibiotic Application Guidelines", the system automatically intercepts them and pushes alternative solutions; Real-time monitoring: Setting key indicator thresholds (e.g., antimicrobial expenditure ≤ 15%, microbial testing rate ≥ 80%), with cases exceeding thresholds requiring immediate review by pharmacy specialists; Post-event evaluation: Incorporating rational drug use into departmental performance assessments and establishing dedicated incentive funds to promote appropriate prescribing practices.

### 5.2. Dual approach of pathway management and policy training

The new grouping policy imposes higher demands on clinical departments' economic operations, primarily regarding case grouping accuracy and internal compensation of medical insurance funds. Key changes in the DRG 2.0 grouping policy cover payment rules, grouping definitions, and the number of disease groups. The chronic obstructive airway disease group (ADRG: ET2) constitutes the largest disease group in Hospital D's respiratory department, accounting for approximately 36% of the department's annual disease groups. Under DRG 2.0, the ADRG ET2 group has been consolidated from three subgroups into two: "with MCC" and "without MCC". Consequently, even minor discrepancies in case grouping can lead to significant variations in insurance reimbursement. Additionally, the payment rules for cases with standard multipliers have changed in DRG 2.0. For cases where the per-hospitalization cost falls between 0.4 and 0.8 times the DRG average cost, the case points are calculated by multiplying the actual multiplier by 0.2 times the DRG base points during settlement. Over the past three years, more than 32% of respiratory medicine cases in Hospital D classified as ET2 under ADRG fell within this 0.4–0.8 multiplier range, a significant proportion. This indicates further compression of reimbursement margins for healthcare institutions under medical insurance funds. Consequently, public hospitals require stricter and more refined cost management to achieve internal compensation, achieving preliminary equilibrium between loss-making disease groups exceeding total budgets and those with remaining surpluses to support their own medical development needs [8–10].

### 5.3. Transitioning from "cost-controlled healthcare" to "value-based healthcare"

Public medical institutions should adopt value-based cost management, including: standardizing pathways to limit unnecessary tests and high-cost consumables; distinguishing between core and elective procedures; retaining key diagnostic and therapeutic procedures [11]. Simultaneously, rational drug management must be strengthened through pathogen-evidence-based protocols and AI-powered alerts. Investment in essential technologies should be ensured, with associated costs offset by reducing indirect expenses through shorter hospital stays [12].

## 6. Limitations of this study

This study did not perform subgroup analysis on the research samples, nor did it deconstruct the synergistic effects of

DRGs and clinical pathways. Future research could conduct more detailed analyses based on patient demographics and further analyze the degree of coupling between the two.

## Funding

Zhejiang Kangenbei Hospital Management Soft Science Research Project (Project No.: 2025ZHA-KEB106)

## Disclosure statement

The authors declare no conflict of interest.

## References

[1] Mu M, 2023, Notice of the General Office of the National Healthcare Security Administration on Issuing the Version 2.0 Grouping Scheme for Diagnosis-Intervention Packet and Diagnosis-Specific Group Payment and on Further Promoting the Implementation of Relevant Work.

[2] He Z, Weng Y, Xia J, et al., 2022, Analysis of Implementation Elements and Strategies for Clinical Pathways Based on Grounded Theory. Chinese Hospital Management, 42(6): 56–60.

[3] Jie C, 2023, An Empirical Study on the Relationship Between Clinical Pathways and DRG in Public Hospitals, thesis, Anhui Medical University.

[4] Guo B, Gan H, Xue M, et al., 2024, The Changing and Predicted Trends in Chronic Obstructive Pulmonary Disease Burden in China, the United States, and India from 1990 to 2030. International Journal of Chronic Obstructive Pulmonary Disease, 19: 695–706.

[5] Gu C, Shi P, He M, et al., 2022, Study on the Implementation Effect of Clinical Pathway Under DRG Payment System: An Analysis Based on Interrupted Time Series Model. China Health Insurance, 2022(5): 11–16.

[6] Wu Y, Jia H, Zhu J, 2014, Study on Influencing Factors of Hospitalization Costs for Colorectal Cancer. Journal of Frontiers of Medicine, 2014(10): 135–136.

[7] Ma Z, Liu M, Hu J, et al., 2022, Impact of DRG Payment Reform on Per-Case Hospitalization Cost for Coronary Heart Disease Patients Based on New Grey Correlation and Structural Variation Degree. Chinese Hospital Management, 42(8): 70–73.

[8] Cao K, Cai S, Chen W, 2022, Integration and Optimization of DRG and Clinical Pathway Management Based on BP Artificial Neural Network Model. Hospital Management Forum, 39(4): 15–17 + 14.

[9] Zhang J, 2021, Analysis of the Impact of DRGs on Hospital Operation Management. China Management Informatization, 24(13): 56–57.

[10] Wu X, Zhuang Y, Dong S, et al., 2019, Strategy and Practice of Localized Improvement in Clinical Pathway Management. Chinese Hospital Management, 39(10): 34–35.

[11] Kong Z, Kong J, 2024, Reflections on Compliance in Public Hospitals Based on the Value-Instrument Framework. Chinese Journal of Hospital Administration, 40(10): 741–745.

[12] Chen H, Xia X, Zhou H, et al., 2022, Influencing Factors and Strategic Analysis of High-Quality Development in Public Hospitals. Chinese Journal of Hospital Administration, 38(8): 555–560.