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Figure 1

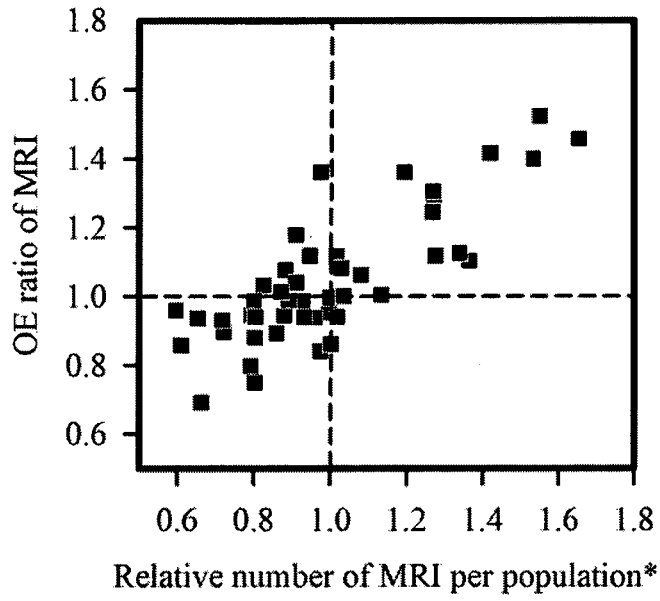


Figure 2

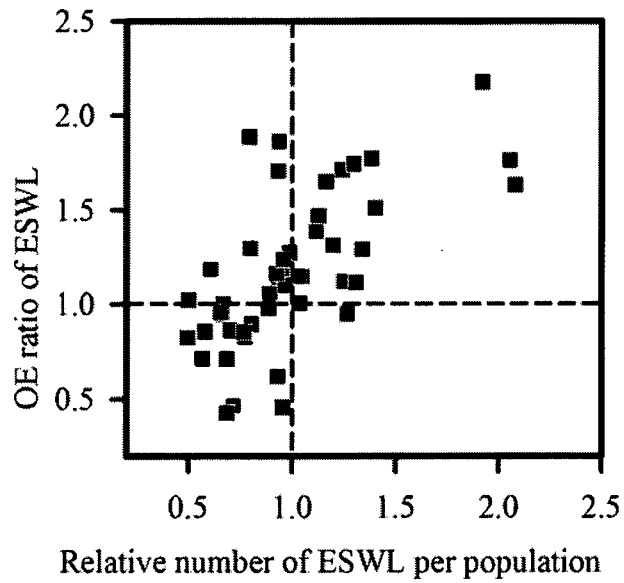


Table 1. Total number of MRI and ESWL by facilities for each fiscal year

		1996	1999	2002	2005
		N	N	N	N
			Rate of Increase	Rate of Increase	Rate of Increase
MRI	Hospital	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	N/A	N/A	889	1,242 (39.7%)
	Equipment	N/A	N/A	996	1,250 (25.5%)
ESWL	Hospital	483	586 (21.3%)	763 (30.2%)	867 (13.6%)
	Equipment	N/A	N/A	794	891 (12.2%)
	Clinic	N/A	N/A	13	14 (7.7%)
	Equipment	N/A	N/A	20	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.

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)

1
2

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

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5

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
per no. of device units ^a	p-value	0.000
No. of examinations/procedures	r	-0.221
per no. of device units	p-value	0.136
Increasing rate of	r	-0.303
no. of device units	p-value	0.038
		0.047
		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 ($r=0.023$, $p=0.876$) 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

Tetsuya Otsubo,¹ Yuichi Imanaka,¹ Jason Lee,¹ Kenshi Hayashida,¹ Shinya Matsuda²

¹Department of Healthcare Economics and Quality Management

School of Public Health, Graduate School of Medicine, Kyoto University, Kyoto, Japan

²Department of Preventive Medicine and Community Health, University of Occupational and Environmental Health, Fukuoka, Japan

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.

	B	95% CI		β	p-value
		Lower	Upper		
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 volume	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.

	B	95% CI		β	p-value
		Lower	Upper		
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

終末期医療の実態

- わが国では、病院における死亡が全体の8割
- 病院における終末期医療の実態
 - 療養型病院における死亡例63/ 155例(41%)において、終末期の人工栄養 (宮岸,2007)
 - 90歳以上のICU入室者の45%に人工呼吸 (依光,2007)
 - 急性期病院で死亡した患者5/61例(8%)にDNR、34例(56%)の家族は積極的治療を希望 (大谷,2007)
 - 腹部疾患による死亡症例の71%にDNR、しかしその88%は家族による口頭指示 (真弓,2008)

3

終末期と死亡前医療費の定義

- 終末期
 - 近いうちに死が不可避な疾患により病床についてから、死を迎えるまで
 - 通常死亡前6ヶ月
 - ただし一般的に、終末期の予測は困難といわれる (「末期医療に臨む医師の在り方」についての報告, 1992年)
- 死亡前医療費
 - 事後的死亡者の死亡前医療費
 - 死亡前の一定期間の医療費(6ヶ月・1年)

4

終末期医療費に関する既存の研究

- 死亡者は死期が近づくにつれ、多くの医療費を発生
- 20歳未満の終末期医療費は突出して高く、年齢が高いほど相対的な医療費水準は低くなり、高齢者ほど少ない
- 高齢者における医療水準は低いものの死亡者数が多いために、高齢者の終末期医療費が全体に占める割合は高い
 - 65歳以上の終末期医療費は総医療費の22.4%

(今野, 2006; 府川, 1998; 府川, 2003)

5

研究の目的

- 急性期病院において死亡前に、どのような医療が提供されているか？
 - 延命的な治療(集中治療・人工呼吸など)の頻度
 - 死亡前の診療行為や医療費の推移
- 死亡前の診療内容および入院医療費を分析
 - どのような患者が、高額な医療費を使うのか？
 - 疾患や年齢を調整後、死亡前医療費に病院間で違いが存在するか？
 - 違いがあるとしたら、その違いはどこから生じるか？

6

研究対象

- 解析対象: 45病院・302,385件のDPCデータ
(2007年1月～2008年4月退院分)
 - 在院日数が180日を超過する症例を除外
 - 生存退院285,551例と死亡退院12,748例を解析
 - 死亡退院の割合: 4.3%
- 年齢・性別・診断群分類(疾患名＋手術)・
1日毎の医療費・1日毎の診療行為(集中治療・人工呼吸・心肺蘇生など)

7

解析

1. 生存例と死亡例の比較
 - 在院日数・医療費の分布
2. 死亡例における1日あたり医療費の推移
3. 死亡前の集中治療室利用・人工呼吸・
心肺蘇生の実施の推移
4. 死亡前入院医療費の病院間比較

8

生存例と死亡例の比較

項目	生存例 N=285,551	死亡例 N= 12,748	P
年齢	56.3 ± 25.4	74.3 ± 13.9	<0.01
男性(%)	53%	58%	<0.01
在院日数	14.5 ± 19.1	31.3 ± 34.3	<0.01
1入院医療費	635 ± 853	1376 ± 1778	<0.01
手術費	201 ± 476	311 ± 876	<0.01

医療費の単位:千円

9

死亡例における1日あたり医療費の推移

- 1日あたり医療費の推移から、終末に近づくにつれ医療費が増加するのか減少するのかを検討
 - 主たる疾患のICD-10コードにより、分類
 - 症例ごとに、各期間1日毎の医療費を算出

- | |
|--|
| <ul style="list-style-type: none"> ① 死亡前3日間の平均1日あたり医療費 ② 死亡前4～7日の平均1日あたり医療費 ③ 死亡前8～14日の平均1日あたり医療費 ④ 死亡前15～30日の平均1日あたり医療費 |
|--|

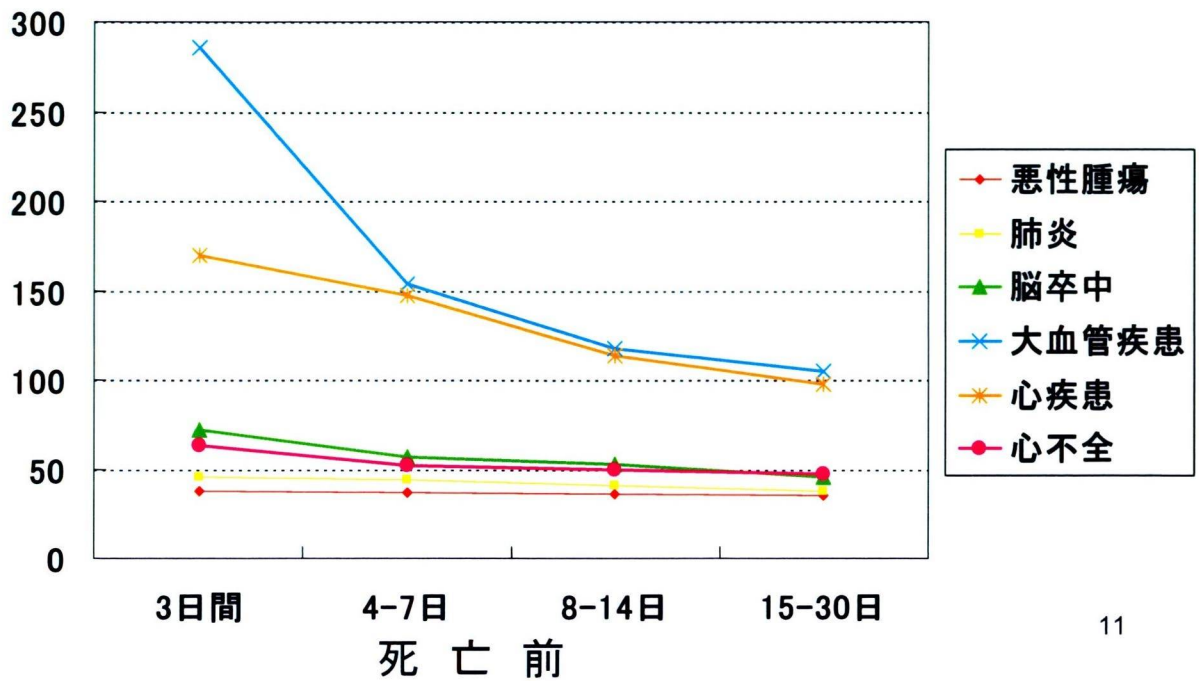
- 「死亡前3日間の1日医療費」を「1」とした場合の、他の期間の1日あたり医療費を評価

10

136

死亡前の各期間における 1日あたり医療費

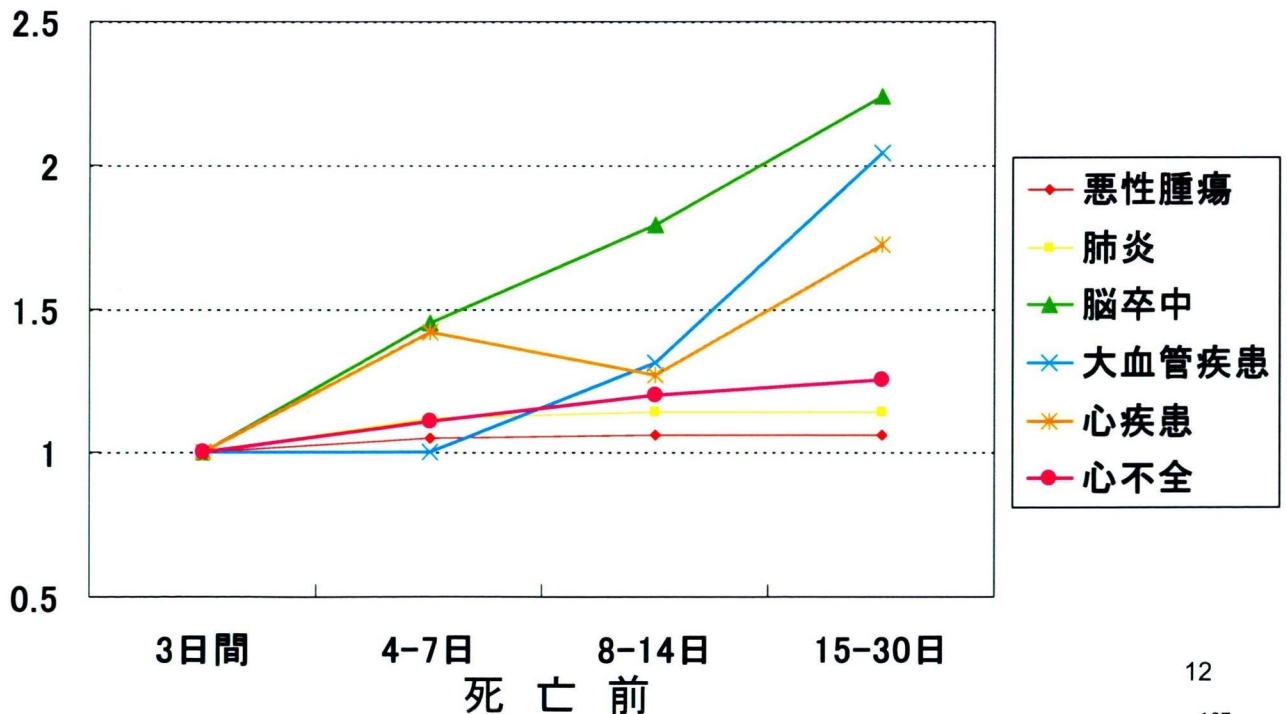
1日あたり医療費(千円)



11

死亡前の1日あたり医療費の推移

O/E比



12

137