

# Health care utilization for patients with stroke: A 3-year cross-sectional study of China's two urban health insurance schemes across four cities

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## Research article

**Keywords:** Stroke, Healthcare utilization, Health insurance, Cost of illness

**Posted Date:** June 22nd, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-37086/v1>

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**Version of Record:** A version of this preprint was published on March 18th, 2021. See the published version at <https://doi.org/10.1186/s12889-021-10456-x>.

## Abstract

## Background

Stroke is a devastating disease and a major cause of death and disability worldwide. We evaluated differences in stroke patients' health care utilization by insurance type across four cities in China.

## Methods

The data were a 5% random sampling from claims data of China Urban Employees' Basic Medical Insurance (UEBMI) and Urban Residents' Basic Medical Insurance (URBMI) from 2014 to 2016. The descriptive analyze and interaction actions were mainly conducted.

## Results

We found that differences in healthcare utilization and medical expenses varied more across the four cities, Beijing, Shanghai, Tianjin, and Chongqing, than they did between the UEBMI and URBMI scheme. On average, UEBMI patients had a significantly larger number of outpatient (4.3) and inpatient (1.4) visits per year than the URBMI group (2.0 outpatient and 1.1 inpatient visits per year). UEBMI members' average length of stay (ALOS) of 18.3 days was significantly longer than the 11 days ALOS of URBMI members. Importantly, the significant differences in healthcare utilization and healthcare expenditures were greater between cities than the average differences between UEBMI and URBMI. Beijing UEBMI outpatient (5.0) and inpatient (1.4) visits and Shanghai UEBMI outpatient (4.8) and inpatient (1.7) visits were significantly higher than Tianjin (3.4 outpatient and 1.4 inpatient visits) and Chongqing (1.8 outpatient and 1.1 inpatient visits). The divergences of UEBMI visits across the four cities were greater than the average UEBMI outpatient (4.3) and inpatient (1.4) visits. ALOS for URBMI Beijing patients (14.8 days) and Shanghai patients (27.7 days) were significantly longer than Tianjin (10.2 days) and Chongqing (10.1 days) URBMI patients. Medical costs, total OOP expenses and OOP reimbursement rates also varied more across the four cities than the average UEBMI or URBMI medical costs, total OOP expenses and reimbursement rates.

## Conclusions

The health care utilization of patients with stroke varied by insurance type and city, and the differences in utilization and health care costs across cities was greater than the average difference between UEBMI and URBMI. Launching a new critical illness insurance scheme and further reforming the UEBMI and URBMI schemes would reduce these inter-city differences in health care utilization.

## Introduction

As the second most common cause of death and one of most significant causes of disability, stroke is a leading global public health issue (1, 2). Compared to all other countries, China has the highest incidence of stroke (3). While the incidence and prevalence of stroke have dramatically increased in China, the stroke mortality rate has been declining. The incidence of first-ever stroke in adults aged 40–74 years increased from 189/100,000 individuals in 2002 to 379/100,000 in 2013, a 8.3% annually increase (4). In 2016, the prevalence of ischemic stroke was 1762.8/100,000 and the incidence was 276.8/100,000, while the prevalence of hemorrhagic stroke was 406.2/100,000 and the incidence 126.3/100,000. Data from Global Burden of Disease (GBD) showed that the age-standardized mortality of ischemic stroke dropped from 73.0/100,000 in 2005 to 56.9/100,000 in 2016, while the mortality from hemorrhagic stroke dropped from 120.69/100,000 in 2005 to 76.0/100,000 in 2016 (5). Increasing stroke incidence, and their higher recovery rate, impose a significant financial burden on patients, families, and the health care system.

In 2015, the total cost burden of stroke in Korea was estimated to be US\$6.9 billion, and the average annual financial burden per stroke case was about US\$7247 (6). From 2015 to 2016, the annual total cost of stroke health and social care in Britain was US\$4 billion, with the mean cost per patient estimated at US\$51083 (7). For China in 2015, the average cost for hemorrhagic stroke inpatients was US\$3972.8 and for outpatients US\$64.3, and the average inpatient cost for ischemic stroke was US\$1445.2 and for outpatients US\$71.1 (8). All types of stroke imposed costs of about US\$6 billion on China's health care system annually in 2011 (9). Stroke is also one of the major causes of financial burden on stroke families, and posed stresses on families through the burden of caring for family stroke victims (10–12). There are many factors influencing the costs of stroke treatment, such as patients' sex, age, family financial status and insurance type (13, 14). There were two major urban health insurance schemes in China, Urban Employee Basic Medical Insurance (UEBMI) for those in work and Urban Residents Basic Medical Insurance (URBMI) for unemployed, retirees, children, and students. A patient's health insurance scheme impacted the financial burden of stroke depending on the coverage, benefit schedule and reimbursements. Insurance type provides a safety net from financial loss, depending on the scope and (dis)incentives for patients to consume health services (15). Surprisingly, there is little evidence of how different health insurance schemes in China impact disparities in health care utilization of stroke patients. What complicates the assessment of stroke health utilization is that both the general conditions in the UEBMI were more favorable than those in URBMI, but there are also differences in the terms of UEBMI and URBMI across cities.

Since the two insurance schemes are separately managed at different prefecture-level cities, contributing to approximately 333 UEBMI and 333 URBMI schemes in China. The sources of funding, benefit packages, service coverage and financial protection vary in different insurance schemes, and Table 1 sets out these key differences (16–19). The UEBMI scheme usually had a larger service coverage, better benefit packages and superior financial protection than URBMI, with UEBMI having different rules on reimbursement rates specified in the benefit schedule. The health schemes paid the hospital some share of the hospital expenses, with UEBMI more generous than URBMI (see Table 1). Some hospital expenses were paid by the patient directly to the hospital. Some of hospital expenses paid by the patient, but not all, were claimed, and reimbursed, by the insurance fund. The reimbursement rates of inpatient services in

UEBMI and URBMI were usually higher than outpatient reimbursements in both schemes. Besides there were also significant differences in health care access in the 333 different cities for the UEBMI and URBMI insured. By comparing differences in average length of stay (ALOS), number of hospital visits and costs of stroke care, we evaluate not only differences between UEBMI and URBMI, but, for the first time, differences in UEBMI and URBMI in the only four province-level cities, Beijing, Shanghai, Tianjin, and Chongqing.

Table 1  
Comparison of UEBMI and URBMI policies.

|  | UEBMI <sup>1</sup>  | URBMI <sup>2</sup>   |
|--|---|--|
| Inception year   | 1998  | 2007   |
| Eligible population  | Urban employed (employees; retirees)  | Urban non-employed (children and full-time students; unemployed adults; elderly residents not covered by the UEBMI scheme) |
| Source of funding  | Contributory (8% of annual payroll, 6% from employers, and 2% from employees) | Government subsidy and individual premium (varied by locations)  |
| Per-capita fund (US\$) (2016)  | \$523.7   | \$94.3   |
| Service package  | Comprehensive   | Limited  |
| Percentage of counties (cities) reimbursed for general outpatient                    | 100%  | 58%  |
| Percentage of counties (cities) reimbursed for major and chronic diseases outpatient | 100%  | 83%  |
| Annual admission to hospital rates <sup>3</sup>                                      | 11.3%   | 7.1%   |
| Rate of physician visits for 2 weeks <sup>4</sup>                                    | 13.4%   | 12.4%  |
| Reimbursed ceiling   | Six times of local employees' annual average wage per year                    | Six times of local household disposable income per year  |

<sup>1</sup>UEBMI Urban Employee Basic Medical Insurance scheme; <sup>2</sup>URBMI Urban Resident Basic Medical Insurance scheme; <sup>3</sup>Annual admission to hospital rates refers to the proportion of hospitalized inpatients as a percentage of all the insured population in one year; <sup>4</sup>Rate of physician visits for 2 weeks refers to the proportion of people receiving treatment for two weeks as a percentage of all the insured population.

There have been comparative studies of patients' utilization of health services under different health insurance regimes (20–22). In Heilongjiang province, China, Zhao et al (23) found that there were significant health service utilization differences across different health insurance schemes, with URBMI members utilizing health service less and facing a heavier financial burden than the UEBMI beneficiaries. Using Taiwan National Health Insurance claims data to evaluate the benefits of the national stroke post-acute care (PAC) program on health care utilization, Li-Ning Peng et al (24) found that the average number of outpatient visits was 22.1 per year, hospitalizations 0.3 times per year and emergency department visits 0.77 times per year and the ALOS was 13.8 days for all stroke patients. Health care utilization by stroke patients in Tianjin (25) found that 77.3% of 335 stroke patients received hospitalization in one year and 72.2% received outpatient treatment. The mean number of outpatient visits was 4.92 times and inpatient visits was 1.12 times per year. Employing China Health Insurance Research Association claims data, Ma reported the average hospitalization cost of UEBMI stroke patients was RMB10131 (US\$1525.2) and for URBMI stroke patients was RMB7662 (US\$1153.5), with the ALOS 22.05 days for UEBMI stroke inpatients and 16.23 days for URBMI stroke inpatients (8). But these previous studies did not examine disparities in UEBMI and URBMI health care access across different cities and prefectures. To address this lacuna, we collected 3-year health insurance claims data on ALOS, number of hospital visits and costs of stroke for each type of insurance in each of four province-level cities, Beijing, Shanghai, Tianjin, and Chongqing. Our utilization rates (ALOS and number of hospital visits) and utilization outcomes (the costs of stroke care) for each city reveals how city-level differences in health schemes shaped health care access.

## Materials And Methods

### Data source

Data were collected from the China Labor Statistics Yearbook 2015-2017, China Statistical Yearbook 2017, and China Health Insurance Research Association UEBMI and URBMI patient claim data. The claim database was a 5% random sample of insurance beneficiaries in 31 provinces in China, and we chose patients' information from four cities: Beijing, Shanghai, Tianjin, and Chongqing between three years, 2014-2016. Different from other cities in China, these four provincial level cities are administered directly by the Central People's Government and have special economic, political, cultural and geographic characteristics, with a high urban disposable income per capita: Beijing US\$10274.4, Shanghai US\$10281.0, Tianjin US\$ 6494.4 and Chongqing US\$ 5272.4, compared to average urban disposable income per capita US\$5931.5 in 2018 (19). Besides, they are the only four both provincial level and municipal level cities in. Since the UEBMI and URBMI are pooled at municipal levels, we can infer differences between all 333 cities by evaluating differences between these four cities. The claim data comprised medical information on each stroke patient, including direct stroke medical cost, health institute name, primary diagnosis (classified according to International Classification of Diseases, 10th edition (ICD-10)), city, out-of-pocket (OOP) expenses and length of hospital stay.

### Study design and patient selection

This is a cross-sectional study designed to evaluate the health service utilization of stroke patients. Between 2014 and 2016, we obtained all related information on patients whose primary diagnosis was stroke according to ICD-10 (ischemic stroke (I63), hemorrhagic stroke (I60, I61, I62, G45) and other types of stroke (I64, I67-I69, 7, 10) (26). The final sample included 68399 patients and 203698 admissions, including 51795 patients who were insured by UEBMI and 16604 patients who were covered by URBMI. Each patient usually has several outpatient or inpatient records in the database. A retrospective, prevalence-based approach was adopted to identify their health care utilization.

### Measures and variables

For patients treated in the four cities, the health insurance claims database contained information on the direct total medical cost of stroke, compensation fee (share of total expenses paid by insurance), OOP expenses within-insurance (share of total medical expenses paid by the patient, but reimbursed by insurance), OOP expenses outside-insurance (share of total medical expenses paid by the patient, but not covered by insurance), average length of stay, number of hospitalizations and outpatient visits. The mean number of outpatient visits and inpatient visits and the ALOS were used to measure the outpatient and inpatient health care utilization. The costs of medical care, comprising mean medical cost, OOP expenses within-insurance, OOP outside-insurance, total OOP cost (OOP expense within-insurance and OOP outside-insurance) and stroke-related health insurance fund consumption rate were outcome variables of health care utilization. The Basic Medical Insurance Reimbursement Directory specifies health services covered by the two urban insurance schemes and the reimbursement rates for these services. The Directory benefits and reimbursement rates will vary between UEBMI and URBMI and vary across cities. The medical costs reimbursed to patients by the health fund is the compensation fee and the health insurance fund consumption rate is the proportion of the total compensation fee consumed by stroke patients account for the insurance revenue in one year. The proportion of medical costs specified in the Directory, but not reimbursed by the health fund are OOP within-insurance expenses. OOP outside-insurance are health care expenses not listed in the Directory and not compensated by the health insurance schemes. The self-paid rate is the OOP inside-insurance and OOP outside-insurance health costs as a proportion of total health expenses. All cost in this study were adjusted by the exchange rate between US dollar and CNY in 2015: US\$1.0 = CNY6.6423.

### Statistical analysis

Descriptive statistics were employed to analyze the demographic information. Then, we calculated the outpatient and inpatient healthcare utilization, hospitalization costs and OOP expenses by insurance type and city. Since the number of outpatient visits and ALOS had a non-normal distribution, we used the Kruskal–Wallis test to evaluate the differences in patients' health care utilization by different groups, including insurance type. To identify the influence of insurance type and cities on health care utilization, multiple linear regression analysis was adopted. To deal with the skewness of data, we converted the number of outpatient visits, the ALOS and the hospitalization cost to their natural logarithm. Statistical analyses were conducted using STATA version 14.0 (Stata Corp LP, College Station, TX) and statistical significance was considered as  $\alpha = 0.05$ .

## Results

### Patient characteristics

As shown in Table 2, there were 69054 patients in our sample: 43016 outpatients and 26038 inpatients; 52412 were URBMI patients, with an average age of 66.5 and 16642 were URBMI patients with an average age of 67.7 years. The ALOS for UEBMI patients was 15.9 days compared to 10.6 days for URBMI patients. In the UEBMI group, 71.4% were outpatients and 28.6% were inpatients while 33.6% were outpatients and 66.4% inpatients in URBMI group. The average UEBMI and URBMI inpatient-outpatient differences in Table 2 were less than these differences across the four cities. Beijing had the largest proportion of UEBMI patients (96.5%) and the largest proportion of outpatients (88.9%); Shanghai had the most inpatients (86.7%); and Chongqing had the highest URBMI patients (61.4%). Reflecting the broad differences between the UEBMI and URBMI scheme conditions, 15.9 days ALOS for URBMI was significantly longer than 10.6 ALOS for URBMI.

Table 2  
Socio-demographic characteristics of stroke patients by types of health insurance, 2014–2016.

| Characteristics | Overall     | UEBMI       | URBMI       | Outpatient  | Inpatient   |
|-----------------|-------------|-------------|-------------|-------------|-------------|
| Insurance type  |             |             |             |             |             |
| UEBMI           | 52412       | –           | –           | 37422(71.4) | 14990(28.6) |
| URBMI           | 16642       | –           | –           | 5594(33.6)  | 11048(66.4) |
| Visit category  |             |             |             |             |             |
| Outpatient      | 43016(62.3) | 37422(87.0) | 5594(13.0)  | –           | –           |
| Inpatient       | 26038(37.7) | 14990(57.6) | 11048(42.4) | –           | –           |
| Age (years)     | 66.8 ± 12.2 | 66.5 ± 12.2 | 67.7 ± 12.0 | 65.5 ± 12.0 | 69.1 ± 12.1 |
| ALOS (days)     | 13.7 ± 16.8 | 15.9 ± 19.5 | 10.6 ± 11.7 | –           | 13.7 ± 16.8 |
| Cities          |             |             |             |             |             |
| Beijing         | 26132(38.2) | 25211(96.5) | 921(3.5)    | 23231(88.9) | 2901(11.1)  |
| Shanghai        | 4262(6.2)   | 4452(90.5)  | 465(9.5)    | 655(13.3)   | 4262(86.7)  |
| Tianjin         | 20056(29.3) | 15828(78.9) | 4228(21.1)  | 12362(61.6) | 7694(38.4)  |
| Chongqing       | 17949(26.2) | 6921(38.6)  | 11028(61.4) | 6768(37.7)  | 11181(62.3) |

## n (%) for categorical variables and mean ± standard deviation for continuous variables UEBMI Urban Employee Basic Medical Insurance scheme, URBMI Urban Resident Basic Medical Insurance scheme

### Health care utilization and outcomes of outpatients in four cities

As shown in Table 3, the UEBMI group, with 4.3 visits per year, had a significantly larger number of outpatient visits than the URBMI group, with 2.0 visits per year. In part, these differences reflect the underlying differences in the UEBMI and URBMI benefits set out in Table 1. But our results in Table 3 reveal significant city-level UEBMI and URBMI differences in outpatient health care utilization by stroke patients. UEBMI Beijing (5.0 visits annually) and Shanghai (4.8) outpatients had significantly more visits than UEBMI outpatients in Tianjin (3.4 visits annually) or Chongqing (1.8 visits annually). URBMI outpatients in Chongqing had significantly fewer visits (1.3 annually), than Shanghai (4.0), Beijing (3.6) and Tianjin (3.1).

On average, outpatients covered by UEBMI had higher outpatient cost, RMB578.3 (US\$87.1) than patients covered by URBMI, RMB261.6 (US\$39.4), but total OOP expenses of UEBMI patients, RMB158.9 (US\$23.9), were significantly higher than RMB111.5 (US\$16.8) for the URBMI group. In terms of outpatient UEBMI and URBMI medical cost, total OOP expenses, self-paid rate, and reimbursement rate, there were also significant disparities by city. For example, in Table 3 the differences in OOP expenses were mostly due to the broad differences in insurance reimbursement rates between the UEBMI and URBMI schemes. More importantly, these significant differences in OOP expenses reflect city-level differences: OOP within-insurance expenses of the UEBMI group in Beijing (RMB127.1/US\$19.1) was lower than the UEBMI group in Shanghai (RMB235.5/US\$35.5) and Tianjin (RMB170.2/US\$25.6), but higher than Chongqing (RMB26.1/US\$3.9). The reimbursement rate of URBMI scheme in Chongqing was higher than the UEBMI or URBMI group in Beijing, Tianjin and Shanghai. As shown in Table 3, similar significant differences across cities also occurred for OOP out-of-insurance, total OOP, self-pay rate, reimbursement rate and number of visits.

Table 3  
Outpatient health service utilization per patient by insurance type and city.

|  | Beijing                 |                       | Shanghai              |                      | Tianjin                |                         | Chongqing               |                         | Total |       | P-value (Total) |
|--|-------------------------|-----------------------|-----------------------|----------------------|------------------------|-------------------------|-------------------------|-------------------------|-------|-------|-----------------|
|  | UEBM <sup>0</sup>       | URBM <sup>0</sup>     | UEBM <sup>0</sup>     | URBM <sup>0</sup>    | UEBM <sup>0</sup>      | URBM <sup>0</sup>       | UEBM <sup>0</sup>       | URBM <sup>0</sup>       | UEBMI | URBMI |                 |
| Mean total costs (CNY)                 | 657.2<br>bcdefgh        | 463.8<br>acdefgh      | 318.1<br>abfgh        | 268.9<br>abh         | 369.6<br>abfgh         | 226.0<br>abcegh         | 413.9<br>abcefn         | 184.1<br>abcdefg        | 578.3 | 261.6 | P < 0.001       |
| SD                                     | 584.7                   | 468.4                 | 236.3                 | 186.0                | 387.4                  | 205.6                   | 475.4                   | 208.0                   | 554.0 | 311.1 |                 |
| Mean OOP-costs within- insurance (CNY) | 127.1<br>bcdefgh        | 217.0<br>adefgh       | 235.5<br>adefgh       | 149.2<br>abcgh       | 170.2<br>abcfgh        | 147.3<br>abcegh         | 26.1<br>abcdefh         | 5.9<br>abcdefg          | 134.2 | 96.5  | P < 0.001       |
| SD                                     | 202.1                   | 330.0                 | 201.2                 | 101.3                | 226.1                  | 144.9                   | 52.8                    | 14.1                    | 206.9 | 199.1 |                 |
| Mean OOP-costs out of insurance (CNY)  | 32.39 <sup>cdefg</sup>  | 50.68 <sup>cdeh</sup> | 1.4 <sup>abefgh</sup> | 0.8 <sup>abegh</sup> | 4.90 <sup>abcdgh</sup> | 3.14 <sup>adgh</sup>    | 3.81 <sup>abcdefh</sup> | 4.80 <sup>cdefg</sup>   | 24.7  | 15.0  | P < 0.001       |
| SD                                     | 101.8                   | 138.7                 | 17.7                  | 5.6                  | 50.4                   | 11.2                    | 29.7                    | 25.3                    | 91.0  | 72.2  |                 |
| Mean total OOP-costs (CNY)             | 159.5<br>bcefg          | 267.7<br>acefg        | 111.0<br>abdefgh      | 128.4<br>cfgh        | 175.1<br>abcfgh        | 150.4<br>abcdegh        | 29.9<br>abcdefh         | 10.7<br>abcdefg         | 158.9 | 111.5 | P < 0.001       |
| SD                                     | 229.4                   | 330.4                 | 201.3                 | 101.4                | 239.1                  | 146.8                   | 61.8                    | 29.4                    | 229.5 | 207.6 |                 |
| Self-paid rate (%)                     | 23.1<br>bcdefgh         | 47.5<br>aefgh         | 35.8<br>aefgh         | 47.7<br>afgh         | 45.8<br>abcfgh         | 79.8<br>abcdegh         | 9.5 <sup>abcdefh</sup>  | 5.5 <sup>bcdefg</sup>   | 28.4  | 38.4  | P < 0.001       |
| Reimbursement rate (%)                 | 76.9 <sup>bcdefgh</sup> | 52.5 <sup>aefgh</sup> | 64.2 <sup>efgh</sup>  | 52.3 <sup>afgh</sup> | 54.2 <sup>abcfgh</sup> | 20.2 <sup>abcdegh</sup> | 90.5 <sup>abcdefh</sup> | 94.5 <sup>abcdefg</sup> | 71.6  | 61.6  | P < 0.001       |
| Mean number of visits                  | 5.0 <sup>bcefg</sup>    | 3.6 <sup>aefgh</sup>  | 4.8 <sup>aefgh</sup>  | 4.0 <sup>gh</sup>    | 3.4 <sup>abcfgh</sup>  | 3.1 <sup>abcegh</sup>   | 1.8 <sup>abcdefh</sup>  | 1.3 <sup>abcdefg</sup>  | 4.3   | 2.0   | P < 0.001       |
| SD                                     | 5.1                     | 3.3                   | 5.6                   | 3.6                  | 3.3                    | 3.3                     | 3.0                     | 0.8                     | 4.6   | 2.2   |                 |

*P-values are based on the Kruskal-Wallis test. UEBMI Urban Employee Basic Medical Insurance scheme, URBMI Urban Resident Basic Medical Insurance scheme, SD standard deviation. Compared with<sup>i</sup>, <sup>a</sup> P < 0.05, compared with<sup>j</sup>, <sup>b</sup> P < 0.05; compared with<sup>k</sup>, <sup>c</sup> P < 0.05; compared with<sup>l</sup>, <sup>d</sup> P < 0.05; compared with<sup>m</sup>, <sup>e</sup> P < 0.05; compared with<sup>n</sup>, <sup>f</sup> P < 0.05; compared with<sup>o</sup>, <sup>g</sup> P < 0.05; compared with<sup>p</sup>, <sup>h</sup> P < 0.05*

## Health care utilization and outcomes of inpatients in four cities

Reflecting the Directory benefits of the insurance schemes and inpatient care preferences, Table 4 reports that the UEBMI group (1.4 visits annually) had a significantly larger number of inpatient visits than the URBMI group (1.1 visits annually). Meanwhile, the UEBMI members' ALOS of 18.3 days was significantly longer than URBMI members' 11 ALOS. Importantly, Table 4 also indicated that there were significant differences between city-level UEBMI and URBMI schemes in inpatient health care utilization by stroke patients. Inpatients with UEBMI in Shanghai (1.7 visits annually) had significantly more visits than UEBMI outpatients in Beijing (1.4 visits annually), Tianjin (1.4 visits annually), and Chongqing (1.1 visits annually). Shanghai (1.7 visits annually) and Chongqing (1.1 visits annually) had significantly different annual inpatient visits than the UEBMI average (1.4 visits annually). URBMI inpatients in Shanghai (27.7 days) and Beijing (14.8 days) had significantly longer ALOS than URBMI inpatients in Tianjin (10.2 days) and Chongqing (10.1 days). The ALOS differences between cities was greater than the ALOS city average.

Similarly, inpatients with UEBMI had higher hospital expenses, RMB17618.2 (US\$2652.4), than those covered by URBMI, RMB9521.7 (US\$1433.5) and total OOP expense of UEBMI group, RMB3889.2 (US\$585.5) was also higher than the URBMI inpatients, RMB2981.1 (US\$448.8). But, Table 4 also shows city-by-city UEBMI and URBMI inpatient hospital costs, total OOP expense, self-paid rate, and reimbursement rate displayed significant disparities. For example, URBMI OOP outside-insurance was higher in Tianjin (RMB2036.72/US\$306.6) than Beijing (RMB1567.32/US\$236.0), Shanghai (RMB948.06/US\$142.7), and Chongqing (RMB631.83/ US\$95.1), with URBMI members in Tianjin having a higher self-paid rate than URBMI members in Beijing, Shanghai, and Chongqing. As shown in Table 4, significant differences by city also existed in OOP within-insurance, total OOP expenses, the reimbursement rate, number of visits and ALOS.

Table 4  
Inpatient health service utilization per patient by insurance type and cities.

|  | Beijing                   |                          | Shanghai                  |                         | Tianjin                   |                          | Chongqing                |                          | Total              |                    | P-value<br>(Total) |
|--|---------------------------|--------------------------|---------------------------|-------------------------|---------------------------|--------------------------|--------------------------|--------------------------|--------------------|--------------------|--------------------|
|  | UEBMI <sup>d</sup>        | URBMI <sup>d</sup>       | UEBMI <sup>d</sup>        | URBMI <sup>d</sup>      | UEBMI <sup>d</sup>        | URBMI <sup>d</sup>       | UEBMI <sup>d</sup>       | URBMI <sup>d</sup>       | UEBMI <sup>d</sup> | URBMI <sup>d</sup> |                    |
| Mean total costs (CNY)                 | 22030.6<br>cdefgh         | 20761.5<br>defgh         | 18893.2<br>bdefgh         | 15886.5<br>abcfgh       | 15610.5<br>abcfgh         | 10445.2<br>abcdegh       | 14721.2<br>abcdeh        | 8133.0<br>abcdefg        | 17618.2            | 9521.7             | P < 0.001          |
| SD                                     | 24391.2                   | 24762.1                  | 21807.5                   | 21003.5                 | 17881.7                   | 14915.6                  | 22050.9                  | 12717.4                  | 21446.1            | 14503.7            |                    |
| Mean OOP-costs within-insurance (CNY)  | 1912.1<br>bcdefgh         | 6282.7<br>acdefgh        | 2504.2<br>abefgh          | 2930.1<br>abfgh         | 2549.0<br>abcfgh          | 3978.6<br>abcdegh        | 1110.7<br>abcdeh         | 476.9<br>abcdefg         | 2122.8             | 1857.1             | P < 0.001          |
| SD                                     | 1825.7                    | 5858.5                   | 3774.2                    | 4055.3                  | 2428.2                    | 5024.0                   | 1589.0                   | 759.6                    | 2779.2             | 3629.7             |                    |
| Mean OOP-costs outside-insurance (CNY) | 1585.01<br>bcdefgh        | 1567.32<br>acdefgh       | 958.63<br>adefg           | 948.06<br>bcdefgh       | 2822.06<br>abcdfgh        | 2036.72<br>abcdeh        | 1663.38<br>abcdeh        | 631.83<br>abdefg         | 1766.4             | 1124.0             | P < 0.001          |
| SD                                     | 6967.9                    | 5340.0                   | 3283.8                    | 4646.9                  | 8097.5                    | 6091.2                   | 5738.7                   | 2431.9                   | 6230.4             | 4206.9             |                    |
| Mean total OOP-costs (CNY)             | 3497.1<br>bcdefgh         | 7850.0<br>acdefgh        | 3462.9<br>abefgh          | 3878.2<br>befgh         | 5371.1<br>abcdgh          | 6015.3<br>abcdegh        | 2774.1<br>abcdeh         | 1108.8<br>abcdefg        | 3889.2             | 2981.1             | P < 0.001          |
| SD                                     | 8145.6                    | 9800.4                   | 5933.0                    | 7832.7                  | 9963.0                    | 10420.6                  | 6709.0                   | 2956.9                   | 7916.8             | 7157.9             |                    |
| Self-paid rate (%)                     | 11.9 <sup>b</sup> bcdefgh | 36.6 <sup>a</sup> acdegh | 14.3 <sup>a</sup> abdefgh | 18.4 <sup>a</sup> bcfgh | 20.6 <sup>a</sup> abcdfgh | 44.3 <sup>a</sup> acegh  | 10.9 <sup>a</sup> abcdeh | 9.2 <sup>a</sup> abcdef  | 15.0               | 21.6               |                    |
| Reimbursement rate (%)                 | 88.1 <sup>b</sup> bcdefgh | 63.4 <sup>a</sup> acdegh | 85.7 <sup>a</sup> abdefgh | 81.6 <sup>a</sup> bcfgh | 79.4 <sup>a</sup> bcfgh   | 55.7 <sup>a</sup> acdegh | 89.1 <sup>a</sup> abcdeh | 90.8 <sup>a</sup> abcdef | 85.0               | 78.4               |                    |
| Mean number of visits                  | 1.4 <sup>c</sup> cegh     | 1.2 <sup>c</sup> gh      | 1.7 <sup>a</sup> abdefgh  | 1.4 <sup>c</sup> cfgh   | 1.4 <sup>a</sup> acgh     | 1.3 <sup>c</sup> cegh    | 1.1 <sup>a</sup> abcdeh  | 1.1 <sup>a</sup> abcdeh  | 1.4                | 1.1                | P < 0.001          |
| SD                                     | 1.1                       | 0.6                      | 1.7                       | 1.0                     | 0.9                       | 0.6                      | 0.4                      | 0.3                      | 1.1                | 0.5                |                    |
| Average LOS (days)                     | 16.1 <sup>c</sup> cefgh   | 14.8 <sup>c</sup> cefgh  | 27.2<br>abdefgh           | 27.7 <sup>c</sup> cefgh | 12.2 <sup>a</sup> abcdh   | 10.2<br>abcdegh          | 15.1<br>abcdh            | 10.1<br>abcdefg          | 18.3               | 11.0               | P < 0.001          |
| SD                                     | 10.9                      | 9.7                      | 33.8                      | 40.8                    | 7.7                       | 6.0                      | 17.7                     | 10.6                     | 22.5               | 13.1               |                    |

*P-values are based on the Kruskal-Wallis test. UEBMI Urban Employee Basic Medical Insurance scheme, URBMI Urban Resident Basic Medical Insurance scheme, SD standard deviation. Compared with<sup>a</sup>, <sup>a</sup> P < 0.05, compared with<sup>b</sup>, <sup>b</sup> P < 0.05; compared with<sup>c</sup>, <sup>c</sup> P < 0.05; compared with<sup>d</sup>, <sup>d</sup> P < 0.05; compared with<sup>e</sup>, <sup>e</sup> P < 0.05; compared with<sup>f</sup>, <sup>f</sup> P < 0.05; compared with<sup>g</sup>, <sup>g</sup> P < 0.05; compared with<sup>h</sup>, <sup>h</sup> P < 0.05*

## Total health care cost in four cities and stroke-related health insurance fund consumption

As shown in Table 5, patients with UEBMI had higher outpatient cost and inpatient cost than patients covered by URBMI, but the UEBMI group (CNY2565.0/US\$386.2) had overall lower total cost than the URBMI group (CNY5238.0/US\$788.6). Also, UEBMI outpatients and inpatients, had higher within-insurance OOP and outside-insurance OOP than those with URBMI. However, the UEBMI group had lower mean total OOP expense, RMB593.8(US\$89.4) than the URBMI group, RMB1653.7(US\$249.0). Patients covered by UEBMI had a higher reimbursement rate (73.4%) and lower self-paid rate (23.1%) than those covered by URBMI (51.8% and 31.6%).

Table 5 also shows significant city-level UEBMI and URBMI differences in total cost, self-paid rate, total OOP expense, and reimbursement rate. UEBMI patients in Shanghai (RMB13117.1/US\$1974.8) had higher total cost than UEBMI patients in Chongqing (RMB6757.6/US\$1017.4), Tianjin (RMB2457.8/US\$370.0), and Beijing (RMB1333.3/US\$200.7), with these city differences greater than the UEBMI-URBMI differences. When analyzing the proportion of stroke-consumed health insurance funds account for health insurance fund revenue in 2014–2016, the annually health insurance fund consumption rate of UEBMI in Beijing (3.29%) was higher than Shanghai (2.35%), Tianjin (2.65%) and Chongqing (2.37%). The health insurance fund consumption rate of URBMI in Beijing (27.12%) was significantly higher than Shanghai (18.55%); Shanghai was significantly higher than Tianjin (9.22%); and Tianjin was significantly higher than Chongqing (1.28%).

Table 5  
Total inpatient and outpatient health service utilization by insurance type and city.

|  | Beijing                 |                         | Shanghai                |                          | Tianjin                 |                         | Chongqing              |                        | Total  |         | P-value (Total) |
|--|-------------------------|-------------------------|-------------------------|--------------------------|-------------------------|-------------------------|------------------------|------------------------|--------|---------|-----------------|
|  | UEBM <sup>d</sup>       | URBM <sup>d</sup>       | UEBM <sup>d</sup>       | URBM <sup>d</sup>        | UEBM <sup>d</sup>       | URBM <sup>d</sup>       | UEBM <sup>d</sup>      | URBM <sup>d</sup>      | UEBM   | URBM    |                 |
| Mean total costs (CNY)                       | 1333.3<br>bcdefgh       | 2471.9<br>acdefgh       | 13117.1<br>abefgh       | 12656.7<br>abefgh        | 2457.8<br>abcdfgh       | 5987.1<br>abcde         | 6757.6<br>abcde        | 4934.3<br>abcde        | 2565.0 | 5238.0  | P < 0.001       |
| SD   | 5756.4                  | 9869.3                  | 21807.5                 | 21003.5                  | 8450.0                  | 12292.8                 | 16316.1                | 10576.4                | 9154.2 | 11593.1 |                 |
| Self-paid rate (%)                           | 22.7 <sup>bcdefgh</sup> | 46.4 <sup>acdefgh</sup> | 21.0 <sup>abdefgh</sup> | 24.5 <sup>abcdefgh</sup> | 42.4 <sup>abcdfgh</sup> | 59.7 <sup>abcdegh</sup> | 10.1 <sup>abcdef</sup> | 7.8 <sup>abcdef</sup>  | 23.1   | 31.6    | P < 0.001       |
| Reimbursement rate (%)                       | 77.3 <sup>bcdefgh</sup> | 53.6 <sup>acdefgh</sup> | 79.0 <sup>abdefgh</sup> | 75.5 <sup>abcdefgh</sup> | 57.6 <sup>abcdfgh</sup> | 40.3 <sup>abcdegh</sup> | 89.9 <sup>abcdef</sup> | 51.1 <sup>abcdef</sup> | 73.2   | 70.7    | P < 0.001       |
| Mean Total OOP costs (CNY)                   | 265.0<br>bcdefh         | 1017.8<br>acdefgh       | 3462.9<br>abefgh        | 3878.2<br>abefgh         | 887.1<br>abcdfgh        | 3456.8<br>abcdegh       | 1246.6<br>bcdef        | 666.9<br>abcdef        | 593.8  | 1653.7  | P < 0.001       |
| SD   | 1578.1                  | 3833.6                  | 5933.0                  | 7832.7                   | 4103.7                  | 8347.5                  | 4670.7                 | 2348.4                 | 2964.3 | 5440.6  |                 |
| Total health insurance fund consumption rate | 3.29%                   | 27.13%                  | 2.35%                   | 18.55%                   | 2.65%                   | 9.22%                   | 2.37%                  | 1.28%                  |        |         |                 |

*P-values are based on the Kruskal-Wallis test. UEBMI Urban Employee Basic Medical Insurance scheme, URBMI Urban Resident Basic Medical Insurance scheme, SD standard deviation. Total health insurance fund consumption rate refers to stroke-consumed health insurance funds as a percentage of health insurance fund revenue. Compared with<sup>d</sup>, <sup>a</sup> P < 0.05, compared with<sup>b</sup>, <sup>b</sup> P < 0.05; compared with<sup>c</sup>, <sup>c</sup> P < 0.05; compared with<sup>d</sup>, <sup>d</sup> P < 0.05; compared with<sup>e</sup>, <sup>e</sup> P < 0.05; compared with<sup>f</sup>, <sup>f</sup> P < 0.05; compared with<sup>g</sup>, <sup>g</sup> P < 0.05; compared with<sup>h</sup>, <sup>h</sup> P < 0.05*

## Disparities in health care utilization and outcomes by health insurance and city

As shown in Table 6, health care utilization, OOP cost and reimbursement rate differed significantly according to insurance type and city (all P < 0.001). For the entire sample, the UEBMI group consumed more health services than the URBMI group: UEBMI patients had a larger number of outpatient (4.3 versus 2.0) and inpatient (1.4 versus 1.1) visits, as well as longer ALOS (18.3 days versus 11.0 days) than URBMI patients. Also, UEBMI members had a higher reimbursement rate, but lower total OOP expenses, than URBMI members. These average UEBMI-URBMI differences were magnified at the city level. From Table 6, differences in outpatient cities' average visits (3.7) was greater the UEBMI-URBMI average (3.2), but the differences in outpatient and inpatient visits across cities were greater than the average differences between cities and insurance type. Similarly, differences in ALOS, total OOP costs and reimbursement rates were greater across cities than the average for cities compared to the insurance type average. For example, outpatients had a larger number of annually visits in Beijing (5.0) and Shanghai (4.8) than Tianjin (3.4) and Chongqing (1.6). Similarly, inpatients in Shanghai, with 1.7 inpatient visits per year, had a significantly larger number of inpatient visits than Beijing (1.4 visits per year), Tianjin (1.3 visits per year) and Chongqing (1.3 visits per year). Patients in Shanghai had longer ALOS (27.3 days) and higher total OOP cost (RMB2469.3/US\$371.8) than Chongqing, while patients in Chongqing enjoyed a higher reimbursement rate (91.2%). Patients in Tianjin had the shortest ALOS (11.4 days) and lowest reimbursement rate (55.2%) among four cities.

Table 6  
Insurance and city types associated with health care utilization.

| Characteristics | Outpatient visits |     |         | Inpatient visits |     |         | ALOS (days) |      |         | Total OOP cost |        |         | Reimbursement rate |      |         |
|-----------------|-------------------|-----|---------|------------------|-----|---------|-------------|------|---------|----------------|--------|---------|--------------------|------|---------|
|                 | Mean              | SD  | P-value | Mean             | SD  | P-value | Mean        | SD   | P-value | Mean           | SD     | P-value | Mean               | SD   | P-value |
| Insurance type  |                   |     | < 0.001 |                  |     | < 0.001 |             |      | < 0.001 |                |        | < 0.001 |                    |      | < 0.001 |
| UEBMI           | 4.3               | 4.6 |         | 1.4              | 1.1 |         | 18.3        | 13.1 |         | 593.8          | 2940.4 |         | 73.2               | 27.4 |         |
| URBMI           | 2.0               | 2.2 |         | 1.1              | 0.5 |         | 11.0        | 22.5 |         | 1653.7         | 5424.5 |         | 70.7               | 31.4 |         |
| Average         | 3.2               |     |         | 1.3              |     |         | 14.7        |      |         | 1420.65        |        |         | 71.95              |      |         |
| Cities          |                   |     | < 0.001 |                  |     | < 0.001 |             |      | < 0.001 |                |        | < 0.001 |                    |      | < 0.001 |
| Beijing         | 5.0               | 5.1 |         | 1.4              | 1.1 |         | 16.0        | 10.8 |         | 282.8          | 1670.6 |         | 76.7               | 26.7 |         |
| Shanghai        | 4.8               | 5.5 |         | 1.7              | 1.7 |         | 27.3        | 34.4 |         | 2469.3         | 5331.5 |         | 78.8               | 19.8 |         |
| Tianjin         | 3.4               | 3.3 |         | 1.3              | 0.8 |         | 11.4        | 7.1  |         | 1249.7         | 5006.7 |         | 55.2               | 27.5 |         |
| Chongqing       | 1.6               | 2.1 |         | 1.1              | 0.4 |         | 11.9        | 13.8 |         | 916.3          | 3550.7 |         | 91.2               | 13.8 |         |
| Average         | 3.7               |     |         | 1.3              |     |         | 16.7        |      |         | 1229.5         |        |         | 70.9               | 27.9 |         |

*P-values are based on the Kruskal-Wallis test; UEBMI Urban Employee Basic Medical Insurance scheme, URBMI Urban Resident Basic Medical Insurance scheme, SD standard deviation,*

## Multiple linear regression

Table 7 shows the influence of insurance type and city type to health services utilization. We found that insurance type and cities were significantly associated with patients' health care utilization. First, outpatient and inpatient visits and ALOS varied significantly by UEBMI-URBMI schemes. Second, Table 7 shows that health care utilization by patients with the same insurance type varied significantly across the four cities. Third, health care utilization significantly varied by insurance type and city. These regressions show that insurance type at the city level resulted in significant inter-city differences in health care utilization for stroke patients.

Table 7  
The impact of insurance type and city on patients' health care utilization.

| Characteristics                 | Outpatient visit |           |         | Inpatient visit |           |         | ALOS   |           |         |
|---------------------------------|------------------|-----------|---------|-----------------|-----------|---------|--------|-----------|---------|
|                                 | OR               | Std. Err. | P-value | OR              | Std. Err. | P-value | OR     | Std. Err. | P-value |
| Insurance type (Ref: UEBMI)     |                  |           |         |                 |           |         |        |           |         |
| URBMI                           | -0.232           | 0.032     | < 0.001 | -0.056          | 0.025     | 0.023   | -0.092 | 0.049     | 0.059   |
| Cities (Ref: Beijing)           |                  |           |         |                 |           |         |        |           |         |
| Shanghai                        | -0.099           | 0.003     | 0.003   | 0.127           | 0.009     | < 0.001 | 0.264  | 0.016     | < 0.001 |
| Tianjin                         | -0.338           | 0.009     | < 0.001 | 0.015           | 0.009     | 0.080   | -0.316 | 0.016     | < 0.001 |
| Chongqing                       | -0.817           | 0.016     | < 0.001 | -0.147          | 0.009     | < 0.001 | -0.223 | 0.018     | < 0.001 |
| Insurance type by city          |                  |           |         |                 |           |         |        |           |         |
| URBMI-Shanghai                  | 0.176            | 0.140     | 0.209   | -0.067          | 0.031     | 0.028   | -0.028 | 0.059     | 0.635   |
| URBMI-Tianjin                   | 0.105            | 0.041     | 0.011   | 0.022           | 0.026     | 0.389   | -0.045 | 0.051     | 0.382   |
| URBMI-Chongqing                 | 0.042            | 0.037     | 0.262   | 0.053           | 0.026     | 0.037   | -0.302 | 0.051     | 0.000   |
| <b>Constant</b>                 | < 0.001          |           |         | < 0.001         |           |         |        |           |         |
| <b>R<sup>2</sup> (adjusted)</b> | 0.140            |           |         | 0.073           |           |         | 0.206  |           |         |

## Discussion

Our study showed that patients with UEBMI consumed more health services, including outpatient and inpatient visits, as well as ALOS than those covered by URBMI. The UEBMI outpatient and inpatient cost, as well as the outpatient and inpatient total OOP expenses were higher than the URBMI group. A higher benefit level, as shown in Table 1, accounted for much of this difference (27). But, our most important finding was that the utilization rate and outcome of UEBMI and URBMI differed significantly across the four cities, and these intercity differences in health care utilization was greater than the differences between UEBMI and URBMI.

The multiple regressions suggest that the health care utilization of UEBMI patients was significantly more than URBMI patients. There are several possible explanations, which also applies to the intercity differences. Since socioeconomic status and education level have been found to be important influential factors in pre-hospital delay, which will affect the ALOS for ischemic stroke inpatients (28), we speculate that patients covered by UEBMI had higher levels of education and socioeconomic status than URBMI members, as well as paying more attention to their personal health (15). Consequently, UEBMI members sought medical treatment at higher level of hospitals and were more willing to consume additional health services, which were not covered by the health insurance, than URBMI patients (29, 30). Second, different therapeutic schedules could be adopted by doctors according to patients' insurance status, and the UEBMI insurance scheme benefit schedule was more generous, as shown in Table 1, and offered a higher reimbursement rate than URBMI (14, 31). These benefit schedules also varied across cities. UEBMI's more generous benefits, a higher reimbursement rate for services, higher annual reimbursement ceiling and more comprehensive service coverage meant UEBMI members consumed more health services. Two additional behaviors potentially followed. UEBMI members demanded more hospital services than they needed and medical staff supplied more hospital services that required (32). The URBMI scheme provided neither adequate financial protection nor service coverage for its members, which deterred the incentive to consume more health services by URBMI members and the provision of excess services by doctors (29). Importantly, these different provisions on coverage, benefits and reimbursements also occurred at the city level, where local differences in the UEBMI and URBMI behavior were magnified.

UEBMI members, whether inpatient or outpatients, had higher within-insurance OOP and higher outside-insurance OOP. This reflected the consumption of more health care by UEBMI members. However, share of total UEBMI OOP expenses in total hospital expenses was lower than URBMI members. One explanation is that UEBMI offers a comprehensive coverage while URBMI focused on inpatient support and catastrophic illness for outpatient services. Some basic outpatient services were not covered by URBMI (33), consequently URBMI patients visited hospital less frequently than UEBMI members (30). Our results also showed that UEBMI members had a larger number of outpatient visits than URBMI members and most of the outpatients in our sample were covered by UEBMI (71.1%). The large number of outpatient visits diluted total average OOP costs for UEBMI patients. Again, these factors also applied differentially at the city level, explaining the intercity differences in health care utilization and health care costs.

Our UEBMI and URBMI findings share several similarities with previous studies (34, 35). An empirical study conducted by Luo et al (36) reported that patients with end-stage malignant tumors covered by UEBMI utilized more health services than those covered by URBMI. Xu et al (37) used 10 years (2005–2014) of

hospital electronic health records to measure the utilization of mental health inpatient services. They found that patients with UEBMI had higher hospitalization cost, OOP cost, reimbursement ratio, greater number of inpatient visits, and much longer ALOS. Wang et al (38) reported that middle-aged and elderly adults who covered by UEBMI had larger number of outpatient visits and longer ALOS than those covered by URBMI. Meanwhile, the UEBMI group had higher outpatient OOP cost and higher inpatient OOP cost, but much fewer total average OOP cost.

Our most important finding was disparities between cities in UEBMI and URBMI health care utilization by stroke patients. These intercity differences in hospitalization cost, OOP cost, reimbursement ratio, inpatient visits and ALOS were greater than the average differences between UEBMI and URBMI. Patients covered by UEBMI in Beijing had the highest outpatient cost and the greatest number of outpatient visits than UEBMI members in other cities. Compared with Tianjin and Chongqing, the regression analysis showed significant differences in the number of outpatient visits, ALOS and hospitalization rates for UEBMI Beijing patients (all  $P < 0.05$ ). Patients in Shanghai had the longest ALOS ( $P < 0.05$ ) compared to other cities. There are several possible reasons for these intercity differences. First, different high income cities had different benefit packages and funding standards per capita, which encouraged divergent health care utilization (39, 40). While all four cities had high per capita incomes, Beijing had the highest UEBMI revenue per capita, followed by Shanghai, Tianjin, and Chongqing in 2018 (19), with Beijing and Shanghai's health care utilization greater on average than Tianjin or Chongqing. We expect variations in income per capita across the 333 cities in China to result in different benefit schemes, with significant differences in health care utilization. Second, the prevalence of stroke differed between cities. A higher stroke prevalence contributed to a higher consumption of health services (41). A study conducted by China Stroke Data Center reported that from 2012 ~ 2016, Beijing had the highest prevalence of stroke among our four cities, and stroke prevalence in Chongqing was the lowest (42). The higher health care utilization in Beijing compared to Chongqing is consistent with different stroke prevalence rates. In addition, as one of the major potentially modifiable risk factors and comorbidities for stroke, hypertension prevalence also differed between cities. Comorbidities significantly increases the utilization of health services in patients with stroke (43). A previous study reported that Beijing had the highest prevalence of hypertension between cities, followed by Tianjin, Shanghai, and Chongqing (44). These intercity risk factors and comorbidities are likely to be multiplied across the 333 cities in China. Third, there were disparities in the social development and economy between the four cities, with the city populations displaying different socioeconomic status. Low socioeconomic status patients had a higher stroke hospitalization risk and case fatality than those with a high socioeconomic status (45). Socioeconomic status differences varied even more significantly across the 333 cities than the four cities in our study. Fourth, there were disparities in charging standard across hospitals our four cities. According to the guidelines from the national government and implementation plans from local governments, the prices for basic medical services provided by public hospitals were formulated to government guidance prices (46). But, there is evidence that the use of health services was strongly linked to price (47). Patients respond to price either in two ways: by changing the frequency of service consumption or changing the quality of care to reduce per visit costs (47). These behaviors would be amplified across the 333 cities in China with different UEBMI-URBMI schemes.

In terms of stroke-related insurance fund consumption, we found the UEBMI consumption rate was higher than the URBMI rate, except in Chongqing. Patients in Beijing consumed the largest proportion of UEBMI (3.29%) and URBMI revenue (27.13%) among the four cities. Patients covered by URBMI in Chongqing consumed a smaller proportion of health insurance revenue than URBMI groups in the other cities. This may be due to much higher UEBMI financing levels and larger fund pool (48). URBMI patients in Chongqing had the fewest number of outpatient and inpatient visits, and the shortest ALOS. Consequently, patients covered by URBMI had the lowest total mean outpatient cost and inpatient cost, as well as the lowest insurance fund consumption rate.

To place our findings in a comparative context, Hagman J(49) found that Finnish patients with a higher glaucoma stage in different districts utilized a different degree of health resources and had differential treatment expenditures. A study in India revealed a wide variation in health care utilization for epileptic sufferers from six Indian cities (50). In Mexico, a study reported that patients covered by insurance called Seguro Popular de Salud (SPS) in larger cities had significantly fewer OOP expense than their uninsured counterparts, but possibly because of the limited access to health resources, no effect was found among SPS-insured households living in smaller cities (51). Wang et al(52) reported that there were wide regional variations of health care utilization and expenditure for patients with type 2 diabetes between Beijing, Guangzhou, Shanghai, and Chengdu.

## Conclusion

Health care utilization of patients with stroke varied by insurance type and across four large cities, Beijing, Shanghai, Tianjin and Chongqing. The differences across the four cities was greater than the average differences between UEBMI and URBMI. Overall, patients covered by UEBMI utilized more health services than those with URBMI. Patients treated in Beijing and Shanghai utilized more health care than patients in Tianjin and Chongqing. These findings not only provide vital information to understand the health care utilization of stroke in China, but also have important reference value in consolidating the fragment social health insurance schemes. Integrating the UEBMI and URBMI schemes may make a considerable improvement in standardizing and improving the equity of patients' health care utilization. Several key points should be considered such as integration in funding level, benefit packages, payment system, and fund management. Integrating the two urban schemes should also address the over-demand by patients and over-supply by doctors of medical services, especially reimbursements and the benefit lists.

Since stroke has high morbidity and mortality rates, as well as causing heavy financial burden for patients, we recommend the government launch a new critical illness contributory insurance covering severe diseases such as stroke. Given differentials in income between urban and rural residents, and across cities, strong leadership and sufficient financial support from the government would be required. We suggest that an independent risk pool of the new insurance scheme could be expanded from city and prefecture level to a larger risk pool at national level. Protected by the same risk pool, residents enjoy the same insurance welfare and economic protection, that may effectively reduce the geographical inequity in stroke patients' health care utilization and expenditure. The new critical illness insurance should set higher reimbursement rates and reimbursement cap lines, to protect patients from catastrophic health expenditure.

## Abbreviations

## Declarations

### Ethics approval and consent to participate

Since the claims data we used was an anonymized database and had no impact on patients' health, the informed consent was exempted. This study was approved by the Ethics Committee of Beijing University of Chinese medicine (No.2019BZHLYL0201).

### Consent for publication

Not applicable

### Competing interests

The authors declare that they have no competing interests.

### Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### Acknowledgments

We thank the support of the China Health Insurance Research Association, for providing the valuable data. We would also like to thank Beijing University of Chinese Medicine, for providing in-kind support.

### Authors' contributions

YY and XFS designed this study and drafted the original manuscript. SN and SL played an important role in analyzing the data and revising the paper; ZWH and XPC participated in drafting the manuscript, YM collected research data and critically revised the manuscript, all authors have read and approved the final manuscript.

### Availability of data and materials

Data in our study are obtained from China Health Insurance Research Association. Authors in this study have the right to use this dataset, but not the right to share and distribute. A de-identified minimal dataset of the quantitative data is available upon request to researchers who meet the criteria for confidential information, by sending a request to corresponding author.

**Ethics approval:** This study was approved by the Ethics Committee of the Beijing University of Chinese Medicine, project number: 2019BZHYP0201

### Availability of data and materials

Data in our study are third party data, and were provided by China Health Insurance Research Association. Authors in this study have the right to use this dataset, but not the right to share and distribute. The datasets used during the current study are available from the corresponding author on reasonable request.

**Author contributions:** YY and XFS designed this study, analyzed data and wrote the original manuscript. SN provided advices on manuscript writing and edited the manuscript; SL and WZ analyzed the data, PX and YM critically revised the manuscript, all authors have read and approved the final manuscript.

**Funding:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Conflict of Interest statement:** The authors declare that they have no competing interests.

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