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1. Background

Qianjiang District is located in the southeast part of Chongqing City, near Wuling Mountain and bordering Hunan, Hubei, and Guizhou provinces. It is 250 km away from the city with the following regional characteristics: elderly, young, marginalized, and mountainous. The region covers an area of 2,402 square km, with a total population of 526,800. Among them, ethnic minorities make up 72.8% of the population, mainly consisting of Tujia and Miao ethnic minorities. The county is a national poverty reduction and development focus district. The district has on average 1.4 physicians per 1,000 people; 0.95 nurse per 1,000 people; and 3.5 open beds per 1,000 people. Qianjiang district is one of the first project districts in the China-UK health collaboration project. It has a wealth of project implementation experience and a good project foundation.

(1) Policy environment

The second phase of the China-UK collaboration project "Strengthening evidence-based decision-making and promoting basic universal healthcare coverage" coincides with the country's new round of medical and health system reform. The pilot project also experienced some impact brought about by changes in external policies (Figure 1).

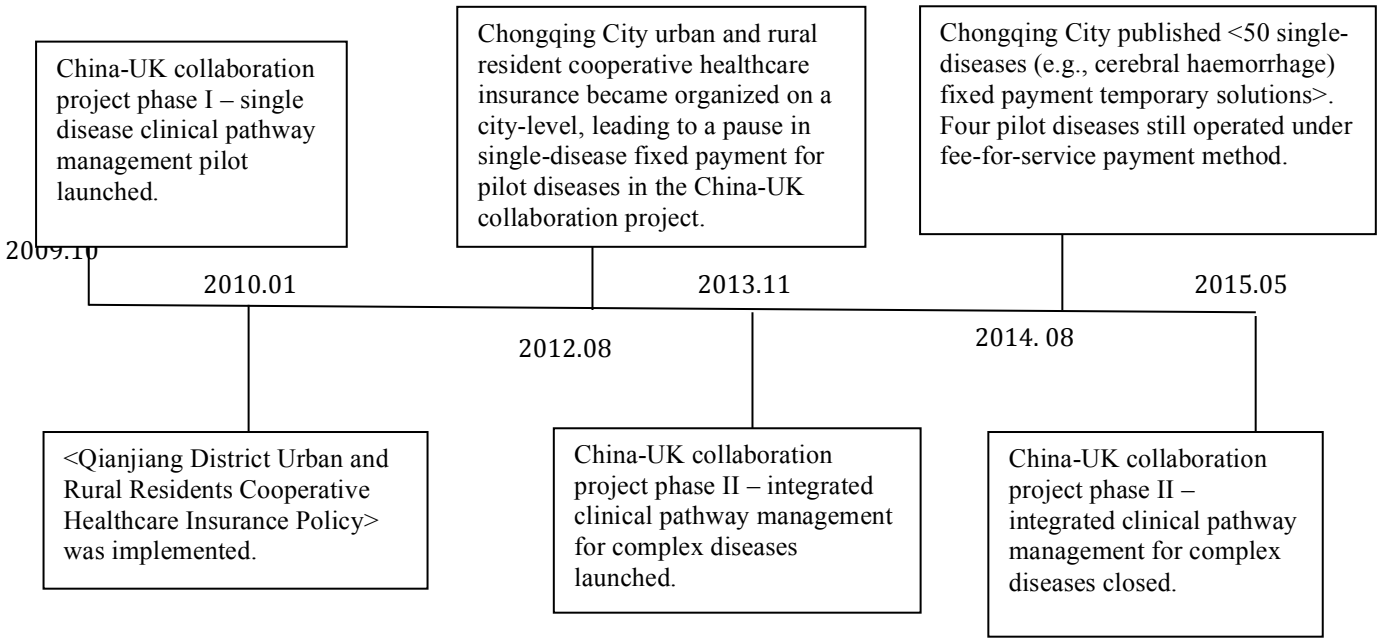

Figure 1 Major policy changes during the pilot phase, 2009 – 2015

Overall, health policies implemented in Qianjiang District have the following four key characteristics:

Implementation of basic public health service equalization: The main strategy is to adopt a three-tier management system for diabetes and other common chronic illnesses. The first tier focuses on village clinics; village doctors regularly organize health examinations; health education is conducted through home visits. Second tier focuses on township health centres. Third tier is led by secondary general hospitals.

Implementation of the essential drug system: Municipal health administrative departments are responsible for supplementing and formulating the local essential drug list based on the national essential drug list. Using online bidding methods, a centralized procurement and distribution is implemented, with township as a unit. A zero mark-up policy for essential drugs will be used at village and township levels. Special financial subsidy is maintained at five million CNY per year. The policy requires that all government-run primary healthcare institutions stock and use essential drugs. Secondary level or above public healthcare institutions must stock and prioritize the use of essential drugs. For hospitals included in the district and county-level Public Hospital Reform Pilot, the proportion of essential drugs utilization and sales must be 50% or above of the hospital's total utilization and sales of medications. For other secondary hospitals, it must be 40% or above; tertiary hospitals' essential drugs sales proportion must be 25% or above.

Health insurance access and affordability: Based on the urban employee basic insurance scheme, the district established and improved urban and rural residents' equitable access to the urban-rural cooperative healthcare insurance scheme. Reimbursement method consists mainly of fee-for-service and global budget payment methods, but also other models were explored such as single disease fixed payment, fee-per-bed-day, and other mixed payment models. For pilot diseases managed by clinical pathways as part of the Phase I China-UK collaboration project, single-disease case payment was implemented. At the same time, restrictions on drug expenses were introduced in healthcare institutions, as a method to control increasing drug expenses.

County-level public hospital reform, clinical pathway management: In October 2010, under the influence of the phase one of the China-UK collaboration project, the World Bank / British grants, and the China Rural Health Development Project, "Optimization of clinical diagnosis and treatment technologies in rural healthcare institutions," Qianjiang Central Hospital implemented a single-disease clinical pathway management "3+1" model (Figure 2), which was also implemented in Qianjiang District Maternal and Child Health Hospital and Qianjiang Traditional Chinese Medicine Hospital.

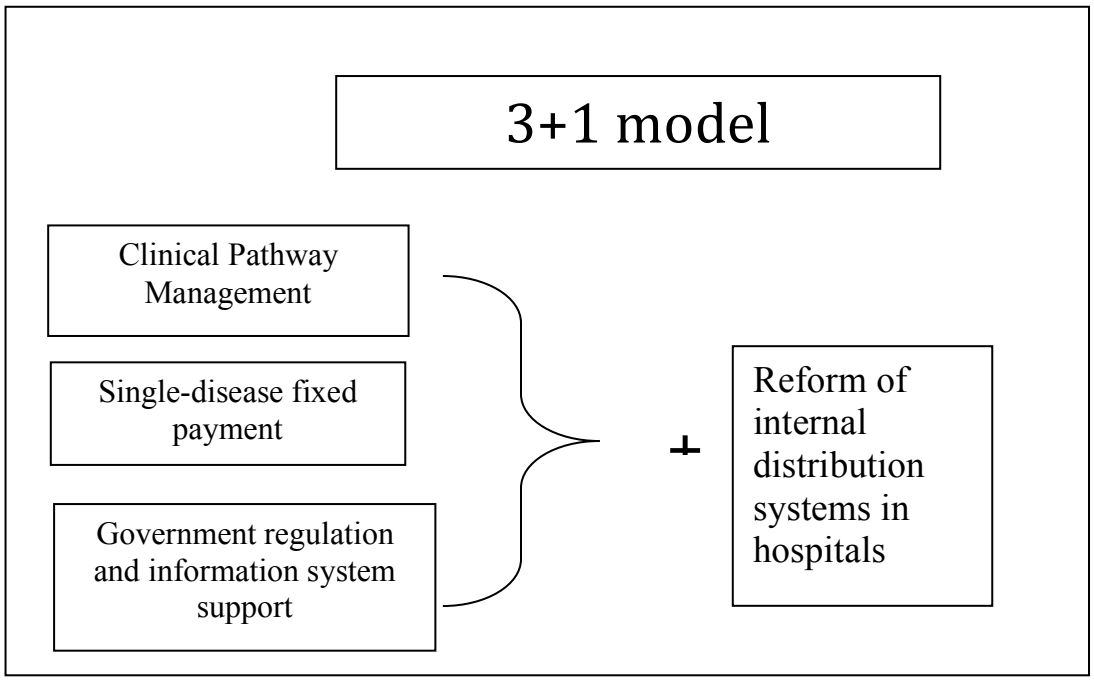

Figure 2 China-UK collaboration project phase I: single-disease 3+1 management model

(2) Hospitals

Qianjiang Central Hospital is the only national level-two tertiary general hospital in the southeast Chongqing area (Figure 3). It is also one of the oldest pilot hospitals in the China-UK collaboration project, with a wealth of experience in pathway management.

Personnel

- Beds: 706
- Staff: 870
- Professional ranks: 15 (senior); 61 (vice-senior); 180 (intermediate)

Service summary

- Outpatient visits: 280,000
- Patient discharges: 22,000
- Discharged patients' average length of hospital stay: 8.76 days
- Outpatient visit average cost: 189.64 CNY
- Discharged patients' average cost: 5,102.45 CNY

Figure 3 Qianjiang Central Hospital overview, 2011

From October 2010 to June 30, 2012, during the implementation of the China-UK collaboration project phase I, "Optimization of clinical diagnosis and treatment

technologies in rural healthcare institutions," Qianjiang Central Hospital implemented a single-disease care pathway management "3+1" model (Figure 3). Furthermore, it expanded the national list of ten single diseases (e.g., acute appendicitis) to include 41 pilot diseases to implement pathway management and single-disease case payment method. This led to the increase in the number of cases managed by clinical pathways, reaching 3,084 and accounting for over 60% of pilot disease hospitalizations over the same period. The implementation of clinical pathways helped standardize healthcare services and provider behaviors, improved quality of healthcare services, controlled the irrational increase of healthcare costs, and fully mobilized the enthusiasm of healthcare staff. In such ways, people were able to enjoy the convenience, safety, high quality, and affordability of healthcare services. It also explored further reform for public hospitals.

(3) Intervention

In November 2013, China-UK collaboration project phase II officially launched in the hospital. Based on the "3+1" model of phase one, using stroke and chronic obstructive pulmonary disease as starting points, phase two added care pathways for pilot diseases' comorbidities and complications in the acute phase clinical treatment. At the same time, phase II added community risk factor management for secondary prevention and rehabilitation pathways, in order to explore integrated diagnosis and treatment pathway management model for complex diseases.

2. Integrated care pathway implementation

(1) Overall implementation status of pathways

During the five-month pilot period from November 2013 to May 2015, Qianjiang Central Hospital hospitalized and treated a total of 2,047 cases for the four pilot diseases (chronic obstructive pulmonary disease (COPD), transient ischemic attack (TIA), cerebral hemorrhage and cerebral infarction). Of these, 1,561 cases (76.26% of total) were managed by integrated care pathways, far exceeding the expected target number of cases completing the pathway management (65%). Furthermore, since August 2014, the number of cases completing the care pathways management has shown a steady increase (Figure 4). Data reveal that the average number that completed pathways management was 82 cases per month during the project; of all cases entered into the pathway management, completion rate was 89.26%. Comparing before and after the pilot, mortality and infection rate for each pilot clinical department showed no significant change; patient satisfaction was maintained above 90%, increasing slightly after the pilot implementation (Figure 4).

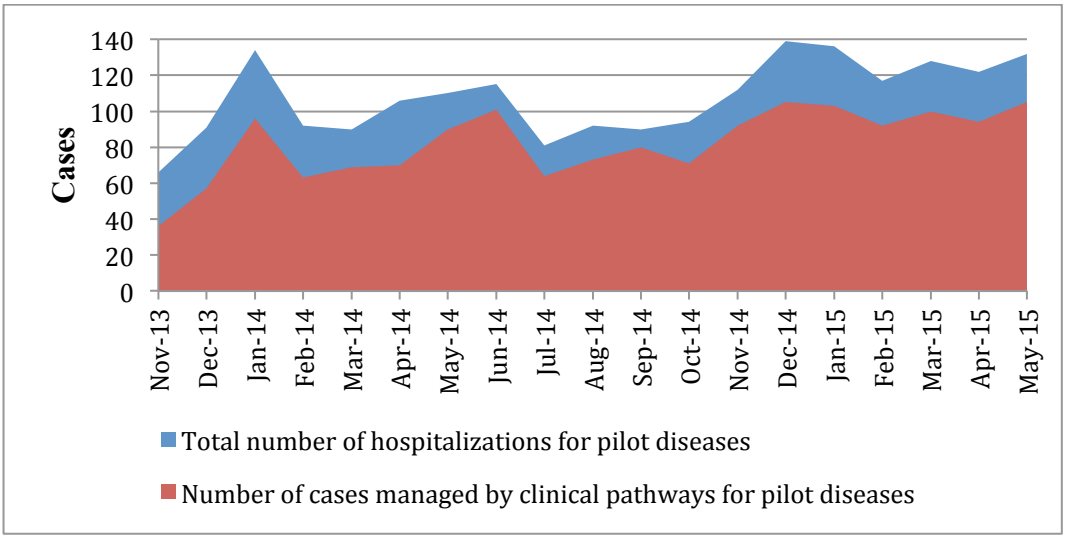

Figure 4 Proportion of care pathway patients from total hospitalizations for four pilot diseases.

Two pilot clinical departments (neurology and respiratory medicine) maintained a patient satisfaction level above 90% throughout the pilot, with an overall increasing trend. Before the pilot and in the beginning phase of the pilot, patient satisfaction in the two departments had larger fluctuations but still maintained slow growth. Until after August 2014, patient satisfaction for the two pilot departments rapidly increased in a short period of time. Respiratory medicine and neurology patient satisfaction reached

above 98% and 96% respectively, and were maintained at this high satisfaction level afterwards (Figure 5).

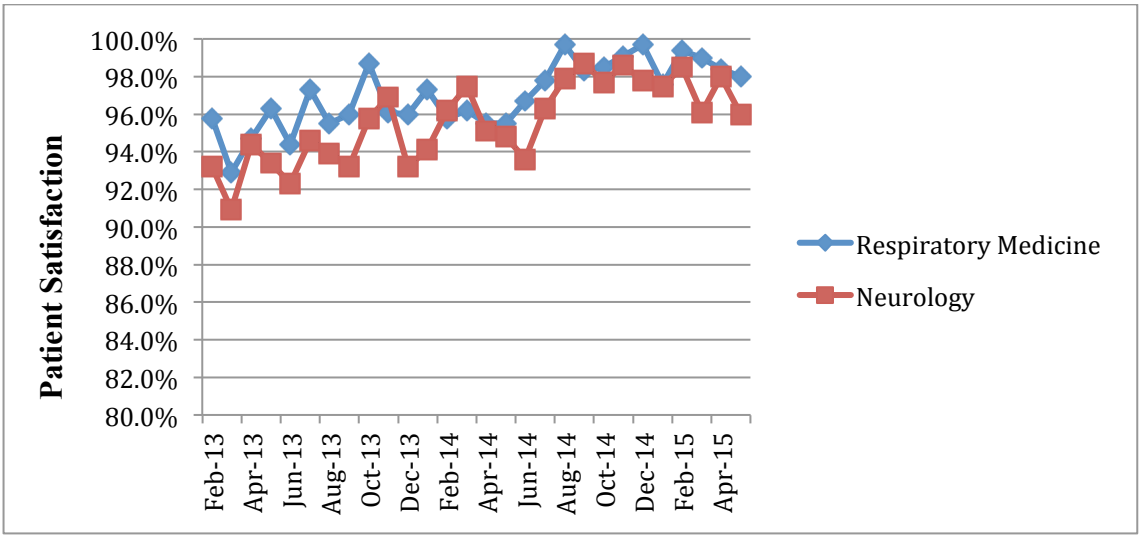

Figure 5 Trends in patient satisfaction in two pilot clinical departments before and after the pilot implementation.

(2) Pathway implementation status for each pilot disease

Looking at each pilot disease separately, there were major differences in the implementation status for the four pilot diseases. TIA and cerebral infarction had the most successful implementation, achieving wide coverage and a high degree of pathway completion rate. On the other hand, COPD and cerebral haemorrhage had a lower number of cases entering pathways (entry rate), but their overall implementation and performance reached or were close to the expected management targets (Table 1, Figure 6). Specifically, TIA and cerebral infarction hospitalized patients had very high rates of pathway management at above 90%; pathway entry rate and completion rate for TIA and cerebral infarction were around 95%. However, pathway entry rate for COPD and cerebral hemorrhage were below 80%; both were 10% lower than the expected entry rates. Cerebral hemorrhage had a higher completion rate, thus compensating for the low entry rate, and allowing the pilot to ultimately reach the target of 65% pathway management rate. On the other hand, COPD pathway management rate fell 10% short of reaching the pilot target.

Table 1 Qianjiang Central Hospital pathway implementation status for four pilot diseases, 2013. 11 – 2015. 05

Disease type	Total hospitalizations	Entries into pathway	Completed pathway	Cases deviating from pathway	Entry rate* (%)	Completion rate* (%)	Management rate* (%)

COPD	769	536	437	99	69.68	81.55	56.83
TIA	767	750	709	41	97.75	94.57	92.44
Cerebral Hemorrhage	206	149	134	15	72.52	89.70	65.05
Cerebral Infarction	305	299	281	18	98.17	93.85	92.13
Total	**2,047**	**1,734**	**1,561**	**173**	**84.71**	**90.02**	**76.26**

*Entry rate = number of cases entered into pathway management / total number of cases hospitalized for that disease x 100%.
*Completion rate = number of cases that have completed pathway management / total number of cases entered into pathway management for that disease x 100%.
*Management rate = number of cases that have completed pathway management / total number of cases hospitalized for that disease x 100%.

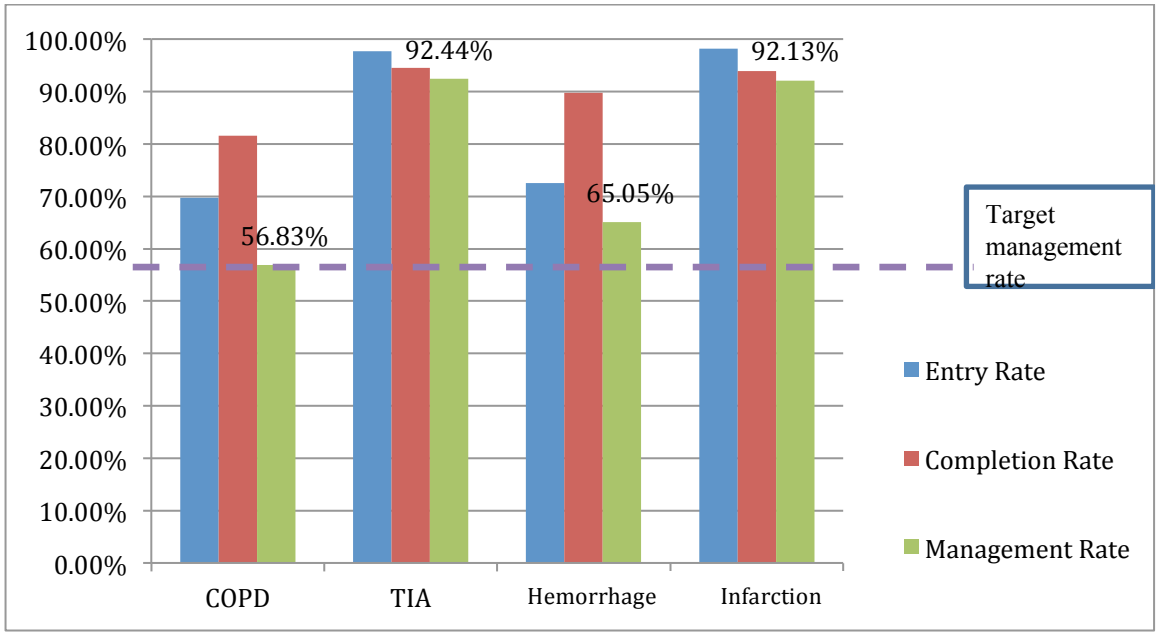

Figure 6 Qianjiang Central Hospital care pathway management status for each pilot disease, 2013.11 – 2015.05

Based on temporal trends in pilot disease pathway management (Figure 7), TIA management rate has been consistently steady, while cerebral hemorrhage management rate showed large fluctuations. In the initial phase of the project implementation, there were large fluctuations in the management rate of pilot diseases, especially for cerebral hemorrhage and cerebral infarction. The fluctuations were particularly due to a lack of payment reform supporting policies. Since August 2014, the management rate of the diseases showed significantly stabilizing trends, with the exception of cerebral hemorrhage. Cerebral hemorrhage pathway management rate

drastically decreased after August 2014, but started to slowly increase again in the beginning of 2015.

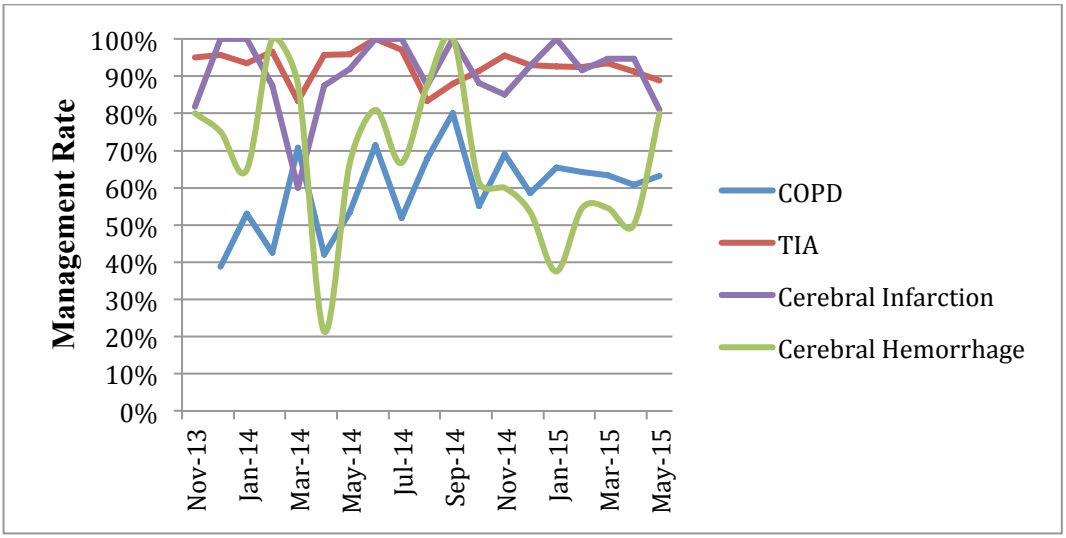

Figure 7 Qianjiang Central Hospital pilot disease management rate trends

A. COPD

a) Clinical pathway management status

Since the pilot launch, Qianjiang District Central Hospital COPD pathway entry rate and completion rate have been relatively steady. Entry rate and management rate saw large fluctuations in the beginning of the pilot, but since August 2014, fluctuations gradually narrowed, and eventually trends stabilized (Figure 8).

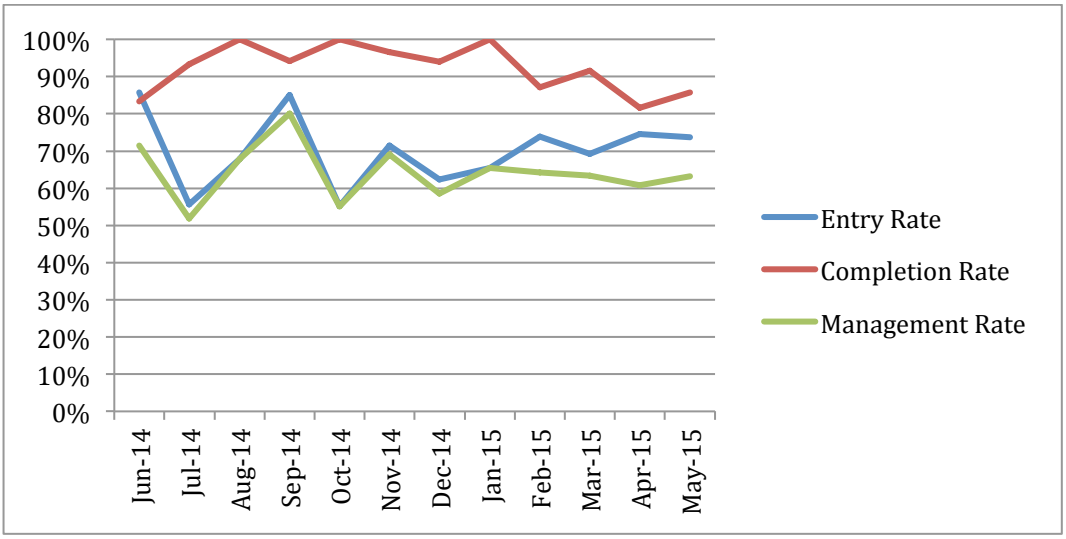

Figure 8 Qianjiang Central Hospital COPD patients pathway management status 2014.06 – 2015.05

b) COPD inpatients in Qianjiang Central Hospital before and after pilot

There were major changes in the characteristics of COPD inpatients in Qianjang Central Hospital before and after the pilot. COPD inpatients' proportion of males increased by 30% after the pilot; there were no change in age distribution; the proportion of patients insured by the Urban and Rural Residents Medical Insurance increased by 15%; and the average length of hospitalization decreased by 1.8 days. There were no significant differences between the pathway and non-pathway patient (Table 2).

Table 2 Characteristics of COPD inpatients in Qianjiang Central Hospital before and after pilot

	Before pilot (n=124)	After pilot		
		All patients (n=769)	Pathway (n=437)	Non-pathway (n=332)
Sex (%)				
Male	27.42	57.09*	59.04*	54.52*
Female	72.58	42.91	40.96	45.48
Age (%)				
30-50	6.45	6.50	8.01	4.52
51-70	41.13	46.68	47.83	45.18
71 or above	52.42	46.81	44.16	50.30
Insurance Type (%)				
Urban and rural residents cooperative medical insurance	58.06	72.95*	74.83*	70.48*

Urban workers basic medical insurance	35.48	24.58	23.80	25.60
Other	6.45	2.47	1.37	3.92
Average length of hospitalization (days)	10.37	8.51	8.32	8.77

*Compared to before pilot, p<0.05

c) Number of service items added outside of clinical pathway

During the pilot in Qianjiang Central Hospital, the number of service items added outside of the COPD pathway showed an overall increasing trend. From June 2014 to October 2014, the number of service items outside of pathway added per case for COPD patients who completed the pathway was less than 100 items; in November 2014, this number quickly increased to 150 – 200 service items. In March 2015, it reached the highest point of 250 service items added per case outside the pathways; but decreased in the next two months to 150 items (Figure 9).

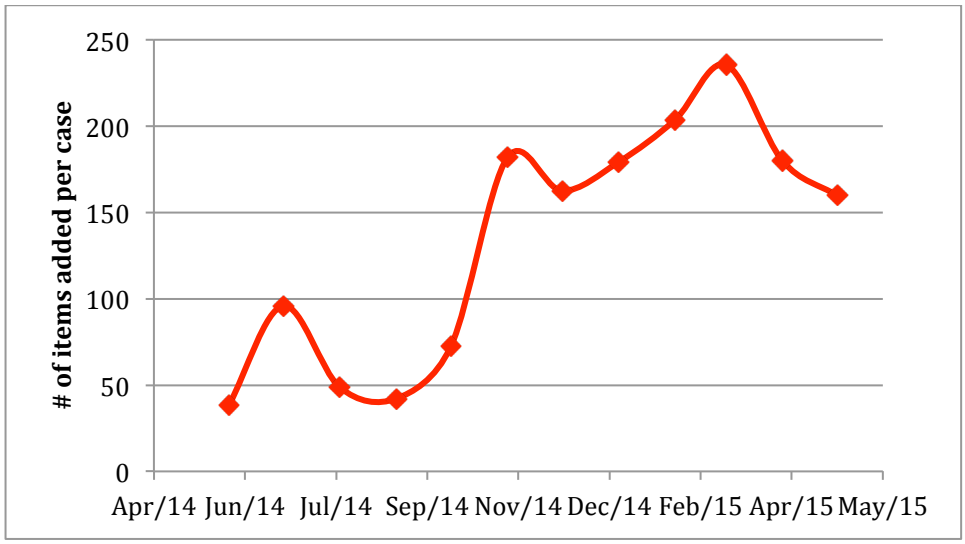

Figure 9 Trends in number of service items outside of pathway added per case for COPD patients who have completed pathway

B. TIA

a) Clinical pathway management status

During the pilot, there were large fluctuations in TIA patients' entry rate into the clinical pathway; completion rate was consistently maintained above 95% and often reaching 100% (Figure 10). Management rate had similar trends as the entry rate.

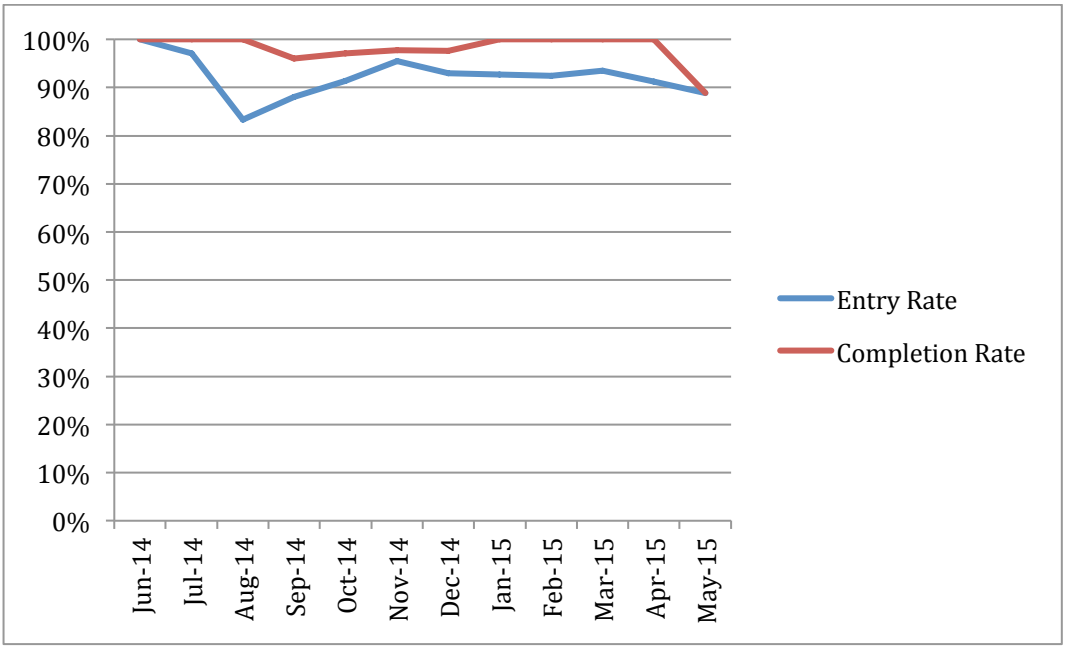

Figure 10 Qianjiang Central Hospital TIA patients' care pathway management status, 2014.06 – 2015.05

b) TIA inpatients' characteristics before and after pilot

TIA inpatients' age, insurance type, length of hospitalization, and other characteristics were similar before and after the pilot. Male patients increased by 30% after the pilot (Table 3).

Table 3 Qianjiang Central Hospital TIA inpatients' characteristics before and after pilot

	Before pilot (n=85)	After pilot		
		All patients (n=767)	Pathway (n=709)	Non-pathway (n=58)
Sex (%)				
Male	12.94	44.59*	44.71*	43.10*
Female	87.06	55.41	55.29	56.90
Age (%)				
29 or below	1.18	2.22	2.12	3.45
30-50	32.94	28.68	29.06	24.14
51-70	45.88	47.72	47.53	50.00
71 or above	20.00	21.38	21.30	22.41
Insurance Type (%)				
Urban and rural residents cooperative medical	68.24	68.71	68.97	65.52

insurance				
Urban workers basic medical insurance	28.24	26.86	26.80	27.59
Other	3.53	4.43	4.23	6.90
Average length of hospitalization (days)	5.15	5.11	5.11	5.1

*Compared to before pilot, p<0.05

c) Number of service items added outside of clinical pathway

During the pilot, the number of service items outside of pathway added per case for TIA patients who have completed the pathway was relatively steady, maintaining approximately at around 90 service items. Out of the four pilot diseases, TIA had the least number of added service items outside the pathway and the most stable (Figure 11).

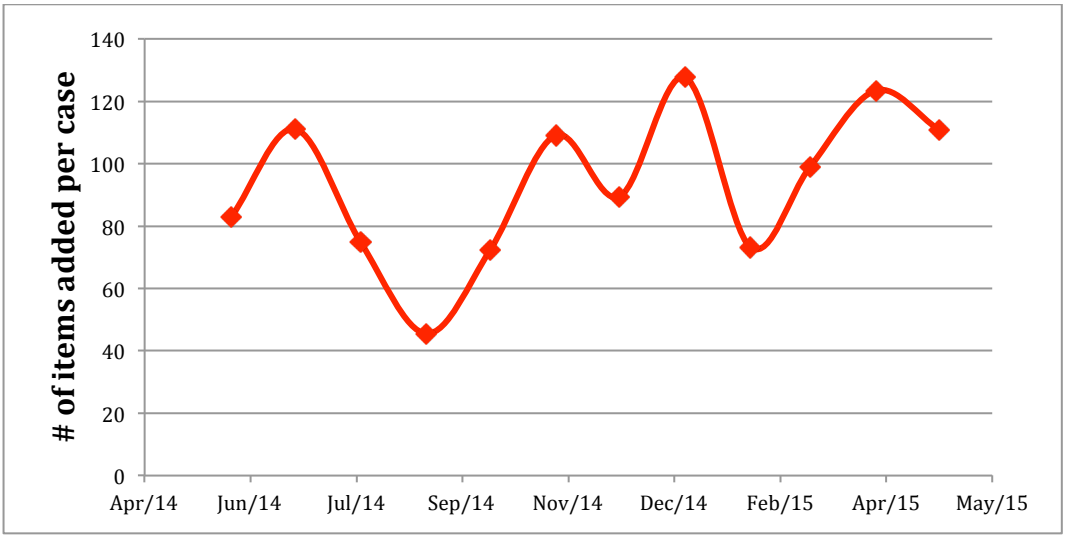

Figure 11 Trends in number of service items added per case for TIA patients who have completed pathway

C. Cerebral hemorrhage

a) Pathway management status

During the pilot, there were large fluctuations in cerebral haemorrhage patients entry rate into clinical pathways, completion rate and management rate. The highest management rate was close to 100% and lowest was 38%. Completion rate was steadily maintained at above 85% prior to January 2015, after which it fluctuated and showed a decreasing trend (Figure 12).

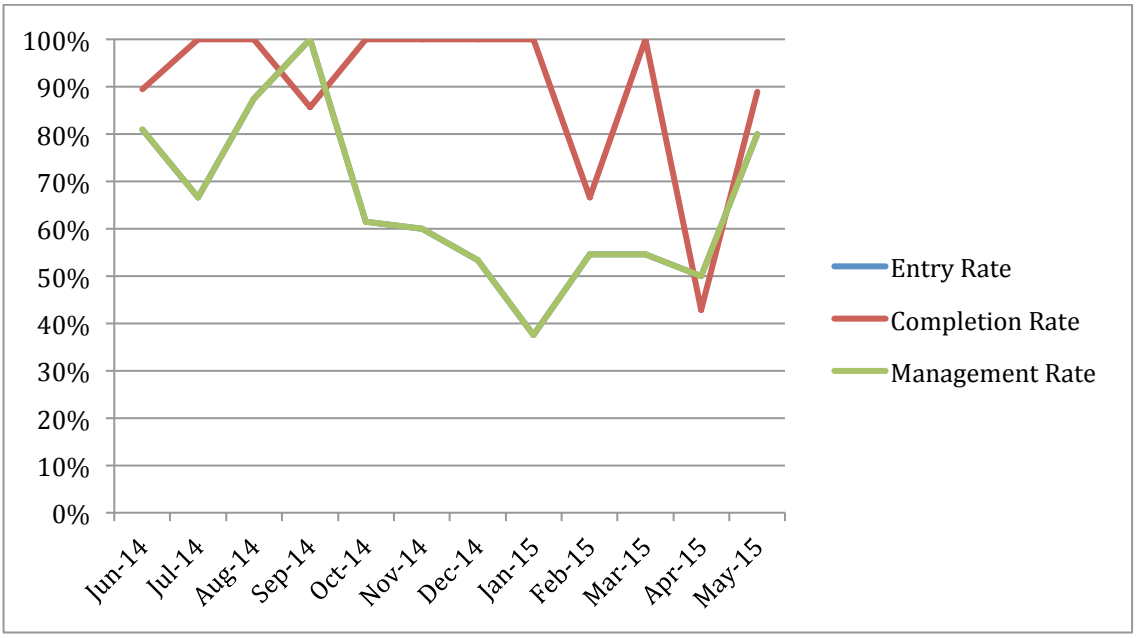

Figure 12 Qianjiang Central Hospital cerebral hemorrhage patients' clinical pathway management status, 2014.06 – 2015.05

b) Cerebral hemorrhage inpatients' characteristics before and after pilot

Cerebral hemorrhage inpatients' age, average length of hospitalization, and other characteristics before and after the pilot were largely equal. Male patients increased by 40% after the pilot; and patients insured by the Urban and Rural Residents Cooperative Medical Insurance increased by 10% (Table 4).

Table 4. Qianjiang Central Hospital cerebral hemorrhage inpatients' characteristics before and after pilot

	Before pilot (n=67)	After pilot		
		All patients (n=206)	Pathway patients (n=134)	Non-pathway patients (n=72)
Sex (%)				
Male	28.36	65.05*	66.42*	62.50*
Female	71.64	34.95	33.58	37.50
Age (%)				
29 or below	2.99	0.49	0.00	1.39
30-50	11.94	14.56	14.93	13.89
51-70	55.22	51.94	50.00	55.56
71 or above	29.85	33.01	35.07	29.17
Insurance Type (%)				

Urban and rural residents cooperative medical insurance	73.13	83.98	82.84	86.11
Urban workers basic medical insurance	17.91	13.59	14.93	11.11
Other	8.96	2.43	2.24	2.78
Average length of hospitalization (days)	16.84	13.82	15.22	11.21

*Compared to before pilot, p<0.05.

c) Number of service items added outside of clinical pathway

During the pilot, the number of service items added per case outside of the pathways for cerebral hemorrhage patients who have completed the pathway was maintained at 200 items per case. Since August 2014, the magnitude of fluctuations increased, and showed an overall increasing trend. The trend reached its highest point in April 2015, where the number of service items added per case was as high as 1,000 items (Figure 13).

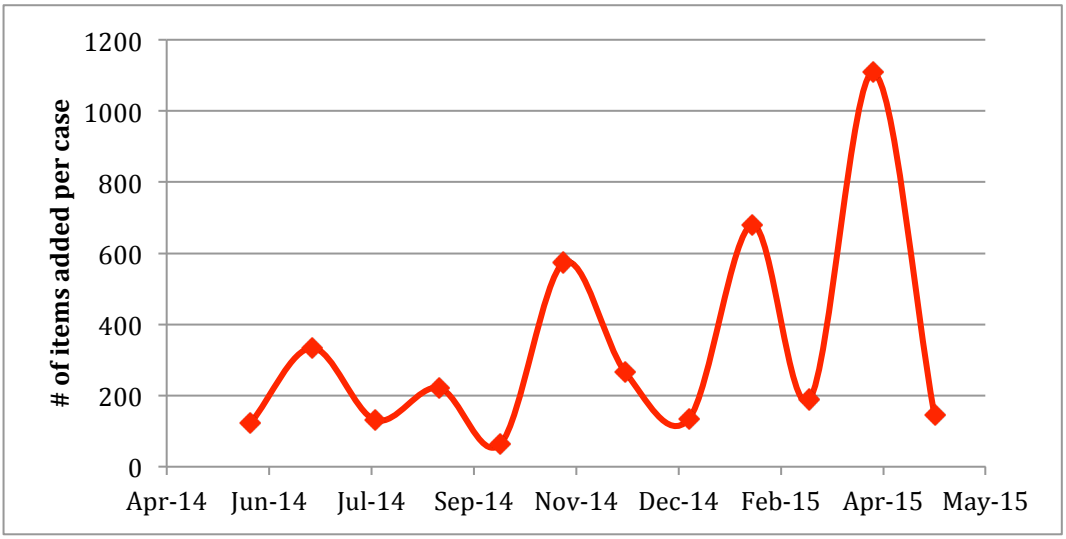

Figure 13 Trends in number of service items added per case o for cerebral hemorrhage patients who have completed pathway

D. Cerebral infarction

a) Clinical pathway management status

During the pilot, cerebral infarction patients' entry rate into pathway, completion rate and management rate were maintained at above 80% with minor fluctuations (Figure 14).

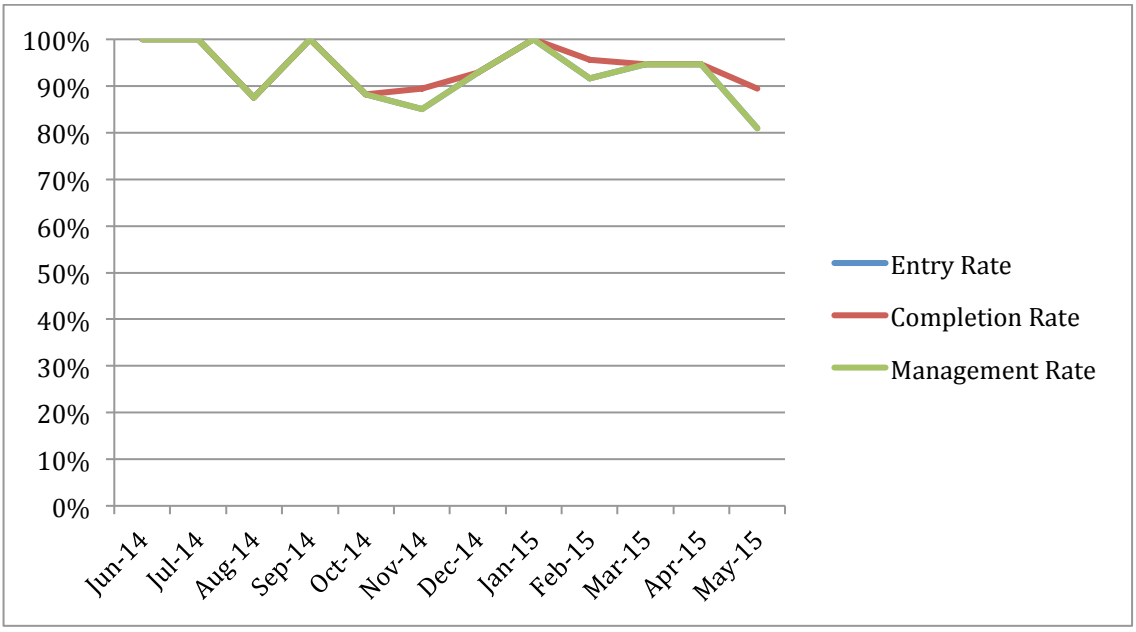

Figure 14 Qianjiang Central Hospital cerebral infarction patients' pathway management status

b) Cerebral infarction inpatients' characteristics before and after pilot

Cerebral infarction inpatients' proportion of males increased by 50% after the pilot, but had no significant change in terms of age distribution and insurance type (Table 5).

Table 5. Qianjiang Central Hospital cerebral infarction inpatients' characteristics before and after pilot

	Before pilot (n=35)	After pilot		
		All patients (n=305)	Pathway (n=281)	Non-pathway (n=24)
Sex (%)				
Male	14.29	66.56*	67.26*	58.33*
Female	85.71	33.44	32.74	41.67
Age (%)				
29 or below	0.00	0.33	0.36	0.00
30-50	20.00	13.11	13.17	12.50
51-70	42.86	44.26	45.55	29.17
71 or above	37.14	42.30	40.93	58.33
Insurance Type (%)				
Urban and rural residents cooperative medical insurance	77.14	82.30	81.85	87.50

Urban workers basic medical insurance	14.29	13.44	13.52	12.50
Other	8.57	4.26	4.63	0.00
Average length of hospitalization (days)	12.46	11.97	12.14	9.96

*Compared to before pilot, p<0.05.

c) Number of service items added outside of clinical pathway

During the pilot, the number of service items added per case for cerebral infarction patients who have completed the pathway showed an increasing trend, from 100 items per case to 300 items per case. In May 2015, this number drastically increased to 700 items (Figure 15).

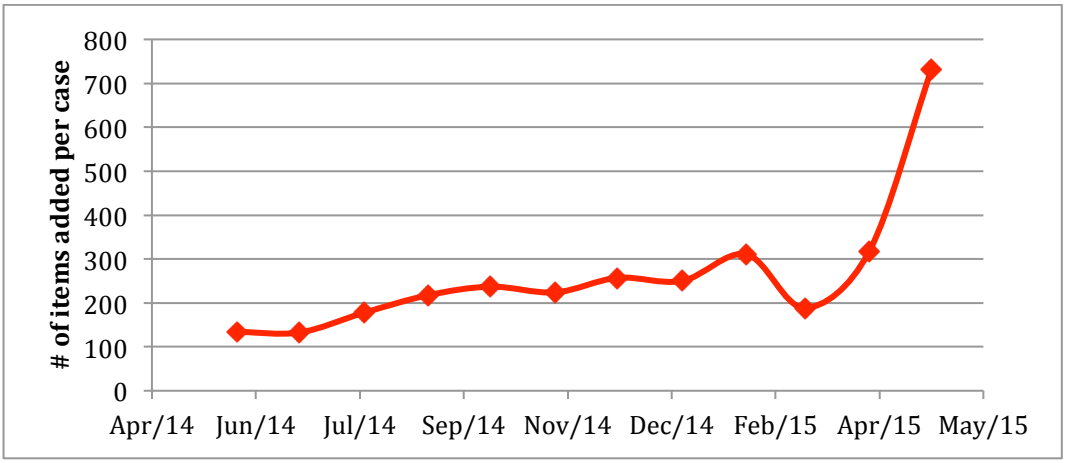

Figure 15 Trends in number of service items added per case for cerebral infarction patients who have completed pathway

3. Clinical behaviors

Prior to the implementation of the China-UK integrated care pathway project, issues of inadequate services and over-treatment have existed for acute COPD and stroke patients in the pilot health institutions. This has also been a prevailing problem for COPD and stroke treatment on all levels of healthcare institutions in China. To use stroke as an example, research has clearly demonstrated the therapeutic effects of swallowing function assessment, early ambulation, and early rehabilitation intervention among others. However, these interventions were rarely carried out in the four pilot healthcare institutions prior to the project. Among the therapeutic interventions that have been in use, many of them have been proven to be ineffective by research, such as neurotrophic agents, stroke anticoagulant drugs (except for atrial fibrillation drugs), electrical stimulation, steroids or mannitol treatment of cerebral edema, brain surgery (except with cancer), stent treatment of intracranial arterial stenosis, and stent treatment of carotid artery stenosis. Other interventions lack supporting evidence and it was not clear whether they are effective as a treatment option for stroke, such as intra-arterial therapy (including thrombosis peel and interventional thrombolysis of arterial thrombosis), new thrombolytic agents, cooling treatment for acute stroke and others. The reasons for the non-standardized medical services can be attributed to the following: on a technical level, domestic clinical practice guidelines update often lags behind; and on a systematic level, medical quality monitoring system, medical insurance reimbursement policy, and public medical institutions financing mechanisms are inadequate. With the existing tensions between doctors and patients, standardizing healthcare services requires long-term cooperation and commitment between the government, healthcare institutions, healthcare providers and patients. Changes cannot happen overnight.

The purpose of clinical pathways is to standardize healthcare service provision using evidence-based treatment principles, narrow service gap among individuals, prioritize the use of low-cost services based on cost-effectiveness research. This will ensure the quality of healthcare services, while controlling the irrational increase of medical costs.

Before the project implementation, the China-UK integrated care pathway project laid out the following recommendations: For hospitalized patients with acute exacerbation of COPD, physicians should increase application of pulmonary function testing in COPD diagnosis, regulate the use of antibiotics, and promote early rehabilitation intervention and secondary prevention measures in communities. For acute stroke patients (including TIA, cerebral haemorrhage and cerebral infarction), physicians should increase the use of aspirin and statins, reduce or avoid interventions with no effect or ambiguous effect, and promote swallowing function assessment and early ambulation. To strengthen the supervision and regulation of healthcare services, both pulmonary function test and non-invasive ventilation were included as mandatory

items. Optional items were divided into two categories. First category was conditional recommended items, where patients must satisfy specific disease-related criteria in order to use such items. Second category was items that were not recommended by key international clinical guidelines, but were included due to inclusion in the national insurance reimbursement list, long-standing habits of patients, current doctor-patient relationship tensions, and other practical factors. However, during the training of healthcare providers and staff, it was made clear that these items (such as oxygen therapy, neurotrophic drugs, etc.) were not recommended.

Analysis of billing data of the four pilot disease hospitalizations in Qianjiang Central Hospital revealed that after more than a year of project implementation, disease diagnosis and treatment behaviors have been standardized in varying degrees for the four pilot diseases. Additionally, use of service items recommended by guidelines increased; use of items not recommended by guidelines was reduced; and differences in treatment between patients were reduced. Overall, implementation of pathways further standardized healthcare service behaviors. There was a significant increase in the proportion of patients who were treated with statin-type drugs for TIA and cerebral infarction, while the use of oxygen therapy and dehydrating agent (not recommended by guidelines) in cerebral haemorrhage patients significantly decreased (Table 6). It is worth noting that the proportion of service items related to imaging tests for COPD and stroke patients was very low, showing a slight decrease compared to before the pilot. The reason could be that such items were usually performed on outpatients as part of the pre-hospitalization examinations; thus, hospitalization billing data may not have captured the utilization of such services. Also, there was the possibility that, due to the implementation of single-disease case payment method and the incentives for healthcare institutions to keep remaining balances, healthcare providers might have transferred some service items to outpatient.

Table 6 Proportions (%) of healthcare services utilization for pilot diseases before and after pilot

Disease	Service item	Before pilot	After pilot	Change
COPD	Pulmonary function test*	16.94	13.33	-3.61
	CT and radiographs*	0	0	0
	Expectorants	94.35	94.00	-0.35
TIA	MRI test*	37.35	36.95	-0.4
	Antiplatelet drugs	19.28	25.12	5.84
	Statins*	25.30	34.48	9.18
	Neurotrophic agents**	43.37	44.83	1.46
Cerebral Hemorrhage	MRI test*	10.77	10.45	-0.32
	Oxygen**	89.23	87.06	-2.17

	Dehydrating agents**	90.77	83.58	-7.19
Cerebral Infarction	Thrombolytic drugs	3.03	7.51	4.48
	Antiplatelet drugs	84.85	90.17	5.32
	Statins*	84.85	89.02	4.17
	Neurotrophic agents**	45.45	57.23	11.78
	Oxygen**	57.58	60.12	2.54

*Effective services **Ineffective services

(1) COPD

By analyzing billing data of COPD hospitalizations in Qianjiang Central Hospital before and after the pilot, it was found that the proportion of antibiotics utilization during treatment in COPD inpatients increased by 5% after the pilot. Among them, the proportion of antibiotics used in pathway patients reached 99% and above (Table 7). The proportion of combined use of two antibiotics significantly increased compared to before the pilot, and single antibiotic use showed no significant changes. The proportion of expectorants utilization showed no significant difference before and after the pilot. Since CT and radiographs can be performed on an outpatient basis, hospitalization billing data cannot reflect the true utilization of pulmonary function test and CT/radiograph. Thus, the proportions of pulmonary function test and CT/radiograph utilization reported by analyzing hospitalization billing data were very low.

Table 7 Utilization proportion of COPD treatment services before and after pilot

Service Items	Before pilot, all patients (%)	After pilot, pathway patients (%)	After pilot, non- pathway patients (%)	P value
Expectorants	94.35	96.67	91.33	0.145
Pulmonary function test*	16.94	6.67	6.67	0.005
Antibiotics, total	92.77	99.33	96.67	-
Use of 1 antibiotic	84.68	84.00	82.67	-
Combined use of 2 antibiotics	8.06	15.33	14.00	-
Combined use of 3 antibiotics or more	0	0	0	-
CT and radiographs*	0	0	0	-

*These services can be delivered on outpatient basis; hospitalization billing data cannot accurately reflect actual utilization volume.

The average cost of expectorants, antibiotics, and pulmonary function test for COPD inpatients showed no significant change compared to costs before the pilot (Table 8).

Table 8 Average costs (CNY) for services items before and after pilot

Service Items	Before pilot, all patients	After pilot, pathway	After pilot, non-pathway	P value
Expectorants	135.19	135.45	148.04	0.496
Pulmonary function test	45.00	49.50	45.00	0.216
Antibiotics	698.42	763.14	711.02	0.6

A. Pulmonary function test

After the pilot implementation, proportion of COPD patients undergoing pulmonary function test has substantially increased, and the magnitude of increase was similar for pathway and non-pathway patients (Figure 16). This demonstrated the overall impact of pathways on the standardization of health service behaviors of healthcare providers.

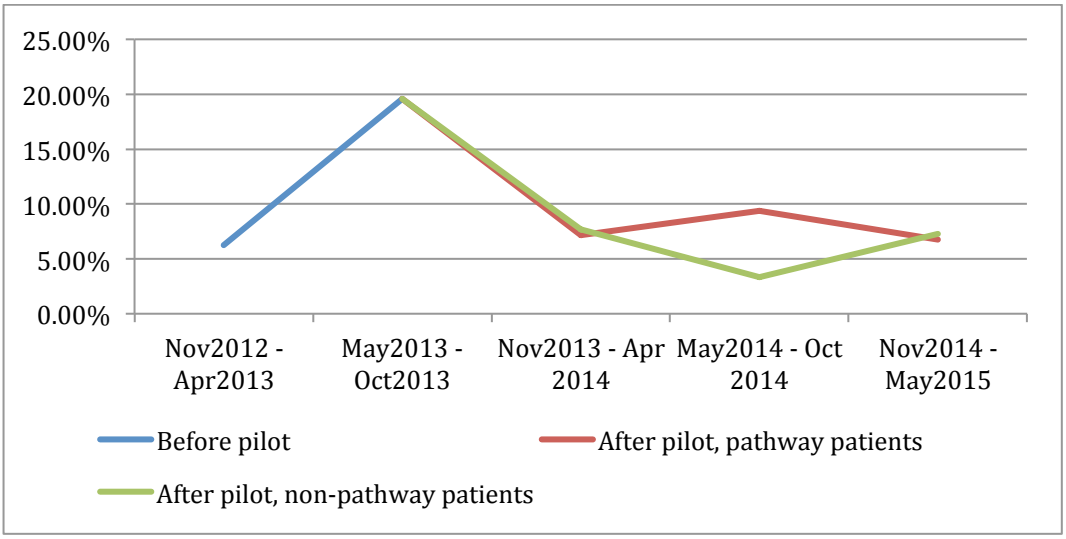

Figure 16 Temporal trends in proportion of pulmonary function test use among COPD hospitalized patients before and after pilot.

B. Antibiotics

Overall, there was no significant change in the types of antibiotics used to treat acute COPD inpatients in Qianjiang Central Hospital before and after the pilot. Commonly injected antibiotics included: cefminox sodium 0.5g (24.38 CNY/dose), ceftizoxime 0.5g (22.66 CNY/dose), piperacillin sodium or tazobactam sodium 1.125g (22.05 CNY/dose), and cefoxitin sodium 1g (27.6 CNY/dose). The reason for the selection of specific antibiotics might be that Qianjiang Central Hospital was part of the first phase of the China-UK clinical pathway pilot project in 2009, leading to a refined selection of drugs with defined costs and utilization proportions. Furthermore, by comparing utilization proportion of different types of drugs before and after the pilot, it was discovered that utilization of more expensive drugs (cefminox sodium injection)

significantly decreased after the pilot; both pathway and non-pathway groups decreased by 8.58% and 13.91% respectively. Meanwhile, ceftizoxime injection, which was similar in price to cefminox sodium, increased in utilization proportion in the the pathway group by 10%, but no significant change in the non-pathway group. The least expensive drug, piperacillin sodium or tazobactam sodium injection, decreased slightly in the pathway group, but slightly increased in the non-pathway group. Conversely, utilization of the most expensive drug, cefoxitin sodium injection, slightly increased in the pathway group, but slightly decreased in the non-pathway group.

Before the pilot, utilization proportions for the four types of antibiotics were similar (Table 9). After the pilot, pathway patients used ceftizoxime injection signficantly more than the other three antibiotics. This reflected the standardization effect of clinical pathways.

Table 9 Changes in utilization proportion of four types of antibiotics before and after pilot

Antibiotic Type	Before pilot, all patients	After pilot, pathway patients	After pilot, non-pathway patients
Ceftizoxime injection 0.5g (22.66 CNY/dose)	20.16%	30.00%	19.33%
Cefminox sodium injection0.5g (24.38 CNY/dose)	22.58%	14.00%	8.67%
Piperacillin sodium / tazobactam sodium injection 1.125g (22.05 CNY/dose)	14.52%	10.67%	18.00%
Cefoxitin sodium injection 1g (27.6 CNY/dose)	13.71%	15.33%	11.33%

(2) TIA

Compared to before the pilot, utilization of project-recommended antiplatelet drugs, statin drugs and MRI tests substantially increased among the pathway patients; neurotrophic agents, which were not supported by evidence-based medicine, did not show significant increase in utilization. On the contrary, non-pathway TIA patients did not show an increase in utilization of antiplatelet drugs, statins and MRI tests after the pilot; however, their utilization of neurotrophic agents increased nearly 8% (Table 10).

It was also revealed that utilization proportion for items that were recommended by guidelines was significantly lower in non-pathway group compared to the pathway group; utilization of items not recommended by guidelines was significantly higher in non-pathway group than the pathway group. This demonstrated that the project increased provision of effective interventions, reduced or avoided ineffective healthcare services, and standardized healthcare provision behaviours.

Table 10 Utilization proportion of treatment services for TIA inpatients in Qianjiang Central Hospital before and after pilot

Service Items	Before pilot, all patients (%)	After pilot, pathway patients (%)	After pilot, non-pathway patients (%)	P value
Antiplatelet drugs*	19.28	27.33	18.87	0.000
Statins*	25.30	36.67	28.30	-
Neurotrophic agents**	43.37	42.67	50.94	-
MRI tests*#	25.86	36.46	25.71	-

*Effective service **Ineffective service

Limited to patients enrolled in the urban and rural cooperative medical insurance

A. Antiplatelet drugs

Before the pilot, TIA patients' utilization proportion of antiplatelet drugs had large fluctuations, with the lowest at 6.67% and the highest at 22.06%. After the pilot, the TIA pathway patients saw a 7% increase in antiplatelet drugs utilization proportion; non-pathway patients had no significant change.

Looking at the time trends, pathway patients' utilization proportion of antiplatelet drugs rapidly increased to 40.00% within 6 months of pilot implementation, but then declined to about 30%, and further decreased to the same level as before the pilot towards the end of the project (Figure 17). However, non-pathway patients' utilization proportion of antiplatelet drugs first decreased from 22.06% to 15.38%, and then steadily increased back to the same level as before the pilot.

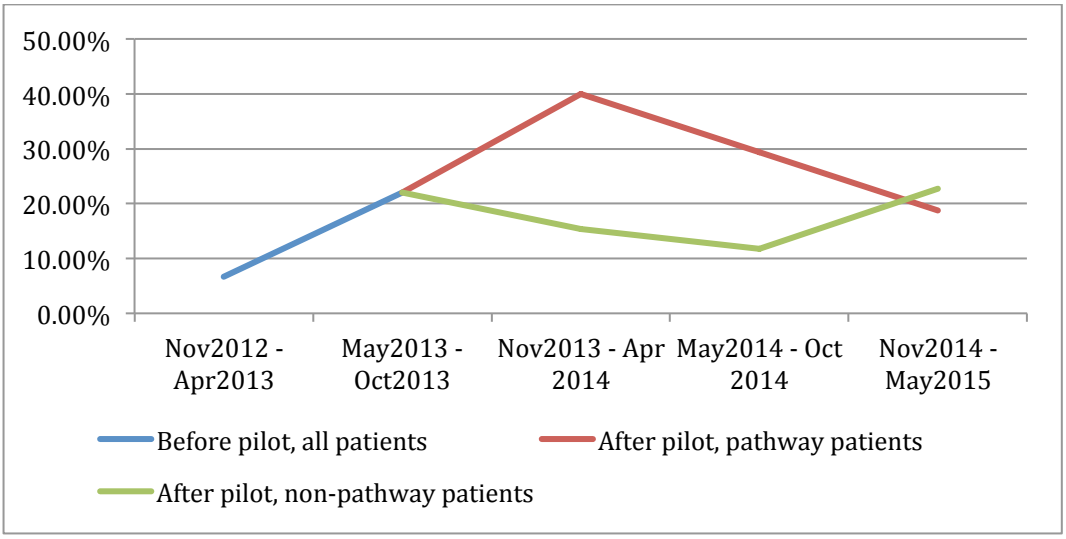

Figure 17 Temporal trends of antiplatelet drugs utilization proportion among TIA inpatients before and after pilot

B. Statins

Overall, the pathway group's utilization proportion of statin-type drugs substantially increased compared to proportions prior to the pilot; the magnitude of increase was over 10%. Non-pathway group had no significant change in utilization proportion.

Looking at time trends, utilization of statins before pilot was already showing an increasing trend with the highest being at 27.94%; after the pilot, it was maintained at approximately 40%. Six months after the pilot implementation, TIA pathway inpatients' statins utilization proportion rapidly increased to 45.71% and then slightly declined; but was still maintained at a higher level than before the pilot. Non-pathway TIA patients' utilization proportion of statins also significantly incrased, and reached similar level as pathway patients (Figure 18).

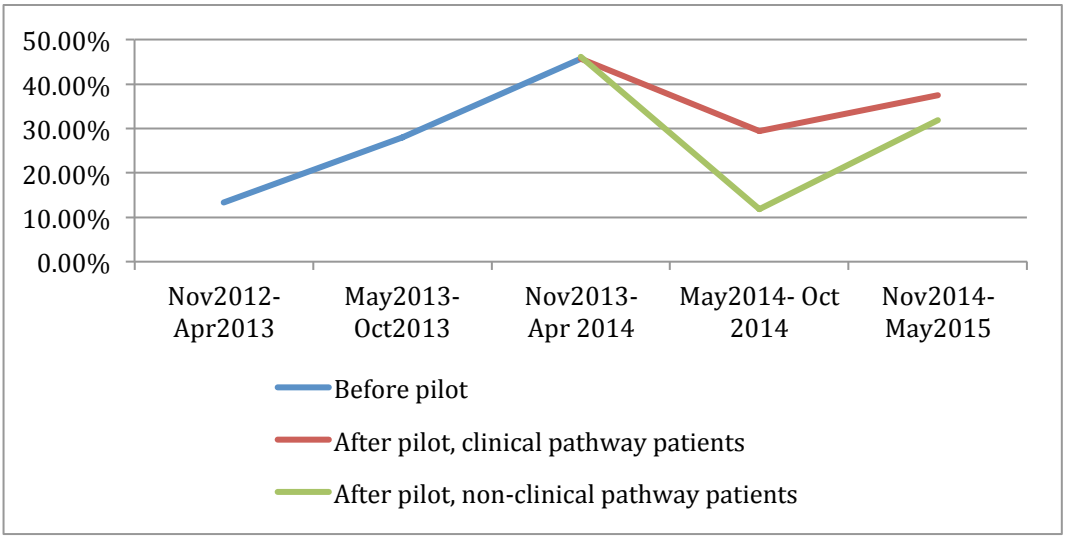

Figure 18 Temporal trends in TIA inpatients' utilization proportion (%) of statins before and after pilot

Approximately 20% - 30% of all TIA hospitalized patients used Atorvastatin. Utilization proportion of the other two types of statin drugs were lower than 5%. After the pilot, the types of statins used by the pathway group drastically changed: utilization proportion of Atorvastatin increased more than 12%; Rosuvastatin was no longer used; and the utilization of Simvastatin slightly increased. The types of statins used by non-pathway group remained the same as before the pilot (Table 11).

Table 11 Utilization proportions of statin-type drugs in TIA inpatients in Qianjiang Central Hospital before and after pilot

Statin Drug Type	Before pilot, all patients	After pilot, pathway patients	After pilot, non-pathway patients
Atorvastatin	20.48%	32.67%	18.87%
Rosuvastatin	3.61%	0.00%	3.77%

Simvastatin	1.20%	4.00%	5.66%

(3) Cerebral hemorrhage

Overall, compared to before the pilot, diagnosis and treatment behaviors for patients hospitalized for cerebral hemorrhage in Qianjiang Central Hospital showed no significant changes. Dehydrating agents and oxygen therapy, which were not recommended by the project, were still being used at a relatively high rate. In fact, the utilization proportion of dehydrating agents in the pathway group slightly increased after the pilot implementation (Table 12). Project recommended CT and MRI tests within 24 hours showed no change in utilization and was maintained at a relatively high level.

Table 12 Utilization proportions of diagnosis and treatment services for cerebral hemorrhage inpatients in Qianjiang Central Hospital before and after pilot

Service Items	Before pilot, all patients (%)	After pilot, pathway patients (%)	After pilot, non-pathway patients (%)	P value
Dehydrating agents**	90.77	93.18	65.22	0.000
CT*	89.23	95.45	81.16	0.321
MRI*	10.77	9.85	11.59	0.927
Oxygen therapy**	89.23	88.64	84.06	0.581

*Effective service **Ineffective service

A. Dehydrating agents

Before the pilot, dehydrating agents were one of the primary treatment drugs for patients hospitalized for cerebral hemorrhage. Healthcare providers and patients have thus become accustomed to using dehydrating agents, leading to an inclusion in the medical insurance reimbursement directory. However, based on current evidence, the project did not support the use of dehydrating agents for the treatment of cerebral hemorrhage. Nevertheless the project included dehydrating agents as an option in the pathways due to a range of factors (e.g., doctor-patient relationship, health insurance reimbursement policies, etc.). Overall, the pathway group's utilization proportion of dehydrating agents increased by 3%, while non-clinical pathway group's utilization proportion decreased by 15% compared to proportion before the pilot.

The main types of dehydrating agents used to treat cerebral hemorrhage in Qianjiang Central Hospital included: Mannitol (87.7%), Furosemide (26.2%), sodium aescinate (43.1%), and glycerol fructose sodium chloride (21.5%). By analyzing the billing data, it was found that utilization proportion of Mannitol in the pathway group had no significant change compared to before the pilot, but decreased by 25% in the non-pathway group. Utilization proportion of Furosemide in the pathway group increased by 7%, and decreased in the non-pathway group to about half the rate before the pilot. Utilization proportion of sodium aescinate increased by 11% in the pathway group, but

decreased to only 2.9% in the non-pathway group (less than 10% of the rate before the pilot). Utilization proportion of glycerol fructose sodium chloride was comparable for pathway and non-pathway groups, with both decreasing drastically after the pilot from 21.54% to 6.82% and 1.45% respectively (Figure 19).

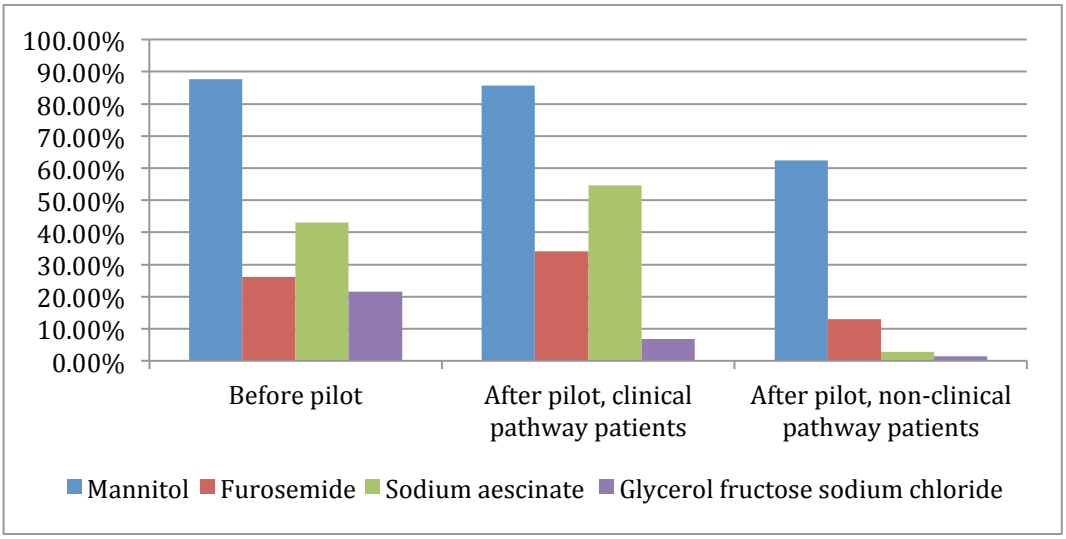

Figure 19 Trends in utilization proportion of dehydrating agents in hospitalized cerebral haemorrhage patients in Qianjiang Central Hospital before and after pilot

B. CT/MRI scans

Before and after pilot utilization proportions of CT/MRI were maintained at a relatively high level (Figure 20). Compared to before the pilot, utilization of CT in the pathway group increased by 6%, and utilization of MRI decreased by 1%; but both were not statistically significant. It is worth noting that after the pilot, the sum of utilization proportion of CT and MRI in the pathway group was far above 100%, significantly higher than the non-pathway group. This meant that a higher proportion of patients in the pathway group received both CT and MRI testing.

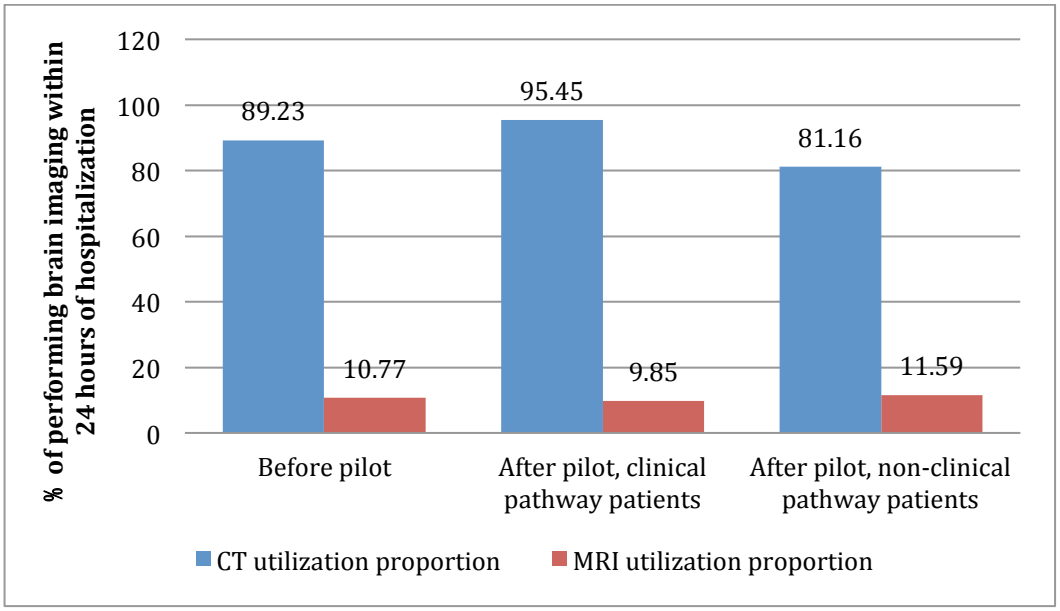

Figure 20 Proportions (%) of CT, MRI scans within 24 hours of hospitalization

(4) Cerebral infarction

Results from billing data of cerebral infarction inpatients in Qianjiang Central Hospital showed that the overall recommended service utilization significantly increased after the pilot implementation (service items included thrombolytic drugs, antiplatelet drugs, statins, and CT/MRI exam within 24 hours of hospitalization). The magnitude of increase was the largest for the pathway patients. In the non-pathway group, utilization of CT within 24 hours of hospitalization increased; whereas utilization of thrombolytic drugs and antiplatelet drugs did not change significantly; and utilization of statins and MRI (within 24 hours of hospitalization) actually decreased by 20%. The use of neurotrophic agents (not recommended by the project) increased by 10% in both pathway and non-pathway groups; the use of oxygen therapy (also not recommended) likewise increased slightly (Table 13).

Table 13 Utilization proportions of diagnosis and treatment services for cerebral infarction inpatients in Qianjiang Central Hospital before and after pilot

Service Items	Before pilot, all patients (%)	After pilot, pathway patients (%)	After pilot, non-pathway patients (%)	P value
Thrombolytic drugs *	3.03	8.00	4.35	0.886
Antiplatelet drugs*	84.85	91.33	82.61	0.358
Statins*	84.85	92.67	65.22	0.001
Neurotrophic agents**	45.45	57.33	56.52	0.840
CT (within 24 hours of	60.61	79.33	69.57	0.131

hospitalization)*				
MRI (within 24 hours of hospitalization)*	66.67	72.67	39.13	0.210
Oxygen therapy**	57.58	60.67	56.52	0.897

*Effective services **Ineffective services

4. Medical expenditure

The purpose of care pathway management, in addition to standardizing healthcare provision behavior and ensuring healthcare quality, was also to increase the efficiency and control irrational healthcare expenditure. Analysis results of patients' medical records showed that, in general, irrational increase in hospitalization cost for the four pilot diseases in Qianjiang Central Hospital was effectively under control. Also, patients' out-of-pocket (OOP) payment proportion decreased, thereby achieving the project objectives of curbing excessive healthcare costs and reducing financial burden on patients.

(1) Overall impact on hospitalization costs

A. Changes in average hospitalization cost

The China-UK pilot project has increased the use of evidence-supported interventions through care pathways, leading to standardization of healthcare provision and ensuring healthcare quality. However, promoting more use of evidence-based interventions did not bring about more costs, as revealed by the analysis results. Compared to pre-pilot costs, Qianjiang Central Hospital's average hospitalization costs for COPD, cerebral hemorrhage and cerebral infarction had no significant changes, achieving the objective of curbing excessive increase in healthcare expenditure (Figure 21). The TIA average hospitalization cost increased by 720 CNY, but this increase was within the range of reasonable growth. The increase may also be due to the fact that TIA treatment was inadequate before the pilot. After the pilot implementation, TIA service provision was more standardized; interventions supported by evidence (antiplatelet drugs, statins, MRI exams, etc.) substantially increased in utilization among pathway patients.

After the pilot, there was more variation in costs among patients of the same disease compared to the pre-pilot period for all four pilot diseases (Figure 21).

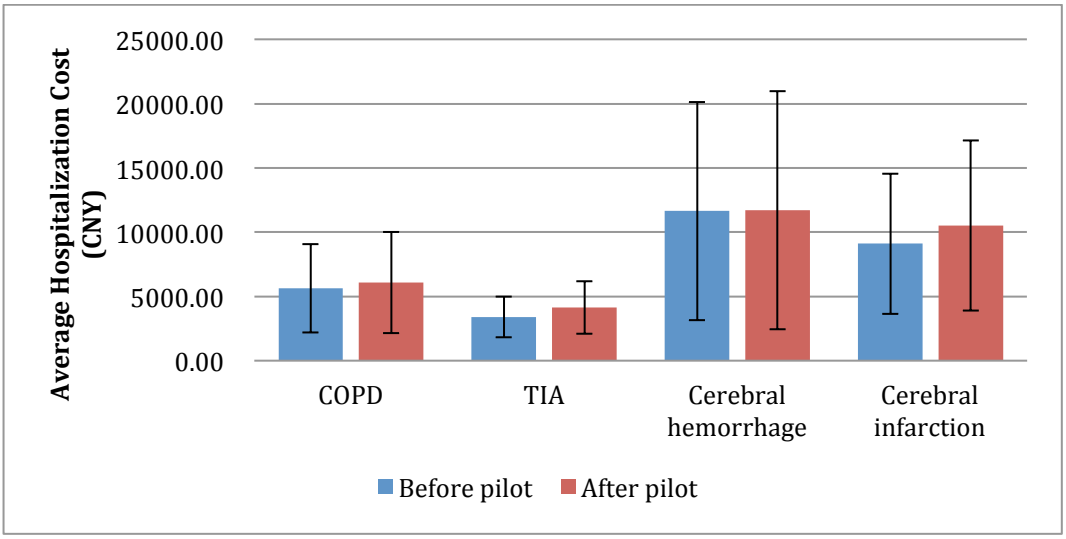

Figure 21 Variations in average hospitalization costs for four pilot diseases before and after pilot

Further data analysis of pathway and non-pathway groups after the implementation found that pathway patients' average hospitalization cost was almost equal to the average before the pilot; for non- pathway patients, the average was slightly higher. Cost variation was the greatest among cerebral hemorrhage and cerebral infarction non-pathway patients. Variation in costs for cerebral hemorrhage pathway patients was lower than the cost variations of the pre-pilot patients and of the non-pathway patients. Cerebral infarction pathway patients' variation was greater than that before the pilot, but was still significantly lower than the non-pathway patients. COPD and TIA pathway patients' and non-pathway patients' variations in average hospitalization costs were relatively stable compared to cost variations before the pilot (Figure 22).

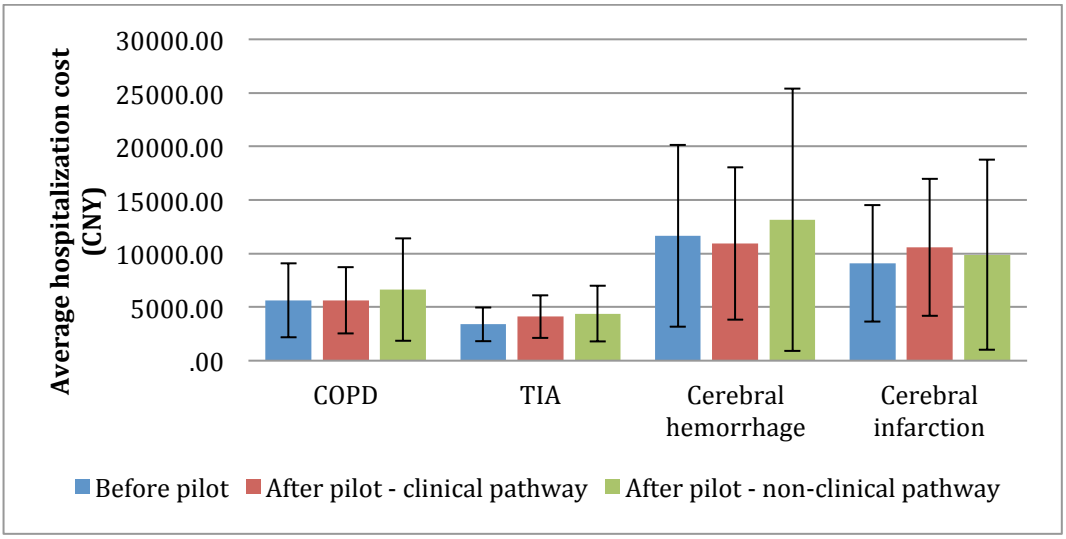

Figure 22 Variations in patients' average hospitalization costs by pathway status before and after pilot

B. Composition of hospitalization cost

To further standardize healthcare provision behaviors, the pilot project promoted the use of tests and drugs that have been proven effective for the four pilot diseases. Analysis of the average hospitalization cost composition revealed that the proportion of examination/lab test fee for all four diseases increased but the magnitude of increase was small. Drug cost proportions for COPD, TIA and cerebral hemorrhage was not significantly different compared to pre-pilot proportions. Drug cost proportion for cerebral infarction increased by nearly 10% (Table 14). COPD and cerebral infarction pathway patients' drug cost proportions increased substantially after the pilot. TIA and cerebral hemorrhage pathway patients' drug cost proportions had no significant change before and after the pilot.

Table 14 Compositions (%) of average hospitalization cost of four diseases in Qianjiang Central Hospital

Disease	Cost category	Before pilot	After pilot		
			All	Pathway	Non-pathway
COPD	Test cost*	28.31	31.10	30.04	33.21
	Drug cost	44.83	45.83	48.10	43.30
TIA	Test cost*	36.68	40.80	40.49	44.24
	Drug cost	47.75	45.21	45.55	41.40
Cerebral hemorrhage	Test cost*	20.65	26.52	26.19	27.01
	Drug cost	40.53	39.95	38.99	41.42
Cerebral	Test cost*	22.74	25.38	25.12	28.60

infarction	Drug cost	38.27	47.81	48.01	45.31

* Test cost includes examination cost and lab test fee.

(2) Changes in hospitalization costs

A. COPD

There were no significant differences between pre- and post-pilot COPD patients' average hospitalization costs, OOP proportions and drug cost proportions. A detailed analysis of the cost categories revealed that drug cost, examination fee and materials cost had no significant differences. Lab test fees increased from below 1,000 CNY to 1,204.01 CNY, which was statistically significant. Analysis of pathway and non-pathway patients revealed that the pathway patients' average hospitalization cost and cost composition were not significantly different from that of before the pilot. Non-pathway patients' average hospitalization cost, drug cost, examination fee, lab test fee and material cost all substantially increased (Table 15).

Table 15 Qianjiang Central Hospital COPD patients' hospitalization cost and cost composition before and after pilot (CNY)

Category	Before pilot: All patients (n=124)	After pilot: All patients (n=769)	After pilot: Pathway patients (n=437)	After pilot: Non-pathway patients (n=332)
Total cost	5,629.16 ± 3,443.32	6,070.88 ± 3,944.21	5,632.73 ± 3,087.21	6,647.61 ± 4,791.06*
Categories				
Drug	2,523.75 ± 1,540.01	2,782.22 ± 1,856.85	2,709.15 ± 1,644.1	2,878.41 ± 2,103.12*
Exam	606.43 ± 538.25	683.81 ± 605.18	599.38 ± 478.92	856.88 ± 716.74*
Lab test	986.98 ± 613.85	1,204.01 ± 976.9*	1,092.59 ± 650.42	1,350.66 ± 1,272.44*
Materials	133.39 ± 142.2	180.19 ± 284.19	136.59 ± 170.1	237.59 ± 378.76*
OOP %	41.62% ± 24.01%	40.36% ± 20.52%	39.49% ± 19.26%	41.50% ± 22.04%
Drug %	45.39% ± 14.02%	46.03% ± 14.32%	47.74% ± 13.57%	43.78% ± 14.98%

*Compared to before pilot, $p<0.05$

Similarly, interrupted time series (ITS) analysis showed that COPD inpatients' average hospitalization costs, drug costs, examination fees, lab test fees, materials costs, and OOP payments had no significant changes before and after the pilot (Figure 23-27).

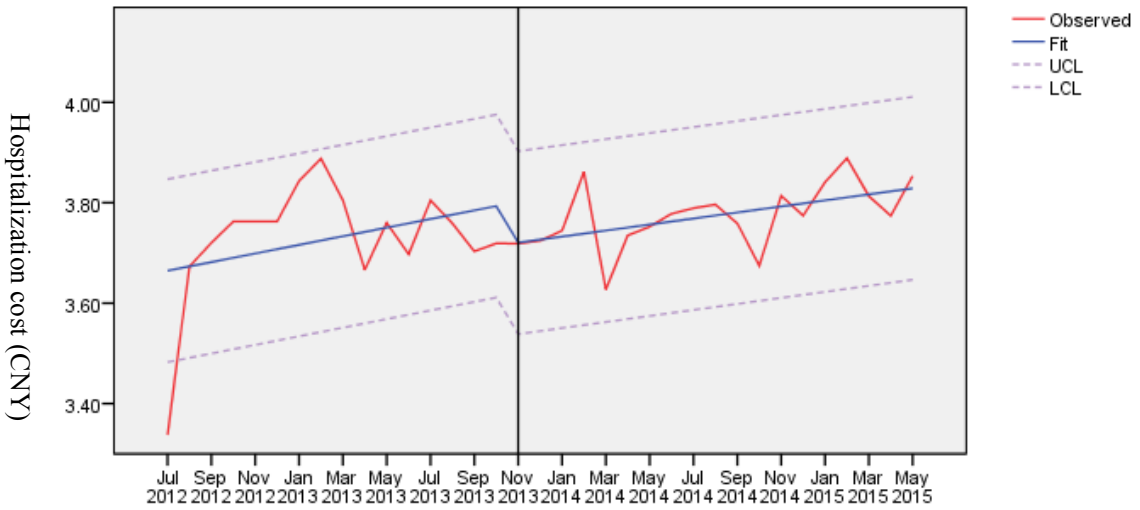

Figure 23 COPD inpatients' average hospitalization cost

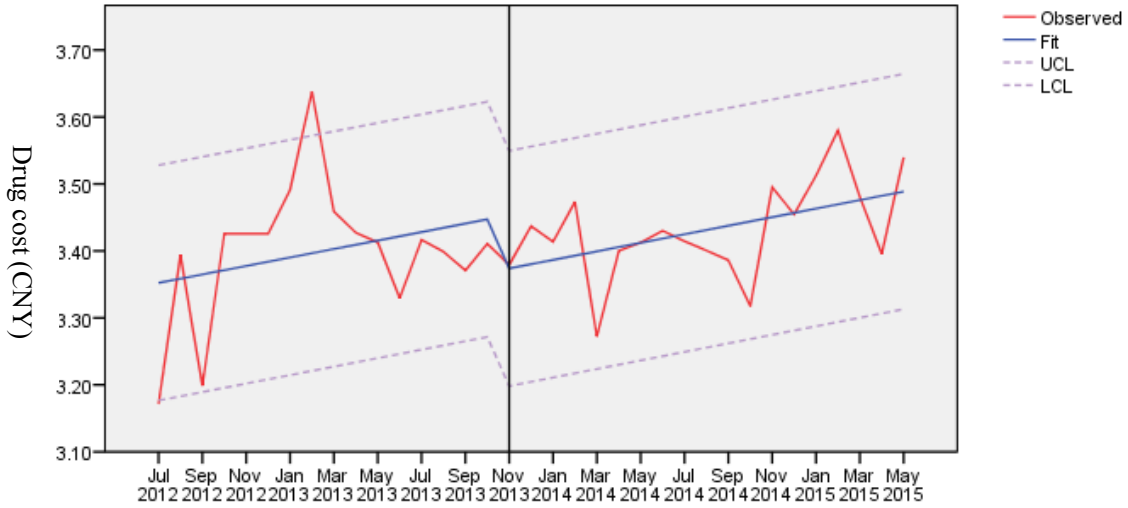

Figure 24 COPD inpatients' average drug cost

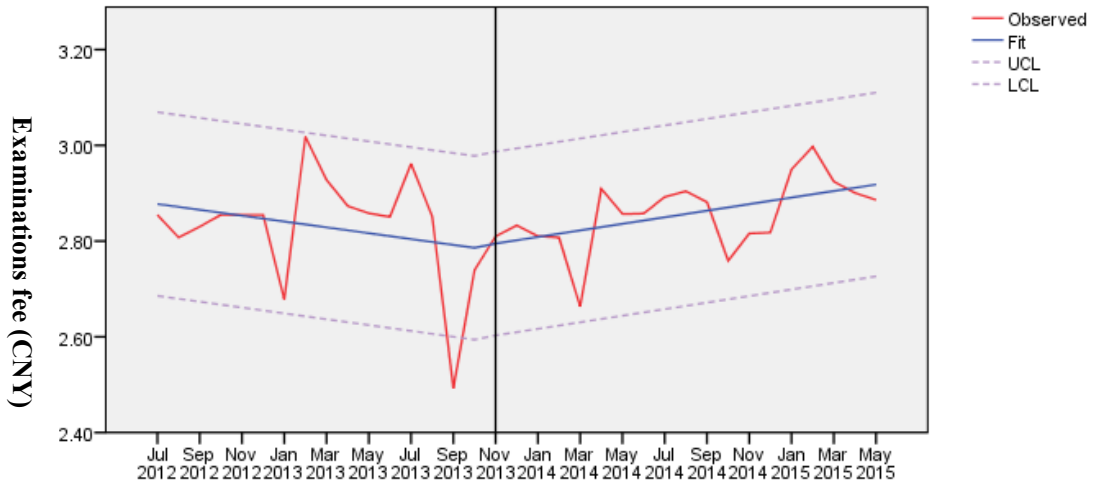

Figure 25 COPD inpatients' examinations fee

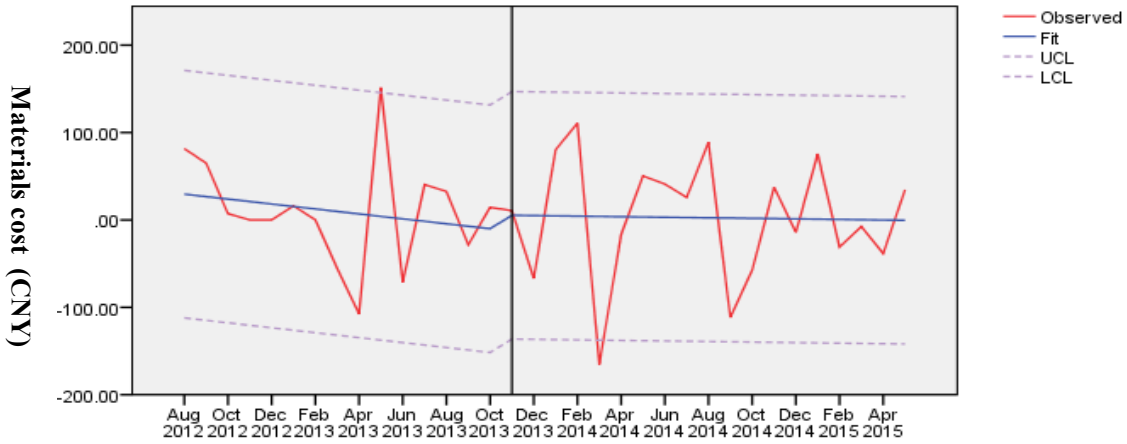

Figure 26 COPD inpatients' materials cost

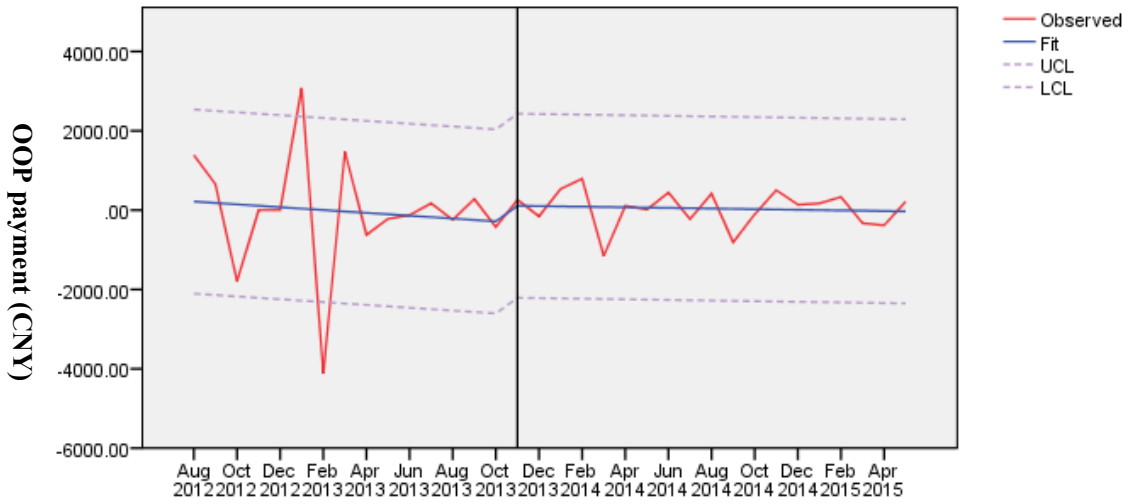

Figure 27 COPD inpatients' average OOP payment

B. TIA

The average hospitalization cost of TIA inpatients' increased by approximately 700 CNY. Among the cost categories, examination fee and lab test fee significantly increased by 300 CNY and 130 CNY respectively (P<0.05). Increase in drug cost had no statistical significance. Further cost comparison of pathway and non-pathway groups revealed that, compared to before the pilot, pathway patients' average hospitalization cost and other cost categories (except for drug cost) all significantly increased. Non-pathway patients' average hospitalization cost, examination fee, lab test fee and materials cost all substantially increased (P<0.05); but drug cost had no significant change (Table 16).

Table 16 Qianjiang Central Hospital TIA inpatients' average hospitalization cost and cost composition before and after pilot (CNY)

Category	Before pilot: All (n=85)	After pilot: All (n=767)	After pilot: Pathway (n=709)	After pilot: Non-pathway (n=58)
Total cost	3,408.55 ± 1,586.81	4,128.49 ± 2,034.11*	4,107.8 ± 1,981.53*	4,381.42 ± 2,600.48*
Categories				
Drug	1,627.6 ± 906.09	1,866.7 ± 1,143.07	1,871.01 ± 1,131.4	1,813.96 ± 1,286.88
Examination	739.94 ± 577.4	1,036.93 ± 860.04*	1,025.58 ± 843.74*	1,175.69 ± 1,037.51*
Lab test	510.27 ± 213.64	647.31 ± 284.97*	637.87 ± 274.19*	762.64 ± 377.98*
Materials	56.47 ± 64.11	80.59 ± 86.64*	76.97 ± 82.73*	124.86 ± 117.06*
OOP%	49.12% ± 19.18%	47.33% ± 21.54%*	47.13% ± 21.36%	40.53% ± 11.13%
Drug%	47.15% ± 13.95%	44.67% ± 13.44%	45.01% ± 13.56%	49.84% ± 23.78%*

*P<0.05

Similarly, ITS analysis results showed that TIA inpatients' lab test fee increased by about 130 CNY, but average hospitalization cost, drug cost, examination cost, materials cost and OOP payment had no significant changes (Figure 28 - 33).

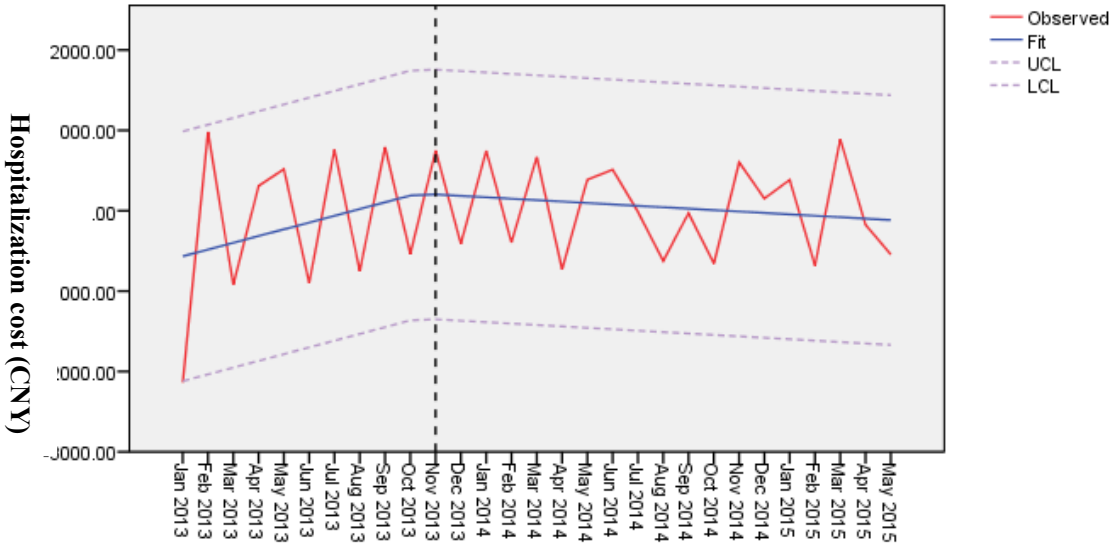

Figure 28. TIA inpatients' average hospitalization cost

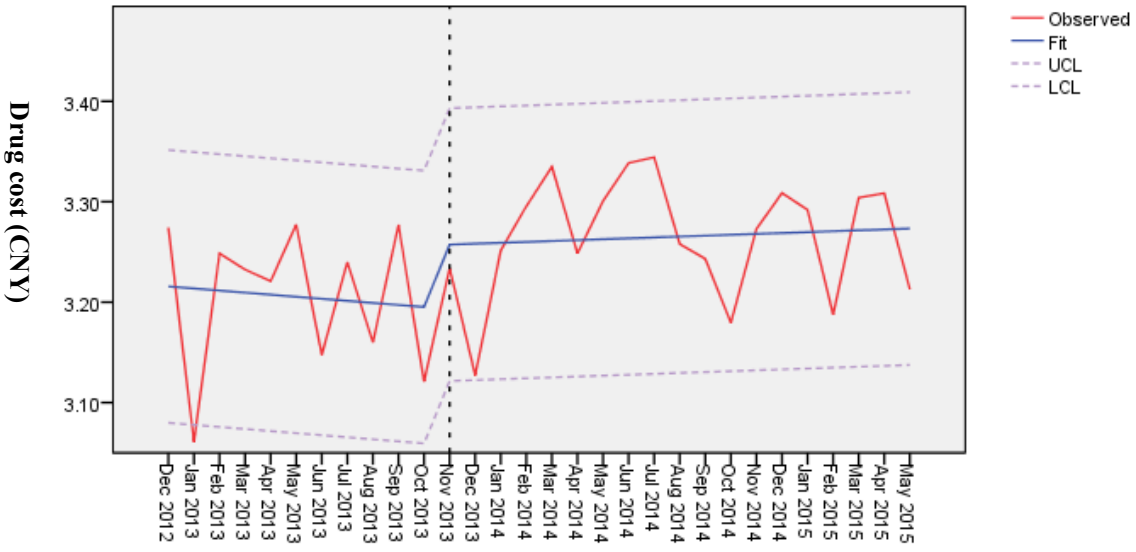

Figure 29 TIA inpatients' drug cost

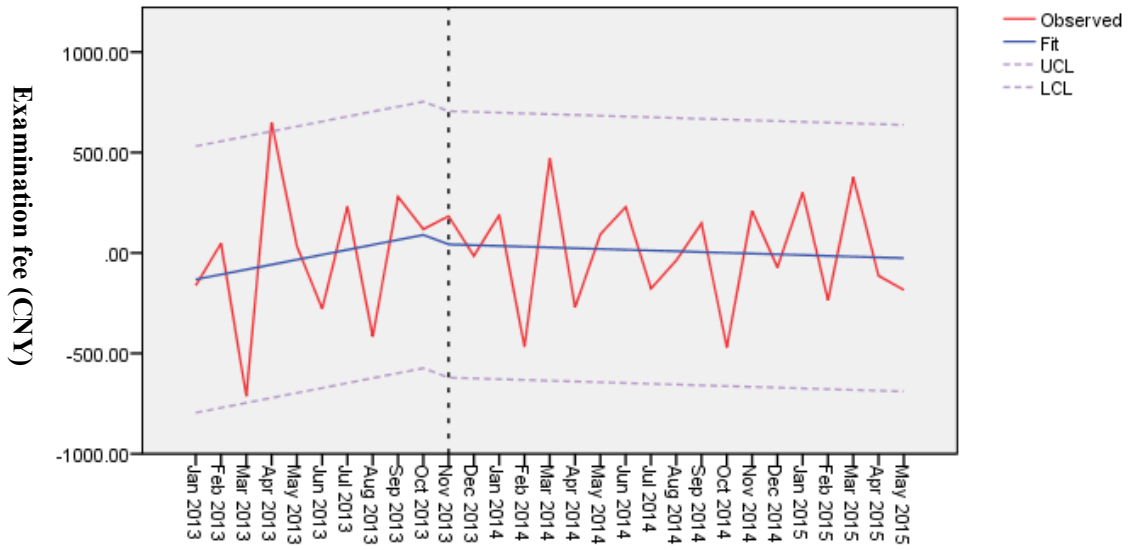

Figure 30 TIA inpatients' average examination fee

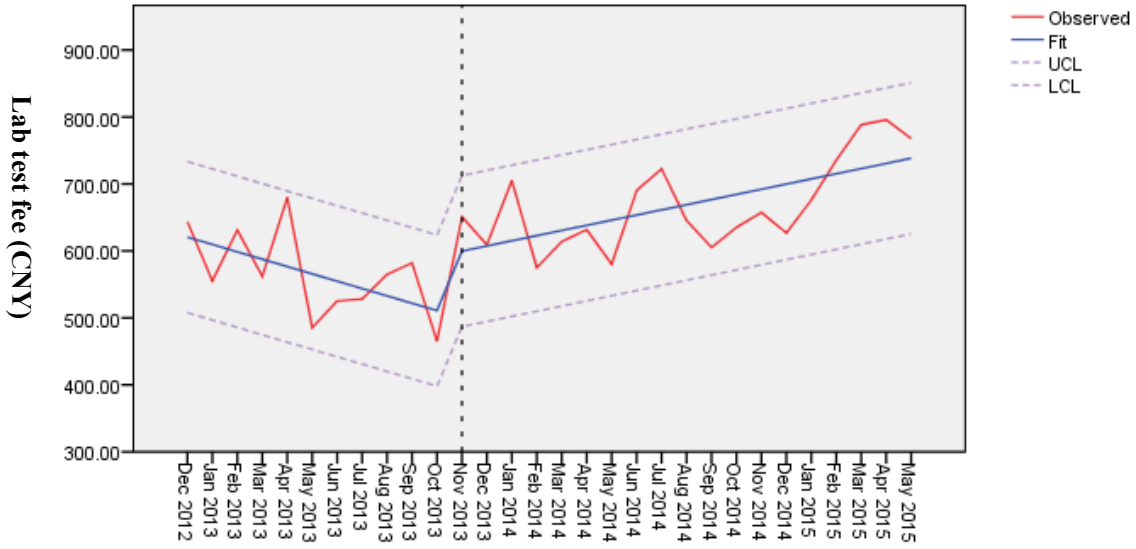

Figure 31 TIA inpatients' average lab test fee

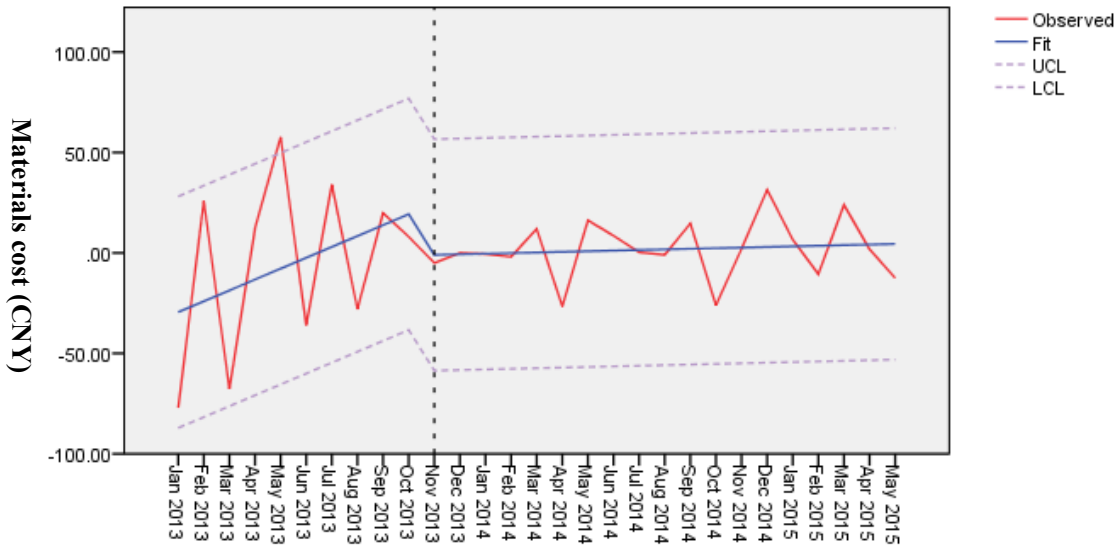

Figure 32 TIA inpatients' average materials cost

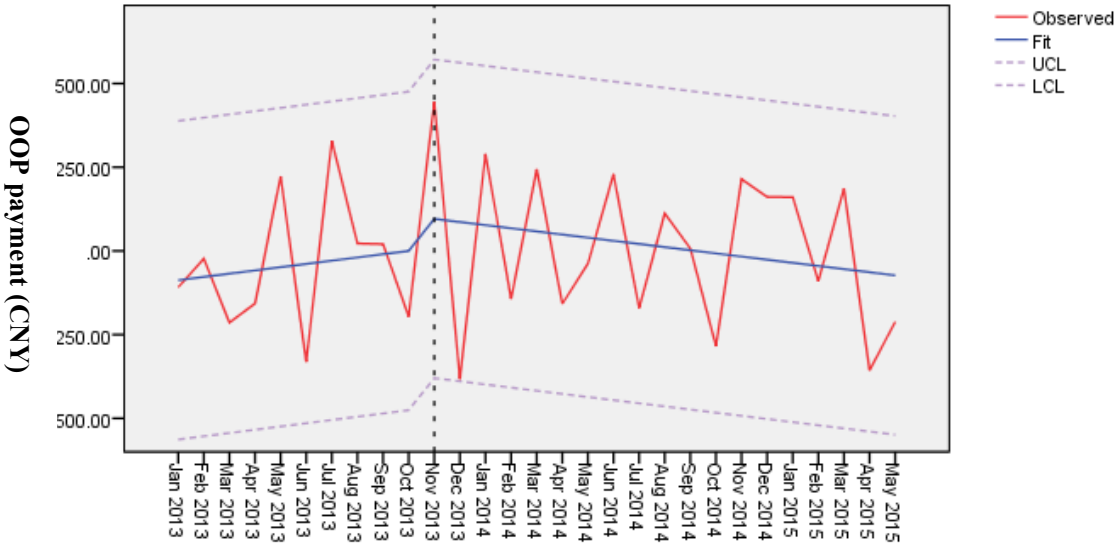

Figure 33 TIA inpatients average OOP payment

C. Cerebral hemorrhage

Compared to before the pilot, cerebral hemorrhage inpatients' average examination fee increased by 600 CNY per person after the pilot; pathway patients' average drug cost decreased by 500 CNY; non-pathway patients' drug cost, examination fee, lab test fee and materials cost all substantially increased, whereas other cost categories had no significant changes (Table 17).

Table 17. Qianjiang Central Hospital cerebral hemorrhage inpatients' average hospitalization cost and cost composition before and after pilot (CNY)

Category	Before pilot: All patients (n=67)	After pilot: All patients (n=206)	After pilot: Pathway (n=134)	After pilot: Non-pathway (n=72)
Total cost	11,643.70 ± 8,489.76	1,1719.80 ± 9,275.51	10,939.66 ± 7,115.95	13,171.74 ± 12,258.47
Categories				
Drug	4,718.72 ± 3,823.26	4,681.66 ± 4,723.46	4,265.66 ± 3140.10*	5,455.86 ± 6,709.26*
Examination	1,334.72 ± 1,036.37	1,907.60 ± 1,572.14*	1,892.27 ± 1,183.01	1,936.13 ± 2,124.5*
Lab test	1,069.73 ± 1,057.45	1,200.02 ± 942.56	973.18 ± 608.26	1,622.21 ± 1,262.62*
Materials	542.51 ± 442.57	537.16 ± 433.68	436.73 ± 291.69	724.07 ± 573.76*
OOP %	47.81% ± 22.24%	45.81% ± 17.35%	44.21% ± 17.61%	35.66% ± 14.03%
Drug %	39.06% ± 12.61%	37.42% ± 11.58%	38.37% ± 09.95%	48.79% ± 16.55%

*Compared to before pilot, p<0.05.

Similarly, ITS analysis showed that cerebral hemorrhage patients' average hospitalization cost, drug cost, examination fee, lab test fee, materials cost and OOP payment had no significant changes in trends before and after the pilot (Figure 34 – 39).

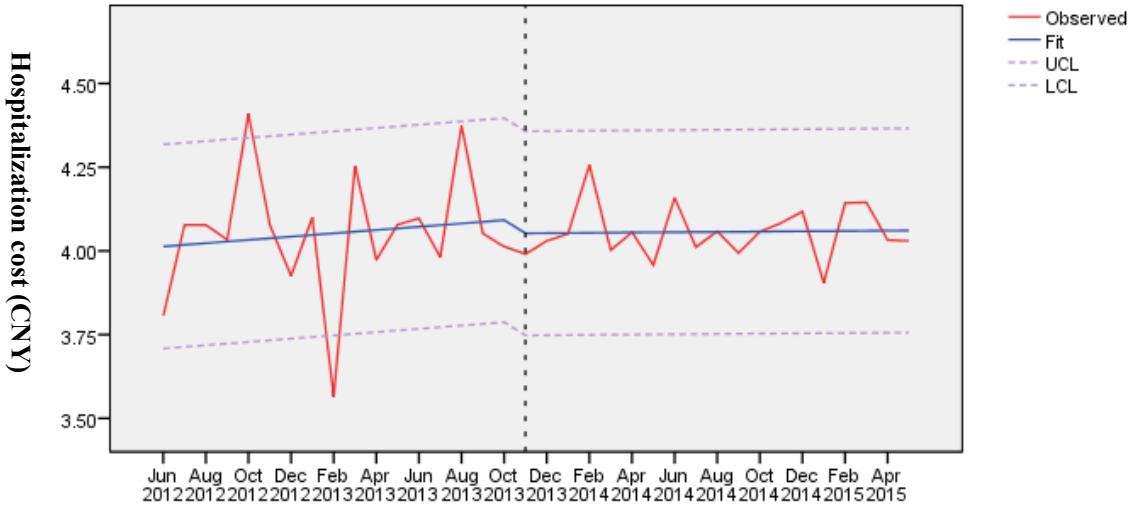

Figure 34 Cerebral hemorrhage inpatients' average hospitalization cost

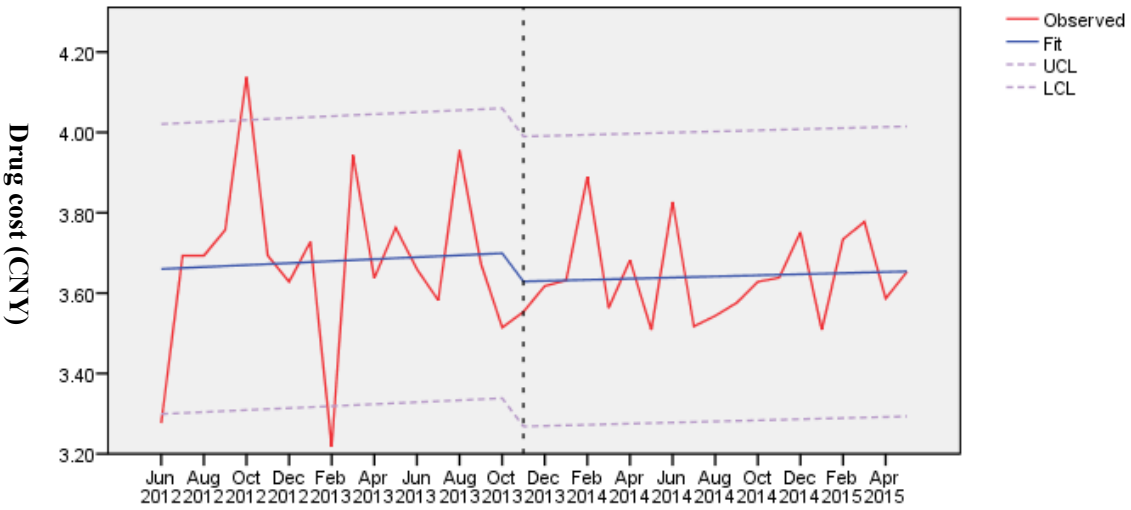

Figure 35 Cerebral hemorrhage inpatients' average drug cost

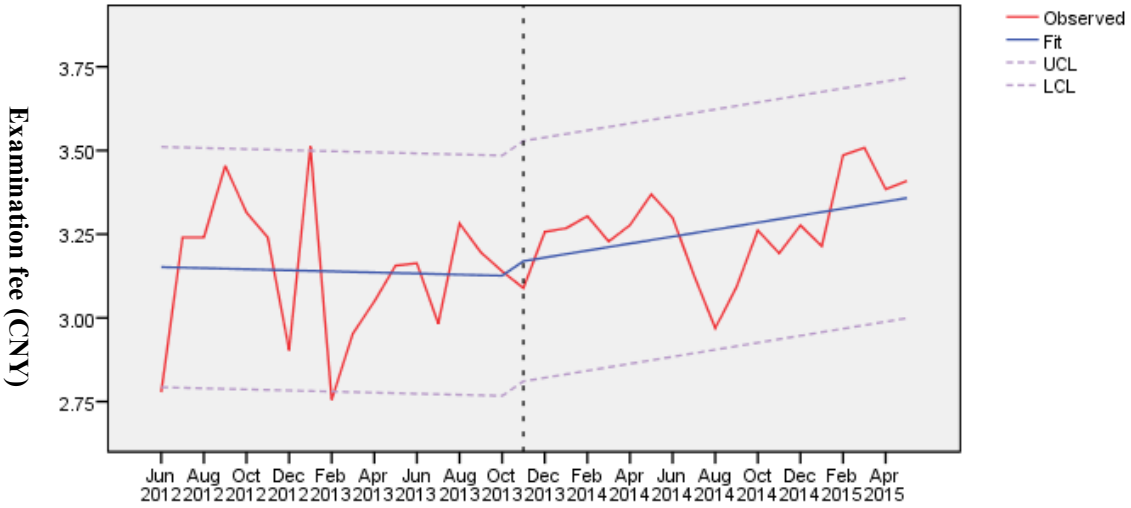

Figure 36 Cerebral hemorrhage inpatients' average examination fee

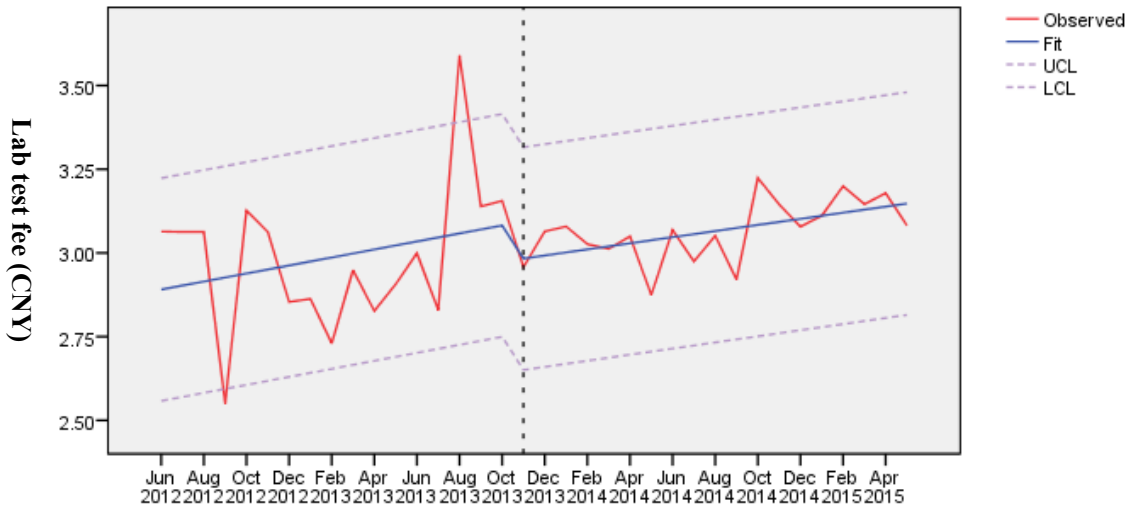

Figure 37 Cerebral hemorrhage inpatients' average lab test fee

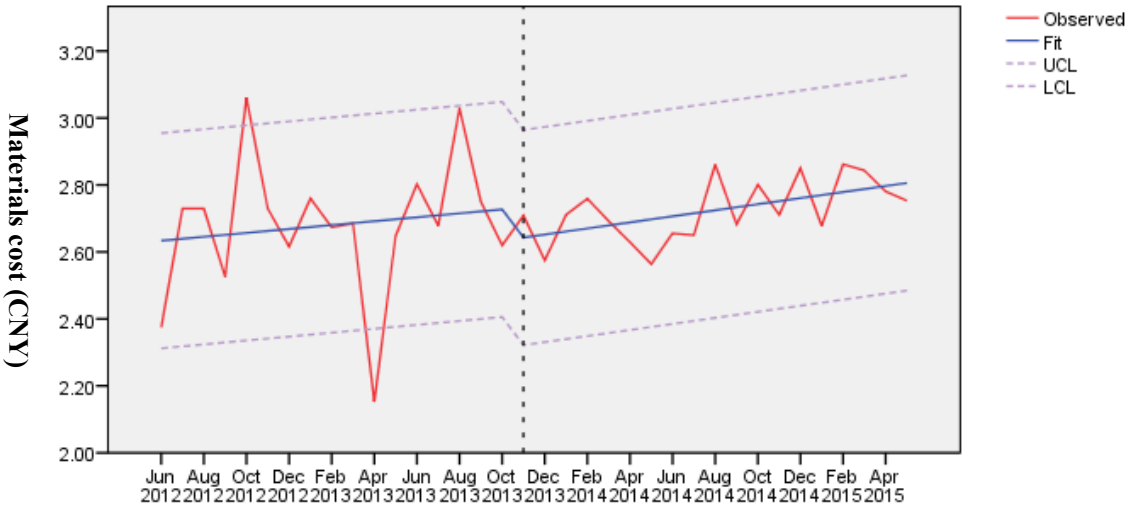

Figure 38 Cerebral hemorrhage inpatients' average materials cost

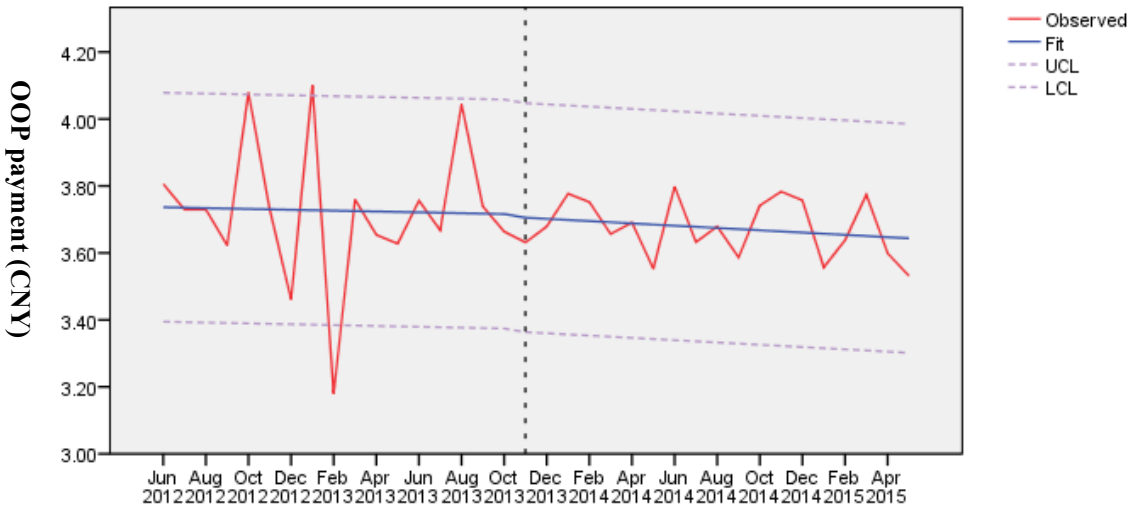

Figure 39 Cerebral hemorrhage inpatients' average OOP payment

D. Cerebral infarction

Compared to costs before the pilot, drug cost and examination cost significantly increased. Changes in examination and drug costs in the pathway patients were similar to the changes in all patients after the pilot implementation. Non-pathway patients' average hospitalization cost and other cost categories had no significant changes compared to costs before the pilot (Table 18).

Table 18 Qianjiang Central Hospital cerebral infarction inpatients' average hospitalization cost and cost composition before and after pilot (CNY)

Category	Before pilot: All patients (n=35)	After pilot: All patients (n=305)	After pilot: Pathway patients (n=281)	After pilot: Non-pathway patients (n=24)
Total cost	9,095.17 ± ,5453.46	10,523.26 ± 6,622.43	10,578.01 ± 6,412.13	9,882.24 ± 8,869.61
Categories				
Drug	4,026.92 ± 2,197.10	5,030.90 ± 3,185.64*	5,078.19 ± 3,091.38*	4,477.25 ± 4,176.78
Examination	1,273.59 ± 765.77	1,714.51 ± 968.44*	1,740.65 ± 948.73*	1,408.5 ± 1,154.34
Lab test	794.34 ± 959.71	956.23 ± 701.81	916.85 ± 535.03	1,417.33 ± 1,668.66
Materials	237.48 ± 426.6	254.55 ± 324.79	241.39 ± 222.06	408.65 ± 875.81
OOP%	50.21% ± 19.18%	46.3% ± 18.1%	46.41% ± 18.51%	45.04% ± 16.28%
Drug %	45.97% ± 12.91%	47.77% ± 10.99%	48.00% ± 10.43%	44.98% ± 12.61%

*Compared to before pilot, p<0.05.

Similarly, ITS analysis results showed that cerebral infarction inpatients' average hospitalization cost, drug cost, examination fee, lab test fee, materials cost and OOP payment had no significant changes compared to trends before the pilot (Figure 40 – 45).

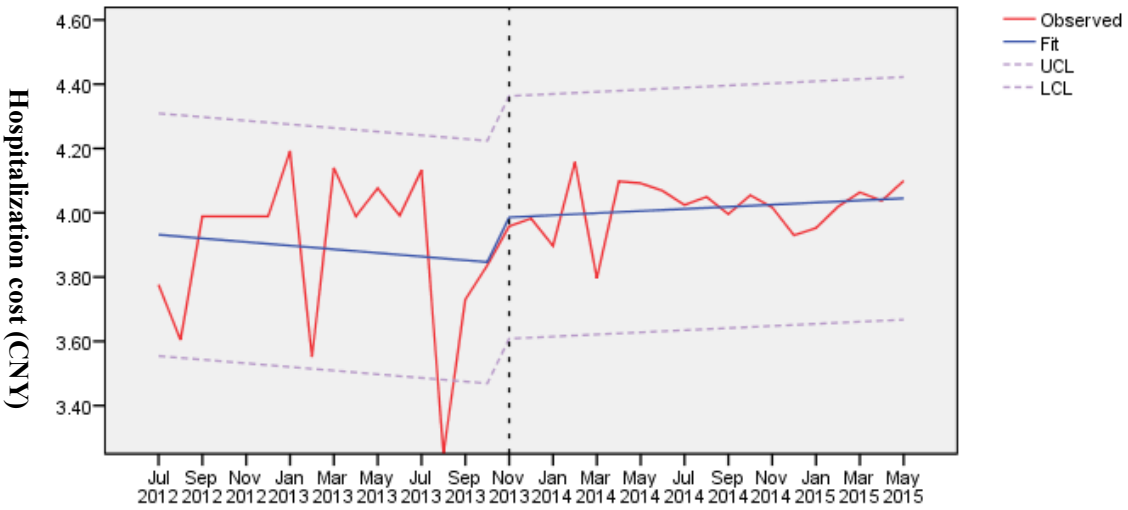

Figure 40 Cerebral infarction inpatients' average hospitalization cost

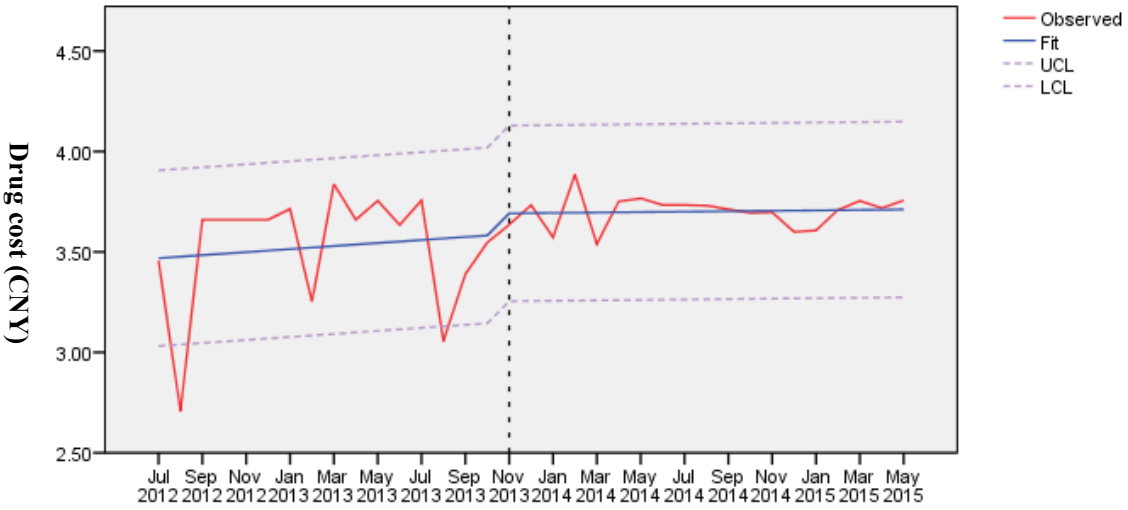

Figure 41 Cerebral infarction inpatients' average drug cost

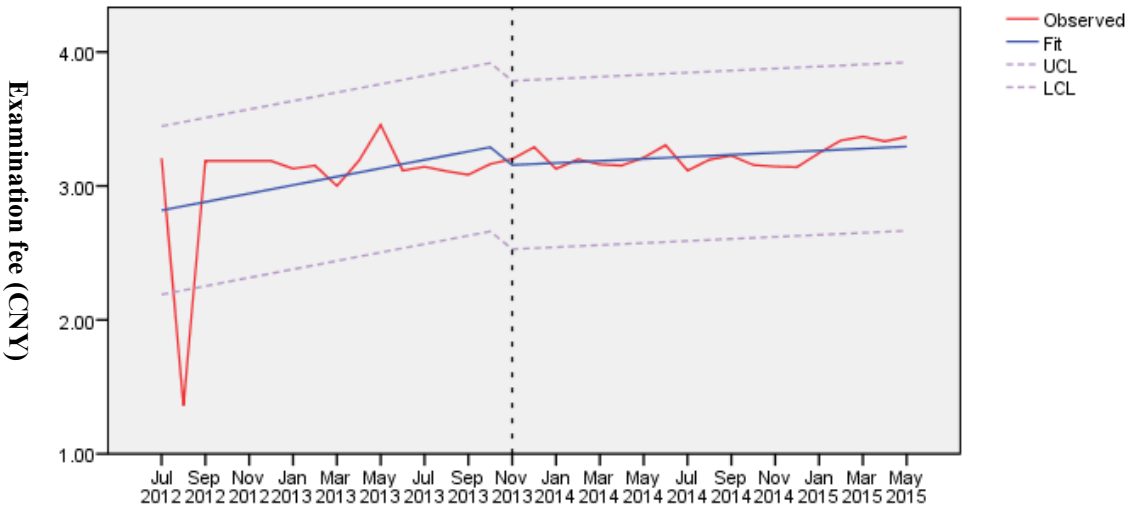

Figure 42 Cerebral infarction inpatients' average examination fee

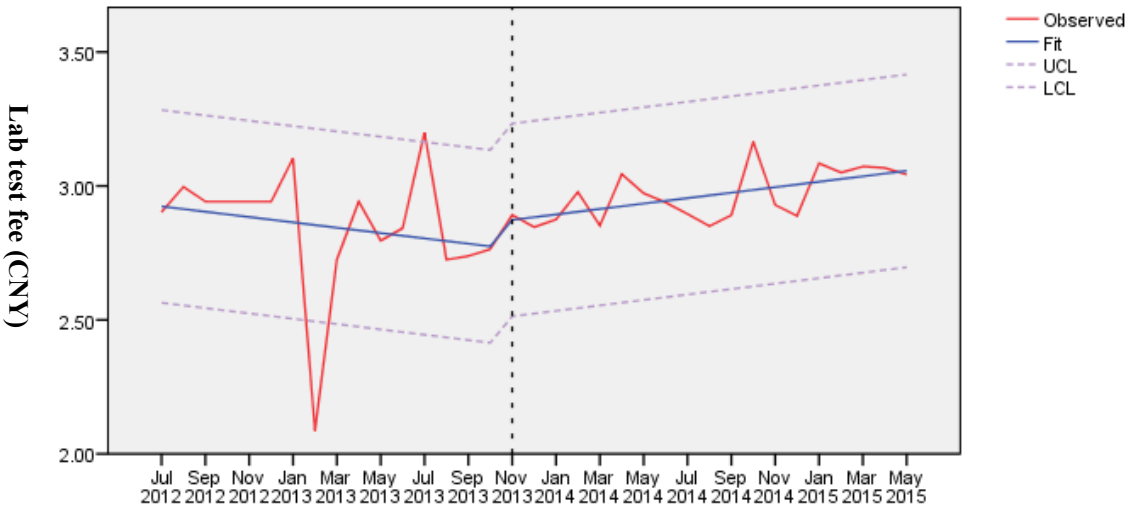

Figure 43 Cerebral infarction inpatients' average lab test fee

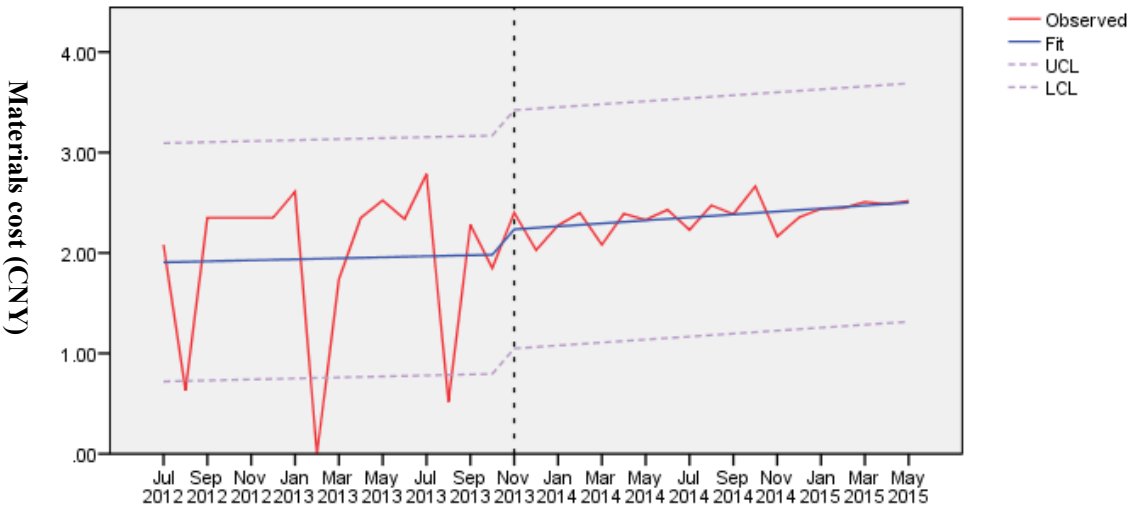

Figure 44 Cerebral infarction inpatients' average materials cost

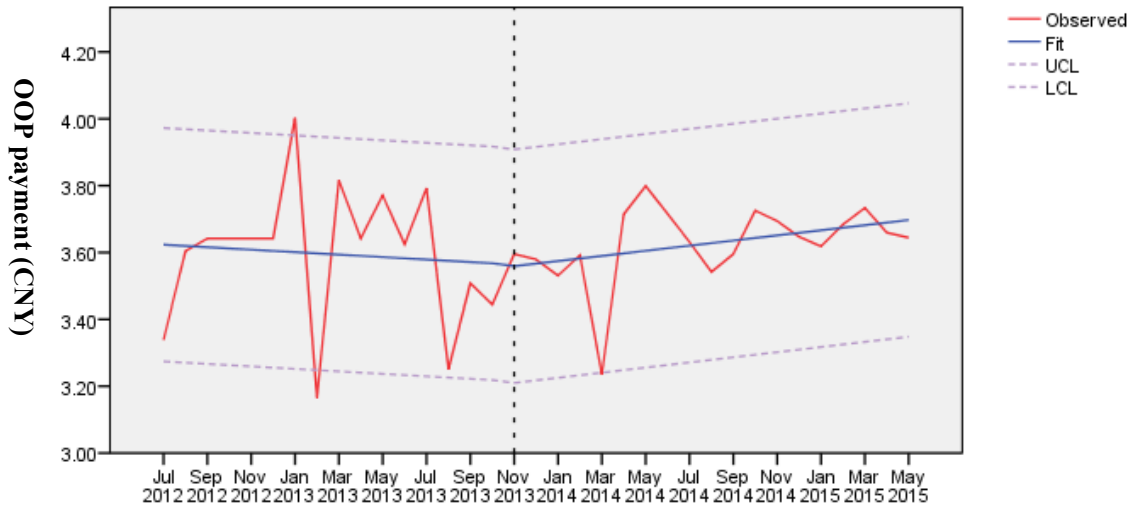

Figure 45 Cerebral infarction inpatients' average OOP payment

5. Healthcare efficiency

The integrated care pathway description has clear standards for length of hospitalization for each disease type. Overall, the implementation of this project significantly improved healthcare efficiency.

Compared to before the pilot, COPD, cerebral hemorrhage, and cerebral infarction's average length of hospitalization in Qianjiang Central hospital significantly decreased, and the magnitude of decrease was quite large. The average length of hospitalization for TIA inpatients did not change significantly before and after the pilot.

Compared to the standard length of hospitalization set by the project, COPD and TIA inpatients' average length of hospitalization for all patients after the implementation was lower than the minimum length of hospitalization in the initial phase of the pilot. This suggested that the standard minimum length of hospitalization set in the initial phase of the project could be adjusted, under the premise that healthcare quality is ensured. Cerebral hemorrhage inpatients' average length of hospitalization after the pilot was close to the standard minimum length of hospitalization. Cerebral infarction inpatients' average hospitalization was within the pathway standard range, and relatively stable compared to before the pilot. This suggested that the pathway hospitalization standards established for cerebral hemorrhage and cerebral infarction were more aligned with actual clinical practice (Table 19).

Table 19 Average length of hospitalization (days) in Qianjiang Central Hospital before and after pilot.

Disease type	Pathway standard		Before pilot	After pilot		
	Min	Max		Total	Pathway	Non-pathway
COPD	10	21	10.37	8.51*	8.32*	8.77*
TIA	9	14	5.15	5.11	5.11	5.10
Cerebral hemorrhage	14	21	16.84	13.82*	15.22*	11.21*
Cerebral infarction	8	14	12.46	11.97*	12.14	9.96*

*Compared to before pilot, $p<0.05$

6. Healthcare quality

EQ-5D was administered to 1,045 inpatients hospitalized with COPD, cerebral hemorrhage or cerebral infarction to measure overall health outcomes. The difference-in-difference method was used to evaluate the outcomes. Results indicate that there were no significant changes in quality of life before and after the pilot for the three diseases. However, there was a possibility that COPD or cerebral hemorrhage patients' quality of life improved, since VAS and EQ-5D results were not consistent (Table 20, 21). However, inpatients' quality of life at time of discharge significantly improved compared to time of admission both before and after the pilot.

EQ-5D difference-in-difference analysis results showed that COPD inpatients' quality of life significantly improved compared to before the pilot; cerebral hemorrhage and cerebral infarction inpatients' quality of life did not change. On the contrary, VAS difference-in-difference analysis showed that, after the pilot, cerebral hemorrhage inpatients' quality of life significantly improved compared to before; COPD and cerebral infarction inpatients' quality of life had no significant change.

Table 20 Changes in Qianjiang Central Hospital inpatients' quality of life (EQ-5D) before and after pilot.

Disease type	Constant	Time#	Group#	T*G#		
				Non-standardized coefficient	t	P
COPD	0.595	-0.093	0.067	0.191	6.164	0.000
Cerebral hemorrhage	0.33	-0.065	0.246	0.086	1.045	0.297
Cerebral infarction	0.381	-0.053	0.261	-0.041	-0.660	0.509

#Time = before pilot vs. after pilot
#Group = admission vs. discharge
#T*G = Time * Group = net effect of inpatients' quality of life changes before and after pilot.

Table 21 Changes in Qianjiang Central Hospital inpatients' quality of life (VAS) before and after pilot.

Disease type	Constant	Time#	Group#	T*G#		
				Non-standardized coefficient	t	P
COPD	52.86	-1.944	15.826	2.708	1.545	0.123
Cerebral hemorrhage	47.189	-5.768	21.111	9.705	2.186	0.030

Cerebral infarction	51.095	-6.787	22.635	1.883	0.644	0.520

#Time = before pilot vs. after pilot

#Group = admission vs. discharge

#T*G = Time * Group = net effect of inpatients' quality of life changes before and after pilot.

Based on the three disease inpatients' EQ-5D score distribution, COPD patients' quality of life score at discharge significantly improved compared to pre-pilot, and the variation narrowed. Cerebral infarction inpatients' quality of life score also significantly improved; cerebral hemorrhage patients' quality of life score had no significant change (Table 22).

Table 22 Qianjiang Central Hospital inpatients' quality of life (EQ-5D) before and after pilot.

Disease type	Before pilot		After pilot	
	Admission	Discharge	Admission	Discharge
COPD (n=142+444)	0.595 ± 0.241	0.662 ± 0.215	0.502 ± 0.291	0.760 ± 0.136*
Cerebral hemorrhage (n=43+81)	0.330 ± 0.278	0.576 ± 0.325	0.265 ± 0.341	0.598 ± 0.283
Cerebral infarction (n=63+272)	0.381 ± 0.302	0.642 ± 0.296	0.327 ± 0.326	0.548 ± 0.307*

*Compared to before pilot, P<0.05.

Based on the three disease type inpatients' VAS score distribution, cerebral hemorrhage patients' quality of life score at admission became lower than before the pilot, but quality of life score at discharge was significantly higher than before the pilot. Overall, the magnitude of increase in quality of life was greater than that before the pilot. Cerebral infarction patients' quality of life improvement from admission to discharge was significantly larger in magnitude compared to before-pilot patients. COPD patients' quality of life scores had no significant difference before and after the pilot (Table 23).

Table 23 Qianjiang Central Hospital inpatients' quality of life (VAS) before and after pilot.

Disease type	Before pilot		After pilot	
	Admission	Discharge	Admission	Discharge
COPD (n=142+444)	52.86 ± 15.21	68.69 ± 16.87	50.92 ± 10.58	69.45 ± 12.14
Cerebral hemorrhage (n=43+81)	47.19 ± 16.32	68.30 ± 24.66	41.43 ± 12.16	72.24 ± 13.93
Cerebral infarction (n=63+272)	51.10 ± 13.48	73.73 ± 16.97	44.31 ± 12.01	68.83 ± 16.96

*Compared to before pilot, P<0.05.

7. Rehabilitation

As an important component of integrated care pathway implementation, rehabilitation pathways were newly built at the pilot hospital. Although rehabilitation medicine is at an early stage of development in China, Qianjiang Central Hospital has already established an independent rehabilitation department based on the solid foundation of the China-UK Pathway Project Phase I using cerebral hemorrhage and cerebral infarction as pilot diseases. With a focus on neurology rehabilitation, the hospital further expanded its rehabilitation department with support from the project: the hospital established and implemented rehabilitation pathways and a downward referral system after several China-UK project rehabilitation training sessions; and also carried out various initiatives to strengthen the development and implementation of integrated care pathways.

(1) Acute rehabilitation period

Currently, Qianjiang Central Hospital has 11 rehabilitation therapists on staff; among them, six are neurology rehabilitation therapists. To support early rehabilitation intervention in acute stroke patients' care pathway, the hospital arranged cooperation between the rehabilitation and neurology departments, requiring that patients see therapists in the rehabilitation department in the mornings, and participate in the neurology department's acute rehabilitation treatment and consultation in the afternoons.

After the pilot, the proportion of stroke patients in Qianjiang Central Hospital implementing NIHSS scoring was 100%. The proportion of early rehabilitation intervention in stroke patients was greater than 90%; the proportion of swallowing function assessment carried out was above 95%.

(2) Stable rehabilitation period

After the pilot, Qianjiang Central Hospital formed collaborations with eight local township health centers and conducted post-discharge rehabilitation through the eight primary care centers. The hospital also strengthened rehabilitation capacity of the primary care centers through training, technical guidance and other methods. By May 31, 2015, 698 COPD and stroke patients were referred by Qianjiang Central Hospital to primary care institutions; among them, there were 174 COPD, 348 TIA, 22 cerebral hemorrhage and 154 cerebral infarction patients.

8. Discussion

Through the integrated care pathways supported by payment method reform, related regulatory measures and information system, the China-UK collaboration project standardized healthcare service behaviors, improved healthcare quality, and curbed excessive healthcare costs. Coincidentally, the project implementation period overlapped with the in-depth development of the healthcare system reform in China. Thus, the pilot sites explored and implemented many healthcare reform policies, leading to an inevitable impact on the implementation of the project.

(1) Overall impact of care pathway management on inpatients

Care pathway is the core quality management tool for project implementation. Integrated care pathway management rate reflects the overall impact of the project on inpatients at the pilot hospital. The management rate is determined by pathway entrance rate and completion rate, and also influenced by healthcare providers' awareness and perception, insurance payment method, and healthcare institution's internal reward and incentive structure. Qianjiang Central Hospital, as one of the oldest pilot sites in the China-UK care pathway project, has a common understanding of the positive impact of care pathways. This is evident from the high pathway management rate of 76.26% for the four pilot diseases during the intervention (COPD, TIA, cerebral hemorrhage and cerebral infarction). In particular, TIA and cerebral infarction inpatients had very high pathway management rates, both above 90%. At the same time, it is recognized that due to Chongqing Healthcare Insurance becoming a municipal-level coordination, the single-disease fixed case payment method implemented in Phase I was discontinued in Phase II. The four pilot diseases all operated under the fee-for-service payment method. In the absence of insurance policy support, the care pathway items became somewhat arbitrary to maintain high pathway management rate, as demonstrated by the large amount of non-pathway items used.

(2) Impact of care pathway on clinical behaviors

The pathways had a clear impact on correcting inadequate healthcare provision, but lacked impact on restricting overtreatment. For service items recommended by the pathways, the four pilot diseases had varying levels of improvement. However, due to the insurance reimbursement method and patients' long-term medication habits, service items that were not supported by evidence were also included as optional items in the pathways; as a result, the restrictive function of the pathways was limited.

(3) Factors affecting physicians' prescription of pathway items

The high usage of non-pathway items indicated a need for pathway improvement and more support from appropriate health insurance payment policies. There are two

reasons for the high prescription volume of non-pathway items in Qianjiang Central Hospital. First, without the support of health insurance single-disease fixed case payment policy, there were uncertainties in physicians' healthcare behaviors under the fee-for-service policy. Second, the hospital drug information database and the care pathway management information system were not linked and updated in real-time. As a result, when there was a change in drug varieties used by the hospital or when the drug manufacturers changed, pathway forms and information management system were not updated; and therefore such items were counted as non-pathway items. This happened most frequently with injection fluids (e.g., sugar fluids, normal saline). In fact, medications prescribed to every pathway patients must be reviewed and publicly assessed by a pharmacist according to pathway guidelines; in principle, there cannot be more than two varieties of drugs in the same drug type, and should mainly contain essential drugs. Thus, the actual use of non-pathway drugs may be relatively low.

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