Background: It is unknown whether insurance status influences care provided and patients’ prognosis, in China.

Methods: This retrospective cohort study included medical records of 4,714 patients with acute myocardial infarction aged 20 and older, discharged consecutively from 14 Chinese hospitals between January 2000 and February 2003. Uni-variate analysis, multivariate logistic regression and linear regression were used to compare differences in patients’ characteristics, care provided and prognosis between insured patients and the uninsured.

Results: The uninsured were more likely to be older, female, have transfer admissions, and less likely to be hospitalized to institutions with cardiac interventional facilities, intensive care units or coronary care units. The uninsured were also less likely to undergo diagnostic procedures, interventions and to receive medications, and stayed shorter in hospital and consumed less health care resources. In-hospital mortality in the uninsured, the non-government insured and the government insured was 10.5%, 12.2% and 8.4% respectively. After adjusting for potential confounders, odd ratio in hospital mortality was 1.079 (95% CI, 0.836–1.392) and 0.763 (95% CI, 0.559–1.041) for the non-government insured and the government insured, compared to the uninsured. At significant level of 0.05, we could not assert insurance status is a significant factor to in-hospital mortality.

Key words: disparity, care, insurance, myocardial infarction

Introduction

As a country in transition, medical insurance in China is divided into the following categories: government insurance scheme (GIS), labor insurance scheme (LIS), basic health insurance scheme (BHIS), severe disease insurance (SDI), commercial insurance (CI), half labor insurance (HLI), cooperative medical scheme (CMS) and other insurance plans. GIS was set up in 1952, covering all government employees, college students and staff, as well as employees in non-profit organizations. LIS was introduced for workers in the state-owned and certain big collective enterprises in 1951. CMS was created in the 1940s in rural areas. CMS members previously received free care in local health centers. However it collapsed rapidly after the breakdown of collective economy in rural areas in the early 1980s. GIS covered nearly all of its members’ medical expenditures except several conditions including registration fee, tonics and plastic surgery. LIS used to provide benefits similar to GIS, but also reimbursed half of medical expenditure to the employees’ immediate dependants (called HLI). Individual enterprise financed and administered LIS and the government served as the payer of last resort. Since introduction of a market economy in the 1980s, the government no
longer assists LIS. As a result, the benefit of LIS decreased and has varied dramatically across enterprises. In some areas, LIS covered only severe diseases (called SDI). BHIS reform was promulgated at the end of 1998. Its main purposes were to develop a community-based insurance scheme, mandating all community employees of the government or private enterprises to participate, and to introduce various cost sharing mechanisms. In principle, a patient’s medical cost amounted to more than 1/10 and less than 4 times of his/her wage, can be covered by the social pooling fund of BHIS with a co-payment rate of no more than 40%. BHIS is operated by local government, and currently an effort to expand its coverage nationwide is under way. CI was a product of the market economy, and in general its benefit is better than CMS, but not than BHIS.

By the end of the 1970s, GIS had covered about 1.5-5% of the total national population (i.e. about 8% of urban population), LIS covered 12-14% (i.e. 60% of urban population), and CMS covered 70% (i.e. 90% of rural population). However by 2003, 70.3% of the national population was not covered by any scheme, and 1.2%, 1.3%, 8.9%, 8.8%, 0.6%, 7.6% and 1.4% were covered by GIS, LIS, BHIS, CMS, SDI, CI and other insurances, respectively. After this dramatic transition, what are the situations in care provided to insured patients and the uninsured, and are there any disparities?

In western countries observed disparities have been noted among insurance schemes or races in preventive care, medical care, medication use, and dental care. In China, studies have reported abuse or unnecessary use of medications and diagnostic procedures in both insured patients and the uninsured and that there is an enormous gap in medical expenses between insured patients and the uninsured. Some researches have revealed that health care resource consumption was significantly related to insurance status, but not to the severity of illness. However, we could not find reports on disparities in medical care utilization and differences in patients' prognosis. Hence, the purposes of this study were to compare clinical features and care provided between insured patients and the uninsured with acute myocardial infarction (AMI), and to examine if insurance status is a significant factor to patients’ prognosis.

Materials and Methods

Sample

Medical records of 4,714 inpatients (1,406 female and 3,308 male), aged 20 and older, with AMI as the primary diagnosis, discharged consecutively between January 2000 and February 2003, were collected from 14 general hospitals in China. Basic characteristics of each hospital were shown as Table 1. Questionnaires were filled out by physicians or staff of medical record department under supervision of cardiologists from each hospital. The study was consistent with the guideline of declaration of Helsinki and informed consent was obtained from each patient prior to the study.

Study variables were classified as baseline characteristics, comorbidities and cardiac risk factors on admission, clinical findings and clinical severity within the first 48 hours, initial electrocardiogram (ECG) findings within the first 24 hours, treatments during hospitalization, and patients’ outcomes.

Considering the validity of obtained information and the physiological mechanism of acute myocardial infarction, we adjusted gender, age, cardiac inteventional facility, comorbidity (a medical history of heart failure, cerebrovascular accident (CVA) and diabetes, and presence of a severe hypertension, renal dysfunction, and anemia on admission), and clinical severity (anterior or septal infarction, Killip class III/IV, and the first creatine kinase level over than 3 times the upper normal limit) step by step to examine the effects of health insurance status on length of hospital stay (LOS), medical expense and in-hospital mortality, referring to early AMI studies.

Statistical analyses

Chi-square test and the Mann-Whitney U test were used to compare categorical variables, and odds ratios (ORs) were estimated for Chi-square tests. Student's t test and analysis of variance were used for continuous variables. We assessed effects of insurance status on medical expenses and LOS by multivariate linear regression. Data of medical expenses and LOS were log transformed due to the skewed distributions. We then performed multivariate logistic regression to test the relationship between insurance status and inhospital mortality, and found a significant gender-age interaction. Thus, the interaction term was included in the model. Multivariate logistic regression was used to examine differences in clinical treatments between insured patients and the uninsured.
SPSS for Windows 10.0 was used for data management and analysis. All significance tests were 2-sided.

Definition of insurance status
In the study sample, 42.7% of the patients had no coverage, and 23.2%, 13.2%, 10.2%, 7.6%, 0.8%, 0.7% and 1.5% of the patients were covered by GIS, LIS, BHIS, SDI, CI, HLI and other insurances, respectively. Since GIS provided the broadest coverage with no co-payment and significantly differed from other schemes, we categorized patients into 3 groups: the uninsured, the non-government insured and the government insured (GIS). Since our interest is differences between insured patients and the uninsured, we did not compare differences between two insured groups in this study.

Results

Baseline characteristics
The uninsured comprised 42.7% of the study population, 34.1% with non-government insurance and 23.2% with government insurance. The uninsured were significantly older than the non-government insured, but not than the government insured. The uninsured patients were more likely to be female, have more transfer admissions and less likely to be admitted to hospitals with advanced cardiovascular facilities (Table 2).

Comorbidities and cardiac risk factors
The uninsured were less likely to report a history of hypertension, hypercholesterolemia, diabetes, smoking, ischemic heart disease in their family, liver failure, CVA, cancer, and drug allergy, and more likely to have a history of heart failure, arrhythmia and chronic obstructive pulmonary disease (Table 3).

Clinical findings within the first 48 hours after admission
Compared to the insured, the uninsured were more likely to have hypertension, anemia and abnormal blood urea nitrogen level, but lower creatinine level and less diabetes (Table 4).

Clinical severities within the first 48 hours after admission
Lower rates of hemorrhage and prolonged angina were observed in the uninsured. Compared with the
non-government insured, the uninsured were less likely to suffer from pneumonia, but more from a MI of Killip class III/IV when compared to the government insured (Table 5).

**ECG findings within the first 24 hours after admission**

Compared to the insured, the uninsured were less likely to have abnormal findings of old MI and ventricular tachycardia, and more likely to have atrial fibrillation
or atrial flutter (Table 6).

**Clinical treatments**

After controlling for patients’ gender, age, Killip class III/IV, anterior or septal MI, and cardiac interventional facilities, the uninsured were less likely to be admitted into ICU/CCU, to undergo echocardiogram, PTCA and CABG, and were less likely to be treated with beta-blockers, nitroglycerin, heparin, warfarin, and vasopressor, compared to the insured. The uninsured received less thrombolytic therapy, ACE inhibitors, and more calcium channel blockers compared to the non-government insured, and more likely to be given thrombolytic therapy and less likely to be treated with ticlopidine compared to the government insured (Table 7).

| Table 4. Clinical findings within the first 48 hours after admission |
|----------------------|-----------------|-----------------|-------------|--------|--------|
|                      | Uninsured(%)    | Non-gov plan(%) | Gov. plan (%) | OR1    | OR2    |
| Mean body temperature (°C) | 36.35           | 36.35           | 36.42       | 0.0195 | 0.022**|
| Hypertension †         | 15.3            | 13.3            | 9.7         | 0.853  | 0.597**|
| Pulse rate > 100 beats/min | 10.4            | 10.1            | 9.0         | 0.962  | 0.657  |
| Abnormal respiration ‡  | 16.2            | 16.7            | 14.5        | 1.031  | 0.878  |
| Anemia (hematocrit<0.3) | 8.0             | 6.6             | 5.3         | 0.806  | 0.640**|
| Abnormal WBC §         | 29.2            | 30.5            | 26.7        | 1.062  | 0.883  |
| Abnormal platelet ¶     | 5.7             | 6.7             | 5.1         | 1.199  | 0.900  |
| Abnormal BUN ¶         | 27.3            | 20.5            | 22.7        | 0.689**| 0.783**|
| Renal dysfunction ††    | 8.3             | 11.0            | 9.3         | 1.367**| 1.138  |
| Diabetes (GLU≥140mg/dl) | 27.6            | 32.3            | 29.6        | 1.249**| 1.104  |

† Admission systolic blood pressure ≥160 or admission diastolic blood pressure ≥95 mmHg
‡ < 16 times/minute or > 20 times/minute
§ For male: >10.40×10⁹/L; for female: >10.80×10⁹/L
¶ <100.00×10⁹/L or > 400.00×10⁹/L
†† BUN: blood urea nitrogen > 20.00 mg/dl

OR1, OR2: odds ratios in prevalence rate of those insured by non-government plan and government plan compared to the uninsured, respectively. S.E: standard error (%): prevalence rate ** p<0.01, * p<0.05
Mean of LOS in the uninsured, the non-government insured and the government insured was 14.01, 16.97 and 19.84 days respectively. Tamhane’s T2 analysis yielded significant differences in LOS between the uninsured and the non-government insured (S.E 0.45, p<0.001), between the uninsured and the government insured (S.E 0.51, p<0.001), and between the non-government insured and the government insured (S.E 0.53, P<0.001). Insurance status was a significant (coefficient 0.086, p<0.001) factor to LOS in multivariate linear regression.
Medical expense
Mean of medical expense in the uninsured, the non-government insured and the government insured was 14,029.18, 26,360.49 and 35,638.26 Chinese Yuan respectively. Tamhane’s T2 analysis revealed significant differences in medical expense between the uninsured and the non-government insured (S.E 1091.92, p < 0.001), between the uninsured and the government insured (S.E 1205.35, p < 0.001), and between the non-government insured and the government insured (S.E 1294.57, P < 0.001). Insurance status was a significant (coefficient 0.156, p < 0.001) factor to medical expense in multivariate linear regression.

In-hospital mortality
In-hospital mortality rate in the uninsured, the non-government insured and the government insured was 10.5%, 12.2% and 8.4% respectively, and insurance status was not a significant (coefficient -0.114, p=0.137) factor to in-hospital mortality after multivariate adjustment.

The unadjusted ORs for in-hospital death for the non-government insured and the government insured were 1.179 (95% CI, 0.959-1.449) and 0.781 (95% CI, 0.604-1.009), compared to the uninsured. After multivariate adjustment, the ORs were 1.079 (95% CI, 0.836-1.392) and 0.763 (95% CI, 0.559-1.041) for the non-government insured and the government insured, compared to the uninsured. We could not draw the conclusion that there are significant differences in in-hospital mortality between the uninsured and the insured, at significant level of 0.05 (Table 8).

Discussion
Disparities in clinical treatments and medical expense
As a country in decentralization, 82.9% of China’s hospitals and 93.1% of hospital beds were owned by governments or state-owned enterprises, but government subsidy reimbursed only 8.0% of hospitals’ expenditure in 2003. On the other hand, these hospitals’ economic is managed autonomously. Revenue indicators are distributed to medical departments, medical teams, and even physicians. Physicians’ bonus is related to the amount of services they provided. Patients have to pay in advance before they are treated. Therefore, a culture of cynicism and corruption in China’s hospitals is widely criticized. Ethical considerations in medical care delivery, such as over-charging, over-providing profitable services, and over prescription of unnecessary drugs, especially to the insured or those who can afford them, were frequently reported.

In this study, we found that hospitals located in

Table 8. Relationship between insurance status and in-hospital mortality and effect of adding covariates

<table>
<thead>
<tr>
<th></th>
<th>Non-government insurance</th>
<th>Government insurance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>0. without risk-adjustment</td>
<td>1.179</td>
<td>0.959-1.449</td>
</tr>
<tr>
<td>I. Gender adjusted</td>
<td>1.294</td>
<td>1.049-1.596</td>
</tr>
<tr>
<td>II. I + age (5 years) *</td>
<td>1.281</td>
<td>1.033-1.588</td>
</tr>
<tr>
<td>III. II + hospital peer group †</td>
<td>1.133</td>
<td>0.906-1.426</td>
</tr>
<tr>
<td>IV. III + comorbidity ‡</td>
<td>1.136</td>
<td>0.899-1.436</td>
</tr>
<tr>
<td>V. IV + clinical severity §</td>
<td>1.079</td>
<td>0.836-1.392</td>
</tr>
</tbody>
</table>

OR: Odds ratio indicates the relative risk to die in hospital for the insured (gov. or non-gov. scheme) compared to the uninsured. CI indicates confidence interval.
* Age (5 years): age was categorized into ≤ 35, 36-40, 41-45,..., 81-85, and ≥ 86 years old.
† Hospital peer group: hospitals without facilities for both percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass grafting (CABG), hospitals with facilities for PTCA only, hospitals with facilities for both PTCA and CABG.
‡ History of heart failure, history of cerebrovascular accident, history of diabetes, severe hypertension (admission systolic blood pressure ≥ 200 mm Hg or diastolic blood pressure ≥ 120 mm Hg), renal dysfunction on admission (creatinine level > 2 mg/dL), and anemia on admission (hematocrit <0.3).
§ Anterior or septum infarction, Killip class III or IV, and first creatine kinase level more than 3 times the upper normal limit.
small towns tended to have a smaller number of beds, less advanced cardiovascular facilities, and a higher proportion of uninsured patients, and the hospitals located in metropolitan areas tended to have more beds, better cardiovascular facilities and more insured patients. These facts may explain to some extent why the uninsured were more likely to be admitted to hospitals with less advanced cardiovascular facilities (Table 2).

Even after multivariate adjustment insurance status is still a significant factor in medical expenses. One explanation is that since we did not include all treatments in multivariate model, and differences may exist in utilization of treatments, some of which were not included but still may have contributed to the difference in medical expense. Another explanation is that amounts of resources consumed, such as duration and frequency of each drug administered, were not reflected and included in the multivariate model. Thirdly, income level may be another factor that affecting received services and medical expense. The effects of income and the interaction term between income and insurance status should be examined in future study, if possible.

The study subjects were recruited from 14 hospitals, which located in 10 cities separately. Each hospital has its special characteristics, such as the number of beds, technical level in medicine, patients’ proportion of insurance schemes, et al (Table 1). In despite of these variances, we selected the indicator of cardiac interventional facility (without facilities of both PTCA and CABG, with facility of PTCA only, and with facilities of both) to represent differences in hospitals’ characteristics in multivariate models in this study.

Policy implications

In this study, we described differences in clinical treatments between the insured and the uninsured. Although we have no intention to judge whether clinical treatments were appropriate or not, we did find that the insured patients consumed more health resources and were more likely to be treated with diagnostic procedures, interventions and medications. Since a relative lower death risk in the government insured compared to the uninsured (OR 0.763, p=0.088), significant at level of p<0.10, we can not assert that there is no difference in hospital mortality between these two groups. China’s health researchers and policy makers should pay more attentions to the uninsured, and measures to improve equity in health care delivery should be considered.

Limitations

Treating timing-time from onset of symptoms to hospital arrival, and timing of therapy-time from hospital arrival to start of therapy, are considered to be important to patients’ prognosis. However, this information was not included in data collection, and therefore we can not analyze whether this would change the results. Hence, the conclusions should be interpreted with caution.

We only examined selected procedures and did not take into account alternate therapies for specific patients. Since we seldom found therapies that were used more frequently in the uninsured, we did not think this would have brought bias to the conclusion.

Acknowledgements

This study was supported by the Yan-Tai Health Economics Association, P.R China and the Department of Medical Administration, the Ministry of Health, P.R.China. The template of Noguchi et al41 was referred to and necessary modification was done according to our design. We sincerely express our acknowledgements to Professor Koichi Kawabuchi, Miss Naoko Murashige, Ms Keiko Kajitani, Ms Xue-Nan Liu, Dr. Isao Igarashi, and reviewers of Journal of Medical and Dental Sciences, for their generous help in the manuscript preparation.

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