Effect of DIP in Guizhou Province: A Case Study of Acute Myocardial Infarction

Li Wei[1], Liu Guoqin[2]*, Liu Shifang[3], Shen Yewei[2]

1.Zunyi Medical University 563000

2.Department of Health Policy and Management, School of Management, Zunyi Medical University 563000

3.Department of Medical Records Management, The First Affiliated Hospital of Zunyi Medical University 563000

Funding: Zunyi Kehe HZ Zi (2020) No. 95

Abstract: Objective To evaluate the implementation effects of the Diagnosis-Intervention Packet (DIP) policy and analyze its impact on the cost structure and changes in hospitalization expenses. Methods Data on hospitalization costs from two tertiary hospitals in Guizhou Province that implemented the DIP payment reform between December 2018 and October 2023 were collected. Patients were divided into inpatient surgical and non-surgical group s based on their treatment modality. Changes in hospitalization costs before and after policy implementation were analyzed using structural change analysis and breakpoint regression analysis. Results A total of 2070 inpatient surgical cases were analyzed (1012 before policy implementation, 1058 after), and 1317 non-surgical cases (1024 before, 293 after). In terms of cost structure, the structural change value of diagnostic fees decreased from 5.40% before the policy implementation to -1.79% after implementation; the structural change value of Western medicine fees decreased from 2.07% to -3.07%. Both categories of expenses saw a reduction in their proportion of the total costs. In terms of cost changes, both surgical and non-surgical groups experienced an increase in comprehensive medical service costs. The average hospitalization costs in the surgical group remained relatively unchanged, while surgical treatment and consumables fees showed significant decreases. For the non-surgical group, the average hospitalization cost dropped significantly from 33,150.94 Yuan to 17,384.96 Yuan ($p < 0.05$), with significant reductions in diagnostic and Western drug costs. Conclusion After the implementation of the DIP policy, the proportion of diagnostic fees and Western drug costs decreased. The average hospitalization cost for surgical patients showed minimal change, while the non-surgical group experienced a significant reduction in average hospitalization costs. The DIP policy has demonstrated preliminary success in reducing the financial burden on patients, though further improvements in stability are needed.

key word: Diagnosis Intervention Packet; Degree of structure variation; Regression Discontinuity Design; Hospitalization Expenses

Introduction

According to the data from the China Health Statistical Yearbook, from 2000 to 2021,

the average annual growth rate of China's total health expenditure reached as high as 14.36%, exceeding the growth rate of the gross domestic product (GDP) during the same period [1]. The continuously increasing medical expenses not only impose a heavier economic burden on individuals and families but also exert enormous pressure on enterprises and government finances.

1 Data and Method

1.1 Data source

This study uses the data from the front pages of medical records of inpatients with acute myocardial infarction (ICD codes: I21.0 to I21.3, I21.9) in two Class III Grade A general medical institutions from December 2018 to October 2023. The inpatient expenses include the total inpatient expenses, comprehensive medical service fees, diagnosis fees (pathological diagnosis fees, laboratory diagnosis fees, imaging diagnosis fees, clinical diagnosis item fees), surgical treatment fees, western medicine fees, consumable material fees (one-time medical consumable material fees for examinations, one-time medical consumable material fees for treatments, one-time material fees for surgeries), and other fees[2].

1.2 Study method

1.2.1 Data cleansing

A total of 3,767 sets of data of inpatients with acute myocardial infarction were collected. The interquartile range method was used to identify and eliminate the outliers (extremely high or low expenses) in the data of total inpatient expenses. Finally, the data of 3,387 inpatients were obtained. Taking October 1, 2021, the implementation date of the policy, as the node, the data were divided into the pre-policy implementation period and the post-policy implementation period. Referring to the "National Medical Security Disease Diagnosis-Related Grouping Scheme (Version 1.2)", according to whether surgical operations were carried out in the treatment methods, the patients were divided into the inpatient surgical group and the inpatient non-surgical group. The SPSS 29.0 software was used to sort out and statistically describe the data. The chi-square test and the independent samples t-test were adopted to evaluate the changes in the basic conditions of patients and expense items before and after the implementation of the policy, with the test standard $\alpha = 0.05$.

1.2.2 Structural variability analysis

The analysis of structural change degree is mainly used to evaluate the degree of change in the structure of medical expenses at different time periods, and it includes the following core indicators: the value of structural variation (VSV), which represents the change in the proportion of a certain expense item within a certain period; the degree of structural variation (DSV), which is the sum of the absolute values of the structural variation values of each expense item and is used to reflect the degree of change in the structure of inpatient expenses; the contribution rate of structural variation (CSV), which is used to measure the contribution degree of the variation of each expense item to the change in the structure of the total inpatient expenses [3].

1.2.3 Regression Discontinuity Design

Regression discontinuity takes the time node of the policy implementation as the breakpoint, establishes a local comparison between the observation samples on both sides

of the breakpoint, and evaluates the effects brought about by the policy [4]. Different bandwidths represent the sample ranges used for estimation.The smaller the bandwidth is, the closer the data used are to the breakpoint, which can better reflect the local impact of the policy. The larger the bandwidth is, the wider the data range is, and the results may reflect a broader trend of change.

In order to evaluate the implementation effect of the Diagnosis-Intervention Packet (DIP) payment policy, this study adopts the sharp regression discontinuity design,uses October 1, 2021, the implementation date of the policy, as the breakpoint, and constructs the following regression discontinuity model to evaluate the impact of the DIP policy: [5]

$$Y_{it} = \alpha + \beta D_{it} + \gamma T_{it} + \delta (T_{it} \cdot D_{it}) + \varepsilon_{it}$$

Among them, Yit represents the cost data of the i-th patient at the t-th time point. Dit is a dummy variable for the implementation of the policy (0 before the policy implementation and 1 after the implementation). Tit represents the number of days between the admission date and the policy implementation date (October 1, 2021), and ε it is the error term. By estimating the coefficient δ, the impact of the implementation of the DIP policy on medical expenses can be evaluated.

2 Study outcome

2.1 Basic characteristics of hospitalized patients with acute myocardial infarction

This study included 3,387 inpatients with acute myocardial infarction,with 2,070 cases (61.12%) in the surgical group. Among them, 1,012 cases (29.88%) were before the policy implementation, and 1,058 cases (31.24%) were after the policy implementation;there were 1,317 cases (38.88%) in the non-surgical group, 1,024 cases (30.23%) before the policy implementation, and 293 cases (8.65%) after the policy implementation. The results of the chi-square test showed that there were statistically significant differences in the number of complications and whether it was the first hospitalization between the surgical group and the non-surgical group before and after the policy implementation ($p < 0.05$),as shown in Table 1. This indicates that the patient structure in medical institutions changed after the policy implementation. The number of patients receiving non-surgical treatment decreased significantly,and more of them were patients who were not hospitalized for the first time and required surgical treatment..

Table 1 Comparison Results of the Characteristics of Inpatients with Acute Myocardial Infarction before and after the Implementation of DIP

Project		Inpatient surgery group（n=2070）				Inpatient non-surgical group（n=1317）			
		Pre-implementation	Post-implementation	χ2	P Value	Pre-implementation	Post-implementatio	χ2	P Value
Gender	Male	777	794	0.848	0.357	728	199	1.102	0.294
	Female	235	264			296	94		
Year/Age	≤44	57	71	1.272	0.529	72	23	1.472	0.479
	45 ~ 59	370	393			280	70		
	≥60	585	594			672	200		

Number of complications	0 ~ 1	60	110	18.173	0.000**	39	7	12.685	0.002*
	2 ~ 3	329	372			330	66		
	⩾4	623	576			655	220		
First hospitalization	YES	929	870	41.616	0.000**	950	243	25.854	0.000**
	NO	83	188			74	50		
Overall		1012	1058			1024	293		

After the implementation of the DIP policy, the average length of hospital stay in the inpatient surgical group increased from 7.64 days to 8.08 days, and the difference mainly came from patients with older age, more complications, or multiple hospitalizations. There was no significant difference in the average length of hospital stay of patients in the inpatient non-surgical group before and after the implementation, as shown in Table 2.This indicates that the DIP policy may have a certain impact on the length of hospital stay for complex cases, while having less impact on the length of hospital stay of patients receiving non-surgical treatment.

Table 2 Comparison Results of the Average Length of Hospital Stay of Inpatients with Acute Myocardial Infarction before and after the Implementation of DIP

Project		Surgery group				Non-surgical group			
		Pre-implementation	Post-implementation	t	p	Pre-implementation	Post-implementation	t	p
Gender	Male	7.66	7.82	-0.923	0.356	6.30	6.85	-1.523	0.128
	Female	7.60	8.87	-3.397	0.001*	7.04	6.89	0.261	0.795
Year /Age	⩽44	7.05	7.25	-0.362	0.718	6.21	9.00	-2.515	0.018*
	45~59	7.44	7.88	-1.898	0.058	6.11	6.49	-0.802	0.423
	⩾60	7.83	8.31	-2.081	0.038*	6.71	6.75	-0.088	0.930
Number of complications	0~1	6.65	6.35	0.548	0.584	5.44	3.29	2.659	0.021*
	2~3	7.05	7.48	-1.859	0.063	5.66	6.11	-1.010	0.315
	⩾4	8.05	8.80	-3.311	0.001*	7.01	7.20	-0.487	0.626
First hospitalization	YES	7.71	8.03	-1.836	0.066	6.55	6.63	-0.254	0.800
	NO	6.89	8.32	-3.133	0.002*	6.05	8.00	-1.692	0.093
Mean length of hospital stay		7.64	8.08	-2.716	0.007*	6.51	6.86	-0.998	0.319

2.2 The composition of inpatient expenses for patients in the inpatient surgical group and the inpatient non-surgical group

For the surgical group, the average inpatient expense was 40,659.17 yuan before the implementation of the DIP policy, and it was 40,967.51 yuan after the implementation. Both the surgical treatment fee and the consumable

material fee decreased after the policy implementation, while the comprehensive medical service fee and the diagnosis fee increased, and the differences were statistically significant ($p < 0.05$).

For the non-surgical group, the average inpatient expense was 33,150.94 yuan before the implementation of the DIP policy, and it was 17,384.96 yuan after the implementation. Except that the comprehensive medical service fee increased, the total inpatient expense, the diagnosis fee, and the consumable material fee all decreased after the policy implementation, and the differences were statistically significant ($p < 0.05$), as shown in Table 3.

Table 3 Composition of Inpatient Expenses of Inpatients with Acute Myocardial Infarction before and after the Implementation of DIP (Unit: Yuan)

Goup ing	Expense items	Pre-implementation（n=2036）				Post-implementation（n=1351）				T Value	P Value
		Mean	Maximum	Median	Minimum	Mean	Maximum	Median	Minimum		
Inpatient surgery group	Total cost of hospitalization	40659.17	90768.09	37733.44	4394.84	40967.51	90061.31	39711.50	8004.37	-0.470	0.639
	Comprehensive Medical Service Fee	1941.02	13343.70	1589.65	49.50	2832.89	17413.40	2175.95	256.20	-11.888	0.000**
	Diagnosis fee	7798.81	25211.14	7232.60	1162.70	8165.04	24773.80	7333.25	1701.30	-2.766	0.006**
	Surgical treatment costs	4183.60	11671.00	3620.40	20.40	3856.10	24426.00	3448.50	20.40	4.189	0.000**
	The cost of western medicine	5408.63	26574.17	4474.75	40.50	5301.04	26097.59	4659.06	2.95	0.652	0.514
	Consumables fee	16773.19	62286.38	15693.95	265.14	15580.65	59772.89	16400.49	7.80	2.170	0.030*
	Others	4553.92	41419.57	161.75	0.00	5231.79	43985.06	1192.20	0.00	-1.930	0.054
Inpatient non-surgery group	Total cost of hospitalization	33150.94	90428.40	33492.02	331.70	17384.96	87432.53	12839.92	832.58	14.002	0.000**
	Comprehensive Medical Service Fee	1714.47	16827.10	1277.00	76.00	2797.89	18249.50	2071.60	76.90	-6.471	0.000**
	Diagnosis fee	5880.00	31449.34	5410.55	58.00	4927.42	27115.20	3979.70	79.50	3.619	0.000**
	The cost of western medicine	5336.59	47028.67	4182.64	3.72	4895.77	41058.69	2692.60	10.21	1.113	0.267
	Consumables fee	17096.83	67205.62	17655.61	1.74	2182.61	32487.19	455.52	4.38	25.097	0.000**
	Others	840.97	32836.55	89.76	0.00	2217.31	24365.06	639.80	0.00	-5.810	0.000**

2.3 Analysis of the variability of the structure of hospitalization costs

The analysis results of the degree of change in the expense structure show that from October 2019 to September 2020, the degree of change in the structure of the total inpatient expenses was 8.98%. Combining with the CSV, the diagnosis fee and the consumable material fee had relatively high contribution rates, which were 27.06% and 15.92% respectively.

From October 2020 to September 2021, the degree of change in the structure of the total inpatient expenses increased to 27.69%, mainly due to the decrease in the consumable material fee (-13.84%) and the increase in the diagnosis fee (5.4%). The consumable material fee had the highest contribution rate, reaching 49.98%, and the contribution rate of the diagnosis fee was 19.5%.

From October 2021 to September 2022, the degree of change in the structure of the total inpatient expenses decreased to 11.71%. The western medicine fee had a relatively large contribution rate (26.62%), followed by the diagnosis fee (15.29%).

From October 2022 to September 2023, the degree of change in the structure of the total inpatient expenses was 15.21%. The consumable material fee had the highest contribution rate (34.52%), followed by the western medicine fee (15.45%) and the diagnosis fee (12.36%) with relatively large proportions, as shown in Table 4 and Table 5.

2.4 Regression Discontinuity Analysis of Inpatient Expenses

In order to comprehensively evaluate the changes in the inpatient expenses of patients before and after the policy implementation, we first analyzed the distribution of the total inpatient expenses of patients in the inpatient surgical group and the inpatient non-surgical group through fitting diagrams, as shown in Figure 1, Figure 2, Figure 3, and Figure 4. The results show that the distribution of inpatient expenses is continuous and shows a jump before and after the breakpoint, which verifies the applicability of the regression discontinuity method.

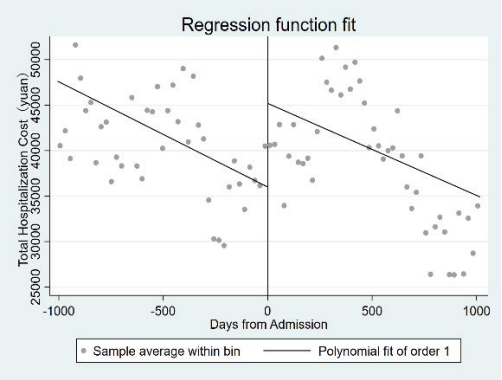

Figure 1 First-order Fitting Diagram of the Total Inpatient Expenses of the Inpatient Surgical Group

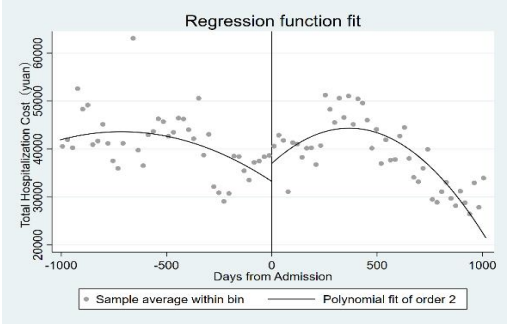

Figure 2 Second-order Fitting of the Total Inpatient Expenses of the Inpatient Surgical Group

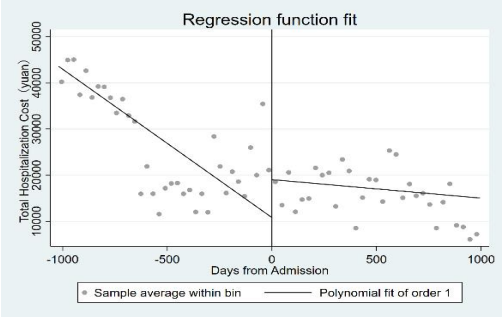

Figure 3 First-order Fitting Diagram of the Total Inpatient Expenses of the Inpatient Non-surgical Group

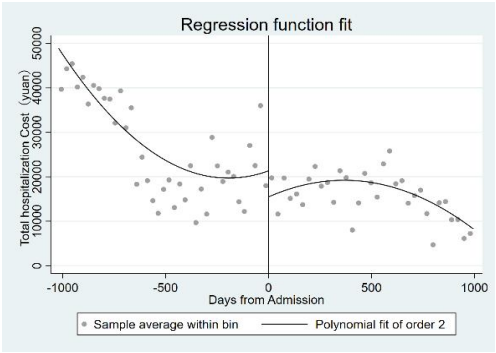

Figure 4 Second-order Fitting Diagram of the Total Inpatient Expenses of the Inpatient Non-surgical Group

A dummy variable is introduced, with each hospital as an independent dummy variable (Hospital A = 1, Hospital B = 0), to ensure that the model can effectively control the differences in medical resource allocation, service levels, and regional policies among hospitals, thereby improving the scientific nature and accuracy of the results. At the same time, after controlling for covariates such as the gender, age, and the number of complications of inpatients, regression discontinuity analyses are respectively conducted on the data of the number of inpatient days and expense items for the inpatient surgical group and the inpatient non-surgical group.

3 Discussion

3.1 The average inpatient expenses of the non-surgical group decreased significantly, while there was no significant difference in the surgical group

The average total inpatient expenses of the inpatient non-surgical group have decreased significantly, mainly due to the reduction in diagnostic fees and consumable material fees, which is consistent with the results of the regression discontinuity analysis. At the same time, some studies have shown that under the DIP payment system, the policy will prompt hospitals to standardize their medical service behaviors and improve the quality of medical services in order to avoid losses caused by exceeding or falling short of the standard fees for disease groups. The decrease in diagnostic fees and consumable material fees may be related to hospitals optimizing the diagnosis and treatment processes, reducing repeated examinations, and implementing strict management and rational use of high-value consumables. By standardizing the diagnosis and treatment behaviors, the economic burden on patients due to diagnosis has been significantly reduced. Meanwhile, the improvement in the efficiency of diagnosis and treatment has also enabled more rational utilization of medical resources.

3.2 The Impact of Policy Implementation on the Number of Inpatient Days for Patients

This study found that after the implementation of the DIP policy, the average number of inpatient days for patients in the inpatient surgical group increased, and the

changes were mainly concentrated in complex cases of elderly patients, those with multiple complications, and patients who were readmitted to the hospital. In contrast, there was no obvious change in the average number of inpatient days for patients in the inpatient non-surgical group.

The results may suggest that the DIP policy prompts medical institutions, when dealing with patients with more severe conditions, to tend to extend the treatment cycle to ensure the quality of treatment. However, for the patient group with relatively simple conditions mainly treated with non-surgical methods, the impact of the policy on the number of inpatient days is relatively limited .

Therefore, during the promotion of the DIP policy, it is necessary to further improve the payment standards and the management mechanism for complex cases, focus on the impact of the characteristics of different patient groups on medical service behaviors, and promote the rational use of medical resources and the improvement of inpatient efficiency.

3.3 The DIP policy has achieved initial results, but its stability still needs to be improved

Overall, the implementation of the DIP policy has achieved initial results. In particular, there have been significant advancements in reducing the inpatient expenses of the inpatient non-surgical group, as well as in cutting down diagnostic fees and consumable material fees. However, there are still some unstable factors during the implementation of the policy. Especially, the fluctuations in Western medicine fees and the number of inpatient days indicate that medical institutions still have deficiencies in cost control of drug use and refined management of the number of inpatient days for patients. The overall stability of the policy still needs to be enhanced.

Advice

The DIP policy shows obvious differences in effectiveness between inpatients undergoing surgical and non-surgical treatments. The cost control effect for non-surgical patients is more effective, while it is more difficult to significantly control the surgical treatment fees of surgical patients. This result reflects that under different treatment methods, a unified payment standard is difficult to adapt to relatively complex cases. Therefore, the policy should apply flexible payment standards according to the complexity of the disease types and treatment methods, and allow the setting of appropriate expense caps for highly complex surgeries or treatments to ensure the resource investment and treatment quality of medical institutions for complex surgeries. For non-surgical patients with good cost control, measures such as further optimizing the diagnosis and treatment process and strengthening the management of rational drug use can be taken to consolidate and enhance the existing cost control achievements. Through such a differentiated management strategy, it is not only helpful to improve the allocation efficiency of medical resources, but also ensures that medical institutions can achieve sustainable cost control while guaranteeing the quality of medical services.

Reference

[1]Chai Peipei, Li Yan, Zhai Tiemin, et al.Accounting Results and Analysis of China's Total Health Exp

enditure in 2022[J].Health Economics Research,2024,41(01):14-9.
[2]Yang Yaqi, Qi Xinhong, Han Xiao, et al. Discussion on Comprehensive Budget Management and Co st Accounting of Public Hospitals under Diagnosis-Intervention Packet Payment[J].Chinese Hospitals, 2021, 25(11): 5-7.
[3]Chen Manli,Zhao Bin. Practical Experience and Enlightenment of Implementing the Diagnosis-Inter vention Packet Payment System[J].Chinese Health Economics,2017,36(06):38-41.
[4]Ren Mengyue, Gao Yuchen, Li Jingxiao, et al.Exploring the Dietary Factors of the Disease Burden o f CVD in China Using the Age-Period-Cohort Model [J]. Chinese Journal of Health Statistics,2024,41 (06):846-50+56.
[5]Liu Mingbo,He Xinyue,Yang Xiaohong,et al.Key Points Interpretation of "Report on Cardiovascular Health and Diseases in China 2023"[J].Chinese Journal of Cardiovascular Medicine,2024,29(04):305-24.