Huangdao People's Hospital

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1. Background

In October 2013, the Qingdao Huangdao District working group and Bureaus (the health system reform leadership working group, the District Bureau of Development and Reform, the District Bureau of Finance, the Bureau of Human Resources and Social Security, the District Bureau of Health) jointly published the "Huangdao District Clinical Pathways and Payment Reform Collaboration Project – Fixed Payment Pilot Project Plan." This Plan selected the Huangdao District People's Hospital to be the pilot hospital that will implement care pathways and payment reform for the China-UK project, "Strengthening evidence-based decision-making and making basic healthcare services available to all: China care pathways and payment reform practice and dissemination", for the. The hospital selected four diseases (including their co-morbidities) to implement care pathway management and fixed payment method: chronic obstructive pulmonary disease (COPD), transient ischemic attack (TIA), cerebral hemorrhage, and cerebral infarction. Single disease fixed payment (without comorbidities) for COPD is 11,000 CNY; TIA is 6,700 CNY, cerebral hemorrhage is 14,100 CNY, and cerebral infarction is 10,200 CNY (see Appendix 1 for fixed payment amount with comorbidities). Urban employees, urban residents and enrollees of the New Rural Corporative Medical Scheme (NRCMS) can all be included in the care pathway management. Urban employees' out-of-pocket (OOP) payment is 18%; OOP for urban residents and NRCMS enrollees is 25%.

After the project implementation, Huangdao District implemented the case payment method for pilot diseases, and adopted the method of "do not pay for excess services; keep remaining funds" to encourage healthcare institutions to deliver standard services required by care pathways while avoiding over-treatment. Diseases not under the care pathway project still operated under the fee-for-service payment method. This allowed a comparison of the changes in patient expenses under different payment methods. In January 2015, Qingdao Health Insurance was reorganized on a city-level, rearranging urban employees, urban residents and NRCMS enrollees into two insurance programs: "Employee Social Healthcare Insurance" and "Resident Social Healthcare Insurance." It was stipulated that all insured persons in the city of Qingdao (approximately 8.1 million people) have access to a three-tiered healthcare insurance system: basic healthcare coverage, catastrophic disease coverage, and catastrophic disease aide. The implementation of this policy has a direct impact on the care pathways. In response, the Huangdao District People's Hospital drafted the "Clinical pathway patient reimbursement ratio revision plan" in February 2015, hoping to increase the reimbursement ratio for urban residents and NCMS patients to 18%, equal to the urban employees' reimbursement ratio. This will be beneficial to the continued implementation of the project. However, since the Qingdao Health and Family Planning Commission has not yet approved the plan, the care pathway project has currently been on hold.

The Huangdao District People's Hospital is a secondary level general hospital, occupying an area of 51,960 square meters, and a total business space construction area of 77,011 square meters. It incorporates healthcare, rehabilitation, teaching and education, research, and emergency services. There are 29 clinical departments in this

hospital, 926 open beds, and annual revenue of 396 million CNY. Prior to the implementation of this project, pathways have been utilized in other clinical departments in this hospital, mainly for surgical interventions, such as cesarean section. In total, 49 clinical pathways have been implemented in the hospital. In January 2014, Huangdao District People's Hospital reimbursed the first patient managed by clinical pathways, marking the official start of the project. In the initial phase of the project implementation, the hospital was in the middle of upgrading its information system, which was not compatible with the pathway software. Physicians reported inconvenience using the programs and software. At the same time, it was discovered that the "secondary reimbursement policy" for below-poverty line patients could not be incorporated into the care pathway. As a result, these poverty patients did not truly benefit from the project. In addition, physicians were not familiar with the project and the operational flow during the initial phase of implementation. As a result, physicians lacked enthusiasm for this work, which adversely affected the number of patients entering the care pathways. In June 2014, the hospital information system upgrade was officially completed, resolving the incompatibility issue between hospital information system and clinical pathway software. In August 2014, Huangdao District Bureau of Health agreed to implement "secondary reimbursement" for poverty patients enrolled in care pathways, providing relief for these patients. Simultaneously, as physicians became more aware and knowledgeable about the project, implementation gradually stabilized.

In terms of incentives, the hospital established the pathway reward and penalty system in order to ensure successful implementation. The reward and penalty system for hospital department director, head nurse, deputy director, deputy head nurse and case managers is as follows:

a) Rewards and penalties are administered based on the monthly number of completed care pathways (Table 1).

Table 1 Rewards and penalties based on pathway completion rate

Completion rate	Reward and penalty amount (CNY)		
	Director	Head nurse, deputy director, deputy head nurse	Case manager
60 or below	-300	-150	-200
60 – 69.9	-200	-100	-150
70 – 79.9	-100	-50	-100
80 – 84.9	200	100	200
85 – 89.9	300	200	300
90 or above	400	300	400

b) Rewards and penalties are administered based on the monthly number of patients initiated in care pathways (Table 2).

Table 2 Rewards system based on monthly number of patients initiated in care pathways

Number of pathway enrollees (monthly)	Reward amount (CNY)		
	Director	Head nurse, deputy director, deputy head nurse	Case manager
5 – 10	100	50	100
11 – 20	200	100	200
21 or above	300	200	300

2. Integrated care pathway implementation

From June 2014 to Feb 2015, the pilot hospital departments of the four pathway diseases admitted 2,608 inpatients total, from which 489 patients entered care pathway management system. The entrance rate was 18.8%, and the completion rate was 88.3% (Table 3). Mortality rate was zero for all four diseases. Average hospital-acquired infection rate was below 2%. Most patient satisfaction rates were higher than 90%.

Table 3 Integrated care pathway entrance rate and completion rate of four pilot diseases, Jun 2014 – Feb 2015

Disease	Total inpatients	Patients that entered pathway	Patients that completed pathway	Entrance rate (%)	Completion rate (%)
COPD	212	206	196	97.2	95.1
TIA	752	55	38	7.3	69.1
Cerebral hemorrhage	309	21	15	6.8	71.4
Cerebral infarction	1,335	207	183	15.5	88.4

(1) Workload indicators

A. Inpatients eligible for care pathway

Since June 2014, the number of inpatients of all four diseases remained stable with few fluctuations (Figure 1). There were more cerebral infarction and TIA patients. The hospital admitted more than 100 cerebral infarction patients and 80 TIA patients every month. There were fewer cerebral hemorrhage and COPD patients, with around 30 monthly admissions for each disease.

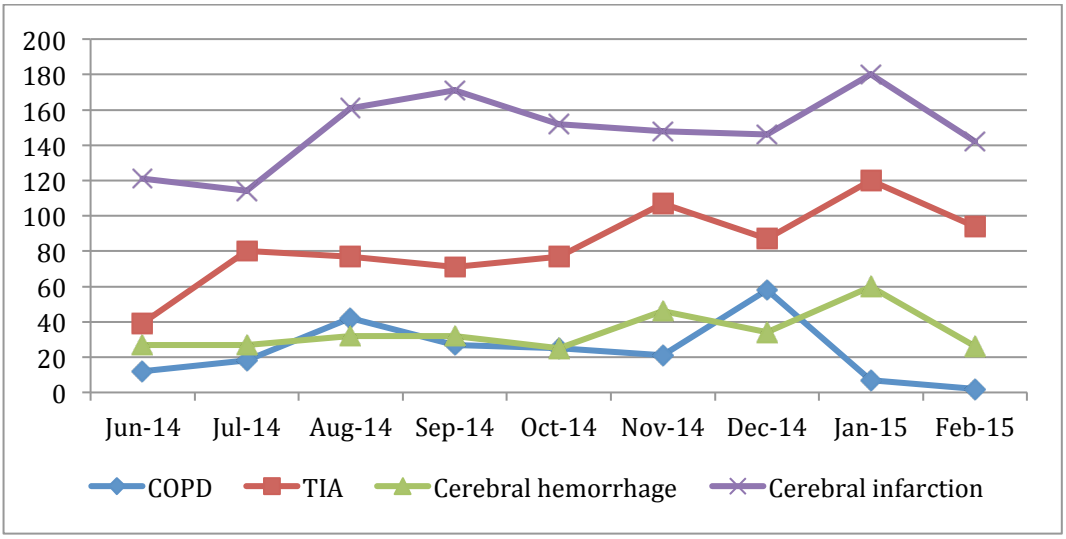

Figure 1 Total number of inpatients of four diseases, Jun 2014 – Feb 2015

B. Care pathway implementation

COPD had the highest entrance rate among the four diseases, with monthly average rates maintained over 90%. TIA and cerebral hemorrhage had lower entrance rates, both below 10%. Cerebral infarction had 20% entrance rate in general (Figure **2**). Overall, only a small portion of inpatients of all four diseases entered the care pathways (Figure 3).

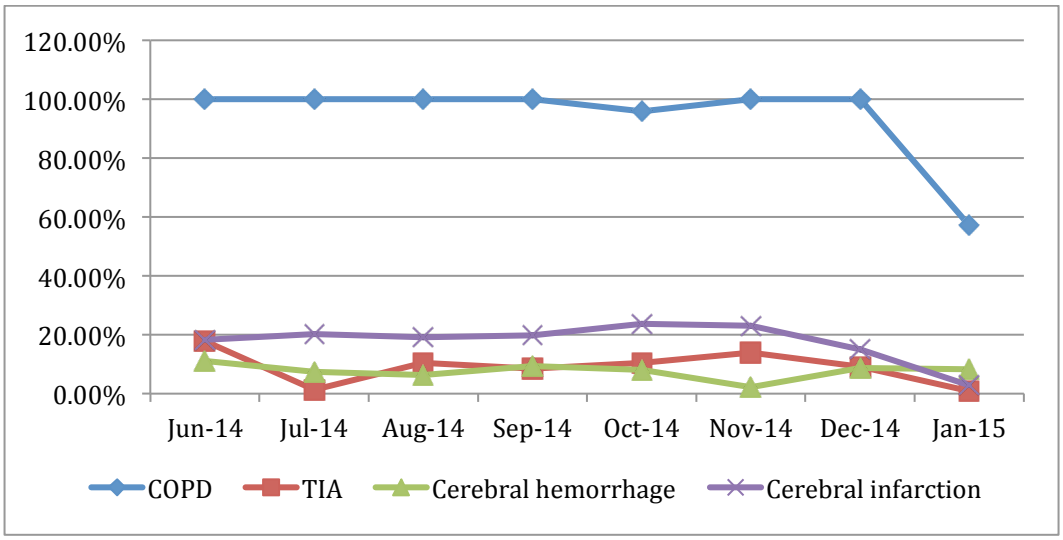

Figure 2 Entrance rates of four diseases, Jun 2014 – Feb 2015

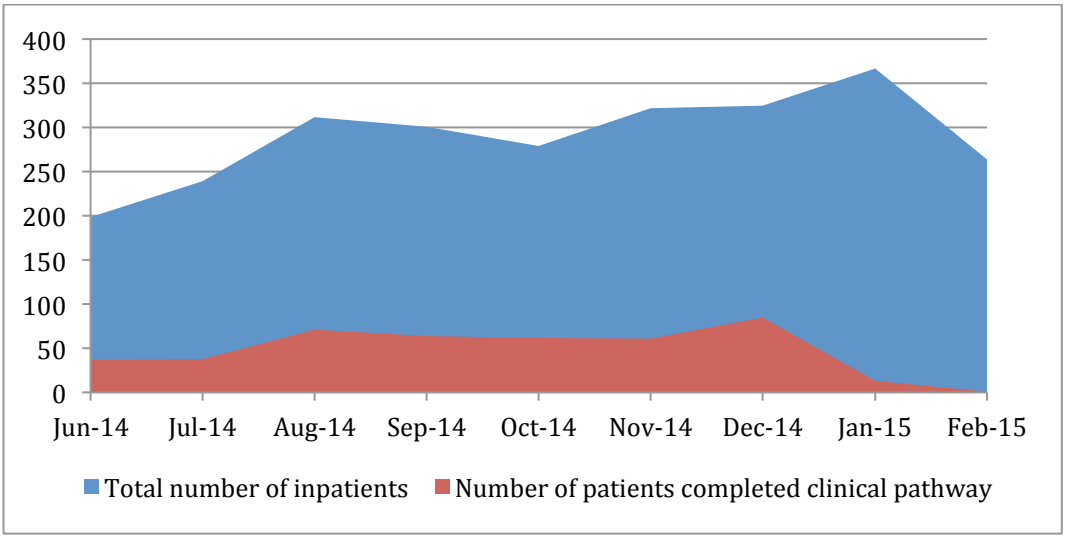

Figure 3 Total number of inpatients and patients completing care pathways, Jun 2014 – Feb 2015

a) COPD inpatient care pathway implementation

COPD patients had high care pathway entrance rate, completion rate and management rate. From June to December of 2014, all monthly entrance rates reached 100% except for October, 2014 (96%). Entrance rate in January 2015 was relatively low at 57.14%. Monthly completion rates and management rates showed an increasing trend, from 83% to 100% (Figure 4).

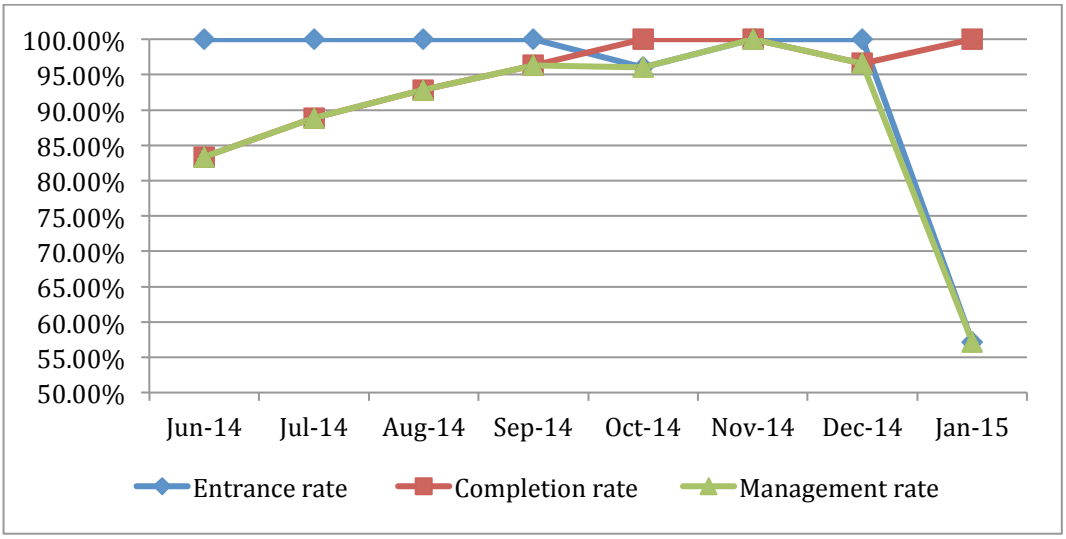

Figure 4 COPD inpatients' monthly entrance rates, completion rates and management rates, Jun 2014 – Jan 2015

b) TIA inpatient care pathway implementation

TIA patients had low care pathway entrance rate, unstable completion rate, and low management rate. Entrance rates were maintained at around 10% in general. Completion rate fluctuated largely from 50% to 100% (Figure 5).

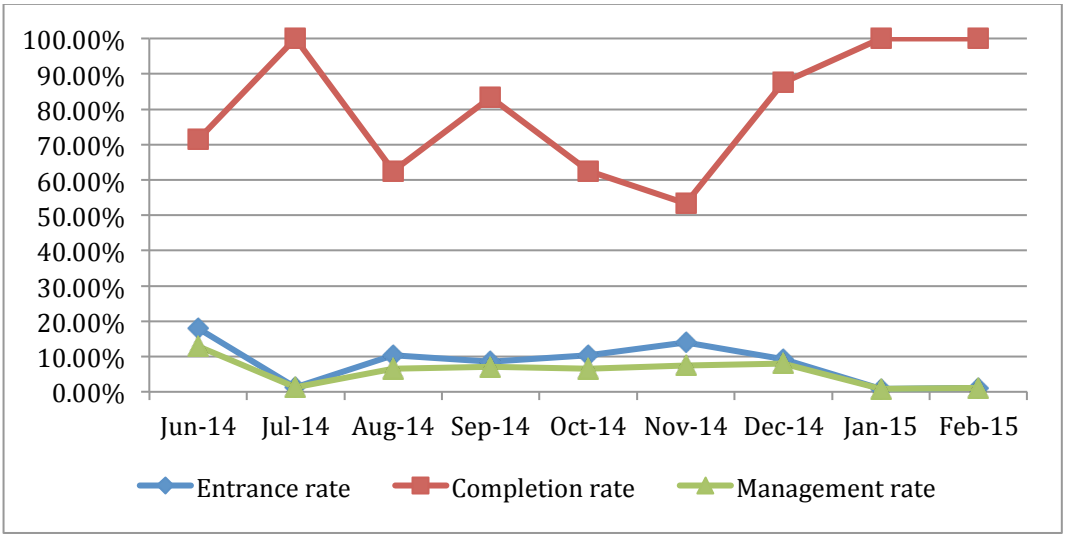

Figure 5 TIA inpatients' monthly entrance rates, completion rates and management rates, Jun 2014 – Jan 2015

c) Cerebral hemorrhage care pathway implementation

Cerebral hemorrhage patients had low care pathway entrance rate, unstable completion rate and low management rate. From June to December 2014, all monthly entrance rates stayed below 10%. Monthly completion rates rose and fell, with an overall average of 71.43% (Figure **6**).

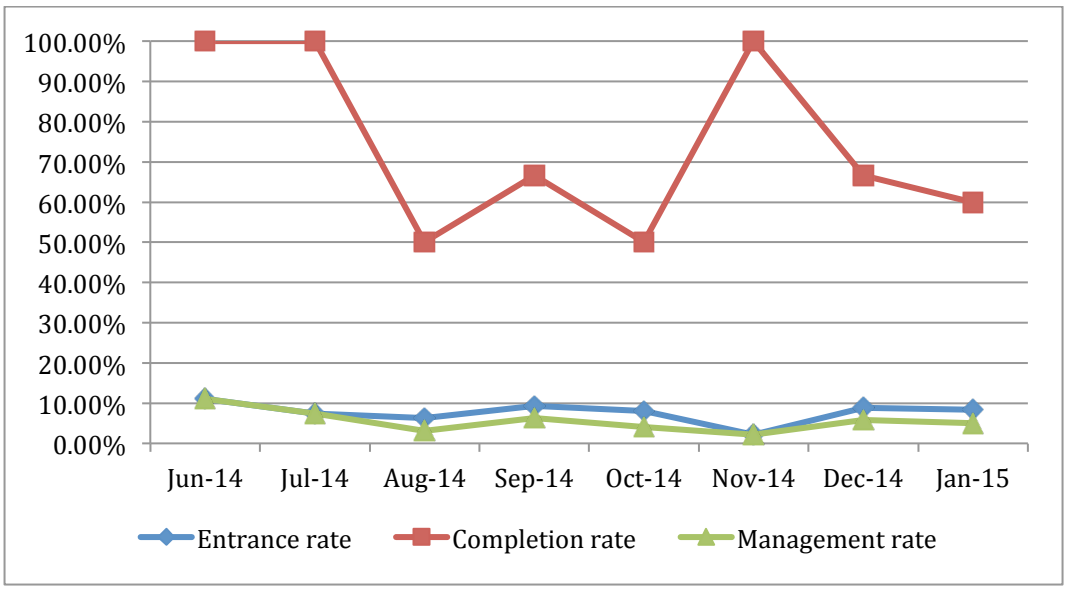

Figure 6 Cerebral hemorrhage inpatients' monthly entrance rates, completion rates and management rates, Jun 2014 – Feb 2015

d) Cerebral infarction care pathway implementation

Cerebral infarction patients had stable low entrance rate and management rate but high completion rate. Monthly entrance rates maintained at around 20%, but reduced significantly in January, 2015. Monthly completion rates maintained high at around 90% (Figure 7).

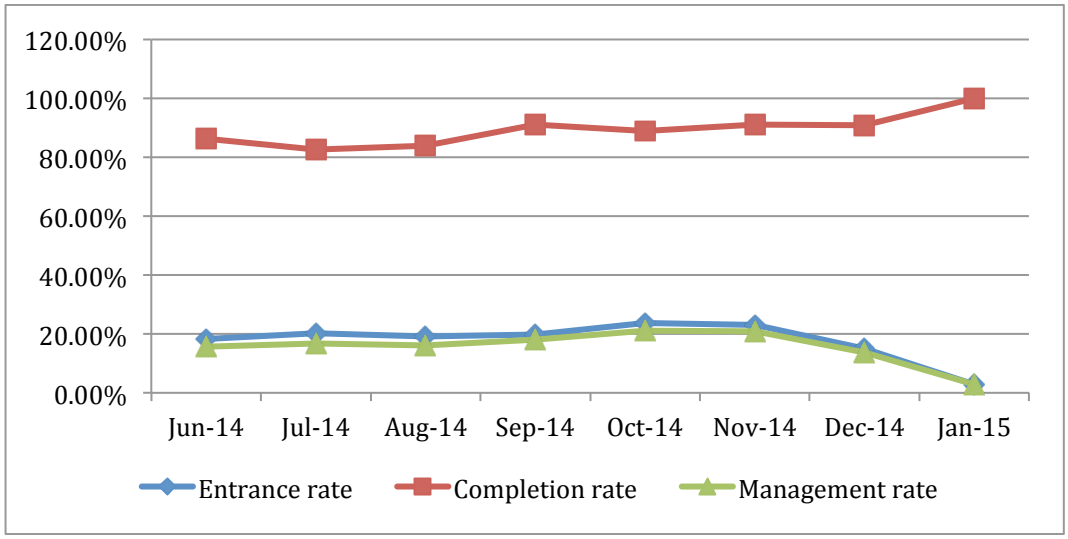

Figure 7 Cerebral infarction inpatients' monthly entrance rates, completion rates and management rates, Jun 2014 – Feb 2015

(2) Outcome indicators

A. Mortality

Mortality of all four care pathway diseases was zero.

B. Hospital-acquired infection rate

The hospital-acquired infection rates of TIA, cerebral hemorrhage and cerebral infarction patients were zero, whereas COPD stayed below 2% (Figure **8**).

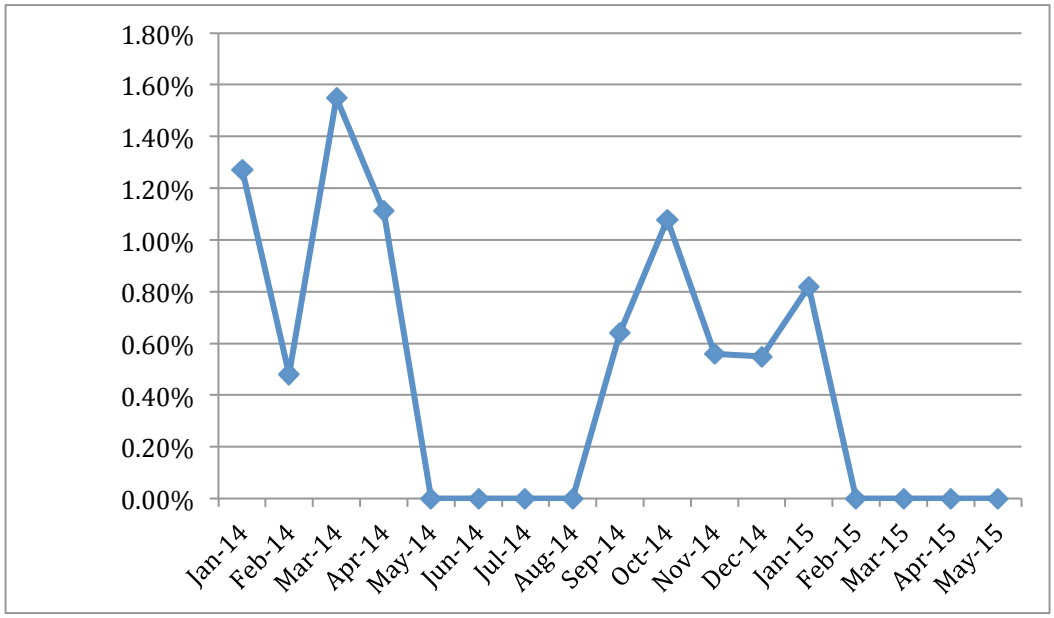

Figure 8 COPD pathway patients' monthly hospital-acquired infection rates, Jan 2014 – May 2015

C. Patient satisfaction

The patient satisfaction rates of TIA, cerebral hemorrhage and cerebral infarction patients were above 90%, whereas COPD rates were generally maintained over 85% (Figure 9).

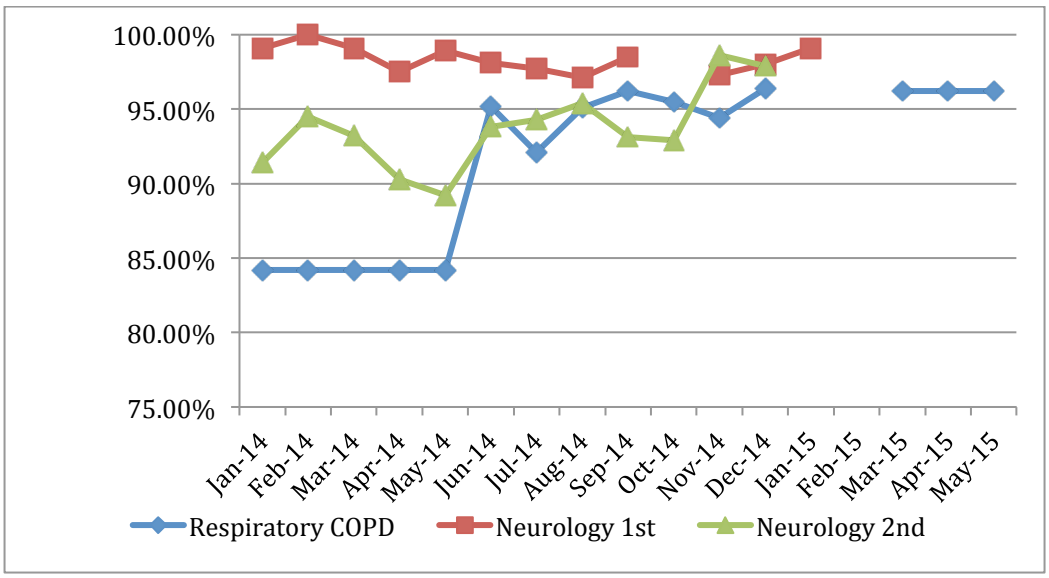

Figure 9 Patient satisfaction rates of four pathway diseases, Jan 2014 – May 2015

3. Clinical behaviors

Integrated care pathways included mandatory items that physicians must provide and optional items that physicians can decide whether to use or not based on the individual medical conditions. Using the hospitalized patients' billing data for cerebral infarction patients and COPD patients, the utilization proportions of mandatory and optional items, utilization volume and duration were analyzed to assess changes in the physician behaviors before and after the pilot. Due to the low sample size of cerebral hemorrhage and TIA care pathway patients in Huangdao District People's Hospital, analysis was not performed for these two diseases.

(1) COPD

The mandatory and optional items included in the COPD clinical pathway were analyzed. Mandatory items included expectorants and 24-hour chest CT. Optional items included antibiotics, pulmonary ventilation function test and pulmonary diffusion function test.

A. Mandatory items

a) Expectorants utilization status

In Huangdao District People's Hospital, the primary type of expectorant used by COPD patients was ambroxol hydrochloride injection. Utilization proportion of expectorants in pathway patients after the pilot was 23.94%, which was lower than the proportion in the non-pathway group both before and after pilot, but the difference was not statistically significant (Table 4). Per capita utilization volume and number of days of utilization reduced after pilot; magnitude of decrease was the most substantial in pathway patients, but the difference was not statistically significant (Table 5).

Table 4 Ambroxol hydrochloride injection utilization status

	Total number of patients	Number of users	Utilization proportion (%)
Before pilot: all patients	140	50	35.71
After pilot: pathway patients	142	34	23.94
After pilot: non-pathway patients	22	7	31.82

Table 5 Ambroxol hydrochloride injection per capita utilization status

	Per capita prescription volume	Per capita utilization days	Per capita cost (CNY)
Before pilot	27.68	6.06	380.84

After pilot: pathway patients	23.15	5.94	263.19
After pilot: non- pathway patients	15.43	3.71	171.72

B. Optional items

a) Antibiotics utilization status

In the pathway patients, the sum of utilization proportions of single antibiotic use and two antibiotics combined use was 94.36%; utilization proportion of three antibiotics combined use was 5.64%, which was significantly lower than the proportion before the pilot at 51.43% (Table 6). Per capita utilization cost and duration for antibiotics in the pathway patients was significantly than non-pathway patients and all patients before the pilot (Table 7).

The most expensive antibiotic of the four types – levofloxacin injection (55.52 CNY/dose) – decreased in utilization after the pilot implementation. Relatively cheaper drug –piperacillin tazobactam powder injection and penicillin powder injection – were commonly used both before and after the pilot (Figure 10).

Table 6 Antibiotics utilization status

	Total patients	Non-users (proportion)*	Single antibiotic users (proportion)*	2 antibiotics combined users (proportion)*	3 antibiotics combined users (proportion)*
Before pilot: all patients	140	0	7 (5.00%)	61 (43.57%)	72 (51.43%)
After pilot: pathway patients	142	0	55 (38.73%)	79 (55.63%)	8 (5.64%)
After pilot: non-pathway patients	22	4 (18.18%)	10 (45.45%)	5 (22.73%)	3 (13.64%)

*P<0.05

Table 7 Antibiotics utilization status per capita

	Per capita number of days using antibiotics *	Per capita cost of antibiotics (CNY)
Before pilot: all patients	5.71	864.88
After pilot: pathway patients	7.52	1573.06

After pilot: non-pathway patients	7.50	981.80

*P<0.05

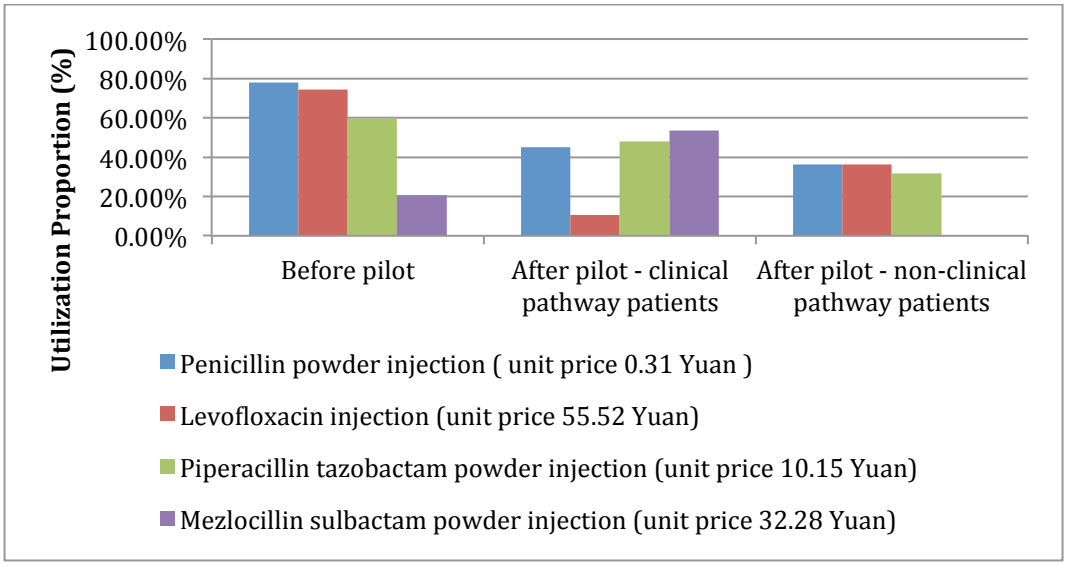

Figure 10 Utilization proportion of four types of antibiotics

b) Medical tests utilization status

After the pilot implementation, COPD patients' utilization proportion of chest CT, pulmonary ventilation function test and pulmonary diffusion function test decreased. The magnitude of change was more substantial in non-pathway patients, with the largest decline in pulmonary ventilation function test and pulmonary diffusion function test, where the utilization proportions reached close to zero (Tables 8 – 10).

Table 8 Chest CT utilization status

	Total number of patients	Number of users	Utilization proportion (%)*
Before pilot: all patients	140	96	68.57
After pilot: pathway patients	142	75	52.82
After pilot: non-pathway patients	22	8	36.36

*P<0.05

Table 9 Pulmonary ventilation function test utilization status

	Total number of patients	Number of users	Utilization proportion (%)*

Before pilot: all patients	140	51	36.43
After pilot: pathway patients	142	20	14.08
After pilot: non-pathway patients	22	2	0.09

*P<0.05

Table 10 Pulmonary diffusion function test utilization status

	Total number of patients	Number of users	Utilization proportion (%)*
Before pilot: all patients	140	48	34.29
After pilot: pathway patients	142	6	4.23
After pilot: non-pathway patients	22	1	0.05

*P<0.05

(2) Cerebral infarction

Mandatory items in cerebral infarction pathway for analysis were: thrombolytic drugs, antiplatelet drugs, statins, and brain imaging within 24 hours of hospitalization. Optional items included neurotrophic agents, MRI and oxygen therapy. Utilization proportions of both mandatory and optional items in the pathway patients increased compared to proportions before the pilot and compared to that of the non-pathway patients.

A. Mandatory items

Among the three types of mandatory drugs, utilization of thrombolytic drugs was relatively low before and after the pilot (Table 11). Utilization proportions of antiplatelet drugs and statins in the pathway patients were significantly higher than other groups.

Clinical pathway patients' utilization proportion of antiplatelet drugs was 94.96%, significantly higher than that of the non- pathway patients and patients before the pilot which were at 57.97% and 7.74% respectively (Table 12). The graph also shows that pathway patients' utilization of antiplatelet drugs significantly increased, and was higher than non- pathway patients' utilization (Figure 11).

Clinical pathway patients' utilization proportion of statins was 95.68%, significantly higher than that of non-pathway patients and patients before the pilot, which were at 79.71% and 24.40% respectively (Table 13). Evident from the graph, all patients' utilization of statins significantly increased, with the pathway patients' utilization increasing at a higher rate than the non-pathway patients' utilization (Figure 12).

Per capita cost and per capita number of days using antiplatelet drugs and statins slightly decreased after the pilot; pathway patients were higher on both of these measures than non-pathway patients (Table 14, 15).

Table 11 Thrombolytic drugs utilization status

	Total number of patients	Number of users	Utilization proportion (%)
Before pilot: all patients	91	0	0
After pilot: pathway patients	131	4	3.05
After pilot: non-pathway patients	85	0	0

*P<0.05

Table 12 Antiplatelet drugs utilization status

	Total number of patients	Number of users	Utilization proportion (%)*
Before pilot: all patients	168	13	7.74
After pilot: pathway patients	139	132	94.96
After pilot: non-pathway patients	138	80	57.97

*P<0.05

Table 13 Stains utilization status

	Total number of patients	Number of users	Utilization proportion (%)*
Before pilot: all patients	168	41	24.40
After pilot: pathway patients	139	133	95.68
After pilot: non-pathway patients	138	110	79.71

*P<0.05

Table 14 Antiplatelet drugs per capita utilization status

	Per capita utilization days*	Per capita cost (CNY)*
Before pilot: all patients	9.69	89.60
After pilot: pathway patients	9.47	75.19
After pilot: non-pathway patients	7.16	39.44

*P<0.05

Table 15 Statins per capita utilization status

	Per capita utilization days*	Per capita cost (CNY)
Before pilot: all patients	10.80	107.07
After pilot: pathway patients	9.95	109.67
After pilot: non-pathway patients	6.88	111.20

*P<0.05

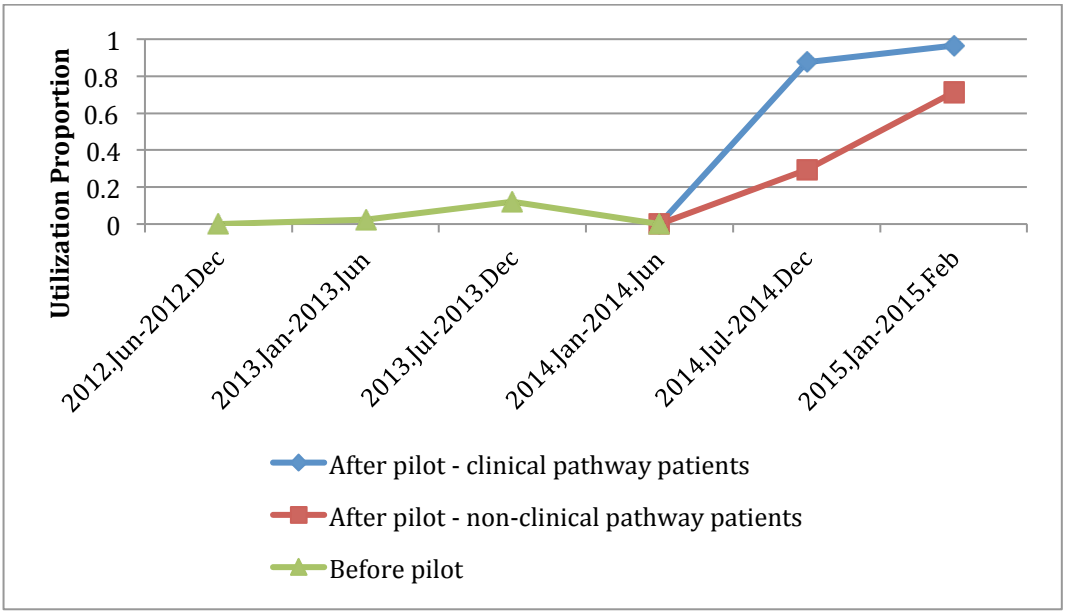

Figure 11 Utilization proportions of antiplatelet drugs before and after pilot (every 6 months)

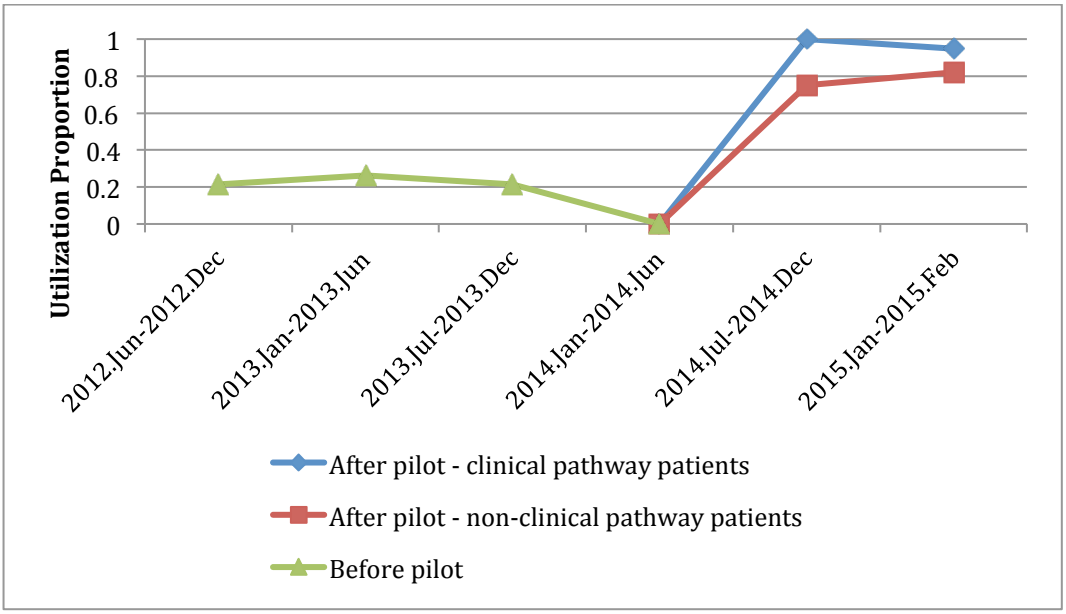

Figure 12 Utilization proportions of statins before and after pilot (every 6 months)

a) Antiplatelet utilization status

The most opted options of antiplatelet drugs were aspirin and clopidogrel. Care pathway patients' utilization proportion of antiplatelet drugs was significantly higher than the proportion before the pilot and the proportion in the non-pathway patients. Care pathway patients' utilization proportion of aspirin and clopidogrel were 76.98% and 50.36% respectively (Figure 13).

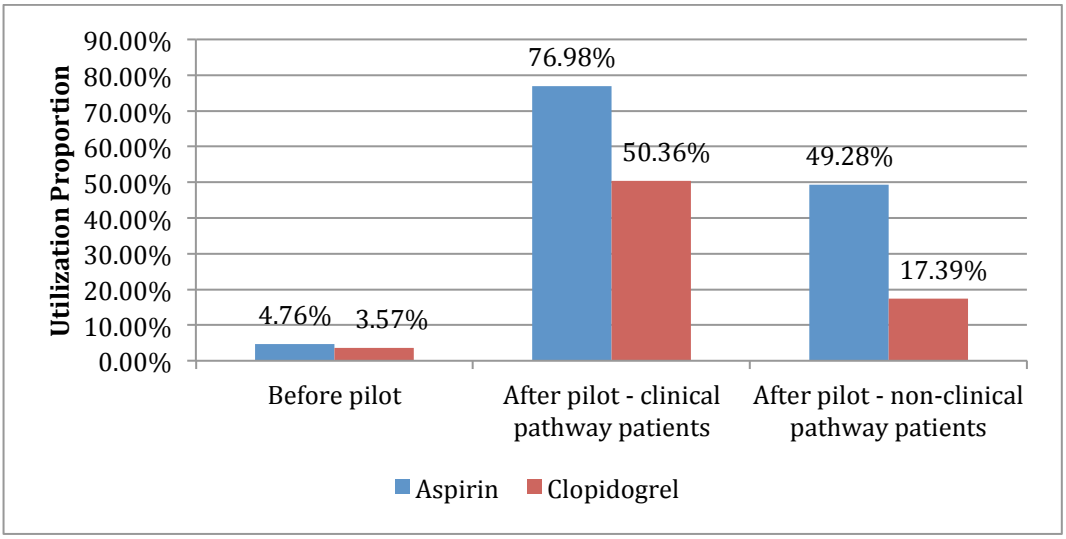

Figure 13 Antiplatelet drugs utilization status

b) CT/MRI utilization within 24 hours

According to the <Clinical Practice Guidelines - Neurology Volume> (Edited by the Chinese Medical Association, People's Health Publishing House), acute cerebral infarction patients should undergo brain-imaging tests within 24 hours of hospitalization. After pilot implementation, the proportion of the pathway patients receiving CT or MRI tests within 24 hours of hospitalization was 89.93%, significantly higher than the proportions of both before the pilot and of the non-pathway patients, which were at 58.93% and 68.12% respectively (Table 16). Among the patients who underwent brain imaging within 24 hours, more patients used MRI than CT. After pilot implementation, the pathway patients' utilization proportion of MRI (76.98%) was higher at 76.98% than the proportions of those before the pilot and of the non-pathway patients, which were at 30.95% and38.41% respectively (Figure 14).

Table 16 Cerebral infarction patients' utilization of CT/MRI tests within 24 hours of hospitalization.

	Total patients	Users	Utilization proportion (%) of CT/MRI within 24 hours*
Before pilot: all patients	168	142	58.93
After pilot: pathway patients	139	134	89.93
After pilot: non-pathway patients	138	107	68.12

*P<0.05

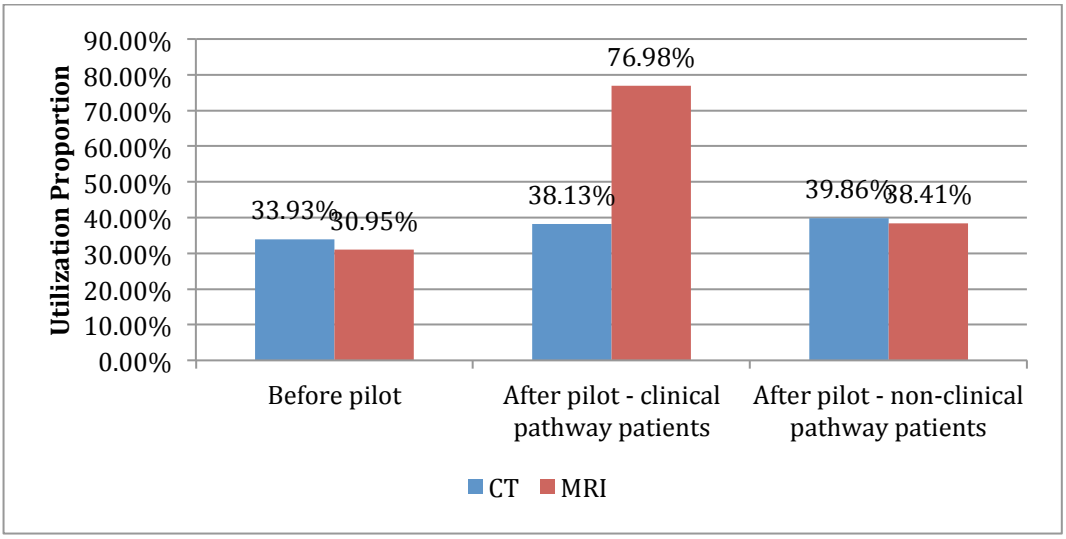

Figure 14 Utilization of brain imaging tests within 24 hours

B. Optional items

a) Neurotrophic agents utilization

After the pilot implementation, the pathway patients' utilization proportion of neurotrophic agents was 98.56%, significantly higher than that of patients before the pilot and of the non-pathway patients, which were at 20.83% and 31.16% respectively (Table 17). After the pilot implementation, the pathway patients' per capita utilization duration (8.59 days) was significantly lower than patients before the pilot (13.23 days) but higher than their non-pathway counterparts (5.79 days). The average cost for pathway patients (1,518.11 CNY) was significantly higher than the cost before the pilot and the cost for the non-pathway patients, which were at 1,390.46 CNY and 776.63 CNY respectively (Table 18). Among the pathway patients, the two types of neurotrophic agents used were Piracetam injection and Oxiracetam, with the utilization proportions at 63.31% and 69.78% respectively (Figure 15).

Table 17 Neurotrophic agents' utilization status

	Total patients	Number of users	Utilization proportion (%)*
Before pilot: all patients	168	35	20.83
After pilot: pathway patients	139	137	98.56
After pilot: non-pathway patients	138	43	31.16

*P<0.05

Table 18 Neurotrophic agents' per capita utilization status

	Per capita utilization duration (days)*	Per capita cost (CNY)*
Before pilot: all patients	13.23	1,390.46
After pilot: pathway patients	8.59	1,518.11
After pilot: non-pathway patients	5.79	776.63

*P<0.05

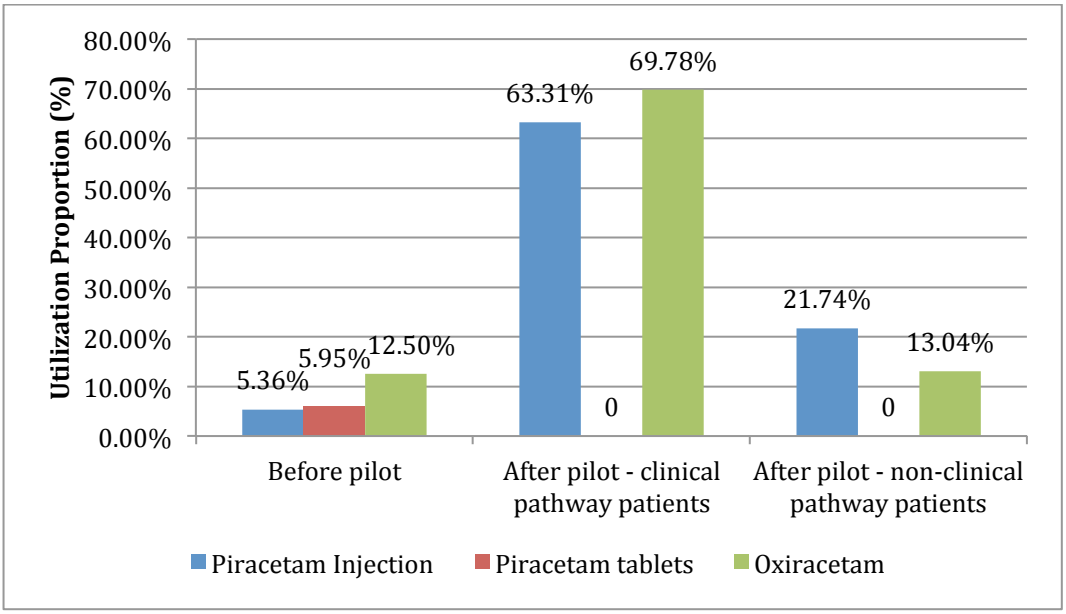

Figure 15 Utilization of three types of neurotrophic agents

b) MRI utilization

The pathway patients' utilization proportion of MRI was 89.21%, significantly higher than patients before the pilot (50.00%) and their non-pathway counterparts, both at 50.00% utilization proportion (Table 19). The average use of MRI among the pathway patients was 1.90 times per person, significantly higher than patients before the pilot and their non-pathway counterparts, at 1.44 and 1.61 times per person (Table 20).

Table 19 MRI utilization status

	Total number of patients	Number of users	Utilization proportion (%)*
Before pilot: all patients	168	84	50.00
After pilot: pathway patients	139	124	89.21
After pilot: non-pathway patients	138	69	50.00

*P<0.05

Table 20 MRI per capita utilization status

	Per capita utilization volume*	Per capita cost (CNY)*
Before pilot: all patients	1.44	1,090.48
After pilot: pathway patients	1.90	1,330.24
After pilot: non-pathway patients	1.61	1,159.42

*P<0.05

c) Oxygen utilization

The utilization proportion of oxygen among the pathway patients was 82.73%, significantly higher than patients before the pilot and the non-pathway patients, which were close to 56% (Table 21). The average oxygen utilization and cost significantly decreased compared to before the pilot; after the pilot implementation, the average oxygen utilization and cost higher in the pathway patients than the non-pathway patients (Table 22).

Table 21 Oxygen utilization status

	Total number of patients	Number of users	Utilization proportion (%)*
Before pilot: all patients	168	94	55.95
After pilot: pathway patients	139	115	82.73
After pilot: non-pathway patients	138	77	55.80

*P<0.05

Table 22 Oxygen per capita utilization status

	Per capita utilization volume *	Per capita cost (CNY)*
Before pilot: all patients	303.51	607.02
After pilot: pathway patients	186.52	373.04
After pilot: non-pathway patients	167.65	335.30

*P<0.05

4. Healthcare expenditure

(1) Total hospitalization cost

After the pilot, the average hospitalization costs for cerebral hemorrhage and TIA patients decreased compared to costs before the pilot; but the magnitude was small, each decreasing by 33.19 CNY and 281.08 CNY respectively. The average hospitalization costs for COPD and cerebral infarction patients increased after the pilot; magnitude of increase was the greatest for COPD at 2,486.97 CNY. After the pilot, the variability in COPD, TIA and cerebral hemorrhage total costs was less than before the pilot, with cerebral hemorrhage having the most noticeable change. Variability in the cerebral infarction total costs was greater after the pilot implementation than before (Figure 16). The total costs for the pathway patients were higher than non-pathway patients, but with less variability (Figure 17).

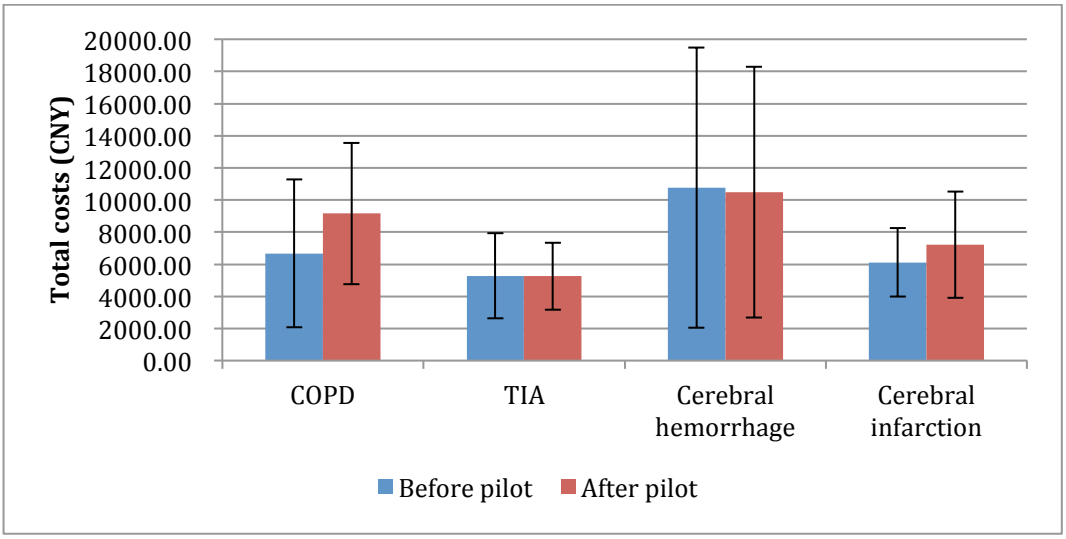

Figure 16 Variation in total costs of four diseases before and after pilot

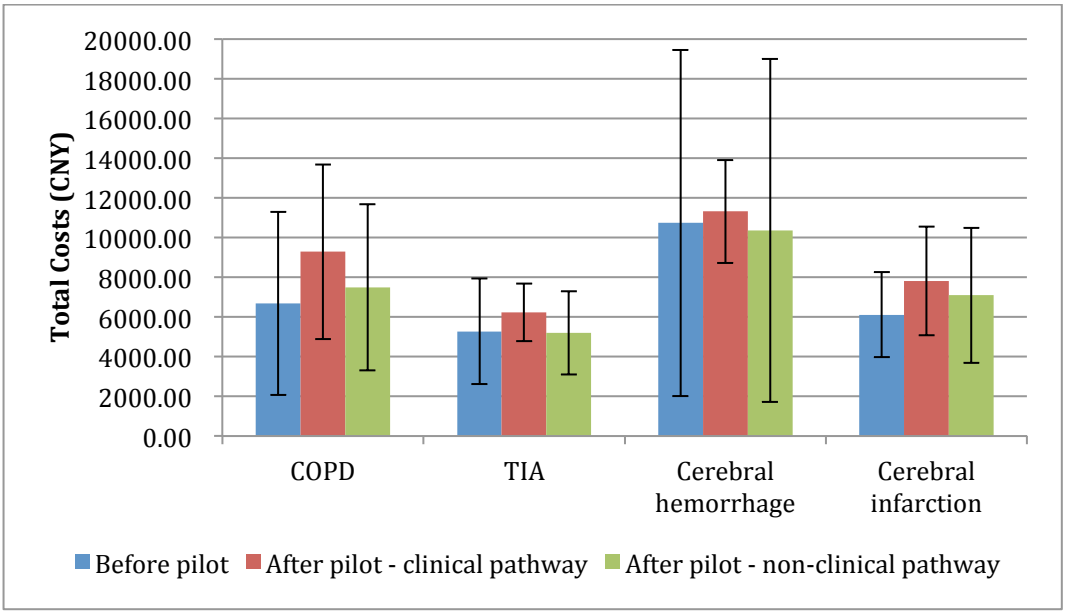

Figure 17 Variation in total costs of four diseases by pathway status before and after pilot

(2) **Healthcare costs of the four diseases**

A. COPD

The COPD patients' average total hospitalization cost after the pilot was 9,164.57 CNY, increasing from 6,677.61 CNY before the pilot to yield a difference of 2,486.97 CNY ($P<0.05$). Among the five cost categories, cost differences in three categories were statistically significant. Drug costs and lab test fees significantly increased after the pilot, each increasing by 1,255.88 CNY and 920.54 CNY respectively (Table 23, Figure 18). Costs for pathway patients were higher than non-pathway patients in all cost categories; among them, the differences in drug costs and lab fees were the largest (Table 23, Figure 19).

Table 23 COPD patients' healthcare costs (CNY) by categories before and after pilot

Category	Before pilot: All patients (n=555)	After pilot: All patients (n=236)	After pilot: Pathway patients (n=219)	After pilot: Non-pathway patients (n=17)
Total cost	6,677.61 ± 4,620.70	9,164.57 ± 4,406.54*	9,293.65 ± 4,405.74	7,501.67 ± 4,190.57*
Drug cost	3,243.69 ± 2,770.23	4,499.57 ± 2,530.52*	4,573.71 ± 2,526.99	3,544.44 ± 2,450.06*
Lab test	1,419.77 ± 788.63	2,340.31 ±	2,366.13 ± 851.55	2,007.71 ± 631.82*

fee		841.71*		
Ultrasound cost	65.53 ± 110.93	79.49 ± 128.93	83.84 ± 131.53	23.53 ± 69.73*
CT cost	212.96 ± 230.32	166.17 ± 187.72	174.96 ± 189.44	52.94 ± 117.89*
Materials cost	419.49 ± 404.85	553.25 ± 346.36*	558.95 ± 352.79	479.75 ± 244.97*

*P<0.05

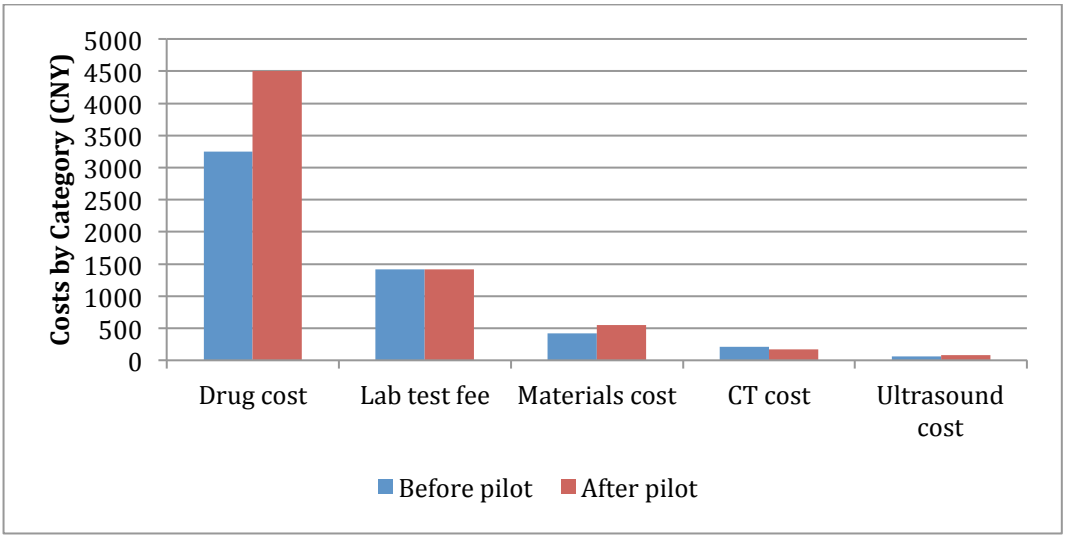

Figure 18 COPD patients' costs (CNY) by category before and after pilot

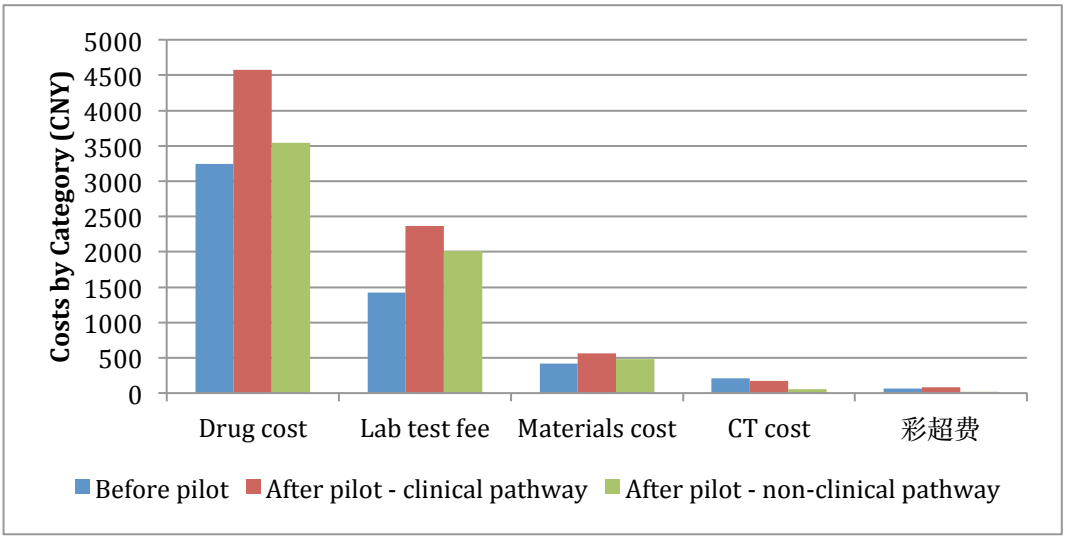

Figure 19 COPD patients' category costs by pathway status before and after pilot

Monthly trends in the average hospitalization cost showed an increasing trend both before and after pilot, with a faster rate of increase after the pilot, but the difference was not statistically significant (Table 24, 25). There were large fluctuations in hospitalization

costs. All patients' hospitalization costs after the pilot implementation ranged between 5,000 and 10,000 CNY and showed a slightly increasing trend (Figure 20). Pathway patients' costs ranged between 4,000 and 9,000 CNY with a slightly increasing trend (Figure 21); however, interrupted time series (ITS) analysis results showed that the differences in trends were not statistically significant (Table 24, 25).

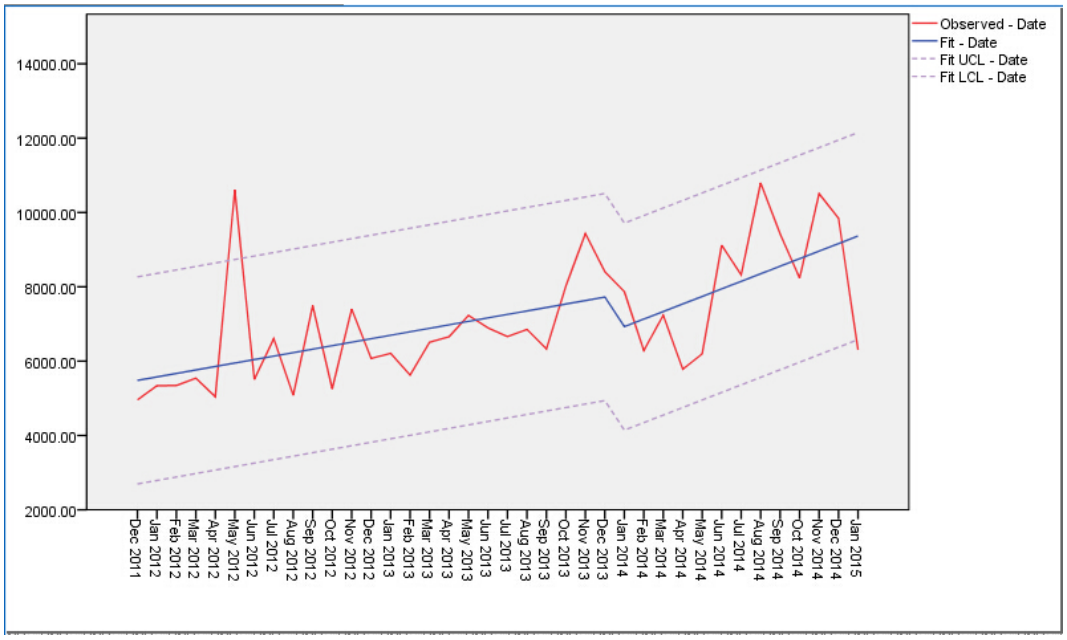

Figure 20 ITS results of COPD total costs, before vs. after pilot implementation, 2011 – 2015

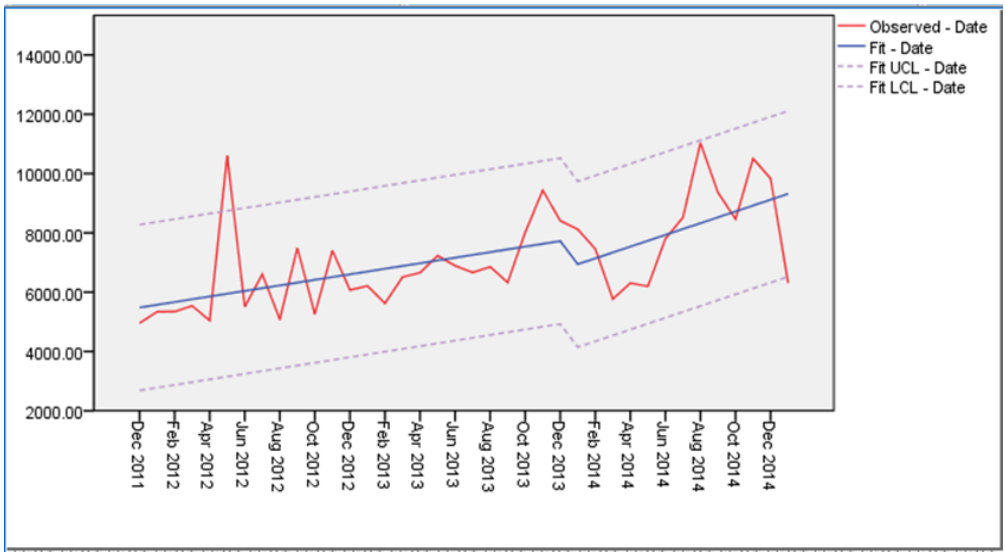

Figure 21 ITS analysis of COPD total costs, before-pilot patients vs. after-pilot pathway patients, 2011 – 2015

Table 24 ITS analysis of COPD total costs, before vs. after pilot implementation, 2011 – 2015

Index	Estimates	Standard Deviation	t Value	P Value
Constant	5388.683	565.094	9.536	.000
Slope – before pilot	93.436	38.012	2.458	.019
Intercept difference before and after pilot	-3738.427	3321.521	-1.126	.268
Slope difference before and after pilot	109.605	108.471	1.010	.319

Table 25 ITS analysis of COPD total costs, before-pilot patients vs. after-pilot pathway patients, 2011 – 2015

Index	Estimates	Standard Deviation	t Value	P Value
Constant	5388.683	567.134	9.502	.000
Slope – before pilot	93.436	38.150	2.449	.020
Intercept difference before and after pilot	-3589.057	3333.514	-1.077	.289
Slope difference before and after pilot	104.375	108.862	.959	.344

B. TIA

TIA patients' total hospitalization cost after the pilot was 5,247.00 CNY, which decreased from 6,280.19 CNY before the pilot. The difference of 1,033.19 CNY before and after the pilot implementation was not statistically significant. Out of the five cost categories, differences in three categories were statistically significant. Drug cost and ultrasound cost decreased by 415.45 CNY and 61.18 CNY respectively; and lab test fee increased by 165.64 CNY (Table 26, Figure 22). Pathway patients' drug cost was higher than that of non-pathway patients; for all other cost categories, pathway patients' costs were equal to or lower than the non-pathway patients' costs (Table 26, Figure 23).

Table 26 TIA patients' costs (CNY) by categories before and after pilot

Category	Before pilot: All patients (n=675)	After pilot: All patients (n=773)	After pilot: Pathway patients (n=40)	After pilot: Non-pathway patients (n=733)

Total cost	6,280.19 ± 2,657.62	5,247.00 ± 2,078.62	6,236.98 ± 1,452.35*	5,192.98 ± 2,094.73*
Drug cost	2,965.20 ± 1,618.76*	2,549.75 ± 1,356.57	2,853.00 ± 973.68*	2,533.20 ± 1,372.96*
Lab test fee	688.03 ± 329.69*	853.67 ± 383.94	853.28 ± 439.96*	853.70 ± 381.05*
Ultrasound cost	256.93 ± 237.70*	195.75 ± 193.10	206.98 ± 170.07*	195.14 ± 194.37*
CT cost	192.03 ± 269.44	201.77 ± 292.56	165.88 ± 227.97	203.73 ± 295.68
Materials cost	154.93 ± 805.10	132.20 ± 164.77	106.26 ± 93.71	133.61 ± 167.71

* P<0.05

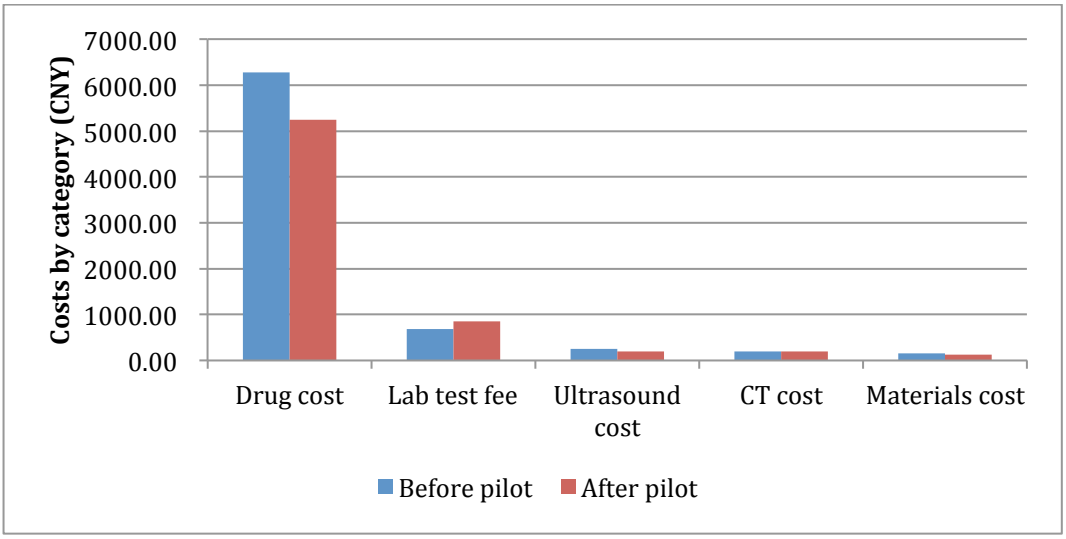

Figure 22 TIA patients' costs by categories before and after pilot

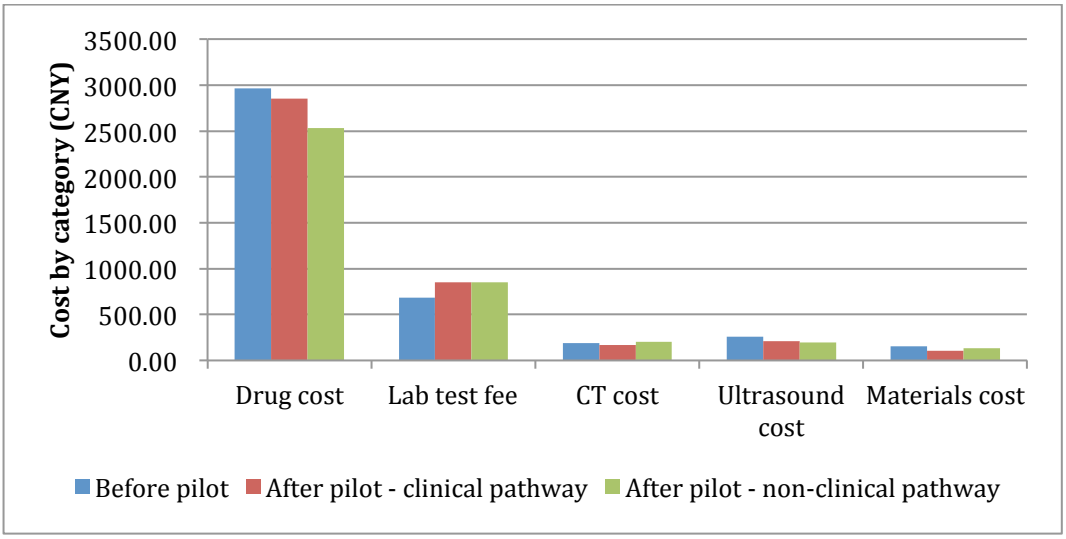

Figure 23 TIA patients' category costs (CNY) by pathway status before and after pilot

Monthly trends in the average hospitalization costs showed that before the pilot, patients' average hospitalization costs fluctuated between 3,000 and 7,000 CNY; afterwards, monthly fluctuations decreased. Costs for all patients after the pilot implementation also fluctuated between 3,000 and 7,000 CNY and showed a slight decreasing trend (Figure 24). However, ITS results showed that the differences in trends were not statistically significant (Table 27).

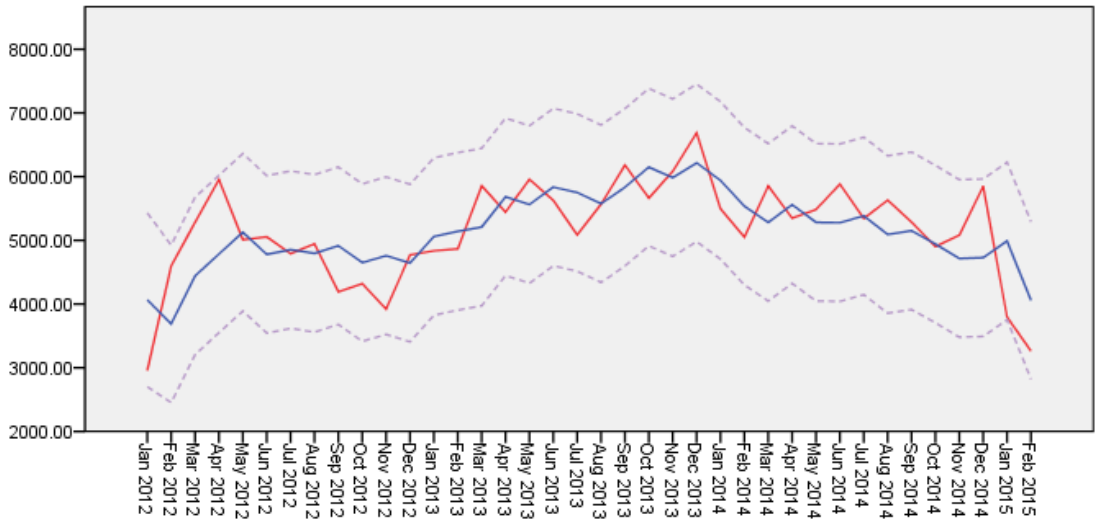

Figure 24 ITS analysis of TIA total costs, before vs. after pilot implementation, 2011 – 2015

Table 27 ITS analysis of TIA total costs, before vs. after pilot implementation, 2011 – 2015

Index	Estimates	Standard Deviation	t Value	P Value
Constant	3971.684	413.105	9.614	0.000
Slope – before pilot	94.706	28.491	3.324	0.002
Intercept difference before and after pilot	4522.975	1960.481	2.307	0.027
Slope difference before and after pilot	-204.322	69.918	-2.922	0.006

C. Cerebral hemorrhage

Cerebral hemorrhage patients' average hospitalization cost after the pilot implementation was 10,484.63 CNY, which decreased from 10,765.71 CNY before the pilot. The difference of 281.08 CNY was not statistically significant. Difference in all six cost categories had no statistical significance. Drug cost, CT cost and oxygen cost decreased when comparing before and after pilot costs; whereas lab test fee increased (Table 28, Figure 25). The pathway patients' average drug cost, CT cost and ultrasound cost were higher than that of the non-pathway patients (P<0.05). The other cost categories for the pathway patients were equal to or lower than the non-pathway patients (Table 28, Figure 26).

Table 28 Cerebral hemorrhage patients' costs by category (CNY) before and after pilot

Category	Before pilot: All patients (n=304)	After pilot: All patients (n=123)	After pilot: Pathway patients (n=25)	After pilot: Non-pathway patients (n=97）
Total	10,765.71 ± 8,718.07	10,484.63 ± 7,803.82	11,319.36 ± 2,596.17	10,367.63 ± 8,647.45
Drug	5,919.12 ± 4,815.79	5,030.82 ± 3,974.84	5,542.26 ± 1,516.65	4,946.57 ± 4,387.87
Lab test	947.19 ± 688.88	1,044.17 ± 563.96	974.82 ± 331.91	1,061.69 ± 612.85
Ultrasound	35.79 ± 112.48	49.50 ± 116.96	114.76 ± 130.83*	33.20 ± 108.18*
CT	596.50 ± 459.81	570.19 ± 446.31	828.10 ± 375.93	514.75 ± 449.29
Materials	1011.35 ± 914.60	993.86 ± 854.61	981.04 ± 544.66	1003.28 ± 920.45
Oxygen	529.47 ± 467.97	497.24 ± 457.34	464.20 ± 307.44	507.39 ± 491.75

* P<0.05

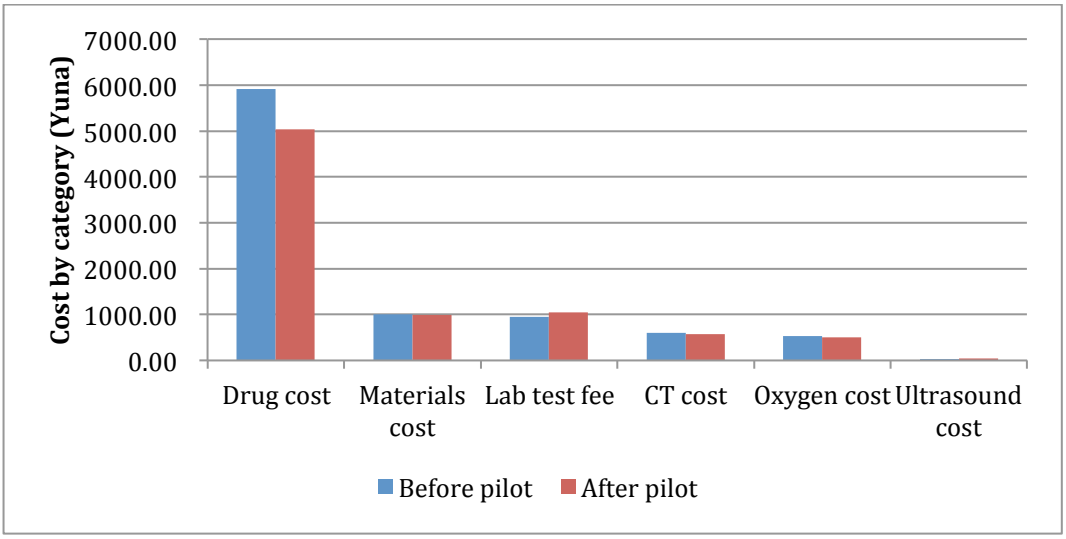

Figure 25 Cerebral hemorrhage patients' costs by category (CNY) before and after pilot

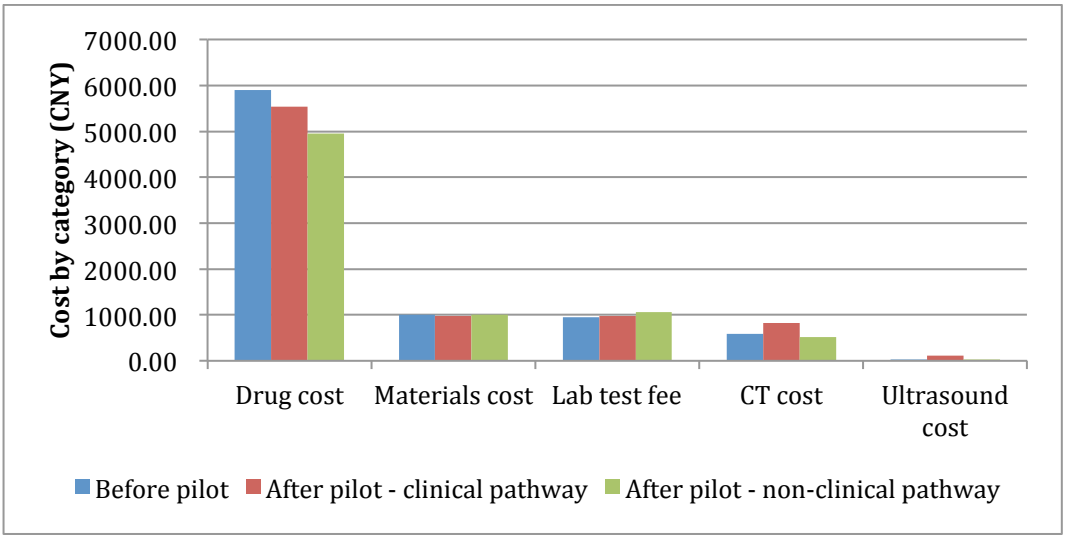

Figure 26 Cerebral hemorrhage patients' category costs (CNY) by pathway status before and after pilot

D. Cerebral infarction

Cerebral infarction patients' average hospitalization cost was 7,214.74 CNY, which increased by 1,095.16 CNY compared to the cost before the pilot (6,119.58 CNY); but the difference was not statistically significant. Difference in other five cost categories also had no statistical significance. Drug cost, lab test fee and materials cost increased; ultrasound cost and CT cost decreased (Table 29, Figure 27). The pathway patients' total hospitalization cost ($P<0.05$), drug cost ($P<0.05$), CT cost and ultrasound cost were higher than the non-pathway patients' costs. The other cost categories of clinical

pathway patients were equal to or lower than that of the non-pathway patients (Table 29, Figure 28).

Table 29 Cerebral infarction patients' costs by category (CNY) before and after pilot

Category	Before pilot: All patients (n=18)	After pilot: All patients (n=1,119)	After pilot: Pathway patients (n=192)	After pilot: Non-pathway patients (n=927)
Total	6,119.58 ± 2,140.07	7,214.74 ± 3,307.63	7,809.75 ± 2,729.32*	7,091.50 ± 3,403.49*
Drug	3,517.24 ± 1,395.28	3,702.69 ± 1,909.37	4,010.81 ± 1,584.87*	3,638.87 ± 1,964.62*
Lab test	735.02 ± 239.01	890.36 ± 430.23	771.74 ± 294.20*	914.92 ± 449.56*
Ultrasound	207.22 ± 226.40	198.04 ± 197.45	211.67 ± 182.98	195.22 ± 200.29
CT	247.78 ± 333.74	222.67 ± 294.55	195.88 ± 250.83	228.22 ± 302.64
Materials	220.55 ± 210.92	384.98 ± 402.80	384.87 ± 317.81	385.00 ± 418.39

* P<0.05

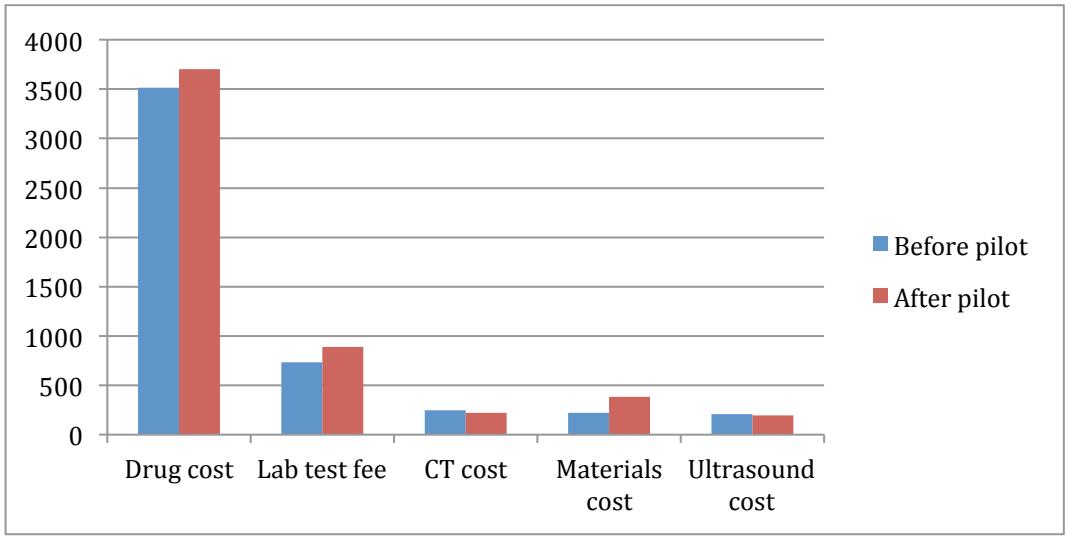

Figure 27 Cerebral infarction patients' costs by category before and after pilot

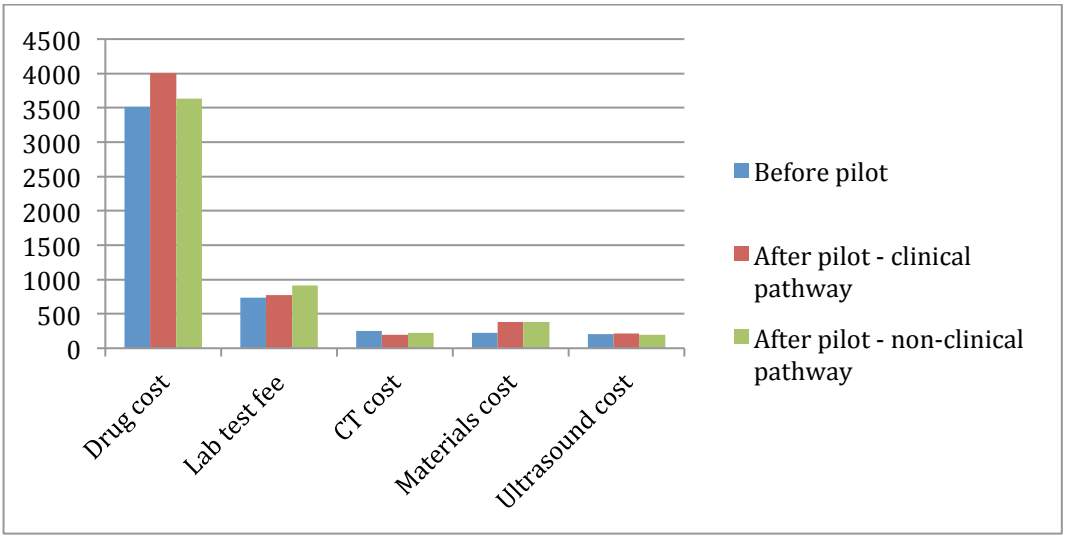

Figure 28 Cerebral infarction patients' category costs (CNY) by pathway status before and after pilot

Monthly trends in average hospitalization costs revealed that the patients' average hospitalization costs before the pilot widely fluctuated between 2,200 and 10,000 CNY and showed an increasing trend. Total hospitalization costs increased after the pilot, but showed a decreasing trend; however, the trend was not statistically significant. Furthermore, the monthly fluctuations in the total hospitalization costs decreased after the pilot (Table 30, Figure 29), but ITS results showed that the trend had no statistical significance.

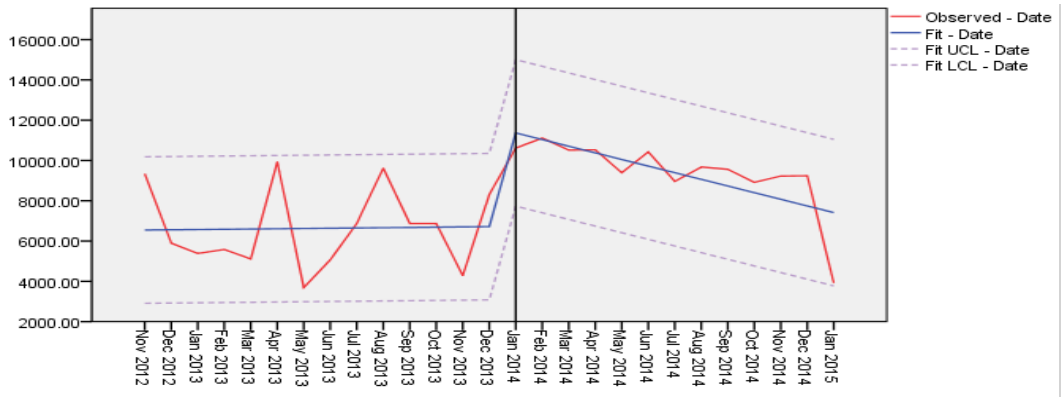

Figure 29 ITS analysis of cerebral infarction total costs, before-pilot patients vs. after-pilot pathway patients, 2011 – 2015

Table 30 ITS analysis of cerebral infarction total costs, before-pilot patients vs. after-pilot pathway patients, 2011 – 2015

Index	Estimates	Standard	t Value	P Value

		Deviation		
Constant	6533.263	992.357	6.584	0.000
Slope – before pilot	12.998	116.546	0.112	0.912
Intercept difference before and after pilot	9781.699	2951.296	3.314	0.003
Slope difference before and after pilot	-342.711	174.820	-1.960	0.062

(3) Proportion of out-of-pocket (OOP) payment

Before the pilot, out-of-pocket (OOP) payment proportion of the four diseases was 51.05%. After the pilot, patients' OOP proportion was 29.14%, a decrease of 21.91% (P<0.05). The pathway patients' OOP proportion was 24.59%, which was significantly lower than that the proportions of the non-pathway patients (30.48%) and of patients before the pilot (Table 31). Long-term trends showed that the OOP proportion of patients of the four diseases before the pilot showed a decreasing trend; after the pilot implementation, patients' OOP proportion still showed decreasing trend, but the rate of decrease was slower than before the pilot (Figure 30, 31). ITS analysis results showed that this trend was statistically significant (Table 32, 33).

Table 31 All patients' OOP proportions before and after pilot

Group	Total number of patients	OOP proportion*
Before pilot: All patients	1,332	51.05 ± 31.21
After pilot: All patients	2,006	29.14 ± 13.81
After patient: Pathway patients	456	24.59 ± 12.89
After patient: Non-pathway patients	1,550	30.48 ± 13.79

*P<0.05

Table 32 ITS analysis of OOP proportions before and after pilot

Index	Estimates	Standard Deviation	t Value	P Value
Constant	0.860	0.040	21.362	0.000
Slope – before pilot	-0.592	0.216	-2.746	0.009
Intercept difference before and after pilot	-0.025	0.003	-9.167	0.000
Slope difference before	0.026	0.007	3.696	0.001

and after pilot

Table 33 ITS analysis of OOP proportions, before-pilot patients vs. pathway patients

Index	Estimates	Standard Deviation	t Value	P Value
Constant	0.860	0.042	20.507	0.000
Slope – before pilot	-0.627	0.225	-2.791	0.008
Intercept difference before and after pilot	-0.025	0.003	-8.800	0.000
Slope difference before and after pilot	0.026	0.007	3.590	0.001

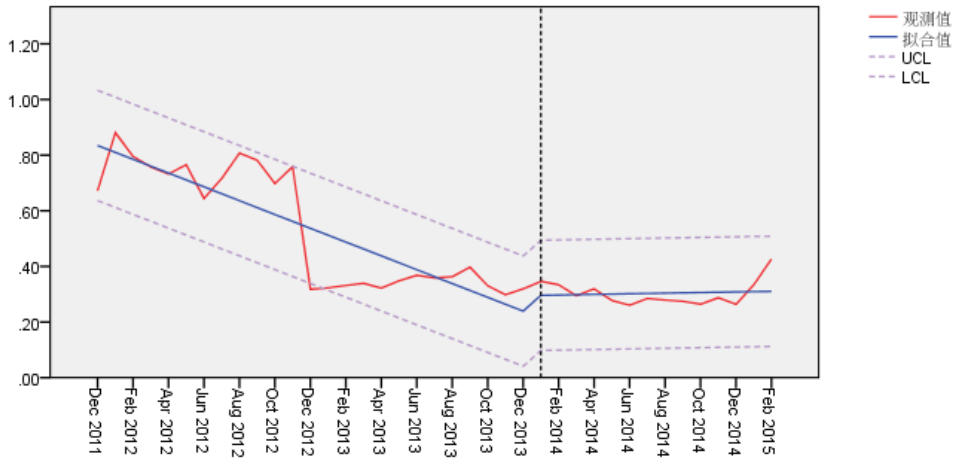

Figure 30 ITS analysis of OOP proportions, before vs. after pilot implementation

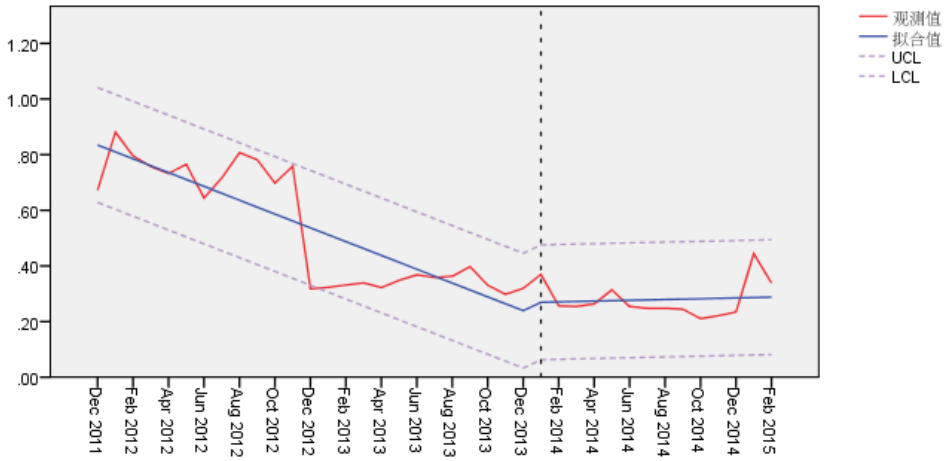

Figure 31 ITS analysis of OOP proportions, before-pilot patients vs. after-pilot pathway patients

(4) Proportion of drug cost

Before the pilot, drug cost accounted for 51.80% of the total cost. After the pilot, it dropped to 47.98%, yielding a decrease of 3.82% (P<0.05). Among the pathway patients, drug cost proportion was 49.16%, which was significantly lower than proportion before the pilot, but higher than the non-pathway patients' proportion of 47.66% (Table 31). Long-term trends showed that the drug cost proportion showed a decreasing trend before the pilot; afterwards, the rate of decrease was faster (Figure 32, 33). ITS analysis results showed that this trend was statistically significant (Table 32, 33).

Table 31 All patients' drug cost proportions before and after pilot

Group	Total number of patients	Drug cost proportion (%)*
Before pilot: All patients	1,541	51.80 ± 11.61
After pilot: All patients	2,166	47.98 ± 11.27
After pilot: Pathway patients	469	49.16 ± 8.20
After pilot: Non-pathway patients	1,697	47.66 ± 11.96

*P<0.05

Table 32 ITS analysis of drug cost proportions, before vs. after pilot

Index	Estimates	Standard Deviation	T Value	P Value
Constant	0.58	0.01	46.54	0.00
Slope – before pilot	0.00	0.00	-5.20	0.00
Intercept difference before and after pilot	0.19	0.07	2.81	0.01
Slope difference before and after pilot	-0.01	0.00	-2.27	0.03

Table 33 ITS analysis of drug cost proportions, before-pilot patients vs. after-pilot pathway patients

Index	Estimates	Standard Deviation	T Value	P Value
Constant	0.58	0.01	44.93	0.00
Slope – before pilot	0.00	0.00	-5.06	0.00
Intercept difference before and after pilot	0.14	0.07	1.96	0.06
Slope difference before and after pilot	0.00	0.00	-1.56	0.13

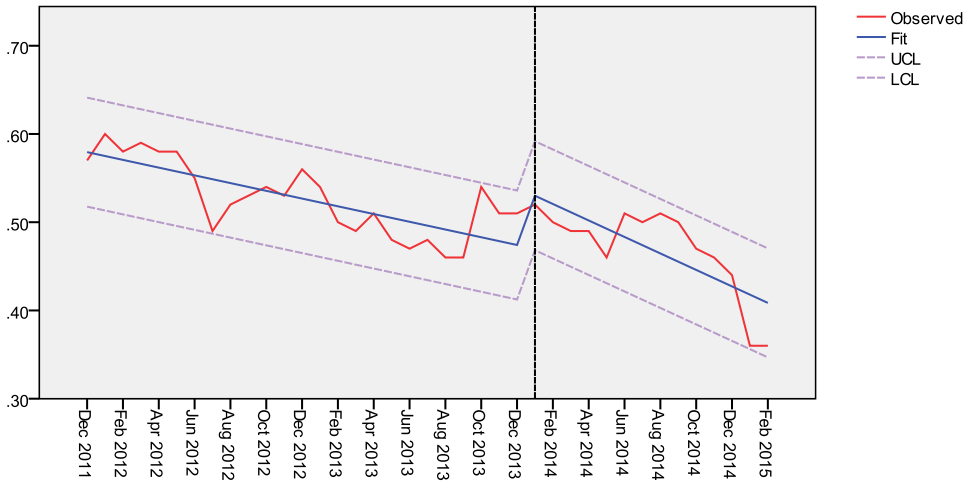

Figure 32 ITS analysis of drug cost proportions, before vs. after pilot

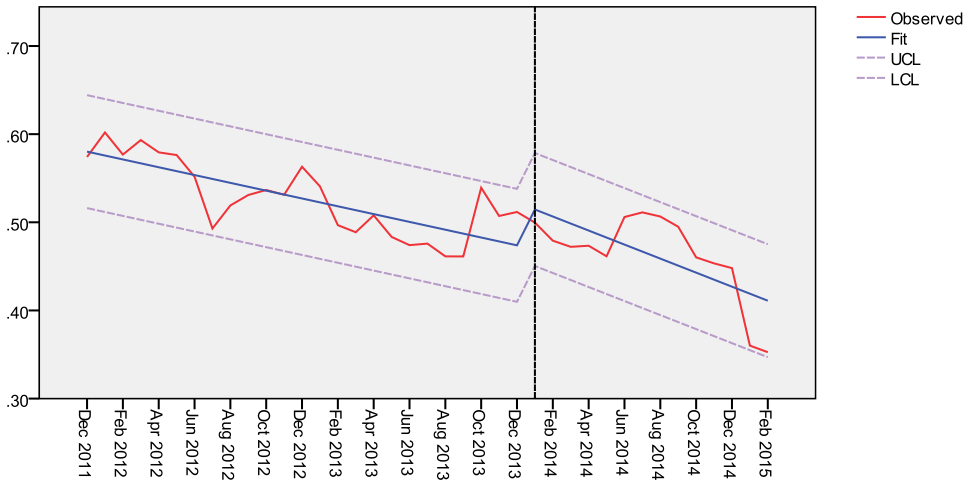

Figure 33 ITS analysis of drug cost proportions, before-pilot patients vs. after-pilot pathway patients

(5) **Proportion of examination and lab test fee**

For all patients before pilot, the proportion of examination and lab test fees from the total cost was 23.59% (fees include lab tests costs, CT costs and ultrasound costs). The proportion decreased to 22.91% after the implementation, showing a decrease of 0.68%. Among the pathway patients after the pilot, the test fee proportion was 22.13%, which was lower than that before the pilot and that of the non-pathway patients (23.12%); both differences were not statistically significant (Table 34). Long-term trends showed that before the pilot, patients' test fee proportion was at an increasing trend; after the pilot implementation, the increasing trend persisted but the rate of increase was slower (Figure 34, 35). ITS results showed that this trend was statistically significant, but the intercept change was not statistically significant (Table 35, 36).

Table 34 All patients' examination and lab test fee proportions, before and after pilot

Group	Total number of patients	Exam fee proportion (%)
Before pilot: All patients	1,546	23.59 ± 11.72
After pilot: All patients	2,215	22.91 ± 11.76
After pilot: Pathway patients	475	22.13 ± 11.34
After pilot: Non-pathway patients	1,740	23.12 ± 11.86

Table 35 ITS analysis of examination and lab test fee proportions, before vs. after pilot

Index	Estimates	Standard Deviation	T Value	P Value
Constant	0.16	0.01	13.59	0.00
Slope – before pilot	0.01	0.00	5.99	0.00
Intercept difference before and after pilot	0.07	0.06	1.08	0.29
Slope difference before and after pilot	-0.01	0.00	-2.38	0.02

Table 36 ITS analysis of examination and lab test fee proportions, before-pilot patients vs. after-pilot pathway patients

Index	Estimates	Standard Deviation	T Value	P Value
Constant	0.16	0.02	10.83	0.00
Slope – before pilot	0.01	0.00	4.77	0.00
Intercept difference before and after pilot	0.16	0.08	1.96	0.06
Slope difference before and after pilot	-0.01	0.00	-3.03	0.01

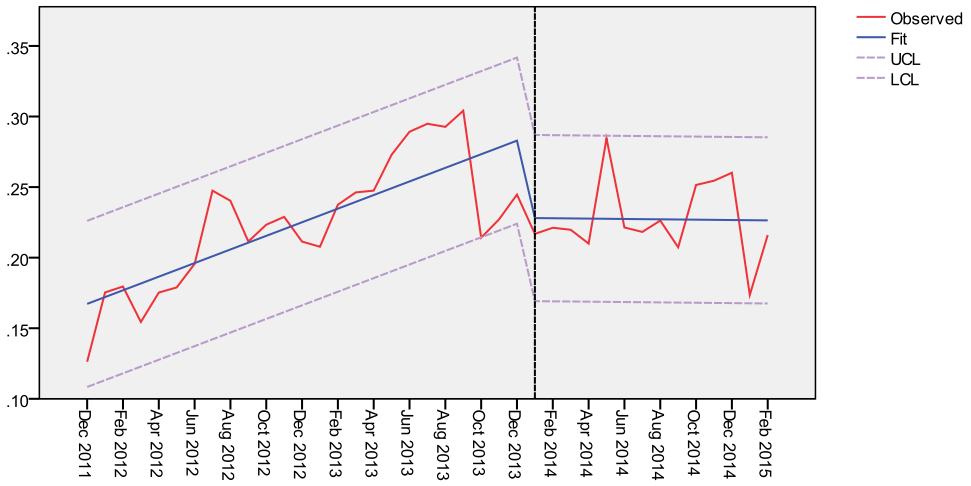

Figure 34 ITS analysis of examination and lab test fee proportions, before vs. after pilot

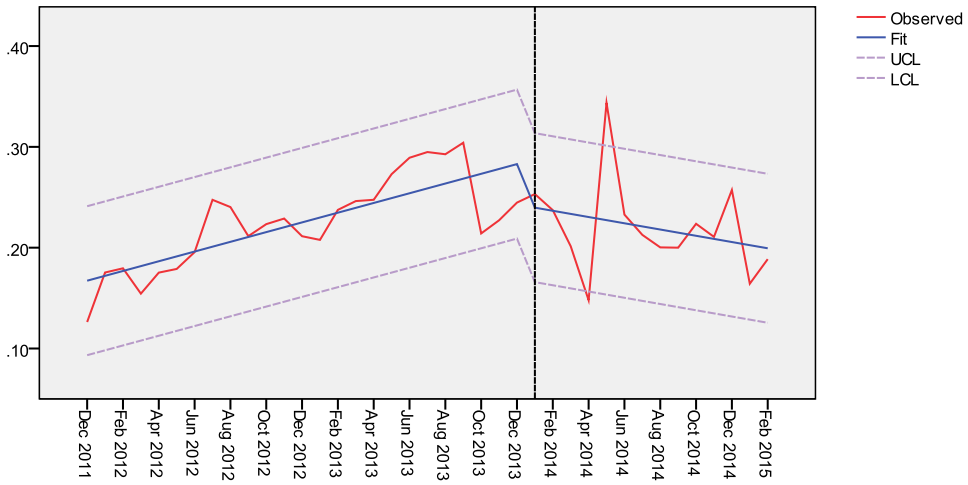

Figure 35 ITS analysis of examination and lab test fee proportions, before-pilot patients vs. after-pilot pathway patients

5. Healthcare efficiency

The average lengths of hospitalization of the four pilot diseases were all within the required standards. Among them, TIA and cerebral hemorrhage patients' average length of hospitalization decreased after the pilot, but the magnitude was minimal (0.48 and 0.81 days respectively). COPD and cerebral infarction patients' average lengths of hospitalization slightly increased after the pilot by 0.41 and 0.49 days respectively, but the differences were not statistically significant (Figure 36). Pathway patients' average length of hospitalization was higher than that of non-pathway patients; the differences were largest for TIA and cerebral hemorrhage pathway vs. non-pathway patients, but they were not statistically significant (Figure 37).

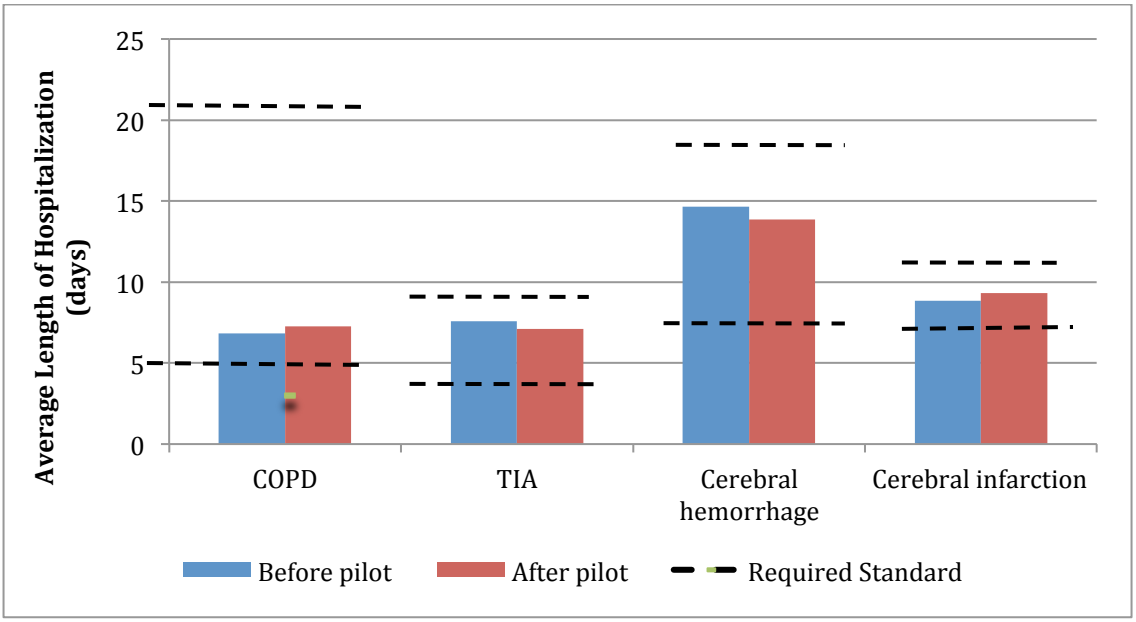

Figure 36 Average length of hospitalization for four pilot diseases before and after pilot

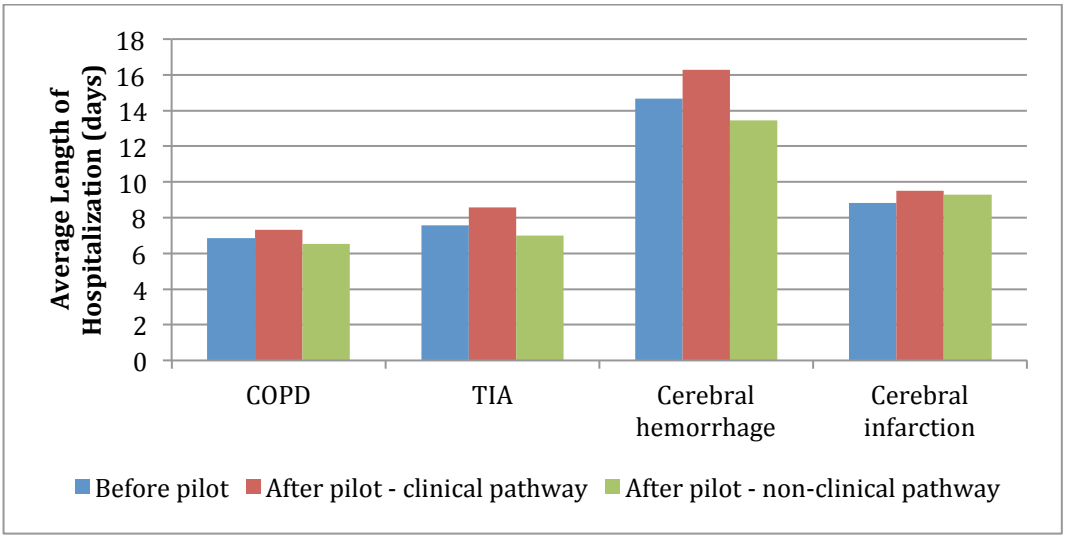

Figure 37 Average length of hospitalization for four pilot diseases by pathway status before and after pilot

(1) COPD

Before the pilot, COPD patients' average length of hospitalization was 6.85 days; afterwards, COPD patients' average length of hospitalization increased by 0.41 days. Pathway patients' average length of hospitalization (7.32 days) was higher than that of non-pathway patients (6.53 days), but the difference was not statistically significant (Table 37). Looking at long-term trends, pre-pilot patients' average length of hospitalization was at a decreasing trend; after the pilot implementation, it began to show an increasing trend but the trend was not statistically significant (Table 38, 39; Figure 38, 39).

Table 37 COPD patients' average length of hospitalization

Group	Total number of patients	Average length of hospitalization (days)
Before pilot: All patients	555	6.85 ± 4.34
After pilot: All patients	236	7.26 ± 3.09
After pilot: Pathway patients	219	7.32 ± 3.01
After pilot: Non-pathway patients	17	6.53 ± 4.02

Table 38 ITS analysis of COPD length of hospitalization, before vs. after pilot, 2011 – 2015

Variable	B value	Standard	T value	P value

		Deviation		
Constant	7.196	0.404	17.792	0.000
Slope – before pilot	-0.018	0.027	-0.674	0.505
Intercept difference before and after pilot	-2.974	2.377	-1.251	0.219
Slope difference before and after pilot	0.106	0.078	1.364	0.182

Table 39 ITS analysis of COPD length of hospitalization, before-pilot patients vs. after-pilot pathway patients, 2011 – 2015

Variable	B value	Standard Deviation	T value	P value
Constant	7.196	0.428	16.820	0.000
Slope – before pilot	-0.018	0.029	-0.637	0.528
Intercept difference before and after pilot	-1.913	2.515	-0.761	0.452
Slope difference before and after pilot	0.074	0.082	0.902	0.374

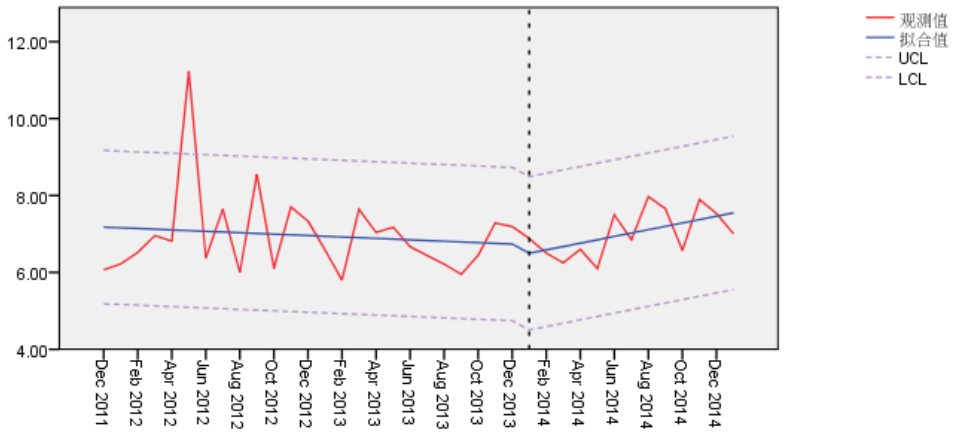

Figure 38 ITS analysis of COPD length of hospitalization, before vs. after pilot, 2011 – 2015

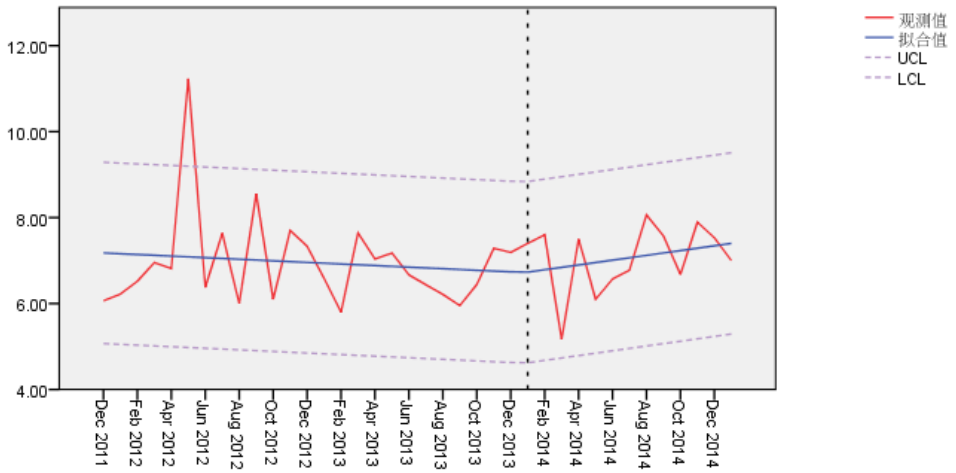

Figure 39 ITS analysis of COPD length of hospitalization, before-pilot patients vs. after-pilot pathway patients, 2011 – 2015

(2) TIA

Before the pilot, TIA patients' average length of hospitalization was 7.57 days. After the implementation, TIA patients' average length of hospitalization decreased by 0.48 days. Pathway patients' average length of hospitalization (8.57 days) was higher than that of non-pathway patients (7.01 days), but the difference was not statistically significant (Table 40).

Table 40 TIA patients' average length of hospitalization

Group	Total number of patients	Average length of hospitalization (days)
Before pilot: All patients	675	7.57 ± 3.96
After pilot: All patients	773	7.09 ± 3.03
After pilot: Pathway patients	40	8.57 ± 2.55
After pilot: Non-pathway patients	733	7.01 ± 3.32

(3) Cerebral hemorrhage

The average length of hospitalization for cerebral hemorrhage patients before the pilot was 14.67 days. After the pilot implementation, cerebral hemorrhage patients' average length of hospitalization decreased by 0.81 days. Care pathway patients' average length of hospitalization (16.28 days) was higher than that of non-pathway patients (13.46 days), but the difference was not statistically significant (Table 41).

Table 41 Cerebral hemorrhage patients' average length of hospitalization.

Group	Total number of patients	Average length of hospitalization (days)
Before pilot: All patients	305	14.67 ± 9.52
After pilot: All patients	122	13.86 ± 7.49
After pilot: Pathway patients	25	16.28 ± 3.13
After pilot: Non-pathway patients	97	13.46 ± 8.07

(4) Cerebral infarction

Cerebral infarction patients' average length of hospitalization was 8.83 days before the pilot. After the pilot implementation, cerebral hemorrhage patients' average length of hospitalization increased by 0.49 days. Care pathway patients' average length of hospitalization (9.49 days) was higher than that of non-pathway patients (9.29 days), but the difference was not statistically significant (Table 42).

Table 42 Cerebral infarction patients' average length of hospitalization.

Group	Total number of patients	Average length of hospitalization (days)
Before pilot: All patients	18	8.83 ± 4.74
After pilot: All patients	192	9.32 ± 4.25
After pilot: Pathway patients	927	9.49 ± 3.62
After pilot: Non-pathway patients	38	9.29 ± 4.38

6. Healthcare quality

Analysis of patients' EQ-5D data after the pilot and the 30-day readmission rates for COPD and cerebral infarction between December 2011 and February 2015 revealed that patients' quality of life at discharge was higher than their quality of life at admission; additionally, 30-day readmission rate was maintained at a relatively low level both before and after the pilot. Due to the low sample size of TIA and cerebral hemorrhage clinical pathway patients, analysis was not conducted for the two diseases.

(1) COPD

A. EQ-5D analysis

COPD patients' EQ-5D average score at the time of discharge was 0.812, higher than the average score at the time of admission (0.261). The visual analogue scale (VAS) average score at the time of discharge (97.75) was higher than the average score at admission (58.99) ($p<0.05$) (Table 43).

Table 43 COPD patients' quality of life scores at hospital admission and discharge

Variable	COPD EQ-5D Scores		COPD VAS Scores	
	Admission	Discharge	Admission	Discharge
Sample size	70	70	70	70
Mean	0.261	0.812	58.99	97.75
Median	0.189	0.848	60	10
Standard deviation	0.230	0.050	7.47	41.82
Minimum value	-0.062	0.595	50	10
Maximum value	0.750	0.848	71	99

B. Analysis of 30-day readmission rate

Patients' 30-day readmission rate was relatively low both before and after the pilot. After the pilot, patients' readmission rate was 1.24%, lower than the rate before the pilot (1.73%). Clinical pathway patients' 30-day readmission rate was 1.36%, higher than that of the non-pathway patients at 0.00% (Table 44), but the difference was not statistically significant.

Table 44 COPD patients' 30-day readmission rate

Group	Total number of patients	Number of patients re-admitted within 30 days	30-day readmission rate

Before pilot: All patients	577	10	1.73%
After pilot: All patients	242	3	1.24%
After pilot: Pathway patients	220	3	1.36%
After pilot: Non-pathway patients	22	0	0.00%

(2) Cerebral infarction

A. EQ-5D analysis

Cerebral infarction patients' EQ-5D average score at the time of discharge was 0.738, higher than the average score at admission (0.540). The VAS average score at the time of discharge (78.15) was higher than the average score at the time of admission, which was 54.99 ($p<0.05$) (Table 45).

Table 45 Cerebral infarction patients' quality of life scores at hospital admission and discharge

	Cerebral infarction EQ-5D scores		Cerebral infarction VAS scores	
Variable	**Admission**	**Discharge**	**Admission**	**Discharge**
Sample size	135	135	135	135
Mean	0.540	0.738	54.99	78.15
Median	0.532	0.773	60.00	80.00
Standard deviation	0.142	0.148	12.34	10.55
Minimum value	-0.111	0.001	25.00	10.00
Maximum value	0.804	0.848	85.00	95.00

B. Analysis of 30-day readmission rate

Patients' 30-day readmission rate was relatively high after the pilot: the readmission rate was 8.14%, higher than the rate before the pilot which was at 0%. Among the pathway patients, the readmission rate was 3.33%, which was lower than the non-pathway patients' rate at 9.00% (Table 46), but the difference was not statistically significant.

Table 46 Cerebral infarction patients' 30-day readmission rate

Group	Total number of patients	Number of patients re-admitted within 30 days	30-day readmission rate

Before pilot: All patients	40	0	0.00%
After pilot: All patients	1006	82	8.14%
After pilot: Pathway patients	150	5	3.33%
After pilot: Non-pathway patients	856	77	9.00%

7. Rehabilitation

As an important component of the China-UK integrated care pathway project, a rehabilitation program was implemented by Huangdao District People's Hospital to care pathway patients. Focusing on stroke patients in the neurology department, the hospital facilitated patient rehabilitation using early interventions and transferring them to lower-level healthcare institutions. Early rehabilitation implementation rate reached 90%. After the pilot, Huangdao District People's Hospital incorporated the National Institutes of Health Stroke Scale (NIHSS) into the care pathway information system for stroke inpatients. NIHSS scoring implementation rate was 100% for care pathway patients.

Under the influence of the project, Huangdao District People's Hospital and its lower-level township health center, Po Li Health Center, established an integrated rehabilitation system. For early rehabilitation, the rehabilitation department physicians from the hospital went to the neurology department to conduct early interventions to patients, helping patients restore swallowing function, and getting patients off the bed to conduct upper and lower limb rehabilitation exercises. After patients were restored to a stable state, the hospital transferred patients to Po Li Health Center to receive further rehabilitation. The transfer rate was 30%.

8. Discussion

The China-UK integrated care pathway project selected four complex chronic diseases (COPD, stroke, cerebral infarction and TIA) as pilot diseases for care pathways, inviting Chinese and British experts to formulate the pathway templates, and utilizing computerized information systems to standardize patient management. These activities helped the project achieve the goals of regulating and standardizing physicians' diagnosis and treatment behaviors, controlling irrational increase in healthcare costs, and ensuring low out-of-pocket expenses for patients. From the project implementation in January 2014 to a temporary pause in February 2015, the project had significant impact on Huangdao District People's Hospital.

(1) Project impact on inpatients

Care pathway is the core project management tool. The management rate directly reflects the impact of the project on the hospital. Management rate is in turn directly affected by pathway entrance rate and pathway completion rate, both of which jointly determine the outcome of care pathways. Local healthcare insurance policy, project implementation status in the hospital, healthcare providers' awareness and perceptions, internal incentives structures, patient distribution within the hospital, and patients' conditions among others have had a direct impact on pathway entrance rate and completion rate.

Among the four pilot diseases, COPD patient management rate was the highest, reaching 92.4%; the three types of neurological diseases had relatively lower management rates; cerebral infarction patient manage rate was 13.7%; TIA 5.0%; and cerebral hemorrhage was the lowest at 4.9%. Combining data analyses and interview results, several reasons were identified that may have caused the low management rate for the neurology patients:

(1) Stroke patients were scattered in different departments in the hospital. After data analysis, it was found that some patients diagnosed with cerebral infarction, cerebral hemorrhage and TIA were scattered in a total of 14 non-neurology departments such as the emergency department, traditional Chinese medicine department, endocrinology department, and others. Such patients accounted for a large proportion of the total number of patients: cerebral infarction and cerebral hemorrhage patients accounted for about 30%, and TIA patients accounted for 7.8%.

(2) Some neurology patients did not meet the criteria for entrance into care pathway. Through interviews, it was found that some neurology patients were long-term chronic disease patients, and therefore did not meet the pathway entrance criterion of being "first episode". Chronic TIA patients' routine habitual care was intravenous (IV) infusion. However, since outpatient IV infusion could not be reimbursed, patients were admitted to the hospital to receive inpatient infusion treatment. Such patients accounted for about 50% of the total.

(3) Some healthcare providers had low enthusiasm and low motivation. The Huangdao District People's Hospital's neurology department was consisted of two departments: Neurology 1 and Neurology 2. One of the departments had lower care pathway implementation capacity, and the enthusiasm of the involved department director was low.

(2) Project impact on physicians' diagnosis and treatment behaviors

The integrated care pathway project, by setting mandatory and optional items, corrected physicians' diagnosis and treatment behaviors, and allowed healthcare providers to be flexible based on patient-specific conditions and physicians' habits, while ensuring the provision of basic healthcare (mandatory items). Since any remaining balance (cost savings) from the fixed case payment would be allocated to the physicians, overtreatment could be prevented.

The project had a clear impact on correcting inadequate healthcare provision, but lacked impact on restricting overtreatment. Analysis of two diseases showed that implementation of mandatory items significantly improved compared to before the pilot, with some mandatory items being implemented at over 90%. At the same time, most optional items also increased after the pilot implementation, some being implemented at over 90%. The main reasons are the following:

(1) Hospital fixed case payment price was higher than the actual cost incurred. When local healthcare insurance reimbursed pathway patients, patients' actual spending must not be lower than 80% of the case payment, otherwise patients will not be reimbursed. Thus, to bring patients' actual spending closer to the fixed case payment price, physicians added optional items for patients with less severe conditions.

(2) Physicians diagnosis/treatment habits and patients' perceptions were hard to change in a short period of time. For some diagnosis/treatment behaviors that were not evidence-based (such as TIA patients' annual IV infusion, cerebral infarction patients' oxygen treatment, etc.), data still showed that these were highly prescribed. Through interviews, it was found that most neurology patients were chronic disease patients. These patients have been receiving the same aforementioned treatment for a long time. If one was to suddenly change the treatment regimen, patients may not accept it, easily leading to medical disputes. At the same time, in situations where the treatment has not resulted in any adverse events or side effects for a period of time, physicians may still choose to maintain the original treatment regimen.

(3) Project impact on healthcare costs

One of the goals of the integrated care pathway project was to control irrational increase in healthcare costs. Total cost, drug cost proportions, examination/lab fee proportions, etc. were important indicators of healthcare costs, directly reflecting the project impact on hospital costs.

After the project implementation, total healthcare cost generally was maintained at the same level or slightly decreased: the drug cost proportion decreased, and the examination/lab fee proportion decreased, reaching the expected target of the project. With the exception of COPD, total costs of the other three diseases decreased or were maintained at the pre-pilot level. However, COPD total cost had an increase of 2,487 CNY after the project implementation. The main reason was that COPD case payment price was set too high. As a result, physicians added optional items to increase patients' treatment cost to ensure that patients could be reimbursed by their insurance.

(4) Project impact on patient burden

The ultimate goal of the care pathway project, under the premise of first promoting patients' quality of care, was to ensure that patients pay a reasonable cost and obtain high-quality treatment without adding to the patient burden. After the project implementation, patients' OOP proportions significantly decreased from 51.05% (before the pilot) to 29.14% (after the pilot). This reduced patients' burden considerably, and analysis indicated that patients' OOP proportions were still at a downward trend, achieving the expected goal of the project.

(5) Project impact on healthcare efficiency and quality

After the pilot implementation, inpatients' length of hospitalization was within the specified limit, and not significantly different than before the pilot. Patients' quality of life at time of discharge was higher than that at the time of admission, and the 30-day readmission rate was on average relatively low. This suggested that the project maintained the original level of healthcare efficiency and healthcare quality.

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