限界

- DPCデータは記入枠に限界があり、病名のみで実際の病態を十分反映できるとは限らない。
- NYHA分類は 現場医師の判断によるが、医師が必ずしも専門医ではないため、判断が正しいとは限らない。
- 結果の解釈にあたり、QIP参加病院は医療の質改善に積極的な傾向があるなどの交絡については留意が必要である。

結論

本研究で開発した急性心不全患者の院内死亡予測モデルの予測力は高く、高額医療につながる急性心不全医療の提供内容について、病院間比較を行ったり、病院の診療を継時的にモニターする上で、今後も広く利用できると考えられる。

Variations in Healthcare Spending and Quality among Institutions

Tetsuya Otsubo, Yuichi Imanaka, Toshitaka Morishima, Noriko Sasaki, Sungchul Park, and Jason Lee

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Contents

Variations in Healthcare Spending and Quality among Institutions

Abstract

Unwarranted institutional variations in healthcare spending and quality may indicate discrepancies in the quantity of services provided, management efficiency, and staff ability at the hospital level. However, because not all variations are unwarranted, analyses must take into account the differences in the needs and preferences of the various patient groups served. These variations can be influenced by factors such as payment systems, hospital ownership, management methods, resource availability, teaching status, and practice patterns. Although institutional variations may be intertwined with variations at the regional level, some measures of care are more meaningful when quantified at the hospital level, such as nosocomial infection rates or indicators of hospital management efficiency. Accurately identifying unwarranted variations as stemming from causes at the institutional level would also help to identify the appropriate stakeholders and decision makers who have the relevant authority and jurisdiction to address the problem. In this chapter, we address the empirical evidence of institutional variations in healthcare spending, medical practice patterns, and outcomes. We also investigate the factors that have been shown to influence these variations, and discuss the general methodologies used in analyzing institutional-level variations in healthcare spending and quality.

1. Introduction

Unwarranted institutional variations in healthcare spending and quality may indicate discrepancies in the quantity of services provided, management efficiency, and clinical staff ability among different hospitals. These variations can also point to the unequal distribution of resources, inefficient use of existing resources, or provision of sub-optimal healthcare in some hospitals. Growing recognition of the existence and impact of unwarranted variations among hospitals is seen in the advent of quality-incentivizing systems such as pay for performance (P4P) and public reporting systems. The rationale for reducing unwarranted variations among institutions is that, in theory, there is an optimal delivery of healthcare, in which the highest possible quality of care is provided at the lowest possible cost. Deviations from this optimum may simply reflect variations in patient populations, and therefore might not necessarily indicate poorer quality of healthcare. Research into healthcare variations at the institutional level must take into account the differences in the needs of the various patient groups served.

The dependability and usability of observed variations as indicators is limited by the quality of data and methodological approaches. Large databases comprising standardized data from numerous healthcare providers, coupled with appropriate adjustment methodologies, can increase the cogency of any variations observed. Variations that extend beyond the hospital level are covered in elsewhere in this handbook.

Unwarranted variations are those that are not a result of differential patient case mix or environmental factors, and can be reduced through improvements to payment systems, resource distribution, and clinical guidelines. These variations can be influenced by factors such as payment systems, hospital ownership, insurance systems, management methods, resource availability, teaching status, and practice patterns. The identification of "optimal" healthcare can be conducted using the various guidelines and standards promulgated by expert bodies within each field, while taking into account the unique characteristics of each country or region.

Uneven healthcare spending and quality at the institutional level are likely to be of most interest to hospital management staff, policymakers, payers, and health services researchers, who aim to elucidate the variations in order to bring about improvements or adjust payment systems and policies. In addition to these stakeholders, the general public is increasingly aware of these variations. The information asymmetry been patients and doctors has traditionally led to a general impression that the care provided by any medical professional has been correct and necessary. However, growing patient awareness amid reports of hospital variations in the quality of healthcare processes and outcomes (including hospital scorecards and the Centers for Medicaid and Medicare Services' [CMS] Hospital Compare program)

B-2 「Impact of hospital case volume on quality of end-of-life care among cancer patients: a cross-sectional study using claims data 」

京都大学大学院 医学研究科 医療経済学分野 ◎森島 敏隆

【背景】 Issues pertaining to end-of-life cancer care affect a large number of Japanese people. Quality of terminal care draws increasing attention. Nevertheless, the rates of hospice use and home-care service are still low in Japan. Most Japanese people die in acute-care hospitals currently. It is important to examine quality of terminal care in acute-care hospitals.

【目的】 To investigate relationship between quality of end-of-life care and hospital characteristics after adjusting for patient characteristics.

【方法】 A cross-sectional study was conducted. The data source was comprised of claims information electronically submitted to National Health Insurance and Long Life Medical Care System. Patients who died of cancer in acute-care hospitals in Kyoto Prefecture between March 2009 and May 2010, with available claims records for at least 2 months prior to death were included in this study. Patients who used hospice service during their last 2 month of life, and those who received terminal care at hospitals with less than 10 terminally ill cancer patients were excluded. Benchmark quality measures for terminal cancer care developed to identify good- and poor-quality procedures from administrative data were used to determine the following: use of opioids during the last 2 months of life (good-quality), receipt of life-sustaining treatments (cardiopulmonary resuscitation, intubation, or mechanical ventilation) or admission to intensive care units during the last month of life (poor-quality), and receipt of chemotherapy during the last 2 months of life (poor-quality). Patient characteristics data regarding age, sex, cancer types, and comorbidities were obtained. The treating hospital for each patient was defined as the last hospital admitted to or visited before death. Hospital characteristics included teaching status, ownership, palliative care team status, and proportion of board certified oncologists. To determine whether there was a volume effect that might explain the differences of procedures, hospitals were grouped into quartiles according to their case volume during the study period. Multilevel logistic regression models were used to handle data consisting of patients within a given hospital.

【結果】 We analyzed 3205 decedents from 55 hospitals. There were more men than women. The largest age-group was 75-79 years. The most common type of cancer was lung cancer, followed by gastric cancer. There were significant associations between quality of terminal care and the hospital case volume after adjusting for the patient characteristics and the hospital characteristics. The opioid use model revealed that hospitals in higher volume quartiles were more likely to provide opioids, compared to those in the lowest volume quartile. The life-sustaining treatment model revealed that hospitals in higher volume quartiles were less likely to provide life-sustaining treatment or intensive care, compared to those in the lowest volume quartile. The likelihood of chemotherapy was not significantly associated with the case volume in the chemotherapy model. We found no associations between other hospital characteristics and procedure indicators.

【考察】 The case volume of terminally ill cancer patients correlated positively with the likelihood of opioid use, and correlated negatively with that of life-sustaining treatments. Quality of terminal care should be improved in hospitals with smaller case volume.

Impact of hospital case volume on quality of end-of-life care among cancer patients: a cross-sectional study using claims data

Presented at the 7th annual meeting of JHEA
on July 21, 2012

京都大学大学院医学研究科
医療経済学分野
森島敏隆、Jason LEE、大坪徹也、
猪飼宏、今中雄一

背景1

- わが国の最多の死因はがん
- 諸外国に比べて遅れている[1]緩和ケアが普及するように政府が推進[2]
- ホスピス・在宅医療は十分に普及していないので、現状では大多数の患者が一般病院で死亡
- 一般病院の終末期医療の質はどうか？
- 緩和ケアチームの体制・実績に差がある[2]

1. Wright et al. J Pain Symptom Manage 2008.
2. がん対策推進基本計画（厚生労働省）2012

背景2

- 政府は全国どこでも緩和ケアを適切に提供することを目指している[1]
- がん治療の質の均てん化を目指す[2]のなら、症例数の多寡にかかわらず良質な終末期医療を提供する必要
- 症例数はstructureのような性質で、医療の質に関連[3]
- 症例数と終末期医療の質の関係は不明

1. がん対策推進基本計画(厚生労働省)2007
2. がん医療水準均てん化の推進に関する検討会報告書(厚生労働省)2005
3. Epstein et al. NEJM 2002.

目的

一般病院のがん末期患者の症例数と、がん終末期医療(プロセス)の質の関係を検証

方法、デザイン、データ

- デザイン
  Cross-sectional
- データソース
  京都府の国民健康保険と後期高齢者医療制度の診療報酬明細書のデータベース
- 研究対象患者
  包含基準 (n=3535)
  - ✓ 2009年3月～2010年5月にがん (ICD-10 codes: Cxx.x)で死亡
  - ✓ 死亡月を含む終末期2か月間の診療報酬明細書が利用可能

  除外基準 (n=241)
  - ✓ 終末期2か月間にホスピスを利用

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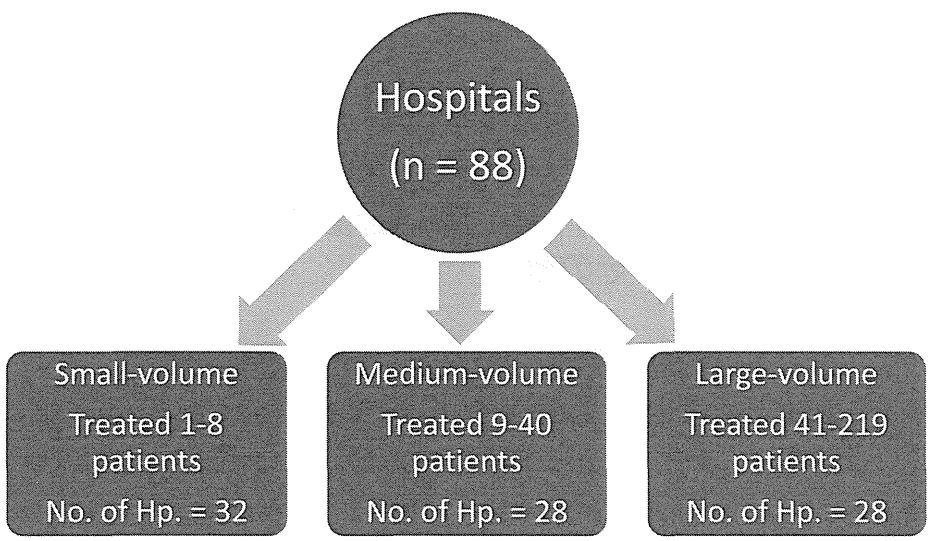
病院のグループ分け



患者を治療した病院
= 患者を死亡診断した病院と定義

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終末期医療の質の指標

麻薬 Good-quality care[1,2]

- 最期2か月間の使用の有無

ICU or 延命治療 Poor-quality care[1-4]

- 最期1か月間のICU、心肺蘇生、気管内挿管、人工呼吸のいずれかの有無

化学療法 Poor-quality care[1-4]

- 最期2か月間の抗癌剤（細胞傷害性or分子標的薬）の使用の有無

1. Setoguchi et al. J Clin Oncol. 2008.
2. Grunfeld et al. Cancer. 2008.
3. Earle et al. J Clin Oncol. 2004.
4. Tang et al. Ann Oncol. 2009.

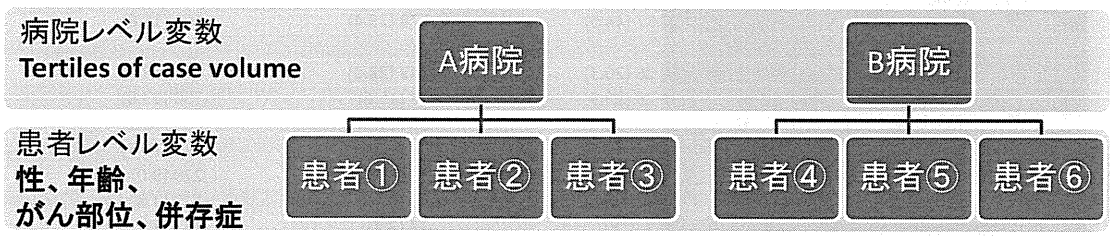
患者特性

- 性別
- 年齢グループ（-64, 65-69, 70-74, 75-79, 80-84, 85-）
- がんの部位
  肺、胃、大腸、肝、胆、膵、血液（白血病とリンパ腫）
  前立腺、乳、その他
- 併存症
  がん以外の疾患をCharlson Indexに従って
  スコア化[1,2]したものをグループ化（0-1, 2, 3, 4-）

1. Charlson et al. J Chronic Dis 1987.
2. Quan et al. Med Care 2005.

統計解析

- 各指標の実行の有無（2値変数）を目的変数
- マルチレベル・ロジスティック回帰モデル（ランダム切片）



方法、その他

- P <0.05（両側検定）を統計学的有意

- 統計ソフトウェア
  IBM SPSS 19とSAS 9.2

- 倫理審査
  京都大学大学院医学研究科
  医の倫理委員会承認(E-1023)

結果・患者特性

	Hospital case volume		
	Small	Medium	Large
No. of patients (n = 3294)	128	627	2539
Women	58 (45.3)	257 (41.0)	983 (38.7)
Age, y			
≤64	2 (1.6)	61 (9.7)	334 (13.2)
65–69	6 (4.7)	59 (9.4)	341 (13.4)
70–74	12 (9.4)	67 (10.7)	389 (15.3)
75–79	22 (17.2)	127 (20.3)	576 (22.7)
80–84	29 (22.7)	135 (21.5)	497 (19.6)
≥85	57 (44.5)	178 (28.4)	402 (15.8)
Cancer type			
Lung	26 (20.3)	143 (22.8)	475 (18.7)
Stomach	26 (20.3)	98 (15.6)	350 (13.8)
Colorectum	20 (15.6)	85 (13.6)	281 (11.1)
Liver	10 (7.8)	55 (8.8)	271 (10.7)
Pancreas	5 (3.9)	40 (6.4)	229 (9.0)
Biliary tract	7 (5.5)	33 (5.3)	122 (4.8)
Blood	1 (0.8)	23 (3.7)	181 (7.1)
Prostate	9 (7.0)	21 (3.3)	67 (2.6)
Breast	2 (1.6)	16 (2.6)	63 (2.5)
Other	22 (17.2)	113 (18.0)	500 (19.7)
Charlson Comorbidity Index			
0–1	30 (23.4)	157 (25.0)	925 (36.4)
2	20 (15.6)	132 (21.1)	514 (20.2)
3	24 (18.8)	98 (15.6)	339 (13.4)
≥4	54 (42.2)	240 (38.3)	761 (30.0)

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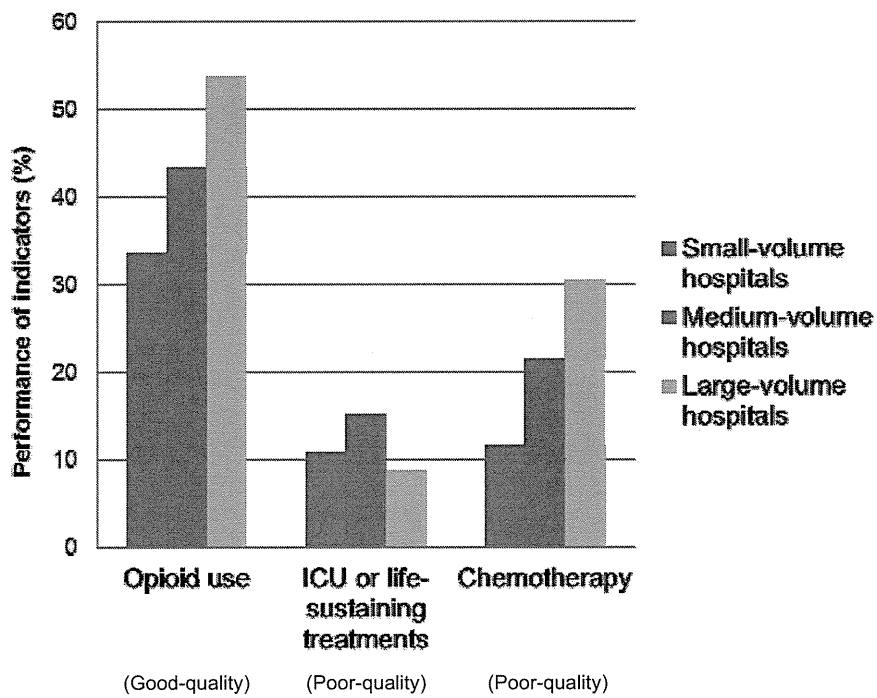
質指標の実行の割合（調整前）



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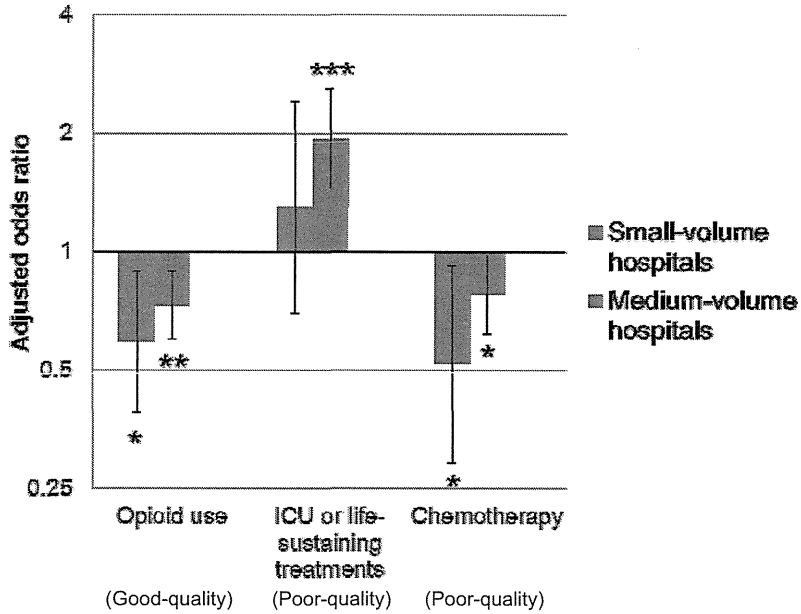
患者特性を調整した後のオッズ比



Adjusted odds ratios are presented as ratio relative to large-volume hospitals.
Vertical lines indicate 95% confidence interval.
* P <0.05, ** P <0.01, *** P <0.001 when compared to large-volume hospitals.

結果のまとめ

麻薬 Good-quality care

- small-volume hospitals < large-volume hospitals
- medium-volume hospitals << large-volume hospitals

ICU or 延命治療 Poor-quality care

- medium-volume hospitals >>> large-volume hospitals

化学療法 Poor-quality care

- small-volume hospitals < large-volume hospitals
- medium-volume hospitals < large-volume hospitals

Inequality signs indicate larger/smaller in adjusted odds ratio.

考察

- がん終末期医療の3つのプロセス指標と、一般病院の症例数の関係を調べた。
- 3つの指標について、医療の質と症例数の一定の関係は得られなかった。

麻薬の使用に関する考察

麻薬 Good-quality care

- small-volume hospitals < large-volume hospitals
- medium-volume hospitals << large-volume hospitals

- 症例数の少ない病院では、麻薬を処方する必要性の認識不足か、ためらいがあるのか。
- 一方、症例数の多い病院ではそのようなためらいがなくなるのかも。

麻薬の使用に関する含意

- 疼痛を十分にコントロールすることは終末期患者のQOLの向上に不可欠[1]
- 麻薬はがん緩和ケアに不可欠[2]

- 麻薬の処方に関する障壁を同定し、取り除く努力の必要性[3]
- あるいは、症例数の多い病院に患者を集約する必要性

1. Cleeland et al. NEJM 1994.
2. De Lima et al. J Pain Symptom Manage 2007.
3. Friedenberg et al. J Palliat Med. 2012.

ICU, 延命治療の施行に関する考察

ICU or 延命治療 — Poor-quality care

- medium-volume hospitals >>> large-volume hospitals
- small-volume hospitals ≒ large-volume hospitals

- medium-volume hospitalsでは、最期までできる限りの延命をしなくてはならないと考えているのかも。
- small-volume hospitalsでは、集中治療や延命治療をする必要性を感じても、リソースが不足していて実行できないのかも。

ICU、延命治療に関する含意

終末期の集中治療・延命治療は、患者のQOLを落とすことになることが多い[1-2]ことを知る必要性

1. Wennberg et al. Health Aff. 2009.
2. Teno et al. J Am Geriatr Soc. 2005.

化学療法の施行に関する考察

化学療法 Poor-quality care

- small-volume hospitals < large-volume hospitals
- medium-volume hospitals < large-volume hospitals

- 症例数の多い病院では、がん治療の専門医が多く在籍。専門医は自らの経験を積むために化学療法のoverindicationの傾向があるのかも。
- 症例数の多い病院には、治癒を目指した治療を希望する患者が集まるのかも。

化学療法に関する含意

治癒から緩和へと治療方針を変更することについて、医療側と患者側が話し合うことの必要性[1]

1. Wright et al. JAMA. 2008.

限界

admin. dataを使用

- 臨床の詳細情報がない

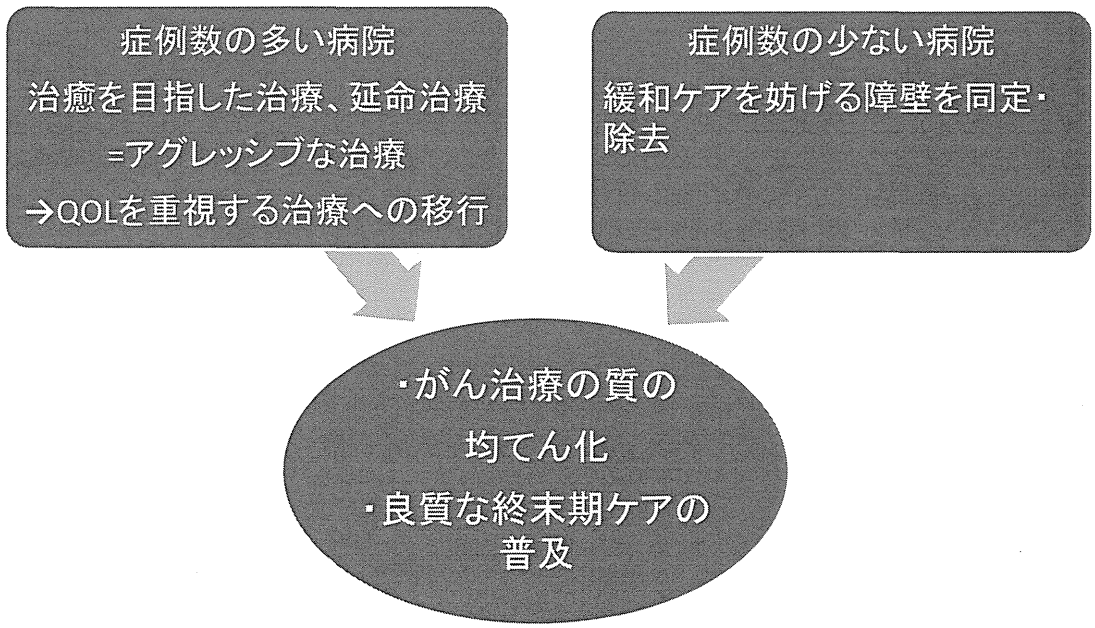
病院の症例数だけに着目

- 病院の経験と医師の経験の区別が不可能

被用者保険のデータがない

- 各病院の症例数を正確に表しているわけではない

結論


症例数の多い病院
治癒を目指した治療、延命治療
=アグレッシブな治療
→QOLを重視する治療への移行
症例数の少ない病院
緩和ケアを妨げる障壁を同定・除去
・がん治療の質の均てん化
・良質な終末期ケアの普及

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Impact of Hospital Case Volume on Quality of End-of-Life Care in Terminal Cancer Patients

Toshitaka Morishima, M.D., Jason Lee, Ph.D., Tetsuya Otsubo, Ph.D., Hiroshi Ikai, M.D., Ph.D., and Yuichi Imanaka, M.D., M.P.H., Ph.D.

Abstract

Background: Quality of end-of-life (EOL) care is gaining increasing attention. However, the relationship between hospital case volume and performance of benchmark quality indicators is not well characterized. The aim of this study was to determine whether hospital case volume affects EOL care for terminal cancer patients.
Methods: We conducted a retrospective cross-sectional study using claims data of patients who died of cancer at acute-care hospitals in Kyoto prefecture, Japan, between March 2009 and May 2010. Hospitals were grouped into tertiles based on the number of terminal cancer cases. We used multilevel logistic regression models to examine the association of the following quality indicators with the tertiles: opioid use during the last 2 months of life (indicating good quality of care), provision of intensive care unit (ICU) service or life-sustaining treatments during the last month of life (poor quality), and chemotherapy during the last month of life (poor quality).
Results: The final sample for analysis consisted of 3294 decedents from 88 hospitals. Significant associations between hospital case volume and quality of EOL care were identified after adjusting for patient and hospital characteristics. Small- and medium-volume hospitals were found to be less likely to administer opioids, and medium-volume hospitals were more likely to provide ICU service or life-sustaining treatments when compared with large-volume hospitals. No significant association between chemotherapy use and case volume was observed.
Conclusions: The results showed that the case volume of terminally ill cancer patients was associated with several aspects of quality of EOL care.

Introduction

Cancer is a leading cause of death associated with age in most industrialized nations. With the number of deaths from cancer expected to rise, there has been increased interest in the quality of end-of-life (EOL) cancer care, as seen by the numerous studies that have evaluated the quality of processes and developed quality indicators for administrative data to compare hospital performance.[1–5] Furthermore, variations in terminal cancer care among hospitals or geographic regions have been well documented, and are thought to arise from an uneven availability of palliative care services.[6–8]

Previous research has helped identify the hospital factors that affect different practice patterns in EOL care. However, little remains known about the relationship between hospital case volume and quality of EOL care. Case volume can reflect hospitals' and physicians' experience with a particular disease or procedure, which may lead to more reliable adherence to care processes and consequently a superior clinical outcome, such as quality of life (QOL).

Although EOL care for cancer patients can take place in settings other than acute-care hospitals, palliative and hospice care are not well established in Asian countries.[9] In Japan, approximately 80% of patients die at acute-care hospitals, and only 4% die at hospices.[10] These facts highlight the importance of comparing the quality of EOL care at different acute-care hospitals in Japan.

Despite some limitations, the use of administrative data allows for the reliable evaluation of certain aspects of the quality of EOL care, such as the underuse of opioids or overuse of chemotherapy at a multihospital level.[1–4] Intensive anticancer treatments during EOL are not always associated with better quality of care, when taking into account improved QOL or satisfaction with care.[11,12]

In this study, we hypothesized that hospitals with a larger case volume would be more likely to provide good-quality EOL cancer care and less likely to provide poor-quality care compared with hospitals with a smaller volume. The objective of this study was to elucidate the relationship between hospital volume and performance of quality indicators among

Department of Healthcare Economics and Quality Management, Kyoto University Graduate School of Medicine, Yoshida Konoe-cho, Sakyo-ku, Kyoto, Japan.
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acute-care hospitals using a large-scale multi-institutional administrative database.

Methods

Data source and study population

We conducted a retrospective cross-sectional study using all electronic claims data submitted from hospitals and offices in Kyoto prefecture, Japan. Paper-based claims comprise less than 10% of the total reimbursement claims, and were not included in this analysis. The database was comprised of claims information that had been submitted to National Health Insurance (NHI) and Long Life Medical Care System (LLMCS), two major insurance payers. NHI provides insurance coverage for individuals not working in companies (e.g., farmers, the self-employed, retirees, the unemployed, part-time workers, and corresponding families); LLMCS provides coverage for individuals aged 75 or older and disabled individuals aged 65 to 74 years. Information regarding patient demographics, comorbidities, diagnostic and therapeutic procedures, and administered medications is available from the database. This study was approved by the Ethics Committee at Kyoto University Graduate School of Medicine (Registration Number E-1023).

Patients were included for analysis if they died of cancer at hospitals between March 2009 and May 2010 and if they had available claims records for at least 2 months prior to death. Cancer was identified according to the *International Classification of Diseases, 10th Revision* (ICD-10; codes Cxx.x).[13] Patients who used hospice services during their last 2 months of life were excluded. Although the use of hospice services is generally indicative of good-quality care, the vast majority of Japanese patients do not benefit from specialized EOL care offered by hospices due to the low number of hospices in Japan. The inclusion of hospices in this analysis would therefore not appear to provide substantial advantage, and might potentially bias the results.

Hospital case volume

To determine whether hospital volume affects the quality of procedures, hospitals were divided into tertiles according to case volume during the study period (case numbers of 1–8, 9–40, 41–219); the first tertile represented the group of hospitals with a small volume, whereas the third tertile represented the group of hospitals with a large volume. A treatment hospital was defined as the hospital where the patient died.

Patient and hospital characteristics

Data on patient characteristics were obtained using claims data corresponding to the last 2 months of life. Based on ICD-10 codes, cancer types were classified into the following categories: lung (C34.x), stomach (C16.x), colorectum (C18.x, C19.x, C20.x), liver (C22.x), pancreas (C25.x), biliary tract (C23.x, C24.x), blood (leukemia, Hodgkin's disease, and non-Hodgkin's lymphoma; C81.x–C85.x, C91.x–C95.x), prostate (C61.x), breast (C50.x), and others (C00.x–C15.x, C17.x, C21.x, C26.x, C30.x–C33.x, C37.x–C41.x, C43.x–C49.x, C51.x–C58.x, C60.x, C62.x–C80.x, C88.x, C90.x, C96.x, C97.x). Comorbidities were scored according to ICD-10 coding algorithms for the Charlson Comorbidity Index (excluding cancer-related diseases).[14,15] Hospital characteristics included teaching status (yes or no), ownership (public, nonprofit, or private), palliative care team (present or absent), and location (urban referring to within the prefectural capital city or rural referring to anywhere outside the city).

Quality of care indicators

We used the following quality indicators of EOL care for administrative data to identify good and poor quality of care: opioid use during the last 2 months of life (good quality of care),[3,4] admission to intensive care units (ICUs) or administration of life-sustaining treatments (cardiopulmonary resuscitation, intubation, or mechanical ventilation) during the last month of life (poor quality of care),[1–4] and chemotherapy (cytotoxic agents or molecular-targeted therapies) during the last month of life (poor quality of care).[1–4] The latter two indicators are related to the outcome of QOL and satisfaction with care during EOL,[16] and have undergone testing in other health care settings.[17] Next, although opioid use has not yet been sufficiently validated as an indicator of EOL care, opioids are considered essential medicines for palliative care by the World Health Organization[18] and have been used as quality indicators.[19,20]

Statistical analysis

Initial bivariate analysis was performed to compare the proportion of patients who received each procedure by tertile of case volume using a χ^2 test. To examine the impact of case volume on the quality of care, multilevel (hierarchical) logistic regression models for patients nested within hospitals with a random intercept at level 2 were developed for each quality indicator. Multilevel modeling allowed us to adjust for variable clustering in two levels. In the first model for each quality indicator, patient characteristics were entered at level 1, and hospital volume tertiles were entered at level 2. In the second model for each indicator, hospital characteristics were added at level 2 in addition to the variables included in the first model. The second model was used to examine whether quality of EOL care was affected by hospital case volume or hospital characteristics. In both models, the large-volume hospital group was used as the reference category.

Binary results (e.g., whether a particular procedure was performed or not) were used as response variables for each regression model. The following patient characteristics were used as explanatory variables for both the first and second model: sex, age group at death (years: <65, 65–69, 70–74, 75–79, 80–84, ≥ 85), cancer type, and Charlson Comorbidity Index (excluding cancer-related diseases; 0–1, 2, 3, ≥ 4). The hospital characteristics of teaching status, ownership, palliative care team status, and location were used as explanatory variables for the second model.

The goodness of fit of the models was compared by using the Akaike information criterion (AIC), with smaller values indicating a better fit. We used IBM SPSS version 19 (SPSS Inc., Chicago, IL) for data manipulation, and SAS version 9.2 (SAS Institute Inc., Cary, NC) for analyses. Two-sided tests were used and a $p < 0.05$ was considered to be statistically significant.

Results

A total of 3535 patients who died of cancer at hospitals with available claims records for at least 2 months prior to death were selected for analysis. Patients who used hospice services

during their last 2 months of life ($n=241$) were excluded. Thus, 3294 patients corresponding to 88 hospitals were analyzed. Patient characteristics are presented in Table 1. Four percent of the patients died at small-volume hospitals, 19% at medium-volume hospitals, and 77% at large-volume hospitals. There were more men (60.6%) than women across hospital tertiles. The majority of decedents were in the 75 to 79 age group (22.0%). Patients who died at small- and medium-volume hospitals were older and had more comorbidities compared with patients who died at large-volume hospitals. The most common type of cancer at medium- and large-volume hospitals was lung cancer, whereas lung cancer and stomach cancer were the most common at small-volume hospitals.

Approximately a third of the hospitals were grouped into each tertile (Table 2). Among all tertiles, 26% of the hospitals were teaching hospitals. Across each condition, large-volume hospitals were more likely to be teaching institutions and publicly owned, compared with hospitals with a smaller volume.

The unadjusted performance proportions across each quality indicator by tertile are presented in Table 3. Approximately half (51.0%) of the study patients received opioids during the last 2 months of life; 10% were provided with ICU service or received life-sustaining treatment during the last month; 8% underwent chemotherapy during the last month. Performance proportions on all indicators were significantly different across tertiles.

TABLE 1. STUDY POPULATION CHARACTERISTICS BY TERTILE OF CASE VOLUME

	Hospital case volume		
	Small	*Medium*	*Large*
No. of patients ($n=3294$)	128	627	2539
Women	58 (45.3)	257 (41.0)	983 (38.7)
Age, years			
≤64	2 (1.6)	61 (9.7)	334 (13.2)
65–69	6 (4.7)	59 (9.4)	341 (13.4)
70–74	12 (9.4)	67 (10.7)	389 (15.3)
75–79	22 (17.2)	127 (20.3)	576 (22.7)
80–84	29 (22.7)	135 (21.5)	497 (19.6)
≥85	57 (44.5)	178 (28.4)	402 (15.8)
Cancer type			
Lung	26 (20.3)	143 (22.8)	475 (18.7)
Stomach	26 (20.3)	98 (15.6)	350 (13.8)
Colorectum	20 (15.6)	85 (13.6)	281 (11.1)
Liver	10 (7.8)	55 (8.8)	271 (10.7)
Pancreas	5 (3.9)	40 (6.4)	229 (9.0)
Biliary tract	7 (5.5)	33 (5.3)	122 (4.8)
Blood	1 (0.8)	23 (3.7)	181 (7.1)
Prostate	9 (7.0)	21 (3.3)	67 (2.6)
Breast	2 (1.6)	16 (2.6)	63 (2.5)
Other	22 (17.2)	113 (18.0)	500 (19.7)
Charlson Comorbidity Index			
0–1	30 (23.4)	157 (25.0)	925 (36.4)
2	20 (15.6)	132 (21.1)	514 (20.2)
3	24 (18.8)	98 (15.6)	339 (13.4)
≥4	54 (42.2)	240 (38.3)	761 (30.0)

Values are expressed as number of patients (column percentage). Because of rounding, percentages may not add up to 100%. Volume group ranges: small volume=1–8, medium volume=9–40, and large volume=41–219 terminally ill cancer patients during the study period.

TABLE 2. HOSPITAL CHARACTERISTICS BY TERTILE OF CASE VOLUME

	Hospital case volume		
	Small	*Medium*	*Large*
No. of hospitals ($n=88$)	32	28	28
Teaching hospitals	1 (3.1)	2 (7.1)	20 (71.4)
Ownership			
Public	2 (6.2)	2 (7.1)	10 (35.7)
Nonprofit	0 (0)	0 (0)	6 (21.4)
Private	30 (93.8)	26 (92.9)	12 (42.9)
Presence of palliative care team	0 (0)	0 (0)	5 (17.9)
Urban location	20 (62.5)	19 (67.9)	15 (53.6)

Values are expressed as number of hospitals (column percentage). Volume group ranges: small volume=1–8, medium volume=9–40, and large volume=41–219 terminally ill cancer patients during the study period.

Hospital case volume and quality of care

The effects of case volume on the quality of EOL care (the first model without hospital characteristics) are shown in Table 4. Three models were generated to help identify the statistical association between hospital case volume and quality indicators. Significant associations were identified after adjusting for patient characteristics. Patients with advanced cancer were found to be less likely to receive opioids during the last 2 months of life at small-volume hospitals (adjusted odds ratio [OR], 0.59; 95% confidence interval [CI], 0.39–0.89) and medium-volume hospitals (adjusted OR, 0.73; 95% CI, 0.60–0.89), compared with large-volume hospitals. Patients were more likely to be admitted to the ICU or receive life-sustaining treatments during the last month at medium-volume hospitals (adjusted OR, 1.94; 95% CI, 1.45–2.60), compared with large-volume hospitals. There was no significant association between case volume and chemotherapy during EOL.

Among patient characteristics, older patients, patients with liver or blood cancer, and patients with higher Charlson Comormidity Index scores were less likely to receive opioids at the EOL. Patients with liver or biliary tract cancer were less likely to be admitted to the ICU or receive life-sustaining treatments,

TABLE 3. PERFORMANCE OF QUALITY INDICATORS BY TERTILE OF CASE VOLUME

	Hospital case volume			
	Small (n=128)	*Medium (n=627)*	*Large (n=2539)*	P *value*
Good-quality care				
Opioid use[a]	43 (33.6)	272 (43.4)	1366 (53.8)	<0.001
Poor-quality care				
ICU or life-sustaining treatments[b]	14 (10.9)	95 (15.2)	220 (8.7)	<0.001
Chemotherapy[b]	3 (2.3)	36 (5.7)	218 (8.6)	0.004

Values are expressed as number of patients (%).
P values were calculated using χ^2 tests.
[a]Identified during the last 2 months of life.
[b]Identified during the last month of life. Volume group ranges: small volume=1–8, medium volume=9–40, and large volume=41–219 terminally ill cancer patients during the study period.
ICU, intensive care unit.