

(21) Ministry of Health, Labour and Welfare. Kokumin Iryohi (National health expenditure). 2010; Available at: <http://www.mhlw.go.jp/toukei/saikin/hw/k-iryohi/10/>. Accessed November 20, 2012.

Figure Legends

Figure 1. Quantities of drugs dispensed and utilization rates by therapeutic categories: branded drugs with no generic equivalent; substitutable drugs; and generic drugs

Figure 2. Quantity-based shares of generic drugs used and the substitution indices of individual health care institutions within the outpatient, inpatient, and pharmacy health care sectors.

Table 1

Quantity and costs of dispensed drugs and generic drugs in Kyoto Prefecture (January -March 2010)

	Quantity of dispensed drugs		Cost of dispensed drugs		Proportion of generic drugs (based on quantity)	Proportion of generic drugs (based on cost)	Maximum potential proportion of generic drugs (based on quantity)
	Million units	(%)	Million USD	(%)			
Total	563.6	(100.0%)	223.6	(100.0%)	17.9%	8.1%	50.1%
Outpatients in clinics	76.0	(13.5%)	25.8	(11.5%)	27.7%	13.7%	62.3%
Outpatients in hospitals	54.0	(9.6%)	39.0	(17.5%)	18.4%	5.5%	54.6%
Inpatients	56.1	(10.0%)	42.1	(18.8%)	12.3%	11.3%	32.2%
Pharmacies	377.4	(67.0%)	116.6	(52.2%)	16.7%	6.6%	49.6%
Reference values from published government data March 2010							
National level					19.0%	6.9%	
Kyoto Prefecture level					19.5%	6.3%	

Note: Costs were calculated in Japanese yen and converted to U.S. dollars using the purchasing power parity rate in 2010 (USD1 = JPY111.39).

174

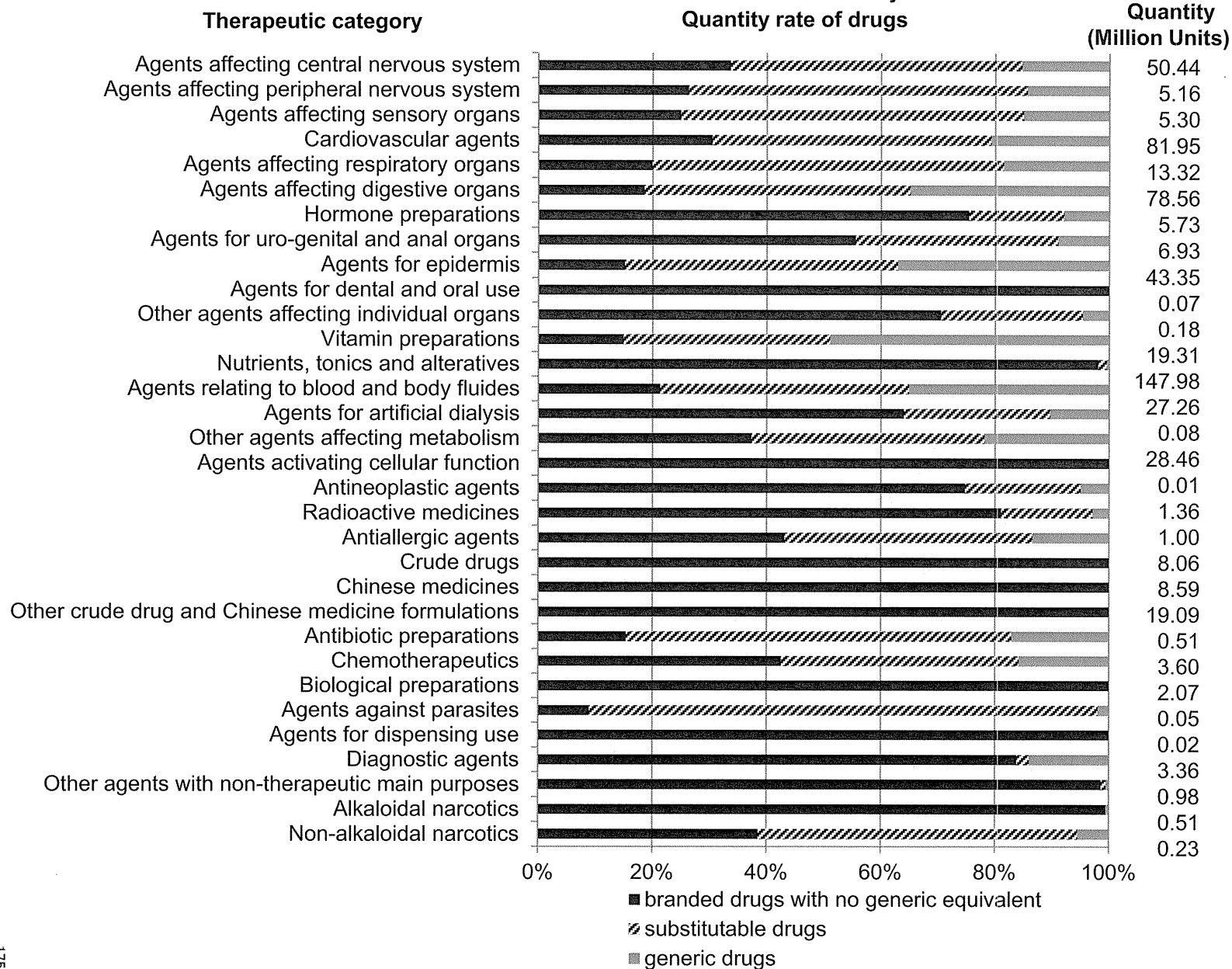
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48

Table 2

Quantity-based share, maximum potential quantity-based share, and substitution index of generic drugs for individual health care institutions

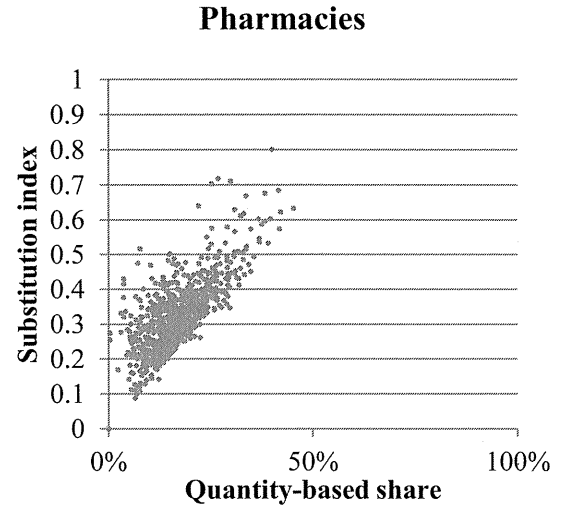
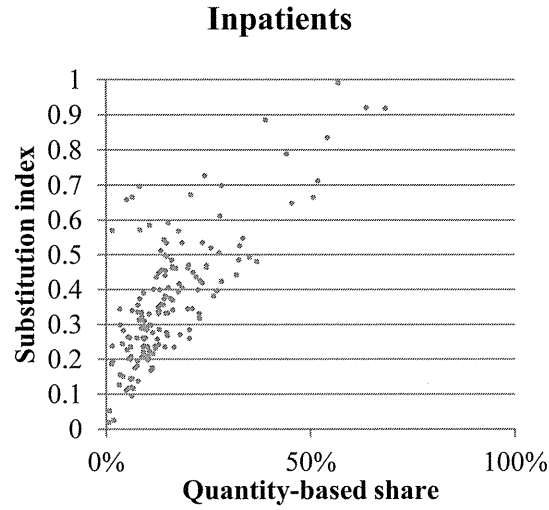
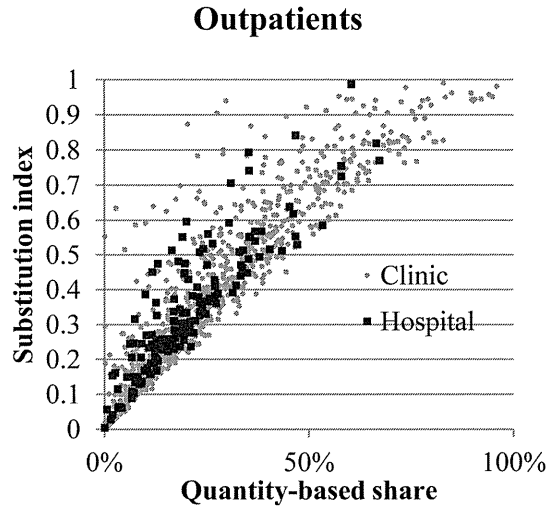
	N	Average	Lowest	Lower quartile	Median	Upper quartile	Top
Quantity-based share of individual institutions							
Outpatients in clinics	853	26.5%	0.0%	10.8%	22.4%	38.7%	96.0%
Outpatients in hospitals	154	20.6%	0.1%	11.7%	17.8%	25.7%	67.4%
Inpatients	159	15.5%	0.6%	8.0%	12.8%	19.3%	68.3%
Pharmacies	747	17.2%	0.0%	12.3%	16.4%	21.4%	45.2%
Maximum potential quantity-based share of individual institutions							
Outpatients in clinics	853	65.9%	0.2%	56.9%	69.1%	78.4%	100.0%
Outpatients in hospitals	154	59.7%	13.0%	50.0%	63.2%	70.8%	91.5%
Inpatients	159	41.4%	2.7%	29.6%	40.4%	52.8%	78.3%
Pharmacies	747	52.5%	1.2%	42.7%	55.1%	63.9%	87.0%
Substitution index of individual institutions							
Outpatients in clinics	853	38.9%	0.0%	18.5%	35.5%	56.7%	99.1%
Outpatients in hospitals	154	33.9%	0.4%	22.5%	30.5%	46.0%	98.6%
Inpatients	159	36.7%	1.9%	23.7%	33.8%	46.3%	99.1%
Pharmacies	747	32.8%	0.0%	26.0%	31.8%	38.4%	80.1%

Notes: The substitution index indicates quantity-based share of generic drugs for all drugs substitutable with generic drugs.



176

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43



IV

医療の質の評価と費用との関係

医療資源密度が低く費用も低い地域・施設では、効率性以前の問題として、医療の質に悪影響が出ている可能性が示唆される。一方で、医療管理データで妥当な質指標が得られることを示してきた。これらは資源配備や医療費関連政策における質評価の必要性・実現性を示すものである。

The association between health care spending and quality of care for stroke patients in Japan

Short Title: Association between spending and quality

Authors:

1. Jason LEE, **PhD; Post-Doctoral Fellow**
2. Toshitaka MORISHIMA, **MD; Doctoral Candidate**
3. Sungchul PARK, **BA; Masters Candidate**
4. Tetsuya OTSUBO, **PhD; Assistant Professor**
5. Hiroshi IKAI, **MD; Lecturer**
6. Yuichi IMANAKA, **MD; Professor**

Authors' Affiliations: Department of Healthcare Economics and Quality Management, School of Public Health, Graduate School of Medicine, Kyoto University, Japan.

***Correspondence to:** Professor Yuichi IMANAKA

Address: Department of Healthcare Economics and Quality Management, School of Public Health, Graduate School of Medicine, Kyoto University, Yoshida Konoe-cho, Sakyo-ku, Kyoto, 606-8501, Japan

E-mail: imanaka-y@umin.net

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 **ABSTRACT**

2 **Objective:** To elucidate the association between health care spending and the quality of
3 care in ischaemic stroke patients in Kyoto prefecture, Japan.

4 **Methods:** Municipalities in Kyoto were categorized into quartiles based on age-sex
5 adjusted spending for ischaemic stroke admissions. We used logistic regression models to
6 analyse if patients from lower spending municipalities were less likely to obtain high
7 quality care. The sample consisted of patients admitted to hospitals in Kyoto prefecture due
8 to ischaemic stroke between February 2009 and March 2010. Quality measures included
9 process indicators such as diagnostic tests, recommended medications, and rehabilitation
10 services; and outcome measures of in-hospital mortality and 30-day mortality rates.

11 **Results:** Mean health care spending per patient ranged from USD9 749 to USD14 303
12 from the lowest to highest municipalities. Patients from municipalities in the lowest
13 spending quartile were significantly associated with poorer performance in the majority of
14 the process indicators, but had similar mortality rates with patients from high spending
15 municipalities.

16 **Conclusions:** Spending was found to be unevenly associated with the quality of care
17 provided, and may be indicative of an insufficient provision of resources and specialist
18 expertise in the lower spending municipalities. Further efforts must be made to improve the
19 quality of care in lower spending regions in Japan.

1 INTRODUCTION

2 The aging population of Japan, among other factors, has contributed to the rapid rise in
3 health care spending, with annual costs expected to reach 56 trillion yen by 2025 at current
4 spending levels.¹ Japanese governing bodies at the national and local levels are exploring
5 cost-cutting measures but efforts must also be made to ensure consistent quality of care.

6
7 The quality of care for stroke and other cardiovascular diseases is important as they
8 remain a major cause of death and disability,² representing the third commonest cause of
9 mortality in Japan.³ Quality of care may be dependent on the availability of resources such
10 as specialists and other trained staff. Unequal distribution of such resources may result in
11 regional variations in the quality of care.

12
13 The existence of regional variations in health care quality have been observed in
14 other countries.⁴⁻⁸ These studies have attributed the variations to differences in the use of
15 hospital beds, intensive care and drugs. Elucidation of the underlying factors for regional
16 variations in quality could support and influence health care reform. A lack of association
17 between health care utilization and quality might imply the overutilization of health
18 services in regions with high health care spending which have no accompanying benefit.^{4,5}
19 Conversely, an observed association between health care utilization and quality may
20 indicate underutilization in regions of low spending and quality.

21

1 These concepts have yet to be explored in Japan where little is known about the
2 relationship between regional variations in spending and the quality of care provided. Japan
3 has had a universal insurance system in place since 1961, as well as a uniform
4 reimbursement system for acute care hospitals (Diagnosis-Procedure Combination
5 prospective payment system, or DPC system) since 2003. These systems should ostensibly
6 reduce variations in hospital spending. Furthermore, as the DPC system precludes price
7 competition to a large degree, hospitals have to compete on quality, which should minimise
8 wide variations. Although these factors may act to reduce differences in spending, other
9 factors—such as the concentration of large university hospitals in urban areas—may create
10 variations. In that case, it is plausible that observed differences in spending are to some
11 extent a result of planned actions. Alternatively, market-driven supply-side factors may
12 result in an uneven distribution of resources, such as the differential diffusion of
13 technologies and an uneven supply of physicians.^{9,10} Also, the DPC system is still in the
14 process of implementation and although DPC hospitals account for more than half of the
15 acute care beds, many hospitals still use fee-for-service payment. It is possible that such a
16 difference may influence resource utilization.

17 The objective of this study was to describe the extent of variations in health care
18 spending and quality of care in ischaemic stroke patients residing in Kyoto Prefecture,
19 Japan and to assess if health care spending is associated with quality.

21 **METHODS**

22 **Data**

1 Japan consists of 47 prefectures (regions) of which Kyoto prefecture is on the main island
2 of Honshu and has a population of approximately 2.6 million people. Hospital claims data
3 from all hospitals in Kyoto prefecture were provided by the Kyoto National Health
4 Insurance Organizations, in a project conducted by the Kyoto Prefectural Government.
5 These data included information on patient demographics, comorbidities upon admission,
6 diagnostic and therapeutic procedures, administered medications, hospital ownership, size,
7 teaching status, and DPC system status. This study was approved by the Ethics Committee
8 of Kyoto University Graduate School and Faculty of Medicine.

9
10 Ischaemic stroke was identified using International Classification of Diseases, 10th
11 Revision (ICD-10) codes that signified admission due to a cerebral infarction (I63x). The
12 study sample included admissions to hospitals in Kyoto prefecture between February 2009
13 and March 2010. Patients were excluded from the analysis if they had been hospitalized for
14 a previous cerebral infarction within 30 days before the index admission, in order to
15 remove readmissions, or if the length of hospital stay was greater than 90 days.
16 Municipalities with fewer than 10 cases during the study period were excluded from
17 analysis.

18 19 **Spending categories**

20 Age-sex adjusted health care spending per patient for ischaemic stroke was calculated for
21 all 37 municipalities (including the 11 wards of Kyoto city). These municipalities were then
22 categorized into quartiles based on age-sex adjusted spending: quartile 1 represented the

1 group of municipalities with the lowest spending and quartile 4 the highest spending
2 municipalities. Health care spending in Japanese yen was converted to US dollars (USD)
3 using 2009 purchasing power parities (JPY100 = USD0.80).

4 **Quality of care indicators**

5 The process indicators included (1) computed tomography (CT) or magnetic resonance
6 imaging (MRI) scans conducted during hospitalization;¹¹ (2) tissue plasminogen activator
7 (t-PA) administration during hospitalization;¹² (3) antithrombotics (aspirin, ozagrel,
8 argatroban, heparin, low molecular weight heparin, ticlopidine, clopidogrel, cilostazol, and
9 warfarin) administered during hospitalization;^{13,14} (4) in-hospital rehabilitation services;⁵
10 (5) early rehabilitation (within 30 days of admission); (6) rehabilitation for dysphagia; and
11 (7) warfarin-administered to patients with AF.¹⁵ The following two outcome indicators
12 were used: (1) in-hospital mortality and (2) 30-day in-hospital mortality. The performance
13 in each quality indicator was calculated for each spending quartile.

14 **Statistical analyses**

15 Unadjusted characteristics and indicators by spending quartiles were analysed using
16 analysis of variance. Logistic regression models were used to analyse the association
17 between spending and the quality of care. The binary result of each indicator was used as
18 the dependent variable in analysis, and independent variables used are shown in Table
19 1. Using quartile 4 (comprising municipalities with the highest spending) as the referent
20 category, the lower three quartiles were included in the regression models as dummy
21 variables in order to test if municipalities with lower spending had differential performance
22

1 in the various quality indicators when compared to the high spending municipalities. All
2 statistical analyses were conducted using SPSS, version 19. Statistical significance was set
3 at P-value < 0.05 (two-tailed).

5 RESULTS

6 There were 3,958 admissions, 667 of which presented with atrial fibrillation (AF). At the
7 individual municipality level, the mean health care spending per patient ranged from USD9
8 749 to USD14 303 from the lowest to highest municipalities, a difference of 47%. When
9 the municipalities were categorized into quartiles by spending, the highest quartile had a
10 mean spending per patient 26% higher than that of the lowest quartile.

11
12 Table 2 presents the mean health care spending per patient, patient characteristics
13 and hospital characteristics for each of the quartiles. There were no variations observed in
14 sex or mean length of stay between the four quartiles. There were, however, significant
15 differences in age, hospital DPC status, teaching status, privately-owned hospitals and
16 hospitals with more than 300 beds.

17
18 Variations in performance in each of the quality indicators by spending quartiles are
19 shown in Table 3. Imaging scans were used in similar proportions in all four quartiles. In-
20 hospital mortality and 30-day in-hospital mortality showed no significant differences
21 between quartiles. The other quality indicators had statistically significant differences

1 between quartiles. In general, recommended medications and rehabilitation services
2 showed better performance in the higher spending quartiles.

3
4 Associations between spending and quality from the regression analyses are shown
5 in Table 4. The results reveal that patients admitted to hospitals in quartile 1 had
6 significantly poorer performance in almost all process indicators (except CT/MRI scans).
7 Patients in quartile 1 presenting with atrial fibrillation were also less likely to be
8 administered warfarin during admission. These results were most pronounced in t-PA
9 administration, dysphagia rehabilitation and warfarin administration, with patients in the
10 referent category having more than 50% increased likelihood to be provided with these
11 services compared to patients in quartile 1. In quartile 2, patients were significantly less
12 likely to be provided with dysphagia rehabilitation and warfarin administration in AF
13 patients when compared to patients in quartile 4. patients from quartile 3 were significantly
14 less likely to be provided with dysphagia rehabilitation and warfarin when presenting with
15 AF. In all quartiles, CT or MRI scans and both mortality indicators showed no significant
16 associations with different levels of spending.

17 18 **DISCUSSION**

19 Regions with the lowest health care spending were found to be significantly associated with
20 poorer performance in all but one of the process indicators, even after adjusting for
21 variations in patient and hospital characteristics. Regression analyses demonstrated that
22 even after adjusting for DPC status, there was significantly poorer performance in most of

1 the process indicators for hospitals in the lower spending regions. This suggests that the
2 observed differences are not explained by DPC status.

3
4 In contrast, mortality showed no statistically significant association with spending.
5 Because Japan has one of the lowest mortality rates following ischaemic stroke, it may be
6 difficult to improve current mortality rates.¹⁶ Other outcome measures such as improvement
7 in functional ability or patients' health related quality of life should be analysed in future
8 studies.

9 Most of the process indicators showed significantly poorer performance in the lower
10 spending quartiles. It is possible that the increase in rehabilitation services in quartile 4 was
11 due to more hospitals in this quartile providing these services, while hospitals in the lower
12 quartiles rely on step-down facilities to provide the same services. However, the Japanese
13 health care system is such that any acute service would only be provided at one institution
14 at any one time, and rehabilitation services that occur post-discharge may mean a lengthier
15 period before these services commence, thereby still indicating a possible target for quality
16 improvement. Additionally, t-PA administration showed a consistent, though not
17 statistically significant, increase with higher spending. The lack of sufficient staff with
18 appropriate training in the lower spending regions may have contributed to these
19 observations.

20 These results may indicate the existence of variations in care that are dependent on
21 resources, in which an uneven distribution of resources has led to an inadequate provision
22 of specialist expertise and rehabilitation services in the lower spending regions. The results

1 of the CT and MRI diagnostic tests may reinforce this concept, as the known abundance of
2 CT and MRI scanners in Japan may be sufficient to provide similar performances for this
3 indicator in all spending quartiles.^{17,18} If so, the current system of allowing market forces to
4 dictate resource distribution may need to be augmented with government intervention at the
5 prefectural level in order to ensure more equitable access in the lower spending regions.

6 This study has several limitations. First, Kyoto prefecture is not a closed system and
7 there may be some inter-prefectural movements of patients, in which patients residing in
8 Kyoto choose to obtain their health care in other prefectures. However, the nature of
9 ischaemic stroke is such that patients would very likely be admitted to hospitals in close
10 proximity, which would minimize the effects of such movements. Second, we are unable to
11 state with certainty that the relationship between spending and quality is causal. It is
12 possible that regions with higher quality of care have better management that result in
13 increased income. Third, due to limitations of administrative data, we were unable to adjust
14 for several clinical variables such as consciousness level, stroke severity and activities of
15 daily living upon admission and discharge. However, the process indicators selected were
16 largely independent of these factors and therefore should not strongly influence the results.
17 And fourth, the exclusion of between-hospital transfers (which are likely to have occurred
18 soon after the initial admission) might have had an impact. We found that only about 5% of
19 patients were discharged alive within 3 days, and further investigation of the cases revealed
20 an even distribution across hospitals, municipalities, and spending quartiles (data not
21 shown). Given the low incidence of such cases, as well as their apparent lack of clustering

1 in any of the sample units, we feel that there is little impact on our study objectives and
2 conclusions.

3 This study offers a first glimpse of regional variations in health care spending in
4 Japan. The novelty of these findings lies in the observation of variations in spending and
5 quality despite the presence of a universal insurance system and hospital reimbursement
6 system. Understanding the relationship between health care spending and the quality of
7 health care on a larger scale would provide further insight into the balance between health
8 care economics, resource distribution and quality. Care must be taken when policy-makers
9 reduce resources to ensure that the quality of care provided is not detrimentally affected.
10 Because the free market can lead to a maldistribution of resources, there may be a need for
11 policy interventions to ensure proper distribution, continuity, and efficient concentration of
12 care. As Japan faces massive challenges in ensuring an equitable, effective and affordable
13 health care system, understanding the nature of regional variations will be central to
14 effective regional health planning and policy.

15
16
17
18
19
20
21

17 **Acknowledgements**

18 This work was supported in part by a Health Sciences Research Grant from the Ministry of
19 Health, Labour and Welfare of Japan [grant number H22-seisaku-ippa-028]; and a Grant-
20 in-Aid for Scientific Research from the Japan Society for the Promotion of Science [grant
21 number Kiban-A-22249015]. The funding sources had no role in study design; in the

1 collection, analysis, and interpretation of data; in the writing of the report; or in the decision
2 to submit the article for publication.

6 **References**

- 7 1. McCurry J. Japan moves to guard against future health-spending rises. *Lancet*
8 2006;367:1385–6.
- 9 2. Kim AS, Johnston SC. Global variation in the relative burden of stroke and ischemic
10 heart disease. *Circulation* 2011;124:314–23.
- 11 3. Ministry of Health, Labour and Welfare, Japan [website]. Analysis by cause of death.
12 Abridged Life Tables For Japan 2010. [http://www.mhlw.go.jp/english/database/db-
14 hw/lifetb10/4.html](http://www.mhlw.go.jp/english/database/db-
13 hw/lifetb10/4.html) Accessed [11th October 2012].
- 15 4. Fisher ES, Wennberg DE, Stukel TA, et al. The implications of regional variations in
16 Medicare spending. Part 1: The content, quality and accessibility of care. *Ann Intern
17 Med* 2003;138:273–87.
- 18 5. Fisher ES, Wennberg DE, Stukel TA, et al. The implications of regional variations in
19 Medicare spending. Part 1: Health outcomes and satisfaction with care. *Ann Intern
20 Med* 2003;138:288–98.
- 21 6. Stukel TA, Fisher ES, Alter DA, et al. Association of hospital spending intensity with
mortality and readmission rates in Ontario hospitals. *JAMA* 2012;307:1037-45.

- 1 7. Rudd A, Irwin P, Rutledge Z, et al. Regional variations in stroke care in England,
2 Wales and Northern Ireland: results from the National Sentinel Audit of Stroke. *Clin*
3 *Rehabil* 2001;15:562–72
- 4 8. Fisher ES, Wennberg JE. Health care quality, geographic variations and the challenge
5 of supply-sensitive care. *Perspect Biol Med* 2003;46:69–79.
- 6 9. Otsubo T, Imanaka Y, Lee J, et al. Evaluation of resource allocation and supply-
7 demand balance in clinical practice with high-cost technologies. *J Eval Clin Prac*
8 2011;17:1114–21.
- 9 10. Tanihara S, Kobayashi Y, Une H, et al. Urbanization and physician maldistribution: a
10 longitudinal study in Japan. *BMC Health Serv Res* 2001;11:260
- 11 11. Adams H, del Zoppo G, Alberts M, et al. Guidelines for the Early Management of
12 Adults With Ischemic Stroke: A Guideline From the American Heart Association/
13 American Stroke Association Stroke Council, Clinical Cardiology Council,
14 Cardiovascular Radiology and Intervention Council, and the Atherosclerotic Peripheral
15 Vascular Disease and Quality of Care Outcomes in Research Interdisciplinary Working
16 Groups: The American Academy of Neurology affirms the value of this guideline as an
17 educational tool for neurologists. *Stroke* 2007;38:1655–711.
- 18 12. The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group.
19 Tissue plasminogen activator for acute ischemic stroke. *N Engl J Med* 1995;333:1581–
20 7.

- 1
2
3
4
5
6 1 13. Albers GW, Amarenco P, Easton JD, et al. Antithrombotic and thrombolytic therapy
7
8 2 for ischemic stroke: the Seventh ACCP Conference on Antithrombotic and
9
10 3 Thrombolytic Therapy. *Chest* 2004;126:483S–512S.
11
12 4 14. Sandercock PA, van den Belt AG, Lindley RI, et al. Antithrombotic therapy in acute
13
14 5 ischaemic stroke: an overview of the completed randomised trials. *J Neurol Neurosurg*
15
16 6 *Psychiatry* 1993;56:17–25.
17
18 7 15. Sudlow M, Rodgers H, Kenny RA, et al. Population based study of use of
19
20 8 anticoagulants among patients with atrial fibrillation in the community. *BMJ*
21
22 9 1997;314:1529–30.
23
24 10 16. Organisation for Economic Co-operation and Development. "In-hospital mortality
25
26 11 following stroke", in OECD, *Health at a Glance 2011: OECD Indicators*, OECD
27
28 12 Publishing. [http://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-](http://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2011/in-hospital-mortality-following-stroke_health_glance-2011-43-en)
29
30 13 [glance-2011/in-hospital-mortality-following-stroke_health_glance-2011-43-en](http://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2011/in-hospital-mortality-following-stroke_health_glance-2011-43-en)
31
32 14 Accessed [11th October 2012].
33
34 15 17. Hisashige A. MR imaging in Japan and the United States: analysis of utilization and
35
36 16 economics. *Am J Roentgenol* 1994;162:507–10.
37
38 17 18. Oh EH, Imanaka Y, Evans E. Determinants of the diffusion of computed tomography
39
40 18 and magnetic resonance imaging. *Int J Technol Assess Health Care* 2005;21:73–80.
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60