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Letter to the Editor

Impact of hospital and physician characteristics on medical expenditures for acute myocardial infarction hospitalization

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Abstract

This study aims to examine the impact of length of stay, hospital characteristics, physician characteristics and other factors on the expenditures of hospitalization for acute myocardial infarction (AMI) under Taiwan's National Health Insurance program. This study uses data collected from the Taiwan's National Health Research Institute's 2001–2003 *National Health Insurance Research Database*. We estimated contributors to increased expenditures of hospitalization using three-stage least square regression model. The hospital expenditures for the treatment of AMI averaged NT$126,366 (US$3829, US$1=NT$33) per discharge, with the largest proportion (27%) spent on room expenditures. They were strongly impacted by length of stay, increasing around 4.8% per day. We conclude that hospital expenditures for the treatment of AMI patients may vary widely depending on the characteristics of the hospital and physicians that provide them care.

Keywords: Hospital expenditures; Acute myocardial infarction; National Health Insurance

Heart disease, one of the most common chronic diseases in Taiwan, has been one of the top four leading causes of death since the 1970s, just behind malignant neoplasms, cerebrovascular disease, and accidents [1]. To protect patients with acute myocardial infarction (AMI) from catastrophic financial burden, Taiwan's National Health Insurance (NHI) has, since it inception in 1995, covered the treatment of heart disease with some co-payment by the patients. In 2004, there were more than two hundred thousand inpatients with AMI, account for 11.23% of total admissions and 7.14% of total hospital expenditures claimed [2].

Since its first financial crisis in 1998, the NHI has tried with varying results to manage costs by making several major policy changes in its payment system. With changes in the financing and delivery of health care, there was an increasing need to explore the contributors to increased medical expenditures, but not many evidences were provided in Taiwan.

Hospital length of stay (LOS) has been the most important determinant of the total cost over the past three decades [3]. Although prior studies have demonstrated LOS as a crucial contributor to increased costs [3,4], no one adjusted for the factor of LOS in the estimation model. Since no study has researched how these increased costs relate to hospital LOS, this study aims to evaluate such a relationship.

The data used in this study was selected from Taiwan's *National Health Insurance Research Database* provided by National Health Research Institutes. This database contains the medical benefit claims for the inpatient and outpatient care for almost all of Taiwan's 23 million citizens. A total of 31,104 patients were admitted for acute myocardial infarction (ICD-9-CM code 410) between Jan. 2001 and Dec. 2003. After excluding those discharged because of death, those discharged at their own request, those transferred to other hospitals, and those readmitted within a 30-day period, and

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those with missing data, we were left with 19,708 effective samples to analyze.

LOS was, no doubt, a function of other factors and was not suitable to be treated as an independent variable in the estimation. Therefore, controlling for endogeneity of LOS, we performed two-equation simultaneous model treating both hospital expenditures and LOS as two dependent variables in the estimation. A three-stage least square model was regressed on 3 years of NHI claim data of people hospitalized for AMI to obtain unbiased, consistent, and efficient estimates of hospital expenditures. The STATA 9.0 (2005) computer software package was used for the analyses.

As expected, room expenditures made up the greatest largest proportion of the hospital expenditures (27%). Mean hospital expenditures for patients treated at medical centers and regional hospitals were more than 3 times those of patients treated in district hospitals. The hospital expenditures at non-profit hospitals and public hospitals were higher than they were at profit-making hospitals. Most (55.8%) of the physicians specialized in internal medicine, followed by cardiovascular medicine (28.2%), and others (16.0%). Physicians with specialties in internal medicine or cardiovascular medicine reported fewer hospital expenditures than those with other specialties.

The associations between the possible contributing factors and increased hospital expenditures were analyzed (Table 1). As expected, LOS had a significant and positive impact on hospital expenditures with $p<0.001$. Except for region and physician specialties, all the hospital and physician characteristics we tested were significantly (all $p<0.001$) associated with hospital expenditures. Medical centers and regional hospitals reported greater expenditures than district hospitals. Public hospitals and non-profit hospitals reported significantly more hospital expenditures than profit-making hospitals. High-volume hospitals reported significantly more hospital expenditures than low-volume hospitals. In contrast, "high-volume" physicians tended report fewer hospital expenditures than those with fewer cases. Physicians specializing in cardiovascular medicine and internal medicine reported fewer hospital expenditures than physicians with other medical specialties.

This study found that the mean LOS was 9.1 days during our study period 2001 to 2004, which is lower than LOS reported for Japan (31.2 days) between 1998 and 2003 [5], but comparable to the 7–12 days reported for the US, Canada and France [6–9]. Hospital expenditures averaged NT$126,366 (US$1=NT$33) per discharge in Taiwan from 2001 to 2003, much lower than those reported for Japan (US$28,925) and the US (US$12,828) in 1999 [10]. Room expenditures were found to made up the largest proportion (27%) of hospital expenditures and played a crucial role in increased hospital expenditures. There was approximately a 4.8% increase in hospital expenditures for each additional day. We also calculated the marginal effect (in bed day elasticity) to elucidate how much change in hospital expenditures would occur in response to a 1% increase in the LOS. Elasticity was found to be 0.4, meaning that with each 1% increase in the LOS came a 0.4% increase in hospital expenditures.

Table 1
Predictors of hospital expenditures for acute myocardial infarction analyzed by three-stage least square regression model ($n=19,708$)

Variables	Hospital expenditures			Length of stay		
	Coeff.	SE	*P* value	Coeff.	SE	*P* value
Length of stay	0.048	0.01	<0.001	–	–	–
Hospital characteristics						
Hospital level						
Medical center	0.530	0.03	<0.001	3.397	0.28	<0.001
Regional hospital	0.512	0.02	<0.001	1.936	0.23	<0.001
District hospital (*ref.*)						
Hospital ownership						
Public	0.119	0.01	<0.001	0.742	0.20	<0.001
Non-for-profit	0.101	0.01	<0.001	0.006	0.18	0.972
For profit (*ref.*)						
Hospital location						
Central	−0.003	0.02	0.857	−1.266	0.16	<0.001
South	0.041	0.01	0.001	−1.109	0.12	<0.001
East	−0.607	0.02	0.010	−0.389	0.33	0.242
North (*ref.*)						
AMI case load						
≥150	0.083	0.01	<0.001	0.287	0.18	0.110
Physician characteristics						
Physician gender						
Male	0.160	0.02	<0.001	–	–	–
Physician age						
<41	0.059	0.01	<0.001	0.089	0.11	0.420
>50	−0.098	0.01	<0.001	0.030	0.20	0.882
41–50 (*ref.*)						
Physician specialty						
Cardiovascular	−0.043	0.02	0.076	−2.603	0.17	<0.001
Internal medicine	−0.068	0.02	0.004	−2.588	0.15	<0.001
Others (*ref.*)						
AMI case load						
≥54	−0.064	0.02	<0.001	−1.645	0.12	<0.001
Constant	9.553	0.07	<0.001	8.490	0.26	<0.001

Note: Patient demographic factors (age, gender), pre-existing comorbidity (Charlson comorbidity Index score), coronary risk factors (Hypertension, Hyperlipidemia), procedure (coronary angiography, stenting, cardiac catheterization, percutaneous transluminal, PTCA, CABG, temporary pacemaker, intra-aortic balloon pumping, mechanical ventilation), in-hospital cardiac complications (congestive heart failure, cardiogenic shock, second- or third-degree AB block etc.), in-hospital non-cardiac complications (respiratory failure, pneumonia) were controlled in the estimation.

The hospital characteristics found to be most crucial factors in other studies were also found to be significant here [7]. More specifically, the hospital expenditures in medical centers or regional hospitals were on an average about 55% or 53% higher than those in district hospitals. The hospital expenditures in public hospitals or in non-profit hospitals were 10% higher than those of profit-making hospitals. Female physicians, older physicians, those whose specialties were cardiovascular or internal medicine, and those with more AMI cases than average were less likely to generate lower hospital expenditures. The hospital expenditures for AMI patients attended by physicians specializing in cardiology or internal medicine were 4.3% and 6.8% lower than those whose attending physician specializing in others.

In conclusion, this study is the first to present a detailed discussion of the hospital expenditures for acute myocardial infarction in Taiwan. It found hospital expenditures to vary widely depending on characteristics of hospitals and their physicians, particularly medical specialty, leading to believe that further investigation of differences in treatment procedures used by providers and their impact on hospital expenditures might help lower medical expenditures for AMI and help reduce some of the expenditures contributing to the financial crisis occurring in the National Health Insurance program.

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