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Medical expenses of lung cancer patients under the New Rural Cooperative Medical Scheme in coastal and inland areas of Fujian Province from 2007 to 2016: differential trend analysis

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Abstract

Objective By analyzing the medical cost index and difference trend among inpatients with lung cancer who participated in the New Rural Cooperative Medical Scheme (NRCMS) in coastal areas and inland areas of Fujian Province from 2007 to 2016, we evaluated the medical cost burden and health security level of rural lung cancer patients in Fujian Province under the background of the NRCMS.

Methods Medical record cost data of 88,191 inpatients with lung cancer under the NRCMS were collected from medical institutions at all levels in Fujian Province from 2007 to 2016. The mean and standard deviation of total hospitalization expenses, average daily hospitalization expenses, reimbursement ratio, and OOP ratio (the ratio of out-of-pocket expenditure and disposable income) for lung cancer patients in coastal areas and inland areas during 2007–2016 were calculated. After adjusting for sex, age, length of stay, and hospital level, the relative differences with 95% confidence intervals (CI) between coastal and inland areas in various cost indicators were calculated using generalized linear models to assess the trends in the differences over time.

Results We found differences in the total hospitalization cost, average daily hospitalization cost, reimbursement ratio, and OOP ratio of lung cancer patients in coastal areas and inland areas of Fujian Province. The burden of medical expenses for lung cancer patients in coastal areas is relatively greater than that in inland areas. From 2007 to 2011, the difference in medical expenses for inpatients with lung cancer in coastal areas and inland areas and inland areas gradually narrowed. However, from 2012 to 2014, the difference in medical expenses between the two regions gradually widened. From 2014 to 2016, the difference between the two regions gradually narrowed again, and in 2016, it returned to the difference level between the two regions in 2010.

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Conclusions Under the influence of the NRCMS, the hospitalization cost, average daily hospitalization cost, and OOP ratio of lung cancer patients in coastal areas were higher than those in inland areas from 2007 to 2016, but the reimbursement ratio was lower. In general, the medical expenses of lung cancer patients in coastal areas of Fujian Province are greater than those in inland areas, which may be affected by differences in the level of hospitals, treatment methods, drug scope, expected survival level, and medical assistance policies of lung cancer patients in the two regions.

Keywords Lung cancer, New Rural Cooperative Medical Scheme, Burden of medical expenses, Analysis of difference

Introduction

The New Rural Cooperative Medical Scheme (NRCMS; hereinafter referred to as "New Rural Cooperative Medical Scheme") is an important part of basic medical insurance system in China. Organized, guided, and supported by the government, with the voluntary participation of rural residents and multi-party fundraising by individuals, collectives, and the government, the medical mutual aid system for farmers is based on the overall planning for serious diseases. Funds are raised through individual payment, collective support, and government funding. In 2002, China proposed the establishment of a new rural cooperative system, with major diseases as the main plan, focused on solving the problems of farmers caused by serious diseases that arise owing to poverty. In 2003, the General Office of the State Council forwarded the Notice of Opinions on the Establishment of a New Rural Cooperative Medical Care System (No. 3, 2003), requiring all provinces to pilot the establishment of the NRM-CMS [1]. Since the pilot program began, the NRCMS has been continuously developed and improved. By the end of 2008, the NRCMS had covered all counties (cities and districts) with an agricultural population, with a participation rate of 91.5%, covering all rural areas [2]. According to the "Implementation Opinions of Fujian Provincial People's Government on Further Strengthening Rural Health Work," the first batch of pilot counties in Fujian Province, Anxi County, Xinluo District, and Tongan District carried out pilot projects for the NRCMS in March 2004 and made remarkable achievements. In 2007, Fujian NRCMS completed the transformation from pilot to provincial promotion [3]. The rate of participating insurance in the New Rural Cooperative Medical Insurance System in Fujian increased from 85.05% in 2007 to 99.9% in 2015, with more than 20 million rural residents in Fujian benefiting from the policy [4]. Fujian is the first province in China to implement the NRCMS serious disease medical insurance. As early as 2008, the province took the lead in exploring and implementing supplementary hospitalization compensation for serious diseases in Putian, Sanming, and other locations. Based on the pilot, the province carried out supplementary hospitalization compensation for serious diseases in the New Rural Cooperative Medical Care System (NRCMS) in 2010, gradually lowering the eligibility level and increasing the compensation proportion and capping level [5]. In 2012, Fujian Province issued the Opinions on Further Improving Serious Disease Insurance for Urban and Rural Residents, which included 20 specific diseases such as lung cancer in the scope of serious disease subsidies, and raised the reimbursement rate to over 70%, with additional subsidies available to people with financial need [6].

Fujian Province is located on the southeast coast of China, with Fuzhou as its capital. There are six coastal cities (Fuzhou, Xiamen, Putian, Quanzhou, Zhangzhou, Ningde) and three inland cities (Longyan, Sanming, Nanping). However, for natural and historical reasons, there is a clear difference in economic development between the coastal and inland areas of Fujian Province [7]. Compared with inland areas, coastal areas have advantages such as convenient land and water transportation, preferential policy development, and a siphoning effect of human talent. Industry and agriculture are more developed, and the economic development level is higher. According to the statistics of relevant departments, in 2021, the total GDP of Fujian's coastal areas was 4,072,198 billion RMB, accounting for 83.32% of the province's total GDP. The total GDP of inland areas was 815.283 billion RMB, accounting for 16.68% of the province's total. The coastal area has a permanent population of 33.99 million and a land area of 55,245.39 square kilometers. The inland area has a permanent population of 7.88 million and a land area of 68,255.8 square kilometers. Per capita GDP is 11,9805.77 RMB in coastal areas and 1,03,462.31 RMB in inland areas, with a gap of 16,343.46 RMB. From the perspective of land per capita GDP, the total for coastal and inland areas is 7371.11 million RMB and 11.9445 million RMB per square kilometer, respectively, and that for coastal areas was 6.2 times that of the inland areas. According to data from the Fujian Bureau of Statistics, the per capita GDP of residents in coastal areas is higher in recent years than that in inland areas, and the absolute per capita GDP gap is widening over time [8].

Lung cancer is one of the most burdensome malignancies in the world. GLOBOCAN estimated that in 2020, there were about 2.2 million new cases of lung cancer worldwide, accounting for 11.4% of all malignant tumors, and about 1.8 million deaths, accounting for 18.0% of malignancy-related deaths. The incidence and death of lung cancer in China accounted for 37% and 39.8% of the global total, respectively [9]. According to the "2021 Annual Report of Tumor Registration in Fujian Province," lung cancer ranked first in incidence and death owing to malignant tumors in tumor registration areas of Fujian Province. In 2018, the crude incidence and mortality of lung cancer in Fujian Province reached 53.48/100,000 and 39.15/100,000, respectively [10]. It is clear that with the increasing incidence in recent years, lung cancer has become the main cause of death among Chinese residents, resulting in a huge economic burden of the disease [11-13]. In this paper, we aimed to explore whether there is a difference in the economic burden of lung cancer between coastal areas and inland areas under the NRCMS, and how the difference changes over time, to provide a basis for further improving the medical insurance system of Chinese residents and enhancing the equity of public health services.

Methods

Data sources and study population

The data were collected from medical records of hospitalized patients with lung cancer in hospitals at all levels in Fujian Province from January 1, 2007, to December 31, 2016. To be eligible for the study, all lung cancer patients had to be diagnosed according to the International Classification of Diseases, 10th Revision (ICD-10) and participate in the Fujian New Rural Cooperative Medical Insurance. After excluding missing values such as sex and income, and outliers such as age > 90 years, age < 20 years, and total hospitalization cost < 500 RMB. Variables for the study population included sex, age, county of residence, name of disease, ICD-10 code, name of admitting hospital, length of stay, hospital level, and average per capita income. Missing values and/or illogical values were excluded, and 88,191 lung cancer patients admitted to medical institutions at all levels, including provinces, cities, counties, and towns, were eventually included in the study and divided into coastal and inland areas according to the patients' residence.

 Table 1
 CPI index and actual price after conversion from 2007

 to 2016
 Conversion

10 2010		
Year	CPI	Real price (RMB)
2007	493.6	100.0
2008	522.7	94.4
2009	519.0	95.1
2010	536.1	92.1
2011	565.0	87.4
2012	579.7	85.2
2013	594.8	83.0
2014	606.7	81.4
2015	615.2	80.2
2016	627.5	78.7

Indicators of medical expenses

In this paper, the economic burden of lung cancer patients was evaluated using four medical cost indexes. These include

- total hospital expenses: total medical expenses incurred during a hospital stay;
- average daily hospitalization cost: total hospitalization cost divided by total hospitalization days;
- reimbursement ratio: the reimbursement amount divided by the total hospitalization expenses;
- 4) ratio of out-of-pocket expenditure to disposable income (OOP ratio): out-of-pocket expenditure divided by disposable income (out-of-pocket expenditure is the out-of-pocket expenses after hospitalization reimbursement, i.e., the total hospitalization expense minus the reimbursement amount; disposable income refers to the per capita annual disposable income of rural residents in the county where the patient lives, which is taken from the statistical yearbook of Fujian Province from 2008 to 2017).

To make cross-time cost indicators more meaningful, medical costs from 2007 to 2016 were transformed based on the price level of the 2007 Consumer Price Determined Index (CPI) (the transformation formula is: actual price = nominal price × (base year CPI/target year CPI)). See 1978 CPI = 100 [14]. Therefore, the actual price after conversion from the nominal price of 100 RMB in 2008 is 94.4 RMB [100 RMB × (493.6/522.7)]), and so on. The CPI index from 2007 to 2016 and the actual price after conversion are shown in Table 1.

Statistical analysis

The relative number of classification variable calculations used the average calculation method and standard deviation of total hospitalization cost, average daily hospitalization cost, reimbursement ratio, OOP ratio, and other cost indicators. Taking inland areas as a reference, the relative difference in the medical cost index of inpatients with lung cancer in the NRCMS between coastal areas and inland areas was defined as the difference in the medical cost burden between the two regions. The medical cost index was set to obey the gamma distribution, and the relative difference and 95% CI between coastal and inland areas during 2007-2016 were calculated by fitting a generalized linear model connected via logarithmic function. The relative difference and 95% CI were calculated after adjusting for variables such as gender, age, length of stay, and hospital level. Whether the initial value of the relative difference is greater than or less than 1.0, if the gap gradually moves away from 1.0 over time, it

 Table 2
 Demographic characteristics of inpatients with lung cancer in NRCMS in Fujian Province from 2007 to 2016

Variables	Group	Inland	Coastal	Total
		(n=25,935)	(n=62,256)	(<i>n</i> =88,191)
Gender	Male	19204 (29.86)	45119 (70.14)	64323
	Female	6731 (28.20)	17137 (71.80)	23868
Age	20–29	125 (32.38)	261 (67.62)	386
	30-39	656 (31.69)	1414 (68.31)	2070
	40-49	3636 (33.64)	7173 (66.36)	10809
	50-59	7976 (28.77)	19744 (71.23)	27720
	60–69	8456 (28.67)	21039 (71.33)	29495
	70–79	4310 (29.35)	10376 (70.65)	14686
	80-90	776 (25.65)	2249 (74.35)	3025
Low	Yes	537(41.53)	756(58.47)	1293
income	No	25398(29.23)	61500(70.77)	86898
Hospital	Primary	3366(26.46)	9354(73.54)	12720
level	Secondary	8409(44.11)	10653(55.89)	19062
	Tertiary	14160(25.10)	42249(74.90)	56409
Year	2007	396(20.57)	1529(79.43)	1925
	2008	997(27.93)	2573(72.07)	3570
	2009	1488(25.97)	4242(74.03)	5730
	2010	1861(27.38)	4936(72.62)	6797
	2011	2442(34.12)	4716(65.88)	7158
	2012	2678(32.09)	5666(67.91)	8344
	2013	3317(34.43)	6317(65.57)	9634
	2014	3354(34.94)	6246(65.06)	9600
	2015	4002(26.05)	11359(73.95)	15361
	2016	5400(26.90)	14672(73.10)	20072

means that the gap in the medical cost burden between the two regions is "widening." Conversely, if it gets closer to 1.0, the regional gap is considered "closing." If the 95% CI of the relative differences at different time points did not overlap, the difference change between coastal and inland areas was considered statistically significant [15, 16]. All analyses were performed using IBM SPSS version 25.0. Owing to the large sample size, the *P* values of the relative differences between the two groups are not reported in this paper.

Results

Demographic characteristics

The demographic characteristics of the study population are shown in Table 2. A total of 88,191 people were included in the study, including 62,256 people in coastal areas (70.6%) and 25,935 people in inland areas (29.4%). The proportion of men was significantly higher than that of women (72.9% vs. 27.1%); 74,926 participants (84.96%) were older than or equal to age 50 years. There were 537 low-income patients in inland areas (2.07%) and 756 lowincome patients in coastal areas (1.21%). From 2007 to 2016, the number of lung cancer patients enrolled in the study in coastal areas and inland areas increased each year.

Total inpatient costs

From 2007 to 2016, the total inpatient costs of lung cancer patients in coastal areas were significantly higher than those in inland areas. From 2007 to 2010, the total inpatient expenses showed an opposite trend, showing that the total inpatient expenses decreased slowly in coastal areas and increased rapidly in inland areas. In 2011, the total inpatient expenses in both regions decreased significantly. From 2007 to 2011, the difference in the total inpatient cost of lung cancer patients between the two regions continued to narrow, and the relative difference gradually approached 1.0, indicating that the difference in the total inpatient cost between the two regions gradually narrowed. From 2011 to 2014, the relative difference between the two regions was far from 1.0, indicating that the difference was constantly expanding. From 2014 to 2016, the relative difference gradually approached 1.0, which led to the gradual narrowing of the difference between the two regions again. In 2016, the difference in total inpatient cost between the two regions returned to the level in 2010 (Table 3, Fig. 1).

Average daily hospitalization costs

Except for 2009 and 2011, the average daily hospitalization costs were not significantly different between the

Year	Relative difference (95% Cl)		Coastal		Inland	
	Estimated	Adjusted	Mean	Std	Mean	Std
2007	1.75 (1.57–1.96)	1.28 (1.18–1.38)	11,269	13,621	6435	9072
2008	1.56 (1.45–1.67)	1.26 (1.20–1.33)	11,188	11,922	7194	8682
2009	1.35 (1.27–1.43)	1.15 (1.10–1.19)	10,853	12,339	8038	10,168
2010	1.20 (1.14–1.27)	1.13 (1.09–1.17)	10,824	12,705	8999	11,696
2011	1.14 (1.09-1.20)	1.09 (1.06–1.13)	9471	11,655	8292	11,302
2012	1.25 (1.20–1.31)	1.29 (1.25–1.33)	10,414	12,989	8324	10,334
2013	1.20 (1.15–1.25)	1.22 (1.18–1.25)	10,629	12,688	8862	11,606
2014	1.33 (1.28–1.39)	1.28 (1.25–1.32)	11,572	13,787	8690	11,051
2015	1.32 (1.27–1.36)	1.22 (1.19–1.25)	10,866	12,610	8254	10,351
2016	1.19 (1.16–1.23)	1.13 (1.10–1.15)	10,394	12,734	8702	11,003

Table 3 Relative differences in total hospitalization expenses for lung cancer under the NRCMS in Fujian Province from 2007 to 2016



Fig. 1 Relative differences in total hospitalization expenses for lung cancer under the NRCMS in Fujian Province from 2007 to 2016

Table 4 Relative differences in average daily hospitalization expenses of lung cancer patients under the NRCMS in Fujian Province from 2007 to 2016

Year	Relative difference (95% Cl)		Coastal		Inland	
	Estimated	Adjusted	Mean	Std	Mean	Std
2007	1.08 (0.98–1.19)	1.14 (1.06–1.23)	694	965	642	1202
2008	1.43 (1.35–1.52)	1.26 (1.20-1.32)	755	967	527	680
2009	0.95 (0.90-1.00)	1.00 (0.96-1.05)	767	946	811	1334
2010	1.02 (0.97-1.07)	1.04 (1.00-1.07)	816	971	801	1304
2011	0.97 (0.93-1.01)	1.00 (0.97-1.04)	761	858	784	1153
2012	1.21 (1.16–1.26)	1.19 (1.15–1.23)	885	1137	733	945
2013	1.24 (1.19–1.28)	1.19 (1.16–1.22)	918	1045	743	947
2014	1.40 (1.35-1.45)	1.27 (1.23-1.31)	1065	1297	759	988
2015	1.16 (1.13–1.20)	1.13 (1.11–1.16)	997	1202	858	1249
2016	1.15 (1.12–1.18)	1.08 (1.06-1.11)	980	1160	850	1130



Fig. 2 Relative differences in average daily hospitalization expenses of lung cancer patients under the NRCMS in Fujian Province from 2007 to 2016

two regions, and the coastal areas were higher than the inland areas in other years. From 2007 to 2016, the average daily hospitalization costs of lung cancer patients in coastal areas and inland areas showed a slow-rising trend. From 2008 to 2011, the relative difference in average daily hospitalization costs for lung cancer patients in the two regions was close to 1.0, indicating that the difference was decreasing. From 2012 to 2014, the relative difference was far from 1.0, indicating that the differences between the two regions were constantly expanding. From 2014 to 2016, the relative difference gradually

approached 1.0 again, indicating that the difference in average daily hospitalization costs of lung cancer patients between the two regions narrowed again. In 2016, the average daily hospitalization cost difference between the two regions returned to nearly the 2010 level (Table 4, Fig. 2).

Reimbursement ratio

During the study period, the reimbursement ratio of inpatients with lung cancer in coastal and inland areas was lower than that of inland areas during other years,

Year	Relative difference (95% Cl)		Coastal		Inland	
	Estimate	Adjusted	Mean	Std	Mean	Std
2007	0.95 (0.89–1.01)	1.04 (0.99–1.08)	27.43	15.85	28.77	13.21
2008	0.79 (0.76-0.82)	0.87 (0.85-0.90)	29.69	16.48	37.60	16.93
2009	0.79 (0.77-0.82)	0.87 (0.85–0.89)	33.34	17.89	41.97	17.72
2010	0.89 (0.87-0.92)	0.94 (0.92-0.95)	34.52	17.76	38.72	16.12
2011	1.03 (1.00-1.05)	1.07 (1.05–1.09)	43.73	20.82	42.59	19.48
2012	0.99 (0.96-1.01)	0.99 (0.97-1.00)	46.36	22.69	47.14	19.48
2013	094 (0.92–0.95)	0.95 (0.94–0.96)	47.13	21.07	50.34	18.76
2014	0.87 (0.85-0.89)	0.91 (0.90-0.92)	42.11	18.57	48.54	17.39
2015	0.82 (0.81-0.84)	0.87 (0.86-0.88)	39.10	18.83	47.58	17.77
2016	0.90 (0.89-0.92)	0.96 (0.95–0.98)	42.06	20.43	47.21	17.72

Table 5	Relative differences in	inpatient reimbursement ratio for lun	g cancer under the NRCMS in Fu	ijian Province from 2007 to 2016
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Fig. 3 Relative differences in inpatient reimbursement ratio for lung cancer under the NRCMS in Fujian Province from 2007 to 2016

except that there was no statistically significant difference in the reimbursement ratio between coastal and inland areas in 2007 and the reimbursement ratio of coastal areas was slightly higher than that of inland areas in 2011. From 2007 to 2016, the reimbursement ratio of the two regions showed a trend of rapid growth, first to the highest point, then falling, and finally flattening. In 2007, the reimbursement ratio of the two regions was the lowest, less than 30%. In 2013, the reimbursement ratio in both regions reached the highest level, slightly more than 50% in inland areas but less than 50% in coastal areas. From 2008 to 2012, the relative difference in the reimbursement ratio between coastal areas and inland areas gradually approached 1.0, indicating that the difference was decreasing. From 2012 to 2015, the relative difference was gradually moving away from 1.0, indicating that the gap between the two regions was constantly expanding. However, the difference between the two regions narrowed significantly in 2016, returning to a level close to that in 2010 (Table 5, Fig. 3).

Ratio of cash expenditure to disposable income (OOP ratio)

The OOP ratio of lung cancer patients in coastal areas was significantly higher than that in inland areas during the whole study period. From 2007 to 2016, the OOP ratio of the two regions showed a decreasing trend. In 2016, the OOP ratio of coastal and inland regions reached the lowest level, at 0.58 and 0.46, respectively. Since 2011, the actual hospitalization expenditure of lung cancer patients in coastal areas was lower than the annual disposable income whereas the actual hospitalization expenditure of lung cancer patients in inland areas was lower than the annual disposable income. From 2007 to 2012, the relative difference in the OOP ratio of lung cancer patients between the two regions gradually approached 1.0, indicating that the difference between the two regions was decreasing. From 2012 to 2014, the relative difference between the two regions gradually moved away from 1.0, indicating that the difference was constantly expanding. From 2014 to 2016, the relative difference gradually approached 1.0, indicating that the differences between the two regions were decreasing (Table 6, Fig. 4).

Discussion

According to the analysis results of medical records for inpatients with lung cancer in the NRCMS of Fujian Province from 2007 to 2016, the number of inpatients with lung cancer has increased sharply in recent years, from less than 2000 in 2007 to more than 20,000 in 2016,

Year	Relative difference (95% Cl)		Coastal		Inland	
	Estimate	Adjusted	Mean	Std	Mean	Std
2007	1.87 (1.66–2.11)	1.37 (1.26–1.49)	1.80	2.47	0.96	1.57
2008	1.71 (1.59–1.84)	1.44 (1.36–1.52)	1.55	1.80	0.90	1.20
2009	1.45 (1.36–1.55)	1.40 (1.34–1.47)	1.31	1.60	0.90	1.25
2010	1.25 (1.18–1.32)	1.31 (1.26–1.37)	1.20	1.48	0.97	1.41
2011	1.05 (0.99–1.10)	1.23 (1.18–1.29)	0.78	0.95	0.75	1.14
2012	1.30 (1.24–1.37)	1.51 (1.45–1.58)	0.80	1.03	0.62	0.87
2013	1.31 (1.26–1.38)	1.67 (1.61–1.73))	0.74	0.84	0.56	0.82
2014	1.50 (1.44–1.57)	1.78 (1.72–1.85)	0.77	0.92	0.51	0.73
2015	1.45 (1.40-1.50)	1.60 (1.56-1.65)	0.66	0.70	0.46	0.64
2016	1.26 (1.22–1.30)	1.39 (1.36–1.42)	0.58	0.65	0.46	0.67

 Table 6
 Relative differences in the OOP ratio of lung cancer under the new rural cooperative medical system in Fujian Province from 2007 to 2016



Fig. 4 Relative differences in the OOP ratio of lung cancer under the new rural cooperative medical system in Fujian Province from 2007 to 2016

an increase of approximately nine times. This can explain the increasing incidence of lung cancer in the province, to some extent. Indeed, the increase in lung cancer incidence has been accompanied by the development of medical technology, improvement of residents' health awareness, increase in per capita disposable income, and rising participation rate and reimbursement ratio of the NRCMS [17]. More patients with lung cancer can take the initiative to seek medical treatment and are detected, diagnosed, and treated in a timely manner, which is also an important reason for the increase in the number of hospitalized patients with lung cancer. Epidemiological studies show that the occurrence and development of lung cancer result from the interaction between heredity and environment, among which smoking history is the biggest risk factor [18], Compared with non-smokers, smokers are 22 times more likely to develop lung cancer [19]. In this study, A total of 88191 cases of lung cancer patients were included, the proportion of male lung cancer patients who were hospitalized was much higher than the proportion of female lung cancer patients, by about 2.7 times, which also confirms that smoking is an important risk factor for lung cancer. One of the important reasons for this is the high smoking rate of males in our province, and the smoking population of males is much higher than that of females, resulting in the risk of lung cancer in males being much higher than that of females.

From 2007 to 2011, the difference in medical expenses of lung cancer patients in coastal and inland areas gradually narrowed. However, from 2012 to 2014, the difference in medical expenses between the two regions gradually widened. From 2014 to 2016, the difference between the two regions gradually narrowed and basically returned to the difference level between the two regions during 2010. The difference in the medical expense burden between coastal areas and inland areas fluctuates from large to small, which may be related to the lag in policy implementation and positive effects. The NRCMS in Fujian Province was piloted in 2004 and was extended to the whole province in 2007. In March 2009, the State Council issued the Short-term Key Implementation Plan for the Reform of the Medical and Health Care System (2009–2011) to deepen the reform of the medical and health care system [20]. We focus on improving the basic medical security system, including all urban and rural residents in the basic medical security system, and effectively reduce the burden of medical expenses paid by individuals. Furthermore, we focus on gradually promoting equal access to basic public health services so that all urban and rural residents can enjoy basic public health services and prevent diseases to the greatest extent possible. The deepening reform has made some achievements in reducing the burden of medical expenses and ensuring the accessibility and equity of health services

for residents. Research data show that the difference in medical expense burden for lung cancer patients in coastal and inland areas gradually narrowed from 2007 to 2011. In 2011, the total inpatient expenses and OOP ratio of the two regions both showed a rapid decline, but the decrease was not large or increased in 2010, which indicates that the positive effect of the policy has a certain lag. However, from 2012 to 2014, the difference in the burden of medical expenses among lung cancer patients in coastal areas and inland areas gradually widened. At the same time, the total inpatient expenses of lung cancer patients in the two regions generally showed a slow increase, and the rate of decrease in the OOP tended to be gradual. These may be related to the fact that the positive impact of deepening health system reforms diminishes over time [21]. To consolidate and expand the achievements of deepening reform of the medical and health system in the previous stage, the State Council issued the Notice "Plan and Implementation Plan for Deepening the Reform of the Medical and Health System during the 12th Five-Year Plan Period" (Guofa No. 11, 2012) in March 2012 [22]. With the development of the basic medical and health care system as the core, we further deepen comprehensive reforms in medical security, medical services, public health, drug supply, and the regulatory system; accelerate the establishment of institutional guarantees that the people have access to medical care; and continue to improve the health of the entire population. Further continuous deepening of reform promoted the difference in the medical cost burden among lung cancer patients in coastal areas and inland areas, which gradually narrowed again from 2014 to 2016, and in 2016, the difference between the two regions returned to the level during 2010 to 2011.

Gradual expansion and implementation of the new rural cooperative medical care system (NRCMS) has basically covered the rural population, alleviating to a certain extent the problem of difficult and expensive medical services. Research data show that the NRCMS has indeed achieved certain results in reducing the burden of medical expenses for lung cancer patients, especially in increasing the reimbursement ratio and reducing the OOP ratio. The reimbursement rate of inpatient expenses for lung cancer patients in both coastal and inland areas increased from less than 30% in 2007 to about 45% in 2016, with the reimbursement rate in inland areas exceeding 50% at its peak. From 2007 to 2016, the OOP ratio of the two regions generally showed a downward trend year by year and reached the lowest level in 2016. Compared with 2007, OOP rates in both regions decreased by more than 50% in 2016 and even reached 68% in coastal areas. The NRCMS has brought tangible benefits to farmers, the level of which has been continuously improved. However, there have been some problems in the implementation of the NRCMS. Through continuous exploration and reform, the NRCMS has been increasingly perfected and has matured. At the early stage of the NRCMS, medical expenses rose sharply. This problem is also reflected in the present research project. The total cost of hospitalization in inland areas increased from 6,435 RMB in 2007 to 8,999 RMB in 2010, an increase of nearly 40% in just 3 years. To consolidate and improve the NRCMS, in 2011, the Fujian Provincial Department of Health and Fujian Provincial Department of Finance issued the Fujian Province New Rural Cooperative Medical Payment Reform Guidance Plan (Trial) [23], hoping to reduce the burden of medical expenses through the reform of payment methods. The reform of payment methods has indeed had an immediate role in alleviating the burden of medical expenses for patients. Research data show that in 2011, the total inpatient expenses and OOP ratio in coastal and inland areas both declined sharply, and the total inpatient expenses in coastal and inland areas for lung cancer patients decreased to 12.5% and 7.8%, respectively. The OOP ratio decreased by 35.0% and 22.7%, respectively, which were the largest declines in the 2007-2016 study period. In addition, the reimbursement rate in coastal areas increased by 26.7% in 2011, which was the largest increase during the study period from 2007 to 2016.

The NRCMS also has a low level of insurance for serious illnesses, and the burden of medical expenses for patients with serious diseases, such as lung cancer remains heavy. There is a phenomenon of "poverty owing to illness or return to poverty owing to illness" [24, 25]. Statistics show that [26] the proportion of government health expenditure increased rapidly from 2007 to 2010 and stabilized at about 30% after 2011. The proportion of social expenditure is also rising, from 33.64% in 2007 to 41.21% in 2016. The proportion of personal expenditure decreased yearly, from 44.05% in 2007 to 28.78% in 2016. These data are significantly different from the results of the present study. In 2016, the OOP rates of lung cancer patients in coastal areas and inland areas both exceeded 50%. This large difference may be because when rural residents are diagnosed with lung cancer, the stage is late and the disease is serious. Most patients choose to seek treatment in grade A class three hospital, and the reimbursement ratio of large hospitals is relatively low. In addition, the treatment of lung cancer is more complicated than that of other diseases, and the treatment cycle is longer. Immunological drugs and targeted drugs for lung cancer are expensive and basically need to be selffunded. Therefore, the reimbursement rate of lung cancer patients is lower than that of other diseases, and the proportion of personal expenditure is higher. In August 2012, the National Development and Reform Commission, the Ministry of Health, and other six ministries and

commissions jointly formulated the Guiding Opinions on the Development of Serious Illness Insurance for Urban and Rural Residents, which requires the reimbursement of serious illness insurance in addition to reimbursement of basic medical insurance, and the reimbursement of serious illness insurance shall not be less than 50%, to solve the problem that residents "fall into poverty due to illness or return to poverty due to illness" [27]. On January 1, 2013, Fujian Province fully launched the implementation of serious disease insurance, including 20 specific diseases such as lung cancer, esophageal cancer, and stomach cancer, into the serious disease insurance and relief of the NRCMS. For participants with the 20 above serious diseases, such as lung cancer, the actual reimbursement ratio of the accumulated compliance medical expenses of basic medical insurance and serious disease insurance in the NRCMS increased to more than 70% [6]. In other words, inpatients with lung cancer in Fujian Province can be reimbursed via basic medical insurance of the NRCMS and then can then be reimbursed again by serious disease insurance, which can substantially reduce the burden of medical expenses and prevent illness owing to poverty.

With regards to the results of the present project, the medical expense burden of lung cancer patients in coastal areas of Fujian Province is relatively greater than that of inland patients. Research data showed that the hospitalization cost, average daily hospitalization cost, and OOP ratio of lung cancer patients in coastal areas were higher than those in inland areas during 2007-2016 and the reimbursement ratio was lower. Lung cancer is the malignant tumor with the highest incidence in China, and the 5-year survival rate is only 15%-17%. Owing to the complexity of the disease, the vast majority of lung cancer patients choose large first-class hospitals or firstclass hospitals with better medical conditions and higher technical levels, and most of these hospitals are located in coastal areas with better economic and public resources. With high levels of medical technology, first-class hospitals are more active in the treatment of lung cancer. Emerging therapies, such as immunity and targeting, are also regular treatment methods. Lung cancer patients are expected to live longer but clearly have higher treatment costs. Inland areas mainly have small- and medium-sized hospitals, whose reimbursement ratio is higher than that of third-class hospitals. In addition, inland hospitals mainly provide targeted palliative care for lung cancer patients, and doctors and patients are more inclined to choose treatment means and drugs within the scope of medical insurance reimbursement to reduce hospitalization costs and increase the reimbursement ratio. Therefore, the hospitalization cost and average daily hospitalization cost of lung cancer patients in coastal areas are higher than those in inland areas, but the reimbursement ratio in inland areas is higher than that in coastal areas. In addition, the OOP ratio in the two regions decreased significantly from 2007 to 2016. On the one hand, the per capita disposable income in coastal areas and inland areas of Fujian Province increased each year; on the other hand, the hospital expenses were relatively stable and the reimbursement ratio gradually increased due to the deepening of medical reform, and the OOP expenditure kept declining. However, in 2016, the OOP rate of inpatients with lung cancer in inland areas was about 46% and reached 58% in coastal areas. These data show that if a person has a serious disease such as lung cancer, the patient and their family would experience a disastrous event, which is prone to the phenomenon of "the whole family suffers when one person has a serious disease." In the implementation of the serious disease insurance policy in Fujian Province, we assist with specific diseases, such as lung cancer, which has improved the level of protection for specific diseases and disadvantaged groups and effectively solved the problem of patients with serious illness and serious diseases and their families experiencing poverty due to illness.

To sum up, this study collected the data of inpatients with lung cancer under the New Rural Cooperative Medical Insurance Scheme in Fujian Province from 2007 to 2016, analyzed the gap of economic burden of lung cancer patients in coastal and inland rural areas and the trend of the gap over time, and aimed to evaluate the difference of medical cost burden and health security level of rural lung cancer patients in Fujian province. To provide reference for perfecting the residents' medical insurance system and the fairness of public health service. The purpose of implementing the new rural cooperative medical system in China is to reduce the burden of medical expenses of rural residents. In the early stage of the implementation of the new rural cooperative medical system in Fujian Province, the burden of medical expenses of patients with lung cancer has been alleviated to a certain extent, but it is relatively limited, and the cost burden of patients with serious diseases such as lung cancer is still heavy. With the continuous development and reform of the new rural cooperative Medical care system, major diseases such as lung cancer are included in the serious illness guarantee and assistance of the new rural cooperative medical care system, and serious illness insurance can be reimbursed twice after the basic insurance reimbursement, which significantly reduces the burden of medical expenses for patients with lung cancer and other serious diseases. This study found that from 2007 to 2016, the burden of medical expenses of lung cancer patients in coastal areas of Fujian Province was heavier than that of patients in inland areas, which may be affected by the differences in hospital level, treatment methods, drug scope, expected survival level and

medical assistance policies of lung cancer patients in the two regions. Therefore, in order to ensure the fairness of medical and health services, The resident medical insurance system needs to be continuously optimized, supplemented and perfected. At the same time, this study also has certain limitations. NRCMS and the medical insurance for urban residents were merged into "Medical Insurance for Urban and Rural Residents" of Fujian Province in 2017, and the data was saved in another database. Since there is no permission to use the data, the data in this paper comes from the data of Fujian New Rural Cooperative Medical insurance from 2007 to 2016, and we plan to apply for the latest data to update corresponding findings.

Conclusions

In this study, we found that under the influence of the NRCMS, the hospitalization cost, average daily hospitalization cost, and OOP ratio of lung cancer patients in coastal areas were higher than those in inland areas from 2007 to 2016, but the reimbursement ratio was lower. Statistically, from 2007 to 2011, the difference in the burden of medical expenses for lung cancer patients in coastal and inland areas narrowed gradually. However, from 2012 to 2014, the difference in medical expenses between the two regions gradually widened. From 2014 to 2016, the difference between the two regions gradually narrowed and returned to the difference level of 2010 in 2016. In general, the medical expenses of lung cancer patients in coastal areas of Fujian Province are greater than those in inland areas, which may be affected by differences in the level of hospitals, treatment methods, drug scope, expected survival level, and medical assistance policies of lung cancer patients in the two regions.

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

LQ analyzed and interpreted the data, and was a major contributor in writing the manuscript; RF analyzed and interpreted the data; HF and JY designed the work, ZZ and HZ abstracted the data; HF and HZ designed the work and interpreted the data. All authors reviewed the manuscript.

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Data availability

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Fujian Medical University (Fuzhou, China) and all participants proved signed informed consent.

The study was approved by the Ethics Committee of Fujian Medical University (committee's reference number: 2019–27). Because the structure of medical records was designed for administration purposes rather than academic research, patients were given oral informed consent to participate in this study. To protect their confidentiality, only de-identified data were available to the researchers and the data was analysed anonymously. The Ethics Committee approved this consent procedure.

The authors declare that the research did not involve human experiments.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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