

# The inequity of inpatient services in rural areas and the New-Type Rural Cooperative Medical System (NRCMS) in China: repeated cross sectional analysis

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## Abstract

**Objective** The main aim of the New-type Rural Cooperative Medical System (NRCMS) put into effect in 2003 was to reduce financial barriers in accessing health care services among vulnerable populations. The aim of this study was to assess the association between NRCMS and income related inequality in hospital utilization among rural inhabitants in Jiangxi Province, China.

**Methods** A multistage stratified random cluster sampling method was adopted to select 1838, 1879, and 1890 households as participants in 2003/2004, 2008 and 2014, respectively. The Erreygers Concentration index (EI) of two measures of hospital inpatient care including admission to hospital and hospital avoidance, were calculated to measure income-related inequality. The decomposition of the EI was performed to characterize the contributions of socioeconomic and need factors to the measured inequality.

**Results** An affluent-focused (pro-rich) inequity was observed for hospital admission adjusting for need factors over time. The level of inequity for hospital admission decreased dramatically, while hospital avoidance decreased marginally, and with a high value (EI, -0.0176) in 2008. The implementation of the NRCMS was associated with decreased inequity in 2008 and in 2014, but the associations were limited. Income contributed the most to the inequality of hospital utilization each year.

**Conclusion** The coverage of the NRCMS expanded to cover nearly all rural inhabitants in Jiangxi province by 2014 and was associated with a very small reduction in inequalities in admission to hospital. In order to increase equitable access to health care, additional financial protections for vulnerable populations are needed. Improving the relatively low level of medical services in township hospitals, and low rate of reimbursement and financial assistance with the NRCMS is recommended.

**Keywords:** Equity/inequity of inpatient services, rural areas, new-type rural cooperative medical system (NRCMS), China

### Key Messages

- The disproportionate growth of China's economy brings with it several issues in terms of equity in accessing and utilizing needed health care services, especially among economically disadvantaged rural farmers.
- Major health policy reform was implemented targeting rural residing adults facing major disparities in utilization equity.
- Overall, this policy change was potentially met with greater utilization equity over the course of a decade in terms of utilizing needed health care resources, yet more must be done to reduce inequity in health use.

## Introduction

Globally, hundreds of millions people lack access to one or more primary medical services and 100 million fall into poverty every year as a result of out-of-pocket expenses on medical services (World Health Organization 2015). Member States signed the resolution on 'Strengthening national policy dialogue to build more robust health policies, strategies and plans' in 2008 for achieving the goal of 'universal health coverage' proposed by the World Health Organization (World Health Organization 2015). Financial barriers in access to health care are likely to be lessened when individuals participate in risk pooling within an insurance mechanism (Lee and Shin 2013). Targeting funds towards insurance mechanisms that cover the disadvantaged or vulnerable individuals with regard to socioeconomic position is one strategy some countries around the world have used and are using to improve equity in access to health services (van Doorslaer *et al.* 2006). Equity here, refers to the absence of socially determined factors that influence one's ability to reach one's full health potential (National Center for Chronic Disease Prevention and Health Promotion 2015).

China has struggled to establish a highly successful health insurance scheme for reducing inequity in health services for several decades. The New-type Rural Cooperative Medical System (NRCMS) was put into effect to improve the equity in the use of health services in 2003 (Li *et al.* 2008). The State Council declared that 'equitable access' is the primary aim of the NRCMS (Zhou *et al.* 2011). The equity in health care utilization of inpatient service for rural inhabitants is a significant index to evaluate outcomes that may be related to the government's activities, given that financial burden of inpatient services has been the main reason for inhabitants having difficulty in accessing medical services (Dai *et al.* 2011).

A full understanding of factors potentially associated with providing universal access to health care services is insufficient to date. Underlying characteristics of populations and unique characteristics of countries and governments make a single one-size-fits-all approach to health care financing unrealistic across both developed and developing countries thus far. Understanding the unique needs and resources available to support tailored financing mechanisms that seek to ensure universal access to health care services is critical. Limited evidence from developing countries, like Iran (Etemad *et al.* 2015), China (Zhou *et al.* 2011) and Chile (Núñez and Chi 2013) suggests that insurance coverage may be the most feasible target intervention for reducing inequity in the utilization of health care services. Some scholars have suggested that the NRCMS, targeting rural inhabitants in China, is likely to have had limited or insignificant impacts on reducing income-related inequity in inpatient health care utilization (Liu *et al.* 2012, Yu *et al.* 2010). Further, Yang (Yang 2013) found that the NRCMS may have had some influence on lowering income-related health inequity in health care, yet the potential contribution of the NRCMS was rather limited. This was largely owing to low participation rates and reimbursement rates in the initial years after the NRCMS was launched. However, Zhang

(Zhang *et al.* 2010) showed that the NRCMS partly reduced catastrophic health expenditures among poorer inpatients when compared to more affluent inpatients. Another study found that the NRCMS may contribute to reducing overall inequity in health care (Zhang *et al.* 2010). Possible explanations of this relationship include that the NRCMS may help government healthcare subsidies distribute equitably among low-income rural inhabitants in particular (Chen *et al.* 2015), and that it may contribute to decreased out-of-pocket expenses on health care for low-income individuals (Wang *et al.* 2012). Therefore, research that is more comprehensive is needed to bring together this conflicting evidence.

Although previous work is considerable, evidence on whether the NRCMS potentially influences income-related inequity in accessing health care utilization is subject to limited recent empirical research. Previous studies fail to reflect the current potential association of NRCMS on equity in health care utilization over time. Furthermore, most previous studies focused on a given point in time or used limited evaluation methods or broadly focused on the entirety of rural areas in China while failing to account for large variations in poverty and other characteristics at the province level, namely the relatively poverty-stricken rural areas of Jiangxi province (Yu *et al.* 2010, Zhang *et al.* 2010). Policies may be more tailored if informed in the light of local circumstances (Dai *et al.* 2011), which may vary widely across provinces in China (Zhang and Kanbur 2005). The NRCMS has been associated with varied outcomes that may be related to equity in access to health care in the form of out-of-pocket expenditures on health care and different financing mechanisms for health insurance for rural individuals (Wang *et al.* 2012). Inequity in healthcare utilization may be driven in large part by the health needs and socioeconomic factors present within the target population (Zhou *et al.* 2011). Therefore, a major driver of the current study is to provide timely empirical evidence for policymakers of possible associations with the implementation of the NRCMS and access to care. This evidence may be used to improve the NRCMS in Jiangxi province, an area with high poverty and a large rural population. This was done using a corrected concentration index (Erreygers concentration index) proposed by Erreygers and the decomposition of this index (Erreygers 2009). As of 2013, Jiangxi province, the target area for the current study, had a total population of over 45 million individuals with rural inhabitants making up 51% of that population (National Bureau of Statistics of China 2013). Thus, there is a critical need to identify solutions that will improve equity in accessing and utilizing health care services for this large population.

High inpatient health care costs may contribute to rural adults entering poverty or incurring unmanageable debt, especially among those with limited resources. Thus, the current study focused on inpatient services among potentially vulnerable adults in rural areas. Previous studies indicated that there was pro-rich inequity in inpatient services (Zhou *et al.* 2011), while minimal inequity in outpatient services existed (Yang 2013). One of the main purposes of the

NRCMS was to lessen the burden associated with the cost of inpatient health care services (Li *et al.* 2008). Therefore, the current study sought to respond to a timely and critical need, namely investigation into the potential relationship of health care financing reform related to costly inpatient health care utilization among potentially vulnerable populations over time. Two indexes (rates of hospital admission and rates of hospital avoidance) were used to evaluate the utilization of inpatient services in the current study. Thereby, allowing for a more complete picture of the analyses of the number of and the reasons for rural inhabitants' avoidance or utilization of inpatient health care services (Zou *et al.* 2016) rather than simply identifying the probability of inpatient health care utilization.

### The new rural medical cooperative system

In 1970s the Cooperative Medical System (CMS), a form of community-sponsored health care, was put into effect and became popular for a while in the context of Chinese planned economic health care systems. To a limited extent, the CMS was able to improve access to health care services among rural inhabitants (Liu 2004). However, this planned economic health care system fell apart in the 1980s which was accompanied by a collapse in the CMS, resulting in cost prohibitive health care for many once again (Liu 2004). Evidence from the third national health services survey (Center for Health Statistics and Information of MOH 2004) revealed that the rate of hospital avoidance in rural areas was 40.6% in 1993, 34.5% in 1998, and 30.3% in 2003. Thereby it gave rise to inequalities in health care utilization among rural inhabitants in China given the majority of these individuals, aside from those who were public servants and those with employees' social medical insurance, had no medical insurance (Yang 2013). In addition, disproportionate rates of economic development also contributed to these inequities in China (Tang *et al.* 2008). Ultimately, the New-type Rural Cooperative Medical System (NRCMS) was brought into force in 2003 (Li *et al.* 2008).

The NRCMS, which is government- and individually-sponsored, was designed to increase equity in health care for rural inhabitants, where individuals can be reimbursed a percentage of medical expenses when they receive health care in medical and health institutions designated for use by the NRCMS by the government (Yu *et al.* 2010). The Chinese health systems in rural areas included three levels of health service including: village clinics offering outpatient services only; and township hospitals and county hospitals offering both inpatient services and outpatient services.

The NRCMS premium is financed both by individuals and different levels of government which has been increasing over time. For example, in 2003/2004, the total premium was 30 Yuan (10 Yuan from individuals and 20 Yuan from the government) per capita each year in Jiangxi province. After inflating costs to 2014, using the rural consumer price index, the premium in 2003–4 represented 42 Yuan (14 Yuan from individuals and 28 Yuan from the government). The premium increased dramatically to 390 Yuan (70 Yuan from individuals and 320 Yuan from the government) for each person in 2014. In Jiangxi province, risk pooling is based on the county level. The in-patient reimbursement proportion designated by the government (the proportion of rural inhabitants' reimbursable inpatient cost from relevant departments to the total reimbursable medical cost), increased each year as well. In 2003, the reimbursement rate for inpatients in Jiangxi province at designated medical institutions varied by area designations, with townships at 60%, counties at 40%, out-counties at 30% and non-designated areas for out-

county at 0%, in 2003, increasing to 90%, 80%, 50%, and 35%, respectively in 2014.

### Aim

In an attempt to bridge the gap in what is known regarding these key policy issues, we aimed to identify the relationship between the implementation of the NRCMS and the inequity of inpatient health care utilization among rural inhabitants in Jiangxi province.

### Methods

#### The equity in inpatient utilization

The Concentration index (CI) was used to measure equity in health care use. The CI draws on the idea of the Lorenz curve and Gini coefficient, and is one of the most commonly used indexes to measure health service equity (Wagstaff *et al.* 1991). The formula of the concentrated area under the curve is:

$$CI = \frac{2}{\bar{y}} COV(y_i, r_i^t) \quad (1)$$

Where  $\bar{y}$  is the mean of health variable ( $y$ ),  $i$  refers to the individual,  $r$  is the rank of an individual's income level,  $t$  is the year. A negative value indicates disproportionate concentration of the variable among those with low incomes, vice versa and zero means no inequity. When the absolute value is smaller, the equity is better.

However, recently some limitations in the CI have been suggested in that if the health variable of interest is binary, the bounds of the CI may be unstable (Kjellsson and Gerdtham 2013, Wagstaff 2005). Therefore, at the suggestion of Erreygers (Erreygers 2009) who corrected the CI for binary health variables, the Erreygers's Concentration Index (EI) was used in this paper:

$$EI = \frac{4\bar{y}}{(y_{\max} - y_{\min})} CI(y) \quad (2)$$

Where  $y_{\max}$  and  $y_{\min}$  indicate the maximum and minimum of the health variable ( $y$ ),  $\bar{y}$  is the mean of  $y$  and  $CI(y)$  is computed by the equation (1).

#### The decomposition of inequity in health use

The decomposition of inequality was used to assess the contribution of various determinants of utilization to the inequality in inpatient utilization and was also used to calculate horizontal inequity. We used the method proposed by O'Donnell *et al.* (O'Donnell *et al.* 2007) where utilization can be written by a linear regression model as displayed in equation 3:

$$y_i = a + bx_{lnic} + \sum_n c_n x_i^n + \sum_m d_m x_i^m + e_i \quad (3)$$

Where  $y_i$  is hospital inpatient care use for individual  $i$ ;  $x_{lnic}$  is the variable of natural logarithm of income;  $x_i^n$  are need variables;  $x_i^m$  are other control variables;  $b$ ,  $c$  and  $d$  are coefficients;  $e_i$  is the potential error term. Being consistent with previous studies, the CI of  $y_i$  can be decomposed as:

$$CI_y = \left( \frac{b\bar{x}_{lnic}}{\bar{y}} \right) CI_{lnic} + \sum_n \left( \frac{c_n \bar{x}_n}{\bar{y}} \right) CI_n + \sum_m \left( \frac{d_m \bar{x}_m}{\bar{y}} \right) CI_m + \frac{GCI_e}{\bar{y}} \quad (4)$$

The decomposition of Erreygers's Concentration Index differs from the decomposition of CI by a multiplier of 4 and  $\bar{y}$  (Erreygers 2009). The equation is as:

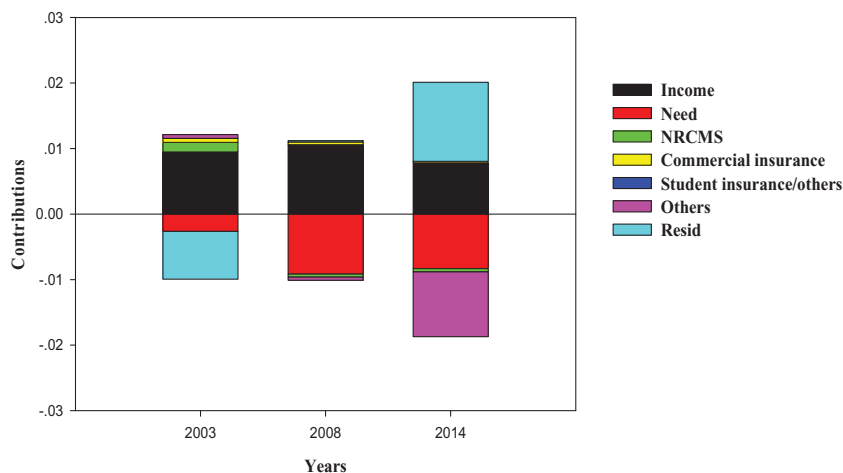


Figure 1. Decomposition of inequality in hospital admission from 2003/4 to 2014

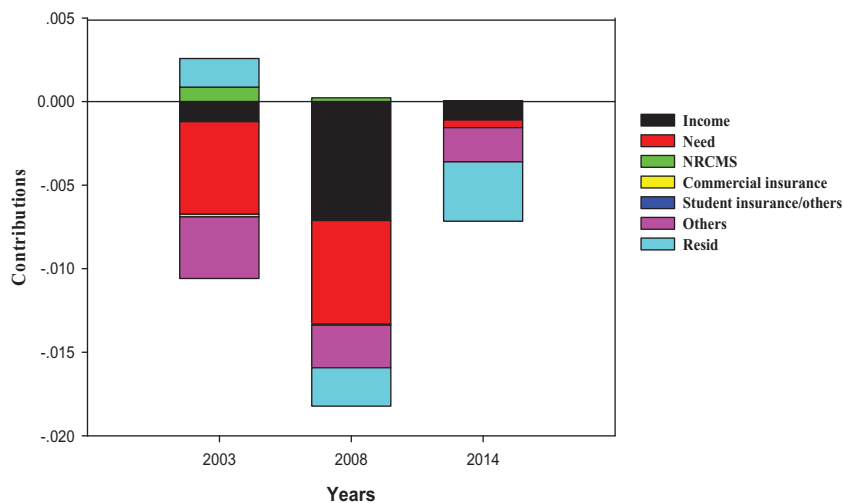


Figure 2. Decomposition of inequality in hospital avoidance from 2003/4 to 2014

$$EI_y = 4[b\bar{x}_{nic}CI_{nic} + \sum_n c_n\bar{x}_nCI_n + \sum_m d_m\bar{x}_mCI_m + GCI_e] \quad (5)$$

In equation 4 and 5,  $CI_y$  and  $EI_y$  is the CI and EI of inpatient use, respectively,  $\bar{y}$  is the mean of inpatient use,  $\bar{x}_{nic}$ ,  $\bar{x}_n$  and  $\bar{x}_m$  are the mean of  $x_{nic}$ ,  $x_n$  and  $x_m$  respectively.  $CI_{nic}$ ,  $CI_n$  and  $CI_m$  are the concentration index of each health determinant,  $GCI_e$  is the generalized CI of the error term. Therefore, in this study we decomposed the inequity in inpatient utilization into four parts (Núñez and Chi 2013): **Part 1:** The contribution of income level,  $4b\bar{x}_{nic}CI_{nic}$ ; **Part 2:** The contribution of the need variables,  $4\sum_n c_n\bar{x}_nCI_n$ ; **Part 3:** The contribution of non-need variables (*i.e.* NRCMS),  $4\sum_m d_m\bar{x}_mCI_m$ ; and **Part 4:** The contribution of the residual term,  $4GCI_e$ . Wagstaff (Wagstaff *et al.* 1991) demonstrated that the degree of inequity in health use after controlling for need factors, namely horizontal equity (HI) is computed by subtracting the contribution of need variables from the EI of inpatient services.

The absolute value of the contribution was defined as the extent to which this variable contributes to inequality. A positive value stands for a greater inequality among those with higher incomes or ‘pro-rich inequity’ attributed to this variable. In the current study, we use ‘pro-rich inequity’ to mean that the ‘affluent’ were more

likely to experience inpatient utilization or hospital avoidance than those with lower incomes, and vice versa. As the variables were separated into four determinants or parts (*i.e.* income, need, other, and residual), the contribution of each part is equivalent to the summation of contributions of each variable within each part (as shown in Figures 1 and 2). For example, the summation of each part would be zero if inpatient utilization was distributed equally among income and the bar of need part would be the only one to appear if there were consummate equity.

## Data

### Data sources

Data from household surveys conducted in 2003/2004 (baseline), 2008, and 2014 by researchers from the School of Public Health, at Nanchang University in Jiangxi province were used (Zou *et al.* 2016). Participants age 18 years and older were analyzed in this study. The baseline measurement period was before the implementation of the NRCMS, while the two follow-up household surveys were conducted after NRCMS implementation. A multistage stratified random cluster sampling method adopted from the Ministry of

Health was used to select respondents. First, all counties in Jiangxi province were ranked by income level from low to high. Then, they were divided into three tiers equally and three counties were randomly selected from each tier, including the County of Luxi (in the top-income level tier), the County of Wuyuan (in the middle-income level tier), and the County of Xiushui (in the low-income level tier). Likewise, three townships from each sampled county and three administrative villages from each sampled township were selected. Finally, 70 households from each administrative village were selected to participate in the study. The householder of each household/family was interviewed face-to-face about survey items concerning themselves and their whole family. The same administrative villages were studied in all three household surveys to insure comparability and reliability.

### Data analysis

The EI was used to evaluate the inequity of hospital utilization and the decomposition of EI was employed to estimate the contributions of need factors and socioeconomic factors to the inequity in inpatient use. The linear probability model (LPM) was performed to decompose the Erreygers's concentration index (Yang 2013). Logistic regression was applied to analyze the factors of the binary health variables as comparisons for the results of using LPM. Unless otherwise noted, an alpha of  $\alpha = 0.1$  was used in all analyses. Microsoft Excel 2013 was employed to establish the database. Stata MP14 was used to assess the concentration index, Erreygers index for the variables and the linear probability regression. SPSS version 17.0 was used to run logistic regression. In addition, SigmaPlot 10.0 was used to generate the figures representing the decomposition of inequality in inpatient utilization.

### Dependent variable

The related indexes for inpatient utilization were the dependent variables:

The rate of hospital admission (%) was operationally defined as the counts of respondents being hospitalized due to illness relative to the total number of respondents in each survey year. Hospital admission was measured by asking whether respondents received any inpatient hospital services in the past year (received any versus not received).

The rate of hospital avoidance (%) was operationally defined as the counts of respondents who needed in-hospital or inpatient care but did not go to the hospital relative to the number of respondents hospitalized plus the counts of those who avoided the hospital (when needed) in the past 12 months. Hospital avoidance was measured by asking whether there was a time in the past year when a doctor thought they should be treated in a hospital but they did not go to the hospital (avoided versus not).

Two indexes were included from the third national survey report (Center for Health Statistics and Information of MOH 2004), which represented the actual utilization of inpatient services.

### Independent variable

Need variable: We used a set of proxy variables as need factors, given this concept is difficult to measure directly (Núñez and Chi 2013). These included sex (male versus female); age treated as a categorical variable, age of 18–44 (referent), age of 45–64, age of 65 years and older; and chronic disease (reporting having at least one chronic disease in the past 6-months or longer versus not).

Socioeconomic factors: Socioeconomic factors included occupation status (farmer versus non-farmer), educational level treated as a

categorical variable (illiterate, primary school, middle school versus high school and above), marital status (married, divorce/widowed/others versus unmarried), type of insurance (if any) (NRCMS versus otherwise, commercial insurance versus otherwise, student insurance versus otherwise) and county (Wuyuan county, Xiushui county, Luxi county). The per capita income per year in each year was inflated to be representative of 2014 using the rural consumer price index, the Natural log of which was treated as continuous variables being introduced into regression models and calculating CI or EI for the variables.

## Results

### Descriptive statistics

In each of the three survey rounds, the response rate was 100%. Table 1 demonstrates that, from 2003/2004 to 2014, inpatient utilization increased, with an annual average growth rate at 9.07%. Table 1 also demonstrates that the number of individuals whose doctor suggested they be hospitalized but who also decided not to go to the hospital (hospital avoidance) decreased, with an annual average growth rate at  $-12.64\%$ . The rate of reporting having at least one chronic disease was 10.93% in 2003/2004, 9.81% in 2008, and 12.44% in 2014. The type and rate of health insurance coverage also underwent a significant change. In 2003/2004, <23% of respondents were covered by health insurance, while at the same time 21.53% of respondents were covered by NRCMS. In 2014, nearly 100% of respondents were covered by NRCMS. After inflating the per capita income of 2003/2004 and 2008 to 2014 levels (using the rural consumer price index), the per capita income in 2003/2004, 2008, and 2014 were 2862.93 Yuan, 4971.95 Yuan, and 14154.09 Yuan respectively. This represented an annual average growth rate was 17.33%.

### Inequity in health care use

Table 2 describes the results of the assessment of inequity in health care use from 2003/2004 to 2014. Results indicate that pro-rich inequity was observed for hospital admission even after adjusting for the needs variables ( $P > 0.1$ ) and pro-poor inequity was observed in hospital avoidance (all  $P$  values  $< 0.1$ ). The inequity for hospital admission decreased while the horizontal inequity increased. The inequity for hospital avoidance changed slightly but with a high value of EI at  $-0.0176$  in 2008, while the horizontal inequity increased.

### Decomposition analysis

The EI of inpatient utilization was decomposed into multiple contributions (as shown in Tables 3 and 4). Amongst the contributions, income contributed the most to the inequality of hospital utilization every year under study. In terms of reporting hospital admission in the past year, the income contributions of 2003/2004, 2008, and 2014 were all positive, indicating that most of the pro-rich inequity was explained by income. In terms of hospital avoidance, the contributions of income changed slightly over time but with a high contribution in 2008. The need variables decreased the inequality in hospital admission, while they increased the inequity in hospital avoidance each year. In 2003/2004, the NRCMS was associated with increased inequality of inpatient care utilization, while the NRCMS was associated with lowered inequality of hospital care utilization in 2008 and 2014 to a limited degree. In 2003/2004, individuals with NRCMS had pro-poor inequity in 2003/2004 and were less likely to report inpatient care. However, individuals with NRCMS had little pro-poor inequity in 2008, 2014 and were more likely to report hospital admission in the past year. However, in 2003/2004 Commercial Insurance was associated with the higher



**Table 1.** Distribution of selected variable among the study population in 2003/2004, 2008 and 2014 [Mean/n (%)]

| Variable  | Definition  | 2003/<br>2004(n=7919) | 2008(n= 8015) | 2014(n= 7811) |
|---|---|-----------------------|---------------|---------------|
| <i>Variables of hospital inpatient care</i>                       |   |                       |               |               |
| Hospital admission  | Dummy variable:1=Yes; 0=No  | 260(4.26)             | 363(5.68)     | 612(10.15)    |
| Hospital avoidance*   | Dummy variable: 1=Yes; 0 =No  | 150(36.59)            | 91(20.04)     | 64(9.47)      |
| <b>Health needs variable</b>                                      |   |                       |               |               |
| Male  | Dummy variable: 1=male; 0=female  | 3141(51.50)           | 3237(50.63)   | 3122(51.80)   |
| 18~44   | Dummy variable: 1=age between 18 to 44; 0 =otherwise  | 3776(61.89)           | 3852(60.25)   | 3067(50.88)   |
| 45~64   | Dummy variable: 1=age between 45 to 64; 0 =otherwise  | 1686(27.63)           | 1843(28.83)   | 2195(36.41)   |
| 65~   | Dummy variable: 1=age between 65 and above; 0 =otherwise  | 639(10.47)            | 698(10.92)    | 766(12.71)    |
| Reporting having chronic disease(s) in at least the past 6-months | Dummy variable: 1=Yes; 0 =No  | 667(10.93)            | 627(9.81)     | 750(12.44)    |
| <b>Socioeconomic variables</b>                                    |   |                       |               |               |
| Annual per capita household income**                              | Mean of per capita household income inflated to 2014, Natural log of per capita income is introduced in regression models | 2862.93               | 4971.95       | 14154.09      |
| No insurance  | Dummy variable: 1=no insurance; 0 =otherwise  | 4719(77.36)           | 169(2.64)     | 48(0.80)      |
| NRCMS   | Dummy variable: 1=NRCMS; 0 =otherwise   | 1313(21.53)           | 6054(94.69)   | 5979(99.20)   |
| Commercial insurance  | Dummy variable: 1=commercial insurance; 0 =otherwise  | 38(0.62)              | 33(0.53)      | 66(1.10)      |
| Student insurance/others  | Dummy variable: 1= student insurance/others; 0 =otherwise   | 30(0.49)              | 137(2.14)     | 124(2.06)     |
| Unmarried   | Dummy variable: 1=unmarried; 0 =otherwise.  | 1178(19.31)           | 1280(20.02)   | 820(13.60)    |
| Married   | Dummy variable: 1=married; 0 =otherwise   | 4568(74.87)           | 4738(74.11)   | 4821(79.98)   |
| Divorce/Widowed/Others  | Dummy variable: 1=divorce/widowed/others; 0 =otherwise  | 355(5.82)             | 375(5.87)     | 387(6.42)     |
| Farmer  | Dummy variable: 1=farmer; 0 =non-farmer   | 4019(65.87)           | 4160(65.07)   | 3247(53.87)   |
| High school and above   | Dummy variable: 1=high school and above; 0 =otherwise.  | 454(7.44)             | 669(10.46)    | 716(11.88)    |
| Middle school   | Dummy variable: 1=middle school; 0 =otherwise   | 2246(36.81)           | 2950(46.14)   | 2656(44.06)   |
| Primary school  | Dummy variable: 1=primary school; 0 =otherwise  | 2482(40.68)           | 2173(33.99)   | 2091(34.69)   |
| Illiterate  | Dummy variable: 1=illiterate; 0 =otherwise.   | 919(15.06)            | 601(9.41)     | 565(9.37)     |
| County Luxi   | Dummy variable: 1= County Luxi; 0 =otherwise.   | 2089(34.24)           | 2005(31.36)   | 1933(32.07)   |
| County Wuyuan   | Dummy variable: 1=Wuyuan; 0 =otherwise  | 2033(33.32)           | 1933(30.24)   | 1886(31.29)   |
| County Xiushui  | Dummy variable: 1=Xiushui; 0 =otherwise   | 1979(32.45)           | 2455(38.40)   | 2208(36.64)   |

\*In the rate of hospital avoidance, the denominator of which is counts of hospital admission plus counts of hospital avoidance in a year.

\*\*The unit of the annual per capita household income is renminbi (Yuan).

**Table 2.** Erreygers Concentration index and horizontal inequity index in inpatient utilization

| Year                  |            | 2003/2004 | 2008    | 2014    |
|-----------------------|------------|-----------|---------|---------|
| Hospital admission EI | Estimator  | 0.0022    | 0.0011  | 0.0014  |
|                       | Std. error | 0.0059    | 0.0067  | 0.0090  |
|                       | P value    | 0.7083    | 0.8778  | 0.8689  |
| HI                    | Estimator  | 0.0048    | 0.0103  | 0.0093  |
|                       | Std. error | 0.0059    | 0.0071  | 0.0078  |
|                       | P value    | 0.6083    | 0.1778  | 0.4660  |
| Hospital avoidance EI | Estimator  | -0.0075   | -0.0176 | -0.0071 |
|                       | Std. error | 0.0046    | 0.0034  | 0.0031  |
|                       | P value    | 0.0906    | 0.0000  | 0.0198  |
| HI                    | Estimator  | -0.0024   | -0.0118 | -0.0066 |
|                       | Std. error | 0.0050    | 0.0032  | 0.0030  |
|                       | P value    | 0.4606    | 0.0000  | 0.0362  |

inequity of inpatient utilization; while other socioeconomic factors were associated with lower inequity (see Figures 1 and 2).

## Fully adjusted analyses

Supplementary Tables S1 and S2 present results of the fully adjusted analyses.

### Hospital admission

We first provide overall summaries comparing all three waves as related to hospital admission, then we present detailed results of each wave independently. Overall, having a chronic condition was associated with a higher likelihood of hospital admission across all three time points or waves. In the first two waves, being married or being divorced/widowed (versus unmarried) was associated with hospital admission. In the last two waves, being a farmer (versus not) was associated with reporting hospital admission.

### Baseline (2003/2004)

Factors that were associated with a higher likelihood of reporting hospital admission in the past year included having a chronic condition (OR = 3.05, 95% CI 2.25–4.13) versus not having a chronic disease, having commercial insurance (OR = 2.68, 95% CI 1.0001–

Table 3. Decomposition of inequality in hospital admission

| Variable   | 2003/2004 |                   |               | 2008   |                   |               | 2014   |                   |               |
|--|-----------|-------------------|---------------|--------|-------------------|---------------|--------|-------------------|---------------|
|  | n         | LPM model         | Contributions | n      | LPM model         | Contributions | n      | LPM model         | Contributions |
| Male (referent=female)   | 3141      | -0.0012(0.0053)   | 0.0000        | 3237   | -0.0122(0.0058)** | -0.0001       | 3122   | -0.0029(0.0077)   | -0.0001       |
| Age (referent=18~44)   | 3776      |                   |               | 3852   |                   |               | 3067   |                   |               |
| 45~64  | 1686      | -0.0001(0.0069)   | 0.0000        | 1843   | 0.0017(0.0078)    | 0.0000        | 2195   | 0.0200(0.0100)**  | 0.0007        |
| 65~  | 639       | 0.0086(0.0110)    | -0.0004       | 698    | 0.0151(0.0121)    | -0.0010       | 766    | 0.0824(0.0152)*** | -0.0058       |
| Reporting having chronic disease(s) in at least the past 6-months (referent=no chronic diseases) | 667       | 0.0690(0.0085)*** | -0.0023       | 627    | 0.1282(0.0100)*** | -0.0081       | 750    | 0.1756(0.0121)*** | -0.0030       |
| Annual per capita household income (Mean, Natural log)   | 7.6948    | 0.0059(0.0037)    | 0.0095        | 8.2490 | 0.0070(0.0042)*   | 0.0106        | 9.2589 | 0.0049(0.0005)    | 0.0078        |
| Insurance type (referent=no insurance)   | 4719      |                   |               | 169    |                   |               | 48     |                   |               |
| NRCMS  | 1313      | -0.0168(0.0096)*  | 0.0015        | 6054   | 0.0266(0.0179)    | -0.0005       | 5979   | 0.0420(0.0433)    | -0.0005       |
| Commercial insurance/others  | 68        | 0.0459(0.0250)*   | 0.0006        | 170    | 0.0393(0.0256)    | 0.0004        | 66     | 0.0367(0.0371)    | 0.0002        |
| Student insurance  | -         | -                 | -             | -      | -                 | -             | 124    | 0.0406(0.0276)*   | 0.0000        |
| Marital status (referent=unmarried)  | 1178      |                   |               | 1280   |                   |               | 820    |                   |               |
| Married  | 4568      | 0.0244(0.0074)*** | 0.0004        | 4738   | 0.0291(0.0084)*** | 0.0001        | 4821   | 0.0152(0.0126)*   | -0.0006       |
| Divorce/Widowed/Others   | 355       | 0.0262(0.0145)*   | -0.0002       | 375    | 0.0248(0.0160)*** | -0.0005       | 387    | -0.0126(0.0210)   | 0.0001        |
| Occupational (referent=non-farmer)   |           |                   |               |        |                   |               |        |                   |               |
| Farmer   | 4019      | 0.0035(0.0066)    | -0.0005       | 4160   | 0.0176(0.0075)**  | -0.0027       | 3247   | 0.0378(0.0095)*** | -0.0067       |
| Education level (referent=high school and above)   | 454       |                   |               | 669    |                   |               | 716    |                   |               |
| Middle school  | 2246      | -0.0003(0.0106)   | 0.0000        | 2950   | -0.0004(0.0104)   | 0.0000        | 2656   | 0.0076(0.0131)    | 0.0005        |
| Primary school   | 2482      | -0.0013(0.0109)   | 0.0000        | 2173   | -0.0041(0.0114)   | 0.0003        | 2091   | 0.0186(0.0142)    | -0.0014       |
| Illiterate   | 919       | -0.0085(0.0132)   | 0.0006        | 601    | -0.0013(0.0149)   | 0.0000        | 565    | 0.0089(0.0185)    | -0.0004       |
| County (referent=county Luxi)  | 2089      |                   |               | 2005   |                   |               | 1933   |                   |               |
| County Wuyuan  | 2033      | 0.0005(0.0092)    | 0.0000        | 1933   | 0.0139(0.0074)*   | 0.0008        | 1886   | -0.0138(0.0096)   | 0.0003        |
| County Xiushui   | 1979      | -0.0083(0.0063)   | 0.0003        | 2455   | -0.0133(0.0069)*  | 0.0015        | 2208   | -0.0249(0.0092)** | -0.0017       |

Note: Annual per capita household income is inflated to the year of 2014 using rural consumer price index.

\*\*\*P<0.01, \*\*P<0.05, \*P<0.1.

**Table 4.** Decomposition of inequality in hospital avoidance

| Variable   | 2003/2004 |                   |               | 2008   |                   |               | 2014   |                  |               |
|--|-----------|-------------------|---------------|--------|-------------------|---------------|--------|------------------|---------------|
|  | n         | LPM model         | Contributions | n      | LPM model         | Contributions | n      | LPM model        | Contributions |
| Male (referent=female)   | 3141      | 0.0033(0.0045)    | 0.0000        | 3237   | -0.0048(0.0029)*  | -0.0001       | 3122   | 0.0048(0.0027)*  | 0.0002        |
| Age (referent=18~44)   | 3776      |                   |               | 3852   |                   |               | 3067   |                  |               |
| 45~64  | 1686      | 0.0066(0.0059)    | 0.0000        | 1843   | 0.0028(0.0039)    | 0.0000        | 2195   | 0.0029(0.0035)   | 0.0001        |
| 65~  | 639       | 0.0060(0.0094)    | -0.0003       | 698    | -0.0098(0.0060)   | 0.0006        | 766    | 0.0010(0.0053)   | -0.0001       |
| Reporting having chronic disease(s) in at least the past 6-months (referent=no chronic diseases) | 667       | 0.1738(0.0071)**  | -0.0057       | 627    | 0.1075(0.0050)**  | -0.0068       | 750    | 0.0396(0.0042)** | -0.0007       |
| Annual per capita household income (Mean, Natural log)   | 7,6948    | -0.0008(0.0031)   | -0.0012       | 8,2490 | -0.0047(0.0021)** | -0.0071       | 9,2589 | -0.0007(0.0017)  | -0.0011       |
| Insurance type (referent=no insurance)   | 4719      |                   |               | 169    |                   |               | 48     |                  |               |
| NRCMS  | 1313      | -0.0108(0.0118)   | 0.0009        | 6054   | -0.0131(0.0089)   | 0.0002        | 5979   | -0.0111(0.0151)  | 0.0000        |
| Commercial insurance/others  | 38        | -0.0125(0.0222)   | -0.0002       | 33     | -0.0082(0.0127)   | -0.0001       | 66     | 0.0064(0.0129)   | 0.0000        |
| Student insurance  | 30        | -                 | -             | 137    | -                 | -             | 124    | 0.0109(0.0096)   | 0.0000        |
| Marital status(referent=unmarried)   | 1178      |                   |               | 1280   |                   |               | 820    |                  |               |
| Married  | 4568      | -0.0002(0.0063)   | 0.0000        | 4738   | -0.0028(0.0042)   | 0.0000        | 4821   | -0.0004(0.0044)  | 0.0000        |
| Divorce/Widowed/Others   | 355       | 0.0246(0.0124)**  | -0.0002       | 375    | 0.0256(0.0080)**  | -0.0005       | 387    | -0.0012(0.0073)  | 0.0000        |
| Occupational (referent=non-farmer)   | 4019      |                   |               | 4160   |                   |               | 3247   |                  |               |
| Farmer   | 454       | 0.0020(0.0056)    | -0.0003       | 669    | 0.0006(0.0037)    | -0.0001       | 716    | 0.0054(0.0033)*  | -0.0010       |
| Education level (referent=high school and above)   | 2246      |                   |               | 2950   |                   |               | 2656   |                  |               |
| Middle school  | 2482      | 0.0032(0.0091)    | 0.0002        | 2173   | 0.0048(0.0052)    | 0.0003        | 2091   | 0.0013(0.0046)   | 0.0001        |
| Primary school   | 919       | 0.0067(0.0094)    | -0.0001       | 601    | 0.0029(0.0057)    | -0.0002       | 565    | 0.0101(0.0050)** | -0.0008       |
| Illiterate   | 2089      | 0.0172(0.0115)    | -0.0013       | 2005   | 0.0150(0.0074)**  | -0.0006       | 1933   | 0.0144(0.0064)** | -0.0006       |
| County (referent=county Luxi)  | 2033      |                   |               | 1933   |                   |               | 1886   |                  |               |
| County Wuyuan  | 1979      | 0.0226(0.0111)**  | -0.0027       | 2455   | -0.0033(0.0037)   | -0.0002       | 2208   | 0.0068(0.0034)** | -0.0001       |
| County Xiushui   |           | -0.0191(0.0050)** | 0.0006        |        | 0.0106(0.0034)**  | -0.0012       |        | 0.0046(0.0032)   | 0.0003        |

Note: Annual per capita household income is inflated to the year 2014 using rural consumer price index.  
 \*\*\*P < 0.01, \*\*P < 0.05, \*P < 0.1.



5.63) versus having no insurance, being married (OR = 2.54, 95% CI 1.53–4.22) or being divorced/widowed (OR = 2.68, 95% CI 1.28–5.59) versus being unmarried after controlling for all other terms in the model.

#### Intermediate post (2008)

Factors that were associated with a higher likelihood of reporting hospital admission in the past year included having a chronic condition (OR = 4.29, 95% CI 3.31–5.56) versus not having a chronic disease, being married (OR = 2.58, 95% CI 1.61–4.13) or being divorced/widowed (OR = 2.48, 95% CI 1.31–4.72) versus being unmarried, and being a farmer (OR = 1.54, 95% CI 1.12–2.12) versus being a non-farmer after controlling for all other terms in the model. In addition, geospatial differences existed in 2008, where those in the county of Wuyuan were more likely (OR = 1.34, 95% CI 1.02–1.76) to report a hospital admission in the past year than those living in the county of Luxi after controlling for all other terms in the model.

#### Long-term follow-up (2014)

Factors associated with a higher likelihood of reporting hospital admission in the past year included being in older age groups (age 45–64: OR = 1.38, 95% CI 1.09–1.76; age 65 and older: OR = 2.07, 95% CI 1.51–2.83) versus those aged 18–44, having a chronic disease (OR = 3.33, 95% CI 2.72–4.09) versus not having a chronic disease, and being a farmer (OR = 1.57, 95% CI 1.24–1.99) versus being a non-farmer after controlling for all other terms in the model. In addition, geospatial difference also existed in 2014, where those in the county of Xiushui were less likely to report a hospital admission in the past year (OR = 0.77, 95% CI 0.62–0.95) than those living in the county of Luxi after controlling for all other terms in the model.

#### Hospital avoidance

We first provide overall summaries comparing all three waves as related to hospital avoidance, then we present detailed results of each wave independently. Overall, the factors associated with hospital avoidance across all three time points included having a chronic condition or disease, where the strongest differences were noted in the first two waves. Further, geospatial differences were also present across all three waves, where variation among counties was measured.

#### Baseline (2003/2004)

Factors that were associated with a higher likelihood of reporting hospital avoidance in the past year included having a chronic disease (OR = 22.93, 95% CI 15.27–34.43) versus not having a chronic disease after controlling for all other terms in the model. In addition, geospatial difference also existed in 2003/2004, where those in the county of Xiushui were less likely to report hospital avoidance in the past year (OR = 0.36, 95% CI 0.22–0.58) after controlling for all other terms in the model.

#### Intermediate post (2008)

Factors that were associated with a higher likelihood of reporting hospital avoidance in the past year included having a chronic disease (OR = 28.37, 95% CI 15.29–49.43) versus not having a chronic disease after controlling for all other terms in the model. In contrast, having a higher income served as a protective factor or was associated with a lower likelihood (OR = 0.73, 95% CI 0.54–0.99) of reporting hospital avoidance in the past year after controlling for all

other terms in the model. Again, geospatial differences existed in 2008, where those in the county of Xiushui were more likely (OR = 2.17, 95% CI 1.25–3.76) to report hospital avoidance in the past year than those living in the county of Luxi after controlling for all other terms in the model.

#### Long-term follow-up (2014)

Factors associated with a higher likelihood of reporting hospital avoidance in the past year included being male (OR = 1.69, 95% CI 1.004–2.86) versus female, and having a chronic disease (OR = 5.80, 95% CI 3.42–9.85) versus not having a chronic disease, after controlling for all other terms in the model. Again, geospatial difference also existed in 2014, where those in the county of Wuyuan were more likely to report hospital avoidance in the past year (OR = 2.04, 95% CI 1.02–4.10) after controlling for all other terms in the model.

#### Reasons for hospital avoidance

The survey also captured the respondents' reported reasons for hospital avoidance as described in Table 5. The percent of individuals reporting economic difficulties as the reason for hospital avoidance was over 80% in 2003. This dropped to 50% in 2014. Nearly half of all respondents were between the ages of 45–64, and among these individuals' economic difficulties were reported at the highest rate (over 70%) for hospital avoidance. Among those age 65 and older over 76% of respondents reported economic difficulties as a reason for hospital avoidance. Among those with insurance nearly 69% reported economic difficulties as the reason for hospital avoidance. This was also true for those with no insurance, but at a rate of > 83%. In addition, the highest rate of economic-related hospital avoidance was among those who were illiterate. Finally, the rate of hospital avoidance for economic reasons was highest for those with the lowest incomes.

#### Discussion

This study was able to generate several interesting findings. First, the study highlighted that a decreasing affluent-focused or pro-rich inequity applied to inpatient use from 2003/2004 to 2014. Meanwhile, a slightly decreasing low-income-focused or pro-poor inequity was observed for hospital avoidance but with the highest value (EI, –0.0176) measured in 2008. In other words, those with lower incomes faced the most relative inequity in hospital avoidance by 2014. However, the level of actual inequity decreased while the horizontal inequity increased. This was likely due to the pro-poor contribution of need for inpatient services increasing and decreasing for hospital avoidance, which reflected that poor individuals with chronic disease were more likely to use inpatient services than report hospital avoidance. This was likely due in part to the improvement of their economic level and/or health care reforms (coverage, financial level of NRCMS). Further, among the reported reasons of hospital avoidance in this study, the percent of individuals reporting economic difficulties dropped from over 80% in 2003 to 50% in 2014. While the percent of those reporting the hospital being unable to cure their disease/Poor health services/having no time increased considerably. Other potential factors influencing this may have been the living standard, which improved throughout the study years, the demand for high quality health services which may have increased along the same timeline. Furthermore, it is also possible that the perception that the quality of health services would be higher in a county hospital than that in township hospital may have contributed

**Table 5.** The reported reasons for hospital avoidance [n (%)]

|   | Regarding as light illness and Self-treatment/Have no time | Economic difficulties | The hospital being unable to cure it/Poor health services | Others    | Total       | P                     |
|---|--|-----------------------|---|-----------|-------------|-----------------------|
| <b>Year</b>   |  |                       |   |           |             |                       |
| 2003  | 16(10.74)  | 199(80.39)            | 8(5.37)   | 6(4.03)   | 149(100.00) | 0.0003 <sup>a,d</sup> |
| 2008  | 10(10.99)  | 73(80.22)             | 4(4.40)   | 4(4.40)   | 91(100.00)  |                       |
| 2014  | 20(31.25)  | 32(50.00)             | 9(14.06)  | 3(4.69)   | 64(100.00)  |                       |
| <b>Sex</b>  |  |                       |   |           |             |                       |
| Female  | 27(16.98)  | 115(72.33)            | 10(6.29)  | 7(4.40)   | 159(100.00) | 0.7930 <sup>b</sup>   |
| Male  | 19(13.10)  | 109(75.17)            | 11(7.59)  | 6(4.14)   | 145(100.00) |                       |
| <b>Age</b>  |  |                       |   |           |             |                       |
| 18~44   | 10(12.66)  | 61(77.21)             | 5(6.33)   | 3(3.80)   | 79(100.00)  | 0.3857 <sup>a</sup>   |
| 45~64   | 29(18.83)  | 109(70.78)            | 8(5.19)   | 8(5.19)   | 154(100.00) |                       |
| 65~   | 7(9.86)  | 54(76.06)             | 8(11.27)  | 2(2.81)   | 71(100.00)  |                       |
| <b>Married status</b>                                 |  |                       |   |           |             |                       |
| Unmarried   | 1(5.88)  | 14(82.35)             | 2(11.76)  | 0(0.00)   | 17(100.00)  | 0.6871 <sup>a</sup>   |
| Married   | 36(14.94)  | 178(73.86)            | 15(6.22)  | 12(4.98)  | 241(100.00) |                       |
| Divorce/Widowed/Others                                | 9(19.57)   | 32(69.57)             | 4(8.70)   | 1(2.17)   | 46(100.00)  |                       |
| <b>Occupational</b>                                   |  |                       |   |           |             |                       |
| Farmer  | 41(15.13)  | 203(74.91)            | 17(6.27)  | 10(3.69)  | 271(100.00) | 0.1925 <sup>a</sup>   |
| Non-farmer  | 5(15.15)   | 21(63.64)             | 4(12.12)  | 3(9.09)   | 33(100.00)  |                       |
| <b>Education level</b>                                |  |                       |   |           |             |                       |
| High school and above                                 | 2(33.33)   | 4(66.67)              | 0(0.00)   | 0(0.00)   | 6(100.00)   | 0.8199 <sup>a</sup>   |
| Middle school   | 11(18.03)  | 43(70.49)             | 4(6.56)   | 3(4.92)   | 61(100.00)  |                       |
| Primary school  | 22(14.29)  | 111(72.08)            | 13(8.44)  | 8(5.19)   | 154(100.00) |                       |
| Illiterate  | 11(13.25)  | 66(79.52)             | 4(4.82)   | 2(2.41)   | 83(100.00)  |                       |
| <b>Annual per capita household income<sup>c</sup></b> |  |                       |   |           |             |                       |
| Lower group   | 8(8.08)  | 84(84.85)             | 2(2.02)   | 5(5.05)   | 99(100.00)  | 0.0000 <sup>a,d</sup> |
| Low group   | 7(9.46)  | 60(81.08)             | 3(4.05)   | 4(5.41)   | 74(100.00)  |                       |
| Middle group  | 6(10.34)   | 46(79.31)             | 5(8.62)   | 1(1.72)   | 58(100.00)  |                       |
| High group  | 8(21.62)   | 23(62.16)             | 4(10.81)  | 2(5.41)   | 37(100.00)  |                       |
| Higher group  | 17(47.22)  | 11(30.56)             | 7(19.44)  | 1(2.78)   | 36(100.00)  |                       |
| <b>County</b>   |  |                       |   |           |             |                       |
| County Luxi   | 12(12.90)  | 75(80.65)             | 5(5.38)   | 1(1.08)   | 93(100.00)  | 0.1065 <sup>a</sup>   |
| County Wuyuan   | 17(17.53)  | 69(71.13)             | 9(9.28)   | 2(2.06)   | 97(100.00)  |                       |
| County Xiushui  | 17(14.91)  | 80(70.18)             | 7(5.83)   | 10(10.00) | 114(100.00) |                       |
| <b>Insurance</b>                                      |  |                       |   |           |             |                       |
| Yes   | 36(18.46)  | 134(68.72)            | 16(8.21)  | 9(4.62)   | 195(100.00) | 0.0635 <sup>b</sup>   |
| No  | 10(9.17)   | 90(82.57)             | 5(4.59)   | 4(3.67)   | 109(100.00) |                       |
| <b>Being chronic diseases in half year</b>            |  |                       |   |           |             |                       |
| Yes   | 28(12.67)  | 164(74.21)            | 17(7.69)  | 12(5.43)  | 221(100.00) | 0.0892 <sup>b</sup>   |
| No  | 18(21.69)  | 60(72.29)             | 4(4.82)   | 1(1.20)   | 83(100.00)  |                       |

<sup>a</sup>Fisher's Exact Test.<sup>b</sup>Pearson Chi-Square.<sup>c</sup>Annual per capita household income is inflated to the year of 2014 using rural consumer price index and is divided into five equal groups in the light of income level sorted from low to high.<sup>d</sup>p<0.05.

to health seeking behaviour. It is also possible that rural inhabitants who lived far from these county hospitals may not be able to travel to or feel substantial barriers to being admitted to the hospital at these locations, which combined with a possible unwillingness to go to the township hospital, may result in higher hospital avoidance. Therefore, one possible solution to improving the equity of inpatient utilization may be to improve both the perceived and actual quality of medical services in township hospital.

In addition, one potential reason for a highest HI value on hospital avoidance may be that inequity regarding income in China at that time was extremely high, represented with a Gini coefficient of 0.491 in 2008, which was the highest for any time between 2000 to 2014 (Yang and Yang 2015). This is consistent with our findings in the decomposition analysis, where income had the greatest contribution on inequity in 2008.

The analysis of decomposition in EI showed that the NRCMS implementation was likely to associate with reduced income-related inequity for inpatient hospital utilization in the last few years. However, a lack of a strong comparison group, coupled with changes in the population at multiple levels make this difficult to measure completely. For example, being able to compare the experience of those in a similar setting and with similar characteristics who were not exposed to this change along the same timeline would have allowed for a greater understanding of the association of the change in financing and our outcomes. Future studies that incorporate comparison groups may add a greater understanding of similar policies being implementation given feasibility. Given that some degree of association is likely directly related to the change in financing, we posit that this is most likely attributable to higher financing levels and strong government support of the NRCMS.

Individuals with NRCMS coverage in 2008 and 2014 experienced a limited pro-poor inequity, while the NRCMS was associated with increased inequity in hospital admission in 2003/2004. A potential reason for this is that even though the NRCMS was distributed among lower income rural inhabitants, they may have been too poor to seek hospitalization in 2003/2004 and that the percent of individuals reporting economic difficulties as the reason for hospital avoidance was over 80% in 2003 in this study. However, income sustained as the strongest contributor of inequity, implying the associations of the NRCMS were considerably limited. This is consistent with the result of a study conducted by Yang (Yang 2013). This was likely in that economic difficulties were by far the most likely reason for hospital avoidance. While less surprising among those without insurance (83%), this rate was also extremely high among those with insurance (69%). This is consistent with the theoretical concepts of the Social Determinants of Health were economic factors play a key role in health-related outcomes (World Health Organization 2010). In addition, economic difficulties serving as the reason for hospital avoidance were highest among those with the lowest incomes. Thus, this is yet another example of how the Social Determinants of Health play key roles in access to health care for vulnerable populations. Therefore, identifying and implementing policies that make improvements related to the Social Determinants of Health is recommended in order to make positive changes in access and utilization of health care.

To some degree, commercial insurance may have helped to increase the inequity in inpatient care utilization in 2003/2004. This is likely due to most rural inhabitants having no insurance before this time and that the affluent were more likely to look for a financial protection for their health services than the poor. However, the strength of the relationship of commercial insurance and increasing the inequity in inpatient care use decreased after 2008 when the NRCMS had developed.

Our findings are consistent with previous studies in other areas of China. For example, Zhou *et al.* (Zhou *et al.* 2011) demonstrated that there was a pro-rich inequity in inpatient care utilization among rural inhabitants both in 2003/2004 (HI, 0.2386) and 2008 (HI, 0.1232), while showing significant decreases in inequity over time. Mao *et al.* (Mao *et al.* 2013) suggested that the utilization of inpatient services for urban inhabitants in one western city of China was a pro-rich inequity in 2011 (HI, 0.1110). However, the absolute values of CI in both above studies were higher than that of the current study, which may be related to differences in area-level economic factors, differences in health care delivery and utilization, and differences in health insurance coverage and between provinces.

To compare this with other countries, Ghosh (Ghosh 2014) demonstrated that inequity of inpatient utilization was in favour of the affluent across different areas in India. This is only somewhat comparable to China and other low- and middle-income countries given differences in culture, health care financing, and other health-related policies at the national level. In addition, a study (Kim *et al.* 2013) conducted in Korea showed HI values of  $-0.1116$  in 2005 and  $-0.0589$  in 2010 for inpatient utilization, indicating a pro-poor inequity in hospital utilization in 2005, which then shifted to be fairly equitable. This also indicated possible disparities in health care delivery and coverage of health insurance between countries of relatively similar income levels.

The purpose of the NRCMS was and continues to be the prevention of economic barriers to seeking health care for vulnerable populations (Zhou *et al.* 2011). The implementation of the NRCMS was associated with reductions in inequitable access to inpatient care,

however many still face economic barriers. One important restriction in the NRCMS is the relatively low rate of reimbursement and higher co-payment for hospital admission. Reimbursement rates for hospital admission under the NRCMS was 55.09% (Health and Family Planning Commission of Jiangxi province 2015) in 2014, far lower than reimbursement under basic health insurance plans for employees (93% at one-class hospital (Li and Yan 2010)). This is likely to be attributed to the fairly low financial levels of the NRCMS (390 Yuan each person in 2014 (Health and Family Planning Commission of Jiangxi province 2015)), when compared to the funds of basic health insurance for employees (6% of the employee's total wages (Li and Yan 2010)). In addition, several studies suggest reimbursement rates and similar financial support are of importance (Somkotra and Lagrada 2008, Knaul and Frenk 2005), indicating a higher reimbursement rate may help the NRCMS. Therefore, a more generous benefit package is urgently needed with the goal of increasing access to inpatient utilization among vulnerable populations.

### Limitations

While the data analyzed in the study represent just three points in time, it does overlap with the entire stage of the expansion of the NRCMS from 2003/2004 (before the rollout of NRCMS), 2008 (when the coverage of NRCMS was 94.69% in Jiangxi province), to 2014 (when the coverage of NRCMS was 99.20% in Jiangxi province). Thus, the data reported in the current study were able to capture critical time points throughout the rollout of the NRCMS.

Survey data (*e.g.* gross household income) were collected in light of personal recall and as such recall bias may serve as a limitation of the current study. Even so, several global surveys (*e.g.* the Behavioural Risk Factor Surveillance System in the USA (Centers for Disease Control and Prevention (CDC) 1995)) are also subject to recall bias. Thus, this is a common limitation in survey research. However, the response rates of all surveys were 100%, indicating non-response bias was not a significant issue. This is due in large part to the village leaders in each village guiding researchers to interview rural inhabitants.

Another limitation is that we were unable to investigate the exact same individuals in every year of the study. Thus, any potential migratory flow within China should be taken into account when interpreting the results. However, we did measure changes in the same villages over time. Further, causality is not explicitly implied when discussing the relationship between insurance and our outcomes, given the lack of a comparison group as might be available in a natural experiment. Finally, the variable used to measure 'need' in the current analyses did not incorporate all possible need variables. Thus, the measure is somewhat restricted when considering all possible need variables. Thus, the implications should be considered in light of these limitations.

### Conclusion

The NRCMS was a major policy change in terms of health care financing. Health care financing systems play a critical role in several factors related to the equitable distribution of health care services and their utilization. The current study adds greater insight into the outcomes of a major policy change affecting vulnerable populations (*e.g.* rural, poor) in one province in China. A pro-rich inequity was observed for inpatient care use even after adjusting for needs over time. The coverage of the NRCMS nearly expanded to

all rural inhabitants in Jiangxi province. The NRCMS was associated with reduced inequitable access to inpatient care to some degree in the years after it was implemented, yet it has not eliminated this inequitable access as of 2014. The NRCMS may have affected pro-poor inequity in this study, while commercial insurance may result in a pro-rich inequity distribution. Given the NRCMS cannot fulfill the demand of health insurance among the affluent, they may tend to look for commercial insurance in an attempt to compensate their medical cost, which may result in larger income-related inequities in health care utilization over time. What's more, the quality of health services in township hospitals is lower relative to county hospitals. Therefore, while the demand for high quality medical services increases, the more affluent may be more likely to seek health services in county hospitals, thereby potentially resulting in a greater pro-rich inequity in health services use. One possible solution is to supply additional financial protections for low-income participants, to provide a better-designed and stronger financing mechanism for the NRCMS. This may serve to promote a greater level of equitable access to health care among rural inhabitants.

In conclusion, we suggest the following: increased efforts aimed at improving the quality of care received in rural township hospitals with the goal of improving health outcomes related to the receipt of health care services, and reduced financial barriers in the utilization of health care services where possible, especially for vulnerable economically disadvantaged rural inhabitants. The implications of similar policies must be interpreted in light of the setting, timing, and a number of other factors (e.g. economic, cultural). China is a diverse nation in terms of several factors directly related to the Social Determinants of Health (World Health Organization 2010). Identifying policies that take into account the vast differences in socioeconomic status and other key population characteristics of China's diverse provinces is needed. The inclusion of a rural-focused policy analysis adds to the current literature of the experience of vulnerable populations. Further studies should include similar analyses that focus on the unique characteristics and populations as complementary to large country-wide analyses.

## Supplementary data

Supplementary data are available at HEAPOL online.

Conflict of interest statement. None declared.

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