





## ORIGINAL ARTICLE

## EPIDEMIOLOGY, CLINICAL PRACTICE AND HEALTH

# Characteristics associated with hospitalization within 30 days of geriatric intermediate care facility admission

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**Aim:** To identify facility-level characteristics associated with hospitalization within 30 days after admission to a geriatric intermediate care facility (GICF) (30-day hospitalization) in Japan.

**Methods:** This retrospective cohort study used nationwide long-term care insurance claims data and a national survey of long-term geriatric care facilities. The study population was residents admitted to GICFs between October 2016 and February 2018. The outcome variable was 30-day hospitalization. The independent variables were facility-level characteristics such as level of healthcare professionals.

**Results:** The final sample for analysis comprised 282 991 residents of mean age  $\pm$  SD,  $85.8 \pm 7.2$  years, of whom 12 814 (4.5%) experienced 30-day hospitalization. In a multivariable logistic generalized estimating equation model adjusted for facility- and resident-level characteristics, and clustering GICFs, the odds of 30-day hospitalization were 0.906 times lower (95% confidence interval [CI] 0.857–0.958) among residents in a GICF with dental hygienist than in those in a facility without. Furthermore, the risk of 30-day hospitalization was lower among residents who had been admitted to a GICF with higher staffing levels of pharmacists (adjusted odds ratio [aOR] 0.941, 95% CI 0.899–0.985), registered nurses (aOR 0.931, 95% CI 0.880–0.986), care workers (aOR 0.920, 95% CI 0.879–0.964) and speech-language pathologists (aOR 0.926, 95% CI 0.874–0.982) than in those who had been admitted to a GICF with fewer of these healthcare professionals.

**Conclusions:** Transitional care including dental hygienist or higher staffing levels of pharmacists, registered nurses, care workers and speech-language pathologists may be a more effective way to prevent 30-day hospitalization. *Geriatr Gerontol Int* 2021; 21: 1010–1017.

**Keywords:** big data, care transitions, health services, long-term care, public health.

## Introduction

Older adults with physical and cognitive impairment, and/or chronic diseases often experience frequent transitions between care settings, which can be burdensome for both older adults and care providers.<sup>1–3</sup> Care transitions that involve different locations or different levels of care at the same location include the discharge plan, follow-up and promoting coordination care during transitions.<sup>2,3</sup> High-quality transitional care would prevent the rehospitalization within 30 days of admission to long-term care (LTC) setting, resulting in savings of billions of dollars in Medicare and Medicaid expenditure.<sup>2–5</sup> Although prevention of hospitalization within 30 days of admission to LTC facility (LTCF)

including early rehospitalization is not a new topic, it has still been important in the LTC setting because of minimizing the burden of older adults and care providers.<sup>2–7</sup>

A mandatory public long-term care insurance (LTCI) system was started in Japan in 2000.<sup>8</sup> Geriatric intermediate care facilities (GICFs) covered by this system aim to help older adults who have been discharged from hospital and those with functional and/or cognitive impairment to return home by providing nursing care and rehabilitation that allows them to carry out their daily tasks independently.<sup>9–11</sup> However, hospitalization of residents in a GICF is common,<sup>9–11</sup> and many of these hospitalizations may be preventable.<sup>10</sup>

The characteristics of the hospital and the LTCF, such as setting for healthcare professionals, may be an important determinant of the quality of care for residents.<sup>11–16</sup> For example, US studies found positive associations of the number of full-time equivalent hours provided by a physical therapist or occupational therapist with both better quality of care and more independent performance of activities of daily living in nursing home residents.<sup>12,13</sup> A Japanese study also showed that the care-need level, which was one of the indicators of functional status was more likely to be deterioration at a LTCF with lower proportion of registered nurses per licensed practical nurses.<sup>14</sup> Moreover, several studies have demonstrated an association between a higher nurse staffing level or nurse retention rate and a lower hospitalization rate in LTCFs.<sup>15,16</sup> However, few studies have investigated the association of the hospitalization within 30 days after admission to LTCFs with the types of healthcare professional staff other than nurses in these facilities. GICF must have different healthcare professionals such as physician, nurses, social worker, caregivers, dietician, pharmacist and rehabilitation staff according to staffing requirement of Ministry of Health, Labour and Welfare (MHLW).<sup>17</sup> Such information would help policymakers and healthcare providers to optimize transitional care in LTCF, thereby preventing hospitalization within 30 days after admission to GICFs (30-day hospitalization). The aim of this study was to identify facility-level characteristics, including those of healthcare professionals, which are associated with 30-day hospitalization in Japan by using nationally representative data.

## Methods

### Study design and setting

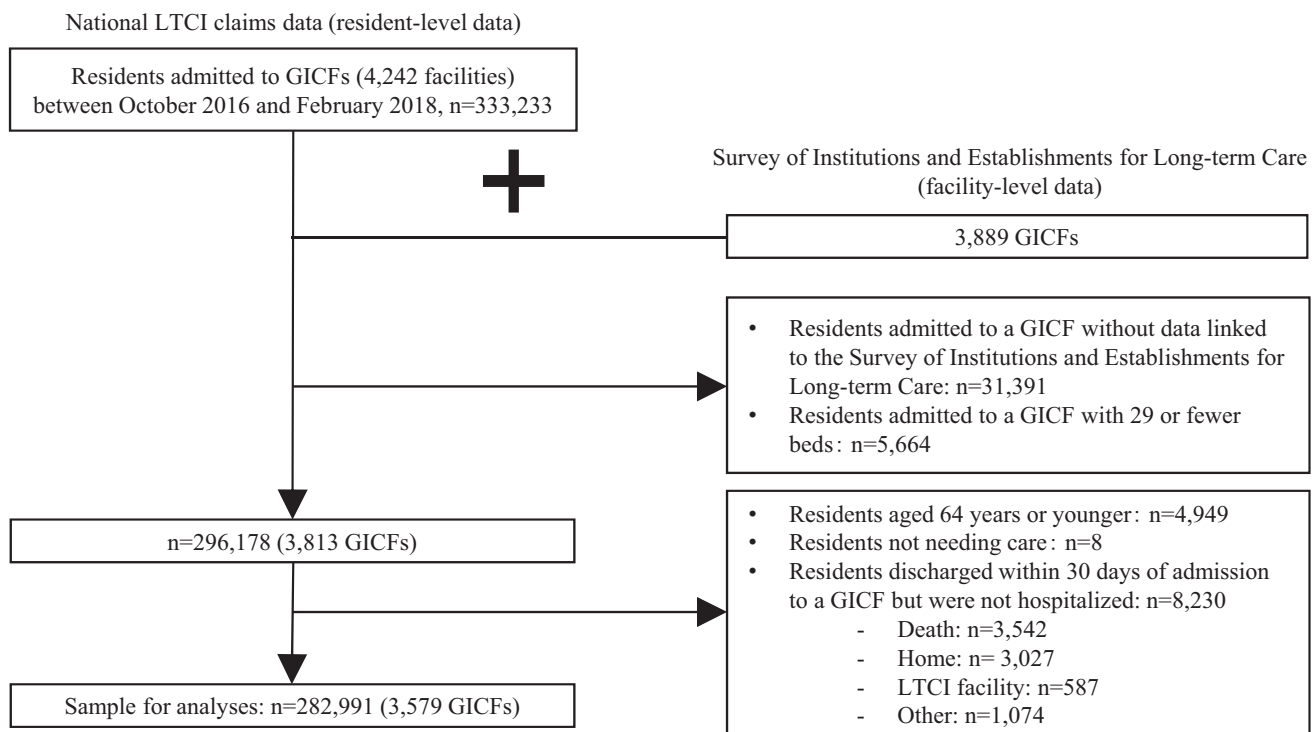
This study had a retrospective cohort design and analyzed LTCI claims data nationwide (individual-level data) from April 2016 to

March 2018, which are linked with the Survey of Institutions and Establishments for Long-Term Care (SIELTC) data for 2016. The LTCI claims data included demographic characteristics, level of care needed, monthly use of care services and healthcare facility codes. The claims data also included date of admission, location before admission to a facility, date of discharge and the discharge destination. The MHLW conducts the SIELTC annually in October.<sup>18</sup> This survey included the type of LTCFs, facility code, ownership of the facility, number of beds and number of individual healthcare professionals. The LTCI claims data are linked with the SIELTC data using unique facility codes.

Approval for secondary use of data collected by the MHLW was obtained from the Statistics and Information Department under Article 33 of the Statistics Act. The study protocol was approved by the Ethics Committee of the University of Tsukuba and Tokyo Metropolitan Geriatric Hospital and Institute of Gerontology.

### Sample description

The study sample comprised older individuals admitted to a GICF in Japan between October 1, 2016 and February 28, 2018. If an individual was admitted to a GICF on more than one occasion during the study period, the first admission was selected. Residents who were admitted to a GICF without data linked to the SIELTC were excluded. In addition, residents admitted to a GICF with fewer than 29 beds were excluded because of the difference in staffing requirement of MHLW between GICFs with up to 29 beds and those with  $\geq 30$  beds (i.e., while those with  $\geq 30$  beds must have one social worker, one care manager, or one rehabilitation therapist, those with up to 29 beds need no set requirements for these healthcare professionals). Residents aged  $\leq 64$  years, those deemed not to require care-need level  $\geq 1$  by LTCI, those for whom data were missing, and those who were discharged within



**Figure 1** Flow chart showing the process used to select residents in a GICF for enrolment in this study. GICF, geriatric intermediate care facility; LTCI, long-term care insurance.

**Table 1** Resident-level and facility-level characteristics and percentage of residents who were hospitalized within 30 days of admission to a geriatric intermediate care facility

Characteristic		<i>n</i> (%)	% <sup>†</sup>
Total		282 991 (100)	4.5
Resident-level			
Sex	Men	87 495 (30.9)	6.5
	Women	195 496 (69.1)	3.6
Age group (years)	65–74	22 101 (7.8)	3.6
	75–79	28 718 (10.1)	4.3
	80–84	57 886 (20.5)	4.4
	85–89	81 616 (28.8)	4.5
	90–94	64 949 (23.0)	4.8
	≥95	27 721 (9.8)	5.1
Level of care needed	1	36 350 (12.8)	3.3
	2	53 493 (18.9)	3.7
	3	69 142 (24.4)	4.0
	4	78 025 (27.6)	4.9
	5	45 981 (16.2)	6.7
Location before admission	Home	74 033 (26.2)	3.0
	Medical institution	142 320 (50.3)	7.0
	LTCI facility	51 164 (18.1)	0.5
	Other	15 474 (5.5)	2.6
Facility-level			
Enhanced night care system	No	30 358 (10.7)	5.0
	Yes	252 633 (89.3)	4.5
Ownership	Medical corporation	213 301 (75.4)	4.6
	Social welfare corporation	39 016 (13.8)	4.3
	Other	30 674 (10.8)	4.0
Size of facility <sup>‡</sup>	Low: <90	89 708 (31.7)	4.4
	Medium: 90–100	22 877 (8.1)	4.6
	High: ≥100	170 406 (60.2)	4.6
Medical doctors <sup>§</sup>	Low: <1.00	38 375 (13.6)	4.3
	Medium: 1.00–1.20	138 758 (49.0)	4.6
	High: ≥1.20	105 858 (37.4)	4.5
Dentists	No	276 518 (97.7)	4.5
	Yes	6473 (2.3)	4.5
Dental hygienists	No	242 805 (85.8)	4.6
	Yes	40 186 (14.2)	4.0
Pharmacists <sup>§</sup>	Low: <0.29	95 039 (33.6)	4.6
	Medium: 0.29–0.40	85 829 (30.3)	4.5
	High: ≥0.40	102 123 (36.1)	4.5
Registered nurses <sup>§</sup>	Low: <4.67	94 426 (33.4)	4.8
	Medium: 4.67–7.25	94 806 (33.5)	4.6
	High: ≥7.25	93 759 (33.1)	4.2
Licensed practical nurses <sup>§</sup>	Low: <3.87	94 505 (33.4)	4.2
	Medium: 3.87–6.35	94 141 (33.3)	4.7
	High: ≥6.35	94 345 (33.3)	4.7
Care workers <sup>§</sup>	Low: <29.1	94 070 (33.2)	5.1
	Medium: 29.1–34.1	94 395 (33.4)	4.3
	High: ≥34.1	94 526 (33.4)	4.3
Social workers <sup>§</sup>	Low: <1.43	98 227 (34.7)	4.7
	Medium: 1.43–2.00	43 380 (15.3)	4.6
	High: ≥2.00	141 384 (50.0)	4.4
Care managers <sup>§</sup>	Low: <1.24	94 395 (33.4)	4.5
	Medium: 1.24–2.00	82 791 (29.3)	4.7
	High: ≥2.00	105 805 (37.4)	4.4
Dietitians <sup>§</sup>	Low: <1.00	51 553 (18.2)	4.5
	Medium: 1.00–1.42	157 128 (55.5)	4.6
	High: ≥1.42	74 310 (26.3)	4.3

(Continues)

**Table 1** Continued

Characteristic		<i>n</i> (%)	% <sup>†</sup>
Physical therapists <sup>§</sup>	Low: <1.43	95 069 (33.6)	4.6
	Medium: 1.43–2.50	90 556 (32.0)	4.5
	High: ≥2.50	97 366 (34.4)	4.5
Occupational therapists <sup>§</sup>	Low: <1.00	86 230 (30.5)	4.8
	Medium: 1.00–2.00	101 826 (36.0)	4.5
	High: ≥2.00	94 935 (33.5)	4.3
SLPs <sup>§</sup>	Low: none	159 699 (56.4)	4.6
	Medium: <1.00	83 921 (29.7)	4.5
	High: ≥1.00	39 371 (13.9)	4.2
Region	Hokkaido	13 128 (4.6)	4.4
	Tohoku	22 599 (8.0)	4.1
	Kanto	86 873 (30.7)	4.6
	Chubu	52 051 (18.4)	4.5
	Kinki	31 387 (11.1)	4.7
	Chugoku	24 682 (8.7)	4.2
	Shikoku	11 983 (4.2)	4.5
	Kyushu	40 288 (14.2)	4.7

LTCI, long-term care insurance; SLPs, speech-language pathologists.

<sup>†</sup>Percentage of patients hospitalized within 30 days of admission to a geriatric intermediate care facility.

<sup>§</sup>Number of beds.

<sup>§</sup>Staffing level calculated the number of full-time workers per 100 beds.

30 days of admission to a GICF but were not hospitalized were also excluded.

### Outcome variable

The outcome variable was the occurrence of 30-day hospitalization, defined by the code of discharge to a medical facility from the LTCI claims database, between October 1, 2016 and March 31, 2018.

### Independent variables

We analyzed facility-level characteristics that were included in the LTCI claims database (e.g., enhanced night care system) and the SIELTC database (ownership, facility size, number of healthcare professionals and region). GICFs with registered nurses, licensed practical nurses and/or care workers that work during the night shift are regarded as having an “enhanced night care system,” and are eligible to receive additional fees from the government. We determined if a GICF had an enhanced night care system (yes or no) based on whether or not the additional relevant fees were charged in October 2016. Ownership was divided into the following three categories: medical corporation, social welfare corporation, or other (e.g., municipal or incorporated foundation). We also selected 13 types of healthcare professionals (medical doctors, dentists, dental hygienists, pharmacists, registered nurses, licensed practical nurses, care workers, social workers, care managers, dietitians, physical therapists, occupational therapists and speech-language pathologists [SLPs]), and calculated the number of full-time workers (number of full-time employees and number of part-time employees based on full-time equivalents) in each occupation and per 100 beds. Facility size and the staffing level of each type of healthcare professional (medical doctors, pharmacists, registered nurses, licensed practical nurses, care workers, social workers, care managers, dietitians, physical therapists and occupational therapists) were categorized as low, medium or high using tertiles based on a previous study that examined the association between GICF staffing levels and discharge to home.<sup>11</sup> However, the

staffing levels of dentists, dental hygienists and SLPs could not be categorized in this way. Dentists and dental hygienists could not be categorized based on tertiles because their respective 33.3rd and 66.6th percentiles were zero. Therefore, the levels of dentists and dental hygienists were treated as dichotomous variables (yes or no). For clinical purposes, we also divided the levels of SLPs into none, <1.00 or ≥1.00 given that their 33.3rd percentile was zero.

We also included the resident-level variables available in the LTCI claims database (age, sex, level of care needed and location before admission to a GICF) as independent variables. The level of care needed ranged from one (lowest) to five (highest), and was assessed based on the standardized nationwide criteria for the degree of independence in daily living for older persons in Japan.<sup>19</sup> Location before admission to a GICF was divided into four categories (home, medical facility, LTCI facility or other).

### Statistical analysis

First, we examined the associations between each independent variable and the risk of 30-day hospitalization in separate unadjusted logistic regression models. Second, we constructed a logistic regression model fitted with a generalized estimating equation that adjusted for independent variables and clustering of residents within GICFs. This multivariable, logistic, generalized estimating equation model used a logit link function and included a binomial sampling distribution. We calculated the adjusted odds ratios (aORs) and their 95% confidence intervals (CIs) that accounted for other independent variables and clustering of patients within GICFs.<sup>20</sup> All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

### Results

Figure 1 shows the resident selection process. In total, 333 233 candidate subjects were admitted to a GICF during the study period. We excluded 31 391 residents who had been admitted to a

GICF without data linked to the SIELTC and 5664 residents who were admitted to a GICF with  $\leq 29$  beds. We further excluded 4949 residents aged  $\leq 64$  years, eight of those deemed not to require care-need level  $\geq 1$  by LTCI, two with missing data and

8230 who were discharged within 30 days of admission to a GICF but without hospitalization. Finally, data for 282 991 residents were available for analysis. Table 1 summarizes the descriptive characteristics of the final study sample. The overall mean

**Table 2** Associations of resident-level and facility-level characteristics with hospitalization within 30 days of admission to a geriatric intermediate care facility

Characteristic		OR	95% CI	aOR <sup>†</sup>	95% CI <sup>†</sup>
Resident-level					
Sex (vs. male)	Female	0.543	(0.520–0.562)	0.535	(0.515–0.555)
Age group (vs. 65–74 years)	75–79	1.216	(1.111–1.331)	1.340	(1.222–1.469)
	80–84	1.236	(1.140–1.341)	1.496	(1.378–1.625)
	85–89	1.267	(1.172–1.370)	1.649	(1.522–1.786)
	90–94	1.341	(1.239–1.452)	1.878	(1.730–2.038)
	$\geq 95$	1.453	(1.329–1.587)	2.134	(1.947–2.339)
Level of care needed (vs. level 1)	2	1.126	(1.046–1.211)	1.095	(1.017–1.178)
	3	1.216	(1.135–1.303)	1.223	(1.140–1.311)
	4	1.502	(1.406–1.605)	1.479	(1.382–1.582)
	5	2.105	(1.966–2.253)	1.993	(1.859–2.137)
Location before admission (vs. home)	Hospital facility	2.441	(2.329–2.559)	2.151	(2.049–2.258)
	LTCI facility	0.169	(0.148–0.192)	0.149	(0.130–0.169)
	Other	0.867	(0.779–0.966)	0.813	(0.729–0.906)
Facility-level					
Enhanced night care system <sup>‡</sup>	Yes	0.894	(0.846–0.945)	0.999	(0.942–1.060)
Ownership (vs. medical corporation)	Social welfare corporation	0.920	(0.872–0.970)	1.013	(0.959–1.070)
	Other	0.850	(0.800–0.903)	0.923	(0.865–0.985)
Unit, facility size <sup>§</sup>	90–100	1.042	(0.972–1.117)	1.040	(0.966–1.120)
	$\geq 100$	1.037	(0.997–1.078)	1.020	(0.973–1.070)
Medical doctors <sup>§</sup>	Medium	1.080	(1.022–1.142)	1.055	(0.996–1.116)
	High	1.060	(1.001–1.122)	1.061	(0.998–1.127)
Dentists <sup>‡</sup>	Yes	1.003	(0.891–1.129)	1.025	(0.907–1.157)
Dental hygienists <sup>‡</sup>	Yes	0.857	(0.812–0.904)	0.906	(0.857–0.958)
Pharmacists <sup>§</sup>	Medium	0.986	(0.943–1.031)	0.956	(0.913–1.002)
	High	0.970	(0.929–1.012)	0.941	(0.899–0.985)
Registered nurses <sup>§</sup>	Medium	0.958	(0.918–1.000)	0.970	(0.925–1.017)
	High	0.886	(0.848–0.926)	0.931	(0.880–0.986)
Licensed practical nurses <sup>§</sup>	Medium	1.108	(1.060–1.157)	1.034	(0.983–1.088)
	High	1.101	(1.054–1.151)	0.969	(0.916–1.026)
Care workers <sup>§</sup>	Medium	0.839	(0.803–0.875)	0.875	(0.837–0.915)
	High	0.836	(0.801–0.873)	0.920	(0.879–0.964)
Social workers <sup>§</sup>	Medium	0.986	(0.935–1.041)	1.043	(0.987–1.103)
	High	0.934	(0.898–0.971)	1.050	(1.006–1.095)
Physical therapists <sup>§</sup>	Medium	0.973	(0.931–1.016)	0.977	(0.933–1.023)
	High	0.969	(0.928–1.011)	0.994	(0.948–1.041)
Occupational therapists <sup>§</sup>	Medium	0.928	(0.889–0.968)	0.967	(0.924–1.012)
	High	0.871	(0.833–0.910)	0.967	(0.921–1.016)
SLPs <sup>§</sup>	Medium	0.959	(0.921–0.998)	0.992	(0.951–1.035)
	High	0.907	(0.859–0.958)	0.926	(0.874–0.982)
Dietitians <sup>§</sup>	Medium	1.040	(0.992–1.091)	1.044	(0.992–1.098)
	High	0.960	(0.909–1.015)	1.007	(0.948–1.070)
Region (vs. Hokkaido)	Tohoku	0.930	(0.836–1.034)	0.912	(0.818–1.018)
	Kanto	1.057	(0.967–1.156)	1.057	(0.961–1.162)
	Chubu	1.021	(0.930–1.121)	1.017	(0.922–1.122)
	Kinki	1.072	(0.972–1.183)	1.090	(0.982–1.210)
	Chugoku	0.950	(0.856–1.055)	0.954	(0.855–1.064)
	Shikoku	1.013	(0.898–1.142)	0.975	(0.861–1.104)
	Kyushu	1.069	(0.972–1.176)	1.041	(0.942–1.150)

aOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio; SLPs, speech language pathologists.

<sup>†</sup>Adjusted for resident-level and facility-level characteristics.

<sup>‡</sup>Reference: no.

<sup>§</sup>Reference: low.

age  $\pm$  SD was  $85.8 \pm 7.2$  years and 87 495 of the residents (30.9%) were men. In total, 12 814 residents (4.5%) experienced 30-day hospitalization. Table 2 shows the associations of resident-level and facility-level characteristics with 30-day hospitalization. At the resident-level, the aOR for 30-day hospitalization in women was 0.543. The aORs of 30-day hospitalization were higher for residents aged  $\geq 75$  than for residents whose age was  $< 75$  years. The aORs of 30-day hospitalization were higher for residents needing level  $\geq 2$  care than for those needing level 1 care. Moreover, the risk of 30-day hospitalization was higher among residents received into a GICF from a medical facility than among those received from home.

At the facility level, the odds of 30-day hospitalization for residents of GICFs owned by other entities were lower than those for residents of GICFs owned by medical corporations (aOR 0.923, 95% CI 0.865–0.985). Moreover, the odds of 30-day hospitalization for residents of GICFs with a dental hygienist were 0.906 times lower (95% CI 0.857–0.958) than those for residents of GICFs without a dental hygienist. The respective odds of 30-day hospitalization for residents of GICFs with medium and high levels of care workers were 0.875 times lower (95% CI 0.837–0.915) and 0.920 times lower (95% CI 0.879–0.964) than for residents of GICFs with a low level of care workers. Furthermore, the odds of 30-day hospitalization were lower for residents of GICFs with higher staffing levels of pharmacists (aOR 0.941, 95% CI 0.89–0.985), registered nurses (aOR 0.931, 95% CI 0.88–0.986) and SLPs (aOR 0.926, 95% CI 0.874–0.982) than for residents of GICFs with fewer of these healthcare professionals.

## Discussion

To our knowledge, this study is the first to examine the association between facility-level characteristics, including the different healthcare professionals, and the likelihood of 30-day hospitalization using representative nationwide Japanese data. The results showed that the 4.5% of residents who had been received by a GICF were hospitalized within 30 days. The risk of 30-day hospitalization was lower among residents who had been admitted to a GICF with a dental hygienist and had higher staffing levels of pharmacists, registered nurses, SLPs and care workers after adjusting for various facility-level (e.g., ownership and facility size) and resident-level variables. Moreover, at the resident level, the risk of 30-day hospitalization was higher in men than in women, and the highest risk was found in the oldest residents and those needing a high level of transitional care. Residents who had been admitted to a GICF from a medical facility were also more likely to be hospitalized within 30 days than those who were admitted from home or an LTCI facility.

At the facility level, the presence of a dental hygienist and higher staffing levels of SLPs in a GICF were associated with lower rates of 30-day hospitalization. Dental hygienists and SLPs provide oral care directly and indirectly by providing oral care instructions for other staff members. Several studies have shown that a professional oral care service helps to prevent hospitalization for pneumonia and is associated with improved general health status among residents in LTCFs.<sup>21–23</sup> SLPs can also contribute to prevent hospitalization for pneumonia through providing therapy to improve swallow function among residents with swallowing impairment, as swallowing impairment is a risk factor for pneumonia.<sup>24</sup> Pneumonia is a major cause of hospitalization among residents in GICFs.<sup>10</sup> Therefore, dental hygienists and SLPs could contribute to better oral care and SLPs also improving swallow function, which would lead to reducing the risk of hospitalization

in GICFs. Although GICFs must have at least one physician, nine nurses, one social worker, one care manager, 25 caregivers, one dietician and one rehabilitation therapist (physical therapist, occupational therapist or SLP) per 100 residents according to staffing requirements for MHLW,<sup>17</sup> GICF does not need to have dental hygienists or SLPs. It is important to consider appointing dental hygienists and SLPs for LTCFs to optimize transitional care.

Our finding of a relationship between a higher staffing level of registered nurses and a decreased risk of 30-day hospitalization or increased care needs among long-term nursing home residents has already been reported.<sup>16</sup> A previous study found that the clinical knowledge, coordination of care and professional oversight provided by registered nurses resulted in better quality of care indicators in nursing home residents.<sup>25</sup> Therefore, transitional care that involved a higher staffing level of registered nurses would be important, and may explain our finding of a lower 30-day hospitalization rate among residents from GICFs with registered nurses on staff.

Another finding of this study was that a higher staffing level of pharmacists was associated with a lower rate of 30-day hospitalization. Changes in medication are common in transitional care and are a cause of adverse drug events.<sup>26</sup> A previous study showed that reconciliation of medication by pharmacists and communication between pharmacists and physicians reduced the risk of drug discrepancy-related adverse events in nursing home residents transitioning between the nursing home and hospital.<sup>27</sup> Therefore, a higher staffing level of input by pharmacists, who are likely to allow more time for reconciliation and communication with physicians in the hospital or home care setting before admission to a GICF could decrease the risk of a nursing home resident being hospitalized within 30 days.

At the resident level, our finding that men were more likely to be hospitalized within 30 days than women is consistent with a previous report on hospitalization among nursing home residents.<sup>15</sup> Similarly, a systematic review of sex-related differences in hospitalization rates among nursing home residents and a study of GICF residents also indicated that men were more likely to be hospitalized than women.<sup>10,28</sup> Next, our study showed that the risk of 30-day hospitalization among adults aged 90–94 years and  $\geq 95$  years was approximately twice that of adults aged  $\leq 74$  years. Although a recent systematic review concluded that the contribution of age to the risk of hospitalization among nursing home residents was unclear,<sup>28</sup> other studies have found an association between older age and an elevated risk of early rehospitalization among US nursing home residents<sup>29</sup> and older Japanese adults who had undergone rehabilitation during hospitalization and were discharged to home.<sup>30</sup> Given that transitions of care can impose a heavier burden on nursing home residents aged  $\geq 90$  years than on those aged  $\leq 80$  years, the contribution of age to the risk of early hospitalization is likely to be high. Our finding of an association of a higher need for care with a higher risk of 30-day hospitalization likely reflects the fact that physical and/or cognitive impairments are more severe in nursing home residents who require a higher level of care.<sup>19</sup> Moreover, this finding is consistent with that of previous studies, which also found a higher risk of early hospitalization in nursing home residents with severe decline in physical function or severe dementia.<sup>6,7,15</sup> Furthermore, the risk of 30-day hospitalization was higher among residents who had been admitted to a GICF from a medical facility than in their counterparts admitted from other locations. We were unable to identify the health status of our study participants because the database used for this study did not contain medical information. However, unlike residents admitted to a GICF from other locations, those admitted from a medical facility would have had an

acute medical condition before admission. Given that previous research has shown a relationship between acute illness, such as infection or pneumonia, and a high risk of early rehospitalization,<sup>15</sup> individuals who are received by a GICF from a hospital facility would be at higher risk of hospitalization within 30 days than those who are received from another location. Therefore, strategies designed to improve the transition of care from hospital to GICF should be prioritized to avoid hospitalization within 30 days among nursing home residents.

This study has several limitations. First, the LTCI claims data used in this study do not include medical information or any details concerning physical function or cognitive status. Therefore, we were unable to include these factors as covariables potentially associated with the risk of hospitalization within 30 days. Second, no information on causes of hospitalization was available, which meant that it was not possible to identify the reasons for early hospitalization. However, the findings of the study indicate that LTCFs staffed by healthcare professionals who practice oral healthcare could reduce the risk of hospital admissions for pneumonia. Further research is needed on hospitalizations for pneumonia among residents in LTCFs and the contribution of oral healthcare professionals to reducing the risk of hospitalization in this population. Third, the LTCI claims data on hospitalizations (i.e., discharge to a medical facility) may include errors because these were manually entered by GICF staff. However, these records directly affect the care-related claims and reimbursements for GICFs, and undergo stringent checks by insurers. Therefore, we believe that such errors would be relatively rare. Nevertheless, further studies are needed to verify the accuracy of these data using medical care claims data as hospitalization is an important indicator of the quality of care in LTCI facilities. Finally, although use of a representative population of GICF residents in Japan was a strength of this study, in view of the inherent differences in healthcare systems between countries, our findings may not be directly generalizable to other populations. However, the presence or level of healthcare professionals who are practicing oral care may have similar effects on early hospitalization rates among residents in LTCFs in other countries, given that oral functional decline and poor oral hygiene are risk factors for pneumonia in older adults worldwide.

In conclusion, because the risk of 30-day hospitalization was lower among residents who had been admitted to a GICF with a dental hygienist and higher staffing levels of pharmacist, registered nurses, care workers and SLP, transitional care including dental hygienist or high level of these healthcare professionals may be a more effective way to prevent 30-day hospitalization. Although placing a dental hygienist or SLP in a GICF is not a requirement at present, appointing dental hygienists and SLPs may be also important to optimize transitional care in LTCFs.

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## Disclosure statement

The authors declare no conflict of interest.

## Author contributions

Study concept and design: Seigo Mitsutake, Tatsuro Ishizaki. Acquisition of data: Xueying Jin, Taeko Watanabe, Kazuaki Uda, Nanako Tamiya. Analysis and interpretation of data: Seigo Mitsutake, Tatsuro Ishizaki, Shohei Yano, Rumiko Tsuchiya-Ito. Drafting of the manuscript: Seigo Mitsutake, Shohei Yano. Critical revision of the manuscript for important intellectual content: All authors.

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