ACKNOWLEDGEMENTS

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Tables

Figures

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Figure 1

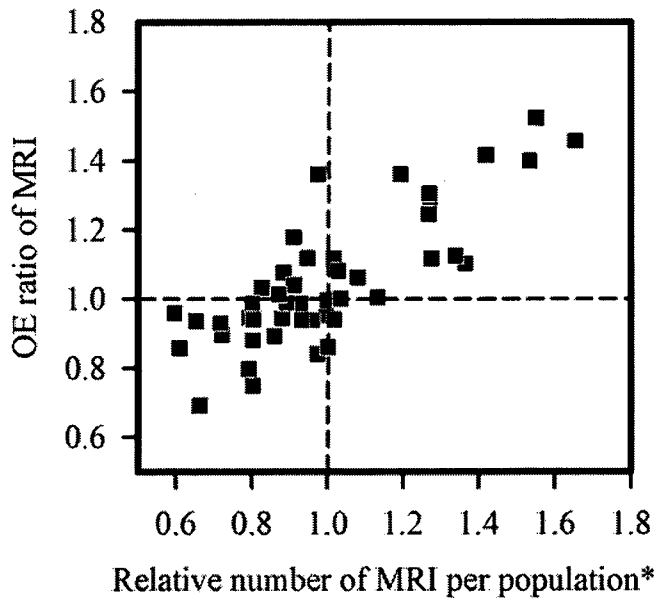
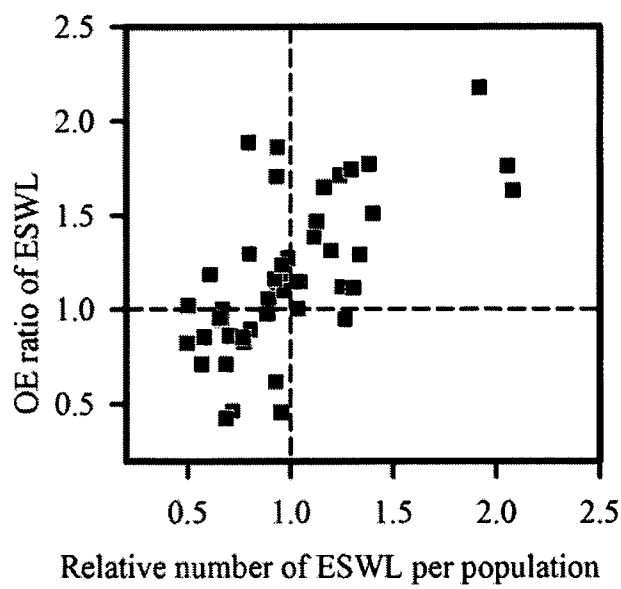


Figure 2



1

Table 1. Total number of MRI and ESWL by facilities for each fiscal year

			1996	1999		2002		2005	
			N	N	Rate of Increase	N	Rate of Increase	N	Rate of Increase
MRI	Hospital	Facility	2,175	2,622	(20.6%)	3,067	(17.0%)	3,322	(8.3%)
		Equipment	2,360	2,938	(24.5%)	3,505	(19.3%)	3,878	(10.6%)
	Clinic	Facility	N/A	N/A	N/A	889	N/A	1,242	(39.7%)
		Equipment	N/A	N/A	N/A	996	N/A	1,250	(25.5%)
ESWL	Hospital	Facility	483	586	(21.3%)	763	(30.2%)	867	(13.6%)
		Equipment	N/A	N/A	N/A	794	N/A	891	(12.2%)
	Clinic	Facility	N/A	N/A	N/A	13	N/A	14	(7.7%)
		Equipment	N/A	N/A	N/A	20	N/A	21	(5.0%)

MRI : Magnetic resonance imaging scanner
ESWL : Extracorporeal shock wave lithotripter
N : Total number for each fiscal year in Japan
Rate of increase : Rate of increase over the previous 3 fiscal years
N/A : Not available
Clinic : A facility having fewer than 20 beds
Hospital : A facility having equal to or more than 20 beds
Source : National Survey of Medical Care Institutions
The survey items on medical technology are included in a large-scale survey conducted every 3 years.

2

Table 2. Utilization proportions of MRI and ESWL by classification of primary diagnosis

Major Diagnostic Categories	No. of classifications of primary diagnosis	Utilization proportion of MRI (%)			Utilization proportion of ESWL (%)		
		Mean[a]	Min[b]	Max[c]	Mean[a]	Min[b]	Max[c]
Nervous System	37	8.8	0.0	37.5	0.0	0.0	0.2
Eye	37	0.4	0.0	6.5	0.0	0.0	0.0
Ear, nose, mouth and throat	37	0.8	0.0	20.0	0.0	0.0	0.0
Respiratory system	27	0.6	0.0	3.2	0.0	0.0	0.0
Circulatory system	26	1.2	0.0	7.7	0.0	0.0	0.0
Digestive system	37	1.5	0.0	9.8	0.0	0.0	0.3
Musculoskeletal system	37	1.8	0.0	12.5	0.0	0.0	0.0
Skin and subcutaneous tissue	25	1.1	0.0	2.2	0.0	0.0	0.0
Mammary gland	5	0.3	0.0	0.3	0.0	0.0	0.0
Endocrine and metabolic system	37	1.7	0.0	33.3	0.0	0.0	0.0
Kidney, urinary tract and male reproductive system	32	0.9	0.0	7.7	3.4	0.0	30.2
Female reproductive system, pregnancy and puerperium	29	0.0	0.0	2.6	0.0	0.0	0.0
Blood and blood forming organs	16	1.3	0.0	2.7	0.0	0.0	0.6
Neonates and congenital malformation	37	1.2	0.0	4.7	0.0	0.0	0.0
Other pediatrics	9	0.4	0.0	9.8	0.0	0.0	0.0
Injuries, burns, toxicosis and others	37	1.2	0.0	33.3	0.0	0.0	0.1

[a]: Mean utilization proportion in each major diagnosis category
[b]: Minimum utilization proportion in each classification of primary diagnosis
[c]: Maximum utilization proportion in each classification of primary diagnosis
Number of sampled hospitals: 16 (MRI), 15 (ESWL)
Total number of patients in sampled hospitals: 387 644 (MRI), 383 362 (ESWL)

Table 3: Summary statistics of OE ratio and supply indicators of MRI and ESWL at prefectural level (N = 47)

		Mean	Standard deviation	Min	Max
MRI	OE ratio of device units	1.05	0.19	0.69	1.52
	No. of radiologists per MRI	1.33	0.42	0.60	2.33
	No. of radiological technologists per MRI	9.20	1.64	5.80	13.20
	No. of examinations per MRI [a]	171.25	39.65	110.00	329.50
	Increasing rate of no. of MRI [b]	10.75	6.24	0.00	27.80
ESWL	OE ratio of device units	1.18	0.41	0.43	2.18
	No. of urologists per ESWL	7.59	2.27	3.30	14.20
	No. of procedures per ESWL [a]	11.08	3.27	3.60	17.60
	Increasing rate of no. of ESWL [b]	12.57	20.94	-37.50	63.60

[a]: Survey period for utilization: one month

[b]: Reference period for increasing rate: 2002-2005

Table 4: Correlations between OE ratio and supply indicators of MRI and ESWL (N = 47)

		OE ratio of MRI	OE ratio of ESWL
No. of specialist personnel	r	-0.701	-0.417
per no. of device units [a]	p-value	0.000	0.004
No. of examinations/procedures	r	-0.221	-0.377
per no. of device units	p-value	0.136	0.009
Increasing rate of	r	-0.303	0.047
no. of device units	p-value	0.038	0.753

[a]: specialist personnel consists of radiological technologists (MRI) and urologists (ESWL)
The no. of radiologists per MRI was not included as it was found to have a non-significant correlative coefficient (r=.023, p=.876) with the OE ratio of MRI.

Title

Determinants of return on resource input based on the cost database of a patient classification system: cases of percutaneous coronary intervention and gastrectomy

First author: Tetsuya Otsubo

Co-authors: Yuichi Imanaka, Jason Lee, Kenshi Hayashida, Shinya Matsuda

Introduction

The aim of this study was to elucidate any possible association of return on resource input (RORI, given by individual charge divided by individual cost) with patient factors and hospital factors among patients who underwent percutaneous coronary intervention (PCI) or gastrectomy.

Data

The charge and cost data of 411,706 patients discharged from 189 hospitals in Japan between July 2006 and December 2006 used in the national DPC research project. The hospitals included 9 national or private university hospitals, 102 governmental or insurance association hospitals and 78 others. Charge data were calculated based on the diagnosis procedure combination (DPC) payment system. Patient-level costs were obtained through a standardized methodology.

Methods

We selected 4,896 operable angina pectoris patients (mean age: 68 years) and 2,616 operable gastric cancer patients (mean age: 66 years) from the above database.

Multiple regression analyses were performed to identify factors associated with RORI. The independent variables consisted of patient-level and hospital-level factors. Patient-level variables included gender, age, total length of stay (LOS), surgical procedure type, and Canadian Cardiovascular Society (CCS) classification for angina pectoris patients or chemotherapy for gastric cancer patients. Hospital-level variables consisted of the proportion of PCI or gastrectomy patient volume to total inpatient volume and the ratio of total inpatient charge to total inpatient cost (RTCC).

Results

The mean RORI for PCI and gastrectomy were found to be 0.99 and 1.09, respectively. The mean LOS for PCI was 6.8 days and the LOS for gastrectomy was 25.1 days.

Results from both the PCI and gastrectomy multiple linear regression models revealed that a shorter LOS, a higher RTCC and female patients were significantly associated with higher RORI ($P < 0.01$). Furthermore, in both regression models, LOS was found to have the strongest association among all the independent variables.

With regard to procedure-specific features, the proportion of PCI patient volume to total inpatient volume was found to have a significant association with RORI, while there was no significant association between the proportion of gastrectomy patient volume to

total inpatient volume and RORI.

Discussion and Conclusions

Our results show that a shorter LOS results in a higher RORI, and reflects that the design of the current Japanese healthcare reimbursement system results in an economic incentive for reducing LOS in individual patients.

On the other hand, from the viewpoint of hospital management, a simple reduction of LOS with the same volume of patients would result in the reduction of RTCC, thus diminishing any economic incentive for hospitals to reduce hospital stay durations. Therefore there may be a necessity for interventions that seek to decrease LOS of each individual patient while increasing the hospital-level RTCC by increase patient volume. Furthermore, our results show that there may be an economic incentive for hospitals to specialize to a certain degree in PCI patients, as increasing the proportion of PCI patient volume to total inpatient volume would result in a higher RORI. However, as this association was not observed in gastrectomy, this type of advantage in specialization may be procedure-specific.

Keywords: cost; revenue; length of stay; patient classification; Japan

Determinants of return on resource input based on the cost database of a patient classification system: cases of percutaneous coronary intervention and gastrectomy

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Introduction

Many Japanese hospitals currently face profitability issues, with approximately 50% of private/public hospitals operating at a loss.[1] As the profitability of a hospital was found to be the most important factor in determining hospital closure,[2] it appears imperative to identify the factors that influence the profitability of hospitals in Japan. In an already over-loaded healthcare provision system exacerbated by a high ratio of fixed costs to variable costs and a shortage of doctors, preventing the closure of hospitals due to poor profitability is an essential step in maintaining the capacity and accessibility of the Japanese health system.

Poor profitability in Japanese hospitals may be attributed to some extent to effects that arose due to the implementation of the Diagnosis Procedure Combination (DPC) –based payment system in 2003. While the system allows for reimbursements to partially reflect the severity of each individual patient, it does not take into account variations in hospitals' burdens due to differences in casemix. Such a system could therefore detrimentally affect the profitability of hospitals that have an unfavorable casemix.

Using a sample of patients who underwent either percutaneous coronary intervention (PCI) or gastrectomy, the aim of this study was to elucidate any possible association of patient and hospital factors with return on input (RORI, given by individual charge divided by individual cost).

Methods

Data

We obtained both the charge and cost data of 411,706 patients discharged from 189 hospitals in Japan between July 2006 and December 2006 used in the national DPC research project. The hospitals included 111 public hospitals and 78 private hospitals.

From this database, we selected 4,896 operable angina pectoris patients who underwent PCI and 2,616 operable gastric cancer patients who had a gastrectomy performed. These patients were identified using the DPC patient classification system which is based on ICD-10, and made up of 1438 diagnosis groups,

consisting of 16 major diagnostic categories and 516 disease categories (2006 version). Patients were excluded from above patient samples if they had died during admission or had other surgeries prior to PCI or gastrectomy. Charge data was calculated based on the DPC based payment system. Patient level costs were obtained through a standardized framework.[3, 4]

Statistical Analysis

Multiple regression models were developed to identify patient-level and hospital-level factors associated with RORI, in which RORI was the independent variable. Patient-level factors included gender, age, total length of stay (LOS), surgical procedure type, and either the Canadian Cardiovascular Society (CCS) classification for angina pectoris patients or whether chemotherapy treatment was given for gastric cancer patients. Hospital-level factors consisted of the proportion of PCI or gastrectomy patient volume to total inpatient volume and the ratio of total inpatient charge to total inpatient cost (RTCC).

Statistical analyses were performed using SPSS Ver. 15.0J (SPSS Japan Inc., Tokyo, Japan)

Results

After employing the exclusion criteria, the number of patients used in analysis was 4,256 for PCI and 1,321 for gastrectomy. The mean RORI for PCI and gastrectomy were found to be 0.99 and 1.09, respectively. Patient and hospital characteristics are shown in Table 1. We observed that men were more heavily represented in both PCI and gastrectomy patient samples. Mean ages were similar (68 years and 66 years for PCI and gastrectomy patients, respectively), but gastrectomy patients had a much longer hospitalization duration. The mean LOS for PCI was 6.8 days and that of gastrectomy was 25.1 days.

As shown in Table 2, all patient- and hospital-level variables except for age were significantly associated with RORI in PCI patients. Furthermore, of these variables, LOS was the only factor that was negatively associated with RORI. A larger proportion of PCI patient volume to total inpatient volume was associated with greater RORI.

In the case of gastrectomy patients, as shown in Table 3, only the proportion of gastrectomy patient volume to total inpatient volume was not significantly associated with RORI. Age and LOS were negatively associated with RORI, and RTCC was found to have the largest impact within the regression model.

Table 1: Patient- and Hospital-level characteristics

		PCI	Gastrectomy
Patient-level variables			
Total number of patients		4,256	1,321
Gender (N, %)			
	male	3,208 (75.4)	890 (67.4)
Age			
	Mean, SD	68 (10)	65 (11)
Surgical Procedure (N, %)			
	PCI with stent placement	3,326 (78.1)	
	partial gastrectomy		1,073 (81.2)
CCS classification (N, %)			
	Class I	1,914 (44.9)	
	Class II	1,607 (37.8)	
	Class III	520 (12.2)	
	Class IV	215 (5.1)	
Chemotherapy (N, %)			
	none		1,219 (92.3)
Length of Stay			
	Mean, SD	6.8 (5.7)	25.1 (11.5)
Hospital-level variables			
Total number of hospitals		142	148
Proportion of PCI/Gastrectomy patient volume to total inpatient volume (%)			
	Mean, SD	8.1 (4.8)	1.7 (0.9)
Ratio of total inpatient charge to total inpatient cost (%)			
	Mean, SD	88.7 (13.2)	88.6 (131.3)

Abbreviation: N; number. SD; Standard Deviation.
PCI; Percutaneous Coronary Intervention. CCS; Canadian Cardiovascular Society.

Table 2: Results of Multiple Regression Model with return on resource input (RORI) as Dependent Variable -PCI.

		95% CI			
	B	Lower	Upper	β	p-value
Constant	64.488	61.175	67.802		0.000
Patient-level variables					
Gender (Reference: male)	1.024	0.262	1.787	0.031	0.008
Age	0.002	-0.031	0.034	0.001	0.914
surgical procedure (Reference: without stent placement)	2.274	1.485	3.063	0.067	0.000
CCS Classification	0.464	0.079	0.849	0.028	0.018
Length of stay	-1.319	-1.380	-1.257	-0.508	0.000
Hospital-level variables					
Proportion of PCI patient volume to total inpatient volur	0.191	0.122	0.259	0.065	0.000
Ratio of total inpatient charge to total inpatient cost	0.430	0.403	0.458	0.364	0.000
R^2	0.434				

Table 3: Results of Multiple Regression Model with return on resource input (RORI) as Dependent Variable -Gastrectomy.

		95% CI			
	B	Lower	Upper	β	p-value
Constant	24.113	18.129	30.097		0.000
Patient-level variables					
Gender (Reference: male)	2.128	0.811	3.445	0.040	0.002
Age	-0.076	-0.131	-0.020	-0.034	0.007
surgical procedure (Reference: partial gastrectomy)	4.938	3.586	6.290	0.092	0.000
Chemoherapy (Reference: none)	5.061	2.557	7.565	0.051	0.000
Length of stay	-0.863	-0.918	-0.808	-0.403	0.000
Hospital-level variables					
Proportion of Gastrectomy patient volume to total inpatient volume	-0.389	-1.070	0.291	-0.014	0.262
Ratio of total inpatient charge to total inpatient cost	1.212	1.168	1.256	0.683	0.000
R^2	0.633				

Discussion

In this study, we utilized multiple regression analyses to identify the patient-level and hospital-level factors associated with profitability in hospitals using data from 4,256 patients who underwent PCI, and 1,321 patients underwent gastrectomy from July 2006 to December 2006.

In general, most of the variables that we analyzed were significantly associated with RORI. In the case of PCI patients, gender, surgical procedure, CCS classification, proportion of PCI patient volume to total inpatient volume and RTCC were all significantly and positively associated with RORI, while only LOS

showed negative association. This is supported by previous work that has shown the daily income of a hospital is reduced in extended LOS.[5] Furthermore, the direction of associations of surgical procedures implies that higher RORIs were associated with the more costly cases, including PCI with stent placement, and the more severe cases as per the CCS classification,.

For gastrectomy patients, gender, surgical procedure, chemotherapy, proportion of gastrectomy patient volume to total inpatient volume and RTCC were all significantly and positively associated with RORI, while age and LOS showed negative association. This means that the more serious and costly cases, referring to patients who had total gastrectomy performed and the more costly cases where patients were treated with chemotherapy, were associated with a higher RORI.

From the perspective of a patient-level financial situation, our results show that an increase in LOS was associated with a decrease in RORI, implying that a longer hospital stay would result in reduced profits in a patient as time went by. Despite this, from the perspective of a hospital-level financial situation, simply reducing the LOS of each patient would result in a loss of direct income. Therefore there may be a necessity for interventions that seek to decrease the LOS of each individual patient while increasing the hospital occupancy rate by increasing patient volume.

Furthermore, our results show that even after adjusting for various patient- and hospital-level factors, increasing the proportion of PCI patient volume to total inpatient volume would result in a higher RORI, thus implying that increasing the ratio of PCI patients would increase profitability. This may imply an economic incentive for hospitals to specialize to a certain degree in PCI patients, although the same type of association was not observed in our sample of gastrectomy patients.

Policy implications

The centralization of PCI may offer collective benefits as our results show the economic benefits that occur with a higher proportion of PCIs performed. However, it is too early to recommend the centralization of these procedures, as this would require more specific volume-outcome studies as well as analyses to ensure that essential accessibility for emergency patients is not compromised. On the other

hand, these results show that the current payment system favors some forms of casemix over others, and points to the necessity to address the issue at a policy level.

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終末期における入院医療
疾患・診療パターンと医療費

京都大学大学院医学研究科
医療経済学分野

関本美穂・今中雄一

2009年7月18日　第4回医療経済学会

研究の背景

- 近年高齢化に伴う、終末期医療費の増加
  - 全体のわずか5%を占める死亡者が30%の医療費を使う
    (Hogan, et al. 2001; Lubitz et al, 1993)
  - わが国における死亡前1年間の医療費は、約9000億円と推定
    (財政制度審議会　財政制度分科会　2007年5月)
- 「終末期に無駄な医療が行われている」という批判