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Original Article

Assessment of Medical Expenditures for Sepsis: Differentiating between Cases with and without Ruled-out Diagnoses

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Setting public health priorities requires precise estimation of the burden of disease, including disease-specific medical expenditure. Information on multiple and ruled-out diagnoses on health insurance claims (HICs) has been ignored in traditional analyses of disease-specific medical expenditures in Japan. This study reviewed 448 inpatients with at least one diagnosis of sepsis on their HICs, who were insured by corporate health insurance organizations making claims on services provided from April 2006 to March 2007 in Japan. Subjects in whom sepsis-related diagnoses were specified as "ruled-out" were compared with subjects in whom sepsis-related diagnoses were classified as "not-ruled-out" (*i.e.*, subjects in whom sepsis was considered possibly or likely present). Direct medical expenditure, length of stay (LOS), cost per day, cost of antibiotics, and proportion of administered cephalosporin and carbapenems were significantly higher in subjects classified as not-rule-out. When using health insurance claims in Japan, the statistics of medical expenditures and LOS are influenced by procedures performed to rule out a diagnosis, as well as those performed to treat a confirmed diagnosis of sepsis.

Key words: health insurance claims, length of stay, medical expenditures, ruled-out diagnoses, sepsis

Setting public health priorities requires precise estimation of the burden of disease, including disease-specific medical expenditures. However, there are some technical limitations for estimating disease-specific medical expenditures in Japan [1–5]. In Japan, health insurance coverage is universal and was originally based on fee-for-service reimbursement. In 2003, DPC/PDPS (Diagnosis Procedure Combination/Per-Diem Payment System) was introduced in hospitals for acute inpatient care. However, the fee-for-service reimbursement system for outpatient care and hospitals for chronic inpatient care has continued without major change. In order to claim reimbursement for the costs of healthcare services provided in a given calendar month, each healthcare provider submits health insurance claims (HICs) to the Health Insurance Claims Review & Reimbursement Services (HICRRS) or to the National Health Insurance Organization (NHIO), depending on the patient's specific health insurance plan. The HICRRS or NHIO investigates the HICs to determine the patients' eligibility for coverage and whether the healthcare services provided meet the regulations of the reimbursement rules defined by the Ministry of Health, Labour and Welfare. After the investigations, the HICRRS or NHIO then sends the HICs to the insurers.

The data fields recorded on the HICs are identical regardless of the insurance provider [6]. The statistics concerning medical expenditures in Japan, such as those from the Estimation of National Medical Expenditure, Social Insurance Claims Survey, or National Health Insurance Medical Benefit Surveys,

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are based on data from these HIC reports. The actual medical expenditures and length of stay (LOS) for inpatients hospitalized for 2 or more months has not yet been estimated in Japan because conventional statistics using HIC data in Japan have been based on the analysis of one month's HICs only (the month of May) [4, 7]. Statistics concerning disease-specific medical expenditures in Japan are based on broad disease categories subdivided from the chapters in the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10). For example, medical expenditures for sepsis alone have not yet been estimated because sepsis is classified under the broad category of "other infectious diseases and parasitic diseases."

Owing to the regulations of reimbursement in Japan, health care providers are required to submit a single HIC combining all health care services for an individual rendered by the provider in a given calendar month; thus, most HICs contain more than one diagnosis [3, 5, 8]. As a result of technical limitations for handling all of the information recorded on an HIC, it is common to select only one principal diagnosis from an HIC and ignore the existence of additional diagnoses when estimating disease-specific medical expenditures.

Furthermore, HICs contain not only confirmed diagnoses, but also diagnoses that are unconfirmed or disproved. Each clinical procedure must be justified by a corresponding diagnosis; as a result, ruled-out diagnoses are included in the HICs to ensure reimbursement for the diagnostic tests, even when the results show that the suspected diseases are not present. Thus, estimations of disease-specific medical expenditures in Japan include expenditures on patients in whom diseases are suspected but not present because information provided on the HICs does not distinguish between confirmed diagnoses and ruled-out diagnoses [9, 10].

Sepsis is a life-threatening disease and requires significant medical resources for treatment [11–15]. Blood cultures are commonly performed to confirm or rule out sepsis in patients hospitalized due to cancer or trauma, as nosocomial bloodstream infections can cause complications that result in a substantial increase in hospital LOS and total cost of care [13]. Such procedures to rule out sepsis are included in HICs to ensure reimbursement for these clinical procedures, even if sepsis is not confirmed in the patients. When conducting an analysis of expenditures specific to a condition like sepsis, it is important to distinguish between procedures performed to rule out the diagnosis, and those that are performed to treat a confirmed diagnosis.

This study aimed to more accurately describe the medical expenditures, LOS, and clinical procedures performed on patients whose HICs include the diagnosis of sepsis. By including information on multiple and ruled-out diagnoses reported on the HICs, which have previously been ignored in the statistics of disease-specific medical expenditure in Japan, our study was able to differentiate between procedures performed to rule out the diagnosis of sepsis versus those performed due to a confirmed diagnosis of sepsis.

Methods

Study setting. This study investigated all inpatient HICs submitted to an employee health insurance organization from April 2006 to March 2007. The employee health insurance organizations used in this study were the same ones we examined in our previous reports [8–10]. The number of insured persons and their dependents was 330,195 as of March 31, 2007. We identified 448 inpatients with at least one HIC including a diagnosis classified as sepsis. We collected data on medical expenditures, LOS, cost of antibiotics, injected cephalosporin and carbapenems, and all diagnoses listed on the HICs. If a patient was hospitalized for 2 or more months, all the inpatient HICs were collected and the data were combined.

Definition of ruled-out diagnosis for sepsis group. In this study, sepsis is defined as a diagnosis of one of the following according to the ICD-10: A40 (Streptococcal sepsis), A41 (Other sepsis), P36 (Bacterial sepsis of newborn), and T81.4 (Infection following a procedure, not elsewhere classified). In accordance with the reimbursement rules of the Japanese health insurance system, we classified each diagnosis as either a ruled-out diagnosis or confirmed diagnosis, based on whether or not the diagnosis was marked "ruled-out diagnosis" on the HIC [9, 10]. If all of a patient's diagnoses for sepsis were ruled-out diagnoses, we classified the patient under the "ruled-out" group. These were the patients in whom sepsis was confirmed not to be present.

However, if a patient had at least one diagnosis of sepsis not marked "ruled-out diagnosis," we classified the patient under the "not-ruled-out" group. These were the patients in whom sepsis was presumably confirmed to be present.

Statistical analysis. Total medical expenditures, cost per day, and cost of antibiotics were expressed in Japanese yen (¥100 = US$1.08 or €0.83, as of February 26, 2013). We conducted logarithmic transformation for total medical expenditures, LOS, cost per day, and cost of antibiotics before conducting the Student's *t*-test. Student's *t*-test was used to compare the various parameters for the ruled-out and not-ruled-out sepsis groups. The χ^2 test was used for categorical data. A two-sided *p*-value of < 0.05 was considered to be statistically significant. All analyses were performed using the IBM SPSS Statistics Version 19 (International Business Machines Corporation, Armonk, NY, USA).

Personally identifiable information was removed prior to the analysis using the MediC4 encoding system (Japan Medical Data Center Co. Ltd., Tokyo, Japan) [16]. The study protocol was approved by the Ethics Committee of Fukuoka University.

Results

Table 1 shows data on sex, age, LOS, and direct medical expenditures related to the diagnosis of sepsis. There were slightly more patients with ruled-out diagnoses (260; 58.0%) than with not-ruled-out diagnoses for sepsis (188; 42.0%). The proportion of male subjects in the ruled-out group and the not-ruled-out group were 63% (164/260) and 57% (107/188), respectively, with no statistical difference. The average age of subjects in the ruled-out group was lower than that of subjects in the not-ruled-out group, but the difference was not significant. The average LOS and amount of direct medical expenditures for subjects in the not-ruled-out group were more than twice as high as those for subjects in the ruled-out group, and these differences were statistically significant ($p <$

Table 1 Sex, Age, Length of Stay (LOS), and direct medical expenditures for subjects in whom sepsis was and was not ruled out

	Ruled-Out Group	Not-Ruled-Out Group	*p*-value
Number of subjects	260	188	
Sex			
Male	164 (63.1%)	106 (56.4%)	0.153
Female	96 (36.9%)	82 (43.6%)	
Age			
Minimum	0	1	
Median	23.5	31.5	
Maximum	90	95	
Mean (±SD)	28.1 (±25.2)	30.7 (±27.1)	0.298
LOS (days)			
Minimum	3	3	
Median	10	27.5	
Maximum	335	345	
Mean (±SD)	25.3 (±39.5)	56.8 (±69.0)	<0.001
Direct medical expenditure			
Minimum	73,860	81,460	
Median	330,585	1,028,855	
Maximum	14,805,550	23,827,580	
Mean (±SD)	900,873 (±1,528,472)	2,643,084 (±3,705,097)	<0.001
Cost per day			
Minimum	13,187	7,834	
Median	32,966	38,856	
Maximum	215,234	262,172	
Mean (±SD)	38,083 (±24,420)	47,351 (±32,311)	<0.001

Medical expenditures are expressed in Japanese yen (¥).
SD indicates standard deviation.

0.001). The average cost per day for subjects in the not-ruled-out group was 25% higher than that for subjects in the ruled-out group, and the difference was statistically significant ($p < 0.001$).

Table 2 shows the cost of antibiotics (injected cephalosporin and injected carbapenem) associated with a diagnosis of sepsis. Antibiotics were administered prophylactically to all patients, regardless of type of sepsis diagnosis (ruled-out or not-ruled-out). The average cost of all antibiotics given to subjects in the not-ruled-out group (¥46,633.70) was 66% higher than that of subjects in the ruled-out group (¥28,034.00); the difference was statistically significant.

Cephalosporin was administered to a significantly higher proportion of subjects in the not-ruled-out group (149; 79.3%) than the ruled-out group (184; 70.7%) ($p = 0.042$). The average cost for subjects in the not-ruled-out group who were administered cephalosporin (¥23,142.90) was 60% higher than that of subjects in the ruled-out group (¥14,334.30). However, the difference was not statistically significant ($p = 0.194$).

Carbapenems were administered to a significantly higher proportion of subjects in the not-ruled-out group (59; 31.4%) than in the ruled-out group (31; 11.9%) ($p = 0.001$). However, the average cost of administered carbapenems for subjects in the not-ruled-out group was not significantly different from that of subjects in the ruled-out group ($p = 0.590$).

Discussion

This study investigated 448 inpatients with at least one HIC that included a diagnosis classified as sepsis, and the associated medical expenditures, LOS, cost per day, and cost of antibiotics. Our analysis yielded 2 major findings. First, we found that the average direct medical expenditure and cost per day for subjects in whom sepsis was not ruled out were significantly higher than for subjects in whom sepsis was ruled out. Second, we found that the amount and average total cost of antibiotics administered was higher in subjects in whom sepsis was not ruled out.

This is the first study in Japan that reveals differences in procedures and medical expenditures for inpatients with and without a ruled-out diagnosis for sepsis. Japan's health insurance system is originally based on a fee-for-service reimbursement model, the rules of which dictate that each clinical procedure must be justified by a corresponding diagnosis. As a result, ruled-out diagnoses are often included in the

Table 2 Cost of antibiotics for subjects in whom sepsis was and was not ruled out

	Ruled-Out Group	Not-Ruled-Out Group	*p*-value
All antibiotics			
Number of patients	260 (100%)	188 (100%)	NA
Minimum	174	148	
Median	11,096	16,688	
Maximum	1,245,776	1,092,749	
Mean (±SD)	28,034 (±91,399)	46,634 (±100,337)	<0.001
Cephalosporin for injection			
Number of patients	184 (70.7%)	149 (79.3%)	0.042
Minimum	492	312	
Median	9,486	10,752	
Maximum	131,093	413,261	
Mean (±SD)	14,334 (±17,943)	23,143 (±45,412)	0.194
Carbapenems for injection			
Number of patients	31 (11.9%)	59 (31.4%)	<0.001
Minimum	2,455	564	
Median	20,628	21,384	
Maximum	119,772	138,600	
Mean (±SD)	25,254 (±25,128)	29,509 (±27,251)	0.590

Medical expenditures are expressed in Japanese yen (¥).
SD indicates standard deviation.

HIC to ensure reimbursement for these clinical procedures, even when results show that the suspected diseases are not present [9, 10]. Since most HICs were being submitted on paper until recently, technical limitations had prevented analysts' ability to distinguish between ruled-out diagnoses and confirmed diagnoses. As such, estimates of disease-specific medical expenditures in Japan may not have been accurate because they did not account for these differences [4, 7]. Only since April 2011 have medical facilities been mandated to provide HIC data through online systems. Such computerization will facilitate the analysis of information from HICs, including information that has not yet been available by the conventional method.

Compared to the conventional estimation of disease-specific medical expenditures [4, 7], this study has 2 strengths. First, this study investigated all the diagnoses classified as "sepsis" in the HICs studied. Even though multiple diagnoses may be mentioned on the claim, it is common for researchers to select only one principal diagnosis from an HIC in their analyses of disease-specific medical expenditures [8]. Classification by principal diagnosis cannot avoid bias, in that some diagnoses are more likely to be chosen as principal diagnoses than others; for example, hypertensive diseases (ICD-10: I10–15) are more likely than other diseases of endocrine, nutrition and metabolism (ICD-10: E15–90) to be chosen as a principal diagnosis [3, 8]. These biases may contribute to over-estimation of health care expenditures for some diseases and under-estimation of expenditures for others. The HICs can represent a suitable data source if all diagnoses listed are analyzed, as has been demonstrated in studies evaluating measles surveillance [17] and in the assessment of the quality of care for diabetes patients [18].

The next is that diagnoses were classified according to the disease categories of the ICD-10. In most Japanese statistics on medical expenditures, sepsis is classified under "other infectious diseases and parasitic diseases" based on the broad groups of disease categories subdivided from the chapters in the ICD-10, making it difficult to estimate the medical expenditures for sepsis alone. The classification of diagnoses according to the specific disease category of the ICD-10 should be utilized in the analysis of disease-specific medical expenditures.

This study has 2 major limitations. First, the subjects were limited to patients covered under employee health insurance; therefore, data from the HICs analyzed in this study are not necessarily representative of the total population in Japan. However, we can assume that the current results are broadly applicable, since health insurance coverage in Japan is universal, with a uniform claims format and fee schedule.

Second, the comorbid diagnoses included in the HICs are not unified for all the patients; thus, the severity of the patients' diagnoses was not taken into account in this study. For instance, the LOS and cost of care for cancer patients with severe sepsis are around 3 times higher than those of cancer patients without severe sepsis [11]. The information on HICs in Japan is limited to diagnoses, medical procedures used, and names of prescribed drugs. As test results are not provided in the HICs, this study was unable to directly evaluate the severity of the diagnoses of the sample population. In addition, evaluations of total medical expenditures, LOS, cost per day, and cost of antibiotics associated with the diagnosis of sepsis using laboratory-confirmed blood-stream infection based on international guidelines [19] or isolation of a pathogen from blood culture bottle [13], with severity of sepsis, or with comorbid diagnoses [11, 15, 20], still await further investigation.

In conclusion, we revealed differences in medical expenditures and procedures for inpatients in whom sepsis was and was not ruled out. Our analyses provide objective justification for utilizing information ignored by conventional methods of estimating disease-specific medical expenditures in Japan.

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