# Medicine®

# Analysis of hospitalization expenditures and influencing factors for inpatients with coronary heart disease in a tier-3 hospital in Xi'an, China

## A retrospective study

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## Abstract

**Background:** The medical costs for inpatients with coronary heart disease (CHD) have risen to unprecedented levels, putting tremendous financial pressure on their families and the entire society. The objective of this study was to examine the actual direct medical costs of inpatients with CHD and to analyze the influencing factors of those costs, to provide advice on the prevention and control of high medical costs of patients with CHD.

**Methods:** A retrospective descriptive analysis of hospitalization expenditures data examined 10,301 inpatients with coronary heart disease of a tier-3 hospital in Xi'an from January 1, 2015 to December 31, 2015. The data included demographic information, the average length of stay, and different types of expenses incurred during the hospitalization period. The difference between different groups was analyzed using a univariate analysis, and the influencing factors of hospitalization expenditures were explored by the multiple linear stepwise regression analysis.

**Results:** The average age of these patients was 60.0 years old, the average length of stay was 4.0 days, and the majority were males (7172, 69.6%). The average hospitalization expenses were $6791.38 (3294.16–9, 732.59), and the top 3 expenses were medical consumables, operation fees, and drugs. The influencing factors of hospitalization expenditures included the length of stay, the number of times of admission, the type of medical insurance schemes, whether have a surgery or not, the gender, the age, and the marriage status.

**Conclusion:** The inpatients with CHD in this tier-3 hospital were mostly over 45 years old. The average medical cost of males was much higher than that of females. Our findings suggest that the solution for tremendous hospitalization expenditures should be that more attention is paid to controlling the high expense of medical consumables and that the traditional method of reducing medical expenses by shortening the length of stay is still important in nowadays. Furthermore, the type of medical insurance schemes has different impacts on medical expenses. Reducing or controlling high hospitalization expenditures is a complicated process that needs multifaceted cooperation.

**Abbreviations:** AMI = acute myocardial infarction, ANOVA = analysis of variance, CAD = coronary artery disease, CHD = coronary heart disease, CT = computed tomography, ICD = international classification of disease, LOS = the length of stay, MRI = magnetic resonance imaging, NRCMS = the new rural cooperative medical scheme, PCI = percutaneous coronary intervention, SA = stable angina, UA = unstable angina, UEBMI = the urban employee basic medical insurance, URBMI = the urban resident's basic medical insurance.

**Keywords:** hospitalization expenditures, influencing factors, medical insurance schemes, payment methods

## 1. Introduction

With the rapid development of the economy, the change in lifestyles and the progression of aging, the morbidity and mortality of cardiovascular diseases has continued to increase in recent years. Coronary heart disease (CHD) is the most common and new type of cardiovascular disease in this century, and the global mortality rate was more than 8 million people in 2013. This accounted for 50% of the deaths caused by cardiovascular diseases, which makes CHD the primary global killer.[1] Evidence shows that the general morbidity of CHD in America was approximately 6.0%.[2] In addition, Chinese researchers have proven that the morbidity and mortality of CHD increased every year.[3,4] The general morbidity of CHD in China was approximately 2.23% to 6.81%, and the morbidity varied from place to place.[4,5] What is worse, CHD has become the second leading cause of death in China,[6] and the economic burden of cardiovascular disease, especially direct medical expenses, already accounts for 20% of the country's annual health care costs.[7] In addition, some data showed that the direct cost of coronary artery disease (CAD) was 4183 million euros in France in 2009, 50% of which was spent on inpatient care.[8]

Thus, a comprehensive understanding of the direct economic burdens of CHD is imperative to recognize the societal and

individual impacts of this disease while making decisions on health resources allocation. However, there is little international or national evidence on the analysis of hospitalization expenditures among inpatients with CHD. Previous studies paid a lot of attention to other common chronic diseases, such as atrial fibrillation-related stroke, chronic kidney disease and diabetes.[9–11] Regarding the economic burdens of cardiovascular disease, the focus was on other, more traditional cardiovascular disorders, such as acute or chronic heart failure or perioperative myocardial infarction.[12–15]

In addition some literature examined CHD from other perspectives, one study[16] examined the catastrophic medical payments faced by patients with CHD and the effectiveness of the new rural cooperative medical system at alleviating the impact of the diseases in fourth-class rural areas, Kelley et al[17] measured the health care costs of the patients with heart disease in the last 5 years of life, and Huber et al[18] examined the effect of integrated care models on medical expenditures and the quality of care in cardiovascular disease patients.

The Chinese government started "The New Healthcare Reform" program in the year 2009 with a goal to reduce medical costs using a series of actions. The tremendous cost of medical care not only increases the economic burdens for patients and their families but those costs also impede the successful operation of health insurance funds. Both burdens are harmful to the long-term stability of the nation. Therefore, it is necessary to explore the structure of hospitalization expenditures and the influencing factors of cost for inpatients with CHD. This approach could provide some advice on how to control high medical expenses. In this study, we described the actual direct medical cost of inpatients with CHD and its components according to the inventories of patients' hospitalization fees and analyzed the influencing factors for the costs to provide advice on the prevention and control of the high medical cost of the patients with CHD.

## 2. Methods

### 2.1. Data resources

Data of inpatients with CHD were collected from discharge records from a tier-3 hospital in Xi'an from January 1, 2015 to December 31, 2015. This tier-3 hospital in Xi'an is Xijing hospital, which is the best and the largest nonprofit medical organization in China's northwest. In 2014, the hospital's designated bed capacity was 3218 beds, the volume of both outpatient and emergency visits included 3,728,000 cases and the highest volume visits in those departments in a single day was 15,437 cases, the inpatient service volume was 151,000 cases, and the operation capacity was 88,000 cases annually. CHD includes a series of diseases classified by the International Classification of Diseases (ICD) with codes 120-125, which include acute myocardial infarction (AMI), unstable angina (UA), stable angina (SA), and other types. The collected data included demographic information, the basic information on the hospitalization, and different types of expenses that were incurred during the hospitalization period. The demographic information included age, gender, the number of times of admission, the type of medical insurance schemes, marriage status, and the means by which the patient paid their hospitalization bills at admission (out-of-pocket or directly compensated by medical insurance funds in the hospital). The medical insurance schemes include the urban employee basic medical insurance (UEBMI), the urban

resident's basic medical insurance (URBMI), and the new rural cooperative medical scheme (NRCMS). It could be argued that some patients should pay all medical costs up-front even though they are covered by a medical insurance plan. There were 2 reasons for this: one is that migrant workers were not insured in Xi'an or even in Shaanxi province where they live and work, and in rural communities where their permanent residence is listed, they were not covered by the basic medical insurance scheme. The other reason is that some patients come to Xi'an from other provinces or municipalities for the high-level medical treatment. All these reasons create barriers to hospital payment from medical insurance funds upon the patient's admission to the hospital. Because the service of medical insurance reimbursement in different places has not been widely realized, patients should pay their hospital bills out-of-pocket at the time of discharge and then later apply for reimbursement from the local medical insurance agencies, even though co-payments are usually greatly increased once outside the local regions. The basic hospitalization-information included the length of stay (LOS), whether the patient had surgery, and the primary diagnosis on the discharge records. The hospital's expenditures were cataloged into 7 types, including: drugs (western medicine and Chinese traditional medicine), surgeries, medical consumables (low-value and high-value supplies), nursing, examinations (biochemical tests, blood tests, ultrasonography, computed tomography [CT], magnetic resonance imaging [MRI], digital imaging, and pathological examinations), ward bed, and other fees (blood infusions, etc.). The dead cases, the inpatients with key information missing or with more than 1 admission except for the admission with the highest medical expenditures and those from the army were excluded.

### 2.2. Statistical analysis

The whole statistical analysis process in this study can be divided into 3 steps. The first step was the statistical description, which described the distribution of the relevant variables, the mean ± standard deviation for normal variables while the median ($Q1$–$Q3$) for the non-normal variables and the confidence intervals will be estimated for all relevant parameters. The second step was the univariate analysis, referring to only considering one variable when compared the difference among groups, that is, exploring there were any differences among groups in only one aspect. The common method included analysis of variance (ANOVA) for the variables with normal distribution, *Mann–Whitney U* tests and *Kruskal–Wallis H (K)* tests for the variables with non-normal distribution.[19] The third step was multiple linear regression, the stepwise regression analysis was used to explore probable influencing factors of hospitalization expenditures, which can automatically remove the insignificant variables out of the model.[19,20] The hospitalization expenditures of inpatients with CHD acted as the dependent variable ($y$), and the possible influencing factors were the independent variables ($x$); then the hospitalization expenditures can be estimated by $y = \alpha + B_1X_1 + B_2X_2 + \ldots B_nX_n + v$, $\alpha$ represents the constant, $v$ represents the random error, $X_i$ is the $i$th possible influencing factor of the hospitalization expenses, and $B_i$ is the non-normalized regression coefficient of the $i$th independent variable, indicating the average change of $y$ when the $X_i$ increases or decreases by one unit and the other variables remain unchanged. However, in the same model, the magnitude of the influence of each independent variable ($x$) on the dependent variable ($y$) is determined by the normalized coefficient of the variable $|\beta|$. In this study, 9 possible

influencing factors were selected, including "$X_1$ The admission times (the actual admission times of each inpatient)," "$X_2$ The gender (female=1, male=0)," "$X_3$ The type of medical insurance schemes (UEBMI=-1, URBMI=0, and NRCMS=1)," "$X_4$ The means of payment (received reimbursement=1, paid out-of-pocket=0)," "$X_5$ Surgery (Yes=1, No=0)," "$X_6$ The age (the real age of each inpatient)," "$X_7$ Farmer (Yes=1, No=0)," "$X_8$ The marriage status (Single person=1, Non-single=0)," and "$X_9$ LOS (the actual days of each inpatient)." We assumed that $X_1$, $X_2$, $X_4$, $X_5$, $X_7$, and $X_8$ were negatively correlated with the total hospitalization expenditures, whereas X3, X6, and $X_9$ were positively related to the total hospitalization expenditures.

All statistical analyses were conducted with the IBM SPSS Statistics 19.0. Significance testing was 2-sided, and the significance threshold was set at $P < .05$. Costs were expressed in 2015 dollars ($), and $100=622.84Yuan, €100=691.41Yuan.

### 2.3. Ethical approval

Not applicable. All data were collected by the department of information from the hospital management system and do not contain any private information on the study subject.

## 3. Results

### 3.1. Basic information of CHD inpatients

In 2015, there were 13,302 inpatients with CHD admitted to the tier-3 hospital. After the dead cases, the case with more than 1 admission except for that admission with the highest medical costs, the case with missing information and members of the army were excluded, 10,301 inpatients were left with complete discharge records. This was the first admission to the hospital for most of the inpatients (8117, 78.8%). Among the 10,301 inpatients, males accounted for 7172 (69.6%), while females accounted for 3129 (30.4%). The number of inpatients who had joined the UEBMI, URBMI, and NRCMS were 799 (7.8%), 5881 (57.1%), and 3621 (35.2%), respectively. Even though the medical insurance coverage among the inpatients included in this research was 100%, most of the inpatients (7508, 72.9%) were required to pay all the medical expenses at the time of hospital discharge and later request reimbursement from their local medical insurance agencies. Only a small fraction of inpatients (2793, 27.1%) directly received compensation from their medical insurance funds. The average age of these inpatients was 60.0 (52.0–67.0) years old and the median LOS was 4.0 (3.0–7.0) days. The median costs of each type of expenditure (in dollars) were as follows: total hospitalization expenditures, 6791.38 (3294.16–9732.59); drugs, 499.76 (255.44–771.24); surgical fees, 867.0 (0–867.0); medical consumables, 3120.96 (254.34–6093.22); nursing, 5.62 (3.38–9.41); examinations, 88.64 (60.53–158.15); ward beds, 12.84 (9.63–22.48); and other costs, 125.39 (39.52–2760.95). These 10,301 patients were divided into 2 groups according to the means used to pay at the time of admission. More information of these 2 groups and the differences between them are presented in Table 1.

### 3.2. Comparisons of total hospitalization expenditures among different groups

The nonparametric tests of total hospitalization expenditures showed that there was no significant difference between these 2 groups ($P > .05$). With the exception of drugs and surgical fees,

the other principal components of the hospitalization fees (medical consumables, nursing, examinations, ward bed, and the other costs), which included the daily hospitalization cost, were different in patients with different payment methods ($P < .01$, in Table 1). There were significant differences overall between the 2 groups in the categories of gender, LOS, age, and the type of medical insurance schemes. The median of the total hospitalization expenditures were presented in Tables 2–4.

From these 3 tables, we found that there were no significant differences in the total hospitalization expenditures between these groups with different LOS. However, if we neglected gender and the type of medical insurance schemes a LOS between 8 and 14 days ($P < .01$, in Table 2) was significant. In addition, we found that regardless of LOS, age or the type of medical insurance schemes, the total hospitalization expenditures of males were much higher than that of females ($P < .05$, in Tables 2–4). However, male inpatients who were more than 76 years old ($P > .05$, in Table 3) and the inpatients who had joined the URBMI and paid out-of-pocket ($P = .20$, in Table 4) were not significant. From Table 2, we found that total hospitalization expenditures increased along with the extensive LOS. There was an exception, when the LOS was between 8 and 14 days ($P < .05$) the total hospitalization expenditures of inpatients who received reimbursement was lower than those inpatients who paid out-of-pocket at the time of admission. From Table 3, we found a similar association between age and total hospitalization expenditures. Total inpatient hospitalization expenditures increased along with advancing age. However, when the inpatients were more than 76 years old, the total hospitalization expenditures of inpatients decreased exceptionally, and there was no significant difference between genders regardless of payment method.

When inpatients received compensation at the number of times of admission, there was no significant difference among the inpatients who were female and joined different medical insurance schemes. There was also no significant differences among the male inpatients who joined the URBMI and UEBMI, but the total hospitalization expenditures of male inpatients who joined the NRCMS was much lower than that of inpatients who joined either of the 2 other types of medical insurance schemes. On the other hand, when patients out-of-pocket at the number of times of admission, and regardless of gender, the total hospitalization expenditures of inpatients who joined the NRCMS was the highest, followed by the URBMI, and the UEBMI (details are presented in Table 4).

### 3.3. Influencing factors of total hospitalization expenditures

At the beginning, 9 independent variables were introduced into the multiple linear regression analysis, then the stepwise regression analysis model excluded 2 insignificant variables, "$X_4$ The method of payment" and "$X_7$ Farmer or not," which indicated that the rest of variables were related to the total hospitalization expenditures. We found that the admission times, the gender and have a surgery had negative impacts on the total hospitalization expenditures. In other words, the more time a patient was admitted to the hospital, the lower the total hospitalization expenditures would be ($B = -575.55$, $P < .01$). When compared with their male inpatients, females spent less on total hospitalization expenditures ($B = -1102.0$, $P < .01$). Compared to the inpatients without a surgery, those inpatients had a surgery in the hospitalization period would spend less ($B = -3425.75$, $P < .01$). Whereas the age ($B = 36.70$, $P < .01$), the

## Table 1

**Basic information of the 2 payor groups (n [%] or M [Q1–Q3]).**

| | Patients who received compensation (n = 2793) | Patients who paid out-of-pocket (n = 7508) | Statistics | P values |
|---|---|---|---|---|
| Gender | | | | |
| Male | 2016 (72.2) | 5156 (68.7) | $\chi^2 = 11.84$ | <.01 |
| Female | 777 (27.8) | 2352 (31.3) | | |
| The type of medical insurance schemes | | | | |
| URBMI | 2770 (99.2) | 3111 (41.4) | $\chi^2 = 27{,}771.46$ | <.01 |
| UEBMI | 15 (0.5) | 784 (10.4) | | |
| NCMS | 8 (0.3) | 3613 (48.1) | | |
| Age | 63.0 (56.0–71.0) | 59.0 (51.0–66.0) | $Z = -16.54$ | <.01 |
| ≤18 years old | 6 (0.2) | 30 (0.4) | $\chi^2 = 234.71$ | <.01 |
| 19–45 years old | 191 (6.8) | 819 (10.9) | | |
| 46–60 years old | 959 (34.3) | 3273 (43.6) | | |
| 61–75 years old | 1284 (46.0) | 2967 (39.5) | | |
| ≥76 years old | 353 (12.6) | 419 (5.6) | | |
| Marital status* | | | | |
| Married | 2768 (99.1) | 7396 (98.5) | $\chi^2 = 5.52$ | .02 |
| Single | 25 (0.9) | 112 (1.5) | | |
| The LOS (days) | 5.0 (3.0–7.0) | 4.0 (3.0–7.0) | $Z = -8.45$ | <.01 |
| ≤3 days | 950 (34.0) | 3112 (41.4) | $\chi^2 = 58.01$ | <.01 |
| 4–7 days | 1162 (41.6) | 2957 (39.4) | | |
| 8–14 days | 565 (20.2) | 1199 (16.0) | | |
| ≥15 days | 116 (4.2) | 240 (3.2) | | |
| Surgery performed | | | | |
| Yes | 1679 (60.1) | 4266 (56.8) | $\chi^2 = 9.06$ | <.01 |
| No | 1114 (39.9) | 3242 (43.2) | | |
| The total hospitalization expenditures (dollars) | 6777.35 (2350.53–9914.71) | 6804.19 (3536.53–9667.50) | $Z = -1.02$ | .31 |
| Daily hospitalization cost | 1365.96 (598.07–2533.70) | 1588.89 (752.74–2714.76) | $Z = -6.98$ | <.01 |
| Drugs | 490.00 (262.93–743.76) | 503.85 (251.15–782.05) | $Z = -0.64$ | .52 |
| Surgical fees | 867.00 (0–867.00) | 867.00 (0–878.24) | $Z = -0.22$ | .83 |
| Medical consumables | 2202.80 (234.84–5941.56) | 3354.02 (258.69–6173.47) | $Z = -4.76$ | <.01 |
| Nursing | 6.04 (3.79–10.07) | 5.49 (3.28–9.00) | $Z = -7.39$ | <.01 |
| Examinations | 92.13 (63.16–172.20) | 86.70 (60.53–153.33) | $Z = -5.17$ | <.01 |
| Ward bed | 16.06 (9.63–22.48) | 12.84 (9.63–22.48) | $Z = -8.45$ | <.01 |
| Other costs | 138.56 (44.60–3258.13) | 120.55 (38.15–2568.20) | $Z = -3.69$ | <.01 |

From this table, we found that most of the inpatients paid the medical costs at the time of admission out-of-pocket, and there were many differences in basic information between these 2 groups. When compared to the group of patients who received insurance compensation, there were more females in the out-of-pocket group. Most of the inpatients (99.2%) who received compensation at the number of times of admission joined the URBMI while the majority of inpatients who belonged to the out-of-pocket group joined the NRCMS (48.1%) or the URBMI (41.4%). The average age of inpatients who received insurance compensation was a little older than that of the out-of-pocket group, and we found that most of the inpatients in these 2 groups were >45 years old. The average LOS of inpatients who received compensation was slightly longer than that of the out-of-pocket group, and the most of the inpatients (41.6%) who received compensation stayed in the hospital for approximately 4 to 7 days, while the most of the (41.4%) of patients who paid out-of-pocket stayed in the hospital no more than 3 days. The proportion of inpatients who received a surgery in the group of "patients received compensation" (60.1%) was slightly higher than that of the out-of-pocket group (56.8%). There were no significant differences between these 2 groups in terms of total hospitalization expenditures, drug costs, and the surgical fees. The cost of daily hospitalization and the cost of medical consumables for the group of "patients who paid out-of-pocket" were much higher than the group of "patients received compensation," while other types of expenses were lower.

LOS = the length of stay, NRCMS = the new rural cooperative medical scheme, UEBMI = the urban employee basic medical insurance, URBMI = the urban resident's basic medical insurance.

* Marital status includes "married" and "single," "married" refers to the inpatient who was married and whose spouse is alive and "single" refers to those inpatients who were unmarried, divorced, or widowed.

## Table 2

**Comparisons of the median total hospitalization expenditures among different groups according to gender and the length of stay (dollars).**

| | Patients who received compensation at the number of times of admission | | | Patients who paid out-of-pocket at the time of admission | | | P values |
|---|---|---|---|---|---|---|---|
| | Male | Female | P values | Male | Female | P values | |
| LOS ≤3 days | 6566.86 | 5348.61 | <.01ᵃ* | 6362.24 | 6004.63 | <.01 ᵃ* | .82 |
| LOS between 4–7 days | 8042.92 | 6567.76 | <.01ᵃ* | 7636.09 | 7051.67 | <.01ᵃ* | .81 |
| LOS between 8–14 days | 5804.73 | 3856.12 | .04ᵃ* | 6741.77 | 5911.39 | .02ᵃ* | <.01ᵇ* |
| LOS ≥15 days | 14,910.52 | 5662.83 | <.01ᵃ* | 14,063.88 | 10,395.00 | <.01ᵃ* | .68 |
| P values | <.01ᶜ* | <.01ᶜ* | | <.01ᶜ* | <.01ᶜ* | | |

Other than inpatients who stayed in the hospital approximately 8 to 14 days, there were no significant differences in hospitalization expenditures between these 2 groups with any other LOS (P>.05). When the LOS was between 8 and 14 days, the total cost for inpatients who received compensation from their insurance was lower than that of inpatients paid out-of-pocket (b*, P<.01). We found that the total hospitalization costs for males were higher than that of females no matter how long they stayed in the hospital or to which group they belonged (a*, P<.05). In the same group, the hospital expenditures of inpatients vary based on different LOS (c*, P≤.01).

LOS = the length of stay.

**Table 3**

**Comparisons of the median total hospitalization expenditures among different groups according to gender and age (dollars).**

| | Patients got compensation at this admission | | | Patients paid by themselves at this admission | | | |
|---|---|---|---|---|---|---|---|
| | Male | Female | P values | Male | Female | P values | P values |
| Age ≤18 | 3954.95 | – | | 6266.13 | 1439.43 | .04[a*] | .67 |
| Age between 19 and 45 | 6277.41 | 1957.46 | <.01[a*] | 6622.70 | 4599.62 | <.01[a*] | .07 |
| Age between 46 and 60 | 7117.84 | 5313.20 | <.01[a*] | 6929.22 | 6062.43 | <.01[a*] | .84 |
| Age between 61 and 75 | 7592.17 | 6124.08 | <.01[a*] | 7313.24 | 6782.47 | <.01[a*] | .30 |
| Age ≥76 | 6212.49 | 5954.35 | .56 | 6145.66 | 6276.30 | .69 | .66 |
| P values | <.01[b*] | <.01[b*] | | <.01[b*] | <.01[b*] | | |

"–" means that there were no female patients who received compensation at the time of admission who were under 18 years old.
No matter the patient's age, there was no significant difference in hospital expenditures between the 2 groups ($P > .05$). Up to 76 years of age, the males spent more on hospitalization than females in both groups (a[*], $P < .05$). No matter the group or gender, the hospital expenditures of patients vary between ages (b[*], $P < .01$).

**Table 4**

**Comparisons of the median total hospitalization expenditures among different groups according to gender and type of medical insurance schemes (dollars).**

| | Patients who received compensation at the time of admission | | | Patients who paid out-of-pocket at the time of admission | | | |
|---|---|---|---|---|---|---|---|
| | Male | Female | P values | Male | Female | P values | P values |
| URBMI | 7093.16 | 5777.86 | <.01[a*] | 7026.14 | 6061.29 | <.01[a*] | .66 |
| UEBMI | 6927.83 | 4769.08 | .04[a*] | 6414.84 | 5451.97 | .20 | .76 |
| NRCMS | 5958.51 | – | | 7077.96 | 6645.83 | <.01[a*] | .62 |
| P values | .79 | .61 | | <.01[b*] | <.01[b*] | | |

"–" means that among the patients who joined the NRCMS and got compensation at the number of times of admission, none were females.
We found that no matter which kind of medical insurance schemes the patients joined, the difference of hospitalization expenditures between the 2 groups was not significant ($P > .05$). More money was spent by males versus females on the total cost of the hospitalization (a[*], $P < .05$) except for the inpatients who joined the UEBMI and paid the cost out-of-pocket at the time of admission. For inpatients who received reimbursement at the time of admission, there was no significant difference in the total hospitalization expenses among different types of medical insurance schemes. While for the inpatients who paid out-of-pocket at the time of admission, the hospital expenditures of inpatients varied from different kinds of medical insurance schemes (b[*], $P < .05$).
NRCMS = the new rural cooperative medical scheme, UEBMI = the urban employee basic medical insurance, URBMI = the urban resident's basic medical insurance.

**Table 5**

**Influencing factors of the total hospitalization expenditures.**

| | Nonstandardized coefficients | | | | | 95%CI | |
|---|---|---|---|---|---|---|---|
| | B | SD | β | t | P values | Lower | Upper |
| Constants | 4767.61 | 375.11 | | 12.71 | <.01 | 4032.31 | 5502.90 |
| $X_1$ The admission times | −575.55 | 48.16 | −0.107 | −11.95 | <.01 | −669.96 | −481.15 |
| $X_2$ The gender | −1102.00 | 88.23 | −0.109 | −12.49 | <.01 | −1274.95 | −929.04 |
| $X_3$ The type of medical insurance schemes | 529.62 | 68.75 | 0.068 | 7.70 | <.01 | 394.87 | 664.38 |
| $X_5$ Surgery | −3425.75 | 82.63 | −0.363 | −41.46 | <.01 | −3587.71 | −3263.79 |
| $X_6$ The age | 36.70 | 3.70 | 0.091 | 9.91 | <.01 | 29.45 | 43.96 |
| $X_8$ The marriage status | 1370.41 | 367.73 | 0.034 | 3.73 | <.01 | 649.59 | 2091.24 |
| $X_9$ LOS | 330.49 | 10.09 | 0.286 | 32.76 | <.01 | 310.72 | 350.27 |

From this table, we found that the type of medical insurance schemes (UEBMI = −1, URBMI = 0, NRCMS = 1), the age, the marriage status (single person = 1, nonsingle person = 0), and the LOS had a positive relationship with the total hospitalization expenditures, while the admission times, female, and has a surgery in the hospitalization period were negatively associated with the total hospitalization expenditures. And in these factors, "$X_5$ Surgery" got the greatest impact ($\beta = -0.363$) while "$X_8$ The marriage status" got the least ($\beta = 0.034$).
LOS = the length of stay

marriage status ($B = 1370.41$, $P < .01$) and the LOS ($B = 330.49$, $P < .01$) were positively related to the medical expenses. According to the assignment of the type of medical insurance schemes, we found that the type of medical insurance schemes was positively related to the medical costs ($B = 529.62$, $P < .01$), which means compared to the inpatients joined the URBMI, the inpatients who joined the UEBMI would pay 529.62 dollars less, while the inpatients who joined the NRCMS would pay more another 529.62 dollars (details in Table 5). In all these 7 influencing factors, "$X_5$ Surgery" had the greatest impact on the

medical costs ($\beta = -0.363$), then followed by "$X_9$ LOS" ($\beta = 0.286$), but "$X_8$ The marriage status" had the least ($\beta = 0.034$).

## 4. Discussion

More people visit the hospital and are admitted for the treatment of CHD, not only because of the high incidence and death rate but also because of both an increased awareness of the disease and accessibility to medical services. In addition, most of the medical expenses related to a specific disease are incurred in the

hospital;[21] therefore, total hospitalization expenditures are direct economic burdens for the inpatients and their families. It is a huge undertaking to control the sharp increase in medical expenses for the government, the medical insurance agencies, and the hospitals. It should be noted that there are many patients who make medical decisions based on the cost or their ability to pay rather than making decisions based on their health needs.[12,22] A review reported that direct co-payments had a major impact on reducing medication use, including life-sustaining or essential drugs to treat chronic conditions.[23] In addition, Piamjariyakul et al[24] held the viewpoint that a financial assessment and patient referral to social services to assist with expenses could provide some relief of the burden of medication costs and improve medication adherence.[25] Worse still is the household health-related financial risk that is the greatest problem among those social groups least able to cope with that burden, which further contributes to the poverty of the vulnerable family (especially for widows and widowers who lack of sufficient economic support from other family members) and creates a continued intergenerational cycle of poverty.[26,27] It is meaningful to study the structure of hospitalization expenditures and their predictors to understand the financial needs of patients with CHD while evaluating their economic burdens.

In this study, we found that most of the inpatients (7508, 72.9%) paid the hospitalization bills for this admission out-of-pocket, which suggested that the government and medical insurance agencies at all levels should pay more attention to the progress of realizing the service of medical insurance reimbursement in different places. Similar to another study, we found that the number of male inpatients was more than that of their female counterparts ($\chi^2 = 11.839$, $P < .01$), and the total hospitalization expenditures of males was higher than that of females ($P < .05$).[28] Two reasons might cause the high admission rate of males: (1) the high morbidity of males with CHD[29] and (2) the cultural background. It is possible that males were taken for granted as the main source of family income and that once the man in the family was sick, the family had a high chance to seek out better medical services. That the total hospitalization expenditures of males were higher than that of females might also relate to an unhealthy lifestyle that included smoking and drinking. One study showed that total hospitalization expenditures of patients with CHD who quit smoking were much lower than those who did not.[30]

We found that the average total hospitalization expenditures of inpatients with CHD in this tier-3 hospital was $6791.38 (3294.16–9732.59) and the direct medical cost to the patient was found to be significant, which far surpassed the 2014 annual per capita income for urban residents in the whole country (4717.26 dollars).[31] For the low-income group, even though health insurance could provide some financial protection, the co-payment is still unaffordable for many families.[32] Thus, policies and regulations should be made that provide more financial support for low-income groups who have CHD. The average direct cost of hospitalization with CHD estimated in this research was slightly smaller when compared to another study's results of 13,220.73 dollars (82,344 Yuan) for inpatients with free medical service and 9781.65 dollars (60,924 Yuan) for inpatients who joined the NRCMS in China.[33] A Spanish study showed that the mean costs of nonfatal acute myocardial infarction, unstable angina, and chronic heart failure with hospitalization were €8669, €3162, and €3353, respectively.[34]

The main components of the hospitalization expenditures were medical consumables (median of 3120.96 dollars), operation fees (median of 867.00 dollars) and drugs (median of 499.76 dollars). The expense of medical consumables accounted for approximately 45.95% of hospitalization costs. The high expense of medical consumables might be the result of more people chose to receive setting heart-stents instead of using drugs alone. With the development of medical technology, interventions with heart-stents have become the preferred method of revascularization because of significant effects and minor invasion. The type and number of heart-stents were the key factors of hospitalization expenditures and may account for at least 40% of the cost. Evidence showed that there might be as many as 1.56 heart-stents used per person in a surgical procedure.[35] Take the Cypher stent for example, the hospitalization expenditures would increase to 6552.15 dollars (40,809.41 Yuan) if one more stent was used.[36] Additionally, the price of a drug-eluting stent from outside China is 1129.46 dollars (7097 Yuan) higher than a domestic one. For example, the XIENCEV drug-eluting stent from Abbott in America costs 3219.13 dollars (20,050 Yuan) while the Firebird 2 drug-eluting stent from MicroPort in China only costs 1894.55 dollars (11,800 Yuan). Furthermore, there was no consistent conclusion about which type of heart-stents was better than the others, a meta-analysis indicated the generalized use of drug-eluting stent has not led to the expected reduction in the total number of procedures performed in the real-life situations,[37] and a Chinese study showed that domestic stents performed better when compared to foreign stents.[38] Hospitalization expenditures would decrease by 30% if the price of heart-stents decreased by 15 to 30%.[39] What is worse, the effects of treatments with heart-stents have been questioned by some researchers, someone found that there was no difference in the cost-effectiveness ratio after 4 years of follow-up between percutaneous coronary intervention (PCI) versus contemporary medical therapy in the COURAGE trial.[40] All this evidence provided another measure to reduce the economic burden of inpatients with CHD, and there is a great room for the continued decrease of medical consumables, despite the immovable traditional expenses (such as drugs and examinations) that cannot be decreased.

From Table 2, we found that there was a significant difference in the total hospitalization costs among patients with varying LOS ($P < .01$) except when the LOS was between 8 and 14 days but the regression analysis showed that the medical costs increased along with an extensive LOS ($B = 330.49$, $P < .01$). Then we conducted further analysis to find out what made this strange phenomenon, and we had found that the inpatients whose LOS was between 8 and 14 days had a higher surgery rate ($R_{surgery} = 61.28\%$, $\chi^2 = 47.76$, $P < .01$), a higher rate of being a single person ($R_{single} = 3.76\%$, $\chi^2 = 105.63$, $P < .01$), a lower rate of inpatients joined the NRCMS ($R_{NRCMS} = 29.65\%$, $\chi^2 = 104.78$, $P < .01$) and a lower average age ($57.96 \pm 14.43$, $F = 4.62$, $P < .01$), which all led to reducing the medical costs for the inpatients whose LOS was between 8 and 14 days. Thus, this result indicated that shortening the LOS was an important method to reduce medical costs. However, most hospitals reduce the LOS by discharging patients to another facility and eventually reduce the total medical costs incurred during a hospitalization period. In addition, we are not sure whether discharge to another medical institution simply represents a transfer of cost and risk or improves the quality of health care.

This study also confirmed that there was a positive association between age and hospitalization expenditures ($B = 36.70$, $P < .01$). The older the inpatient was, the more he or she paid. However, an exception exists. The total hospitalization

expenditures of inpatients whose age was >76 years old was not the highest, and this abnormal phenomenon was also detected by other researchers,[14,41] who found that the total healthcare and pharmacy expenditures of the most elderly patients (>84 years old) was lower than that of relatively younger elderly patients (65–74 years old). The reason might be that the older patients are likely to choose relatively conservative medical treatments such as fewer heart-stents, fewer invasive treatments, and more drugs.

Stratified analyses indicated that a significant difference in hospitalization fees was not found among patients with different types of medical insurance schemes when they received compensation directly at this admission ($P = 0.79$) but was noted among patients who paid the medical costs out-of-pocket during this admission ($P < .01$). Obviously, the latter group has a low reimbursement rate of total medical expenses in their local areas. This result was partially similar to a previous study, which found that after excluding different types of medical insurance, a different proportion of reimbursement would create a significant difference in total hospitalization fees.[42] However, we found that the type of medical insurance schemes had an impact on hospitalization expenditures without considering the payment methods of the patients ($B = 529.62$, $P < .01$). Considered the assignment of the dummy variables of "$X_3$ The type of medical insurance schemes (UEBMI = −1, URBMI = 0, and NRCMS = 1)," we would know that among the inpatients joined different medical insurance schemes, compared to the inpatients joined the URBMI, the inpatients joined the UEBMI had the least financial burdens while the inpatients joined the NRCMS had the largest. What is worse, a study showed that the NRCMS increased the incidence of catastrophic expenditure among households in the western region of China.[43] Two reasons might have caused this abnormal phenomenon, one is that increased reimbursement by the NRCMS and URBMI was slower than the increase of medical expenses. For example, from 2008 to 2010, the NRCMS reimbursement per admission increased by 4% on average, despite a total expenditure and out-of-pocket payment rate per admission that increased at an even faster rate of 11% and 18%, respectively.[44] The other reason that might explain this phenomenon is that the governance of the URBMI and NRCMS at a provincial, municipal, or even county level could have created huge differences in the reimbursement rate and co-payments. These differences could further lead to variations in medical costs since the type of medical insurance schemes were found to influence the direct medical costs of hospitalization in this study.

Interestingly, our study also found that hospitalization costs were negatively correlated with had a surgery and being a single person. In fact, it is not that hard to understand. The treatments of CHD for Chinese included the medical therapy, interventions with heart-stents, and surgery, more than 50% of patients choose the revascularization with heart-stents, which often accompanied with high expenses on medical consumables and high costs related to complications.[21,36] Being a single person means he or she would get relatively less social and financial supports from family members, which reduced the medical costs by reducing their use of health services, and several recent studies have offered evidence that marriage fulfills a protective function for elderly males,[45,46] and Simeonova found out that there were negative effects of bereavement on health care utilization among chronically ill elderly males.[47]

There are 3 main limitations of this study. The first is the potential bias of the subjects since all inpatients were from a single tier-3 hospital in Xi'an. Thus, the generalizability of the sample may be poor. The truth is that the trust of patients in their clinics and community health centers is low and approximately 85% of patients in China seek medical service in a tier-3 hospital for simple health problems because of the excellent health resources, such as doctors and advanced equipment. On the other hand, the difference in reimbursement among different hospitals at different levels according to the same medical insurance scheme was not significant, and most of the inpatients can afford the difference. The second limitation is that only the direct medical cost of hospitalization was described, and this study did not account for reimbursement or out-of-pocket expenses and the out-of-pocket expenses may present a more complete representation of the economic burden of CHD. Because of that, we were limited in that we did not clearly know the scope and rate of reimbursement in the local region for the majority of subjects in this study. The third limitation is that there was not enough information that was collected that included family incomes, jobs, education levels, and especially the co-morbidities within the target population. This lack of additional data leads to the limitation of the multiple regression analysis.

This was a retrospective, cross-sectional, non-randomized, hospital-based cost-of-illness chart review study from a social perspective, and this study described the actual direct medical costs of a hospitalization with CHD that included the main components of the costs. This helped us to have a better understanding of the economic burden of this new type of chronic disease. The inpatients with CHD in a tier-3 hospital (Xijing hospital in Xi'an, China) were mostly over 45 years old, with more male inpatients than females. The average hospitalization expense was 6791.38 dollars, and the total expenditure of males was much higher than that of females. Expenses for medical consumables were higher than the other expenses, which suggest that a solution for tremendous hospitalization expenditures included that closer attention was paid to controlling the high expense of medical consumables with the exception of traditional expenses (e.g., drugs and examinations). Our findings suggest that age, gender, the number of admissions, LOS, and the type of medical insurance schemes were independently associated with medical expenditures. Furthermore, surgery might achieve appreciable savings in hospitalization expenditures compared with invasive treatments with stents. Reducing or controlling high hospitalization expenditures is a complicated process that requires multi-cooperative efforts.

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