Original Research

Comparison of Diagnosis-Related Group Rehabilitation Reimbursement Payments With Those of a Novel Patient Classification-Based Payment System

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KEYWORDS
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Abstract *Objective*: To compare the difference of reimbursement payments between diagnosis-related group (DRG) and a novel patient classification-based payment system, diagnosis-intervention packet (DIP), among rehabilitation inpatients in tertiary hospitals.
Design: Retrospective cohort study.
Setting: TTertiary hospitals in Shenzhen, China.
Participants: We assessed the records of 268,362 individuals who visited tertiary hospitals providing rehabilitation services.
Interventions: Not applicable.

Main Outcome Measures: The outcome variable was the patients' rehabilitation hospitalization cost of in our study. A quantile regression analysis was conducted to estimate the effects of DIP payment on the rehabilitation hospitalization cost.

Results: The results showed that the predicted marginal hospitalization cost with DRG payment were 9%, 7%, 14%, and 10% higher than that with DIP payments in 2019, 2020, 2021, and 2022. The total difference in predicted marginal hospitalization cost between DRG and DIP was −1269 RMB (−193 USD). This difference in 2019, 2020, 2021, and 2022 was −1419 RMB (−228 USD), −1088 RMB (−158 USD), −1585 RMB (−246 USD), and −1034 RMB (−154 USD), respectively. All differences in predicted marginal hospitalization cost between DRG and DIP was significant (*P*<.001), after controlling for patients' age, sex, public or private hospital, the type of disease, and the length of stay of hospitalization.

Conclusions: The findings of DIP payment reduced the rehabilitation hospitalization cost would be helpful in developing more effectively and efficiently tailored interventions for rehabilitation health care in China. Furthermore, the results of this study could provide advice on building more effective strategies and intervention options for other countries that struggle with controlling rehabilitation hospitalization costs.

Introduction

Controlling hospitalization costs remain a challenge of improving quality of care. To create an effective framework for monitoring the quality of care and the utilization of services in hospital, various payment approaches are applied to different settings or conditions, with diagnosis-related groups (DRGs) being the most widely adopted payment approach globally. The DRGs payment was designed and developed in the late 1960s in the United States. The DRGs payment are a patient classification scheme, which provides a means of relating the type of patients a hospital treats (ie, its case mix) to the costs incurred by the hospital. DRGs payment can serve as a basis for budgeting, cost control, and quality control in hospitals. Evidence indicated that adopting DRGs payment has resulted in savings of money and extended the solvency of the local health care funding.[1,2] Since that, many countries adopted DRGs payment in hospitals to control the growth of hospitalization costs.[3-5]

In China, government has announced plans to reform provider-payment methods at public hospitals including the DRGs payment to control health expenditures.[6] In 2012, Beijing pioneered China's first DRGs payment system in 6 hospitals. Evidence showed that DRGs payment led to 6.2% reductions in health expenditure and 10.5% reductions in out-of-pocket payment per admission. Readmission rates were reduced 1.4% with DRG payment relative to non-DRG.[6] Although DRGs is an internationally recognized advanced hospital management method, it is difficult to fully implement DRG in developing countries such as China in the short term because of the high investment in the groundwork, operational difficulties, and high-administrative costs of DRG payment methods.[7]

Under the regional global budget, the Chinese government developed and implemented an innovative case-based payment method called the diagnosis-intervention packet (DIP) payment to pay for inpatient care.[8] The DIP payment is based on historical data from patients, and the "disease diagnosis + treatment" of each case is exhausted and clustered, and stable inpatient diseases are combined, and the corresponding number of disease points is determined according to the average cost of each disease, technical difficulty, etc, about a benchmark disease, and then the total amount of payment is calculated by combining the unit price of points and the total number of points carried out by each medical institution.[9] Since 2020, to promote the reform of DIP payment, the Chinese National Healthcare Security Administration has issued formal policy documents. The scope of application of DIP policies in all provinces and cities was basically consistent with national requirements. Under the guidance of the national top-level design, all localities have adjusted and refined the design of key elements (disease directory, score, and medical institution coefficient) and supervision measures according to the actual medical conditions.[10] Although several studies have indicated DIP payment reform had benefit on regulating health provider's behavior of inpatient care and allocating the regional health care resources,[9,11,12] the long-term effects of the DIP payment reform still need to be investigated.[13]

Rehabilitation addresses the effects of health conditions on a person's everyday life by optimizing their functioning and reducing their experience of disability.[14] Globally, 1 in 3 people is estimated to live with a health condition that would benefit from rehabilitation.[15] Owing to changes in the health and characteristics of the population, the needs for rehabilitation is predicted to increase in the coming years.[15-17] The increase in patient rehabilitation needs has aggregated the medical burden of rehabilitation, especially rehabilitation hospitalization costs.[18,19] However, to the best of our knowledge, the difference of rehabilitation hospitalization cost between DRG to DIP payments have not been characterized. This study aimed to compare the rehabilitation hospitalization cost between DRG and DIP payments among rehabilitation inpatients in tertiary hospitals in southeastern China. We hypothesized that DIP payments would reduce the rehabilitation hospitalization cost.

Methods

Research design and sample

We conducted a retrospective, population-based, longitudinal cohort study of patients (aged 1-108 years) who were enrolled between June 30, 2019 and July 30, 2022 in Shenzhen, China. The tertiary hospitals providing rehabilitation services in Shenzhen were enrolled in this study. Data were obtained from the medical records and hospital information systems. This study protocols were approved by the Medical Ethics Committee of Shenzhen Second People's Hospital (no. 20180926006). We have cooperated with Healthcare Security Bureau of the Shenzhen Municipality, who was responsible for collecting the medical record data and provided the data on medical record to our team. The use of the data was approved by the Healthcare Security Bureau of the Shenzhen Municipality. Because of the nature of this retrospective study and preserved anonymity of patients, a waiver of informed consent was obtained from the Healthcare Security Bureau of the Shenzhen Municipality. We assessed the records of 268,362 individuals who visited tertiary hospitals providing rehabilitation services. This research was funded by the San Min Project of China (grant no. 3000018).

Measurements

We included basic characteristics of patients on age, sex, character of hospital (private or public), medical insurance payment (DRG or DIP), type of diseases (endocrine, nutrition, and metabolic diseases; neurologic diseases; circulatory diseases; respiratory diseases; musculoskeletal system and connective tissue diseases; injuries, poisoning, and other external causes; factors affecting health status and exposure to health services; other diseases such as parasitic diseases, cancer, hematopoietic system diseases, etc), and study period (2019, 2020, 2021, and 2022). We included information on the patients' rehabilitation hospitalization cost, which were measured using continuous variables in RMB units. We also included information of the length of stay of hospitalization, which are measured using continuous variables in days units. The outcome variable was the patients' rehabilitation hospitalization cost of in our study.

Statistical analysis

Descriptive statistics are presented as numbers and proportions for dichotomous variables and as medians (interquartile range [IQR]) for continuous variables. Regarding the "outlier" values of variables (6.9% individuals were recorded that the length of stay of hospitalization was above 20 days, which 20 days is "Q3+1.5 × IQR" of the length of stay of hospitalization), we used "winsor2" command and "cut (0 99) trim" option, values greater than the 99th percentile were discarded.

The Shapiro-Wilk test was used to examine the distribution of rehabilitation hospitalization cost. Analysis of Variance or median tests were used to detect differences in patients' general characteristics (age, sex, public or private hospital, medical insurance payment, the type of disease, hospitalization cost, and length of stay of hospitalization) among different study period (2019, 2020, 2021, and 2022).

To estimate the effects of DIP payment on the rehabilitation hospitalization cost, we first conducted a quantile regression analysis. The quantile regression model is suitable for the outcome with skewed distribution, which is based on analyzing the median. In the quantile regression model, the outcome was the rehabilitation hospitalization cost, and the independent variables were study period, medical insurance payment, and the interaction term (study period × medical insurance payment). The covariates were patients' age, sex, public or private hospital, the type of disease, and length of stay of hospitalization. To further visualize the effects of the DIP payment, we plotted the margin effect of the interaction term (study period × medical insurance payment) on the rehabilitation hospitalization cost. Significance was set at $P<.05$. All data analyses were performed using the Stata statistical software.[a]

Results

Characteristics of the study participants

Among the participants (N=268,362), the median age was 48.0 years (IQR, 36.0-58.0 years), 155,154 (57.8%) were men, and 113,208 (42.2%) were women. Of all participants, 260,180 (97.0%) participants were from public hospitals. Regarding the medical insurance payment, 76,447 (28.5%) participants were applied for the DRG payment, and 191,915 (71.5%) participants were applied for the DIP payment. More than one third of participants (35.6%) were diagnosed with musculoskeletal system and connective tissue diseases. The median hospitalization cost was 9338.9 RMB (IQR, 5876.1-16,518.2 RMB), the median length of stay of hospitalization was 4.0 days (IQR, 0.0-8.0 days) (table 1).

Comparison of DRG rehabilitation reimbursement payments with those of DIP

As demonstrated in the results of the quantile regression (table 2), after controlling for covariates (age, sex, public or private hospital, the type of disease, and the length of stay of hospitalization), compared with 2019, the hospitalization cost was significantly reduced in 2021 (β=−3430.024; 95% confidence interval [CI], −3634.13 to −3225.92), and 2022 (β=−4702.88; 95% CI, −4901.64 to −4504.13). Patients who applied for DIP payment had lower hospitalization cost than that DRG payment (β=−1419.34; 95% CI, −1619.22 to −1219.46). Regarding to the interaction term (study period × medical insurance payment), compared with DRG payment in 2019, DIP payment in 2020 (β=330.72; 95% CI, 38.38-623.05) and DIP payment in 2022 (β=384.96; 95% CI, 157.71-612.21) had higher hospitalization cost.

The results of margin effect regression of hospitalization cost are presented in table 3. The patients' hospitalization cost with DRG payment (Margin effect=15,056.04) were higher than that with DIP payment (Margin effect=13,636.70) in 2019. The patients' hospitalization cost with DRG payment (Margin effect=15,159.05) were higher than that with DIP payment (Margin effect=14,070.43) in

Table 1 General characteristics of the participants (N=268,362)

Characteristics	Total (N=268,362)	2019 (N=36,990)	2020 (N=30,052)	2021 (N=86,176)	2022 (N=115,144)	P Value
Age, median (IQR)	48.0 (36.0-58.0)	46.0 (33.0-56.0)	47.0 (35.0-57.0)	49.0 (37.0-58.0)	49.0 (37.0-58.0)	<.001
Sex						
Female	113,208 (42.2%)	16,477 (44.5%)	12,434 (41.4%)	36,009 (41.8%)	48,288 (41.9%)	<.001
Male	155,154 (57.8%)	20,513 (55.5%)	17,618 (58.6%)	50,167 (58.2%)	66,856 (58.1%)	
Public hospital (yes=1)	260,180 (97.0%)	35,796 (96.8%)	29,180 (97.1%)	83,372 (96.7%)	11,1832 (97.1%)	<.001
Insurance payment						
DRG	76,447 (28.5%)	9452 (25.6%)	8454 (28.1%)	25,278 (29.3%)	33,263 (28.9%)	<.001
DIP	191,915 (71.5%)	27,538 (74.4%)	21,598 (71.9%)	60,898 (70.7%)	81,881 (71.1%)	
Diseases						<.001
Endocrine, nutrition, and metabolic diseases	17,499 (6.9%)	2369 (6.8%)	1899 (6.7%)	5911 (7.3%)	7320 (6.7%)	
Neurologic diseases	19,670 (7.8%)	2628 (7.5%)	2273 (8.0%)	6020 (7.4%)	8749 (8.0%)	
Circulatory diseases	52,227 (20.6%)	5484 (15.7%)	5649 (19.8%)	17,765 (21.9%)	23,329 (21.4%)	
Respiratory diseases	26,280 (10.4%)	5461 (15.6%)	2943 (10.3%)	8190 (10.1%)	9686 (8.9%)	
Musculoskeletal system and connective tissue diseases	90,459 (35.6%)	13,153 (37.7%)	10,207 (35.9%)	28,543 (35.2%)	38,556 (35.3%)	
Injury, poisoning, and other external causes	22,481 (8.9%)	2741 (7.9%)	2476 (8.7%)	7283 (9.0%)	9981 (9.1%)	
Factors affecting health status and exposure to health services[*]	18,108 (7.1%)	2072 (5.9%)	2157 (7.6%)	5369 (6.6%)	8510 (7.8%)	
Others[†]	7038 (2.77%)	990 (2.84%)	866 (3.04%)	2118 (2.61%)	3064 (2.81%)	
Hospitalization cost, median (IQR)	9338.9 (5876.1-16,518.2)	7957.9 (5116.2-12,850.1)	8819.0 (5556.7-14,647.7)	9721.3 (6039.7-17,443.3)	9739.3 (6147.7-17,783.7)	<.001
Length of stay of hospitalization (d), median (IQR)	4.0 (0.0-8.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	5.0 (1.0-9.0)	6.0 (4.0-10.0)	<.001

[*] "Factors affecting health status and exposure to health services" included reexamination after esophageal cancer surgery, postoperative joint stabilization, after cancer radiation therapy, etc.

[†] "Others" included parasite diseases, cancer, hematopoietic system diseases, etc.

Table 2 The quantile regression of the hospitalization cost (N=268,362)

Rehabilitation Hospitalization Cost	β	SE	t	P Value	95% CI	
Independent variables						
Study period						
2019	Ref	-	-	-	-	
2020	103.01	127.28	0.81	.42	−146.45	352.47
2021	−3430.02	104.14	−32.94	<.001	−3634.13	−3225.92
2022	−4702.88	101.41	−46.38	<.001	−4901.64	−4504.13
Insurance payment						
DRG	Ref	-	-	-	-	
DIP	−1419.34	101.98	−13.92	<.001	−1619.22	−1219.46
Interaction term (study period × medical insurance payment)						
2019 × DRG	Ref	-	-	-	-	
2020 × DIP	330.72	149.15	2.22	.03	38.38	623.05
2021 × DIP	−165.99	120.19	−1.38	.17	−401.56	69.59
2022 × DIP	384.96	115.95	3.32	<.001	157.71	612.21
Covariates						
Age	40.59	0.99	41.10	<.001	38.66	42.53
Sex (male=1)	−79.56	34.47	−2.31	.02	−147.12	−12.00
Public hospital (yes=1)	−949.50	98.88	−9.60	<.001	−1143.31	−755.70
The type of disease						
Neurologic diseases	1209.67	87.26	13.86	<.001	1038.65	1380.69
Circulatory diseases	3195.69	73.23	43.64	<.001	3052.16	3339.22
Respiratory diseases	−796.46	81.92	−9.72	<.001	−957.02	−635.90
Musculoskeletal system and connective tissue diseases	1952.00	69.22	28.20	<.001	1816.33	2087.67
Injury, poisoning, and other external causes	13,055.31	84.25	154.96	<.001	12,890.19	13,220.43
Factors affecting health status and exposure to health services*	948.31	89.64	10.58	<.001	772.61	1124.02
Others†	−252.89	117.33	−2.16	.03	−482.86	−22.92
The length of stay of hospitalization	832.53	2.80	297.65	<.001	827.05	838.01

* "Factors affecting health status and exposure to health services" included reexamination after esophageal cancer surgery, postoperative joint stabilization, after cancer radiation therapy, etc.
† "Others" included parasite diseases, cancer, hematopoietic system diseases, etc.

Table 3 The margin effect of hospitalization cost (N=268,362)

	Margin Effect	SE	z	P Value	95% CI	
Study period						
2019	14,044.49	47.17	297.73	<.001	13,952.04	14,136.95
2020	14,383.20	51.55	279.00	<.001	14,282.16	14,484.24
2021	10,496.17	29.29	358.40	<.001	10,438.77	10,553.57
2022	9615.97	26.05	369.10	<.001	9564.90	9667.03
Insurance payment						
DRG	11,947.11	31.00	385.38	<.001	11,886.35	12,007.87
DIP	10,677.41	19.58	545.31	<.001	10,639.04	10,715.79
Interaction term (study period × medical insurance payment)						
2019 × DRG	15,056.04	89.07	169.04	<.001	14,881.47	15,230.62
2019 × DIP	13,636.70	53.96	252.70	<.001	13,530.93	13,742.47
2020 × DRG	15,159.05	93.60	161.95	<.001	14,975.60	15,342.50
2020 × DIP	14,070.43	60.19	233.75	<.001	13,952.45	14,188.40
2021 × DRG	11,626.02	53.67	216.61	<.001	11,520.82	11,731.21
2021 × DIP	10,040.69	34.92	287.49	<.001	9972.24	10,109.14
2022 × DRG	10,353.16	47.02	220.21	<.001	10,261.01	10,445.31
2022 × DIP	9318.78	30.79	302.66	<.001	9258.43	9379.12

Table 4 Difference of hospitalization cost between DRG and DIP payment in each year (N=268,362)

Study Period	Difference of Margin Effect (dy/dx)	SE	z	P Value	95% CI	
Total	−1269.69	36.82	−34.49	<.001	−1341.85	−1197.53
2019	−1419.34	101.98	−13.92	<.001	−1619.22	−1219.46
2020	−1088.62	109.20	−9.97	<.001	−1302.66	−874.59
2021	−1585.33	64.02	−24.76	<.001	−1710.81	−1459.85
2022	−1034.38	55.56	−18.62	<.001	−1143.27	−925.49

2020. The patients' hospitalization cost with DRG payment (Margin effect=11,626.02) were higher than that with DIP payment (Margin effect=10,040.69) in 2021. The patients' hospitalization cost with DRG payment (Margin effect=10,353.16) were higher than that with DIP payment (Margin effect=9318.78) in 2022. The predicted marginal hospitalization cost with DRG payment were 9%, 7%, 14%, and 10% higher than that with DIP payments in 2019, 2020, 2021, and 2022, respectively.

We further analyzed the differences of hospitalization cost between DRG and DIP payment in each year. As shown in table 4. The total difference in predicted marginal hospitalization cost between DRG and DIP was −1269 RMB (−193 USD). This difference in 2019, 2020, 2021, and 2022 was −1419 RMB (−228 USD), −1088 RMB (−158 USD), −1585 RMB (−246 USD), and −1034 RMB (−154 USD), respectively. All differences in predicted marginal hospitalization cost between DRG and DIP was significant (P<.001). To visualize the difference of the hospitalization cost between DRG and DIP payments from 2019 to 2022, we then plotted the interaction effects (study period × medical insurance payment) (fig 1). As shown in figure 1, the green line indicates the DRG payment, and red line indicates the DIP payment. The patients' hospitalization cost was increase from 2019 to 2020, then reduced from 2020 to 2022. The differences in predicted marginal hospitalization cost between DRG and DIP in each year also shown in figure 1.

Discussion

Main finding

DIP is a new payment system in China, but studies evaluating its effectiveness of controlling rehabilitation hospitalization cost are scarce. Our study focused on the DIP payment effect from macro-policy level and reached a relatively vulnerable and neglected population of rehabilitation patients from tertiary hospitals. We first observed the decreased rehabilitation hospitalization cost from 2019 to 2022. We then examine the differences of cost between DRG and DIP payment, we found that the rehabilitation hospitalization cost with DRG payment were higher than that with DIP payment from 2019 to 2022. These finding shows that the DIP payment has alleviated the individual medical burden among rehabilitation patients.
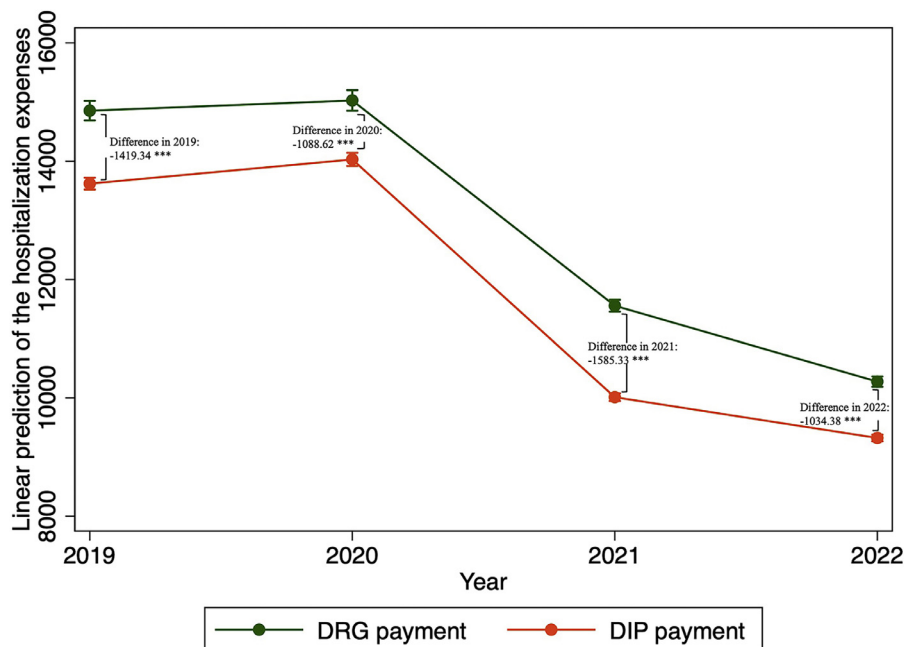

Fig 1 The difference of the hospitalization cost between DRG and DIP payments from 2019 to 2022 (N=268,362). The bars indicate 95% CI of margin effect in each year. The total difference in predicted marginal hospitalization cost between DRG and DIP was −1269.69, the differences in each year indicated in this figure. *** indicate significant differences.

Compared with other studies

We found several mixed findings from previous studies. Some studies indicated that DIP payment reform showed positive effect in controlling hospitalization cost when compared with DRG payment. For example, one study aimed to evaluate the effectiveness of DIP reform among inpatients diagnosed with cancer, results indicated that DIP has been effective in alleviating the personal economic burden of health and maintaining the quality of health care services.[20] One study indicated that DIP policy intervention can improve the drug burden of elderly hypertensive hospitalized patients and has a stable long-term effect.[21] Another study clearly stated that the cost of inpatients with high-cost cases (neurology, respiratory medicine, and other specialties) is in urgent need of optimization and adjustment. DIP payment method can control the use of medical insurance funds more effectively.[22] Our finding that the significant differences of hospitalization cost between DRG and DIP payment (ie, DIP payment reform showed positive effect in controlling hospitalization cost in our study), was consistent with above evidence.

Whereas, some studies indicated that DIP payment reform showed negative effect in controlling hospitalization cost when compared with DRG payment. One study explored the variations in the effect of the DIP reform on medical costs. The results indicated that the DIP payment reform had resulted in a significant increase of the monthly trend of adjusted total expenditure per case in public, tertiary, secondary, and primary hospitals.[23] One study showed that implementation of the DIP payment reform associated with increase in total costs per case in the older and oldest-old groups, and reduction in length of stay in the younger and young-old groups without deteriorating quality of care.[24] Another study found after the DIP reform, the average expenditure per hospital admission and the average length of stay remained unchanged for urban employee basic medical insurance inpatients, whereas urban and rural residents basic medical insurance inpatients experienced a decrease.[25]

The reason of the cost differences between DRG and DIP payment could be explained by the advantages of DIP payments. The DIP platform has a number of advantages over DRG-based payment models, such as more homogeneous resource utilization within groups, design simplicity, dynamic in grouping, reimbursement value in reflecting real world treatment pathways and costs, and easy to implement.[26] In specific, first, compared with DRGs payment, DIP payment directly forms patient categories based on natural combinations of major diagnoses and associated surgical operations.[23] Second, DIP payment is grouped from exhaustive matching, objecting clustering, and adjusting dynamically according to the data. Third, DIP payment forms patient category points based on the ratio of subaverage inpatient costs for each patient category, which requires less medical record coding expertise and can be better adapted to Chinese public hospitals and easier to popularize. Also, other findings indicated that the DIP payment help regulate provider behaviors when treating high-risk patients, and DIP has potential for rapid roll-out in resource-limited areas where lack a uniform coding practice or high-quality historical data.[27] Evidence showed that, in the short term, the DIP payment reform could not only effectively regulate provider behavior of inpatient care in hospitals, but also improves the rational allocation of the regional health care resources.[13] Overall, the introduction of DRG or DIP payments in China poses both opportunities and challenges for health care. Offering robust policy support and ensuring adequate resource allocation are crucial for implementing DIP payments and controlling rehabilitation cost in health care.[28]

Study limitations

Our data consisted of rehabilitation inpatients of the hospital under DRGs and DIP payment reforms during a multiple time point. To the best of our knowledge, this is the first study to examine the difference of rehabilitation hospitalization cost between the DRGs and DIP payment. The results of this study could better provide empirical basis for the development of Chinese local medical payment methods, and provide policy information for Chinese medical insurance payment methods to support the promotion of DIP. However, this study was subjected to several limitations. First, this study is only conducted in Shenzhen, China, which may not represent the overall situation in southeastern China. However, as a practical case, this study serves to illustrate that the rapid growth of rehabilitation costs can be effectively controlled through DIP payment in China. Second, the confusion of other policy interventions may lead to deviation in analysis, which factors we did not enroll and account for in our study, such as other health care policy and other characteristics from patients and hospitals. Therefore, this study may overestimate the effect of DIP policy.

Conclusions

With the rapid growth of medical expenses, the DRGs and DIP payment were designed and developed under health care budgets, respectively. This study collected the data from individual patient level and conduct follow-up studies on individual patients based on a relatively large sample size and long period. The findings of DIP payment reduced the rehabilitation hospitalization cost would be helpful in developing more effectively and efficiently tailored interventions for rehabilitation health care in China. Furthermore, the results of this study could provide advice on building more effective strategies and intervention options for other low- and middle-income countries that struggle with controlling rehabilitation hospitalization costs.

Supplier

a. Stata, version 14.1; StataCorp, College Station, TX.

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Disclosures

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