Table 4. Quality Indicators, Hospital Case Volume, and Patient and Hospital Characteristics

	Odds ratio (95% confidence interval)					
	Opioid use		*ICU or life-sustaining treatments*		*Chemotherapy*	
	1st model	*2nd model*	*1st model*	*2nd model*	*1st model*	*2nd model*
Case volume[a]						
Small	0.59 (0.39–0.89)*	0.54 (0.35–0.83)**	1.30 (0.70–2.42)	0.98 (0.51–1.88)	0.45 (0.14–1.49)	0.44 (0.13–1.49)
Medium	0.73 (0.60–0.89)**	0.67 (0.53–0.86)**	1.94 (1.45–2.60)***	1.50 (1.05–2.14)*	0.80 (0.54–1.20)	0.78 (0.48–1.25)
Patient-level variables						
Sex						
Women	1.18 (1.00–1.39)	1.19 (1.00–1.40)	1.06 (0.81–1.38)	1.05 (0.80–1.36)	0.87 (0.64–1.18)	0.87 (0.64–1.18)
Age[b], years						
65–69	0.90 (0.65–1.24)	0.91 (0.66–1.25)	0.65 (0.38–1.10)	0.65 (0.39–1.10)	0.64 (0.39–1.06)	0.64 (0.39–1.06)
70–74	0.63 (0.46–0.86)**	0.64 (0.47–0.87)**	1.00 (0.63–1.59)	1.03 (0.65–1.65)	0.61 (0.37–1.00)	0.60 (0.37–0.98)*
75–79	0.48 (0.36–0.64)***	0.48 (0.36–0.64)***	0.85 (0.55–1.32)	0.88 (0.57–1.37)	0.73 (0.48–1.13)	0.73 (0.47–1.12)
80–84	0.28 (0.21–0.38)***	0.28 (0.21–0.38)***	0.91 (0.59–1.41)	0.95 (0.61–1.48)	0.45 (0.28–0.73)**	0.45 (0.28–0.73)**
≥85	0.20 (0.15–0.28)***	0.20 (0.15–0.28)***	0.76 (0.48–1.19)	0.79 (0.50–1.24)	0.25 (0.14–0.44)***	0.25 (0.14–0.44)***
Cancer type[c]						
Stomach	0.82 (0.63–1.07)	0.81 (0.63–1.06)	1.04 (0.68–1.57)	1.03 (0.68–1.56)	1.33 (0.82–2.16)	1.31 (0.80–2.12)
Colorectum	1.10 (0.83–1.46)	1.09 (0.82–1.44)	1.05 (0.68–1.63)	1.05 (0.68–1.63)	0.66 (0.35–1.25)	0.64 (0.34–1.22)
Liver	0.43 (0.32–0.58)***	0.43 (0.32–0.58)***	0.55 (0.32–0.93)*	0.55 (0.32–0.93)*	0.49 (0.23–1.03)	0.48 (0.23–1.01)
Pancreas	1.09 (0.80–1.50)	1.09 (0.80–1.50)	0.60 (0.34–1.08)	0.60 (0.34–1.08)	0.90 (0.48–1.67)	0.88 (0.47–1.64)
Biliary tract	0.98 (0.67–1.43)	0.97 (0.66–1.42)	0.39 (0.17–0.89)*	0.38 (0.17–0.87)*	0.42 (0.15–1.23)	0.41 (0.14–1.19)
Blood	0.34 (0.24–0.49)***	0.34 (0.24–0.49)***	2.08 (1.28–3.36)**	2.15 (1.33–3.47)**	8.39 (5.03–14.01)***	8.09 (4.83–13.53)***
Prostate	0.85 (0.53–1.37)	0.85 (0.53–1.36)	1.32 (0.66–2.63)	1.27 (0.64–2.52)	1.71 (0.74–3.97)	1.65 (0.71–3.83)
Breast	0.93 (0.54–1.62)	0.94 (0.54–1.63)	1.20 (0.54–2.66)	1.14 (0.52–2.51)	3.14 (1.49–6.61)**	2.95 (1.40–6.23)**
Other	0.80 (0.63–1.02)	0.80 (0.63–1.02)	1.03 (0.70–1.51)	1.02 (0.70–1.50)	1.19 (0.75–1.89)	1.16 (0.73–1.84)
Charlson Comorbidity Index[d]						
2	0.99 (0.80–1.23)	1.00 (0.80–1.23)	1.33 (0.94–1.88)	1.32 (0.93–1.87)	1.21 (0.84–1.75)	1.19 (0.82–1.72)
3	0.84 (0.66–1.07)	0.84 (0.66–1.06)	1.13 (0.75–1.70)	1.11 (0.74–1.66)	1.04 (0.68–1.60)	1.03 (0.67–1.58)
≥4	0.65 (0.53–0.79)***	0.65 (0.53–0.79)***	1.67 (1.22–2.30)**	1.59 (1.16–2.19)**	0.80 (0.54–1.17)	0.78 (0.53–1.15)
Hospital-level variables						
Teaching status[e]						
Nonteaching		0.94 (0.76–1.17)		1.59 (1.13–2.26)**		1.32 (0.88–1.99)
Ownership[f]						
Nonprofit		0.95 (0.74–1.21)		0.66 (0.44–1.00)		1.10 (0.73–1.65)
Private		1.33 (1.04–1.71)*		0.76 (0.51–1.14)		0.73 (0.46–1.14)
Palliative care team[g]						
Present		1.18 (0.91–1.53)		1.00 (0.65–1.53)		0.83 (0.53–1.30)
Location[h]						
Urban		0.80 (0.66–0.96)*		1.60 (1.17–2.19)**		1.30 (0.90–1.87)
Model fit statistics						
AIC	4226.5	4225.4	2113.8	2106.6	1651.4	1656.5

*$p<0.05$; **$p<0.01$; ***$p<0.001$.

Referent category: [a]large, [b]<65 years, [c]lung, [d]0–1, [e]teaching, [f]public, [g]absent, [h]rural.

Opioid use during the last 2 months of life was considered to be an indicator of good quality of care. ICU admission, life-sustaining treatments during the last month of life, and chemotherapy use during the last month were considered indicators of poor quality of care. The 1st model includes patient characteristics as explanatory variables, and the 2nd model includes both patient and hospital characteristics as explanatory variables.

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; AIC, Akaike information criterion.

whereas patients with blood cancer and patients with more comorbidities were more likely to receive such procedures. Older patients were less likely to undergo chemotherapy, whereas patients with blood or breast cancer were more likely to undergo chemotherapy, compared with patients with lung cancer.

Hospital case volume, hospital characteristics and quality of care

Results from the second model where hospital characteristics were entered in addition to the variables included in the first model are also presented in Table 4. After adjusting for patient and hospital characteristics, hospital case volume remained significantly associated with opioid use. For ICU admission or life-sustaining treatments, patients at medium-volume hospitals remained more likely to undergo such admission or procedures, compared with large-volume hospitals. Finally, the results still showed no association between hospital case volume and chemotherapy in the second model.

Each of the patient characteristics yielded ORs similar to those in the first model that did not include hospital characteristics. Among hospital characteristics, patients at urban hospitals were less likely to receive opioids, whereas patients at private hospitals were more likely to receive opioids. Patients at nonteaching or urban hospitals were more likely to be admitted to the ICU or receive life-sustaining treatments. The AIC indicated that the second, the second, and the first models were superior to each alternative model for evaluating opioid use, ICU admission or life-sustaining treatments, and chemotherapy, respectively.

Discussion

In this study, we determined the relationship between hospital case volume and quality of EOL care. To our knowledge, this is the first multi-institutional study to demonstrate a relationship between case volume and performance of benchmark quality indicators for EOL care.

Our analysis showed that patients had a lower frequency of opioid use for EOL care at small- and medium-volume hospitals after adjusting for patient and hospital characteristics. Although physicians may be reluctant to prescribe opioids for fear of causing addiction or drug abuse,[21] one previous study has shown that the number of patients for whom physicians have administered opioids in the past year correlates negatively with their concern and correlates positively with their confidence and comfort level in prescribing opioids.[22] Although these findings were at the physician level, they may also be underlying factors of our findings in this hospital-level analysis.

Our analysis also revealed that patients at medium-volume hospitals were more likely to undergo ICU admission or receive life-sustaining treatments during the last month of life when compared with large-volume hospitals. A possible interpretation of this observation is that physicians who attend fewer terminally ill patients feel a need to provide the most aggressive procedure or treatment. On the other hand, patients at small-volume hospitals were not associated with the probability of such procedures, possibly because there may not be sufficient health care resources for such intensive care at small-volume hospitals. ICU service and life-sustaining treatments may be difficult to conduct at resource-constrained hospitals even when cases require them.

The results did not show any significant association between hospital case volume and the frequency of chemotherapy use during the last month of life after adjusting for patient characteristics only, or for both hospital characteristics and patient characteristics. This may support the supposition that physicians may not be able to accurately predict patient survival time or know when to halt aggressive anticancer therapy, even with increased experience in EOL care.[23]

Our findings can be interpreted in other ways. The relationship between hospital case volume and quality of care may be explained by a hospital-level complex system of unmeasurable structure variables that relate to EOL care. These variables include reminders in electronic health records or clinical flow charts, clinical teams whose sole responsibility is to manage terminally ill patients, physician education programs, and patient education seminars. An alternative interpretation may be the presence of selective mechanisms, such as "selective allocation" and "selective referral," in which causality runs from quality of care to volume.[24] However, these aspects are not measurable using our data, and thus could not be adjusted for in this analysis.

The observed associations between case volume and quality of EOL care for patients with cancer may have implications for policy and health care system reform. A policy that supports the regionalization of EOL care, such as selective referrals to large-volume hospitals, may be advocated. Although initiatives to concentrate care to specific hospitals may result in improvements to the quality of care, there may also be issues such as a possible reduction in the equity of overall patient access. Alternatively, our findings may lead to the promotion of optimal EOL care, especially to hospitals with a smaller volume. Improvement of EOL care would require efforts to overcome various existing barriers.[25]

Our study also showed that a large number of patients with terminal cancer underwent aggressive procedures and/or did not receive opioids. This relatively high proportion of patients who had received poor quality of care is consistent with previous studies.[1–3] Highly intensive treatments for terminally ill patients in the final stages of life do not necessarily lead to better QOL.[11,12] Such poor quality of terminal cancer care may reflect a lack of discussion among health care professionals, patients, and their families about a transition from curative to palliative care.[26] Therefore, there still remains room for improvement in the overall quality of EOL care.

Limitations

Our study has the following limitations. First, detailed clinical information, such as patient QOL, satisfaction, and preferences for EOL care, could not be addressed using an administrative database. This is a common limitation of studies based on administrative data, but this limitation is offset by the ability to analyze large patient volumes and conduct hospital and regional comparative analyses. Second, we were unable to distinguish between physician- and hospital-related effects. To distinguish between the effects of physician and hospital factors, further studies should be conducted using physician volume and distribution data when available. Furthermore, many studies that analyzed the effects of case volume have similarly not been able to simultaneously adjust for physician and hospital volume measures. Third, the differences between patients who received curative care and palliative care may not be random, and these findings may therefore be affected by possible selection bias. Finally, data from all health insurers in Kyoto prefecture were not available. However, the two major insurers' data that were used in this study cover the majority of elderly people.

Conclusions

This study demonstrated that large-volume hospitals were more likely to provide opioids and less likely to provide intensive care for terminally ill cancer patients when compared with hospitals with a smaller case volume. We believe that these results may help promote efforts among policy makers and clinical leaders to establish a uniform quality of palliative care service so that terminally ill cancer patients receive optimal care wherever they are treated. To accomplish this goal, further research exploring effective interventions to overcome barriers to good quality of EOL care among hospitals with a smaller volume is still required.

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Author Disclosure Statement

No competing financial interests exist.

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在宅医療が癌患者の終末期医療費に与える影響の検証
—京都府の診療報酬明細書データベースを用いた実証研究—

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京都大学大学院医学研究科　医療経済学分野

【背景】わが国では今後，死亡者数とともに終末期医療費が増加する見込みである。政府は在院日数を短縮し医療費を適正化するために在宅医療を推進し，そのために在宅療養支援診療所（在支診）の設置を促進している。しかし在宅医療が終末期医療費を増やすのか減らすのかは明らかにされていない。

【目的】在宅医療の推進および在支診の整備ががん患者の終末期医療費に及ぼす影響を検証する。

【方法】デザイン：横断的研究。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。包含基準：2009 年 4 月～2010 年 5 月にがん（ICD-10：Cxx.x）で死亡，京都府内に居住，終末期 3 か月間の診療報酬明細書が利用可能な患者。除外基準：期間中にがんで死亡した患者が 10 人未満の市町村と当該市町村に居住する患者。

解析（1）で在宅医療（在宅患者訪問診療料か在宅末期医療総合管理料を終末期 3 か月間に 1 回以上算定と定義）の有無と終末期 3 か月間の総医療費（病院と診療所と調剤薬局の合計かつ入院と入院外の合計）の関係（process と outcome の関係）を調べた。総医療費の内訳として入院医療費（病院と診療所の合計）と入院外医療費（病院と診療所と調剤薬局の合計）についても在宅医療の有無との関係を調べた。

解析（2）で府内の市町村を人口あたり在支診数の四分位によって分けたカテゴリーと当該市町村居住患者の終末期 3 か月間の総医療費の関係（structure と outcome の関係）を調べた。

解析（1）（2）ともに医療費を目的変数とする一般化線形モデル（ガンマ分布，ログリンク）を使用した。解析（1）で患者レベル因子（性，年齢，がんの部位，併存症）を調整し，解析（2）で患者レベル因子と市町村レベル因子（人口あたり病床数，人口あたり医師数）を調整した。解析（2）でマルチレベルモデル（ランダム切片）を使用した。

【結果】府内の 23 市町村に居住する 3,083 人のがん患者の終末期 3 か月間の医療費を分析した。総医療費の中央値は 1,497,000 円，四分位範囲は 874,000-2,310,000 円。在宅医療を施行した患者は 191 人（6%）。

解析（1）で在宅医療を行った患者は行わなかった患者に比べて総医療費は低かった（cost ratio 0.77；95% 信頼区間 0.70-0.85；差の推定値 −386,000 円）。総医療費を入院と入院外に分けると，在宅医療を行った患者は行わなかった患者に比べて入院医療費は低く（差の推定値 −726,000 円），入院外医療費は高かった（差の推定値 +340,000 円）。

解析（2）で人口あたり在支診数で第 4 四分位（最多）の市町村の患者は第 1 四分位（最少）の市町村の患者に比べて総医療費は低かった（cost ratio 0.89；95% 信頼区間 0.80-0.99）。

【考察】在宅医療を行うことによって医療費は入院医療から入院外医療にシフトして，入院医療費の減少分は入院外医療費の増加分を上回った。在支診が人口あたりで多い市町村で医療費が低くなったのは，在支診が多い地域では在宅医療を利用しやすいのだろうと解釈される。

在宅医療を行うとがん終末期医療費が抑制される可能性が結果から示唆されたが，医療費が介護費や患者・家族・社会の負担へとコストシフトした可能性があることに留意する必要がある。

限界は，個々の患者の在宅医療の適応・希望の有無を考慮できなかったこと，在宅医療は必ずしも在支診によって行われるわけではないことである。

【結論】医療費の視点からの解析では，在支診を増やすことによって在宅医療の環境を整備し終末期がん患者の在宅医療を推進することによって，がん終末期医療費が抑制される可能性があることが示された。今後は介護費を合算した検討，患者・家族や社会の視点から見た費用・負担を含めたさらなる検討が必要だ。

キーワード：医療政策，医療経済，地域差

在宅医療が癌患者の終末期医療費に与える影響の検証

京都府の診療報酬明細書データベースを用いた実証研究

Presented at the 50th Annual Congress of JSHA
on October 19, 2012

京都大学大学院医学研究科
医療経済学分野
森島敏隆、大坪徹也、今中雄一

背景

死亡者数の増加

- 120万人（2010年）→150万人以上（2025年）に増加

終末期医療費の増加

- 終末期に高額な医療費
- 終末期医療費が増加する見込

政府の政策

- 在院日数短縮と看取り場所確保のために在宅医療を推進[1]
- 在宅医療の推進のために在宅療養支援診療所（在支診）を整備[2]

政策の結果は？

- 終末期医療費を増やす？減らす？
  - 外国では在宅医療は終末期医療費を減らすとの報告[3]

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2. 在宅医療・介護あんしん（厚生労働省）2012
3. Brumley et al. J Am Geriatr Soc. 2007

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目的

①在宅医療の推進が末期がん患者の終末期医療費に及ぼす影響の検証

②在支診の整備が末期がん患者の終末期医療費に及ぼす影響の検証

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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=3094)
  - ✓ 2009年4月～2010年5月にがん (ICD-10 codes: Cxx.x)で死亡
  - ✓ 京都府内に居住
  - ✓ 死亡月を含む終末期3か月間の診療報酬明細書が利用可能

  除外基準 (n=11)
  - ✓ 期間中のがん死亡患者が10人未満の市町村と、その市町村に居住する患者

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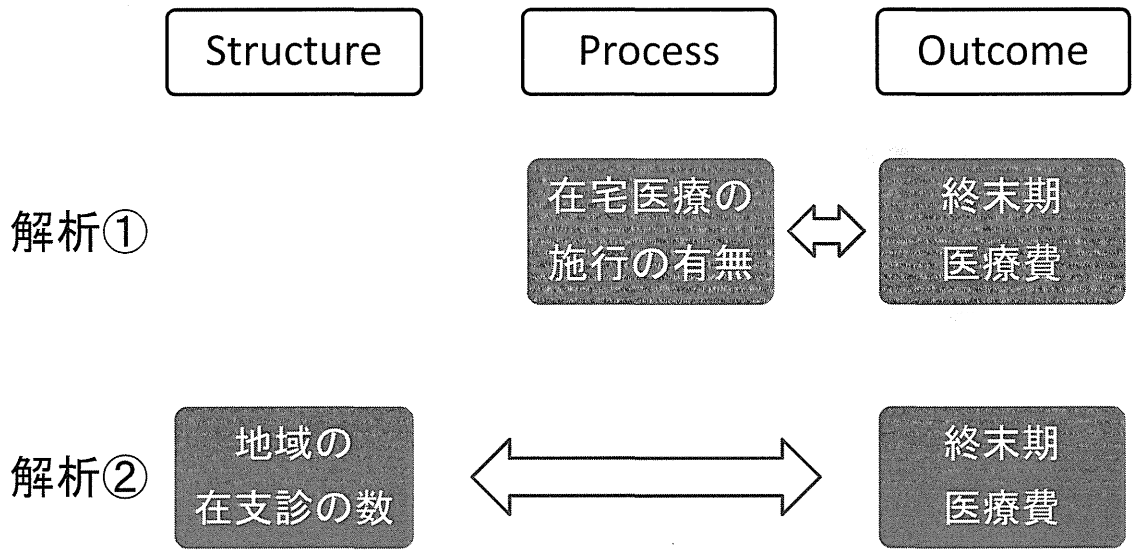
解析の概要



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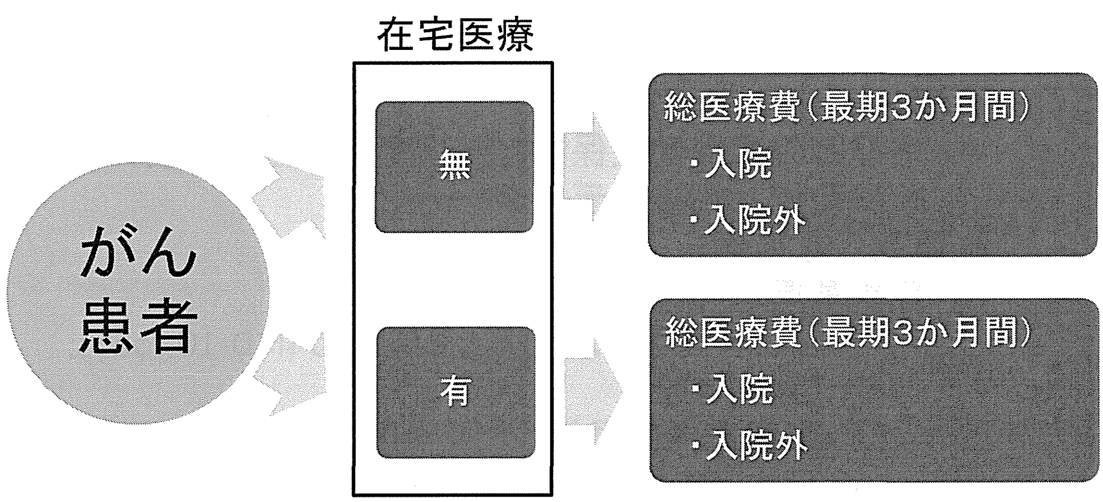
解析①（ProcessとOutcomeの関係）

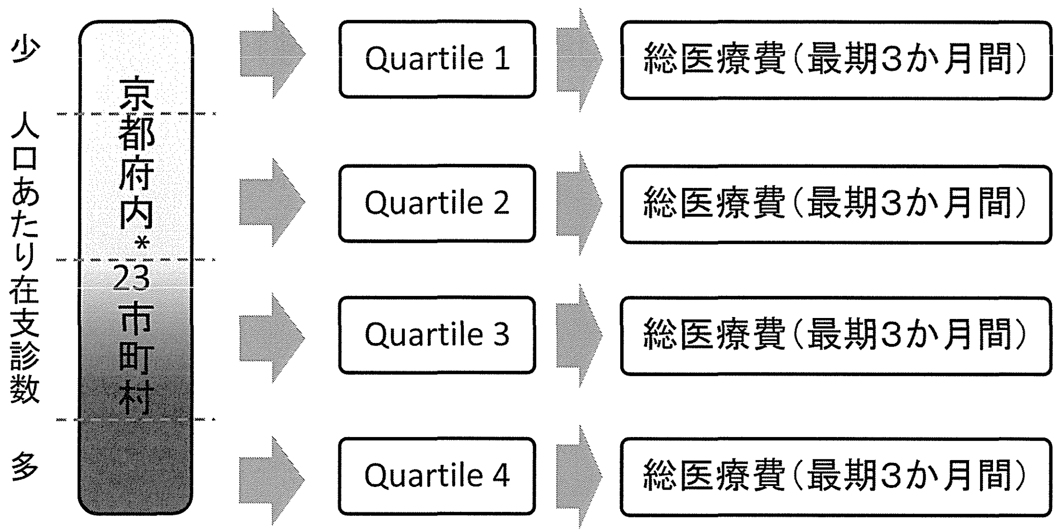


在宅医療：　在宅患者訪問診療料か在宅末期医療総合管理料を
終末期3か月間に1回以上算定

総医療費：病院と診療所と調剤薬局の合計
入院医療費：病院と診療所の合計
入院外医療費：病院と診療所と調剤薬局の合計

6

解析②（StructureとOutcomeの関係）



*患者数が10人未満の3市町村を除外

統計手法

目的変数：医療費
モデル：一般化線形モデル（ガンマ分布、ログリンク）

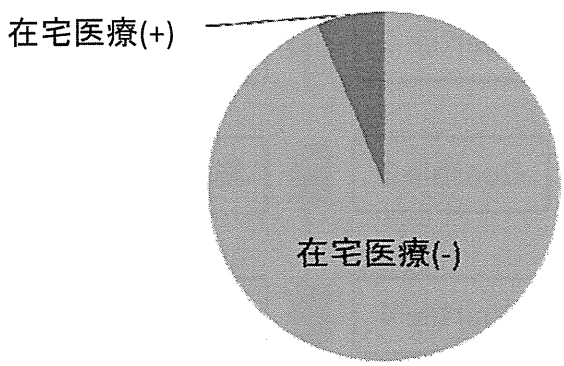
説明変数：

- 解析①
  - 患者レベル
    - 在宅医療の有無
    - 年齢*
    - がんの部位†
    - 併存症‡
- 解析②（マルチレベル§）
  - 市町村レベル
    - 在支診の数のQuartile
    - 人口あたり病床数
    - 人口あたり医師数
  - 患者レベル
    - 年齢*
    - がんの部位†
    - 併存症‡

*年齢カテゴリー： <65, 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
‡併存症カテゴリー：がん以外の疾患をCharlson Indexに従ってスコア化（0-1, 2, 3, 4-）
§ランダム切片モデル

結果

- 患者数: 3083人(23市町村)



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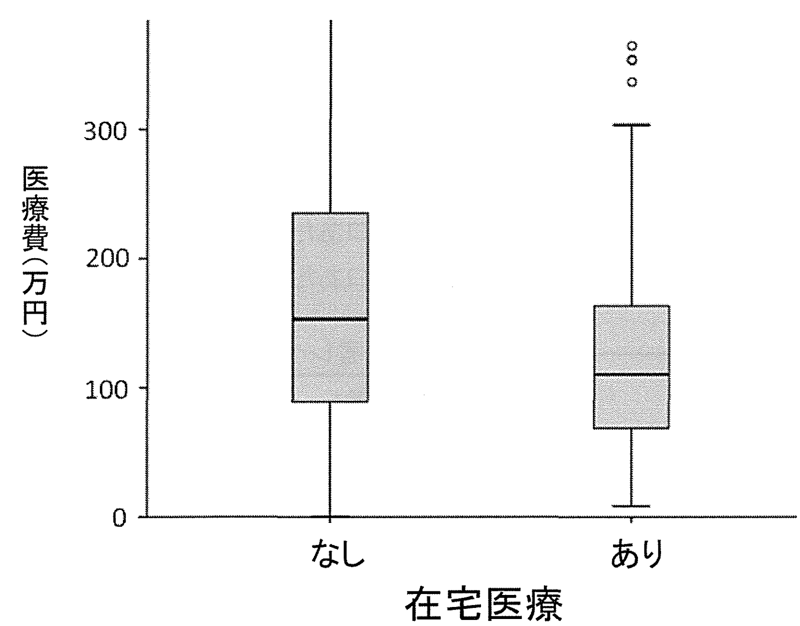
終末期医療費(3か月間)

中央値: ¥1,497,000 (四分位範囲: ¥874,000—¥2,310,000)



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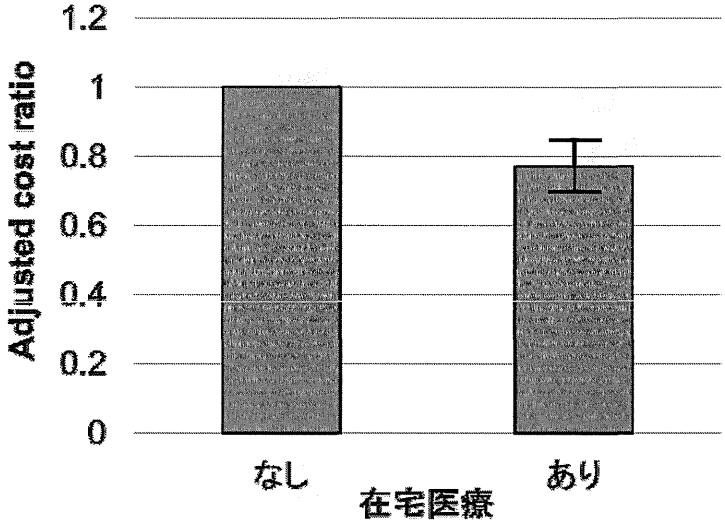
解析①（在宅医療の有無と医療費）



患者数　2892 (94%)　191 (6%)

Cost ratio：　在宅医療を利用しない患者との比較
エラーバー：　95%信頼区間を表す。

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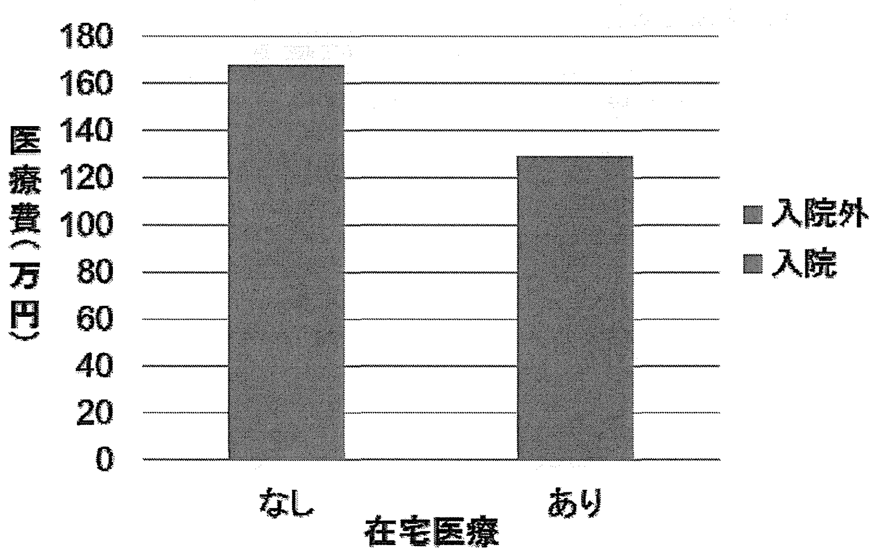
医療費の内訳



患者数　2892 (94%)　191 (6%)

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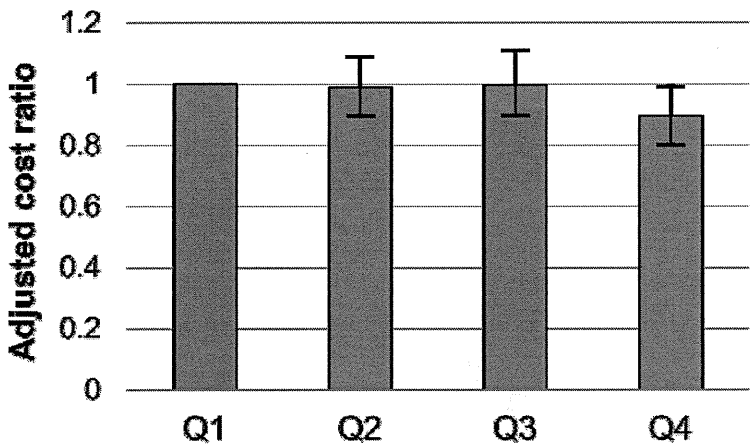
解析②（在支診の多少と医療費）



	Q1	Q2	Q3	Q4
市町村数	6	6	5	6
患者数	288	441	2011	343

少　人口あたり在支診の数　多

Cost ratio： Q1との比較
エラーバー： 95%信頼区間

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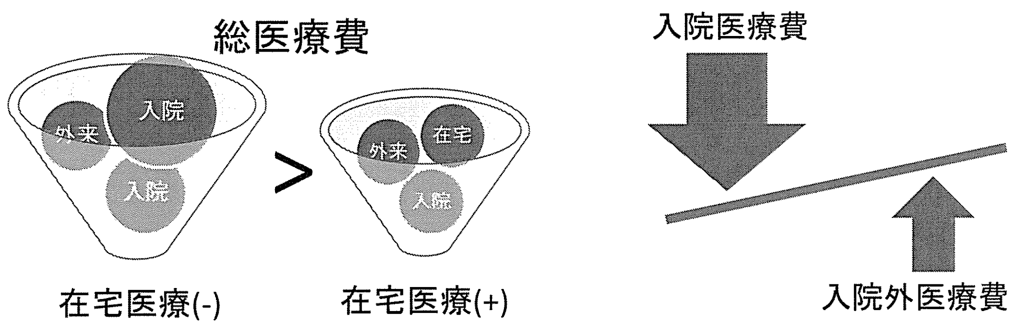
考察1

在宅医療と医療費　ProcessとOutcomeの関係

- 在宅医療⇒終末期がん患者の医療費の抑制を示唆
- 終末期医療の場が入院→入院外にシフト
- 入院医療費の減少分＞入院外医療費の増加分



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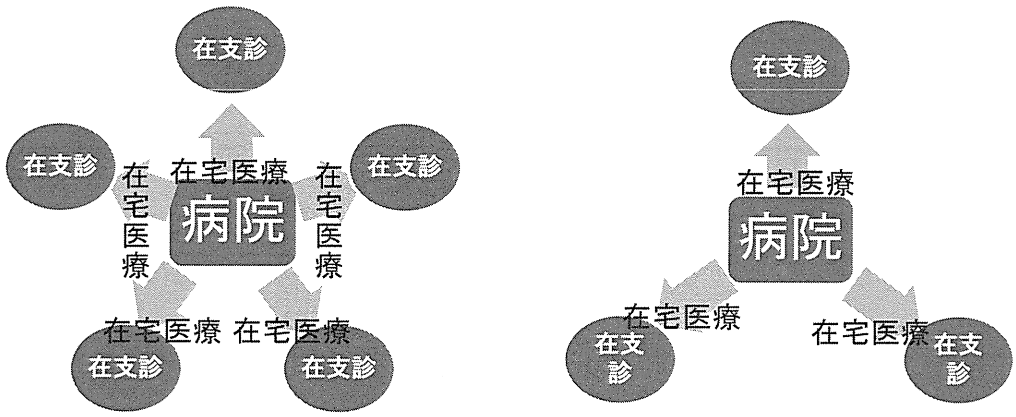
考察2

在支診と医療費 StructureとOutcomeの関係

- 在支診の設置⇒終末期がん患者の医療費の抑制を示唆
- 在支診が多い地域では在宅医療にアクセスしやすいのかも



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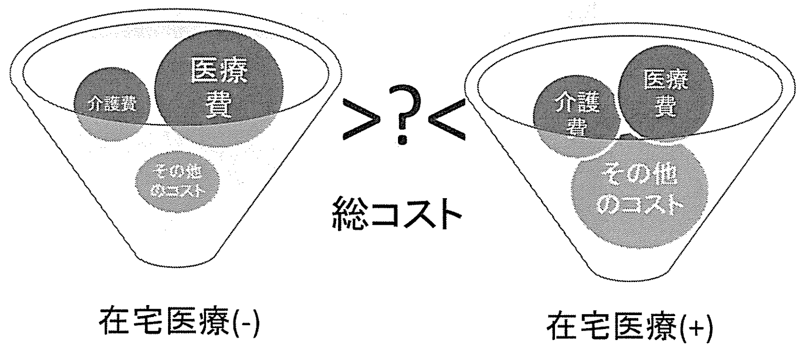
解釈に注意を要する点

- 医療費だけに着目
- 在宅医療は介護費、患者・家族・社会の負担を増やす可能性
- 総コスト（＝医療費＋介護費＋患者・家族・社会の負担）と在宅医療の有無の関係は不明。
  外国で家族・社会の負担を含む終末期費用が高くなるか低くなるかは研究によって異なる (Zimmermann, JAMA 2008)



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限界

診療報酬明細書データ

- 個々の患者の在宅医療の適応・希望の有無を考慮せず

Cross-sectional study

- 因果関係は不明

在宅医療の提供者 ≠ 在支診

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結論

医療費の視点

- 在宅医療の推進
  ⇒がん終末期医療費の抑制
- 在支診の設置を促進
  ⇒がん終末期医療費の抑制

今後の検討

- 介護費の合算
- 患者・家族や社会の費用・負担の合算

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Thank you very much for your attention

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Appendix

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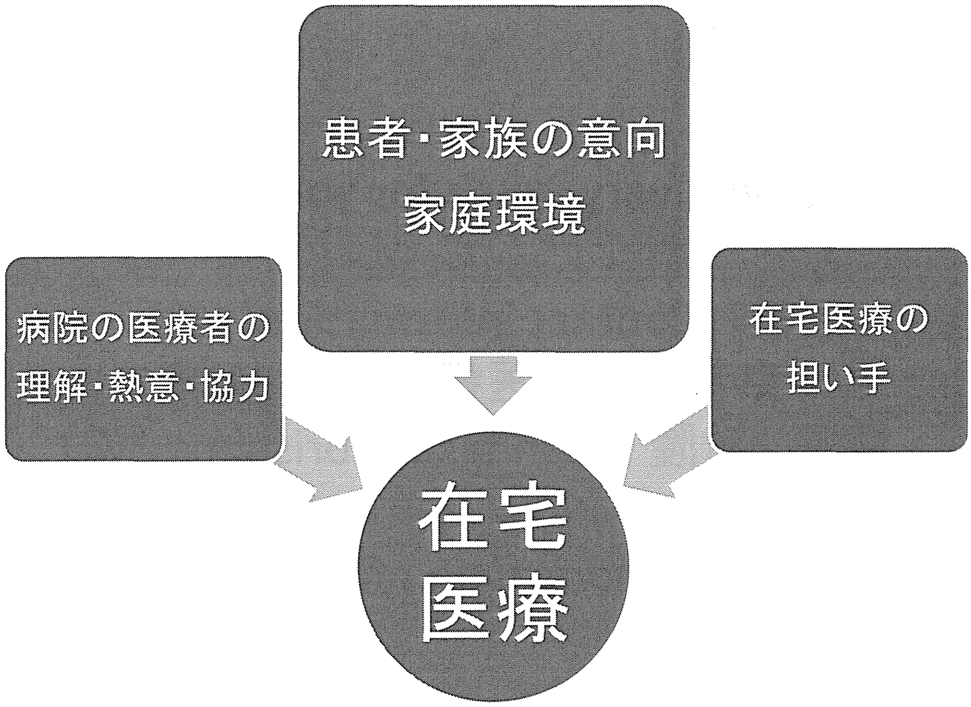

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とはいっても、在宅医療ができない（向かない）患者もいる

- ◆独居者
- ◆最期まであきらめたくない患者
  - ◆若年者
  - ◆化学療法などが奏功
- ◆在宅での緩和ケアが不可能
  - ◆激しい苦痛・疼痛

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An In-Hospital Mortality Equation for Mechanically Ventilated Patients in Intensive Care Units

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Word count: 2390; Table: 5; Figure: 0

Key words: mechanical ventilation, in-hospital mortality, prediction model, intensive care units

ABSTRACT

Objective: To develop an equation model of in-hospital mortality for mechanically ventilated patients in adult intensive care using administrative data for the purpose of retrospective performance comparison among intensive care units (ICUs).

Design: Two models were developed using the split-half method, in which one test dataset and two validation datasets were used to develop and validate the prediction model, respectively. Ten candidate variables (demographics: age and gender; clinical factors: hospital admission course, primary diagnosis, reason for ICU entry, Charlson score, and number of organ failures; procedures and therapies administered at any time during ICU admission: renal replacement therapy and pressors/vasoconstrictors) were used for developing the equation model.

Setting: 282 ICUs in 2008, 310 ICUs in 2009, and 364 ICUs in 2010 in acute-care teaching hospitals in Japan.

Participants: Mechanically ventilated adult patients discharged from an ICU from July 1 to December 31 in 2008, 2009, and 2010.

Main Outcome Measures: The test dataset consisted of 5,807 patients in 2008, and the validation datasets consisted of 10,610 patients in 2009 and 7,576 patients in 2010. Two models were developed: Model 1 (using independent variables of demographics and clinical factors), Model 2 (using procedures and therapies administered at any time during ICU admission in addition to the variables in Model 1). Using the test dataset, 9 variables (except for gender) were included in multiple logistic regression analysis with in-hospital mortality as the dependent variable, and the mortality prediction equation was constructed. Coefficients from the equation were then tested in the validation model.

Results: Hosmer-Lemeshow χ-square values for the test dataset in Model 1 and Model 2 were 11.9 ($p = 0.15$) and 15.6 ($p = 0.05$), respectively; C-statistics for the test dataset in Model 1and Model 2 were 0.70 and 0.78, respectively. In-hospital mortality prediction for the validation datasets showed low- and moderate- accuracy in Model 1and Model 2, respectively.

Conclusions: Model 2 may potentially serve as alternative models for predicting mortality in mechanically ventilated patients, who have so far required physiological data for the accurate prediction of outcomes. Model 2 may facilitate the comparative evaluation of in-hospital mortality in multicenter analyses based on administrative data for mechanically ventilated patients.

INTRODUCTION

Growing concerns about the quality of care and patient safety have increased the importance of monitoring intensive care units (ICUs) in health care organizations. In response to increasing demands to improve the quality of care, performance measures for intensive care have been developed [1-3]. As patient mortality is a major health care outcome, many studies have included this measure as a quality outcome indicator. However, mortality rates vary among ICUs due to differences in patient case mix and disease severity [4-6]. Several risk-adjustment models [1] have been developed to compare ICU mortality rates among institutions; these models include the Acute Physiology and Chronic Health Evaluation (APACHE) system, the Mortality Prediction Model (MPM), and the Simplified Acute Physiology Score (SAPS). Additionally, Render et al. have proposed an automated ICU risk-adjustment tool [7], and the Critical Care Outcome Prediction Equation (COPE) model was developed as a hospital mortality prediction model using only administrative data [8].

There is an increasing demand for performance measurement in ICU benchmarking in health care organizations. Several indicators for ICU performance have been developed [9-11], which include mechanical ventilation-associated indicators such as the prevention of ventilator-associated pneumonia, protocol-driven ventilator weaning, daily sedation interruption policy, low tidal volume ventilation in acute lung injury/adult respiratory distress syndrome (ALI/ARDS), ventilator-associated pneumonia rate, average days on mechanical ventilation, and mortality (crude and severity-adjusted). Therefore, mechanically ventilated patients have been shown to be an important target for ICU performance evaluation.

The Diagnosis Procedure Combination (DPC) system in Japan was introduced in 2004, and has since become the standard method of payment in the health care financial system. Administrative data in this system include records of patient information and daily medical care. From these data, the types of all tests, medications, and procedures; as well as the use of intensive or special care and nursing services are itemized on a daily basis. Procedures such as mechanical ventilation, renal replacement therapy, and the use of vasoactive agents are available from DPC data, and have been reported to be closely associated with mortality [11-16]. However, the utilization rates and patterns of these procedures vary among intensivists, and the inclusion of data concerning these procedures may therefore support the accurate prediction of mortality.

The aims of this study were to use administrative data to develop an in-hospital mortality equation that includes patient demographics and clinical factors, and procedures administered during the ICU admission as independent variables; and to examine the viability of the equation in conducting retrospective evaluations of ICUs.

METHODS

Data sources and case selection criteria

All data for the study were extracted from the Japanese DPC database, which was collected by the DPC Research Group. Data were obtained from July 1st to December 31st for each of the three years from 2008 to 2010. Of the participant hospitals that comprise the database, we included 437 acute care teaching hospitals with ICUs (including surgical ICUs, medical ICUs, and surgical-medical ICUs); we obtained data from 282 ICUs in 2008, 310 ICUs in 2009, and 364 ICUs in 2010. The initial study population included all patients aged ≥20 years treated in an ICU at any of the sample hospitals. We identified the time of ICU entry and the dates of ICU stay based on specific codes in the administrative data. The data did not indicate whether a patient had been previously hospitalized in another ICU, but critical care patients are rarely transferred from one center to another in Japan. We therefore assumed that patients entering the ICU had not been transferred from another ICU.