

# Characteristics and implications of insurance-reimbursed inpatient care for gastric and oesophageal cancers in Anhui, China

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**Background:** This study aimed to identify characteristics and trends in insurance-reimbursed inpatient care (NRIC) for gastric and oesophageal cancers and inform evaluation of medical systems reform.

**Methods:** The study extracted routinely collected records of claims for reimbursement from the New Rural Cooperative Medical System (NRCMS) in Anhui Province, China and performed descriptive and regression discontinuity analysis.

**Results:** From 2013 to 2017, NRIC in terms of person-time per million people (pmp) increased 5.60 and 20.62 times for gastric and oesophageal cancers, respectively. Total expense per episode for gastric and oesophageal cancers increased from 1130.25 and 22 697.99 yuan to 12 514.98 and 24 639.37 yuan, respectively. The ratio of out-of-pocket expenses per inpatient care episode to annual disposable income per capita was 0.43 for gastric cancer and 0.91 for oesophageal cancer and decreased by 0.17 and 0.47, respectively. Regression discontinuity modelling revealed that, when controlled for disposable income, illiteracy rate and months from start time, the treatment variable was significantly associated with person-times of NRIC pmp ( $\beta=0.613$ ,  $p=0.000$ ), length of stay per  $10^5$  people ( $\beta=-52.990$ ,  $p=0.000$ ) and total expenses per NRIC episode ( $\beta=2.431$ ,  $p=0.000$ ).

**Conclusions:** The study period witnessed substantial achievements in benefits to patients, inpatient care efficiency and equity. These achievements may be attributed mainly to the recent reforms launched in Anhui province, China.

**Keywords:** cancer, New Rural Cooperative Medical System, reform.

## Introduction

Gastric and oesophageal cancers are common cancers in China.<sup>1–4</sup> In 2015, the incidence and mortality rates in rural China were 32.79 per million people (pmp) and 24.44 pmp for gastric cancer and 14.8 pmp and 18.39 pmp for oesophageal cancer, respectively.<sup>5</sup> The high death rate from cancers together with the highly complex diagnosis and treatment process incur tremendous economic and psychological burdens on patients, their relatives, physicians and medical care systems worldwide.<sup>6–10</sup> However, there is a general paucity of published data on cancer burden in China. One study estimated that the inpatient care cost for oesophageal or gastric cancer in China was 10 000–50 000 yuan per patient.<sup>11</sup> Another study in Hua County, China, reported that a single episode of inpatient care for oesophageal cancer could cost one's disposable income for a whole year.<sup>12</sup>

Fortunately the catastrophic burden of cancers has gained high recognition in China.<sup>13</sup> In 2009 the Chinese government called for medical system reforms. Being the champion province of China's new medical system reforms, Anhui Province has launched a series of initiatives to reform its New Rural Cooperative Medical System (NRCMS), including additional reimbursement for major diseases (including cancers), medical aid for poverty alleviation, pay by case mix, zero medicine mark-ups, clinical pathway management, level-by-level referral, prescription formularies, negative lists (eg. list of diagnosis not allowed to use antibiotics) and others.<sup>14–16</sup> According to official reports,<sup>17</sup> these efforts have allegedly brought fundamental changes to the existing medical system. However, there is little evidence-based evaluation on the effects of these reforms. This study aims to perform a primitive evaluation of the effects of the recent reforms using

NRCMS-reimbursed inpatient care (NRIC) for gastric and oesophageal cancers.

## Methods

### Data

The study extracted routinely collected records of claims for NRCMS reimbursement for expenses of inpatient care for gastric and oesophageal cancers during 2013 and 2017 from the NRCMS management information system maintained by the Department for Medical Insurance Management of Anhui, a typical inland province in China consisting of 15 administrative prefectures. The NRCMS has long been implemented throughout Anhui and China and covered >95% of all rural residents.<sup>18</sup> But its scope and level of reimbursement remained quite low until recently. Starting in 2013, as one component of the provincial medical reform package, cancers were added into the list of ‘major diseases’ eligible for additional reimbursement by the NRCMS. The extracted data included year and date of admission, patient’s residential location, level of care for the provider hospital, total and categorical expenses (e.g. expenses for drugs, operations, medical consumables, laboratory tests and clinical treatment) and reimbursement by the NRCMS. The study also extracted prefecture-specific data about population, per capita disposable income, birth rate and illiteracy rate from the Statistical Yearbook of Anhui Province for the years 2013 through 2017.<sup>19</sup>

### Analysis

SPSS version 16.0 (SPSS, Chicago, IL, USA) and Excel 2019 (Microsoft, Redmond, WA, USA) were used for statistical analysis. The analysis comprised calculations and comparisons of mean values of selected measures for different subgroups. These selected measures included volume and composition of NRIC for gastric and oesophageal cancers by gender, age, level of care for provider hospital and patient’s residence (in a specific prefecture); admission rate, as defined by person-time of NRIC pmp, for gastric versus oesophageal cancer by prefectures and facility levels and years; length of hospital stay for patients with gastric and oesophageal cancers by years, prefectures and facility levels; total and categorical expenses per admission episode for gastric and oesophageal cancer by prefectures, years and facility levels; ratio of economic burden, as defined by the proportion of out-of-pocket expenses in annual per capita disposable income, for gastric and oesophageal cancers inpatients by years, prefectures and facility levels.

The study also analysed the effects of the reforms using a regression-discontinuity (RD) design<sup>20,21</sup> by dividing the 5-y (2013–2017) period into 60 months; selecting person-times of NRIC pmp, length of stay pmp, expense per NRIC episode and proportion of compensation in total expense as the outcome variable; selecting month 18 as the cut-off point by means of manually examining the scatter plots of the dependent variables selected; building regression models of each of the selected outcome variables and using point D as the treatment variable and months from start time (1 January 2013), per capita disposable income and illiteracy rate as the control variables. The bandwidth for the modelling was set as 12 months before and

after the cut-off point. For all months before the cut-off point, D was set as 0 and for all months after the cut-off point, D was 1.

Numbering of the 15 prefectures in Anhui was based on the corresponding rank order of admission rate. In other words, P1 represents the prefecture with the highest admission rate, while P15 is the prefecture with the lowest admission rate. Expenses or income for different years were discounted into comparable values using 2013 as the baseline. Hospitals in China are classified into three levels: level 3 (the largest and best staffed and equipped), level 2 and level 1 (the smallest and least staffed and equipped hospitals).

## Results

### Volume and composition of insurance-reimbursed admissions

The total insurance-reimbursed admissions from 2013 to 2017 for gastric and oesophageal cancers was 71 460 and 25 645 person-times, respectively. Of these, the number of admissions for men was about 3-fold that for women (75.1% vs 24.9%). The bulk of the patients were 50–79 y of age. There were marked discrepancies in the number of admissions between different prefectures, from 1295 person-times for P13 to 25 053 person-times for P1. These distribution characteristics between gender, age, level of hospital and prefecture groups were all observable for both gastric and oesophageal cancers (for more details, please refer to Table 1).

### Person-times of admissions pmp

Figure 1 presents admission rates for gastric and oesophageal cancers by years of hospitalization and prefectures. From 2013 to 2017, the admission rate increased by 5.6 times (from 11.56 to 65.03) for gastric cancer, 20.62 times (from 1.29 to 26.61) for oesophageal cancer and 7.13 times (from 12.85 to 91.65) for gastric and oesophageal cancers. The admission rates varied greatly between different prefectures, being, for example, 7-fold for gastric cancer between P1 vs P15 and 8-fold for oesophageal cancer between P3 vs P15. Prefectures with a relatively higher admission rate for gastric cancer also had a higher admission rate for oesophageal cancer. Univariate correlation analysis revealed that the correlation coefficient between the descending order of admission rate for a given prefecture and the descending order of disposable income, population size, birth rate, illiteracy rate and ratio of reimbursed expenses to total expenses for the same prefecture was 0.586 ( $p=0.022$ ),  $-0.346$  ( $p=0.206$ ),  $-0.711$  ( $p=0.003$ ),  $-0.529$  ( $p=0.043$ ) and  $0.459$  ( $p=0.207$ ), respectively.

### Composition of inpatient care providers

Level 3 hospitals provided most (57.2%) of the inpatient care, followed by level 2 (27.8%) and level 1 (9.48%). Although this dominance of care provision by level 3 and 2 hospitals was consistent for both gastric and oesophageal cancers, throughout all prefectures, great variations existed in the composition of provider hospitals between prefectures. For example, the proportion of inpatient care for gastric cancer by level 3 hospitals ranged from 17.46% for P4 to 73.47% for P12. In comparison, the composition

**Table 1.** Volume and composition of NRCMS-reimbursed inpatient care for gastric and oesophageal cancers

Characteristics	Gastric cancer		Oesophageal cancer		Total	
	Person-times	%	Person-times	%	Person-times	%
Gender						
Male	53 136	74.36	19 759	77.05	72 895	75.07
Female	18 324	25.64	5886	22.95	24 210	24.93
Age (years)				0.00		
<30	443	0.62	37	0.14	480	0.49
30–39	1058	1.48	52	0.20	1110	1.14
40–49	6561	9.18	1023	3.99	7584	7.81
50–59	14 084	19.71	3920	15.29	18 004	18.54
60–69	28 871	40.40	11 176	43.58	40 047	41.24
70–79	17 928	25.09	8071	31.47	25 999	26.77
≥80	2515	3.52	1366	5.33	3881	4.00
Hospital level		0.00		0.00		0.00
Level 1	4976	6.96	1383	5.39	6359	6.55
Level 2	28 390	39.73	4077	15.90	32 467	33.43
Level 3	35 112	49.14	19 463	75.89	54 575	56.20
Other	2982	4.17	722	2.82	3704	3.81
Prefectures						
P1	18 165	25.42	6888	26.86	25 053	25.80
P2	3424	4.79	1132	4.41	4556	4.69
P3	5357	7.50	1426	5.56	6783	6.99
P4	9631	13.48	1270	4.95	10 901	11.23
P5	8922	12.49	2914	11.36	11 836	12.19
P6	2114	2.96	384	1.50	2498	2.57
P7	1417	1.98	647	2.52	2064	2.13
P8	1394	1.95	338	1.32	1732	1.78
P9	2461	3.44	512	2.00	2973	3.06
P10	2038	2.85	1123	4.38	3161	3.26
P11	7151	10.01	4508	17.58	11 659	12.01
P12	2043	2.86	923	3.60	2966	3.05
P13	974	1.36	321	1.25	1295	1.33
P14	3015	4.22	2023	7.89	5038	5.19
P15	3354	4.69	1236	4.82	4590	4.73
Total	71 460	100	25 645	100	97 105	100

P1–P15 represents the prefectures with the highest to lowest person-times of inpatient care pmp.

of care provision was more focused on level 3 (the highest level) hospitals for oesophageal cancer than for gastric cancer (71.52% vs 42.88%). Prefectures with a higher proportion of care being provided by level 3 or 2 hospitals for gastric cancer also tended to have a higher proportion of care provision by the same level of hospitals for oesophageal cancer. Looking at the trends from 2013 to 2017, the proportion of inpatient care provided by level 3 and 2 hospitals increased from 70.65% to 93.20% for gastric cancer and 77.36% to 92.83% for oesophageal cancer (Figure 2).

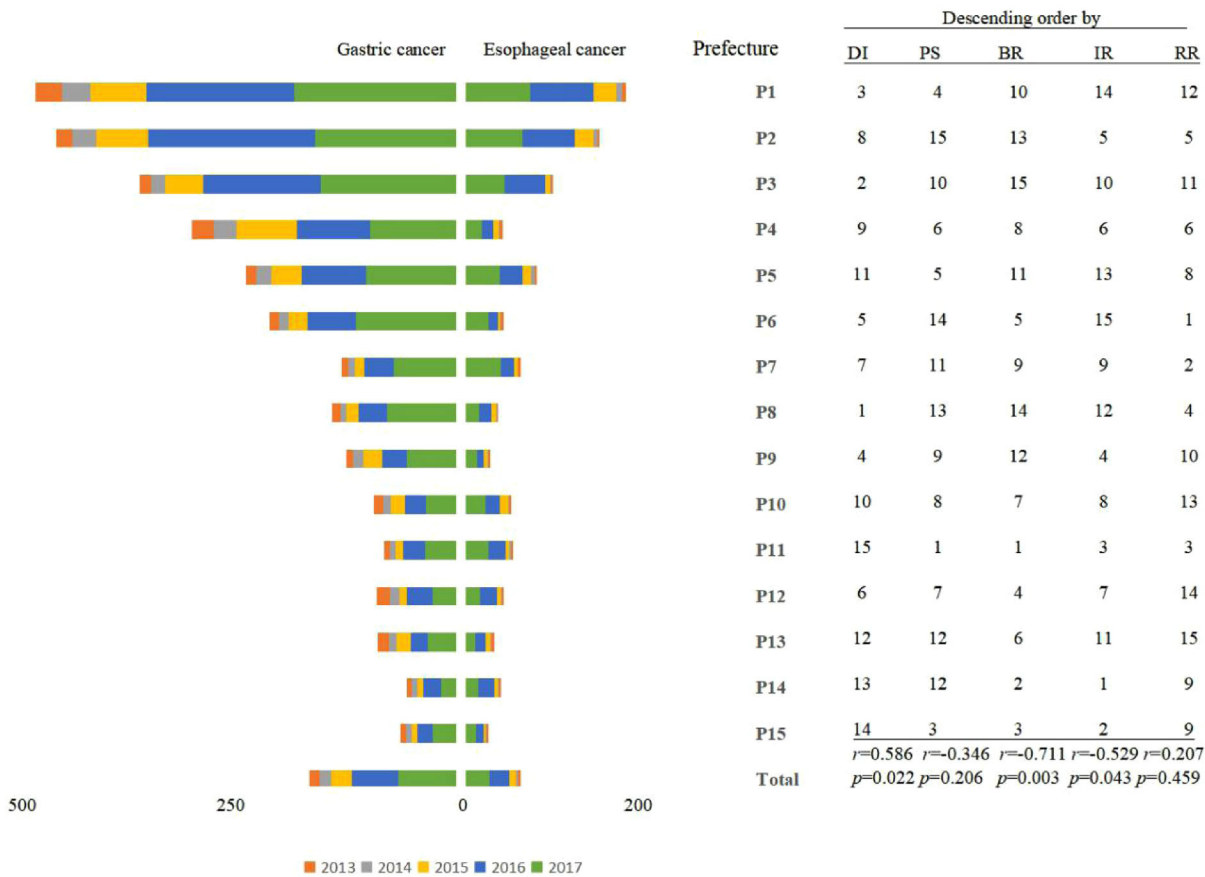
### Length of stay per NRIC episode

Table 2 shows the length of stay per inpatient care episode by location of cancer, prefecture and year of admission. The average length of stay for gastric cancer was shorter than that for oesophageal cancer, being 10.17 d vs 16.27 d. For the entire study

period, the mean length of stay per admission witnessed a downward trend for both gastric and oesophageal cancers, from 13.87 to 9.02 d and from 18.09 to 15.85 d, respectively. This trend was consistent in almost all prefectures. Prefecture-specific length of stay varied from 7.11 to 12.12 d for gastric cancer and from 12.53 to 18.30 d for oesophageal cancer. The length of stay per NRIC episode by facilities is provided in Supplementary Table 1, which shows a downward trend from level 3 to level 1 hospitals.

### Total and categorical expenses per NRIC episode

Figure 3 and Supplementary Figure 1 provide the total and categorical expenses per inpatient care episode by year of admission, facility and prefecture. The total expense per admission was higher for oesophageal cancer than for gastric cancer (24 639.37 vs 12 514.98 yuan; US\$1 equals approximately 7 yuan) and



**Figure 1.** Person-times of inpatient care pmp by different prefectures. P1–P15 represents the prefectures with the highest to lowest person-times of inpatient care pmp. DI: per capita disposable income; PS: population size; BR: birth rate; IR: illiteracy rate; RR: ratio of reimbursed expense to total expense.

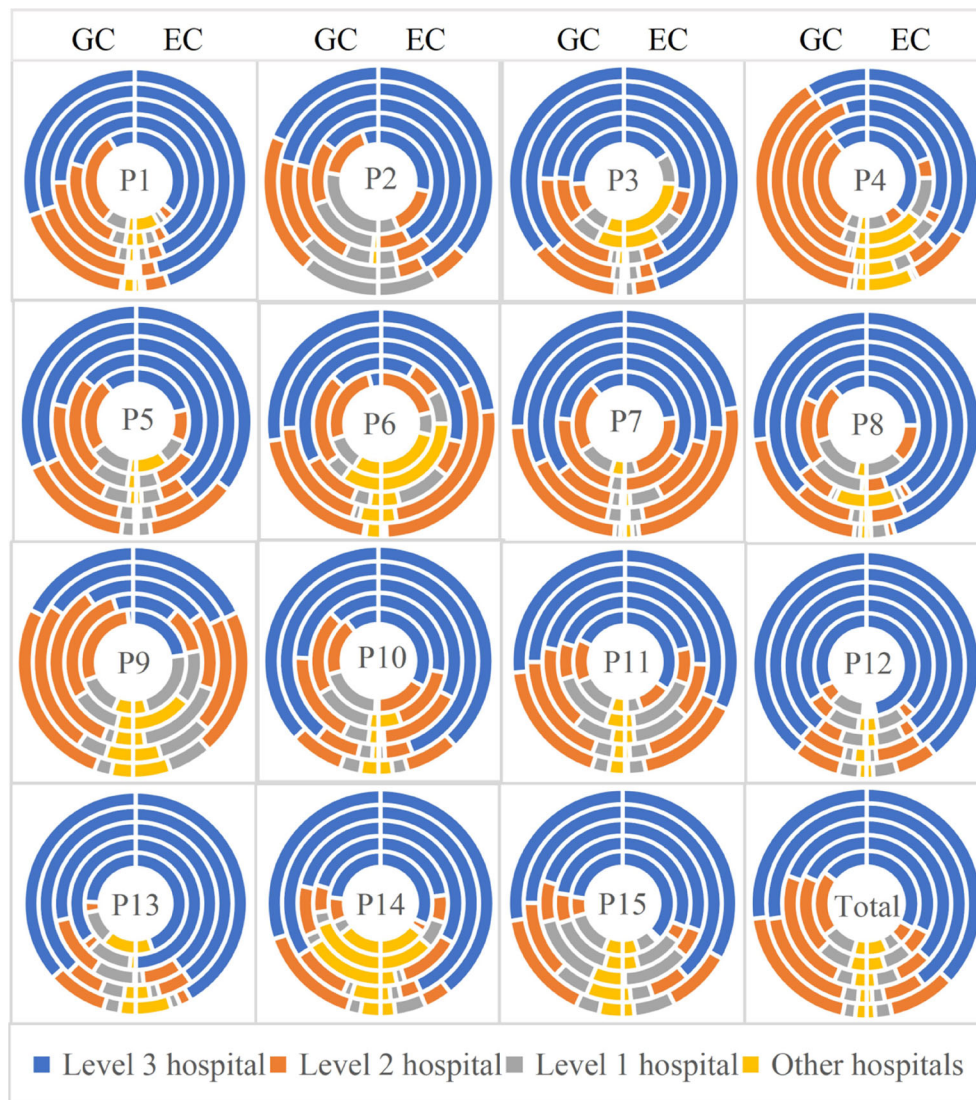
showed a decreasing trend from 2013 to 2017, from 11 422.13 to 10 737.40 yuan and from 20 868.48 to 18 927.10 yuan for gastric and oesophageal cancer, respectively. Total per episode expenses for gastric cancer for different prefectures ranged from 7401.81 to 16 055.18 yuan in 2013 (2.17 times), 8185.91 to 19 157.69 yuan in 2014 (2.34 times), 8169.88 to 19 144.91 yuan in 2015 (2.34 times), 7825.81 to 15 238.68 yuan in 2016 (1.95 times) and 7528.62 to 13 478.01 yuan in 2017 (1.79 times). The difference in total per episode expenses for oesophageal cancer for different prefectures was even greater; ranging from 3428.29 to 25 263.84 yuan in 2013 (7.37 times), 8470.34 to 42 924.32 yuan in 2014 (5.07 times), 14 893.73 to 36 761.21 yuan in 2015 (2.47 times), 11 801.55 to 24 812.81 yuan in 2016 (2.10 times) and from 11 862.77 to 21 354.64 yuan in 2017 (1.80 times). Total per episode expenses also showed a decreasing trend from level 3 to level 1 hospitals.

### Composition of expenses per NRIC episode

‘Unspecified’ expenses formed the largest portion in total for both gastric (32.51%) and oesophageal (32.34%) cancers,

followed by expenses for drugs (29.55% for gastric and 24.28% for oesophageal cancer) and medical consumables (21.71% for gastric and 26.42% for oesophageal cancer). Categories with an increasing proportion of expenses from 2013 to 2017 included surgery, laboratory, treatment, bed, nursing, examination and medical consumables and they added up to an increase of 38.93% for gastric cancer (from 28.94% to 43.39%) and 12.81% for oesophageal cancer (from 8.36% to 35.11%), while the categories with a shrinking expense proportion included drugs (from 32.32% to 24.90% for gastric cancer and 27.31% to 18.45% for oesophageal cancer), ‘unspecified’ expenses (from 36.14% to 25.70% for gastric cancer and 35.19% to 27.19% for oesophageal cancer) and medical consumables (from 25.48% to 19.25% for gastric cancer). Looking at specific prefectures, great discrepancies existed in all main categorical expenses. For example, the cost of drugs for gastric cancer in 2017 ranged from 15.00% for P1 to 40.57% for P6. Similarly, ‘unspecified’ expenses for oesophageal cancer varied from 3.26% for P14 to 38.09% for P1 (Figure 4). Similar characteristics/trends were observable in the expenses by facilities (Supplementary Figure 2).





**Figure 2.** Composition of inpatient care for gastric and oesophageal cancer by level of hospital, prefectures and years. P1–P15 represents the prefectures with the highest to lowest person-times of inpatient care pmp. The circle from the inside to the outside represents 2013 to 2017, respectively. GC: gastric cancer; EC: oesophageal cancer.

### Out-of-pocket expenses in annual per capita disposable income

Table 3 provides the ratio of out-of-pocket expenses to annual per capita disposable income by cancer type, prefecture and year of admission. This ratio was 0.43 for gastric cancer and 0.91 for oesophageal cancer on average. Most of the ratios displayed a downward trend, with a greater reduction being observed in the ratio for oesophageal cancer than for gastric cancer (0.47 vs 0.17 on average). The ratio also displayed substantial variations between prefectures. The largest ratio of out-of-pocket expenses for gastric cancer to annual per capita disposable income in 2013–2017 was 3.32, 3.12, 2.20, 2.68 and 2.80 times that of the smallest ratio in the same year, respectively. Similarly, the largest ratio of out-of-pocket expenses for oesophageal cancer to annual per capita disposable income in 2013–2017 was 14.8, 4.98,

3.24, 2.92 and 3.30 times that of the smallest ratio in the same year, respectively. The ratio of out-of-pocket expenses to annual per capita disposable income by facilities again displayed a downward trend from level 3 to level 1 hospitals (Supplementary Table 2).

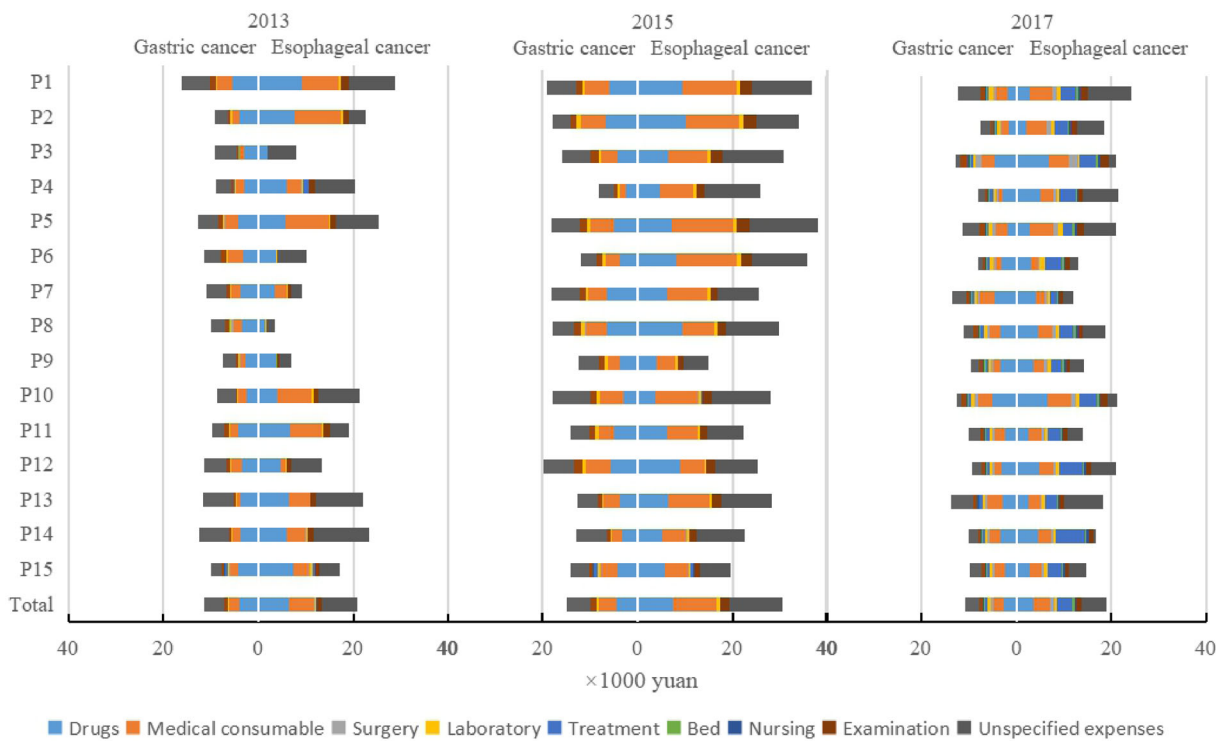
### Regression discontinuity analysis

Table 4 provides results from the modelling using a regression discontinuity design. When controlled for per capita disposable income, illiteracy rate and months from start time, statistically significant ( $p < 0.05$ ) associations were found between the treatment variable (D) and three of the four outcome variables, being 0.613 for person-times of NRIC pmp ( $p = 0.000$ ),  $-52.990$  for length of stay pmp ( $p = 0.000$ ) and 2.431 for total expenses per

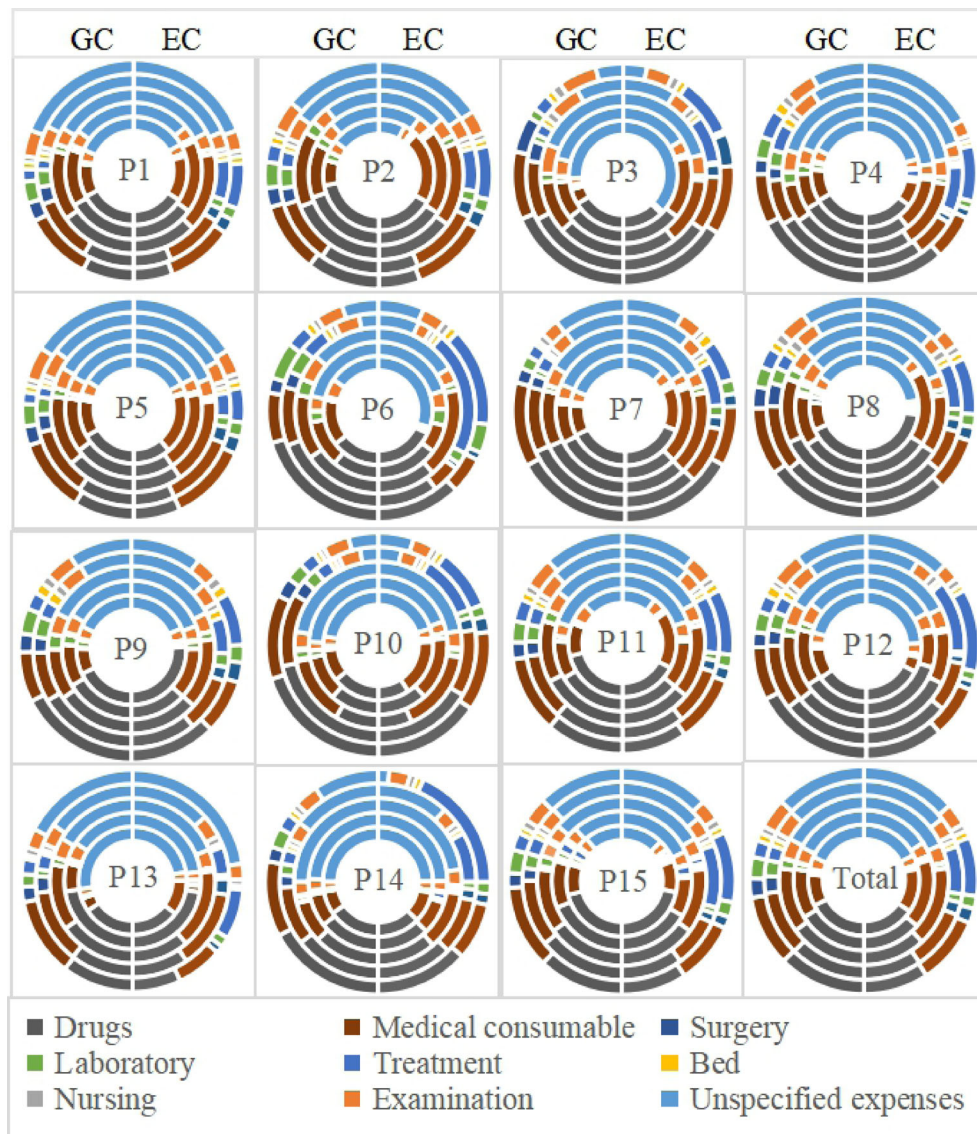
**Table 2.** Length of hospital stay for patients with gastric and oesophageal cancer by years and prefectures

Prefecture	Gastric cancer						Oesophageal cancer					
	2013	2014	2015	2016	2017	Mean	2013	2014	2015	2016	2017	Mean
P1	17.59	15.11	12.45	9.05	8.87	10.41	16.26	19.13	19.39	17.14	17.62	17.72
P2	9.34	10.54	10.95	5.85	6.17	7.11	10.31	19.14	17.58	14.37	12.92	14.34
P3	19.01	21.36	11.82	9.55	8.66	10.36	14.28	24.73	20.19	13.15	14.21	14.14
P4	11.12	11.57	10.92	10.07	10.23	10.53	23.42	16.42	16.68	16.56	18.2	17.98
P5	13.7	12.58	12.26	9.15	8.21	9.7	16.19	20.21	19.88	17.42	16.94	17.57
P6	14.44	12.22	11.46	10.74	9.66	10.52	9.85	8.34	20.42	23.1	16.54	18.14
P7	13.99	15.15	14.01	9.42	8.78	10.15	10.47	14.63	14.98	14.02	11.71	12.53
P8	13.43	11.98	11.27	10.77	8.95	10.07	5.22	17.04	15.96	14.27	13.69	14.16
P9	14.96	11.71	14.78	9.23	9.12	10.54	14.21	19.41	12.12	10.94	14.22	13.24
P10	13.35	12.09	13.65	8.76	8.93	10.19	12.67	15.7	16.05	17.53	17.22	17.07
P11	13.14	12.72	12.09	9.41	9.13	10.15	17.21	16.2	17.34	15.78	13.75	14.97
P12	11.71	13.5	13.52	8.7	11.74	11.26	16.05	13.89	17.16	16.84	20.62	18.3
P13	10.97	10.64	14.14	11.53	12.33	12.12	13.51	11.59	19.25	14.31	14.27	15.14
P14	12.67	11.93	12.2	8.74	8.86	9.96	22.13	21.88	15.67	13.48	15.16	14.72
P15	13.02	11.87	13.08	9.28	9.69	10.52	19.05	24.12	15.58	16.51	15.46	16.15
Total	13.87	13.24	12.12	9.13	9.02	10.17	18.09	18.38	18	15.96	15.85	16.27

P1–P15 represents the prefectures with the highest to lowest person-times of inpatient care pmp.



**Figure 3.** Total and categorical expenses per inpatient cancer care per episode. P1–P15 represents the prefectures with the highest to lowest person-times of inpatient care pmp. GC: gastric cancer; EC: oesophageal cancer.



**Figure 4.** Composition of expenses per inpatient care episode by different years and prefectures. P1–P15 represents the prefectures with the highest to lowest person-times of inpatient care pmp. The circle from the inside to the outside represents 2013 to 2017, respectively. GC: gastric cancer; EC: oesophageal cancer.

NRIC episode ( $p=0.040$ ). Judging by the absolute value of standard coefficients, the first two contributing variables were per capita disposable income and D for person-times of NRIC pmp, months from start time and D for length of stay pmp, per capita disposable income and D for total expenses per NRIC episode, and illiteracy rate and months from start time for proportion of compensation vs total expenses.

## Discussion

This study provides useful information for better understanding the NRCMS and medical care provision (MCP) in Anhui Province and China. The study findings suggest substantial achievements

with the NCRMS and MCP in terms of benefits to patients, efficiency of care provision and equity. The rapidly increasing admission rate may be viewed as an important sign of improvement in benefits to patients. Being chronic diseases, gastric and oesophageal cancers incidence rates, severity and trajectory should remain relatively stable over the short 5-y study period,<sup>22,23</sup> and the rapid increases can hardly be explained by pathological factors. Meanwhile, economic, technological, sociocultural and other relevant aspects had all been developing before and during the same time period in the province. So the massive and province-wide inpatient care expansion should be attributed mainly to enhanced disease detection/diagnosis, hospital admissions and expense reimbursement.<sup>24</sup> The downward trend in the direct economic burden to patients may be regarded as



**Table 3.** Ratio of out-of-pocket expenses on inpatient cancer care to annual per capita disposable income

Prefecture	Gastric cancer						Oesophageal cancer					
	2013	2014	2015	2016	2017	Mean	2013	2014	2015	2016	2017	Mean
P1	0.63	0.64	0.51	0.32	0.29	0.4	1.4	1.24	1	0.7	0.57	0.8
P2	0.3	0.38	0.64	0.27	0.21	0.3	0.83	1.07	1.23	0.75	0.55	0.72
P3	0.32	0.43	0.37	0.34	0.28	0.35	0.27	0.43	0.81	0.53	0.49	0.58
P4	0.49	0.74	0.74	0.43	0.24	0.4	0.38	1.52	0.96	0.68	0.3	0.5
P5	0.39	0.47	0.77	0.55	0.44	0.53	1.11	1.22	1.2	0.99	0.73	0.95
P6	0.37	0.34	0.42	0.31	0.2	0.29	0.55	0.46	1.25	0.54	0.27	0.42
P7	0.29	0.31	0.49	0.38	0.22	0.31	0.1	0.93	0.81	0.5	0.42	0.56
P8	0.22	0.25	0.37	0.25	0.27	0.29	0.3	0.42	0.5	0.38	0.43	0.46
P9	0.28	0.39	0.35	0.27	0.25	0.3	0.85	1.48	1.34	1.11	0.87	1.08
P10	0.47	0.66	0.67	0.48	0.34	0.47	0.95	1.02	1.05	0.87	0.45	0.74
P11	0.52	0.57	0.76	0.47	0.42	0.51	0.62	0.73	0.97	0.74	0.68	0.79
P12	0.59	0.78	0.75	0.5	0.37	0.53	1.48	2.09	1.62	1.04	0.72	1.06
P13	0.69	0.56	0.57	0.67	0.56	0.63	1.4	0.45	1.22	0.82	0.89	1
P14	0.73	0.68	0.67	0.43	0.31	0.49	1.37	1.1	1.02	0.71	0.54	0.76
P15	0.5	0.49	0.73	0.43	0.3	0.43	0.89	1.44	0.93	0.9	0.46	0.74
Total	0.47	0.55	0.53	0.36	0.30	0.43	1.03	1.20	1.09	0.76	0.56	0.91

P1–P15 represents the prefectures with the highest to lowest person-times of inpatient care pmp.

another sign of benefit elevation. From 2013 to 2017, per capita disposable income in Anhui increased by 5.70% annually on average, while the ratio of out-of-pocket expenses for inpatient gastric and oesophageal cancers care to annual per capita disposable income decreased by 9.85% and 13.30% per year, respectively. A third sign of benefit relates to the expanding proportion of expenses for ‘service’ (e.g. nursing, treatment and surgery) as contrasted with a shrinking proportion of expenses for ‘products’ (e.g. drugs, materials).<sup>25,26</sup> Such trends should mean more interactions between patients and physicians/nurses and thus better mutual understanding and care quality. In China, healthcare providers are not allowed to raise service prices on their own. The nation has a long history of almost no charges being made for physician consultations and most patients are used to paying only for medicines, lab tests and examinations using sophisticated equipment. These remuneration mechanisms provide perverse financial incentives for healthcare practitioners to use ‘products’ over ‘services’. Similarly, manifestations of efficiency improvement include the shortening length of hospital stays, the decreasing per admission total expenses and the shrinking proportion of ‘unspecified’ expenses. As for indications of equity progress, the interprefecture discrepancies in per admission total expenses have been reduced from 4.77 times in 2013 to 1.80 times in 2017, the variations in length of hospital stay have been narrowed from 8.08 d to 4.06 d and the ratios of out-of-pocket expenses on inpatient gastric/oesophageal cancer care to annual per capita disposable income have decreased from 9.06 times to 3.05 times.

Although it is difficult to distinguish from a variety of direct and indirect factors, the above achievements may be attributed largely to recent policy and reform efforts in Anhui and in China. As described earlier in the background section. The rapid increase

in admission rates and the downward trend in the direct economic burden may be associated with the expansion of major diseases covered by the NRCMS and the poverty alleviation programs of recent years.<sup>27,28</sup> The decreasing length of stay and per admission expenses may be linked to pay by case mix, zero medicine mark-ups and various other cost-containment incentives.<sup>29</sup> The narrowing interprefecture discrepancies and changing composition between categories may be traced to clinical pathway management, level-by-level referral, prescription formularies, negative lists and other standardization efforts.<sup>30</sup>

Our regression discontinuity modelling provides further evidence in support for the above observation that the recent reform played a major role in the improvement in NRIC. The modelling suggests that the treatment was accountable for 35.2% of the increase in person-times of NRIC pmp, 38.5% of the decrease in length of stay pmp and 19.3% of the increase in total expenses per NRIC episode and these contributions were independent of commonly researched control variables.

This study also identifies important problems for future interventions. The first problem concerns the still catastrophic economic burden. Although the study period witnessed a substantial reduction, the ratios of out-of-pocket expenses on inpatient care in annual per capita disposable income remained as high as 0.43 for gastric cancer and 0.91 for oesophageal cancer. Both of these figures exceed the defining ratio of catastrophic expenditures by the World Health Organization.<sup>31–34</sup> In fact, the actual total burden should be a few times that of the estimated ratios since these ratios were based on only a single inpatient care episode, while a gastric/oesophageal cancer patient generally needs four to six rounds of hospitalized treatment. So there is a clear need to reassess current NRCMS, especially the rationale and feasibility to expand the scope and ceiling of



**Table 4.** Regression analysis about the impact of health reform

Variables	Outcome variable			
	Person-times of NRIC pmp	Length of stay pmp	Total expenses per NRIC episode	Proportion of compensation in total expense
Treatment variable				
D ( $\beta$ )	0.613	-52.990	2.431	0.287
Standardized $\beta$	-0.352	-0.385	-0.193	-0.018
p-Value	0.000	0.000	0.040	0.853
Control variables				
Per capita disposable income ( $\beta$ )	0.166	-7.663	0.697	-0.245
Standardized $\beta$	-0.479	-0.279	-0.278	-0.077
p-Value	0.000	0.000	0.000	0.298
Illiteracy rate ( $\beta$ )	0.044	9.708	0.711	2.026
Standardized $\beta$	-0.051	-0.142	-0.114	-0.255
p-Value	0.443	0.039	0.107	0.001
Months from start time ( $\beta$ )	-0.029	6.935	0.174	0.270
Standardized $\beta$	-0.182	-0.541	-0.148	-0.181
p-Value	0.044	0.000	0.120	0.065
Constant ( $\beta$ )	-0.640	-10.616	-1.745	29.617
p-Value	0.220	0.802	0.661	0.000
R <sup>2</sup>	0.263	0.227	0.182	0.127
Adjusted R <sup>2</sup>	0.251	0.215	0.168	0.114

The bandwidth for the modelling was set as 12 months before and after the cut-off point, D. For all months before the cut-off point, D was set as 0 and for all months after the cut-off point, D was 1. Month 18 was the cut-off point by means of manually examining the scatter plots of the dependent variables selected.

reimbursement. The second problem refers to the large proportion of 'unspecified' expenses. For instance, it may be regarded as an opportunity for data manipulation, e.g. classifying inappropriate or excessive expenses into the category of 'unspecified'. So this 'unspecified' expense should be made as clear and transparent as possible. The third problem relates to the disproportionate expenses on 'service' versus 'products'. Despite progress in this area, as discussed earlier, expenses on 'products' was 3-fold more than that for 'service' by 2017. This phenomenon originates from the tradition established at the beginning of China's health system, when all hospital staff were paid by the government and thus no charges on human activities were allowed.<sup>35</sup> Presently, however, hospital staff are paid mainly via service revenue, and formal or informal limits on 'service' expenses not only discourage nurses/physicians from spending time on patient care, but also induce excessive 'product' use in compensation.<sup>36</sup>

## Conclusions

This study provides useful information for a better understanding of the NRCMS and MCP in Anhui Province and China. It suggests that the medical systems reform has resulted in substantial improvements in terms of increased use of NRCMS-reimbursed inpatient care by gastric and oesophageal cancers patients, elevated efficiency of care provision and reduced economic burden and regional differences. The reforms should be continued with added

efforts on reducing the catastrophic burden and on improving the efficiency of health services and disproportionate 'products' (versus 'service') and 'unspecified' expenses.

## Supplementary data:

Supplementary data are available at *International Health* online.

**Authors' contributions:** AY contributed data analysis and drafting the manuscript. JChai and XS performed data analysis. JChai, JCheng, RL and RF facilitated/performed data extraction and cleaning. DW provided expertise for the overall design of the study and revised and finalized the manuscript. All authors have approved the final manuscript.

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**Data availability:** The data used to support the findings of this study are included within the article.

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