The Effect on Hospitalization Expenses after Promoting the DRGs—Based on the Analysis of a Hospital's Data in Guangdong

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Abstract: This study aims to assess the impact of Diagnosis-Related Groups (DRGs) payment system on hospitalization expenses and their compositional changes. A retrospective analysis was conducted on 4711 medical records across nine diseases treated in a Class 3A hospital in Guangdong province. A comparison was made between hospitalization expenses, their composition, and length of stay in 2022 and 2023. Additionally, structural change analysis was employed to assess the degree of change in the composition of medical expenses.Following the implementation of DRGs, there was a significant decrease in the mean hospitalization costs and a notable reduction in the mean length of hospital stay, albeit with divergent effects observed between medical and surgical cases. Furthermore, a general decrease was observed in drug expenses, service charges, and other miscellaneous expenses. Conversely, treatment and diagnosis expenses showed an increase, with surgical operation and material expenses experiencing significant rises. The overall structure of total expenses underwent considerable alteration, exhibiting disease-specific variations.In conclusion, the adoption of DRGs effectively curbs excessive treatments, encourages optimization of internal management within medical institutions, and fosters collaborative reform efforts across medical services, pharmaceutical practices, and healthcare financing systems. Notably, post-DRGs implementation, the structural changes in total expenses vary across different diseases, highlighting the need for particular attention towards the increased expenses related to diagnostic procedures, surgical interventions, and material utilization.

Keywords: DRGs; hospitalization expenses; mean hospitalization expenses; composition of expenses; structural change

1. Introduction

The reasonable payment mechanism of medical insurance serves as a powerful lever to propel the reform of the medical and health care system. In February 2020, the Central Committee of the Communist Party of China and the State Council issued the "Opinions on Deepening the Reform of the Medical Security System," proposing the establishment of an effective and efficient medical insurance payment mechanism. This mechanism advocates for a diversified and composite medical insurance payment approach primarily based on diagnosis-related payments, promoting the widespread adoption of Diagnosis Related Groups (DRGs)[1]. DRGs, originating in the late 1960s in the United States, were initially developed by Robert B. Fetter and his team at Yale University. The primary objective was to assist hospitals in cost control and began to be implemented in payment system pilot reforms in the late 1970s in New Jersey, USA[2]. DRGs classify patients into respective groups based on factors such as age, gender, length of hospital stay, clinical diagnosis, symptoms, surgeries, disease severity, complications, and comorbidities. DRGs are recognized worldwide as one of the most advanced payment methods and are currently utilized in over 40 countries globally[3]. In 2019, China released a list of 30 pilot cities for DRGs payment, marking the formal entry of the country into the large-scale implementation phase of DRGs payment. In order to evaluate the effectiveness of DRGs reform in China, the author conducted an analysis of medical expenses before and after the implementation of DRGs in a tertiary hospital in Guangdong Province. Corresponding conclusions were drawn to provide reference suggestions for the next phase of DRGs payment reform in China.

2. Data and Methods

2.1. Data Source

The data for this article were sourced from the discharge records of a tertiary hospital in Guangdong Province, China. The dataset covers seven clinical departments including Respiratory Medicine, Cardiovascular Medicine, General Surgery, Gynecology, Pediatrics, Ophthalmology, and Infectious Diseases. Diseases were classified based on their names and corresponding primary diagnoses (ICD-10 codes, precise to three decimal places). Additionally, surgical and procedural codes (ICD-9-CM-3) were utilized to further categorize diseases. Data with unclear or evidently erroneous information were excluded, and extreme values were subsequently removed. After this process, a total of 4,711 records pertaining to nine disease categories were retained (Table 1).

Table 1: Department, ICD Codes, Disease Names, and Case Counts of Sample Data

Serial No.	Department	ICD Code	Disease Name	Case Count	
				2022	2023
1	Respiratory Medicine	J15.902	Bacterial pneumonia	323	419
2	Pediatrics	J18.000	Bronchopneumonia	33	79
3	Cardiovascular Medicine	I10.X05	Hypertension stage3	518	495
4	Cardiovascular Medicine	I21.401	Myocardial infarction	155	113
5	General Surgery	K35.905	Acute appendicitis	40	59
6	General Surgery	K80.101	Acute cholecystitis	187	175
7	Gynecology	D25.900	Uterine fibroids	278	322
8	Ophthalmology	H25.900	Senile cataract	751	609
9	Infectious Diseases	B18.106	Viral hepatitis	53	102

2.2. Research Methodology

The study utilized Stata 15.0 to establish a database for comparative analysis of the mean length of hospital stay and hospitalization expenses, along with their respective components, for nine disease categories in the years 2022 and 2023. An examination was conducted to analyze variations in the nine components of hospitalization expenses: medication costs, service fees (including bed charges), treatment fees, nursing fees, examination fees, consultation fees, material costs, surgical fees (including anesthesia fees), and other expenses.

3. Results

3.1. Changes in Length of Hospital Stay after DRGs Implementation

Table 2: This caption has one line so it is centered. Changes in Length of Hospital Stay for Each Disease Category after DRGs Implementation

Serial No.	Disease Name	2022		2023		Mean Difference	P-value
		Mean	std.	Mean	std.		
1	Bacterial pneumonia	8.31	2.92	6.66	2.35	-1.65	0.0000***
2	Bronchopneumonia	6.97	1.59	5.73	2.00	-1.24	0.0011**
3	Hypertension stage3	7.51	2.73	6.53	2.31	-0.98	0.0000***
4	Myocardial infarction	8.36	6.16	7.31	4.84	-1.05	0.0665
5	Acute appendicitis	6.35	1.82	5.10	1.47	-1.25	0.0001***
6	Acute cholecystitis	8.72	4.32	7.8	4.12	-0.92	0.02*
7	Uterine fibroids	9.69	2.88	9.07	3.01	-0.62	0.0051**
8	Senile cataract	4.94	2.65	4.29	2.78	-0.64	0.0000***
9	Viral hepatitis	10.38	5.32	9.66	4.92	-0.72	0.2007
	Total	7.24	3.72	6.53	3.41	-0.72	0.0000***

Notes:* P<0.05, ** P<0.01, *** P<0.001

Considering all nine disease categories collectively, the average length of hospital stay in 2023 was 6.53 days, compared to 7.24 days in 2022, indicating a noticeable reduction in 2023. When analyzed by individual disease categories, except for myocardial infarction and viral hepatitis where the reduction in length of hospital stay was not significant at the 0.05 significance level, the average length of hospital stay for the other seven disease categories exhibited a significant decrease in 2023 compared to 2022 (Table 2, where the mean difference = mean in 2023 - mean in 2022).

3.2. Changes in Hospitalization Medical Expenses after DRGs Implementation

When considering all nine disease categories collectively, the average per capita hospitalization medical expenses for patients in 2023 amounted to 12,941.32 yuan, compared to 13,361.61 yuan in 2022, indicating a significant decrease in 2023 compared to 2022. Analyzing individual disease categories, it was observed that the average per capita hospitalization medical expenses for bacterial pneumonia, bronchopneumonia, and hypertension stage 3 in 2023 significantly decreased compared to 2022. Conversely, for acute appendicitis, acute cholecystitis, and uterine fibroids, the average per capita hospitalization medical expenses in 2023 showed a significant increase compared to 2022. For other disease categories such as myocardial infarction and senile cataract, the average per capita hospitalization medical expenses in 2023 slightly decreased compared to 2022, while for viral hepatitis, there was a slight increase. However, these changes did not reach statistical significance at the 0.05 level (Table 3).

Table 3: Changes in Hospitalization Medical Expenses for Each Disease Category after DRGs Implementation

Serial No.	Disease Name	2022		2023		Mean Difference	P-value
		Mean	std.	Mean	std.		
1	Bacterial pneumonia	7729.07	3377.52	4924.97	2444.28	-2804.10	0.0000***
2	Bronchopneumonia	4051.44	838.88	3557.86	1001.77	-493.58	0.0030**
3	Hypertension stage3	7015.47	2584.49	6512.38	2360.11	-503.09	0.0013**
4	Myocardial infarction	43012.33	34301.97	35883.59	24222.89	-7128.73	0.5515
5	Acute appendicitis	13241.61	1099.86	14418.14	1164.18	1176.53	0.0000***
6	Acute cholecystitis	13652.88	6675.21	15474.03	7821.34	1821.15	0.0160**
7	Uterine fibroids	15948.62	3249.19	18742.05	3449.16	2793.43	0.0000***
8	Senile cataract	13816.70	4814.72	13369.24	5438.15	-447.45	0.1206
9	Viral hepatitis	7839.85	3138.96	8672.07	3822.36	832.22	0.1904
	Total	13361.61	12941.32	11901.85	9854.58	-1459.76	0.0000***

Notes: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, where P-values are obtained from t-tests after natural logarithmic transformation of total medical expenses.

3.3. Changes in Components of Hospitalization Medical Expenses after DRGs Implementation

Within the hospitalization medical expenses of patients, there are nine constituent items: medication costs, service fees, treatment fees, nursing fees, examination fees, consultation fees, material costs, surgical fees, and other expenses. To facilitate a concise and clear analysis, the following categorizes the nine disease categories for further examination. Based on the analysis from Table 3, bacterial pneumonia, bronchopneumonia, and hypertension stage 3 exhibited significant decreases in average per capita hospitalization medical expenses and are classified as the expense reduction group; acute appendicitis, acute cholecystitis, and uterine fibroids demonstrated significant increases in average per capita hospitalization medical expenses and are classified as the expense increase group; while myocardial infarction, senile cataract, and viral hepatitis showed less notable changes in expenses and are classified as the expense stable group. Subsequently, only the components of expenses for the expense increase and decrease groups were subjected to mean tests. The results revealed that irrespective of the group, service fees (including bed charges), nursing fees, and other expenses significantly decreased, while treatment fees and consultation fees generally increased. Within the expense reduction group, the most pronounced decreases were observed in medication costs and service fees; conversely, within the expense increase group, the most significant increases were in surgical fees and material costs, followed by examination fees (Table 4).

Table 4: Changes in Hospitalization Medical Expenses and Their Components for Each Disease Category in 2023 Compared to 2022

Disease Name	Expense Reduction Group			Expense Increase Group		
	Bacterial Pneumonia	Bronchopneumonia	Hypertension Stage 3	Acute Appendicitis	Acute Cholecystitis	Uterine Fibroids
	Mean Difference	Mean Difference	Mean Difference	Mean Difference	Mean Difference	Mean Difference
Total Medical Expenses	-2804.10***	-493.58**	-503.09**	1176.53***	1821.15**	2793.43***
Medication Costs	-819.33***	-203.15**	53.62	-417.90***	-189.32	-115.63**
Service Fees	-375.90***	-268.74***	-319.23***	-363.71***	-316.08***	-362.00***
Treatment Fees	-130.09***	-5.18	136.45***	136.63***	207.00***	319.60***
Nursing Fees	-19.82***	-31.92**	-29.51***	-35.43***	-17.63	-7.25
Examination Fees	-1497.05***	-1.26	501.28***	-100.14	369.55**	137.90*
Consultation Fees	10.99	121.28***	-67.16***	109.88***	151.41***	235.66***
Material Costs	107.56***	-57.41*	-62.23***	779.32***	444.78*	1015.91***
Surgical Fees	-10.67***	0.00	-143.18***	1073.55***	1183.48***	1582.93***
Other Expenses	-69.78***	-47.19***	-573.12***	-4.73***	-12.03***	-13.69**

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Mean differences represent the change in expenses compared to the previous year.

3.4. Changes in Hospitalization Medical Expenses Structure after DRGs Implementation

Table 5: Analysis of Average Per Capita Hospitalization Medical Expenses and Structural Changes in the Expense Reduction Group from 2022 to 2023

Expense composition (CNY)	2022 (n=874)	2023 (n=993)	2022-2023 Expense Structure Variation	
Total Medical Expenses	7167.28(100)	5607.51(100)	VSV(%)	Contribution rate(%)
Medication Costs	1697.53(23.68)	1383.02(24.65)	0.97	4.95
Service Fees	685.07(9.56)	342.13(6.10)	-3.46	17.66
Treatment Fees	241.32(3.37)	279.99(4.99)	1.62	8.27
Nursing Fees	224.77(3.14)	200.84(3.58)	0.44	2.25
Examination Fees	3284.98(45.83)	2841.89(50.68)	4.85	24.76
Consultation Fees	254.64(3.55)	221.89(3.96)	0.41	2.09
Material Costs	302.56(4.22)	320.47(5.72)	1.5	7.66
Surgical Fees	108.16(1.51)	16.42(0.29)	-1.22	6.23
Other Expenses	368.24(5.14)	0.87(0.02)	-5.12	26.14
DSV			19.59%	

Notes: VSV: Value of Structure Variation, DSV: Degree of Structure Variation

In recent years, the analysis of structural changes has been widely used in the analysis of hospitalization medical expenses to reflect the changes and characteristics of medical expense composition[4]. It mainly includes three core indicators: the value of structure variation (VSV), the degree of structure variation (DSV), and the contribution rate of structure variation, which respectively reflect the degree and direction of changes in the composition of each item, the comprehensive changes in internal structure, and the contribution of changes in a certain component to the total structural variation[4]. The specific calculation formulas are as follows: $VSV_i = X_{i1} - X_{i0}$ ($VSV_i > 0$ indicates positive structural changes, that is, the proportion of a certain expense item i in the total hospitalization expense increases at the end of the period compared to the beginning of the period, and vice versa represents negative

changes), DSV = $\sum|VSV_i| = \sum|X_{i1} - X_{i0}|$ (i = 1,2,3…), structure variation contribution rate = $|X_{i1} - X_{i0}|$ / DSV × 100%. Where i represents the sequence number of the expense item; 0 represents the initial period; 1 represents the end of the period, X_{i0} is the composition ratio (%) of the i-th expense item to the total expense at the beginning of the period, and X_{i1} is the composition ratio (%) of the i-th expense item to the total expense at the end of the period [5]. The results show that from 2022 to 2023, the degree of structure variation (DSV) for the expense reduction group is 19.59%. The top four contributors to the structure variation rate are in the following order: other expenses (negative), examination fees (positive), service fees (negative), and treatment fees (positive), with a cumulative contribution rate of 76.83%. The degree of structure variation (DSV) for the expense increase group is 15.65%. The top four contributors to the structure variation rate are in the following order: surgical fees (positive), medication costs (negative), service fees (negative), and material costs (positive), with a cumulative contribution rate of 73.32% (see Table 5, Table 6).

Table 6: Analysis of Average Per Capita Hospitalization Medical Expenses and Structural Changes in the Expense Increase Group from 2022 to 2023

Expense composition (CNY)	2022 (n=505)	2023 (n=556)	2022-2023 Expense Structure Variation	
			VSV	Contribution rate(%)
Total Medical Expenses	14884.1(100)	17254.71(100)	VSV	Contribution rate(%)
Medication Costs	2301.09(15.46)	2116.47(12.27)	-3.19%	20.41%
Service Fees	780.8(5.25)	432.76(2.51)	-2.74%	17.49%
Treatment Fees	363.14(2.44)	635.5(3.68)	1.24%	7.94%
Nursing Fees	275.28(1.85)	261.28(1.51)	-0.34%	2.14%
Examination Fees	2703.29(18.16)	2879.34(16.69)	-1.47%	9.42%
Consultation Fees	84.89(0.57)	277.85(1.61)	1.04%	6.65%
Material Costs	2612.18(17.55)	3413.1(19.78)	2.23%	14.25%
Surgical Fees	5748.54(38.62)	7235.76(41.93)	3.31%	21.17%
Other Expenses	14.9(0.10)	2.65(0.02)	-0.08%	0.54%
DSV			15.65%	

Notes: VSV: Value of Structure Variation, DSV: Degree of Structure Variation

4. Discussion and Recommendations

4.1. DRGs Effectively Contain Over-medicalization and Control Excessive Medical Expenses

According to data from the "China Statistical Yearbook 2023" released by the National Bureau of Statistics, from 2001 to 2022, the average annual growth rate of total health expenditure in China was 15.4%, while the average annual growth rate of GDP during the same period was 9.3%. The growth rate of total health expenditure far exceeded that of GDP. Therefore, controlling the growth of medical expenses has become a major task for the central and local governments. From the research results of this article, it can be seen that DRGs can effectively reduce the length of hospital stay and decrease the average per capita hospitalization medical expenses. This result is consistent with studies both domestically and internationally. For instance, during the initial implementation of the DRGs prospective payment system in the United States from 1982 to 1985, the average length of hospital stay for Medicare patients decreased by 14.6%[6]. After the introduction of G-DRGs payment in Germany from 2000 to 2015, the average annual growth rate of hospital costs decreased from 2.2% to 1.7%[7]. In 14 DRGs pilot hospitals in Beijing, the average per capita hospitalization medical expenses decreased by 6.2%[8]. The reduction in hospital stay and the decrease in hospitalization medical expenses may have two main reasons: one is that patients receive more appropriate medical services, and DRGs effectively restrain the induced demand and over-medicalization behavior of medical institutions without compromising the quality of medical care. The other reason is that after the implementation of DRGs, due to the profit-seeking behavior of hospitals, medical institutions reduce the volume of medical services to cut costs and thereby increase profits. There are studies in Taiwan, China showing that DRGs may lead to negative

impacts such as shortened hospital stays, patients being readmitted, and increased hospitalization frequency[9].

4.2. DRGs Synergistically Promote the Progress of the "Three Links" Reform

In 2007, then-Premier Wen Jiabao proposed the reform of coordinating medical treatment, health insurance, and pharmaceuticals, marking the first time that the "three links" reform was proposed in China[10]. In November 2016, the Leading Group for Deepening the Reform of the Medical and Health System of the State Council issued "Several Opinions on Further Promoting the Experience of Deepening the Reform of the Medical and Health System," further promoting the "three links" reform, proposing to "create space, adjust structure, and ensure connection," and suggesting to reduce the prices of drugs, consumables, inspections, treatments, and tests, while raising the prices of medical services such as diagnosis, surgery, nursing, rehabilitation, and traditional Chinese medicine, and to ensure the coherence with policies such as medical insurance payment, hierarchical diagnosis and treatment, and cost control. According to the research results of this article, after the implementation of DRGs, the service fees (including bed fees), nursing fees, and other fees of all diseases have significantly decreased, while the drug costs and examination fees of most diseases have decreased. Treatment fees and examination fees have increased. This payment method fully exerts its role in the rational allocation of medical and pharmaceutical resources, synergistically promoting the progress of the "three links" reform and indirectly contributing to the realization of the goals of the "three links" reform.

4.3. Different Diseases Exhibit Varied Structural Changes, with a Focus on Monitoring the Growth of Examination Fees, Surgical Fees, and Material Costs

After the implementation of DRGs, there is a significant variation in the structure of total medical expenses, with different diseases exhibiting different trends in structural changes. According to the research results, the total medical expenses for bacterial pneumonia, bronchopneumonia, and severe hypertension showed a decreasing trend in the 2022-2023 period, with a structural change rate of 19.59%. The top four contributors to structural changes were other fees (negative direction), examination fees (positive direction), service fees (negative direction), and treatment fees (positive direction). While treatment fees reflect respect for the value of medical services, the significant increase in examination fees contradicts the current direction of medical service price adjustments in China. Similarly, acute appendicitis, acute cholecystitis, and uterine fibroids showed an upward trend in costs, with a structural change rate of 15.65%. The top four contributors to structural changes were surgical fees (positive direction), drug fees (negative direction), service fees (negative direction), and material fees (positive direction). Notably, surgical fees and material fees showed positive changes, indicating the possibility of inducement for surgery by doctors. Studies by Taiwanese scholars have demonstrated that the use of DRGs may lead to more patients undergoing additional surgeries[11]. Therefore, to control the growth of medical expenses, it is crucial to focus on monitoring the growth of examination fees, surgical fees, and material fees.

The reform of medical insurance payment methods serves as an important lever for regulating the behavior of medical institutions and allocating medical resources in China's medical and health system reform. Generally speaking, from fee-for-service to DRGs, this is a revolutionary innovation that is in line with China's national conditions and has effectively restrained over-medicalization to a certain extent. Through DRGs, medical service supply-side reform is promoted, prompting medical institutions to actively adjust internal structures, optimize internal management, and control costs. DRGs also advance the progress of the "three links" reform, playing a very important role in China's medical and health system reform. Currently, China is steadily advancing the DRGs payment reform, and we look forward to further achievements in DRGs reform.

5. Conclusions

In conclusion, the adoption of Diagnosis-Related Groups (DRGs) has demonstrated a significant impact on hospitalization expenses and their composition. The findings of this study underscore the effectiveness of DRGs in mitigating over-medicalization and controlling excessive medical expenses. Specifically, the implementation of DRGs led to a notable reduction in both mean hospitalization costs and length of stay, although variances were observed between medical and surgical cases. This reduction in costs can be attributed to a more judicious allocation of medical services, as DRGs effectively curbed induced demand and over-medicalization behaviors without compromising the quality of care.

Furthermore, the structural changes in total expenses post-DRGs implementation underscore the need for targeted attention, particularly towards increased expenses related to diagnostic procedures, surgical interventions, and material utilization.

Moreover, the transition to DRGs payment mechanism has synergistically advanced the objectives of the "Three Links" reform in China's healthcare system. By rationalizing the allocation of medical and pharmaceutical resources, DRGs have contributed to the optimization of healthcare service delivery while indirectly supporting the overarching goals of the reform initiative. Notably, the observed variations in the structural changes of total medical expenses across different diseases highlight the necessity of monitoring the growth of specific cost components such as examination fees, surgical fees, and material costs.

In summary, the adoption of DRGs represents a pivotal step towards optimizing healthcare expenditure and enhancing the efficiency of medical service delivery. The findings of this study contribute to the growing body of evidence supporting the efficacy of DRGs in healthcare reform efforts. Continued exploration and refinement of DRGs implementation are warranted to further advance the goals of cost containment and quality improvement within healthcare systems globally.

Acknowledgements

References

[1] Yu, B. DRGs, disease-based payment, and point-based payment (in Chinese). Chinese Health, 2018(05):44.
[2] Jezzoni, L. Risk adjustment for measuring health care outcomes (3rd ed), Chicago: Health Administration Press. 2003
[3] Deng, X. Research and application of Beijing DRGs system (in Chinese). Beijing: Peking University Medical Press. 2015
[4] Yang, T., Wang, Y., Yang, B., et al. Application of structure change degree in analysis of inpatient medical expenses structure (in Chinese). Chinese Health Statistics, 2010(01):90-91.
[5] Xie, L., Wang, H., Zhou, L., et al. Analysis of inpatient expenditure composition and influencing factors of coronary heart disease patients under disease-based payment in Anhui Province(in Chinese). Chinese Health Policy Research, 2023(05):70-73.
[6] Feinglass, J., Holloway, J. J. The initial impact of the Medicare Prospective Payment System on U.S. Health Care: A review of the Literature. Medical Care Research and Review, 1991(01):91-115.
[7] Li, F. Application research of DRGs in hospital medical expense payment: An empirical analysis based on the UK, Germany, and the USA (in Chinese). Health Economics Research, 2019(01); 32-37.
[8] Jian, W., Lu, M., Chan, K., et al. Payment reform pilot in Beijing hospitals reduced expenditures and out-of-pocket payment per admission. Health Affairs, 2015(10): 1745-1752.
[9] William, G. P. DRG System. Journal of the American College of Surgeons, 2002(01):101-102.
[10] Zhao, Y. Historical process and development dynamics of "three links" reform (in Chinese). Chinese Health Care Management, 2002(12):881-883+920.
[11] Hu, W. Y., Yeh, C. F., Shiao, A. S., et al. Effects of diagnosis-related group payment on health-care provider behaviors: A consecutive three-period study. Journal of the Chinese Medical Association, 2015(11):678-685.