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Investigation into the causes of indwelling urethral catheter implementation and its effects on clinical outcomes and health care resources among dementia patients with pneumonia

A retrospective cohort study

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Abstract

There is a possibility that unnecessary treatments and low-quality medical care, such as inappropriate indwelling urethral catheter use, are being provided to older Japanese individuals.

The aim of this study was to investigate contextual effects relating to indwelling urethral catheters in older people with dementia and to clarify the effects of indwelling urethral catheter use on patients' mortality, length of stay (LOS), and health care spending. This retrospective cohort study involved 4501 male and female Japanese participants. Those who were aged 75 or older with dementia and had a primary diagnosis of acute lower respiratory disease with antibiotics administered during hospitalization were eligible for inclusion. Patient mortality, LOS, and total charge during hospitalization were the main study outcomes. This study showed that indwelling urethral catheter use was significantly associated with higher mortality, longer LOS, and higher total charge for hospitalization. The pattern of indwelling urethral catheter use was clustered by care facility level. Physician density was significantly associated with indwelling urethral catheter use; the relationship was not linear but U-shaped, such that the approximate median had the lowest rate of urethral catheter use and this increased gradually toward both lower and higher physician densities. Our study found considerable variation in indwelling urethral catheter use between care facilities in older people with dementia. Additionally, indwelling urethral catheter use was related to poor outcomes. Based on these findings, we consider there to be an urgent need for constructing a framework to measure, report on, and promote the improvement of care quality for older individuals in Japan.

Abbreviations: CAUTI = catheter-associated urethral tract infection, DPC = diagnosis procedure combination, ICC = intraclass correlation coefficient, ICD-10 = International Disease Classification 10th revision, LOS = length of stay, MOR = median odds ratio, PS = propensity scores, RA = regression analysis, STM = secondary tier of medical care, TC = total charge.

Keywords: care quality, claim data, health policy, indwelling urethral catheter, older people

1. Introduction

The Japanese population has been aging at a remarkably increasing rate. As of 2015, people aged 65 years or older comprised 33.84 million or 26.7% of the total population, which were the highest numbers ever recorded.[1] Dementia is one of the most serious problems in an aging society.[2] The Japanese government estimated that the number of individuals with dementia aged 65 years or older was 4.62 million, which is equivalent to a prevalence of 1 in 7 people in this age group.[3] Therefore, measures targeting dementia are of the utmost importance. The core symptoms of dementia are cognitive impairment, behavioral, and psychological symptoms.

People with dementia are likely to have functional urethral incontinence[4] resulting from cognitive impairment; this type of frequent incontinence[5] diminishes the patient's daily quality of life. As urethral incontinence may be a burden for daily care,[6,7] use of an indwelling urethral catheter in hospitalized dementia patients may mitigate care burden. However, urethral catheter use in these patients violates the indications of indwelling urethral catheters, which are as follows: the patient has acute urinary retention or bladder outlet obstruction; there is a need for accurate measurements of urethral output in critically ill patients; perioperative use for selected surgical procedures; to assist in healing of open sacral or perineal wounds in incontinent patients; the patient requires prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine, or multiple traumatic injuries, such as pelvic fractures); or to improve comfort for end-of-life care if needed.[8] Additionally, indwelling urethral catheters are associated with catheter-associated urethral tract infection (CAUTI),[8,9] immobility,[10] pressure ulcer,[11] mortality,[9,12,13]

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longer hospital stay,[9] and higher care cost.[9,14] Therefore, unnecessary use of urethral catheters could be unethical. Nevertheless, there have been few investigations into indwelling urethral catheter use in older people with dementia in Japan. It has been reported that indwelling urethral catheter use varies by region[15] or care facility,[13,16] although this has never been thoroughly studied in Japan.

Using an insurance claims database, we aimed to investigate contextual effects relating to indwelling urethral catheters in older people with dementia who presented with pneumonia and were admitted to care facilities. Patients with pneumonia were studied as this is a common disease affecting older people, and its incidence has been increasing with the increasing aging population.[17] Indeed, pneumonia has ranked third – ahead of cerebrovascular accident – among the causes of mortality in Japan since 2011.[17]

First, we assessed regional- and care facility-level variation after controlling for patient-level factors. If care providers adhered to the indications of urethral catheter use listed above, variation should be minimal after controlling for individual clinical factors. Conversely, clustered variations irrespective of patient factors indicate contextual effects. Second, we clarified the effects of indwelling urethral catheter use on patients' mortality, length of stay (LOS), and health care spending. We ultimately aimed to clarify issues of Japanese health care quality and suggest policy implications for health care issues in older Japanese people.

2. Materials and methods

2.1. Study subjects, materials, and design

This study was a retrospective cohort analysis that closely followed the internationally recognized Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[18] It used claims data submitted to the Fukuoka Late Elders' Health Insurance from fiscal year 2010 to fiscal year 2013. In Japan, those aged ≥75 years, or those aged 65 to 74 years with a specific disability, are eligible for Late Elders' Health Insurance. Those aged 65 to 74 years were assumed to have specific intractable disease; therefore, we only included those 75 years or older as study subjects. We initially identified 4791 patients whose primary diagnosis was acute lower respiratory disease, had been administered antibiotics during hospitalization, and were diagnosed as having dementia before or on the same day as admission using the International Disease Classification 10th revision (ICD-10). The ICD codes of "acute lower respiratory disease" and "dementia" are J100, J110, J69 and from J12 to J22, and F00, F01, F02, and F03, respectively. We defined those with procedure code 140013810 after admission as those that underwent placement of an indwelling urethral catheter. Those diagnosed with urinary retention (ICD-10: R33) on the same day as indwelling urethral catheter placement were excluded from the study (N=37) as this is a definitive indication. Given that the claims data did not reflect withdrawal of the urethral catheter, we could not calculate the duration of urethral catheter placement. As many facilities in Japan routinely change urethral catheters once a month,[19–21] we excluded those with procedure code 140013810 (implementation of indwelling urethral catheter) and 140013950 (replacement of indwelling urethral catheter) within 1 month of each other (N=82) because we could not rule those out as semipermanent indwelling urethral catheters. We also excluded who had an operation or procedure during hospitalization (N=66). We then excluded missing data and obvious imputation error (N=200). Finally, we identified 4501 patients as study subjects. Inclusion and exclusion details are shown in Fig. 1.

This study was approved by the Institutional Review Board of Kyushu University (Clinical Bioethics Committee of the Graduate School of Healthcare Sciences, Kyushu University).

2.2. Definition of variables

We measured the demographic variables, income state, and year of admission. Additionally, as the claims database used did not include clinical data, we used type of pneumonia, comorbidity, tube feeding, type of claims data, and characteristics of health care facilities to adjust for patient condition. At the patient level, they were categorized by age into 75 to 84 years, 85 to 89 years, and ≥90 years. We defined those having ICD-10 code J69 as having aspiration pneumonia. Urological past history and comorbidities were categorized as either diagnosed before or on the same day of admission. "Urinary retention (ICD-10: R33)" and "neurogenic bladder (ICD-10:N31)" were designated as urological past history, unless the urinary retention occurred on the same day as an indwelling urethral catheter placement. Comorbidities were classified according to the Charlson comorbidity index.[22] We defined those with procedure codes 114005210, 140051210, 140023210, 140023350, 150170550, and 15017610 as those undergoing tube feeding. Income status was determined by use of a meal charge copayment during hospitalization because meal charges are set according to income.[23] Income was classified as lower, middle, and higher. However, we combined middle and higher into a middle-to-higher group because the number in the higher income group was small. The types of claims data were either diagnosis procedure combination (DPC) or not. The DPC is a Japanese case-mix classification and adopted by almost all acute care hospitals.[24] At the level of the care facility, we assessed the number of beds, ownership, and physician density. The number of beds was classified into <200, 200 to 399, and ≥400 because the Medical Care Law stipulates that at least 200 beds for a regional support hospital and at least 400 beds for an advanced treatment hospital are needed.

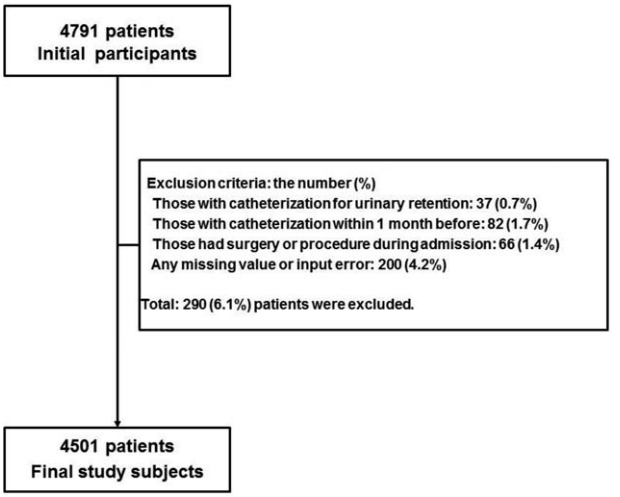

Figure 1. Diagram of subject identification and inclusion and exclusion criteria details.

Physician density was defined as the number of full-time physicians per bed. Because optimal physician density was not known, we classified physician density into 10 quantiles according to prior research.[25] We classified ownership into private or public. At the regional level, we identified the secondary tier of medical care (STM) in which the facility was located. STM is the unit of secondary care governed by a prefecture according to Japan Medical Service Law. Each prefecture must set its own STMs; Fukuoka Prefecture has 13 STMs.[23]

2.3. Definition of outcomes

We set mortality, LOS, and total charge (TC) as outcome measures. Mortality was defined as all-cause death during hospitalization. LOS was defined as duration from admission to discharge or death. The TC (US$1 = ¥100) billed during hospitalization was used as a proxy for cost. Under the Japanese health insurance scheme, hospital charges are determined by a standardized fee-for-service payment system known as the nationally uniform fee table. The TC included physician fees, instrument costs, laboratory or imaging test costs, and administration fees.[26] In this study, the cost of indwelling urethral catheter was charged as a procedural and instrumental cost. We did not include CAUTI as an outcome variable, despite the fact that the relationship between urethral catheter use and CAUTI has been well established,[8,9] because we could not detect the exact duration of indwelling because of data limitations. However, as subjects were administered antibiotics for pneumonia, the rate of urinary tract infection occurrence during hospitalization was extremely low: 0 cases in the indwelling urethral catheter group and 144 in the no indwelling urethral catheter group.

2.4. Statistical analyses

First, we performed Kruskal–Wallis test for continuous variables and Pearson Chi-square for categorical variables. We employed 3-level multilevel models with random intercept, setting patient factors as level 1, care facility factors as level 2, and regional factors as level 3 to detect contextual effects. We created a null model with care facilities as level 2 and STMs as level 3. Next, we created model 1, inputting patient-level factors, with $P < 0.2$ in bivariate analyses to the null model. We created model 2 adding care facility-level variables including number of beds, physician densities, and ownership in model 1 to detect contextual effects for urethral catheter use. We used an intraclass correlation coefficient (ICC) for similarity within groups and the median odds ratio (MOR) for variance between groups.[27]

Subsequently, we analyzed the effects of urethral catheter use on mortality, LOS, and TC. We performed common logarithmic transformations for LOS and TC because these were right-skewed. First, we performed bivariate analyses to detect the association between urethral catheter use and outcomes. We performed regression analyses (RAs) with mortality, logLOS, and logTC as dependent variables and all variables listed in Table 1 as independent variables (RA model). We employed a logistic regression model for mortality and a linear regression model for logLOS and logTC in RA models. Then we performed a nonparsimonious logistic RA inputting all variables listed in Table 1 and dummy variables of STMs to obtain propensity scores (PS). Each patient in the indwelling urethral catheter group was matched with a unique control from the no indwelling urethral catheter group according to PS (PS match model). From the matched cohort, we employed multilevel logistic regression with mortality as a dependent variable and sex and age group as independent variables with random intercept of care facility level. Similarly, a multilevel linear regression model was used with logLOS or logTC as dependent variables and sex and age group as independent variables with random intercept of care facility level. We set caliper width as 0.02.[28]

Last, we employed independent variables, including sex, age group, and PS, stratified by 5 quantiles[28] with random intercept setting care facility as level 2 (PS stratification model). We also performed a multilevel logistic RA for mortality and multilevel linear RAs with logLOS and logTC as dependent variables. All reported *P*-values were 2-tailed, and the level of significance was set at $P < 0.05$. We used Stata statistical software, Release 14 (StataCorp, College Station, TX) for statistical analyses.

2.5. Sensitivity analysis

We employed a generalized linear model with clustering care facilities, changing STMs to dummy variables because regional variables were almost 0 for sensitivity analysis of model 2. With regard to outcome, we again analyzed TC and LOS, excluding mortality, as mortality can affect TC[29,30] or LOS,[31] and some urethral catheters were indwelling for palliation.

3. Results

3.1. Descriptive analysis

The results of the descriptive analysis are shown in Table 1. The number of those with indwelling urethral catheter was 712 (15.8%) among 4501 study subjects. There was no significant association between sex and urethral catheter use. As for age, there was no significant relationship with urethral catheter use. With regard to types of pneumonia, those with aspiration pneumonia had a significantly higher rate of indwelling urethral catheter use. Neurogenic bladder was significantly associated with indwelling urethral catheter use, although urinary retention was not. As for other comorbidities, cerebrovascular accident, pulmonary disease, and diabetes mellitus were associated with urethral catheter use. Those with tube feeding had a significantly higher prevalence of indwelling urethral catheter use.

Claims made by DPC had a significantly higher rate of indwelling urethral catheter use than claims made by non-DPC. Facilities having 200 to 399 beds had more instances of indwelling urethral catheter use and there was a significant difference in distribution. There was no association between ownership and urethral catheter use. There was a significant relationship between physician densities and indwelling urethral catheter use, with the lowest rate of indwelling urethral catheter use in the 6th quantile and a trend toward gradually increased rates toward both lower and higher quantiles.

3.2. Results of the analyses for the variance of urethral catheterization

The results of multilevel analyses to detect contextual effects are shown in Table 2. In the null model, there was almost no variation at the STM level. However, there was variation at the care facility level, with an ICC of 0.15 and an MOR of 2.08.

In model 1, which controlled for patient factors, the variation at the care facility level was barely decreased and the changes of ICC and MOR were also minimal. In model 2, which added care

Table 1

Descriptive analysis of subjects by indwelling urethral catheter use.

		Indwelling urethral catheter		Nonindwelling urethral catheter		*P*
Patient level						
Sex						
Male	%	288	40.4	1643	43.4	0.150
Female	%	424	59.6	2146	56.6	
Age median	IQR	87	8.0	86	7.0	0.160
Age category						
<85	%	244	34.3	1399	36.9	
85≤<90	%	238	33.4	1283	33.9	0.211
90≤	%	230	32.3	1107	29.2	
Type of pneumonia						
Aspiration	%	301	42.3	1270	33.5	<0.001
Urological past history						
Neurogenic bladder	%	67	9.4	219	5.8	<0.001
Urinary retention	%	36	5.1	207	5.5	0.659
Comorbidities						
Acute myocardial infarction	%	19	2.7	79	2.1	0.328
Cerebrovascular disease	%	208	29.2	1336	35.3	0.002
Congestive heart failure	%	256	36.0	1231	32.5	0.071
Collagen disease	%	10	1.4	71	1.9	0.387
Hemiplegia	%	6	0.8	17	0.4	0.176
Peptic ulcer	%	61	8.6	366	9.7	0.362
Peripheral vascular disease	%	21	2.9	72	1.9	0.071
Pulmonary disease	%	159	22.3	999	26.4	0.024
Renal disease	%	36	5.1	202	5.3	0.763
Diabetes						
No complication	%	57	8.0	214	5.6	0.013
With complications	%	17	2.4	59	1.6	
Liver disease						
Mild liver disease	%	16	2.2	92	2.4	0.340
Moderate to severe liver disease	%	3	0.4	6	0.2	
Malignancy						
No metastasis	%	69	9.7	373	9.8	0.942
Metastatic malignancy	%	5	0.7	31	0.8	
Clinical status						
Tube feeding	%	156	21.9	693	18.3	0.023
Economic status						
Lower	%	210	29.5	1123	29.6	0.938
Middle to higher	%	502	70.5	2666	70.4	
Type of claim						
Non-DPC	%	334	46.9	2013	53.1	0.002
DPC	%	378	53.1	1776	46.9	
Fiscal year						
−2010	%	170	23.9	780	20.6	0.060
2011	%	198	27.8	992	26.2	
2012	%	163	22.9	1016	26.8	
2013	%	181	25.4	1001	26.4	
Care facility level						
Number of beds						
−200	%	334	46.9	1934	51.0	<0.001
200–399	%	262	36.8	1039	27.4	
400–	%	116	16.3	816	21.5	
Ownership						
Private	%	598	84.0	3259	86.0	0.157
Public	%	114	16.0	530	14.0	
Physician density						
1st	%	80	11.2	371	9.8	<0.001
2nd	%	69	9.7	394	10.4	
3rd	%	99	13.9	338	8.9	
4th	%	66	9.3	386	10.2	
5th	%	54	7.6	397	10.5	
6th	%	43	6.0	409	10.8	
7th	%	67	9.4	492	13.0	
8th	%	63	8.8	279	7.4	
9th	%	75	10.5	372	9.8	

(*continued*)

Table 1
(continued).

		Indwelling urethral catheter		Nonindwelling urethral catheter		P
10th	%	96	13.5	351	9.3	
Outcome						
Mortality	%	112	15.7	258	6.8	<0.001
Length of stay	IQR	22	23.0	19	20.0	<0.001
Total charge	IQR	5624.5	3632.5	4226	3742	<0.001

DPC = diagnosis procedure combination.

facility factors to model 1, ICC and MOR were decreased (0.13 and 1.93, respectively), although there was variation at the care facility level. Number of beds and ownership were not significantly associated with urethral catheter use. Physician density was significantly associated with indwelling urethral catheter use, and each quantile, except for the 5th, 7th, and 8th, had significantly higher rates of indwelling urethral catheter use compared with the 6th quantile (Fig. 2).

3.3. Results of the assessment of the relationship of urethral catheterization with mortality and care resource use

The number of deaths among all 4501 subjects was 370 (8.2%). There was a significant difference between the number of deaths in the urethral catheter group (112 (15.7%)) and that in the nonurethral catheter group (258 [6.8%]). The indwelling urethral catheter group had significantly longer LOS and higher TC (Table 1). Indwelling urethral catheter was a significant risk factor for mortality, increasing the risk by between 130% and 200% according to all models shown in Table 3 (bivariate analysis: 2.55 [2.01–3.24] $P<0.001$; RA model: 3.13 [2.40–4.08] $P<0.001$; PS match model: 2.30 [1.59–3.33] $P<0.001$; and PS stratification model: 3.04 [2.31–3.99] $P<0.001$). Similarly, the results derived from all models revealed that indwelling urethral catheter use added significantly extra cost (bivariate analysis: 0.13 [0.10–0.16] $P<0.001$, RA model: 0.12 [0.10–0.15] $P<0.001$, PS match model: 0.12 [0.09–0.15] $P<0.001$, and PS stratification model: 0.13 [0.10–0.15] $P<0.001$). Those with indwelling urethral catheters had significantly longer LOS, except for those in the PS match model, where they tended to have longer LOS although this did not reach statistical significance (bivariate analysis: 0.08 [0.05–0.11] $P<0.001$, RA model: 0.07 [0.04–0.10] $P<0.001$, PS match model: 0.04 [0.00–0.08] $P=0.067$, and PS stratification model: 0.06 [0.03–0.09] $P<0.001$).

3.4. Results of sensitivity analyses

The results of the generalized linear model with clustering care facilities were similar to those of model 2 (Supplemental Digital Content 1, http://links.lww.com/MD/B236). The results of all the models, except for mortality, showed significant relationships between indwelling urethral catheter use and longer LOS and higher TC (logLOS: bivariate analysis: 0.09 [0.06–0.12] $P<0.001$, RA model: 0.08 [0.05–0.11] $P<0.001$, PS match mode: 0.06 [0.02–0.10] $P=0.007$, PS stratification model 0.08 [0.05–0.11] $P<0.001$, logTC: bivariate analysis: 0.15 [0.12–0.17] $P<0.001$, RA model: 0.14 [0.11–0.16] $P<0.001$, PS match model: 0.16 [0.12–0.19] $P<0.001$, and PS stratification model: 0.14 [0.11–0.17] $P<0.001$) (Supplemental Digital Content 2, http://links.lww.com/MD/B236).

4. Discussion

4.1. Statement of principal findings

This study showed that indwelling urethral catheter use was significantly associated with higher mortality, longer LOS, and higher TC. The pattern of indwelling urethral catheter use was clustered by care facility level; nevertheless indwelling urethral catheter use was related to worse outcomes and care resource waste, as stated above. Regarding the characteristics of care facilities, number of beds and ownership were not significant determinants for indwelling urethral catheter use. Although physician density was significantly associated with indwelling urethral catheter use, the relationship was not linear but U-shaped, such that the approximate median had the lowest rate of urethral catheter use and this increased gradually toward both lower and higher physician densities.

4.2. Strengths and weaknesses of the study

The strength of this study was its comprehensive coverage; because almost all procedures were claimed, indwelling urethral catheter use was included in claims data. Additionally, the number of subjects belonging to Fukuoka Late Elders' Health Insurance was approximately 600,000 people,[32] which was enough to obtain robust findings. Unavailability of reporting of the severities of pneumonia, activity of daily lives and clinical data including laboratory tests were limitations of the study. Furthermore, we could not find out the duration of indwelling urethral catheter placement because urethral catheter withdrawal was not claimed.

4.3. Important differences in results

It has been reported that those with indwelling urethral catheters had significantly higher mortality, longer LOS, and higher TC because urethral catheter use was closely related to CAUTI.[9,14] However, our study revealed that indwelling urethral catheter use in older patients with dementia was related to higher mortality, longer LOS, and higher TC despite the rare occurrence of urinary tract infection.

Certainly, the claims database used did not include clinical information; therefore, we could not rule out whether patients with indwelling urethral catheter were already in a worse condition although we fully adjusted for patient condition using the available variables (comorbidities, type and characteristics of pneumonia, characteristics of healthcare facilities, and analytic tools, such as propensity score matching). However, the trend toward longer LOS and higher TC was clearly seen even when mortality was excluded. It has been suggested that low-quality care, represented by unnecessary indwelling urethral catheter use, could lead to poorer outcomes as well as wastage of health care resources including longer LOS and higher TC. Although

Table 2

Results of multilevel analyses to investigate contextual effects of indwelling urethral catheter use.

	Bivariate				Multivariate								
					Null			Model 1			Model 2		
	OR	95%CI		*P*	AOR	95%CI	*P*	AOR	95%CI	*P*	AOR	95%CI	*P*
Patients level													
Sex													
Male	Reference							Reference			Reference		
Female	1.13	0.96	1.33	0.150				1.10	0.92 1.32	0.292	1.10	0.92 1.32	0.301
Age category													
−85	Reference							Reference			Reference		
85–90	1.06	0.88	1.29	0.533				1.07	0.87 1.32	0.532	1.06	0.86 1.31	0.573
90–	1.19	0.98	1.45	0.081				1.25	1.00 1.55	0.046	1.25	1.00 1.55	0.049
Type of pneumonia													
No aspiration	Reference							Reference			Reference		
Aspiration	1.45	1.23	1.71	<0.001				1.46	1.18 1.79	0.000	1.45	1.18 1.79	0.001
Urological past history													
Neurogenic bladder	1.69	1.27	2.25	<0.001				2.03	1.46 2.82	<0.001	2.04	1.47 2.84	<0.001
Comorbidities													
Cerebrovascular disease	0.76	0.64	0.90	0.002				0.78	0.65 0.95	0.014	0.79	0.65 0.96	0.018
Congestive heart failure	1.17	0.99	1.38	0.071				1.27	1.05 1.53	0.014	1.26	1.05 1.52	0.014
Hemiplegia	1.89	0.74	4.80	0.183				2.08	0.76 5.69	0.154	2.12	0.77 5.81	0.146
Peripheral vascular disease	1.57	0.96	2.57	0.073				1.66	0.97 2.84	0.065	1.67	0.97 2.85	0.062
Pulmonary disease	0.80	0.66	0.97	0.024				0.79	0.64 0.97	0.026	0.79	0.64 0.97	0.026
Diabetes													
Nondiabetes	Reference							Reference			Reference		
No complication	1.47	1.08	1.99	0.013				1.33	0.95 1.87	0.099	1.33	0.95 1.87	0.096
With complications	1.59	0.92	2.74	0.097				1.60	0.89 2.90	0.119	1.63	0.90 2.95	0.109
Clinical status													
Tube feeding								1.09	0.87 1.37	0.435	1.08	0.87 1.36	0.478
Type of claim													
Non-DPC	Reference							Reference			Reference		
DPC	1.28	1.09	1.51	0.002				1.12	0.84 1.49	0.426	1.16	0.81 1.66	0.418
Fiscal year													
−2010	Reference							Reference			Reference		
2011	0.92	0.73	1.15	0.444				0.89	0.70 1.13	0.346	0.90	0.71 1.15	0.396
2012	0.74	0.58	0.93	0.010				0.73	0.56 0.94	0.013	0.74	0.57 0.95	0.019
2013	0.83	0.66	1.04	0.110				0.78	0.60 1.00	0.050	0.79	0.61 1.01	0.064
Care facility level													
Number of bed													
−200	Reference										Reference		
200–399	1.46	1.22	1.75	<0.001							1.17	0.79 1.73	0.429
400–	0.82	0.66	1.03	0.092							0.74	0.44 1.26	0.273
Ownership													
Private	Reference										Reference		

	Bivariate				Multivariate											
					Null				Model 1				Model 2			
	OR	95%CI		P	AOR	95%CI		P	AOR	95%CI		P	AOR	95%CI		P
Public	1.17	0.94	1.46	0.157									1.31	0.86	2.01	0.213
Physician density																
1st	2.05	1.38	3.05	<0.001									2.46	1.25	4.82	0.009
2nd	1.67	1.11	2.50	0.014									2.38	1.17	4.82	0.016
3rd	2.79	1.89	4.10	<0.001									2.71	1.32	5.55	0.006
4th	1.63	1.08	2.45	0.020									2.28	1.14	4.55	0.020
5th	1.29	0.85	1.98	0.234									1.59	0.79	3.19	0.195
6th		Reference												Reference		
7th	1.30	0.86	1.94	0.210									1.58	0.78	3.18	0.202
8th	2.15	1.42	3.26	<0.001									2.03	0.94	4.37	0.070
9th	1.92	1.29	2.86	0.001									2.23	1.07	4.64	0.031
10th	2.60	1.77	3.83	<0.001									2.67	1.31	5.45	0.007
Intercept					0.16	0.13	0.18	<0.001	0.12	0.08	0.18	<0.001	0.05	0.03	0.11	<0.001
Variation																
Level 3					<0.001				<0.001				<0.001			
Level 2					0.59	0.39	0.87		0.58	0.39	0.87		0.48	0.31	0.74	
ICC																
Level 3					<0.001				<0.001				<0.001			
Level 2					0.15	0.11	0.21		0.15	0.11	0.21		0.13	0.09	0.18	
MOR																
Level 3					1.00				1.00				1.00			
Level 2					2.08	1.82	2.44		2.07	1.81	2.44		1.93	1.70	2.28	

AOR = adjusted odds ratio, CI = confidence interval, DPC = diagnosis procedure combination, ICC = intraclass correlation coefficient, MOR = median odds ratio.

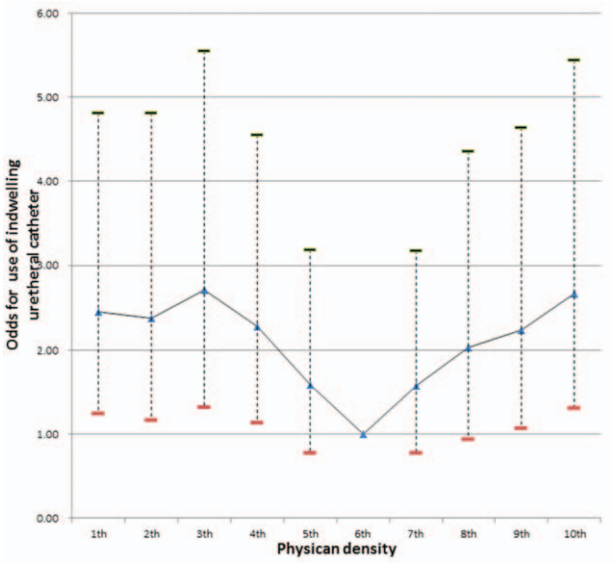

Figure 2. U-like shaped relationship between indwelling urethral catheter use and physician density.

to higher rates of indwelling urethral catheter use even in affluent care resource facilities. Although there were conflicting reports as to whether more physicians could achieve higher care quality,[38–41] our findings indicate that higher physician density alone did not achieve higher care quality, which was consistent with prior research.[39–41] As our study results could not elucidate the specific cause of the relationships between higher physician density and higher rates of indwelling urethral catheter use, further research into this is needed.

4.4. Implications for policymakers

Our study found variation in indwelling urethral catheter use between care facilities. There have been few studies investigating the care quality for older people in Japan; some have reported inappropriate urethral catheter use,[8,33,42] suggesting that greater attention should be paid to care quality in aging societies. Governments should encourage more vigorous ongoing research using electronic administrative data, including insurance claims data, for assessing care quality. It has been reported that the rate of indwelling urethral catheter use tended to decrease once government-mandated nursing home quality measures were implemented in the United States,[8] although there was no

Table 3

Results of the assessment of the relationships among urethral catheterization, mortality, and care resource use.

	Mortality				LogLOS				LogTC			
	OR	95%CI		P	Coefficient	95%CI		P	Coefficient	95%CI		P
Bivariate analysis	2.55	2.01	3.24	<0.001	0.08	0.05	0.11	<0.001	0.13	0.10	0.16	<0.001
RA model	3.13	2.40	4.08	<0.001	0.07	0.04	0.10	<0.001	0.12	0.10	0.15	<0.001
PS match model	2.30	1.59	3.33	<0.001	0.04	0.00	0.08	0.067	0.12	0.09	0.15	<0.001
PS stratification model	3.04	2.31	3.99	<0.001	0.06	0.03	0.09	<0.001	0.13	0.10	0.15	<0.001

CI = confidence interval, LOS = length of stay, OR = odds ratio, TC = total charge.

Georgiou et al[33] reported that indwelling urethral catheter use might be a measure of care quality, this was not clear-cut because their study included various case mixes. Our study clearly showed that urethral catheter use was related to poor care quality in the entire cohort. Other novel findings were that the determinant for indwelling urethral catheter use was not a regional factor but a care facility factor, and that, among care facility factors, physician density was significantly related to indwelling urethral catheter use while number of beds and ownership were not. Additionally, the relationship between the rate of indwelled urethral catheter use and physician density was not linear but U-shaped. Reasons behind the association between low physician density and higher rate of urethral catheter use could include practical style,[34,35] differences in structure, culture and education of care facilities,[13,36] and labor saving in essential care as a result of insufficient care resources. Interestingly, however, those in facilities with higher physician density also had higher indwelling urethral catheter use. We cannot rule out the possibility that the severity and complexity of diseases that were not captured in claims data affected the results of the study. However, diminishing marginal productivity[37] in addition to physicians' practice style[34,35] and differences in structure, culture, and education of care facilities[13,36] could contribute similar activity in Japan. There is an urgent need to construct a framework to measure, report on, and promote the improvement of care quality for older people.

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