CHINA NATIONAL HEALTH DEVELOPMENT RESEARCH CENTER

Appendix J: Detailed results from pilot sites

Hanbin First Hospital

Table of contents

1. Background

Since 2010, the district of Hanbin implemented a mixed payment system for hospital inpatients, which included single-disease fixed payment, fee-for-bed days payment, and fee-for-service payment. Hanbin district required that fee-for-service inpatients should account for 5% or less of total inpatients in healthcare facilities. Under the care pathway's single disease fixed payment, patients should pay 20% and the basic medical insurance should pay 80%. The medical insurance department has implemented the self-management method ("keep surplus; pay for excess services"), which gives responsibility to healthcare facilities to pay or keep whatever is over or below the allocated balance.

Hanbin district saw a need to establish a comprehensive grassroots healthcare facility network and healthcare service management system with adequate task division, service standards, multilevel diagnosis and treatment, two-way referral, separation of acute and chronic disease, and effective operation. In order to meet the need, Hanbin district joined the project, "Enhancing evidence-based decision making and achieving basic healthcare service for all: China integrated care pathways and payment method reform implementation and dissemination" (herein, referred as the project). For chronic obstructive pulmonary disease (COPD) and stroke, the project launched the integrated care pathway management, which included prevention, treatment, and rehabilitation. The integrated pathways of the two diseases and their major comorbidities were established. The project also formed an integrated management model for Hanbin First Hospital, Hanbin Centers for Disease Control, and eight community health centers (or clinics).

In November 2013, the pilot healthcare facilities officially launched the integrated care pathway project, and implemented the single-disease fixed payment for COPD, transient ischemic attack (TIA), cerebral hemorrhage, and cerebral infarction. Fixed payment amount of COPD (without complications) was 6,200 CNY; TIA was 3,200 CNY; cerebral hemorrhage was 7,000 CNY; and cerebral infarction was 6,900 CNY. The costs associated with complications ranged from 100 to 650 CNY. To facilitate the project's progress, Hanbin Health Bureau published the "Implementation of multi-level, multi-stage diagnosis and treatment with integrated management pilot task notice" (Hanbin Health Bureau document number [2014]188) and the "Implementation of multi-level, multi-stage diagnosis and treatment with

integrated management pilot task program" in June 2014.

As the main implementation health facility of the project, Hanbin First Hospital is a level-2A hospital, with 250 registered beds (382 beds in total), and various departments including general medicine, surgery, obstetrics and gynecology, orthopedics, pediatrics, ear, nose and throat, Chinese and western integrative medicine, emergency services, and more. Integrated care pathways were implemented in the general medicine department, the Chinese and western integrative medicine department, the emergency department, and the neurology department. To facilitate the project, the hospital established a task leadership group, and published the "Clinical pathway pilot implementation program," "Clinical pathways pilot task management standards," "Clinical pathway pilot task supervision and evaluation program," and other relevant systems and programs. According to the "Notice of clinical pathway performance management approach" (Hanbin First Hospital office document [2013]1), a fixed payment balance is allocated to the doctor in charge and the department director; fixed payment overrun is shared by the hospital and the department; and a clear penalty provision is set for overruns caused by irrational drug use.

The hospital established the integrated care pathway information system in addition to the original system, optimizing and completing the software for pathway administration and supervision, and forming a network connection with the hospital's information system and medical insurance supervision system.

2. Integrated care pathway implementation

(1) Pathway implementation overview

From June 2014 to May 2015, Hanbin First Hospital admitted a total of 881 inpatients for stroke and chronic obstructive pulmonary disease (COPD). Among them, 641 patients entered the integrated care pathways, which comprised of 72% of total pathway disease patients. A total of 571 patients completed the care pathway, accounting for 89.1% of patients that have entered the pathway management system and 64.8% of admitted patients. The number of patients that completed the pathway changed as the total number of admitted patients fluctuated (Figure 1). During the project period, a monthly average of 48 patients completed pathway, which comprised of 89.1 % of patient that have entered the pathway management system.

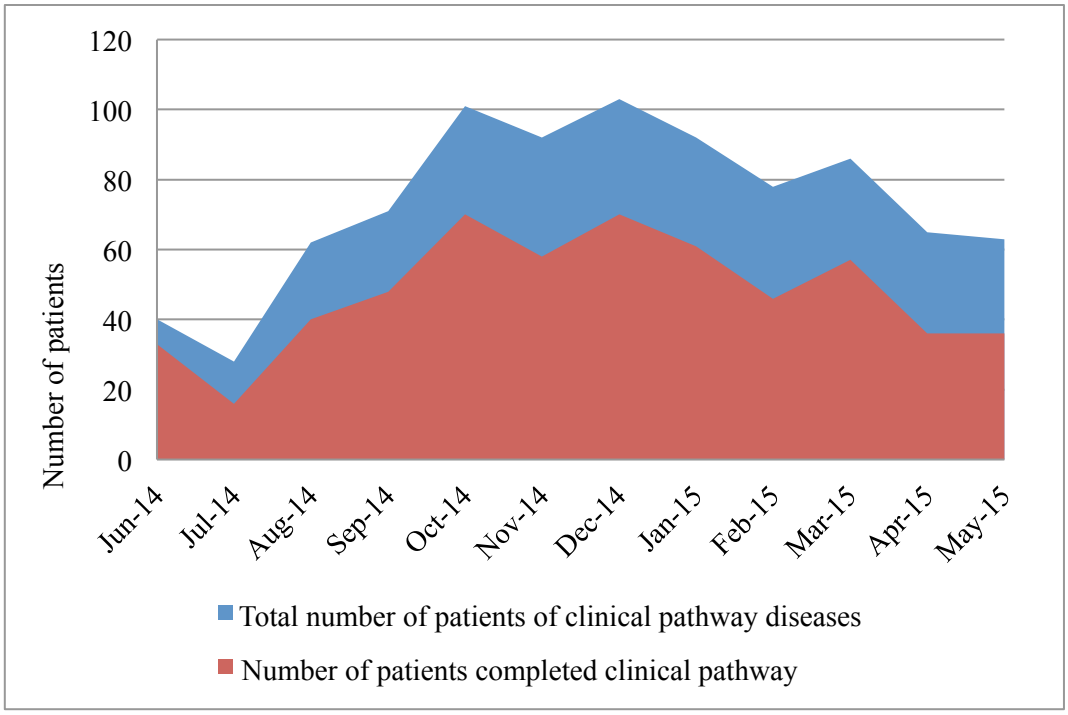

Figure 1 Total number of patients of pathway diseases and number of patients completed pathway, June 2014 to May 2015

Patient satisfaction rates were over 90% both before and after the project in all three departments that participated (Figure 2). Hospital-acquired infection rate stayed

at low levels and showed falling trends after the project (Figure 3). Also, since the start of the pilot in 2013, two cerebral hemorrhage patients, one COPD patient and one cerebral infarction patient deaths occurred.

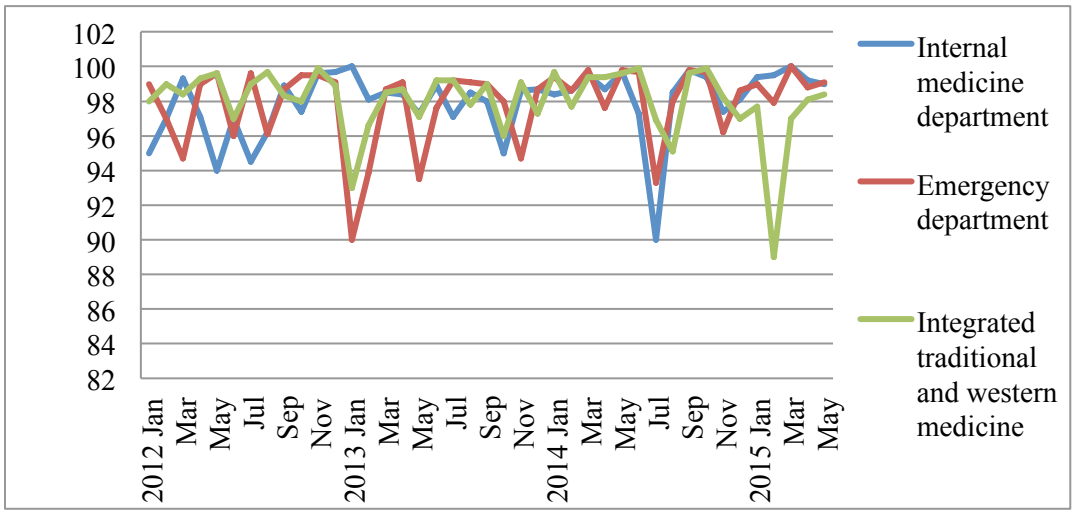

Figure 2 Patient satisfaction rates, 2012 – 2015

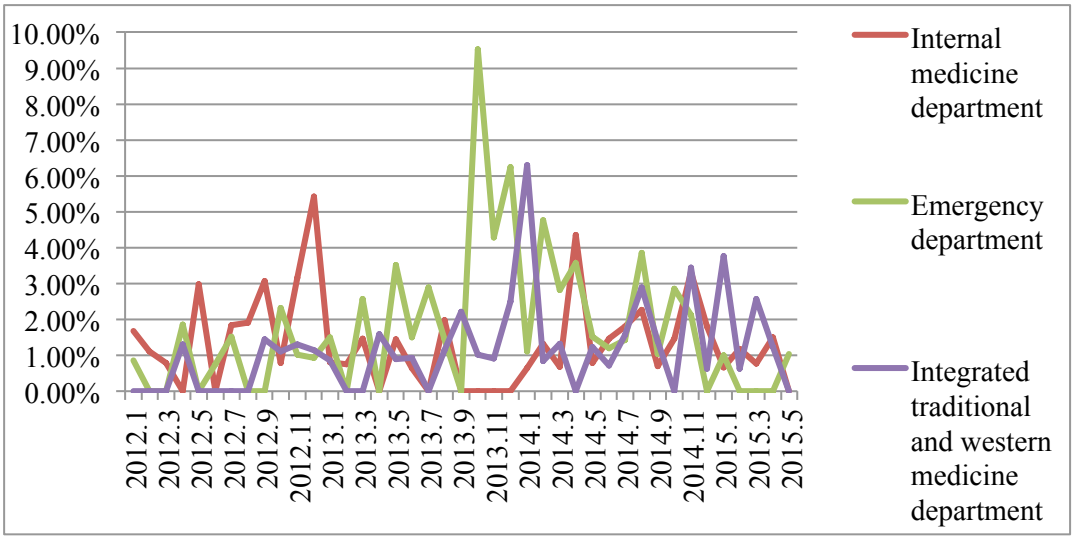

Figure 3 Infection rates, 2012 – 2015

(2) Integrated care pathway implementation of pilot diseases

The four pathway diseases of COPD, cerebral infarction, cerebral hemorrhage, and transient ischemic attack (TIA) had different implementation progress. COPD

and cerebral infarction achieved high coverage and completion rate. Both achieved entrance rates of over 70% and completion rates of around 90%. Cerebral hemorrhage had a relatively lower completion rate, but the overall implementation was close to the planned target. TIA had too few patients to conduct a detail analysis (Table 1, Figure).

Table 1 Care pathway implementation, June 2014 to May 2015

Disease	Total patients	Patients entering pathway	Patients completing pathway	Patients that left pathway	Entrance rate* (%)	Completion rate* (%)	Management rate* (%)
COPD	419	308	281	28	73.5	91.2	67.1
TIA*	9	4	4	0	44.4	100.0	44.4
Cerebral hemorrhage	62	44	34	10	71.0	77.3	54.8
Cerebral infarction	391	285	252	32	72.9	88.4	64.5
Total	881	641	571	70	72.8	89.1	64.8

Most TIA patients were outpatients; only a few were inpatient

*Entrance rate = # of patients that entered pathway / total # of patients of the disease;
*Completion rate = # of patients that completed pathway / # of patient that entered pathway
*Management rate = # of patients that completed clinical pathway / total # of patients of the disease.

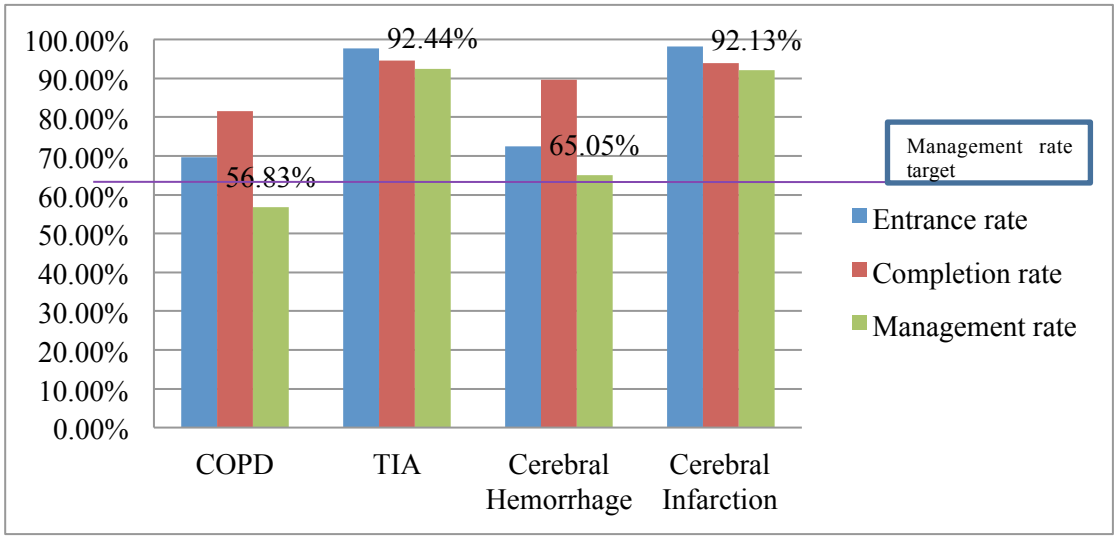

Figure 4 Hanbin First Hospital care pathway implementation results
June 2014 – May 2015

The time series analysis showed that management rates of COPD and cerebral infarction fluctuated between 68% and 80%. Management rates of cerebral hemorrhage and TIA had larger variation due to the inconsistency in number of patients admitted (Figure 4).

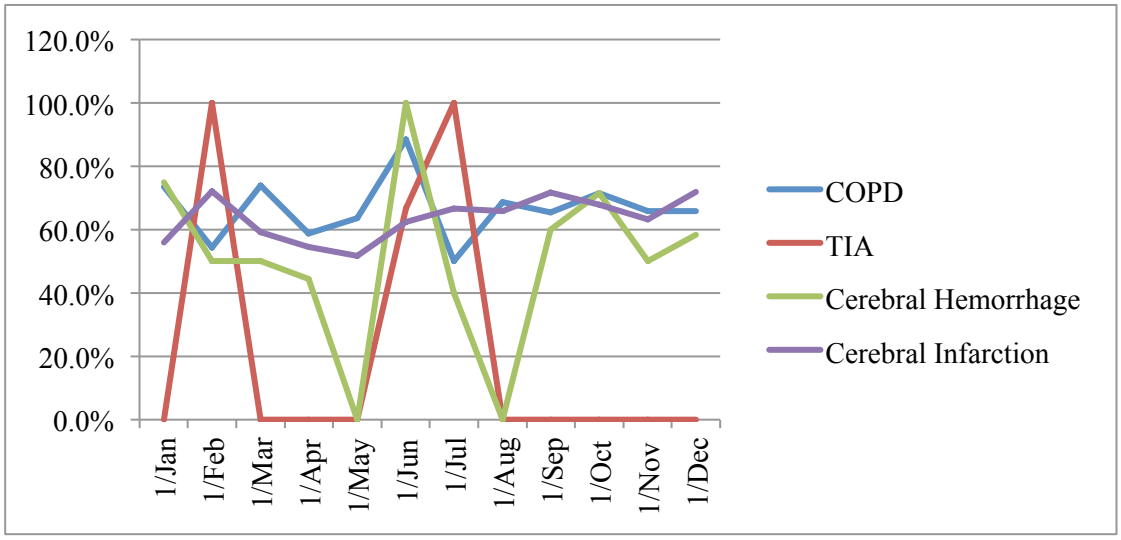

Figure 4 Hanbin First Hospital pathway diseases monthly management rates

A. COPD

From June 2014 to May 2015, the number of COPD inpatients showed an

increasing trend, with a pathway entrance rate of over 60% and a completion rate of over 80%. There was no hospital-acquired infection case; and patient satisfaction was over 96%.

a) Total number of COPD inpatients

From June 2014 to May 2015, the number of COPD patients admitted showed an increasing trend, with a maximum of 57 patients and a minimum of 10 patients admitted per month. The number of COPD patients significantly decreased during the summer months, which might be due to the seasonal effect of COPD (Figure 5).

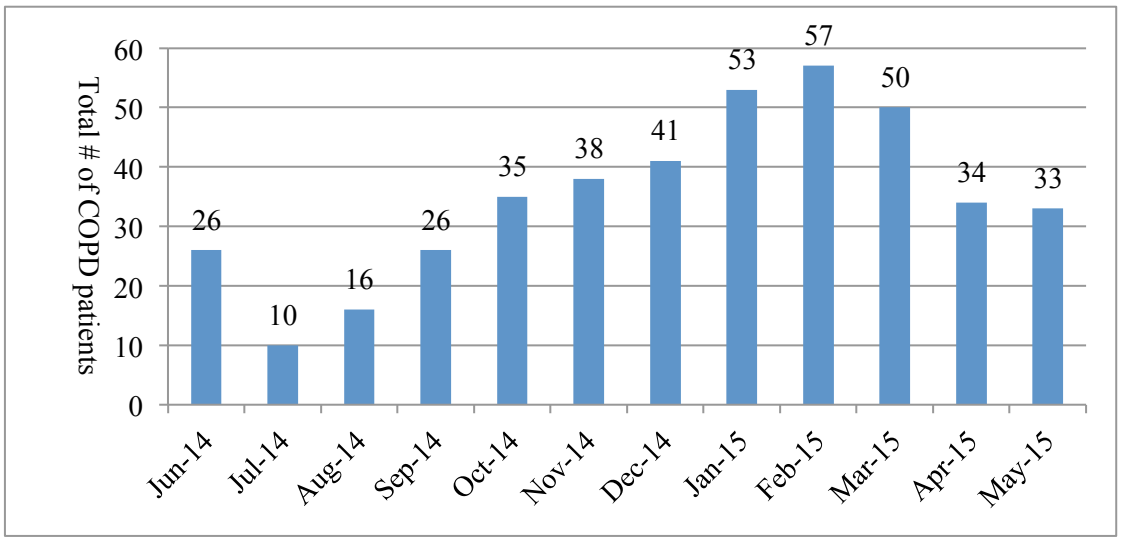

Figure 5 Monthly number of COPD inpatients, June 2014 to May 2015

b) COPD pathway rates

The monthly entrance rate of COPD patient mostly fluctuated between 60% and 80%, and reached 100% in June 2014 and March 2015 (Figure 6).

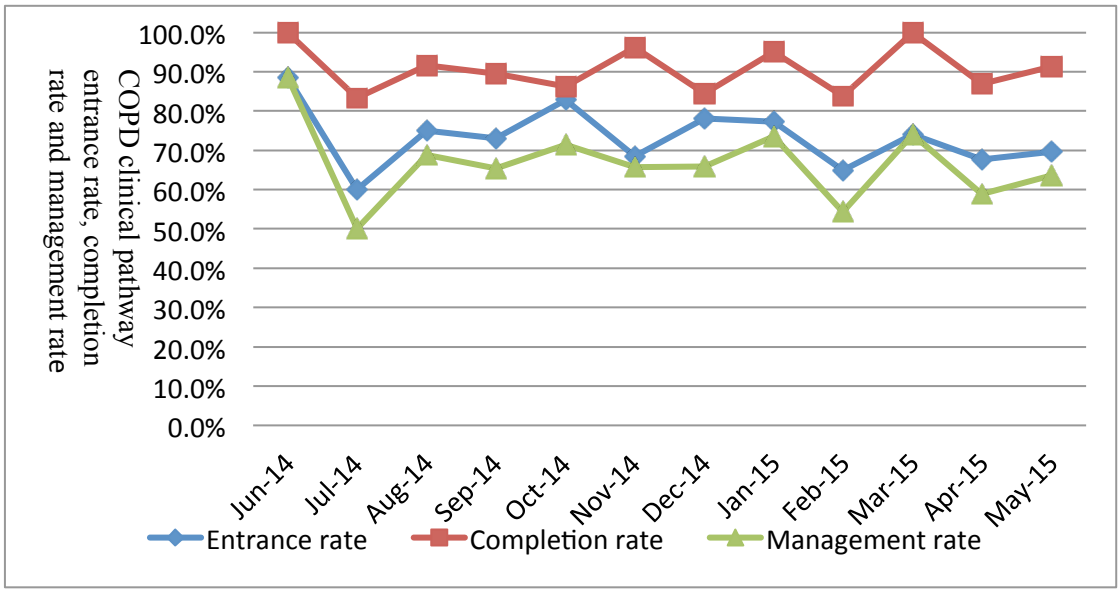

Figure 6 COPD patients' monthly pathway entrance rate, completion rate and management rate

c) Hospital-acquired infection rates

The monthly hospital-acquired infection rate of COPD clinical pathway patients remained at zero. Infection rates of other non-pathway patients were mostly zero except in August 2014 when the infection rate was 14.29%

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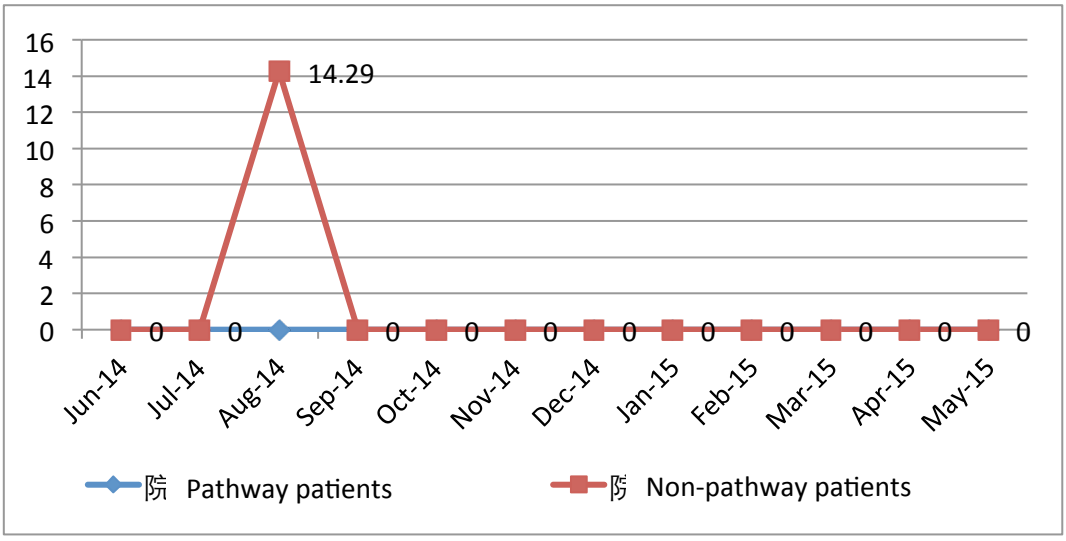

Figure **7**).

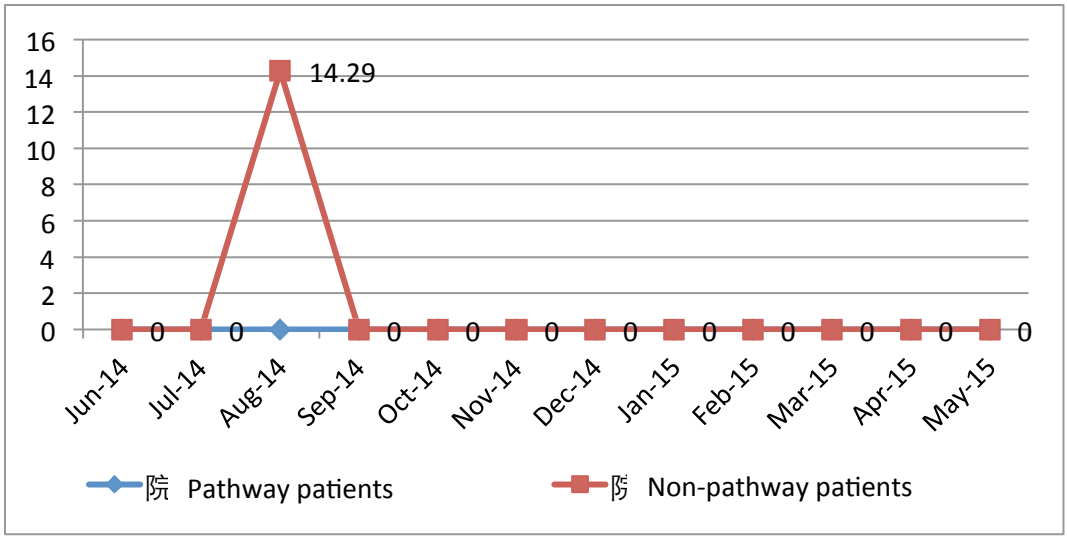

Figure 7 Hospital-acquired monthly infection rate of COPD patients

d) COPD patient satisfaction

From June 2014 to May 2015, patient satisfaction rates of both clinical pathway patients and other patients remained at high levels of above 96% (Figure 8).

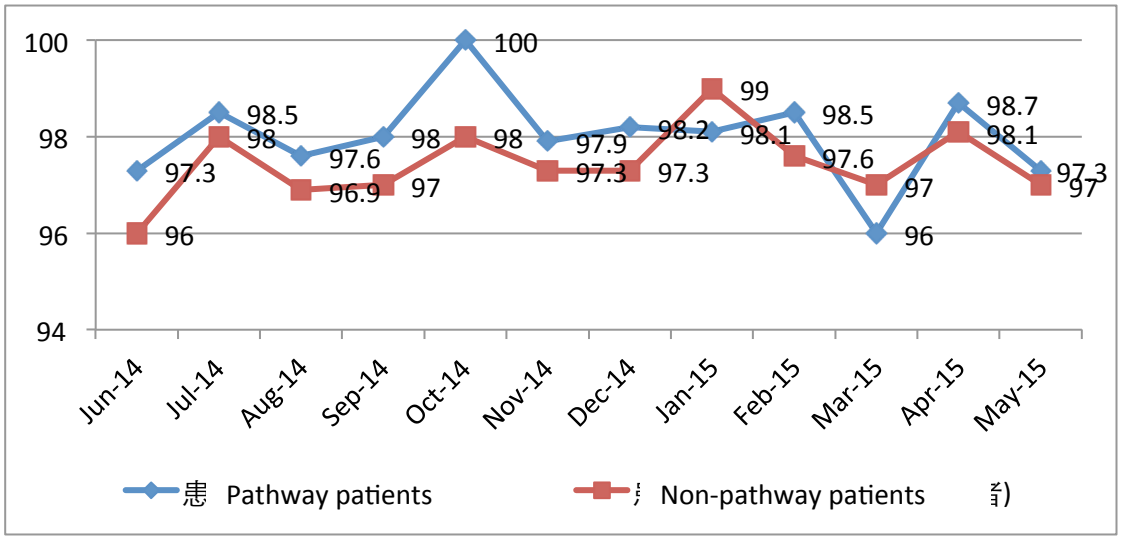

Figure 8 Monthly COPD patient satisfaction rates

e) Number of added prescription items outside of the clinical pathway

From June 2014 to September 2014, the number of added prescription items outside of the pathway rapidly increased to 35 items and fluctuated between 30 and 40 on average for COPD patients that completed the clinical pathway (Figure 9).

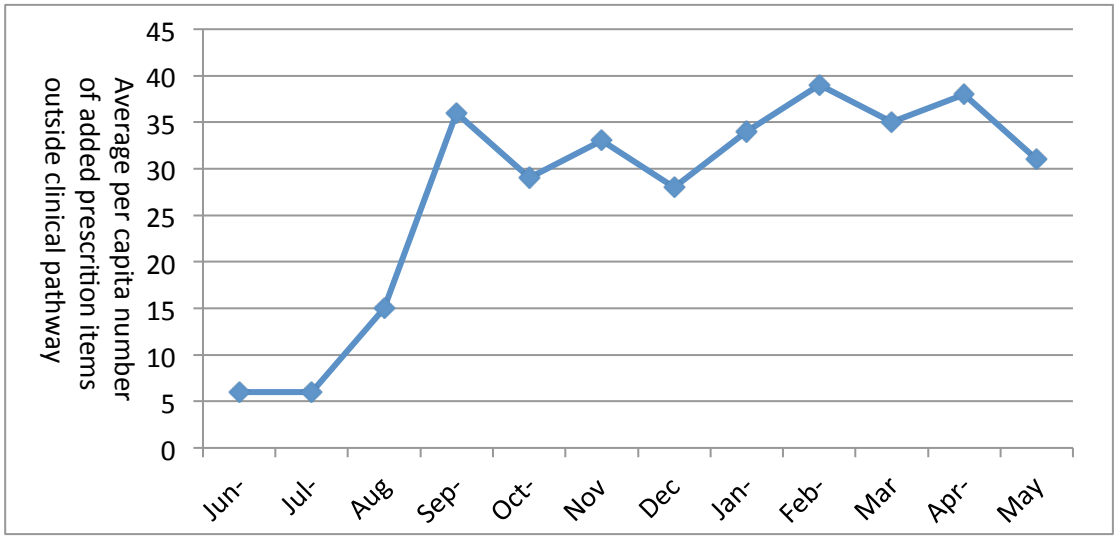

Figure 9 Average added prescription items outside of pathway per COPD pathway patient

B. Cerebral hemorrhage

From June 2014 to May 2015, the number of cerebral hemorrhage inpatients showed an increasing trend, with varied monthly entrance rates and completion rates. The highest monthly pathway entrance rate was 100% and the lowest was 40%. The highest completion rate was 100% and lowest was 44%. There was no case of hospital-acquired infection, and patient satisfaction was over 94%.

a) Total number of cerebral hemorrhage inpatients

There was a small number of cerebral hemorrhage inpatients, with a maximum of 12 patients admitted in December 2014 and a minimum of one patient in May 2015. Overall, there was an increasing trend from June 2014 to May 2015 (Figure 10).

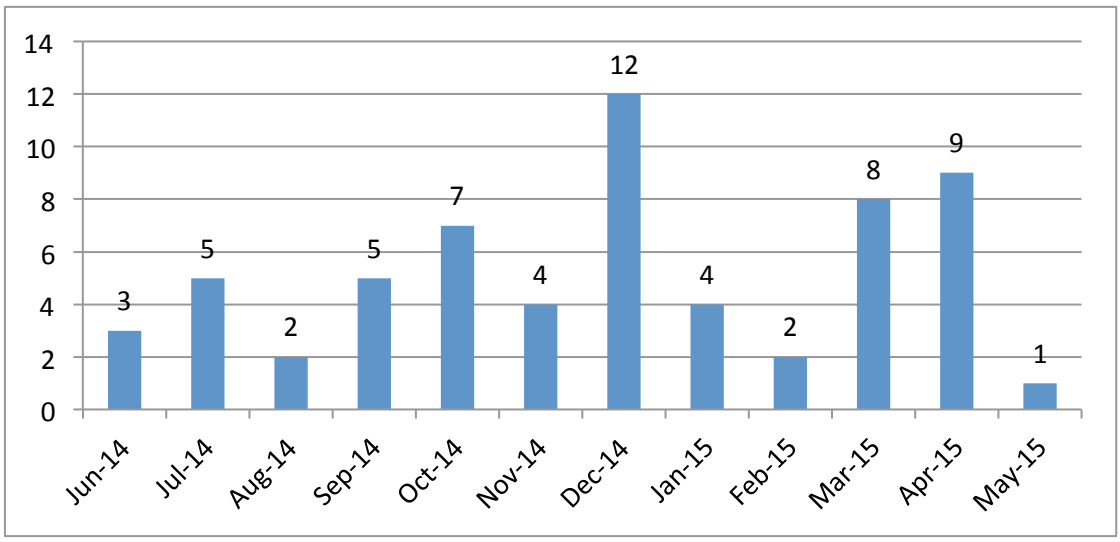

Figure 10 Monthly number of cerebral hemorrhage inpatients

b) Cerebral hemorrhage pathway rates

From June 2014 to May 2015, the overall entrance rate of cerebral hemorrhage patients was 64%, with a fluctuating increasing trend. The entrance rates reached 100% in June and November of 2014. Completion rates reached 100% in June and July 2014, and in January and February 2015 (Figure 11).

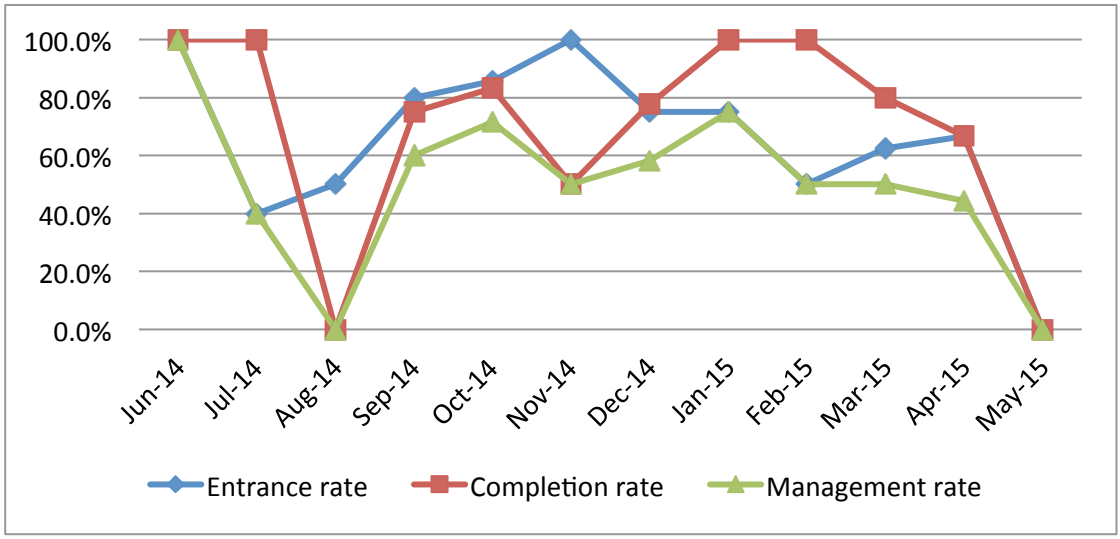

Figure 11 Cerebral hemorrhage patients' monthly pathway entrance rate, completion rate and management rate

c) Cerebral hemorrhage patient satisfaction

Satisfaction rates of patients that completed the clinical pathway were all above 96%, higher than other patients that did not participate in the project (Figure 12).

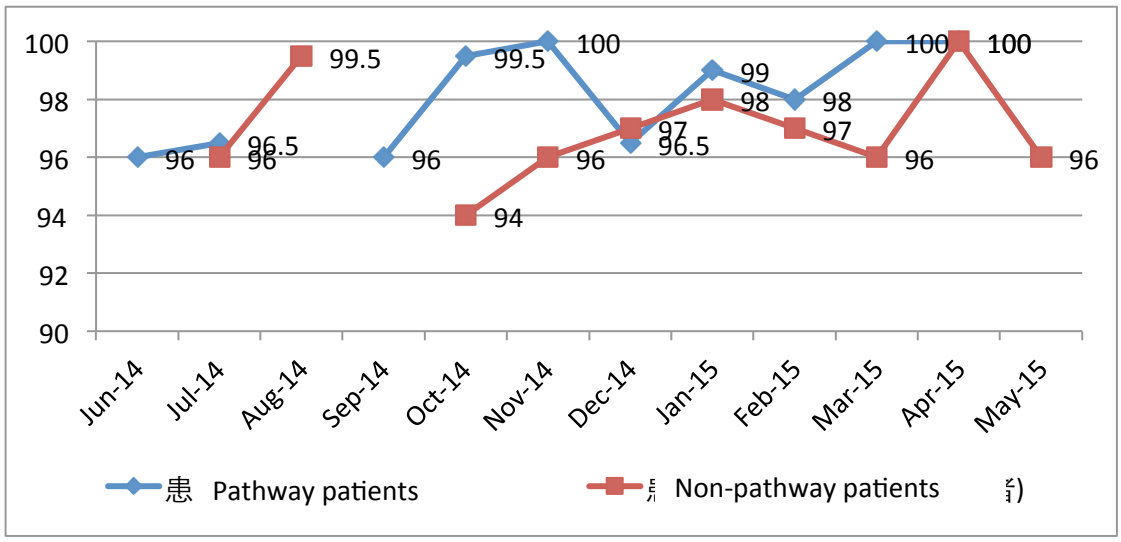

Figure 12 Monthly cerebral hemorrhage patient satisfaction rate

d) Number of added prescription items outside of the clinical pathway

The number of added prescription items outside of the pathway for cerebral hemorrhage patients varied largely, with the highest number at 60 items and the lowest at zero items (Figure 13).

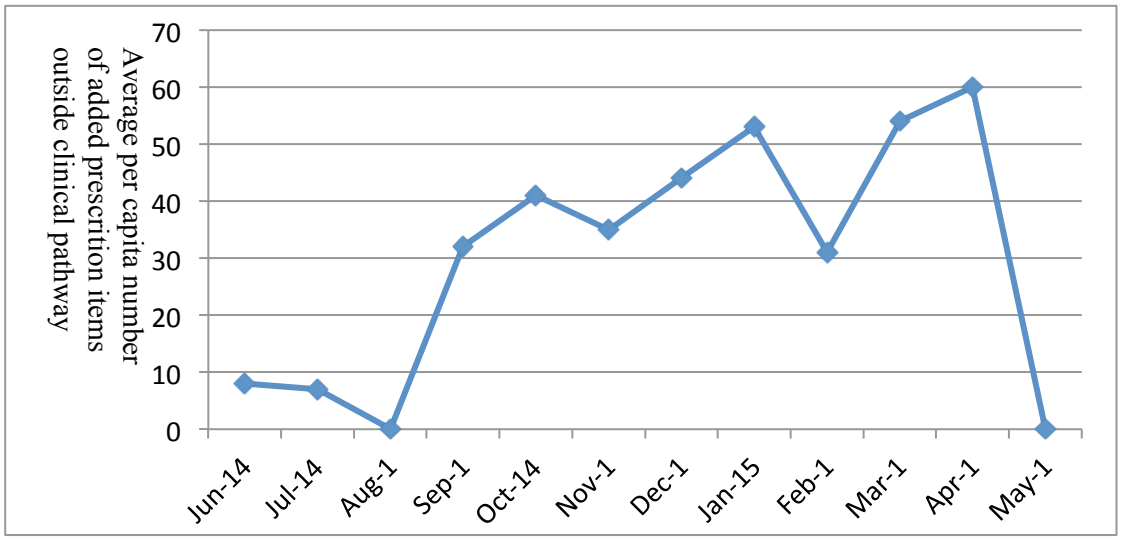

Figure 13 Average added prescription items outside of clinical pathway per cerebral hemorrhage patients that completed pathway

C. Cerebral infarction

From June 2014 to May 2015, the number of cerebral infarction inpatients showed an increasing trend, with clinical pathway entrance rate of over 60%, and a completion rate of over 70%. There was no case of hospital-acquired infection among the clinical pathway patients; and patient satisfaction was over 95%.

a) Total number of cerebral infarction inpatients

From June 2014 to May 2015, the monthly number of cerebral infarction patients showed an increasing trend, with a maximum of 59 patients and a minimum of eight patients admitted per month ().

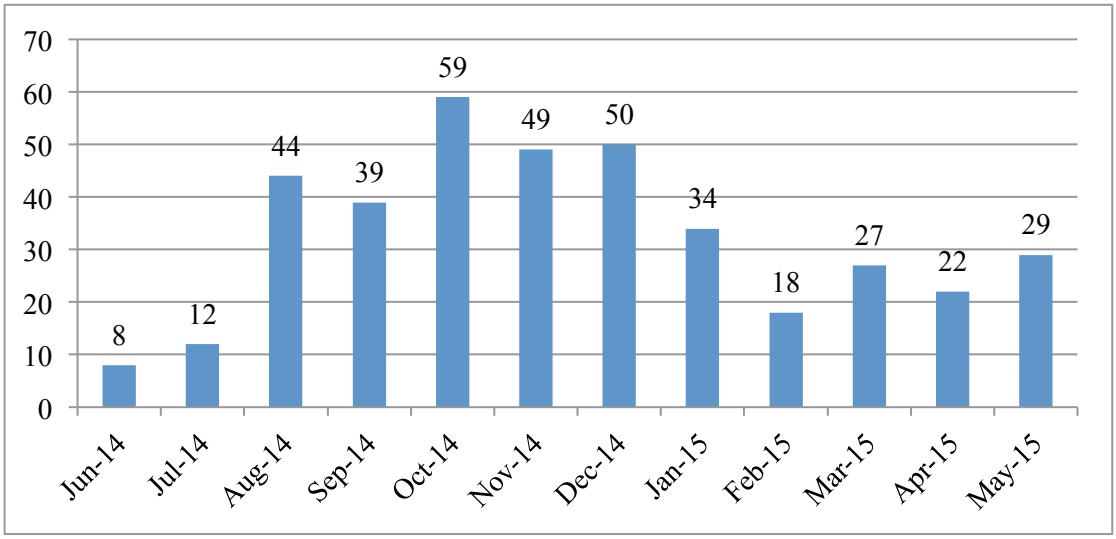

Figure14 Monthly number of cerebral infarction inpatients

b) Cerebral infarction pathway rates

From June 2014 to May 2015, the overall entrance rate and completion rate were stable. The entrance rates fluctuated between 60% and 80%, with an average of 73%. The entrance rates maintained at above 80% except for April and May 2015 (Figure 15).

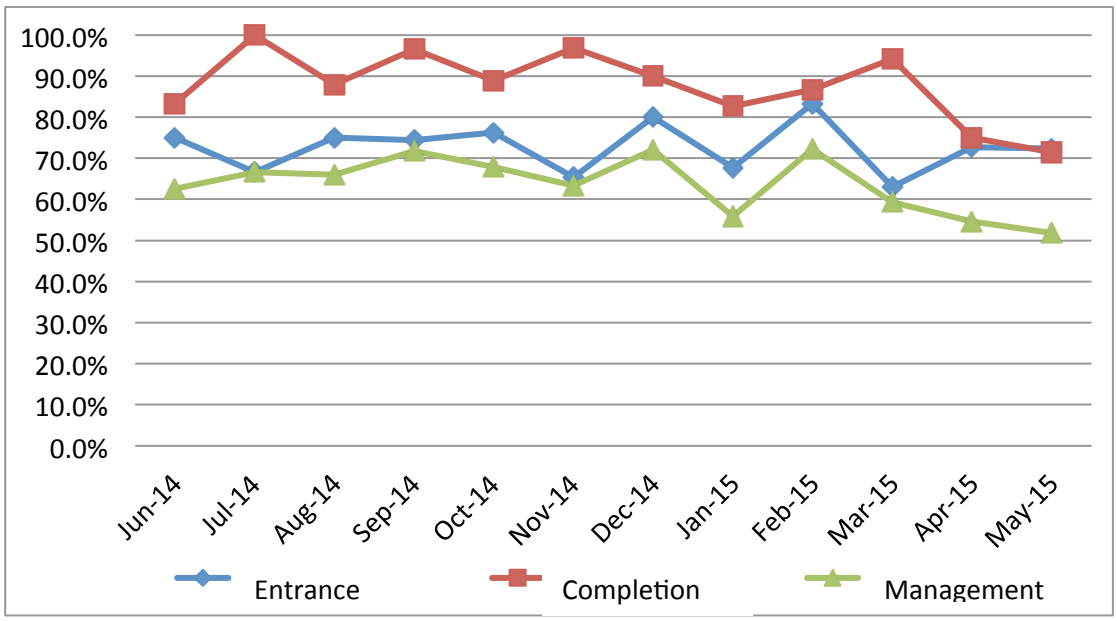

Figure 15 Cerebral infarction patients' monthly clinical pathway entrance rate, completion rate and management rate

c) Hospital acquired infection rate

From June 2014 to May 2015, there was no hospital-acquired infection among the pathway patients. However the monthly infection rates varied for other patients that did not participate in the clinical pathway (Figure 16).

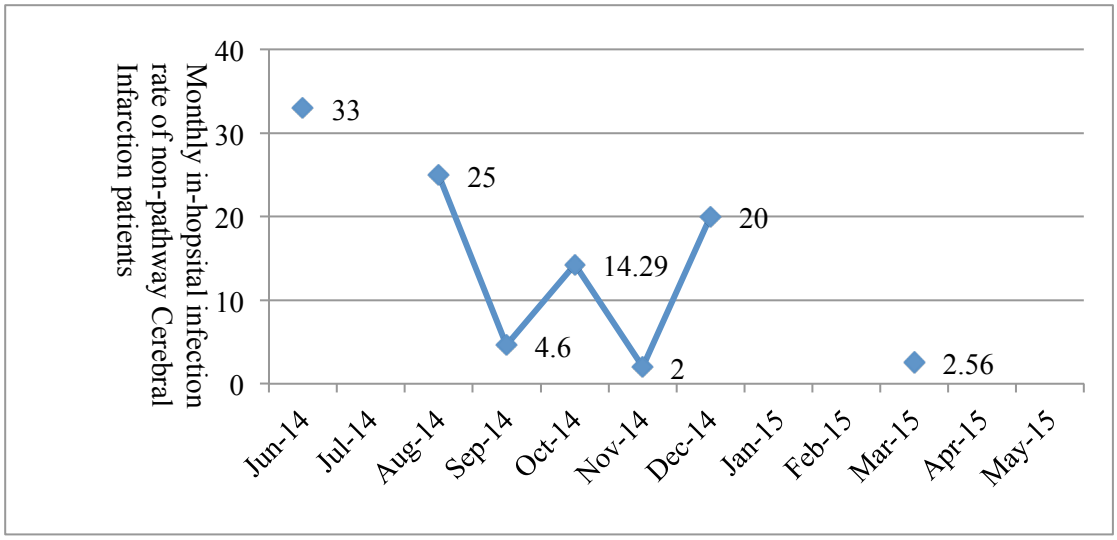

Figure 16 Monthly hospital-acquired infection rate of cerebral infarction patients not enrolled in the pathway

d) Cerebral infarction patient satisfaction

From June 2014 to May 2015, monthly patient satisfaction rates all maintained above 95% for both pathway and non-pathway cerebral infarction patients. Overall, satisfaction rate of pathway patients were higher than non-pathway patients (Figure 17).

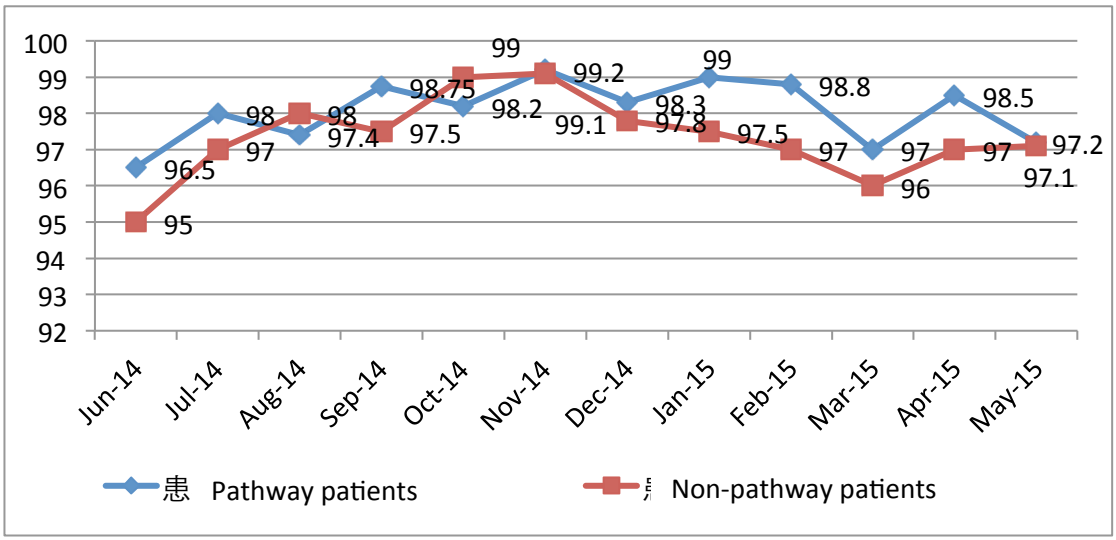

Figure 17 Monthly cerebral infarction patient satisfaction rate

e) Number of added prescription items outside of the clinical pathway

The number of added prescription items outside of the clinical pathway for cerebral infarction patients increased rapidly from June to September 2014, reaching 37 items. The number stayed below 40 items afterwards, except in February 2015 when it reached 47 items (Figure 18).

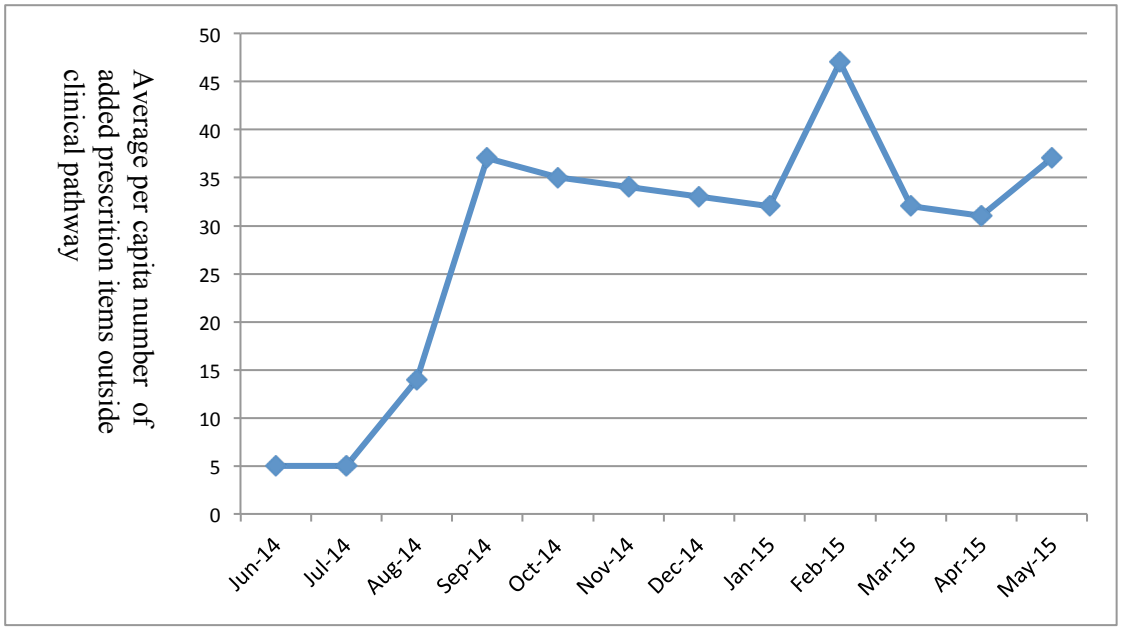

Figure 18 Average number of added prescription items outside clinical pathway per cerebral infarction patient that completed pathway

3. Clinical behaviors

Analysis of the inpatient billing data of Hanbin First Hospital for pilot diseases from January 2012 to May 2015 revealed that implementation of integrated pathway standardized clinical behaviors and increased mandatory drug usage rate. The mandatory drug usage rate of pathway patients was higher than non-pathway patients. For example, the usage rate of antiplatelet drugs for cerebral infarction pathway patients reached over 95%. At the same time, usage of expensive equipment tests, like CT and MRI, had a standardizing trend. However, several optional items remained unchanged, such as the oxygen usage rate that stayed above 40% for cerebral infarction patients both before and after the pilot implementation. (TIA and COPD were not included in billing data analysis because there were too few TIA inpatients, and there were no COPD patients before the pilot.)

(1) Cerebral hemorrhage

A. Mandatory items

According to the national treatment guideline for stroke, patients need to have cranial imaging examination within 24 hours after hospital admission. In the integrated clinical pathway, cranial CT exam is mandatory, whereas cranial MRI is optional. The proportion of cranial imaging scan (within 24 hours of admission) of cerebral hemorrhage patients increased after the pilot. The pathway patient ratio utilizing cranial imaging scan reached 89.55% after the pilot implementation (P≤0.05) (Table 2), with more CT scans performed than MRI (Figure 19).

Table 2 Cerebral hemorrhage patients' utilization of cranial imaging within 24 hours of hospital admission

Groups	Total patients	Patients that completed cranial imaging	Usage proportion (%)*
Before pilot, all patients	128	94	73.44
After pilot, pathway	67	60	89.55

After pilot, non-pathway	38	33	86.84

*P≤0.05

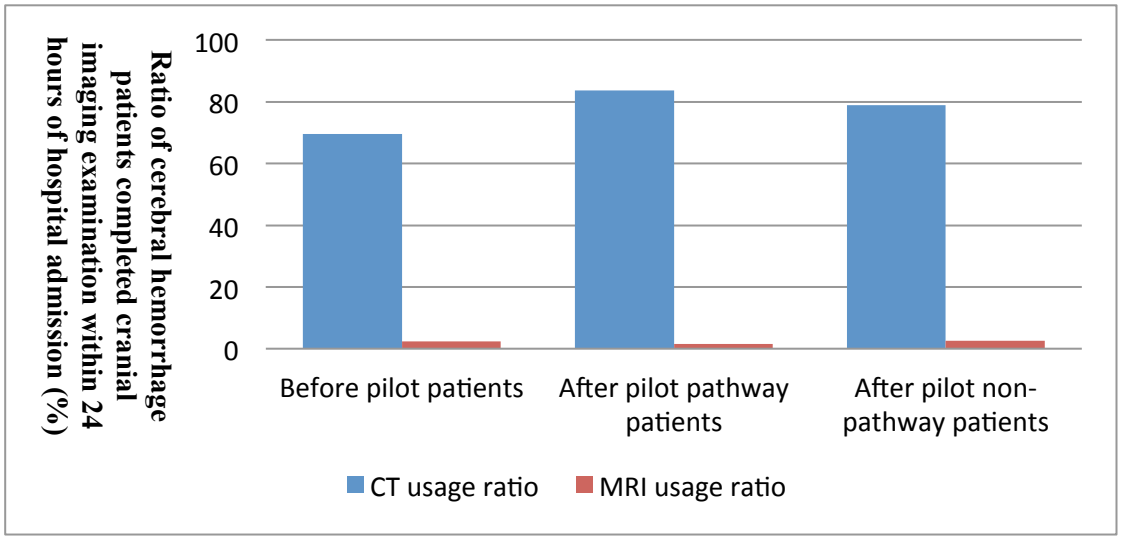

Figure 19 Proportion (%) of cerebral hemorrhage patients that completed CT and MRI tests within 24 hours of hospital admission

The proportion of CT scan within 24 hours of hospital admission among the pathway patients was 83.58% (Table), which was significantly higher than patients before the pilot (P<0.05). The proportion of MRI examination among pilot pathway patient was 4.48%, which was lower than patients before the pilot and non-pathway patients during the pilot (P>0.05) (

Table).

Table 3 Cerebral hemorrhage patients' CT scan

Groups	Total patients	Patients that completed CT	Usage proportion (%)	Usage ratio within 24 hours of admission (%)	Average number of CT scan per person (times)	Average cost of CT scan per person (CNY)
Before pilot, all	128	94	73.44	69.53	1.94	327.19

patients						
After pilot, pathway patients	67	56	83.58	83.58	2.20	360.00
After pilot, non-pathway patients	38	32	84.21	78.95	2.28	383.25

Table 4 Cerebral hemorrhage patients' MRI

Groups	Total patients	Patients that completed CT	Usage proportion (%)	Usage ratio within 24 hours of admission (%)	Average MRI per person (count)	Average cost per person (CNY)
Before pilot, all patients	128	17	13.28	2.34	1.12	447.06
After pilot, pathway	67	3	4.48	1.49	1.00	400.00
After pilot, non-pathway	38	3	7.89	2.63	1.00	400.00

B. Optional items

All drugs in the cerebral hemorrhage clinical pathway list were optional. Analysis revealed that dehydrating drugs were the main therapeutic drugs used for cerebral hemorrhage patients both before and after the pilot implementation. The utilization proportion and duration of dehydrating drugs increased after the pilot implementation (P>0.05) (Table). Time series figure showed that dehydrating drugs usage proportion stayed above 80% before and after the pilot implementation (Figure 20). Pathway patients' usage proportion increased steadily, and non-pathway patients' usage proportion fluctuated (Figure 20).

Table 5 Cerebral hemorrhage patient dehydrating drugs usage

Groups	Total patients	Patients using dehydrating drugs	Usage proportion (%)	Average usage days per person	Average cost per person (CNY)*
Before pilot, all patients	128	111	86.72	8.42	175.65
After pilot, pathway patients	67	61	91.04	9.13	223.67
After pilot, non-pathway patients	38	35	92.11	8.54	267.86

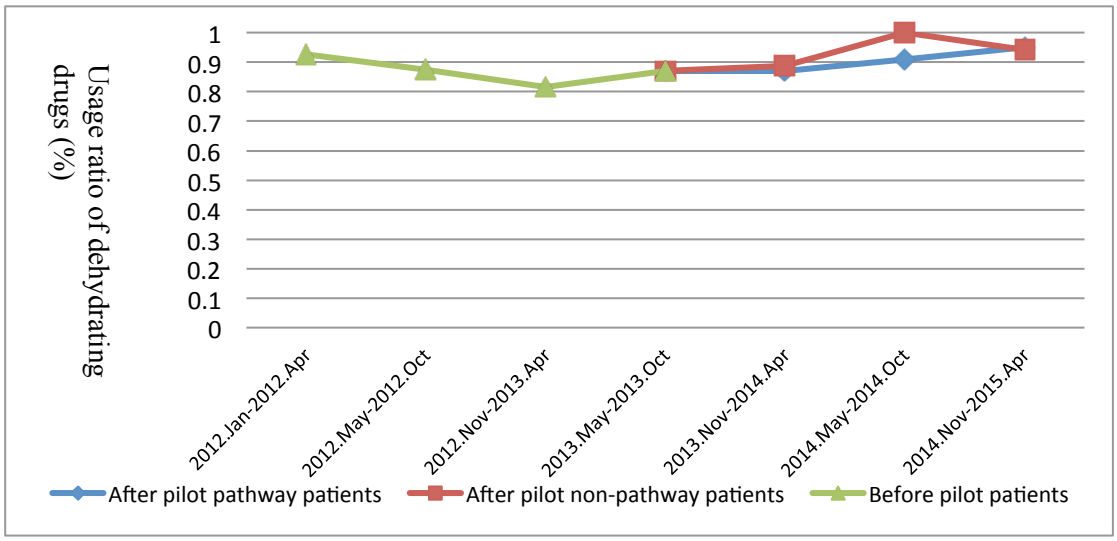

Figure 20 Dehydrating drugs usage ratio (%) in cerebral hemorrhage patients before and after pilot implementation

(2) Cerebral infarction

Cerebral infarction billing list analysis showed that compulsory drugs included antiplatelet drugs and anti-atherosclerotic drugs; optional drugs included thrombolytic drugs and cerebral perfusion improvement drugs. Overall, usage proportion and

duration of both compulsory and optional drugs increased since the pilot began. Expensive equipment utilization proportion and count, like CT and MRI, decreased.

A. Mandatory items

Hanbin First Hospital only used aspirin as an antiplatelet drug. Its usage proportion stayed above 90% both before and after pilot implementation (P>0.05). Time series figure showed that the usage proportion among pathway patients was consistently above 90% with an increasing trend, and usage proportion in non-pathway patients fluctuated (Table , Figure 21).

Table 6 Cerebral infarction patients' aspirin usage

	Total patients	Patients that used aspirin	Usage proportion (%)	Average usage per person (pill)	Average usage days per person	Average cost per person (CNY)
Before pilot, all patients	134	126	94.03	54.02	10.60	15.51
After pilot, pathway patients	132	126	95.45	42.04	8.86	15.18
After pilot, non-pathway patients	62	56	90.32	46.07	7.91	16.03

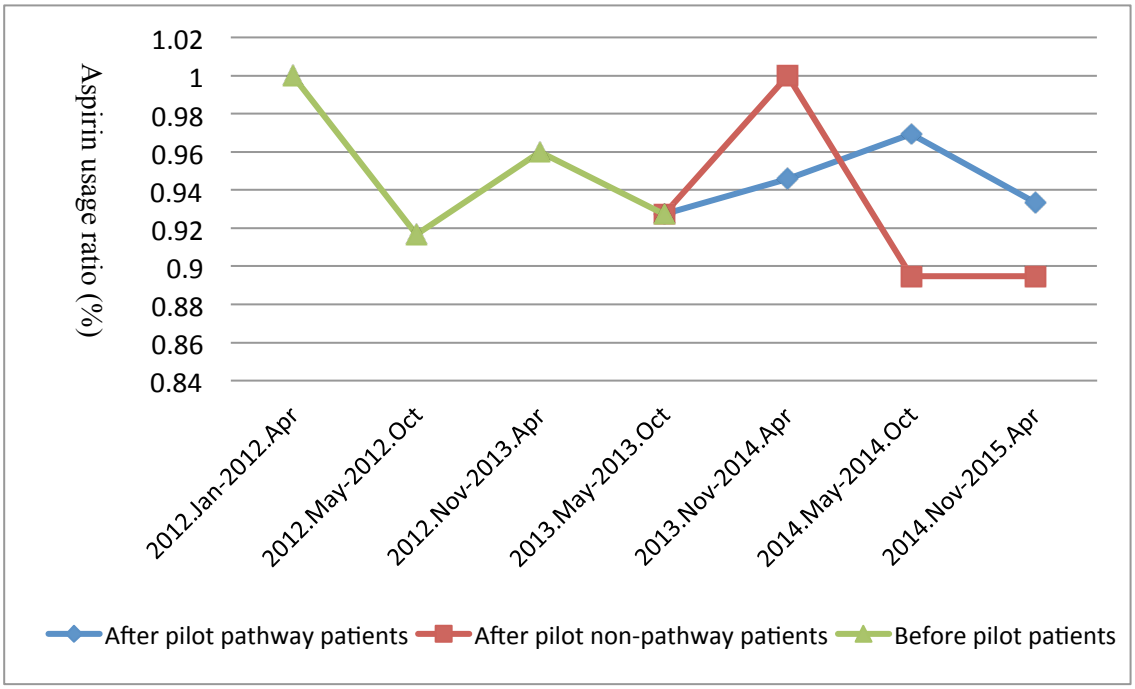

Figure 21 Aspirin usage proportion (%) in cerebral infarction patients before and after pilot implementation

Hanbin First Hospital only used Simvastatin as an anti-atherosclerosis drug. Usage proportion among patients during the pilot was higher than before but the difference was not statistically significant (P>0.05). Per capita usage duration among pathway patients was significantly lower than before pilot patients (P≤0.05), but higher than non-pathway patients (Table , Figure 22).

Table 7 Cerebral infarction patients' anti-atherosclerosis drugs usage

	Total patients	Patients that used Simvastatin	Usage proportion (%)	Average usage per person (pill)	Average usage days per person*	Average cost per person (CNY)
Before pilot, all	134	76	56.72	31.50	3.76	53.63
After pilot, pathway	132	85	64.39	31.39	2.32	50.32
After pilot,	62	37	59.68	25.05	1.95	46.38

non-pathway

*P≤0.05

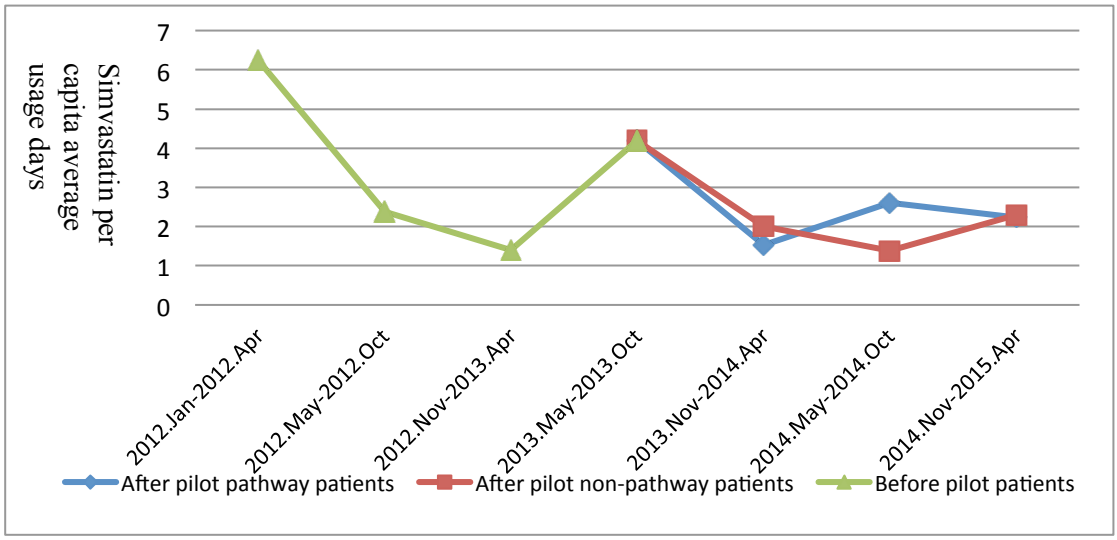

Figure 22 Average duration of anti-atherosclerosis drug use per patient before and after pilot implementation

The proportions of patients that completed cranial imaging scan and completed within 24 hours of hospital admission among the cerebral infarction pathway patients were significantly lower than non-pathway patients and all patients before the pilot (P≤0.05) (Table). More patients completed CT scan than MRI (Figure 23).

Table 8 Cerebral infarction patients' cranial imaging scan within 24 hours of hospital admission

	Total patients	Patients completing scan	Proportion of patients completing scan (%)*	Proportion of patients completing scan within 24 hours of hospital admission (%)*
Before pilot, all patients	134	101	75.37	53.73%
After pilot, pathway patients	132	80	60.61	40.91%
After pilot,	62	51	82.26	67.74%

non-pathway patients

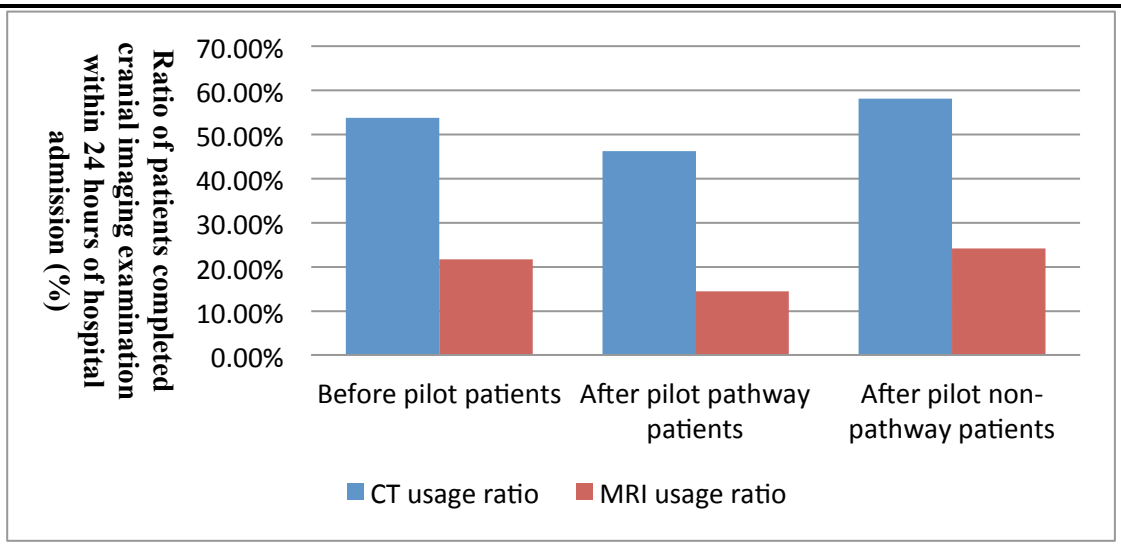

Figure 23 Proportion of cerebral infarction patients that completed CT and MRI within 24 hours of hospital admission (%)

CT scan proportion among pathway patients was lower than both non-pathway patients and before pilot patients (P≤0.05) (Table). MRI proportion among pathway patients was also lower than both non-pathway patients and before pilot patients (P≤0.05), at 27.27% after the pilot from 41.04% before the pilot (

	Total patients	Patients completing CT	Usage proportion (%)*	Usage proportion within 24 hours (%)	Average number of CT per person (count)	Average cost of CT per person (CNY)
Before pilot, all patients	134	72	53.73	53.73	1.68	252.44
After pilot, pathway patients	132	63	47.73	46.21	1.54	243.71
After pilot, non-pathway	62	37	59.68	58.06	1.73	272.32

*P≤0.05

Table). The proportions of patients that completed CT and MRI scans within 24 hour of hospital admission both decreased, but with no statistical significance (P>0.05).

Table 9 Cerebral infarction patients' CT scan before and after pilot

	Total patients	Patients completing CT	Usage proportion (%)*	Usage proportion within 24 hours (%)	Average number of CT per person (count)	Average cost of CT per person (CNY)
Before pilot, all patients	134	72	53.73	53.73	1.68	252.44
After pilot, pathway patients	132	63	47.73	46.21	1.54	243.71
After pilot, non-pathway	62	37	59.68	58.06	1.73	272.32

*P≤0.05

Table 10 Cerebral infarction patients' MRI before and after pilot

	Total patients	Patients that completed MRI	Usage proportion (%)*	Usage proportion within 24 hours (%)	Average number of MRI per person	Average cost per person (CNY)
Before pilot, all patients	134	55	41.04	21.64	1.18	472.73

After pilot, pathway patients	132	36	27.27	14.39	1.06	422.22
After pilot, non-pathway patients	62	29	46.77	24.19	1.10	441.38

*P≤0.05

A. Optional items

The usage proportions of cerebral perfusion improvement drugs before and after the pilot implementation were not significantly different (Table 2). Time series figure showed that usage proportion gradually decreased after the pilot started, and was lower in pathway patients than non-pathway patients (Figure 24). Usage proportion of Betahistine injection decreased significantly, and usage proportions of the other two drugs increased (Figure 25).

Table 2 Cerebral infarction patients' cerebral perfusion improvement drugs usage

	Total patients	**Patients using drugs**	**Usage proportions (%)**	**Average usage days per person**	**Average drug cost per person (CNY)***
Before pilot, all patients	134	78	58.21	10.58	886.73
After pilot, pathway patients	132	90	68.18	10.83	1156.01
After pilot, non-pathway patients	62	42	67.74	10.31	1138.76

*P≤0.05

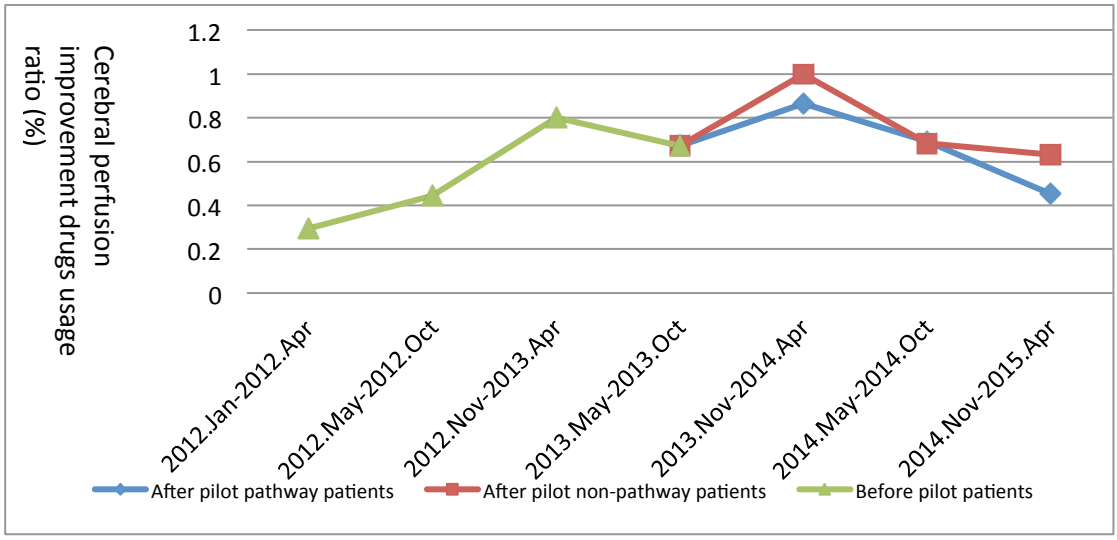

Figure 24 Usage proportion (%) of cerebral perfusion improvement drugs in cerebral infarction patients before and after pilot

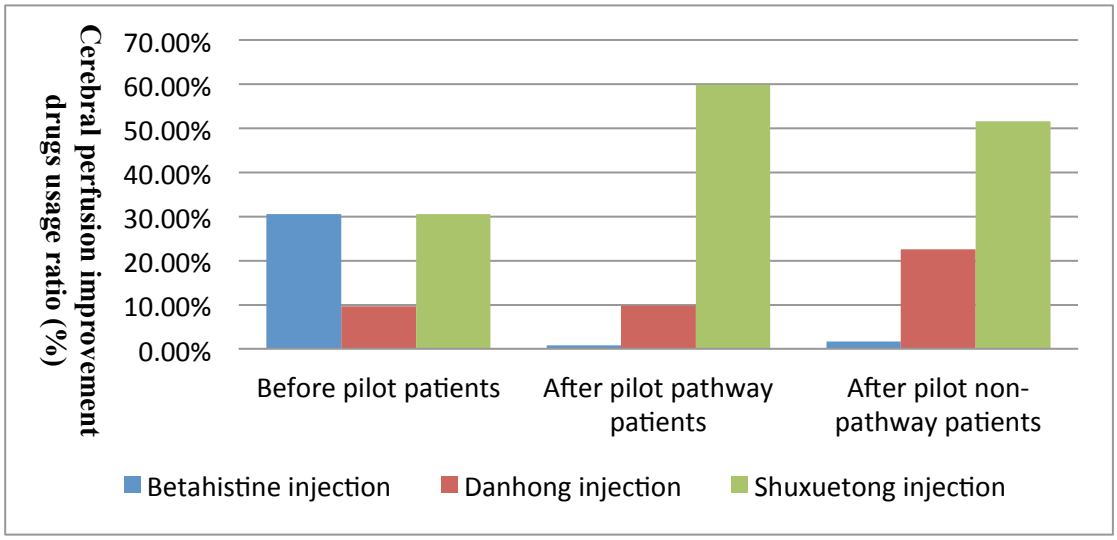

Figure 25 Usage proportion (%) of cerebral perfusion improvement drugs in cerebral infarction patients before and after pilot

Oxygen therapy was not recommended in the clinical pathway. However, usage proportion increased after the pilot, and was higher in pathway patients than both non-pathway patients and patients before the pilot (P<0.05) (Table).

Table 12 Cerebral infarction patients' oxygen usage before and after pilot

	Total patients	Patients that used oxygen	Usage proportion (%)*	Average usage per person (count)	Average cost per person (CNY)
Before pilot, all patients	134	53	39.55	3.00	119.92
After pilot, pathway patients	132	63	47.73	2.46	98.22
After pilot, non-pathway patients	62	12	19.35	2.83	113.00

*P≤0.05

4. Healthcare expenditure

Through analysis of the clinical inpatient medical records of Hanbin First Hospital from January 2012 to May 2015, it was found that the average hospitalization costs of cerebral hemorrhage patients were similar before and after the pilot implementation, and the average hospitalization cost of cerebral infarction patients increased by 25% after the pilot implementation. The out of pocket (OOP) percentages were maintained at less than 30% of total costs. Drug costs were also maintained at below 50% of total costs. Examination costs increased after the pilot implementation, from 23.99% to 29.94% of total costs. (TIA and COPD were not included in the analysis because there were too few TIA inpatients and no COPD patients before the pilot.)

(1) Total hospitalization cost

The average total hospitalization costs of cerebral hemorrhage patients were similar before and after the pilot implementation, but the variability reduced. There was not a significant difference between pathway and non-pathway patients in terms of average total hospitalization cost. The average hospitalization cost of cerebral infarction patients was higher after the pilot implementation with bigger variation, but within the pilot patients, pathway patients had a lower average cost with smaller variation than non-pathway patients (Figure 26, Figure 27).

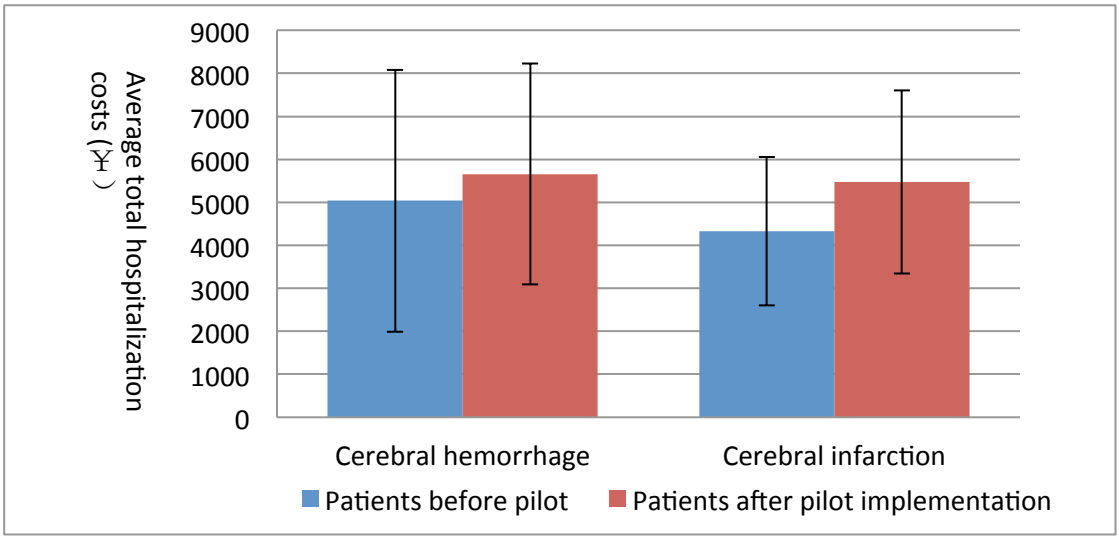

Figure 26 Average total hospitalization costs of cerebral hemorrhage and cerebral infarction patients (CNY) before and after pilot implementation

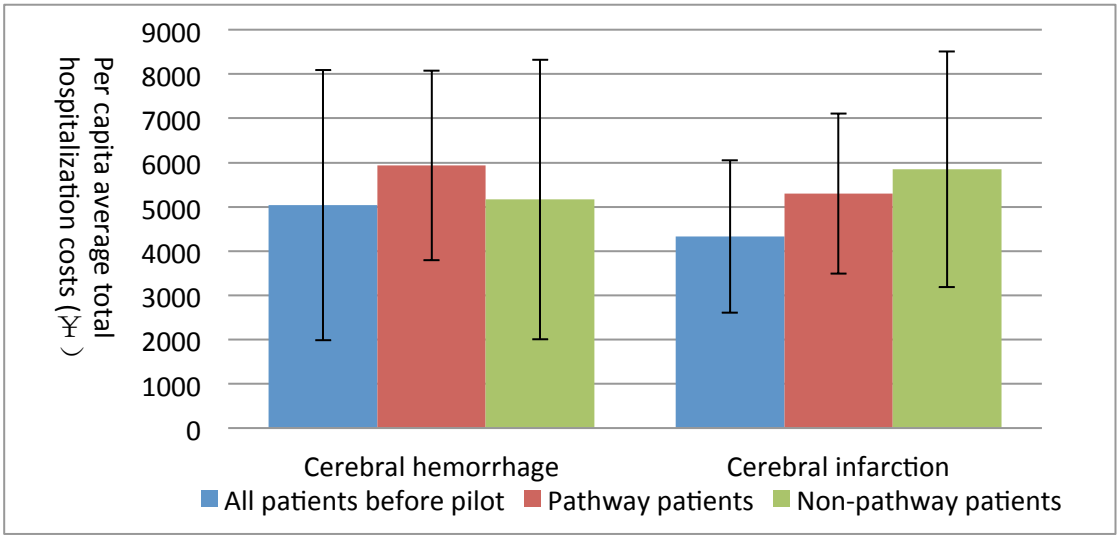

Figure 27 Average total hospitalization costs of cerebral hemorrhage and cerebral infarction patients, by pathway status before and after pilot (CNY)

A. Cerebral hemorrhage

The average total hospitalization cost of cerebral hemorrhage patients after pilot implementation was 5,054.96 CNY, similar to the cost before the pilot at 5,036.53 CNY (Table 3). Drug cost had the highest proportion from the total cost (Figure 28), with a higher average after the pilot than before, though not statistically significant (P≥0.05). Most of the other seven types of costs remained unchanged; only laboratory cost increased after the pilot implementation (Table 3).

Comparison of the three groups (all patients before the pilot, pathway patients and non-pathway patients after the pilot implementation) revealed that the average hospitalization cost of pathway patients was 895.44 CNY higher than patients before the pilot and 765.44 CNY higher than the non-pathway patient but such differences were not statistically significant (P≥0.05). Only laboratory cost increased significantly after the pilot among all other seven types of costs (Table 3), Drug cost had the highest proportion of the total cost (Figure 29).

Table 3 Cerebral hemorrhage inpatients' per capita average costs (CNY)

Cost types	Before pilot: All patients (n=132)	After pilot: All patients (n=105)	After pilot: Pathway	After pilot: Non-pathway

			patients (n=67)	patients (n=38)
Total	5,036.53 ± 3,050.50	5,054.96 ± 2,569.31	5,931.97 ± 2,142.45	5,166.53 ± 3,159.67
Drug	2,382.20 ± 1,592.33	2,561.63 ± 1,365.67	2,741.67 ± 1,197.63	2,244.18 ± 1,587.95
Examination	330.23 ± 446.46	434.13 ± 330.99	458.56 ± 339.85	391.06 ± 314.55
Laboratory	382.80 ± 198.17	595.62* ± 277.75	610.91* ± 221.68	568.65 ± 357.78
Radiation	351.71 ± 304.76	414.99 ± 267.51	403.76 ± 208.34	434.79 ± 350.84
Diagnosis & treatment	910.55 ± 707.39	922.36 ± 517.80	963.08 ± 460.65	850.58 ± 605.66
Nursing	180.07 ± 142.31	153.05 ± 82.73	165.86 ± 68.88	130.45 ± 99.77
Others	143.11 ± 124.78	152.29 ± 123.20	144.15 ± 107.87	166.66 ± 146.87

*P＜0.05

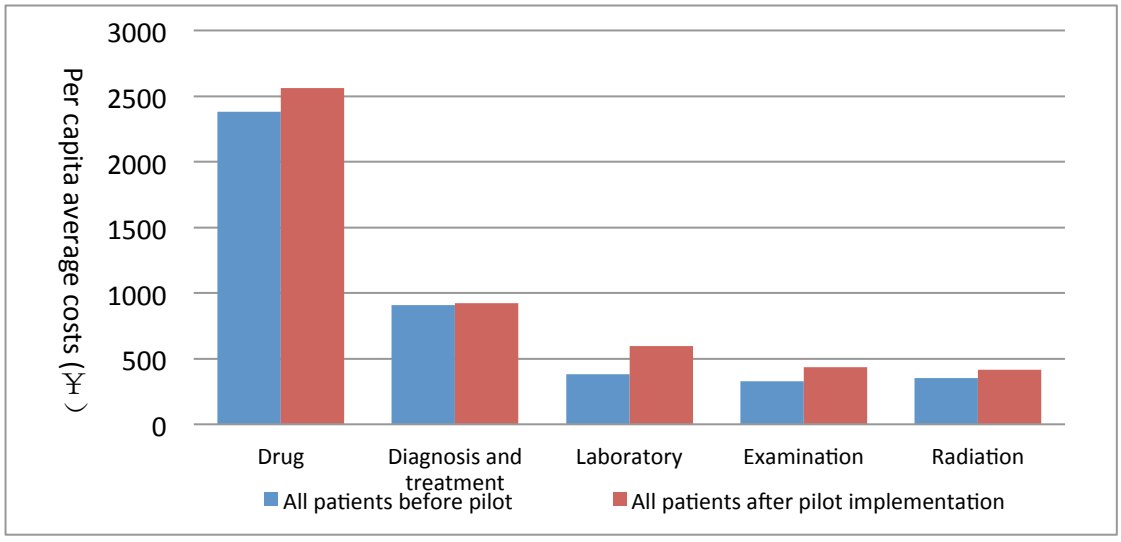

Figure 28 Top five costs for cerebral hemorrhage patients, before and after pilot implementation

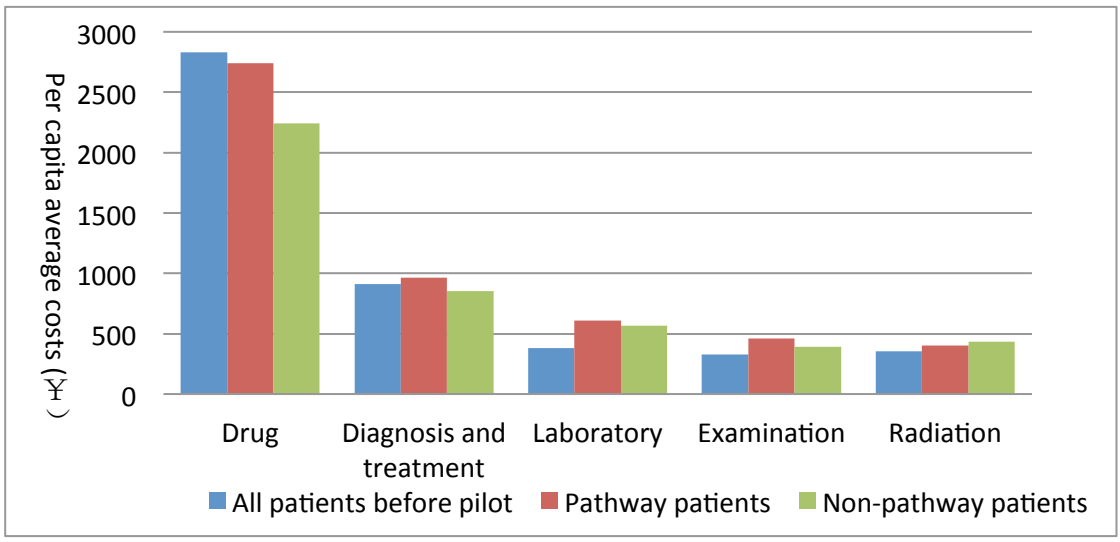

Figure 29 Top five costs for cerebral hemorrhage patients, stratified by before-pilot patients, pathway patients, and non-pathway patients

Long-term trend showed that the average hospitalization cost of cerebral hemorrhage patients before the pilot fluctuated between 2,000 and 8,000 CNY. The average hospitalization cost of all cerebral hemorrhage patients after the pilot implementation had a fluctuating increase (Figure 30). But interrupted time series (ITS) analysis showed that the change was not statistically significant (
Table **4**).

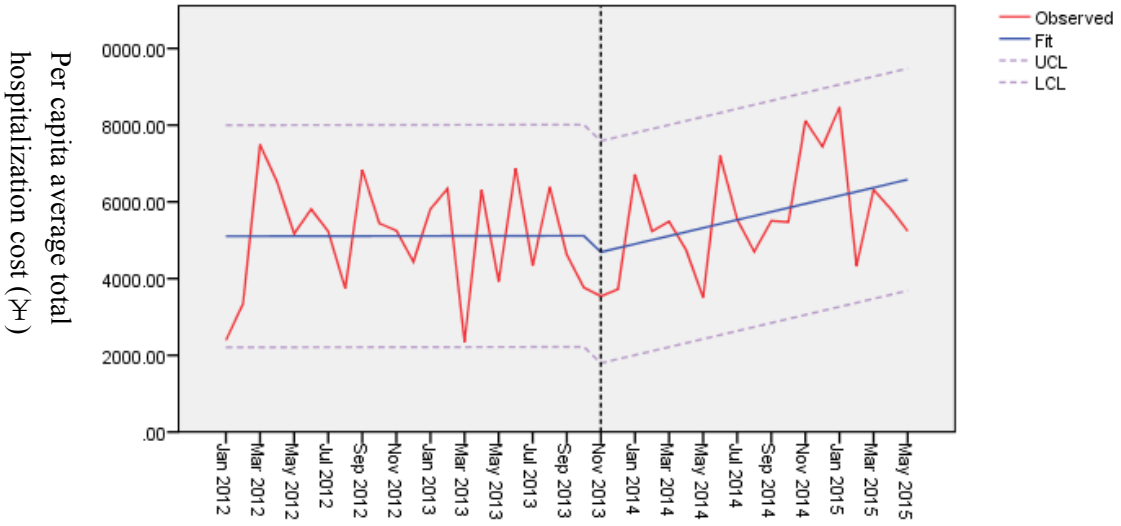

Figure 30 ITS analysis of per capita average hospitalization cost in cerebral hemorrhage patients, before vs. after pilot implementation

Table 4 ITS analysis of per capita average total hospitalization cost, before vs. after pilot implementation

Estimate	b	SE	t-value	P-value
Constant before pilot	5103.132	630.814	8.090	0.000
△ Constant	-2823.906	2043.307	-1.382	0.175
Slope before pilot	0.543	48.029	0.011	0.991
△ Slope	104.383	76.749	1.360	0.182

Among the pathway patients, the average total hospitalization cost ranged between 3,500 and 8,000 CNY, with a fluctuating growth trend. However the change was not statistically significant when comparing with patients before the pilot (Figure 31, Table 5).

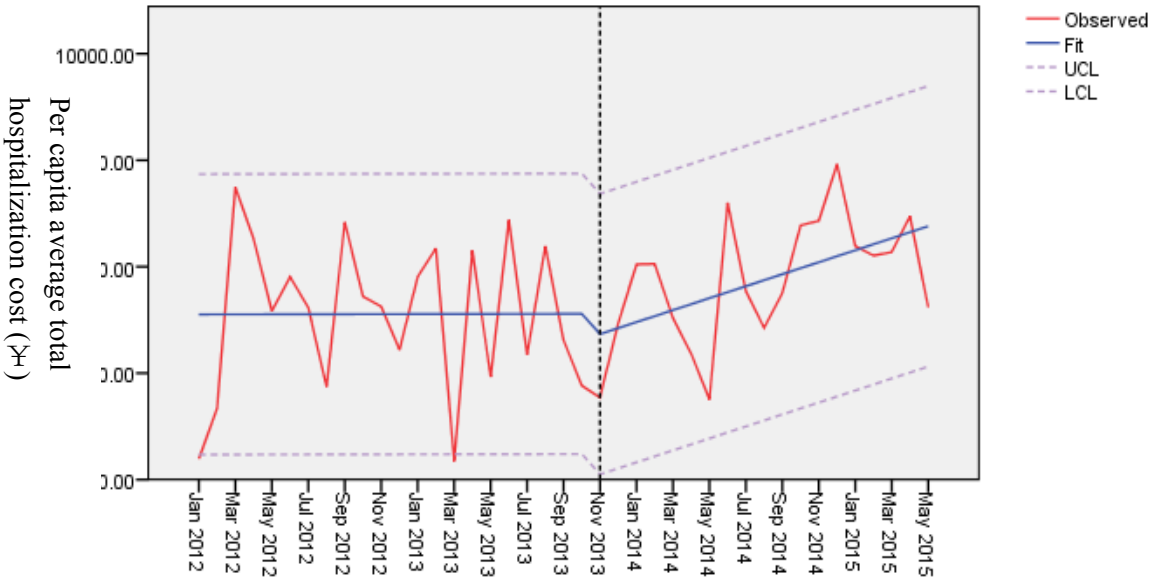

Figure 31 ITS analysis of per capita average hospitalization cost in cerebral hemorrhage patients, before-pilot patients vs. pathway patients

Table 5 ITS analysis of per capita average total hospitalization cost, patients before pilot vs. pathway patients

Estimate	b	SE	t-value	P-value
Constant before pilot	5103.132	573.927	8.892	0.000
△ Constant	-2956.470	1859.041	-1.590	0.120
Slope before pilot	0.543	43.698	0.012	0.990
△Slope	111.975	69.828	1.604	0.117

B. Cerebral infarction

The average hospitalization cost of cerebral infarction patients increased from 4,327.39 CNY before the pilot to 5,474.14 CNY after the pilot implementation, yielding a difference of 1,146.73 CNY (P<0.05). All cost types increased after the pilot implementation except for diagnosis and treatment cost and nursing cost (Table). Drug cost was the highest among all types of costs (Figure 32).

When stratifying by pathway status, the average hospitalization cost of pathway patients was 971.12 CNY higher than patients before the pilot (P<0.05), but was 543.63 CNY lower than non-pathway patients (P<0.05). All types of costs were higher than patients before the pilot but lower than non-pathway patients with the exception of diagnosis and treatment cost and nursing cost (Table). Drug cost was the highest among all types of costs (Figure 32).

Table 16 Cerebral infarction inpatients' per capita average costs (CNY)

Cost types	Before pilot: All patients (n=134)	After pilot: All patients (n=195)	After pilot: Pathway patients (n=132)	After pilot: Non-pathway patients (n=63)
Total	4,327.39 ± 1,724.19	5,474.14* ± 2,129.63	5,298.51* ± 1,807.55	5,842.14 ± 2,661.68
Drug	2,446.67 ± 1,145.37	2,926.45* ± 1,333.77	2,878.08* ± 1,144.38	3,027.79 ± 1,668.47

Examination	323.18 ± 208.91	440.35* ± 173.47	419.90* ± 180.58	483.21 ± 150.00
Laboratory	375.27 ± 121.16	685.63* ± 331.71	636.95* ± 259.80	787.63 ± 431.34
Radiation	281.01 ± 221.05	476.94* ± 272.03	456.49* ± 281.96	519.79 ± 246.61
Diagnosis & treatment	470.05 ± 334.20	459.90 ± 357.91	436.39 ± 298.45	509.17 ± 457.15
Nursing	103.48 ± 50.26	108.45 ± 42.98	107.62 ± 40.34	110.16 ± 48.41
Others	52.55 ± 43.22	75.41* ± 101.72	69.19* ± 78.30	88.43 ± 138.45

*P < 0.05

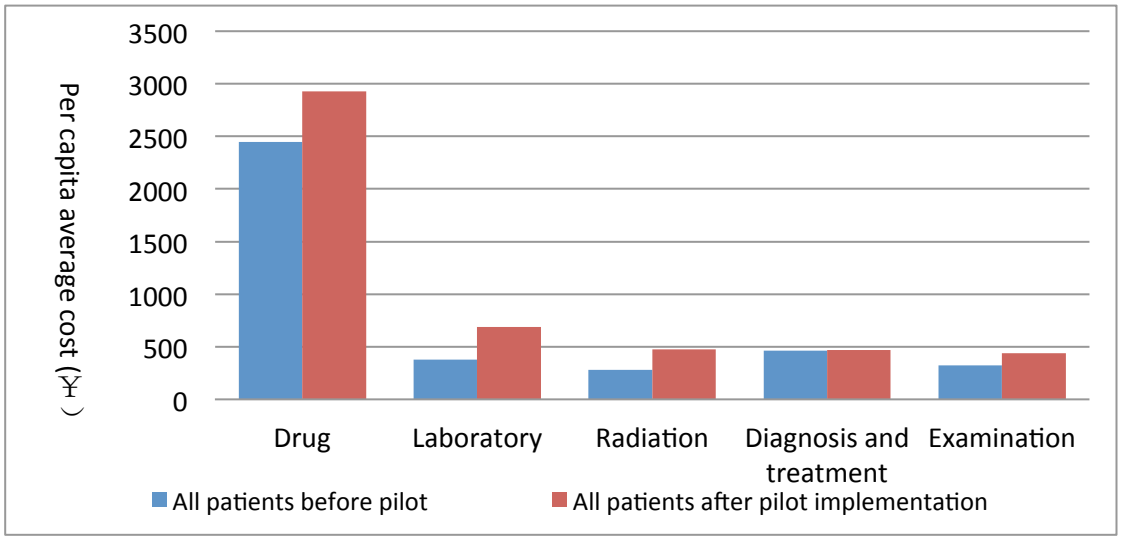

Figure 32 Top five costs for cerebral infarction patients, before and after pilot implementation

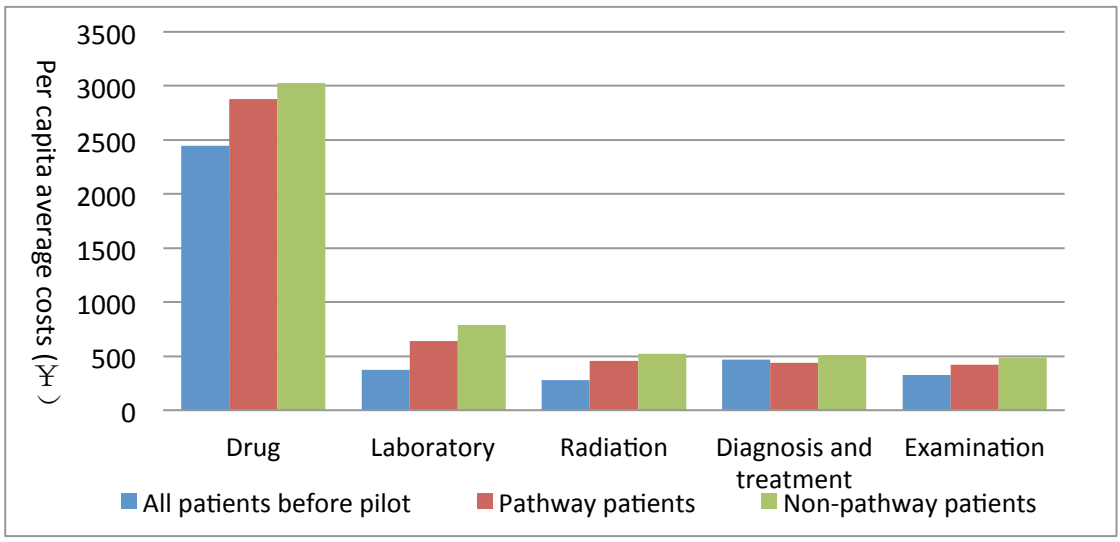

Figure 33 Top five costs for cerebral infarction patients, by pathway status before and after pilot

Long-term trend showed that the average hospitalization cost of cerebral infarction patients fluctuated between 3,000 and 7,000 CNY. After the pilot implementation, the average total cost had a fluctuating growth ranging between 4,000 and 8,000 CNY (Figure 34). ITS analysis, however, showed that the changes were not statistically significant (Table 6).

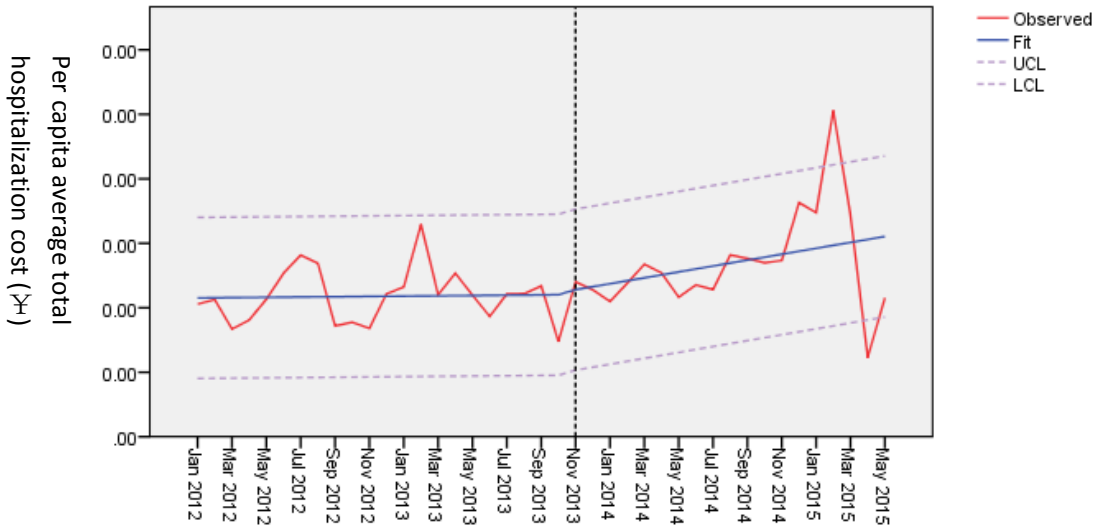

Figure 34 ITS analysis of per capita average hospitalization cost in cerebral

infarction patients, before vs. after pilot implementation

Table 6 ITS analysis of per capita average hospitalization cost in cerebral infarction patients, before vs. after pilot implementation

Estimate	b	SE	t-value	P-value
Constant before pilot	4300.794	543.976	7.906	0.000
△ Constant	-1842.989	1762.025	-1.046	0.302
Slope before pilot	4.679	41.418	0.113	0.911
△ Slope	86.874	66.184	1.313	0.197

Among the pathway patients, the average total cost showed a fluctuating increase, but ITS analysis showed that the changes were not statistically significant when comparing to before-pilot costs (Figure 35, Table).

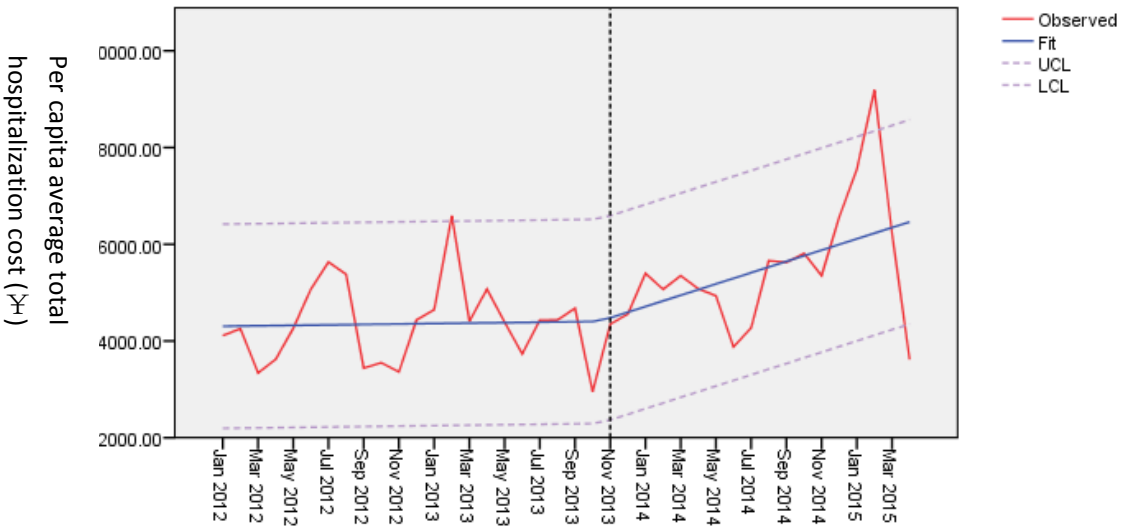

Figure 35 ITS analysis of per capita average hospitalization cost in cerebral infarction patients, before-pilot patients vs. pathway patients

Table 18 ITS analysis of per capita average hospitalization cost in cerebral infarction patients, before-pilot patients vs. pathway patients

Estimate	b	SE	t-value	P-value
Constant before pilot	4365.304	673.094	6.485	0.000
△ Constant	-1136.405	2434.273	2.025	0.644
Slope before pilot	-4.980	350.525	-0.467	0.922
△ Slope	74.971	90.394	-0.099	0.413

(2) Out of pocket (OOP) proportions

The OOP proportions of cerebral hemorrhage and cerebral infarction patients did not change after the pilot implementation, and were maintained below 30%. Pathway patients had a relatively higher OOP (Table 7). Long-term trend showed that the OOP proportions had a fluctuating downward trend throughout the time period, but decreased at a faster rate after the pilot implementation (Figure 36). However, ITS analysis showed no statistical significance (Table).

Table 7 OOP proportions of inpatients before and after pilot implementation

Groups	Total number of patients	OOP (%)
Before pilot: All patients	261	28.80 ± 13.71
After pilot: All patients	295	28.50 ± 14.61
After pilot: Pathway patients	197	29.37 ± 15.63
After pilot: Non-pathway patients	98	26.74 ± 12.16

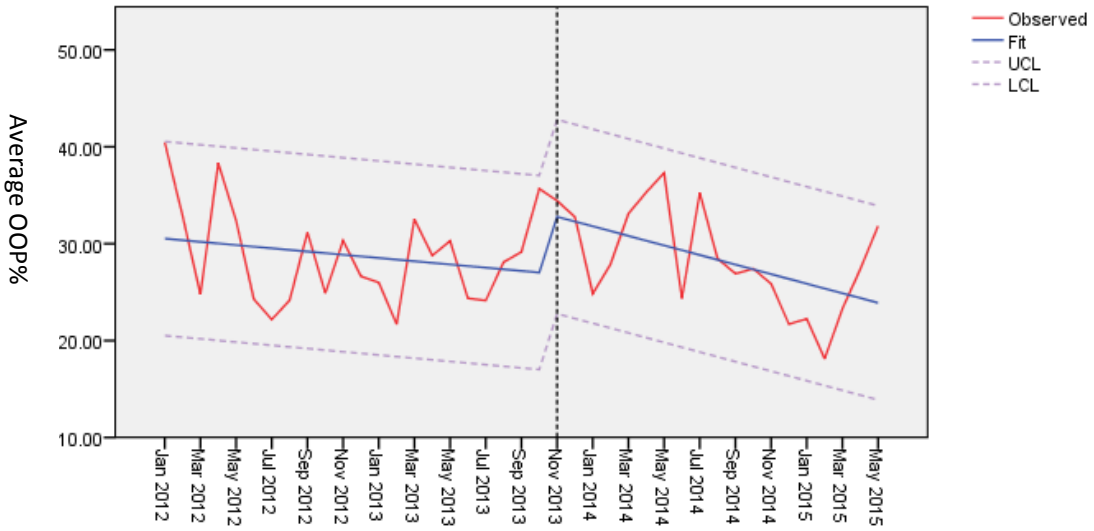

Figure 36 ITS analysis of average OOP proportions, before vs. after pilot implementation

Table 20 ITS analysis of average OOP proportions, before vs. after pilot implementation

Estimate	b	SE	t-value	P-value
Constant before pilot	30.697	2.182	14.071	0.000
△ Constant	13.446	7.066	1.903	0.065
Slope before pilot	-0.167	0.166	-1.004	0.322
△ Slope	-0.327	0.265	-1.232	0.226

Long-term trend showed that the OOP proportions of pathway patients decreased faster than all patients before the pilot and non-pathway patients (Figure 37). However, ITS analysis showed no statistical significance (

Table 8).

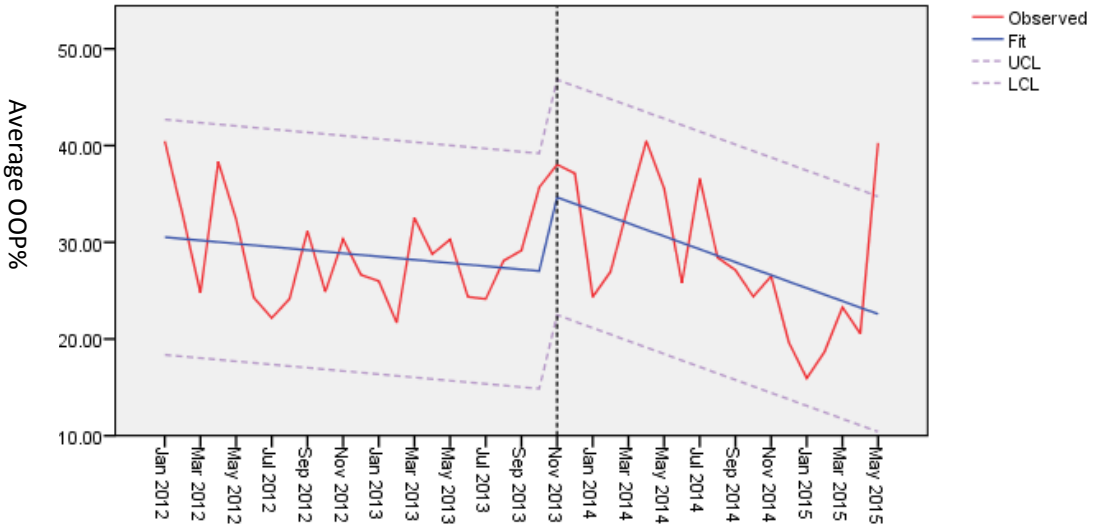

Figure 37 ITS analysis of average OOP proportions, before-pilot patients vs. pathway patients

Table 8 ITS analysis of average OOP proportions, before-pilot patients vs. pathway patients

Estimate	b	SE	t-value	P-value
Constant before pilot	30.679	2.650	11.586	0.000
△ Constant	19.375	8.582	2.257	0.030
Slope before pilot	-0.167	0.202	-0.826	0.414
△ Slope	-0.504	0.322	-1.563	0.127

(3) Drug cost proportions

Drug costs of cerebral hemorrhage and cerebral infarction patients accounted for the highest proportion of the total hospitalization cost. There was no significant change after the pilot implementation, with drug costs accounting for 50.01% in the before-pilot patients, 49.08% in the after-pilot patients, and 50.26% in the pathway

patients (Table 9). Long-term trend showed that that drug cost proportions had a fluctuating decline (Figure 38), with a greater decline before the pilot, but it was not statistically significant (Table).

Table 9Drug cost proportions of inpatients before vs. after pilot implementation

Groups	Total patients	Drug cost (%)
Before pilot: All patients	266	50.01 ± 12.31
After pilot: All patients	300	49.08 ± 10.61
After pilot: Pathway patients	199	50.26 ± 10.34
After pilot: Non-pathway patients	101	46.75 ± 10.80

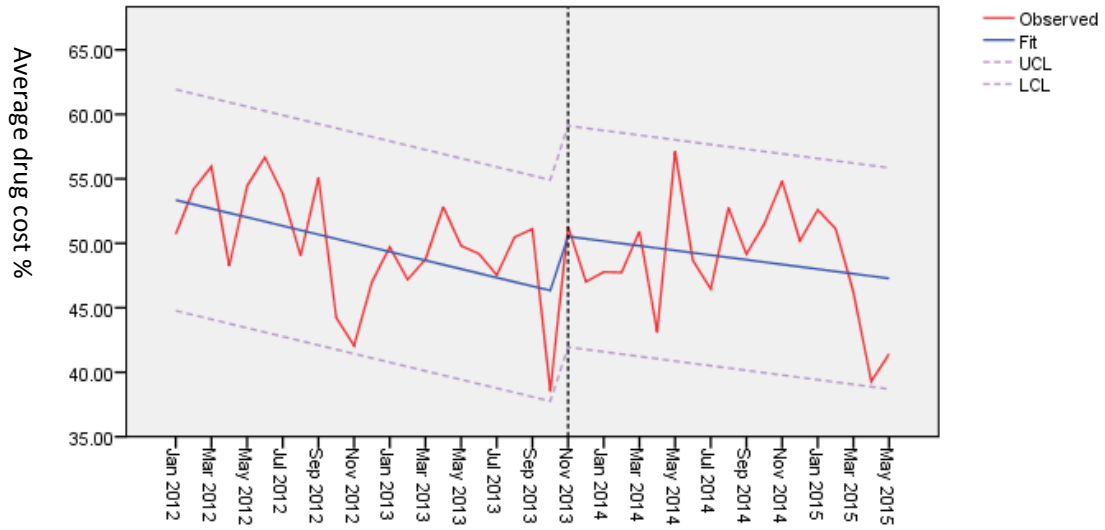

Figure 38 ITS analysis of average drug cost proportions, patients before vs. after pilot implementation

Table 23 ITS analysis of average drug cost proportions, patients before vs. after pilot implementation

Estimate	b	SE	t-value	P-value
Constant before pilot	53.684	1.869	28.731	0.000
△ Constant	1.002	6.052	0.165	0.869
Slope before pilot	-0.334	0.142	-2.348	0.024
△ Slope	-0.153	0.227	-0.674	0.504

Among the pathway patients, the drug cost proportions showed a fluctuated decreasing trend, but ITS analysis showed no statistically significant change from the proportions before the pilot (Figure 39, Table).

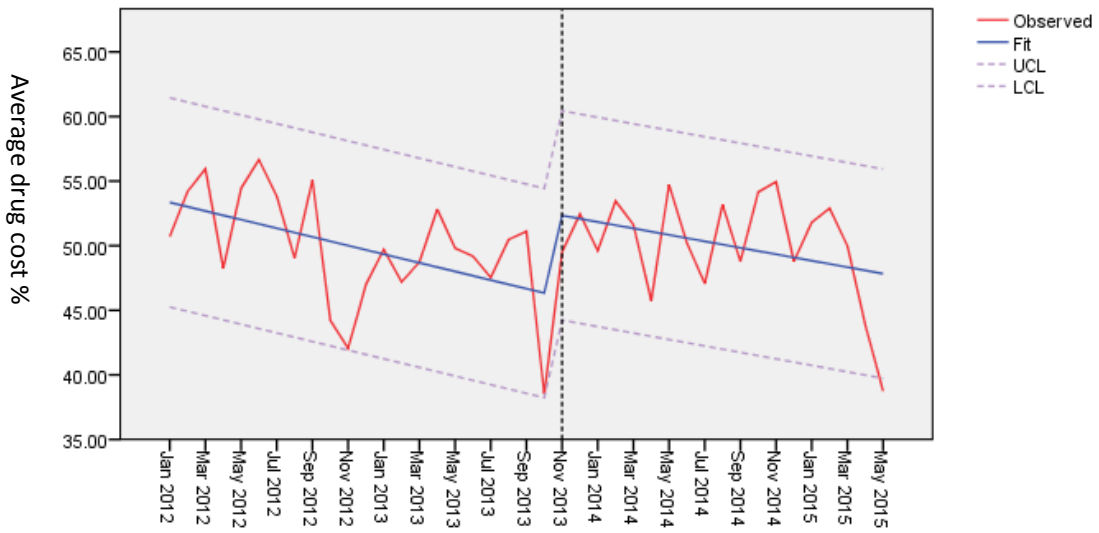

Figure 39 ITS analysis of average drug cost proportions, before-pilot patients vs. pathway patients

Table 24 ITS analysis of average drug cost proportions, before-pilot patients vs. pathway patients

Estimate	b	SE	t-value	P-value
Constant before pilot	53.684	1.764	30.430	0.000

△ Constant	4.409	5.714	0.772	0.445
Slope before pilot	-0.334	0.134	-2.486	0.018
△ Slope	-0.084	0.215	0.390	0.699

(4) Examination cost proportions

Examination costs of cerebral hemorrhage and cerebral infarction patients accounted for 23.99% of the total hospitalization cost before the pilot. The examination cost proportion was 29.94% in all patients after the pilot implementation, which was a 5.95% increase from the proportion before the pilot (P<0.05). The proportion of examination cost was lower in the pathway patients than the non-pathway patients (P<0.05) (Table). Long-term trend showed that examination cost proportion had an increasing trend overall, but had smaller fluctuation and slower rate after the pilot implementation (Figure 40). ITS analysis showed no statistically significant difference (Table).

Table 25 Examination cost proportions of inpatients before and after pilot implementation

Groups	Total number of patients	Examination cost (%)
Before pilot: All patients	266	23.99 ± 10.36
After pilot: All patients	300	29.94* ± 10.51
After pilot: Pathway patients	199	29.02* ± 9.96
After pilot: Non-pathway patients	101	31.75 ± 11.34

*P<0.05

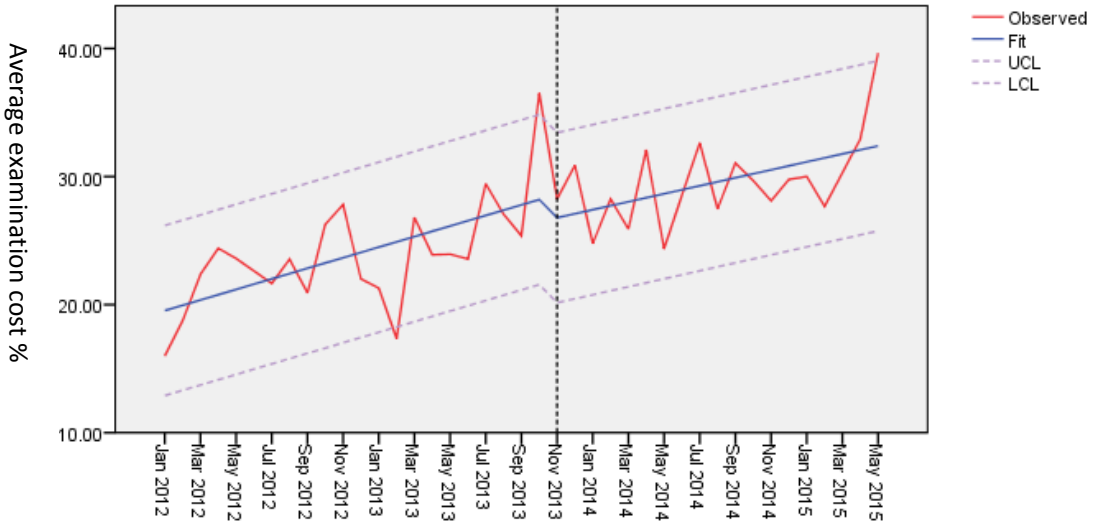

Figure 40 ITS analysis of average examination cost proportions, patients before vs. after pilot implementation

Table 26 ITS analysis of average examination cost proportions, patients before vs. after pilot implementation

Estimate	b	SE	t-value	P-value
Constant before pilot	19.128	1.447	13.224	0.000
△ Constant	0.504	4.686	0.108	0.915
Slope before pilot	0.412	0.110	3.745	0.001
△ Slope	-0.101	0.176	-0.575	0.569

Examination cost proportions of pathway patients decreased when compared to patients before the pilot, and had a slower increasing trend (Figure 41), but ITS analysis showed no statistically significant difference (Table 3).

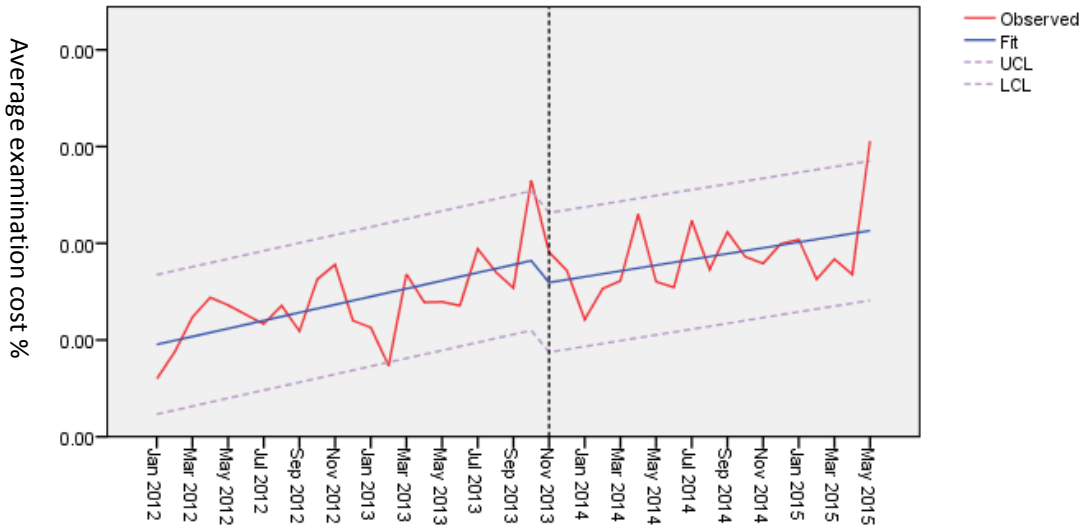

Figure 41 ITS analysis of average drug cost proportions, before-pilot patients vs. pathway patients

Table 10 ITS analysis of average drug cost proportions, before-pilot patients vs. pathway patients

Estimate	b	SE	t-value	P-value
Constant before pilot	19.128	1.569	12.188	0.000
△ Constant	-0.030	5.084	-0.006	0.995
Slope before pilot	0.412	0.119	3.452	0.001
△ Slope	-0.115	0.191	-0.601	0.552

5. Healthcare efficiency

The integrated care pathway has standards for hospitalization days for each disease. For Hanbin First Hospital, the shortest and longest hospitalization days of cerebral hemorrhage and cerebral infarction are 15 days and 25 days respectively. The analysis of hospitalization records of cerebral hemorrhage and cerebral infarction inpatients from January 2012 to May 2015 in Hanbin First Hospital revealed the following: the average hospitalization days of cerebral hemorrhage patients increased after the pilot implementation whereas average hospitalization days of cerebral hemorrhage patients remained unchanged and stayed below the minimum standards (Figure 42, Figure 43). (TIA and COPD were not included in the analysis because there were too few TIA patients and no COPD patients before the pilot implementation.)

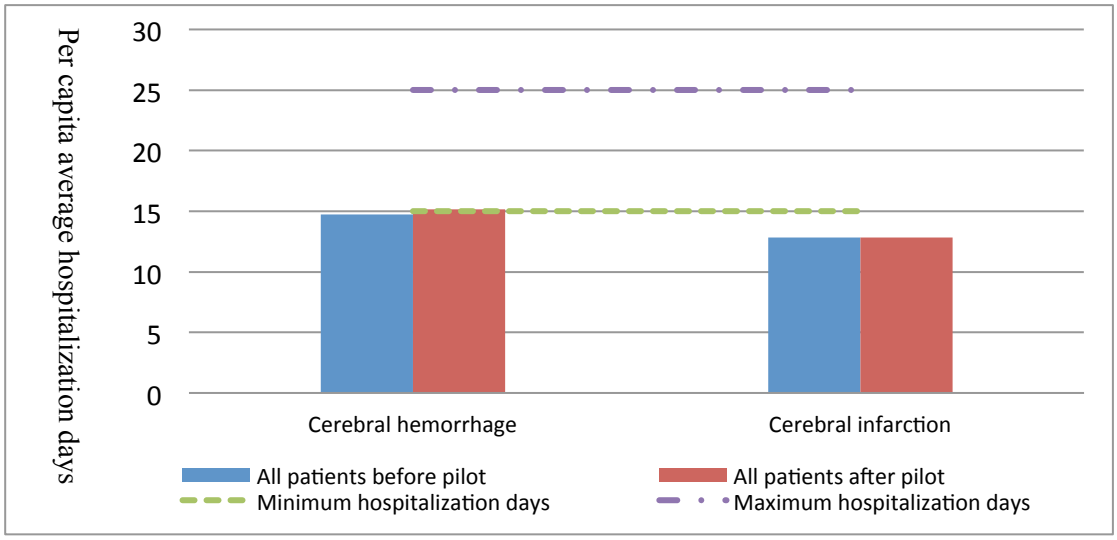

Figure 42 Average hospitalization days, before and after pilot implementation

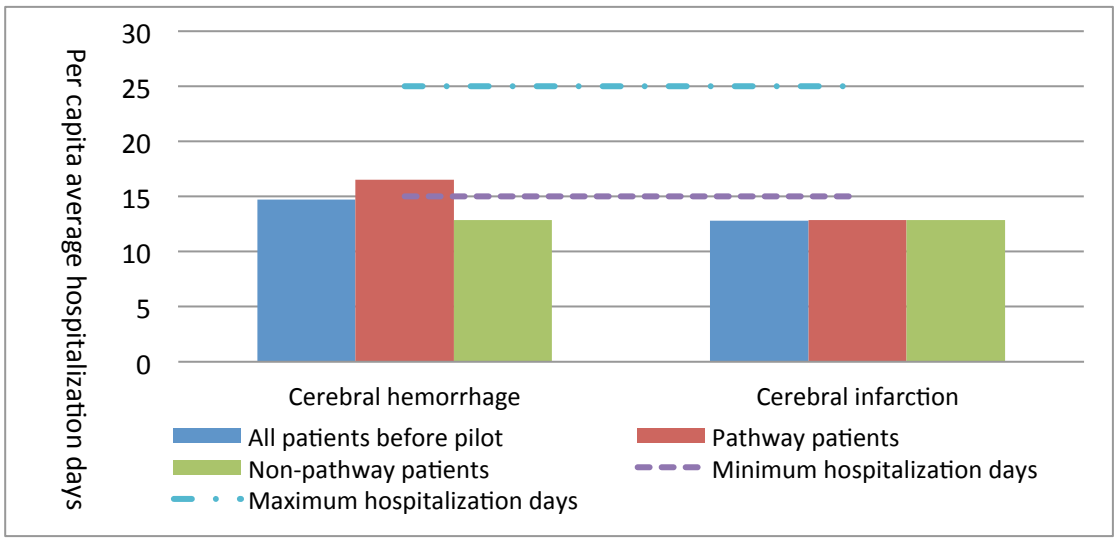

Figure 43 Average hospitalization days, by pathway status before and after pilot

(1) Cerebral hemorrhage

The average hospitalization days of cerebral hemorrhage patients before the pilot were 14.72 days, which was below the minimum standards. After the pilot implementation, the average hospitalization days of cerebral hemorrhage patients increased to 15 days. Average hospitalization days for pathway patients was 16.49 days with smaller variation; and for non-pathway patients, it was 12.84 days with larger variability (Table).

Table 28 Average hospitalization days of cerebral hemorrhage patients before and after pilot implementation

Groups	Total patients	Average hospitalization days
Before pilot: All patients	132	14.72 ± 9.36
After pilot: All patients	105	15.17 ± 8.14
After pilot: Pathway patients	67	16.49 ± 6.94
After pilot: Non-pathway patients	38	12.84 ± 9.56

Long-term trend showed that the average hospitalization days of cerebral hemorrhage patients had a fluctuating decreasing trend before the pilot and an

increasing trend after (Figure 44). Pathway patients' hospitalization days had a fluctuating increasing trend, with a faster rate than all patients before the pilot (Figure 45). But ITS analysis showed no statistically significant changes (Table 11, Table).

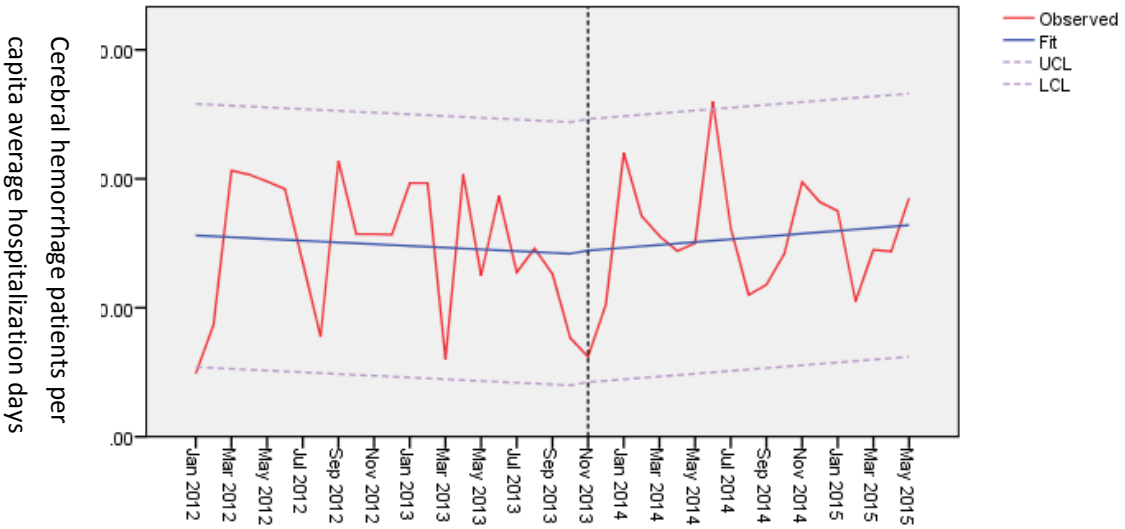

Figure 44 ITS analysis of average cerebral hemorrhage hospitalization days, before vs. after pilot

Table 11 ITS analysis of average cerebral hemorrhage hospitalization days, before vs. after pilot

Estimate	b	SE	t-value	P-value
Constant before pilot	15.674	2.223	7.052	0.000
△ Constant	-3.745	7.199	-0.520	0.606
Slope before pilot	-0.067	0.169	-0.398	0.693
△ Slope	0.177	0.270	0.653	0.518

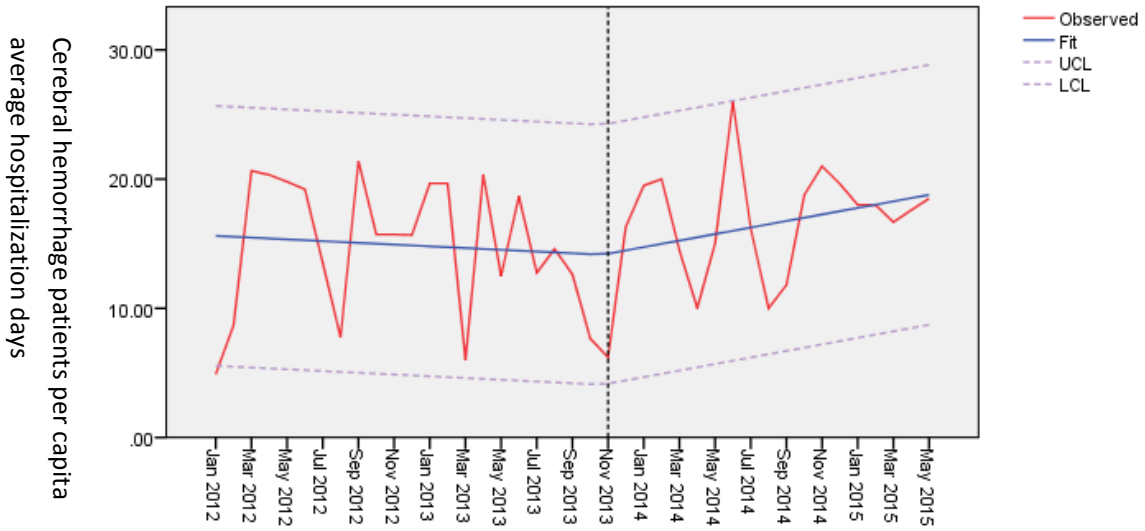

Figure 45 ITS analysis of average cerebral hemorrhage hospitalization days, before-pilot patients vs. after-pilot pathway patients

Table 30 ITS analysis of average cerebral hemorrhage hospitalization days, before-pilot patients vs. after-pilot pathway patients

Estimate	b	SE	t-value	P-value
Constant before pilot	15.674	2.191	7.154	0.000
△ Constant	-3.745	7.097	-1.023	0.313
Slope before pilot	-0.067	0.167	-0.404	0.689
△ Slope	0.320	0.267	1.202	0.237

(2) Cerebral infarction

The average cerebral infarction hospitalization days of patients before and after the pilot were around 12.8 days, with smaller variability in patients after the pilot implementation (Table).

Table 31 Average hospitalization days of cerebral infarction patients before and after pilot implementation

Groups	Total number of patients	Average hospitalization days
Before pilot: All patients	134	12.81 ± 5.35
After pilot: All patients	195	12.85 ± 4.64
After pilot: Pathway patients	67	12.83 ± 4.29
After pilot: Non-pathway patients	38	12.87 ± 5.33

Long-term trend showed that the average hospitalization days of cerebral infarction patients after the pilot implementation was shorter than patients before the pilot, and had a gradual increasing trend (Figure 46). Pathway patients had a fluctuating increasing trend, which was at a faster rate than patients before the pilot (Figure 47). However, ITS analysis showed no statistically significant changes (Table 12, Table 13).

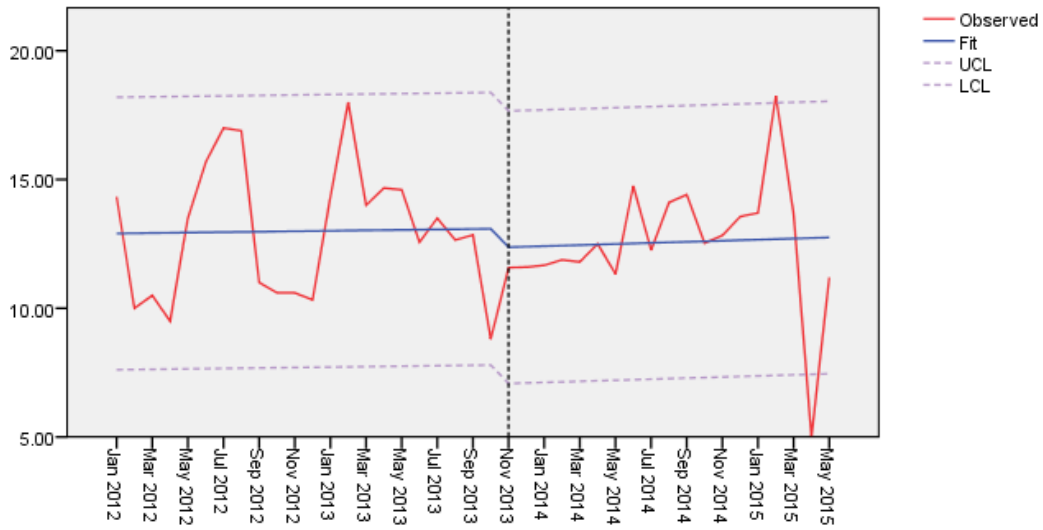

Figure 46 ITS analysis of average cerebral infarction hospitalization days, before vs. after pilot

Table 12 ITS analysis of average cerebral infarction hospitalization days,

before vs. after pilot

Estimate	b	SE	t-value	P-value
Constant before pilot	12.895	1.153	11.186	0.000
△ Constant	-1.006	3.734	-0.269	0.789
Slope before pilot	-0.009	0.088	-0.099	0.921
△ Slope	0.012	0.140	0.087	0.931

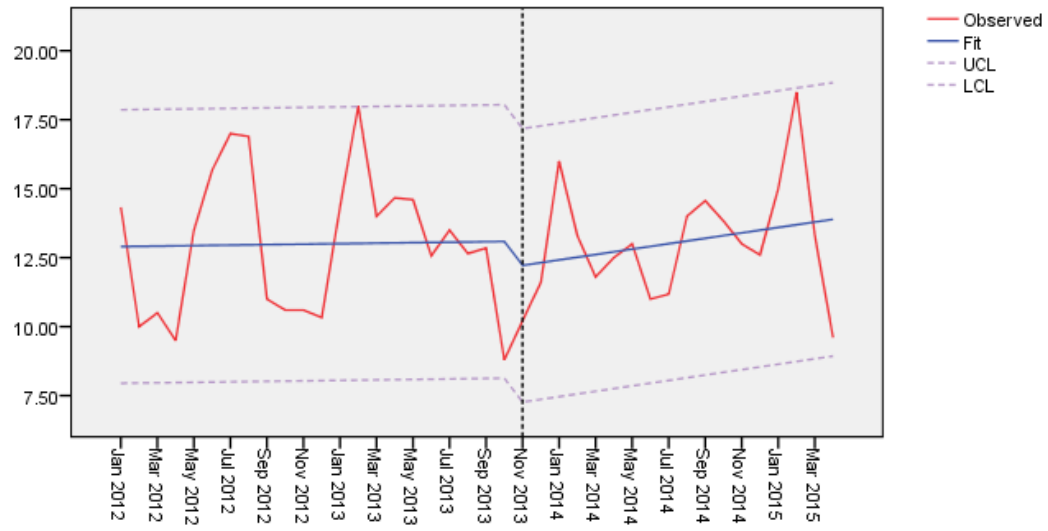

Figure 47 ITS analysis of average cerebral infarction hospitalization days, before-pilot patients vs. after-pilot pathway patients

Table 13 ITS analysis of average cerebral infarction hospitalization days, before-pilot patients vs. after-pilot pathway patients

Estimate	b	SE	t-value	P-value
Constant before pilot	12.895	1.079	11.956	0.000
△ Constant	-2.929	3.705	-0.791	0.434
Slope before pilot	-0.009	0.082	0.106	0.916

△ Slope	0.089	0.138	0.647	0.521

6. Healthcare quality

EQ-5D surveys before and after pilot implementation and 30-day hospital readmission records from January 2012 to May 2015 of cerebral hemorrhage and cerebral infarction patients were collected and analyzed. Results showed that there were no differences in EQ-5D scores between patients before and after the pilot. Hospital readmissions within 30 days stayed at low levels before and after the pilot implementation. (TIA and COPD were not included in the analysis because there were too few TIA patients and no COPD patients before pilot implementation.)

(1) Cerebral hemorrhage

A. EQ-5D analysis

The average EQ-5D score of cerebral hemorrhage patients at admission was 0.063 in all patients after the pilot implementation, lower than the 0.131 in patients before the pilot. The average EQ-5D score at discharge was 0.552 in all patients after the pilot implementation, lower than the 0.532 in the pre-pilot patients before and with smaller variance (**Table 14**). Difference in difference (DID) analysis showed that the average EQ-5D score was higher at discharge than at admission by 0.401 (P<0.05). The difference was larger in patients after the pilot implementation by 0.088, but with no statistical significance (P≥0.05) (

Table).

Table 14 EQ-5D scores of cerebral hemorrhage patients before and after pilot

	Before pilot		After pilot	
	Admission	**Discharge**	**Admission**	**Discharge**
Sample size	26	26	58	58
Average	0.131	0.532	0.063	0.552
Medium	0.052	0.675	-0.111	0.675
SE	0.240	0.317	0.254	0.281
Minimum	-0.111	-0.111	-0.111	-0.111

Maximum	0.532	0.848	0.705	0.848

Table 35 DID analysis of EQ-5D scores of cerebral hemorrhage patients

Model	Unstandardized		Standardized	t	P
	B	SE	Beta distribution		
Constant	0.131	0.053		2.455	0.015
Before vs. after pilot implementation	-0.068	0.064	-0.089	-1.059	0.291
Admission vs. discharge groups	0.401	0.075	0.565	5.317	0.000
DID	0.088	0.091	0.117	0.965	0.336

VAS scores at discharge were 61 for both cerebral hemorrhage patients before and after pilot implementation (**Table**). DID analysis showed that VAS score at discharge was 31.5 points higher than score at admission for cerebral hemorrhage patients (P<0.05). The difference was larger in patients after pilot implementation by 1.293, however with no statistical significance (P≥0.05) (

Table).

Table 36 VAS scores of cerebral hemorrhage patients before and after pilot

	Before pilot		After pilot	
	Admission	Discharge	Admission	Discharge
Sample size	26	26	58	58
Average	30.08	61.58	28.72	61.52
Medium	30.00	63.00	27.50	67.50

SE	12.72	22.92	16.10	22.29
Minimum	5.00	5.00	0.00	0.00
Maximum	60.00	95.00	85.00	90.00

Table 37 DID analysis of VAS scores of cerebral hemorrhage patients

Model	Unstandardized		Standardized	t	P
	B	SE	Beta distribution		
Constant	30.077	3.76		8.000	0.000
Before vs. after pilot implementation	-1.353	4.525	-0.025	-0.299	0.765
Admission vs. discharge groups	31.5	5.317	0.632	5.924	0.000
DID	1.293	6.399	0.025	0.202	0.840

B. Hospital readmission in 30 day analysis

The average hospital readmission in 30 days of cerebral hemorrhage patients in Hanbin First Hospital stayed low, with no difference between before and after pilot implementation (P≥0.05) (**Table 15**).

Table 15Hospital readmission in 30 days of cerebral hemorrhage patients

Groups	Total patients	Patients readmitted in 30 days	Hospital readmission rate in 30 days
Before pilot, all patients	134	2	1.49%
After pilot, all patients	109	2	1.83%
After pilot, pathway patients	67	2	2.98%

After pilot, non-pathway	42	0	0.00%

(2) Cerebral infarction

A. EQ-5D analysis

EQ-5D score was 0.724 in patients after the pilot implementation, higher than the 0.701 in patients before the pilot and with smaller variation (**Table**). DID analysis showed that the difference of discharge and admission was 0.052 points greater in patients after pilot implementation than before pilot, but with no statistical significance (

Table).

Table 39 DID analysis of EQ-5D scores of cerebral infarction patients

	Before pilot		After pilot	
	Admission	**Discharge**	**Admission**	**Discharge**
Sample size	182	182	423	423
Average	0.399	0.701	0.370	0.724
Medium	0.532	0.750	0.532	0.773
SE	0.257	0.201	0.270	0.160
Minimum	-0.111	-0.111	-0.111	-0.111
Maximum	0.785	0.848	0.848	0.848

Table 40 DID analysis of EQ-5D scores of cerebral infarction patients

models	**Unstandardized**		**Standardized**	**t**	**P**
	B	**SE**	**Beta distribution**		
Constant	0.399	0.017		23.986	0.000
Before vs. after pilot	-0.029	0.020	-0.047	-1.444	0.149

Admission vs. discharge	0.302	0.024	0.537	12.832	0.000
DID	0.052	0.028	0.088	1.844	0.065

VAS scores was 41.82 at admission and 72.79 at discharge after pilot implementation, both lower than VAS score before the pilot (**Table**). DID analysis showed that VAS score at discharge was 31.986 points higher than score at admission for cerebral infarction patients (P<0.05). The difference was larger in patients after pilot implementation by 1.012, however with no statistical significance (P≥0.05) (

Table).

Table 41 VAS scores of cerebral infarction patients before and after pilot implementation

	Before pilot		**After pilot**	
	Admission	**Discharge**	**Admission**	**Discharge**
Sample size	182	182	423	423
Average	42.60	74.59	41.82	72.79
Medium	45.00	80.00	40.00	75.00
SE	12.96	16.15	13.98	14.92
Minimum	4.00	10.00	0.00	10.00
Maximum	70.00	99.00	95.00	98.00

Table 42 DID analysis of VAS scores of cerebral infarction patients

Models	**Unstandardized**		**Standardized**	**t**	**P**
	B	**SE**	**Beta distribution**		
Constant	42.600	1.082		39.380	0.000

Before vs. after pilot	-0.781	1.293	-0.017	-0.604	0.546
Admission vs. discharge	31.986	1.528	0.750	20.937	0.000
DID	-1.012	1.827	-0.023	-0.554	0.580

B. Hospital readmission in 30 day analysis

The average hospital readmission in 30 days of cerebral infarction patients stayed low, with no difference between before and after pilot implementation (P≥0.05) (**Table 16**). Pathway patients had 0% readmission rate.

Table 16Hospital readmission in 30 days of cerebral infarction patients

Groups	Total patients	Patients readmitted in 30 days	Hospital readmission rate in 30 days
Before pilot, all patients	132	2	1.51%
After pilot, all patients	195	1	0.50%
After pilot, pathway patients	133	0	0.00%
After pilot, non-pathway	63	1	1.58%

7. Rehabilitation

Stroke rehabilitation treatment included the following: general treatment and early rehabilitation treatment in emergency and neurology departments for patients; rehabilitation for patients in the rehabilitation ward; and rehabilitation for patients in community and at home.

(1) In-hospital rehabilitation

As the pilot project progressed, Hanbin First Hospital implemented early rehabilitation program for stroke patients. The program encouraged cerebral infarction patients to ambulate as soon as possible, and removed the doctor's prescription of long-term bed rest for cerebral hemorrhage and cerebral infarction patients. Stroke patients were evaluated using freehand balancing test, swallowing dysfunction assessment and other tests in the acute rehabilitation pathway. About 10% of stroke patients had early rehabilitation.

(2) Stable phase rehabilitation

In June 2014, the Hanbin hospital implemented the integrated project and chose stroke and COPD and their complications as the two pilot diseases. Eight community health service centers and township hospitals became pilot facilities, accepting downward-referral patients from Hanbin First Hospital for rehabilitation. By May 2015, there were 366 patients that conducted the rehabilitation treatment, which accounted for 41.54% of all hospitalized patient of the pilot diseases.

Further time series analysis of the downward referral patients showed that more than 30% of patients were referred to lower-level health facilities for continued rehabilitation, with the highest ratio reaching 80% (Figure 48).

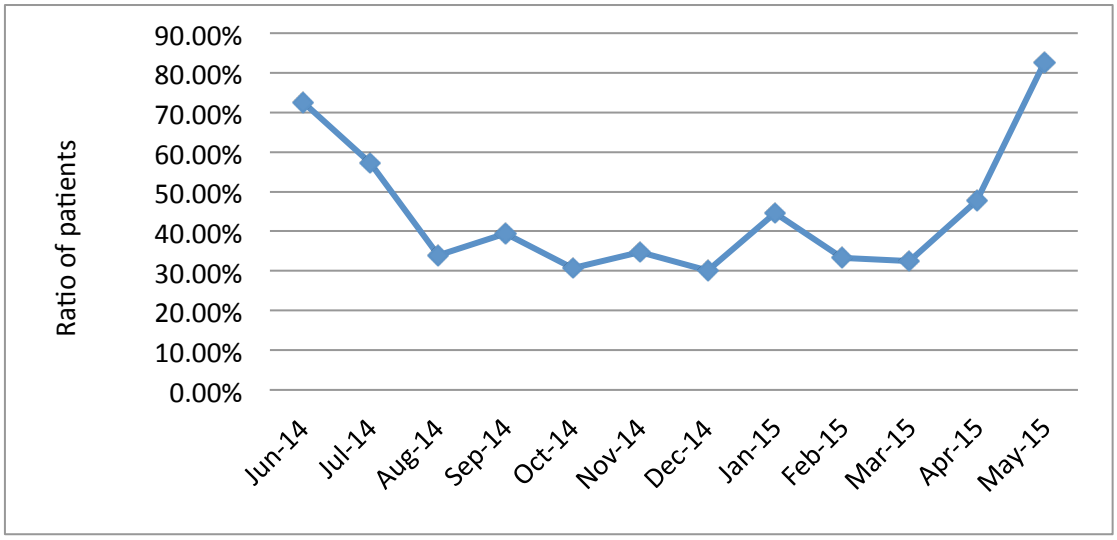

Figure 48 Downward referral and lower level health facilities rehabilitation ratio

8. Discussion

(1) Project implementation

Through the implementation of the integrated care pathway and the support of payment reform and information technology, the number of pathway patients increased gradually in Hanbin First Hospital. COPD, cerebral infarction and cerebral hemorrhage had entrances rates of over 70%, completion rates of over 90% and management rates of over 64%, but most TIA patients received treatment at the outpatient unit.

Medical insurance payment method in Hanbin was relatively stable. Since 2010, the district had implemented mixed payment method for hospitalization. For NRCMS patients, Hanbin implemented a single disease fixed payment method under the clinical pathway, with 20% OOP and 80% reimbursed by the NRCMS. The NRCMS had the management method of "keep surplus; pay for excess services." As the project progressed, the hospital observed improvements in medical quality and efficiency through the care pathways, and continued to support the pathway intervention through the medical insurance policy.

At the same time, 85% of patients in Hanbin First Hospital were NRCMS patients, and over 90% of them entered the care pathway management. The number of patients entering pathway changed depending on the total number of inpatients but with small variation. This indicated that being covered by medical insurance was a major factor of clinical pathway entrance. Also, integrated care pathway entrance had certain level of applicability, and was not dependent on patient's severity of diseases.

(2) Project implementation's effect on clinical behavior

The project implementation standardized clinical behaviors, which was mainly reflected through the usage ratio of mandatory drugs and medical devices. This indicated that clinical pathways had significant effect on insufficient mandatory action, but had weak effect on optional actions.

A. Improvements in insufficient clinical actions

Implementation of pathway standardized doctor's clinical diagnosis and treatment, with increased utilization of evidence-based clinical procedures. For example, the cranial imaging test within 24 hours of hospitalization for cerebral

hemorrhage patients increased to 90%, which was significantly higher than before the pilot.

B. No change in excessive clinical actions

Comparisons of optional items before and after the pilot implementation showed that there was no significant change; in fact, some optional drugs had increase in usage ratios after the pilot implementation. Multiple reasons could contribute to the occurrence. First, doctor's prescription habits were unchanged after the clinical pathway. For example, dehydrating drug usage ratio of cerebral infarction patients was unchanged after the pilot implementation. Second, some optional drugs were covered in the local medical insurance reimbursement list, so that it was easy for doctors to continue prescribing the drug.

(3) Project implementation's effect on medical expense

A. Project implementation's effect on total hospitalization cost

The per capita hospitalization cost of cerebral hemorrhage patients remained unchanged after the pilot implementation with smaller variance. The hospitalization cost of cerebral infarction patients increased and had larger variance after the pilot implementation. Further analysis revealed that pathway patients after the pilot implementation had smaller variance. Project implementation had standardized clinical behaviors by controlling insufficient and excessive clinical actions, resulting in narrower variance of total hospitalization cost.

B. Project implementation's effect on OOP proportions

The primary aim of the project was to improve medical quality while lessoning patients' economic burden. Comparison before and after implementation showed that the pathway intervention did not increase patients' OOP. Patients' OOP further indicated a downward trend, at a faster rate after the pilot implementation.

C. Project implementation on drugs and test cost proportions

In general, project implementation had no significant effect on drug and test cost proportions and the lab test cost slightly increased after the pilot implementation. This might be due to the standardized clinical behavior after the pathway implementation, improving mandatory tests and thus increasing test costs.

(4) Project implementation's effect on clinical efficiency

At the early stage of the pilot, Hanbin First Hospital increased the standard hospitalization days by seven days based on the local geographic and traffic status. Analysis results showed that the average hospitalization days of cerebral hemorrhage was around 15 days, and cerebral infarction was lower than 13 days. Thus, Hanbin First Hospital was able to adjust based on physicians' advice while ensuring medical quality.

(5) Project implementation's effect on clinical quality

EQ-5D analysis revealed that scores did not change before and after pilot implementation. Also, 30-day readmission rate remained consistently low before and after pilot implementation. This showed that the clinical pathway was safe and maintained clinical quality.

(6) Project implementation's effect on rehabilitation

Through the project implementation and training, clinicians improved knowledge in acute and stable rehabilitation treatment, for example, encouraging ambulation of patients. However, due to limitation of hospital rehabilitation equipment, technology and human resource, the percentage of patients receiving rehabilitation was low, requiring further actions.

For stable phase rehabilitation treatment, the eight community health centers and township hospitals received 40% of patients thus far. By continuing the expansion of the intervention, more and more lower-level health service facilities could be integrated into the management system so that more rehabilitation patients can be admitted.

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