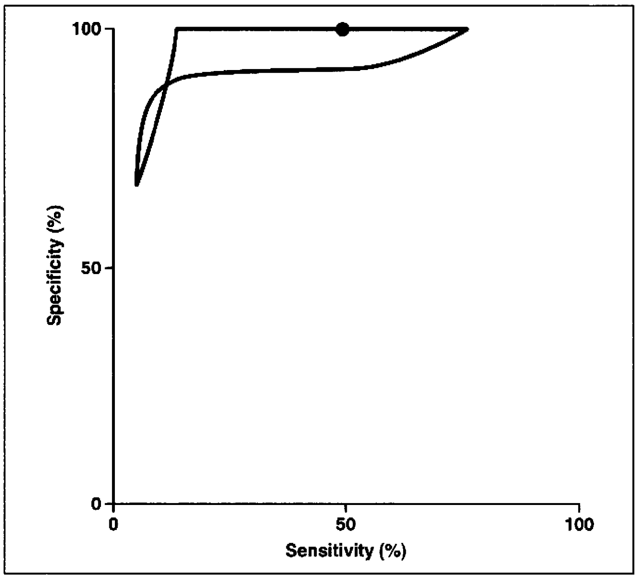

Fig. 3—Plot shows all possible combinations of sensitivity and specificity in first hypothetical case. Enclosed areas represent all possible combinations of values of sensitivity and specificity estimated with global sensitivity analysis. Circle indicates point estimate of sensitivity (52%) and specificity (100%).

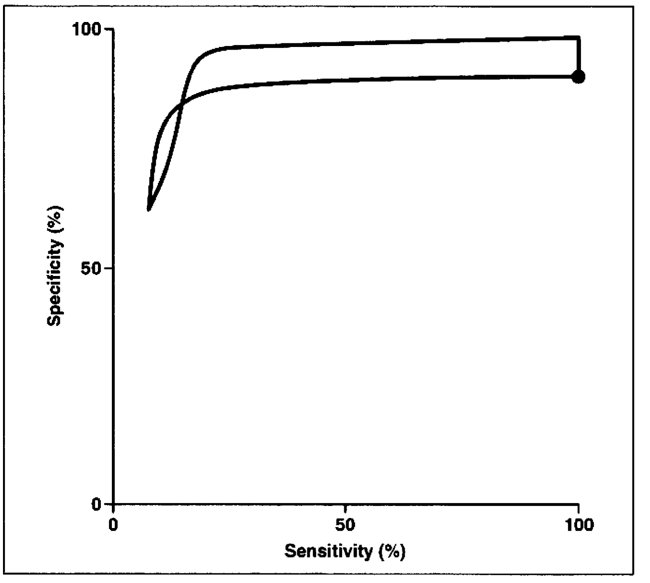

Fig. 4—Plot shows all possible combinations of sensitivity and specificity in second hypothetical case. Enclosed areas represent all possible combinations of values of sensitivity and specificity estimated with global sensitivity analysis. Circle indicates point estimate of sensitivity (100%) and specificity (100%).

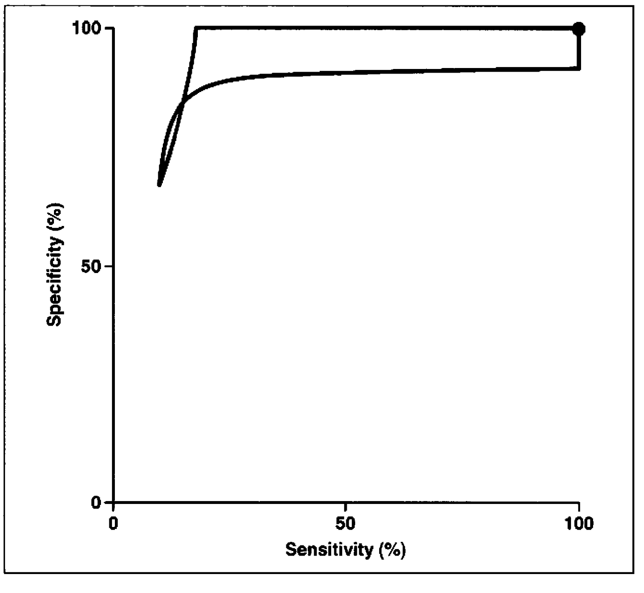

Fig. 5—Plot shows all possible combinations of sensitivity and specificity in third hypothetical case. Enclosed areas represent all possible combinations of values of sensitivity and specificity estimated with global sensitivity analysis. Circle indicates point estimate of sensitivity (100%) and specificity (100%).

patient with spontaneous healing will be associated with a positive arthroscopic result. As such, more cases of spontaneous healing lead to lower sensitivity.

The third explanation for the low sensitivity in this study relates to differences in the patient population that undergoes arthroscopy, which might be associated with the health care system in Japan. In many countries, patients who undergo arthroscopy are stringently selected and referred to a specialized institution by general physicians or primary care physicians. In Japan, specialized tests such as arthroscopy are provided by the same institution as the initial evaluation without stringent selection, and many patients with false-negative findings undergo arthroscopy, resulting in lower sensitivity. We therefore applied global sensitivity analysis to three hypothetical high-sensitivity cases to determine whether lower sensitivity affected the results. In the first high-sensitivity case it was assumed that all patients with false-positive results (six patients) had true-positive results. The sensitivity and specificity in that case were 52% and 100% (Fig. 3). In the second case it was assumed that all patients with false-negative results (13 patients) had true-positive results. The sensitivity and specificity in this case were 100% and 90% (Fig. 4). In the third case it was assumed that all patients with false-positive results and all patients with false-negative results had true-positive results. The sensitivity and specificity in that case were 100% and 100% (Fig. 5). In all cases, the global sensitivity analysis region included the point estimate of sensitivity and specificity. Consequently, these results indicate the robustness of the study, regardless of sensitivity.

In a study in which we used global sensitivity analysis to assess the influence of verification bias on the MRI diagnosis of meniscal tear [3], the presumed region also represented a butterfly shape. The point estimate in our previous study, however, was not included in the presumed region. We concluded that the point estimate was not compatible with observed data and that there was marked verification bias. The main difference between the current study and our previous study is the extent rather than the presence or absence of verification bias. In both studies, the sensitivity and specificity in the base case and the missing at random point estimates differed, but to different degrees. Therefore, the diagnostic utility of MRI can be affected by verification bias, although the extent of the effect can vary depending on the condition being diagnosed.

In the diagnosis of cruciate ligament tears, verification bias has a small effect on the diagnostic utility of MRI. Given the high specificity reported in previous studies and in this study, MRI is reliable in its specificity in the diagnosis of cruciate ligament tear. Our findings, however, suggest that the sensitivity of MRI may not be as reliable as the specificity. As such, in interpreting MRI findings in the diagnosis of cruciate ligament tear, clinicians should consider possible factors that affect the sensitivity of MRI, such as the interval between MRI and arthroscopy.

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(Appendixes start on next page)

APPENDIX 1: Global Sensitivity Analysis

Global sensitivity analysis is a method for graphically determining whether a particular pair of sensitivity and specificity estimates is compatible with the observed data, including cases unverified with the reference standard. The complete range of possible prevalence (0–100%) of cruciate ligament tears for the MRI-positive and the MRI-negative subgroups of cases unverified with arthroscopy is simulated. Sensitivity and specificity then are computed and graphically plotted to depict all possible sensitivity and specificity pairs, including those for unverified cases. The frequency of test results is shown in Table 5. Estimates of sensitivity (*Se*) and specificity (*Sp*) are calculated with the following equations:

TABLE 5: Variables for Calculation of Frequency of Test Results

MRI Result	Verified Cruciate Ligament Tear: Present	Verified Cruciate Ligament Tear: Absent	Not Verified	Total
Positive	$a + E \times e$	$b + (1 - E) \times e$	e	$n1$
Negative	$c + F \times f$	$d + (1 - F) \times F$	f	$n2$
Total				N

Note—E = frequency of cruciate ligament tear in patients with positive MRI results without arthroscopy test; F = frequency of cruciate ligament tear in patients with negative MRI results without arthroscopy; a = number of patients with positive MRI and positive arthroscopic results; b = number of patients with positive MRI and negative arthroscopic results; c = number of patients with negative MRI and positive arthroscopic results; d = number of patients with negative MRI and negative arthroscopic results; e = number of patients with positive MRI results who did not undergo arthroscopy; f = number of patients with negative MRI results who did not undergo arthroscopy; $n1$ = number of patients with positive MRI results; $n2$ = number of patients with negative MRI results; N = number of all included patients.

$$Se(E, F) = \frac{a + E \times e}{a + E \times e + c + F \times f} \times 100 \qquad Sp(E, F) = \frac{d + (1 - F) \times f}{b + (1 - E) \times e + d + (1 - F) \times f} \times 100$$

E and F are independent of each other and can be any value from 0 to 1. All possible combinations of values are assigned to E and F, and *Se* and *Sp* for each combination of E and F can be calculated as in Table 6 with Microsoft Excel software. Pairs of calculated *Se* and *Sp* then are graphically plotted.

TABLE 6: Calculation of Sensitivity and Specificity

Row	A	B	C	D	E	F	G	H
1		Arthroscopy performed	Arthroscopy not performed	Not verified		$a = 8$		
2	MRI result positive	8	6	27		$b = 6$		
3	MRI result negative	13	55	247		$c = 13$		
4				274		$d = 55$		
5						$e = 27$		
6		Arthroscopic result positive	Arthroscopic result negative	Not verified	Total	$f = 247$		
7	MRI result positive	$a + E^{*} e$	$b + (1 - E)^{*} e$	e	$n1$	$n1 = 41$		
8	MRI result negative	$c + F^{*} f$	$d + (1 - F)^{*} f$	f	$n2$	$n2 = 315$		
9					N	$n = 356$		
10								
11	E(%)	F(%)	$a + E^{*} e$	$b + (1 - E)^{*} e$	$c + F^{*} f$	$d + (1 - F)^{*} f$	*Se* (%)	*Sp* (%)
12	0	0	8.00	33.00	13	302	38.09524	90.14925
13	1	0	8.27	32.73	13	302	38.88105	90.22197
14	2	0	8.54	32.46	13	302	39.64717	90.2948
15	3	0	8.81	32.19	13	302	40.39431	90.39775
16	4	0	9.08	31.92	13	302	41.12319	90.44082
17	5	0	9.35	31.65	13	302	41.83445	90.51401
18	6	0	9.62	31.38	13	302	42.52874	90.58732
19	7	0	9.89	31.11	13	302	43.20664	90.66074
20	8	0	10.16	30.84	13	302	43.86874	90.73429
21	9	0	10.43	30.57	13	302	44.51558	90.80795
22	10	0	10.7	30.3	13	302	45.14768	90.88173
23	11	0	10.97	30.03	13	302	45.76554	90.95564
24	12	0	11.24	29.76	13	302	46.36964	91.02966
25	13	0	11.51	29.49	13	302	46.96042	91.1038
26	14	0	11.78	29.22	13	302	47.53834	91.17807
27	15	0	12.05	28.95	13	302	48.10379	91.25246
28	16	0	12.32	28.68	13	302	48.65719	91.32696

APPENDIX 2: Missing at Random Point Estimates

If only patients with verified disease status are considered in the assessment of a diagnostic test, sensitivity estimates can be calculated as $a / (a + c)$ and specificity estimates as $d / (b + d)$. In practice, however, this assumption is unlikely to be true, and the estimates often are subject to verification bias. According to the missing at random assumption, selection of patients with a verified condition is independent of the unobserved variable, and the verification bias–corrected sensitivity and specificity estimates can be calculated by assigning $a / (a + b)$ to E and $c / (c + d)$ to F. Sensitivity and specificity point estimates corrected for verification bias are expressed as follows:

$$Se\ (MAR) = \frac{n1 \times a / (a + b)}{n1 \times a / (a + b) + n2 \times c / (c + d)} \times 100$$

$$Sp\ (MAR) = \frac{n2 \times d / (c + d)}{n1 \times b / (a + b) + n2 \times d / (c + d)} \times 100$$

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Impact of Intensive Care Unit Physician on Care Processes of Patients with Severe Sepsis in Teaching Hospitals

Takeshi Umegaki, Miho Sekimoto and Yuichi Imanaka*

Department of Health care Economics and Quality Management, Kyoto University Graduate School of Medicine, Kyoto, Japan

Abstract

Objective: The purpose of the study was to investigate associations among intensive care unit (ICU) staffing and care processes in patients with severe sepsis.

Design: An observational multicenter cross-sectional study performed from October 2007 to March 2008.

Setting: Forty-nine teaching hospitals in Japan.

Participants: Patients (n=576) with severe sepsis identified using ICD-10 codes from administrative data.

Main outcome measures: Care processes including mechanical ventilation, dialysis, enteral feeding, parentetal nutrition, and antibiotic empirical therapy which were available in administrative data.

Results: ICUs were classified as high- or low-intensity based on policies regarding the responsibilities of intensivists. There were no differences in baseline patient characteristics between the ICU groups. In the high-intensity group, ICU stay for survivors was about two days shorter and hospital stay was significantly shorter by three days. Majority of patients had high rates of enteral feeding; however, the high-intensity group had significantly earlier initiation of enteral feeding and a significantly shorter duration of mechanical ventilation. A shorter duration of mechanical ventilation was significantly associated with the ICU structure.

Conclusions: The results showed an association between ICU physician and processes of intensive care, and high-intensity ICU was aggressive in mechanical ventilation in patients with severe sepsis.

Keywords: Intensive care unit; Sepsis; Structure; Care process; Multicenter study

Introduction

Patients in the intensive care unit (ICU) require complex care relating to a broad range of acute illnesses and pre-existing conditions. The innate complexity of the ICU makes organizational structuring of care an attractive quality measure and a target for performance improvement strategies. In other words, organizational features relating to medical and nursing leadership, communication and collaboration among providers, and approaches to problem-solving may capture the quality of ICU care more comprehensively than do practices related to specific processes of care.

Many authors have shown wide variations in mortality in ICU, which may have developed studies on the associations between ICU organizations and outcomes. There is many patterns in ICU organization, [3,42] and it seemed that differences in ICU organization associated with patient outcomes. For instance, ICU staffings focused on the role of intensivists in critical care units.

The relationship between the role of intensivists and outcomes has been examined since the 1980s. A number of studies have shown that staffing the ICU with intensivists has a beneficial impact on outcomes. [2-16] A recent multicenter retrospective study using a large database of critically ill patients, however, showed that hospital mortality was higher for patients managed by ICU physicians. [17] Intensivists may improve clinical outcomes, but these paradoxical results may be due to differences in patient characteristics and methodology among these studies.

Although indicators such as morbidity and mortality have been used as performance measures of intensive care, it is usually difficult to assess performance of ICUs by simply using of crude mortality, since clinical conditions of patients (i.e., as patient characteristics, diseases, and severity of illness) are quite different between them. Therefore, risk adjustment mortality has been used in ICU outcome study. Clear findings regarding associations between ICU staffings and outcomes, however, have not been gained yet, and it has been desirable to assess ICU structure and care processes to achieve further opinion about ICU performance. [14,11,13] Kahn et al. [26] demonstrated that evidence based approach was associated with the role of intensivists in the ICU. Intensivists may have important role for processes affecting to patient outcomes. We hypothesize that staffing ICUs with critical care physicians (intensivists) have significant association with care processes in intensive care units. In this study, we investigated the effect of ICU physicians on care processes, which were available in administrative data, in patients with severe sepsis. In this study, we used large administrative database of Japan, which is called "Diagnosis procedure combination (DPC)" data introduced in Japanese medical payment system since 2002 [43].

***Corresponding author:** Yuichi Imanaka, Department of Healthcare Economics and Quality Management, Kyoto University Graduate School of Medicine, Yoshida Konoe-cho, Sakyo-ku, Kyoto 606-8501, Japan, Tel: +81-75-753-4454; Fax: +81-75-753-4455; E-mail: imanaka-y@umin.net

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Materials and Methods

Setting

All data were extracted from the Quality Indicator / Improvement Project (QIP). The QIP collects Japan's administrative healthcare data (Diagnosis Procedure Combination data; DPC data) from hospitals and analyzes numerical indices of the healthcare process, patient outcomes, and management efficiency and provides feedback to participating establishments. Administrative data were comprised of clinical information and healthcare claim data. Clinical information included patient demographics, primary and secondary diagnoses, comorbidities at the time of and after admission, operative data, severity of illnesses, as well as any special treatments (i.e., radiation therapy, artificial respiration, chemotherapy). In contrast, healthcare claim data itemized the type, quantity, and fees for all tests, medications, procedures, use of intensive or specialized care, and nursing services.

At the time of the study, one hundred and eight medical institutions voluntarily participated. Among these institutions, we selected 70 teaching hospitals with ICU, which accounted for approximately 10 % of all teaching hospitals in Japan. In November 2008, we sent questionnaires to the directors of these 70 hospitals, with a request for information on ICU management to be provided by the physician responsible for intensive care.

Organizational model

For consistency with previous studies, [2] if the ICU physicians had primary responsibility or mandatory critical care consultation (the intensivist is the patient's primary attending physician or the intensivist is not the patient's primary attending physician, but every patient admitted to the ICU receives a critical care consultation), the ICU was defined as a high-intensity ICU. In contrast, if the ICU physicians had elective critical care consultation or no critical care physician (the intensivist is involved in the care of the patient only when the attending physician requests a consultation or intensivists were unavailable), the ICU was defined as a low-intensity ICU. An intensivist was defined as a physician with a primary appointment in the ICU.

Patient characteristics

All patients who were treated for severe sepsis in ICUs in the studied hospitals between October 1, 2007, and March 31, 2008 were included in the study. Severe sepsis was defined based on the sepsis-related ICD-10 code and coding for single or multiple organ failure (Table 1). Organ failure was based on Martin's study, [18] and ICD9-clinical modification (CM) codes were converted to ICD-10 codes. We excluded ICUs with less than 5 patients of severe sepsis. Patients younger than 20 years of age and those hospitalized for more than 60 days were also excluded from the analysis, since patients with extremely long hospitalization might involve social problems such as the lack of an available nursing home.

Patient characteristics were identified from administrative data. The administrative data included clinical information such as patient demographics, diagnoses, comorbidities at the time of and after admission, operative data, and treatment (radiation therapy, mechanical ventilation, chemotherapy). Age, gender, and reasons for ICU entry were recorded for all patients. To evaluate severity, the expected mortality was calculated using the Critical care Outcome Prediction Equation (COPE). [19] The COPE model uses information from standard administrative data and is a robust, risk-adjusted hospital mortality prediction tool. And we showed that the COPE model had good performance for ICU patients in Japan [20].

Care processes evaluation

Measures for process of care were selected among quality indicators for intensive care that are associated with outcomes and available in administrative data. [21-24] for patients under mechanical ventilation, non-invasive positive pressure ventilation was excluded. Dialysis included continuous renal replacement therapy, intermittent renal replacement therapy, plasma absorption, and plasma exchange, but excluded peritoneal dialysis since this is rarely used for ICU patients. We also examined the initiation of antibiotic empirical therapy (defined as use of a carbapenem, a 3[rd] or 4[th] generation cephalosporin, or a combination of a β-lactam and an aminoglycoside [25]) during the ICU stay. Therefore, processes were evaluated based on the initiation of

Condition	Code	Organ failure	Code
Salmonella septicemia	A02.1	Respiratory	
Septicemic plague	A20.7	Acute respiratory failure	J96.0
Anthrax septicemia	A22.7	Adult respiratory distress syndrome	J80
Erysipelothrix septicemia	A26.7	Respiratory arrest	R09.2
Listerial septicemia	A32.7	Ventilator management	a
Streptococcal septicemia	A40	Cardiovascular	
Other septicemia	A41	Orthostatic hypotension	I95.1
Actinomycotic septicemia	A42.7	Cardiogenic shock	R57.0
Disseminated herpesviral disease	B00.7	Hypovolemic shock	R57.1
Candidal septicemia	B37.7	Septic shock	A41.9
Disseminated coccidioidomycosis	B38.7	Idiopathic hypotension	I95.0
Disseminated histoplasmosis capsulati	B39.3	Renal	
Disseminated blastomycosis	B40.7	Acute renal failure	N17
Disseminated paracoccidioidomycosis	B41.7	Acute nephritic syndrome	N00
Disseminated sporotrichosis	B42.7	Hemodialysis	a
Disseminated aspergillosis	B44.7	Hepatic	
Disseminated cryptococcosis	B45.7	Hepatic failure, not elsewhere classified	K72
Disseminated mucormycosis	B46.4	Hematologic	
Puerperal sepsis	O85	Disseminated intravascular coagulation	D65
		Purpura and other haemorrhagic conditions	D69
		Metabolic	
		Acidosis	E87.2
		Neurologic	
		Delirium, not induced by alcohol and other psychoactive substances	F05
		Anoxic brain damage, not elsewhere classified	G93.1
		Encephalopathy, unspecified	G93.4
		Coma, unspecified	R40.2

[a]Specific code for a universal fee schedule in Japan

Table 1: ICD-10 codes used for identification of septic patients and acute organ dysfunction.

	High-intensity group (n=234)	Low-intensity group (n=342)	P-value
Number of hospitals	19	30	
Number of patients	234	342	
Hospital background			
Number of beds in hospital	637.8±333.4	467.2±153.2	0.15
Number of ICU beds	12.7±9.9	5.8±4.6	0.01*
Number of intensivists per bed	0.4±0.3	0.3±0.4	0.62
Number of nurses per bed per day	1.8±0.9	1.7±1.1	0.72
Patient background			
Age	71.6±12.7	71.4±13.8	0.86
Gender (male %)	60.2	58.7	0.74
(female %)	79.8	41.3	
Admission course (%)			
Scheduled	12.3	12.9	0.85
Emergency	87.7	87.1	
Reason for ICU entry (%)			
Internal medical disease	57.4	44.6	
Post-emergency surgery	21.8	31.3	0.11
Post-scheduled surgery	20.8	24.1	
Processes of care			
Initiation of antibiotic empirical therapy during ICU stay (%)	86.3	85.4	0.89
(Carbapenem) (%)	52.1	52.6	0.51
(3rd or 4th generation cephalosporin) (%)	24.8	26.1	0.59
(Combination of a β-lactam and an aminoglycoside) (%)	9.4	6.7	0.48
Enteral feeding (%)	90.2	88.6	0.45
Timing of initiation of enteral feeding (days)	6.0±8.4	9.0±10.1	<0.01**
(Gastrointestinall diseases)	7.8±6.9 (n=68)	9.8±7.6 (n=129)	0.32
(Other diseases)	5.4±5.4 (n=166)	7.9±7.8 (n=213)	0.04*
Parenteral nutrition (%)	71.7	74.2	0.45
Timing of initiation of parenteral nutrition (days)	2.9±5.0	2.6±3.8	0.54
Mechanical ventilation (%)	67.2	65.6	0.69
Duration of mechanical ventilation (days)	7.5±7.3	11.5±10	<0.01**
Dialysis (%)	6.6	8.9	0.35
Times of dialysis	4.6±4.2	4.4±6.3	0.85
Outcomes			
Duration of hospital stay for survivors (days)	29.5±14.2 (n=111)	33.1±14.9 (n=162)	0.04*
Duration of hospital stay for non-survivors (days)	20.5±16.4 (n=123)	22.2±15.5 (n=180)	0.36
ICU duration of stay for survivors (days)	8.8±5.6 (n=172)	10.5±9.7 (n=267)	0.15
ICU duration of stay for non-survivors (days)	6.5±7.4 (n=62)	7.6±9.5 (n=75)	0.52
Expected mortality (%)	21.7±19.8	20.6±18.7	0.54
ICU mortality (%)	26.5	21.9	0.21
28-day mortality (%)	39.2	44.4	0.53
Hospital mortality (%)	47.4	45.9	0.73

[a]Continuous variable: mean ± SD; Categorical variable: percentage; *: $p < 0.05$, **: $p < 0.01$

Table 2: Hospital and patient backgrounds, processes and outcomes in ICU organizational structures[a].

empirical therapy, frequency and timing of enteral feeding, frequency and timing of parenteral nutrition, use of mechanical ventilation, duration of mechanical ventilation (days), dialysis, and times of dialysis. Monitoring of medical care on an hourly basis is not possible using administrative data, but data based on a calendar day were available. Thus, initiation of enteral feeding and parenteral nutrition therapy were defined with a baseline of the day of ICU entry. The duration of ICU stay and ICU mortality were determined as outcomes.

Statistical analysis

Continuous variables are presented as means ± standard deviations, and categorical variables as percentages. Analyses were performed using a Student t-test or one way analysis of variance for continuous variables and a χ-square test for categorical variables, with $P<0.05$ regarded as significant. To evaluate differences in process of intensive care between high- and low-intensity groups, Cox proportional hazards analysis or multiple logistic regression analysis were performed. Cox proportional hazards analysis used for continuous variables as independent variables. Multiple logistic regression analysis used for nominal variables. All analyses were performed using SPSS 11.0J (SPSS Inc., Chicago, IL). The Institutional Review Board of the Faculty of Medicine at the Graduate School of Medicine of Kyoto University approved the study.

Results

Fifty-two hospitals (74.3%) with ICUs responded to the questionnaire. Between October 1, 2007, and March 31, 2008, a total of 665,442 patients were discharged from these 52 hospitals, and among these patients, 609 (0.1%) patients with severe sepsis were identified. An initial analysis of 665,442 patients discharged from these 52 hospitals identified 609 (0.1%) patients of severe sepsis in ICU patients. Three of the 52 hospitals (5.8%) and 33 of the 609 patients (5.4%) met the exclusion criteria, leaving 576 (94.6%) patients in 49 hospitals for analysis. 52 hospitals in this analysis were general hospitals and had more than 300 beds.

Characteristics of organizations and patients

In 19 of the 49 hospitals (38.8%), the ICU physicians had primary responsibility or mandatory critical care consultation. In another 30 hospitals (61.2%), the ICU physicians had elective critical care consultation. All ICUs in the study had intensivists on staff.

The patients included 234 patients in 19 ICUs in the high-intensity group, and 342 patients in 30 ICUs in the low-intensity group. Patients were identified with an ICD-10 code: the most frequent code was A41 (other septicemia, 94.1 %), followed by A40 (streptococcal septicemia, 3.0%), and B37.7 (candidal septicemia, 2.3%). There were no significant differences in the hospital backgrounds except for the number of ICU beds (Table 2). The mean age of patients (about 71 years old), the percentage of male patients (approximately 60%), and the reasons for ICU entry did not differ significantly between the ICU groups. However, internal medical disease was significantly more frequent in the high-intensity group (57.4% vs. 44.6%).

Variable	Adjusted Relative Risk Measure (95 % CI) Hazards Ratio or Odds Ratio	95 % CI	P-value
Duration of mechanical ventilation[a]	1.36	1.01-1.81	0.04*
Initiation of enteral feeding on ICU day 0[b]	0.87	0.54-1.41	0.57
Initiation of enteral feeding by ICU day 1[b]	0.96	0.58-1.60	0.87
Initiation of enteral feeding by ICU day 2[b]	1.17	0.68-2.02	0.58
Initiation of enteral feeding by ICU day 3[b]	1.15	0.64-2.04	0.65
Duration of hospital stay for survivors[a]	1.14	0.91-1.43	0.27

[a]Hazards Ratio
[b]Odds Ratio
*: $p < 0.05$, **: $p < 0.01$
CI: Confidence Interval
A Hards Ratio > 1 indicates a shorter duration of mechanical ventilation or shorter duration of hospital stay for survivors in high-intensity ICU.
The Odds Ratio indicates the incidence of enteral feeding for the low-intensity ICU versus high-intensity ICU

Table 3: Results of Cox proportional hazards analysis and multiple logistic analysis.

Care process evaluation in different icu physician staffing models

Associations between ICU groups and processes of care are shown in (Table 2). The initiation of antibiotic empirical therapy during the ICU stay (86.3% vs. 85.4%) and the frequency of use of each antibiotic therapy did not differ significantly between the high- and low-intensity groups. Most patients received enteral feeding and the frequency did not differ significantly between the two groups (90.2% vs. 88.6%, p=0.45). However, initiation of enteral feeding occurred significantly earlier in the high-intensity group (6.0 vs. 9.0 days, p < 0.01). Initiation of enteral feeding in patients with gastrointestinal diseases did not differ significantly between the two groups (7.8 vs. 9.8 days, p=0.32), but significantly earlier initiation of feeding in patients of non-gastrointestinal diseases occurred in the high-intensity group (5.4 vs. 7.9 days, p=0.04). The frequency (71.7% vs. 74.2%, p=0.45) and initiation time (2.9 vs. 2.6 days, p=0.54) of parenteral nutrition did not differ significantly between the two groups.

The frequency of mechanical ventilation in the high- and low-intensity groups did not differ significantly (67.2 vs. 65.6%, p=0.69), but the duration of mechanical ventilation was significantly shorter in the high-intensity group (7.5 vs. 11.5 days, p<0.01). The rate and times of dialysis did not differ significantly between the two groups. The mean duration of ICU stay was shorter by approximately 2 days for surviving patients in the high-intensity group (8.8 vs. 10.5 days, p=0.15; Table 2), whereas non-survivors had a similar ICU stay in the high- and low-intensity groups (6.5 vs. 7.6 days; p=0.52). The mean duration of hospital stay was significantly shorter for survivors in the high-intensity group (29.5 vs. 33.1 days, p=0.04), but did not differ significantly for non-survivors (20.5 vs. 22.2 days; p=0.36). There were no significant differences in ICU (26.5% vs. 21.9%, p=0.21), 28-day (39.2% vs. 44.4%, p=0.53), and hospital (47.4% vs. 45.9%, p=0.73) mortality between the high- and low-intensity groups.

Cox proportional hazards analysis or multiple logistic regression analysis

Cox proportional hazards analysis was used to examine the impact between both ICU groups on duration of mechanical ventilation, and on duration of ICU stay for survivors after adjusted for variables of severity of illness (expected mortality calculated from COPE model), age, sex, and the number of ICU beds. In duration of mechanical ventilation, patients were censored for death (n = 113) or long-term ventilator facility (n = 8). The high-intensity group was associated with a shorter duration of mechanical ventilation after adjusted to covariates (Hazards Ratio [HR] 1.36; 95 % CI 1.01 to 1.81; Table 3), but this study showed that duration of hospital stay for survivors had no significant impact on ICU structure (HR 1.14; 95 % CI 0.91 to 1.43; Table 3).

Multiple logistic regression analysis was used for the examination of the impact of ICU structure on initiation of enteral feeding after controlling for the variables by similar approach. The dependent variable in multiple logistic regression analysis was defined as initiation of enteral feeding on ICU day 0, day 1, day 2, and day 3, respectively, because the definition of timing of enteral feeding was controversial, which should be initiated as early as possible. ICU day 0 was defined as the day of entry into ICU. ICU structure was not related to the initiation of enteral feeding by ICU day 3 (Table 3).

Discussion

A systematic review of physician staffing patterns and outcomes in critically ill patients showed that high-intensity ICU physician staffing reduces hospital and ICU mortalities and the durations of hospital and ICU stays compared with low-intensity ICU physician staffing. [2] In comparisons of the duration of ICU stay between staffing models, Pronovost et al. [3] and Rosenfeld et al.[5] found a shortened ICU stay in high-intensity models, whereas Dimick et al. [6] found no significant difference in ICU stay between high- and low-intensity models. Mortality from acute lung injury is lower in a closed-model ICU than in an open-model ICU, [7] and lower mortality has been reported in trauma patients in an intensive model compared to an open ICU. [8] Improved outcomes after a structural change from an open to closed ICU model have also been found, indicating that the staffing model has an important relationship with the outcome. Contrary to reports showing improvement of outcomes by ICU staffing, Levy et al. [17] recently suggested that patients managed by intensivists for the entire ICU stay had a higher risk of death compared to management by non-critical care physicians. Mortality and duration of stay had high impact of ICU studies. However, the effects of ICU staffing for outcomes, such as mortality and duration of stay, were controversial. In this study, there were no significant differences in outcomes in high- and low-intensity groups, except for duration of hospital stay for survivors.

In trend to discussing mortality and duration of stay as outcome indicators on ICU structural studies, Kahn et al. [26] examined some processes in different staffing models, and demonstrated that evidence based approach (e.g. the sedation interruption) was more likely to be taken in high-intensity ICUs, compared to low-intensity ICUs. The sedation interruption contributed to progressive weaning from mechanical ventilation and shorter duration of mechanical ventilation. [27] Singer et al. [28] examined duration of mechanical ventilation (care process) as main outcome on ICU staffing model, showed that a high-intensity ICU was associated with approximately 40 hours lower duration of mechanical ventilation, and that duration of mechanical ventilation was useful indicator for ICU structural study. In this study, we evaluated processes of ICU quality indicators to assess the impact of ICU organization. Addition to mechanical ventilation, indicators related to renal, nutritional, and antibiotic management were also selected as process measures, since these are important indicators at intensive care unit [21-24] and nutrition and anti-infective support in ICUs are essential for critically ill patients. [29,30] Our study also showed that high intensity ICU model was associated with 4 days shorter duration of mechanical ventilation, which supported the findings in previous studies on ICU staffing models, although mortality was not associated with ICU structure in this study. The difference in duration of mechanical ventilation in previous study may cause by the difference in patient settings whether various diseases or only septic patients in the study object.

The association between the timing of initiation of enteral feeding and outcomes in patients with sepsis has been widely investigated. Several meta-analyses and systematic reviews [31-33] have indicated that early initiation of enteral feeding may reduce the incidence of infectious complications and shorten the duration of stay, but Ibrahim et al. [34] and Eyer et al. [35] found no significant effect of early enteral feeding on the incidence of infectious complications or duration of stay. Such mixed results on the effectiveness of nutritional therapy may be due to differences among study subjects and in the definition of early enteral feeding among studies. In this study, we showed earlier initiation of enteral feeding in high-intensity ICU, but the effect of ICU structure on enteral feeding was limited.

To assess antibiotic therapy, we investigated the initiation of antibiotic empirical therapy during the ICU stay. Based on a literature review of antimicrobial therapy for severe sepsis and septic shock using an evidence-based approach, Bochud et al. [25] found that a carbapenem, a 3rd or 4th generation cephalosporin, or a combination of a β-lactam and an aminoglycoside provided equally effective antibiotic empirical therapy. Therefore, we used these therapies as one variable in our study. Rapid initiation of appropriate antimicrobial therapy is a key to improving outcomes and reducing mortality in patients with sepsis and other infectious diseases. [25] In addition, daily reassessment of antibiotic use and discontinuation of antimicrobial therapy for non-infectious diseases are recommended in the 2008 Surviving Sepsis Campaign guidelines, and implementing these protocols may improve outcomes in patients with hospital-acquired pneumonia in critical care. [36]We could not evaluate these recommendations due to the limitations of our data.

In our study, duration of hospital stay was extremely longer than those reported by previous studies. There a specific reason for such long hospitalizations in Japan. Acute care hospitals in Japan have traditionally also provided sub-acute care and sometimes long-term care. [37] Recently shorter duration of hospital stay in the acute care hospitals has been promoted for pressure from Japanese Government. The duration of stay in Japan, however, has been much longer than in most Western nations, and a longer hospital stay may increase hospital mortality. Our results showed higher hospital mortality (45%) and longer hospital stays (20-30 days) in patients with severe sepsis, compared to 18-30% and 12-17 days reported in other countries. [18,38,39] Differences in the function of acute care, in which sub-acute care and nursing home care may or may not be included, in Japan and Western countries may account for these differences. However, ICU mortality (24.2%) and the duration of ICU stay (8.4 days) in our study were similar to the values of 10-35% and 7 days found by Vincent et al. [40] The ICU and hospital stays for survivors were both shorter by 2-3 days in the high-intensity group. This may suggest that the hospital stay is affected by differences in processes, especially duration of mechanical ventilation, in the ICU. Although Singer et al. [28] showed that the high-intensity ICU was associated with a reduced hospital mortality, it was difficult to evaluate the affect of ICU organization to hospital mortality in previous studies with regard to functional differences between Japan and other countries. As concerns ICU mortality, further examination should be performed using generalized severity coring system.

Our study has several limitations. First, risk adjustment and calculation of expected mortality of ICU patients are usually performed using the Acute Physiology and Chronic Health Evaluation (APACHE) versions I-IV, the Mortality Prediction Model (MPM) versions I-II, or the Simplified Acute Physiology Score (SAPS) versions I-III. However, administrative data in Japan does not include these scores. Thus, we evaluated illness severity using the COPE model, which require only administrative data. Second, we do not know the accuracy of the coding for sepsis, since the standard of coding and range of severity may differ among institutions. However, studies of septic patients using administrative data are accepted widely. [18,41] Therefore, we evaluated septic patients regardless of a coding bias among hospitals. In addition, the actual number of septic patients in our settings may be higher than 576 patients, because we selected patients for which both sepsis-related codes as the primary diagnosis and acute organ dysfunction were recorded. We believed that our inclusion criteria were small coding bias compared to the criteria including sepsis-related codes as the primary diagnosis and co-morbidities. In addition, university hospitals were not included in the QIP, which may have led to inclusion of only a small number of severe septic patients. Third, there may be a selection bias of ICU entry and intervention therapy. However, we believe that the effects of these biases were small since the ICUs in our study met the standards of the Ministry of Health, Labor, and Welfare. These standards specify ICU entry criteria and the processes we evaluated are widely performed in critical care settings. Finally, the study included only a small number of the acute-care hospitals in Japan, and the majority of hospitals in the study were large and/or educational hospitals. Therefore, further investigation is needed in smaller and/or non-educational hospitals and in a greater number of hospitals.

The current study is significant as the evaluation of care processes, which were available in administrative data, in ICU organization. The results showed a clear association between ICU organization and care processes. High-intensity ICU is associated with improved quality of care on mechanical ventilation.

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手術室運用の効率性指標の検討と多施設間比較

京都大学　大学院医学研究科　医療経済学分野
田中　将之，猪飼　宏，今中　雄一

要　旨：【背景】手術室の効率性を検討する際に，多施設間比較に基づく評価や各施設の資源や機能を考慮した評価が必要とされている。【目的】手術室の運用度を評価するための指標の候補を検討し，その候補指標の関連要因を，重回帰分析を用いて明らかにする。さらに，重回帰モデルに基づく各施設の資源や機能を考慮した予測値を用いて，手術室運用の効率性指標を提案する。【方法】2006年4月から2008年3月までの133の急性期病院のDPCデータおよび施設調査表を用いた。133病院のデータをランダムに開発用サンプルと検証用サンプルの2群に分け，開発用サンプルを用いて，ステップワイズ法により重回帰分析を行い，予測値を算出した。続いて，検証用サンプルでモデルの安定性を検証した。さらに，算出した予測値を用いて，実測値と予測値の比（以下，OE比とする）と実測値と予測値の差（以下，OE差とする）を施設ごとに示した。【結果】1ヵ月1手術室あたりの手術件数，手術手技報酬と施設の資源や機能との関連がみられた。重回帰分析では，1ヵ月1手術室あたりの手術件数は1手術室あたりの外科系医師数および平均在院日数により，手術手技報酬は1手術室あたりの外科系医師数および病床数により，そのばらつきが説明された。【結論】1ヵ月1手術室あたりの手術件数，手術手技報酬を用いた多施設間比較を行った。また，各施設の資源や機能を考慮した予測値を用いたOE比とOE差を手術室運用の効率性指標として提案する。

キーワード：手術室の効率性，多施設間比較，評価指標

背　景

昨今，医療機関では，効率的かつ安定した経営維持のために必要となる診療報酬を確保するため，経営陣や医師，看護師，医療技術職をはじめとする職員が各々の立場で，医療機関の効率的な運用を実現するための取り組みに努めている[1]。また，医療機関を効率よく運用するためのシステムとして，例えばTQM (Total Quality Management) やBSC (Balanced Score Card) といったツールを活用した経営・目標管理システムを導入し，医療機関組織全体および医療機関における各部門の運用度を把握し，評価し，改善する取り組みを行っている[2, 3]。そのなかで，近年とりわけ着目されている部門として手術室があげられる。それは，これまでの研究では，各医療機関で確保する診療報酬の合計と手術件数には，高い相関関係があることが報告されていることがあげられる[4]。また，手術室で得られる主な診療行為である手術の診療報酬が，出来高払い制であり，手術実施に対して，直接その対価として診療報酬を確保することができること[5]やQIP（Quality Indicator / Improvement Project）に提出された2009年4月～2009年9月の153病院のDPCデータにおいて，全診療報酬に占める手術・麻酔の診療報酬の割合は28.1%であり，全診療報酬に占める手術に関連する診療報酬が高いことから，手術室は，他の部門よりいっそう効率的な運用が重要となる。さらに，定期的に利用状況を把握し，スケジューリングの見直しを行うことも重要となる[6, 7]。以上のことから，医療機関では，より効率的な手術室の運用が求められており[8-11]，手術室で実施される件数や手術手技報酬といった手術室の運用度を把握し，それを評価し，改善する仕組みが必要とされている[8]。

しかしながら，今日，手術室の運用度を評価するための指標や方法が標準化されていないのが現状である。各々の医療機関では，手術室の実績として，手術件数や手術手技報酬，手術の時間などを時系列の変化を見た評価にとどまっている医療機関が少なくない。また，医療機関における診療実績を多くの施設とベンチマークを行い，その結果に基づき評価することは重視されているが[12]，手術室においては未成熟である。

表１　１ヵ月手術室あたりの手術件数の関連要因

	β	P	VIF
１手術室あたりの外科系医師数	0.488	0.002	1.174
平均在院日数	−0.348	0.020	1.174

$R^2 = 0.489$

表２　１ヵ月手術室あたりの手術手技報酬の関連要因

	β	P	VIF
１手術室あたりの外科系医師数	0.413	0.014	1.220
病床数	0.350	0.034	1.220

$R^2 = 0.415$

そのため，一般的に手術室の評価は，他の医療機関の手術件数の実績と比較し，その比較に基づく評価にとどまっており，医療機関によって，手術室におけるスタッフ数，手術室数，病床数など資源や機能に差異があるにも関わらず，それらを考慮した評価がなされていない。これらを回避するためには，各々の施設の資源や機能を考慮したうえで，手術室の運用度を評価し，その評価結果に基づき，手術室の運用度の効率性を高め，より効果的な手術室の運用を実施することが求められている[13]。

目　的

本研究の目的は，急性期医療を担う医療機関で用いられている客観データであるDPCデータを用いて，医療機関の経営陣ならびに手術室スタッフが活用しうる手術室の運用度を評価するための指標の候補を検討し，その候補指標の関連要因を，重回帰分析を用いて明らかにする。さらに，重回帰モデルに基づく各施設の資源や機能を考慮した予測値を用いて，手術室運用の効率性指標を提案することである。

方　法

本研究は，DPC（Diagnosis Procedure Combination）データおよび参加医療機関の施設調査表（病床数，職員数，平均在院日数，手術室数等）を用いた。本研究では，QIP（医療の質指標改善プロジェクト：http://med-econ.umin.ac.jp/QIP/）に提出された2006年4月から2008年3月までの133の急性期病院のDPCデータE，Fファイルおよび施設調査表を使用した。はじめに，各施設の１手術室あたりの医師数や看護師数，そして平均在院日数，病床数などの施設の資限や機能に関する指標ならびに，これまでの研究や医療機関経営の現場で用いられている指標として[2, 5, 7-11]，件数や報酬を示す１ヵ月１手術室あたりの手術件数ならびに手術手技報酬の記述統計を算出した。なお，手術室で実施されている手術の同定は，１病院の過去３年間の手術室における手術実績ならびに各診療科専門医の意見に基づき同定した。統計解析には，Dr. SPSS II for Windowsを用いた。施設の資源や機能と１ヵ月１手術室あたりの手術件数ならびに手術手技報酬の関連性をみるために，単変量解析を行いPearsonの相関係数を算出した。さらに，重回帰分析を用いて，手術室の実績の関連要因を明らかにし，各施設の機能を考慮した各施設の手術室における平均的な運用度である予測値を算出するため，重回帰モデルを作成した。133病院のデータをランダムに２群に分け，一方を開発用サンプルとし，もう一方を検証用サンプルとした[15, 16]。はじめに，開発用サンプルを用いて，目的変数を１ヵ月１手術室あたりの手術件数とし，説明変数に単変量解析で有意（$P < 0.05$）であった施設の資源や機能に関する指標を投入し，ステップワイズ法を用いて重回帰分析を行い，１ヵ月１手術室あたりの手術件数の関連要因を同定するとともに，重回帰モデルを作成し，予測値を算出した。また，目的変数を１ヵ月１手術室あたりの手術手技報酬とした場合についても同様に行った。その後，検証用サンプルを用いてモデルの妥当性を検証した。さらに，重回帰モデルを用いて，１ヵ月１手術室あたりの手術件数ならびに手術手技報酬の予測値を用いて，実測値（Observed Value）と予測値（Expected Value）の比であるOE比と実測値と予測値の差であるOE差を用いて多設間比較を行った。

結　果

各施設の資源や機能を示す指標全てにおいて大きなばらつきがみられた。また，１ヵ月１手術室あたりの手術件数の平均は46件で範囲は10～107件，１ヵ月１手術室あたりの手術手技報酬の平均は7,403千円で範囲は1,147～18,919千円であった。２つの指標において，大きなばらつきがみられた。つづいて，Pearsonの相関係数を算出した結果，１つの手術室で行う手術件数は，施設の資源や機能に強い関連を示しており，人的資源を表す１手術室あたりの外科系医師数で正の相関がみられ，診療プロセスを示す平均在院日数については，負の相関がみられた。また，１つの手術室あたりで確保できる手術手技に対する報酬も同様に施設資源や機能に強く関連している。さらに，目

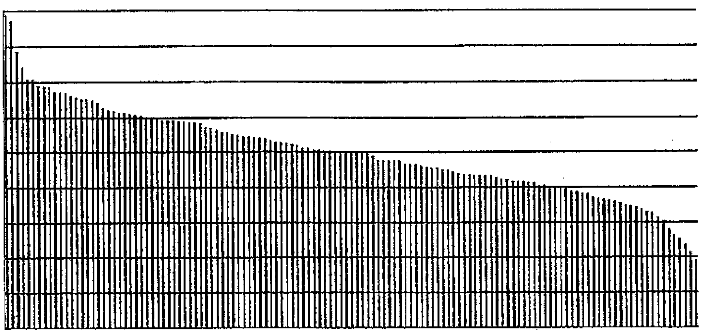

図1　1ヵ月1手術室あたりの手術件数の OE 比（＝実測値／予測値）

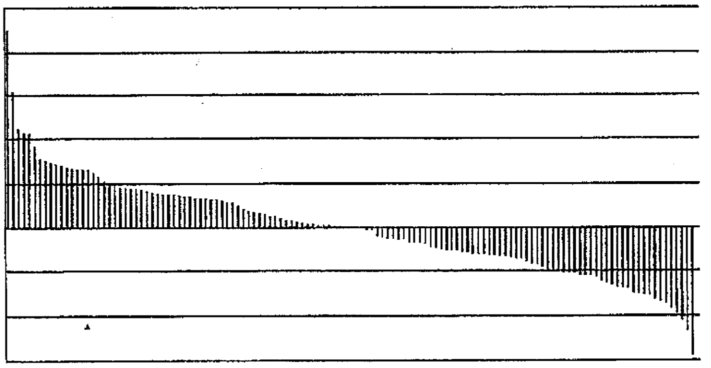

図2　1ヵ月1手術室あたりの手術件数の OE 差（＝実測値－予測値）

的変数を1ヵ月1手術室あたりの手術件数とし，説明変数に単変量解析で有意（$P < 0.05$）であった施設の資源や機能に関する指標を投入し，ステップワイズ法を用いて重回帰分析を行った。結果は，表1の通りである。表1の通り，説明変数として選択されたのは，1手術室あたりの外科系医師数ならびに平均在院日数であった。同様に，目的変数を1ヵ月1手術室あたりの手術手技報酬とし重回帰分析を行った結果は，表2の通りである。

表2の通り，説明変数として選択されたのは，1手術室あたりの1手術室あたりの外科系医師数ならびに病床数であった。その後，作成した重回帰モデルの安定性を検証するため，検証用サンプルにおいて，R^2 を算出した結果，1ヵ月1手術室あたりの手術件数の R^2 は 0.508，手術手技報酬の R^2 は 0.500 であり，重回帰モデルの R^2 と比較すると近い値となった。

その後，1ヵ月1手術室あたりの手術件数を上記の重回帰モデルに投入し，予測値（Expected Value）と実測値（Observed Value）の比（OE 比）と予測値と実測値の差（OE 差）を算出し，その結果を図1，図2に示した。同様に，1ヵ月1手術室あたりの手術手技報酬についても算出した。OE 比は，1より高いものは，実測値が予測値を上回り，1より低いものは実測値が予測値を下回ることを示す。OE 差は，0より高いものは，実測値が予測値を上回り，0より低いものは，実測値が予測値を下回ることを示す。

考　察

本研究では，1ヵ月1手術室あたりの手術件数，手術手技報酬を用いたが，これらの指標は，互いに強い相関がみられた。これより，件数を多く実施している施設ほど手術手技報酬も多く確保できていることがわかる。また，1ヵ月1手術室あたりの手術件数，手術手技報酬は，施設の機能や資源に影響することが示された。重回帰分析の結果より，1手術室あたりの外科系医師数が多いほど，また平均在院日数が短いほど件数が多く，予測値は高い値を示すことが明らかとなった。そこで，経営管理の仕組みの中で目標管理があげられ目標管理において重要な点として，具体的な数値目標を示し改善につなげることとされている

が[2, 17, 18]，本研究で提案する方法として，図1，図2では，1ヵ月1手術室あたりの手術件数のそれぞれOE比，OE差を示しており，OE比を用いることにより，各医療機関が自院の1ヵ月1手術室あたりの手術件数が予測値と比較して，手術件数がどの程度多いのか，もしくはどの程度少ないのかを比で把握することでき，数値化された手術件数の目標値として活用することが可能となる。さらに，OE差を用いることにより，1ヵ月1手術室あたりの手術件数が予測値と比較して，何件多いのか，もしくは何件少ないのかを実数で把握することができる。同様に，1ヵ月1手術室あたりの手術手技報酬は，手術手技報酬が予測値と比較して，どの程度高いのか低いのかを比で把握することや何円高いか何円低いかを実数でも把握が可能である。

本研究では，重回帰モデルを用いて予測値を算出し，実測値と予測値の比であるOE比と実測値と予測値の差であるOE差を算出した。予測値との差には，R^2で説明される部分とその他の病院に関連する要因，そして，誤差が含まれているが，本研究では，その誤差の幅について検証されていないため今後検証する余地がある。しかしながら，本研究では，検証用サンプルを用いて，重回帰モデルの安定性の検証を行い，大きな相違はみられなかった。

本研究の新規性は，第一に，先行研究では手術室の指標を用いた研究では，アンケート調査に基づくものが一般的で，客観データを用いる研究が極めて稀であったため，多施設の手術件数や手術手技報酬を統一の定義で数値化がされていなかった。しかし，本研究では，本邦の多数の急性期病院で用いられている客観データであるDPCデータを用いることにより，統一の定義での指標の算出を可能とし，手術件数，手術手技報酬の多施設間での比較を可能とした。以前より，多施設間ベンチマーキングには，自組織の強み弱みを把握することができること，多くの位置を知ることができること，ベスト・プラクティスを参考にできるなどといった利点があり，目標管理や業務改善の方法として有効であるとされ[13, 19]，本研究もその可能性を秘めている。第二に，これまでの医療経営の領域で用いられていた手術室の運用度を測定する方法としては，時系列の変化に基づく実績の評価や他の施設の資源や機能を考慮しないままの手術の件数のみで評価を行い目標管理がなされていたが，本研究では，特に現場の努力で直ちに変更できないような施設の資源や機能との関連要因を，重回帰分析を用いて明らかにした後，予測値を算出することにより，OE比やOE差を用いた件数，報酬の視点から目標値を設定することが可能となった。

近年，手術室の運用の効率化と目標管理の必要性がいっそう高まりつつあるため[8]，本研究で考案した手術室運用の効率性指標は，急性期医療を担う医療機関経営に求められているものであると言えよう。考案した指標は，全国共通の標準データセットであるDPCデータを用いているため，他のDPCを導入している医療機関においても適応することが可能であり，今後，さらに多数の医療機関においての分析も期待できる。

結　論

本研究では，1ヵ月1手術室あたりの手術件数，手術手技報酬を統一の定義で多施設間比較可能な形で算出することができた。また，これらの指標と1手術室あたりの外科系医師数ならびに病床数や平均在院日数といった施設の資源や機能に強い関連がみられた。これらの関連の強い変数群を反映した予測値を算出し，1ヵ月1手術室あたりの手術件数，手術手技報酬の実測値と予測値の比（OE比）ならびに差（OE差）を手術室運用の効率性指標として提案する。

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<連絡先>
京都大学　大学院医学研究科　医療経済学分野
今中　雄一
E-mail : imanaka-y@umin.net.

心不全診療における費用の構造

～入院DPCデータを用いた原価計算から分かること～

京都大学 医療経済学分野
猪飼　宏, 大坪 徹也,
林田 賢史, 今中 雄一

第58回日本心臓病学会学術集会
特別企画1「循環器疾患の医療経済学」
2010年9月17日

http://med-econ.kyoto-u.ac.jp/

心不全診療の特徴と資源利用のバラツキ

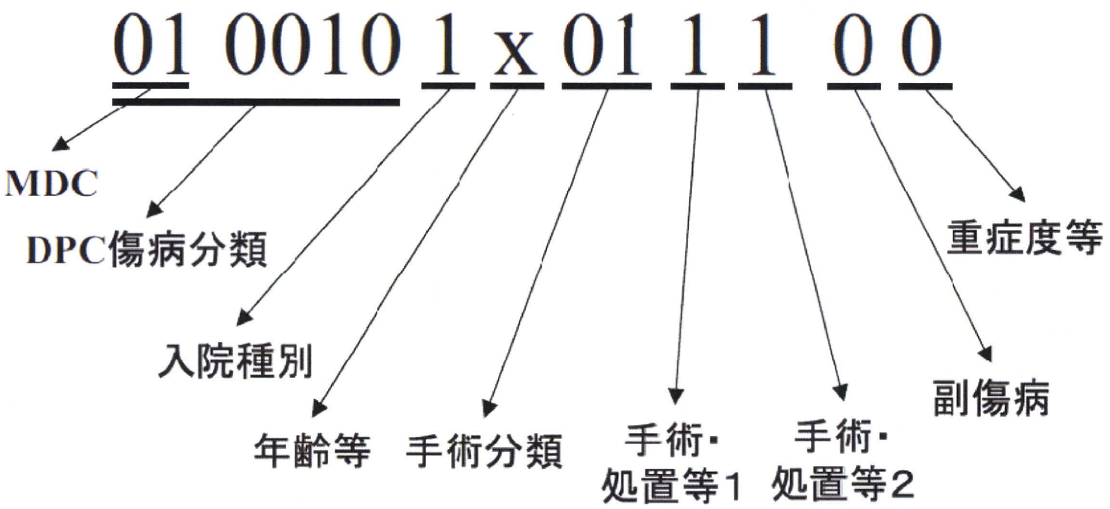
原価計算からみた循環器領域の特徴

原価計算から見た心不全診療の特徴

DPC支払い制度における適切な値決めに向けて

2

DPCコード体系



050130 心不全

番号	診断群分類番号	傷病名	手術名	手術・処置等1	手術・処置等2	副傷病	重症度等	期間日数	期間日数	期間日数	期間点数	期間点数	期間点数
510	050130xxxx00xx	心不全		なし	なし			10	19	42	2,854	2,068	1,758
511	050130xxxx01xx	心不全		なし	1あり			8	25	66	3,330	2,691	2,287
512	050130xxxx02xx	心不全		なし	2あり			13	25	50	3,318	2,417	2,054
513	050130xxxx04xx	心不全		なし	4あり			[illegible]	[illegible]	[illegible]	3,991	3,015	2,563
514	050130xxxx10xx	心不全		あり	なし			[illegible]	[illegible]	[illegible]	3,383	2,500	2,125
515	050130xxxx11xx	心不全		あ[illegible]	1あり			[illegible]	[illegible]	[illegible]	3,624	2,780	2,363
516	050130xxxx12xx	心不全		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	3,543	2,586	2,198
517	050130xxxx14xx	心不全		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	3,982	2,912	2,475

右心カテ・
左心カテ

1) 人工腎臓（透析）・
2) シンチグラム・
SPECT・
4) 人工心肺・
経皮的心肺補助・
補助人工心臓・
埋込型補助人工心臓

2010.3.19 平成22年厚生労働省告示 第95号
厚生労働大臣が指定する病院の病棟における療養に要する費用の額の算定方法の一部を改正する件

手術症例が極めて少なかったため、主たる手術の有無による分岐は行われなくなった。

背景: 心不全治療における資源利用の特徴

- 高額な検査･薬剤はそれなりに多いが、
  高額な手術手技の件数は少ない。

- 薬剤
  - hANP ('95~) 2436円/1000mcg
  - ミルリノン ('98~) 6348円/10mg
  - (ACEI /ARB ('87~))
- 検査
  - 脳性ナトリウム利尿ペプチド(BNP) ('96~入院, '98~外来でも) 1400円
  - 心臓核医学検査　13000円
  - 心エコー　8800円
  - 経食道心エコー　15000円
- 手術
  - ステント、CABG、心室瘤切除、左室形成術
  - 植え込み型除細動器(ICD) 、カテーテル焼灼術
- リハビリ

- 症例ごとの資源利用度に大きなバラツキがある。

5

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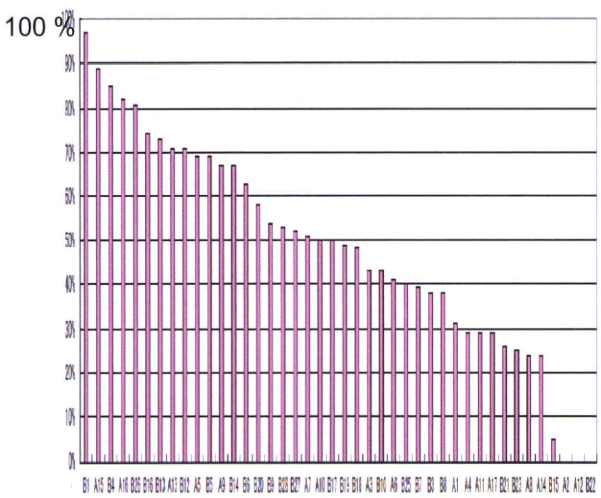
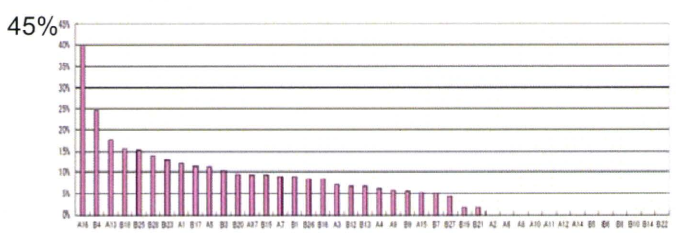
DPC参加病院(急性期病院)45施設における心不全症例への資源利用のバラツキ

QIP
Quality Indicator/Improvement Project

- BNP定量
- 右心カテ(S-G)





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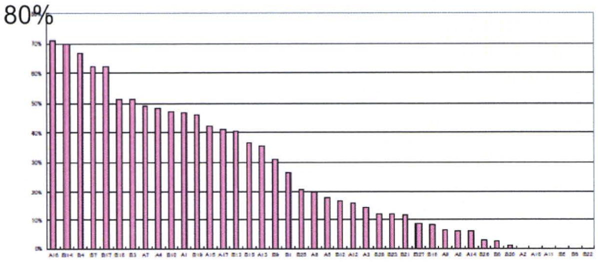
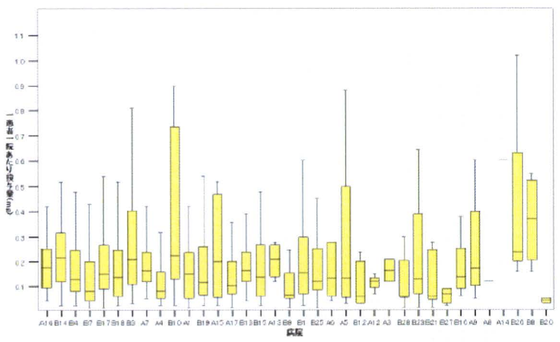
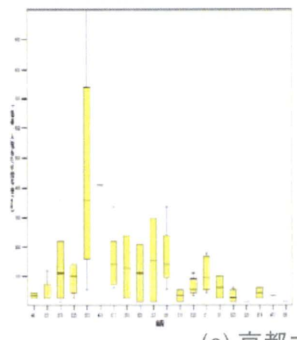
DPC参加病院(急性期病院)45施設における心不全症例への資源利用のバラツキ

QIP
Quality Indicator/Improvement Project

- カルペリチド(hANP)
- ミルリノン







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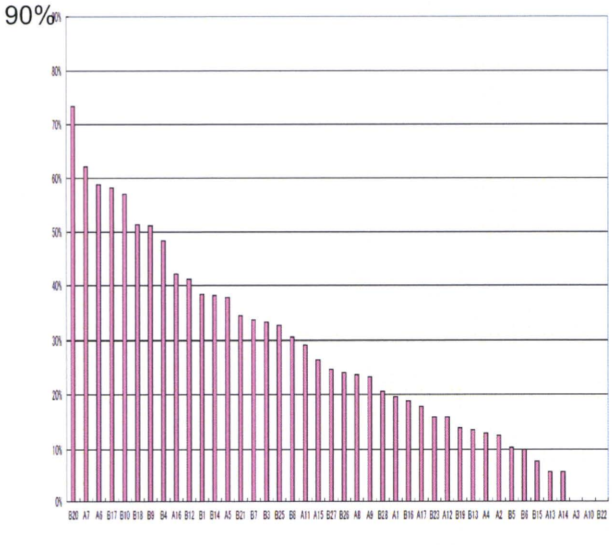
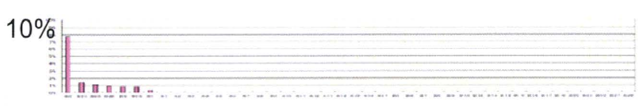
DPC参加病院(急性期病院)45施設における心不全症例への資源利用のバラツキ

QIP
Quality Indicator/Improvement Project

- 心大血管リハ
- ICD植え込み





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(c) 京都大学 医療経済学分野

心不全診療の特徴と
資源利用のバラツキ

原価計算からみた
循環器領域の特徴

原価計算から見た
心不全診療の特徴

DPC支払い制度における
適切な値決めに向けて

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医療向上･経営向上のための原価計算

- コストパフォーマンスの評価と向上
- 予算の編成および統制
- 資金確保における交渉材料
- 実現可能な質向上のへの計画策定
- 経営の基本計画の設定

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