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# Effects of Caregiver's Gender or Distance Between Caregiver and Patient's Home on Home Discharge from Hospital in 285 Patients Aged $\geq 75$ Years in Japan

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Data Collection B  
Statistical Analysis C  
Data Interpretation D  
Manuscript Preparation E  
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**Background:** Many hospitalized aged patients in Japan, the most super-aged society, are unable to be discharged home. This study was performed to clarify the factors associated with home discharge, not to a long-term care (LTC) facility or another hospital, among inpatients aged  $\geq 75$  years.





**Material/Methods:** A single-center prospective cohort study was performed for inpatients aged  $\geq 75$  years in a rural acute-care hospital in Japan, from November 2017 to October 2019. We divided the patients into 2 groups: those who resided at home or had died at home by 30 days after discharge, and others. We obtained data from medical charts and questionnaires given to patients and their caregivers. For each factor shown to be statistically significant by the univariable analysis, a multivariable analysis with adjustment was conducted.

**Results:** In all, 285 patients agreed to participate. With adjustment by where the patient was admitted from, residing with other family members, cognitive function scores, and Barthel index, multivariable analysis using each factor identified as relevant by univariable analysis identified the following as associated with home discharge: being less informed about LTC insurance; cost of home-visit medical, nursing, or LTC services; shorter hospital stays; close proximity between patient and caregiver; main caregiver being female; and life expectancy of over 6 months ( $P < 0.05$ ).

**Conclusions:** Male gender and a long distance between the caregiver and patient's home significantly hindered home discharge in patients aged  $\geq 75$  years, suggesting the need to provide information regarding home-visit services under Japan's LTC insurance system for such caregivers.

**Keywords:** **Aged • Caregivers • Home Environment • Long-Term Care • Patient Discharge**

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## Background

Japan is the world's most super-aged country: in 2020, it had a record-breaking 29% of its population aged  $\geq 65$  years [1]; the rate is even higher in rural areas [2]. Accordingly, the cost of the national pension system, medical health insurance, and long-term care (LTC) insurance for the aged exceeds 723 billion United States dollars (USD) annually, which is 10% of gross domestic product [3,4]. To reduce this expenditure, Japan's government has undertaken reform of the national health-care system (implemented at the prefectural level), which has reduced the number of inpatient beds nationwide [5]. However, owing to limited facilities, the number of people aged  $\geq 65$  years on waiting lists for LTC was almost 292 000 in 2019; 34 000 of those needed immediate institutionalization [6]. Thus, it is necessary for home medical or nursing care of aged patients to compensate for the lack of inpatient beds [7], which shows the increasing importance of LTC at home.

Contrary to the increasing importance of home care, however, a considerable proportion of aged individuals worldwide (about 9-11%) was discharged to facilities other than the home after undergoing inpatient treatment [8,9]. Currently, 68% of people in Japan and 58-70% in other countries die in hospitals – even though worldwide the proportion who wish to die at home is 25-97% [10,11]. Evidently, it is becoming increasingly difficult for aged patients to be discharged home after having undergone repeated hospitalization.

Investigating how Japan copes with various problems that have emerged owing to its aging society – especially in rural areas – may be helpful for other countries: they could address their own problems based on the efforts made in rural Japan. Some research has examined the characteristics of patients discharged home [12-19]; however, no studies have investigated home discharge after acute-care hospitalization, and few studies have reported the characteristics of caregivers for patients discharged home – even in Japan. We conducted the present study to clarify the factors promoting home discharge without being transferred to an LTC facility or another hospital among inpatients aged  $\geq 75$  years in Japan. These findings will help to identify appropriate and effective interventions.

## Material and Methods

### Ethics Statement

The present study conforms to the ethics guidelines for medical and health research involving human subjects issued by Japan's Ministry of Health, Labour, and Welfare and Ministry of Education, Culture, Sports, Science, and Technology. This study was approved by the Research Ethics Committee of the Yuai-Kai Foundation and

Oda Hospital (no. 20170725). We obtained written informed consent from each patient, and patient anonymity was protected.

### Study Design and Population

This was a single-center-based prospective cohort study using medical charts, questionnaires, and telephone inquiries. We enrolled all patients aged  $\geq 75$  years admitted to an acute-care hospital in a rural city in Japan from November 2017 to October 2019. We divided the patients into 2 groups according to the results of telephone inquiries performed over 30 days after discharge: those who had remained at home longer than they did elsewhere or had died at home by 30 days after discharge (the Home group); and others (the Other group). We compared the data derived from medical charts and questionnaire responses between the groups.

### Study Hospital Characteristics

The hospital is located in a rural city, Kashima, in Saga Prefecture, southern Japan, and the city's population is approximately 27 000 [20]. That hospital treats over 3 100 inpatients annually, with a mean length of stay of 12.1 days. The institution has 111 beds and has 10 departments, including internal medicine, general surgery, and cardiovascular surgery, without orthopedic surgery. The hospital provides home services, such as medical and nursing care and rehabilitation with home visits. The institution also focuses on key areas such as special treatment for patients suffering from dementia by means of a specific ward (Dementia Care Unit) and providing support for patients, caregivers, or family members about life after hospital discharge.

### Data source

Written responses to the questionnaires were made within 24-72 hours after admission by the patients themselves and their main caregivers. If patients had difficulty writing their answers, hospital medical staff assisted them. The telephone inquiries were made by research assistants within 3 days after 30 days of discharge to determine where the patients resided or where they had died after discharge.

We selected all the variables listed below from factors reportedly relevant to home discharge [12-19]; relevant to home death [21-23]; or that doctors, nurses, or certified care managers at the hospital involved in this study believed relevant.

### Variables Extracted from the Health Records

The variables extracted from the health records were the following: patient's age (years); gender (man or woman); Barthel index (0-100) [24]; official Japanese activity of daily living (ADL) scale for aged people (bedriddenness rank – normal, J1, J2, A1,

A2, B1, B2, C1, C2) [25,26]; official Japanese cognitive function scores for aged people (cognitive function scores – normal, 1, 2a, 2b, 3a, 3b, 4, M) [25,26]; requiring continuous medical treatment after discharge (present or absent); requiring continuous sputum aspiration after discharge (present or absent); necessity of home remodeling to stay home after discharge (necessary or unnecessary); facility to which the certified care manager belonged (hospital where the present study was conducted or other); main diagnosis on discharge; life expectancy (up to 6 months or longer); and date of admission and discharge (date). A certified care manager is a person who plans, conducts, or monitors a patient's nursing care under Japan's LTC insurance system [5,27-30]. The name of the in-hospital attending physician, main diagnosis, and life expectancy were determined and recorded by a physician based on medical charts. Attending nurses determined and recorded the basic ADLs for calculating the Barthel index and assessing whether or not medical treatment was required after discharge. Care managers at the study hospital determined and recorded the facility to which the certified care manager responsible for the patient belonged. Necessary medical treatment after discharge was defined as follows: presence of pressure ulcer, skin wound, or gastric, colonic, or urinary stoma; necessity for applying ointment, self-injection, sputum aspiration, or respirator, urethral catheter, intravenous infusion, or administration of oxygen; or self-monitoring of blood glucose.

### Variables in the Questionnaire for Patients

The variables on the questionnaire for patients included the following: other resident family members; place the patient was admitted from (home, LTC facility, another hospital); whether the patient had talked with other family members about where and how to live at the end of their lives (had talked, had never talked); how much the patient preferred to stay at the 3 kinds of places (home, LTC facility, another hospital) immediately after discharge, during LTC life, or at the end stage of life (visual analog scale [VAS] ranging from 0 to 100); whether the patient owned or rented their place of residence; how long the patient lived at the residence (years); patient's knowledge of home-visit medical care, home-visit nursing care, home-visit rehabilitation, home-visit LTC, care managers [29,30], and Japan's LTC insurance system [5,27,28] (had never heard about the service, had heard the term, was well informed or had experience of use); and patient's knowledge of the cost of home-visit medical care, home-visit nursing care, home-visit rehabilitation, and home-visit LTC (had never heard the cost, had heard the cost, had experience of using the service).

### Variables in the Questionnaire for Main Caregivers

The variables on the questionnaire for main caregivers included the following: caregiver's age; gender (man or woman);

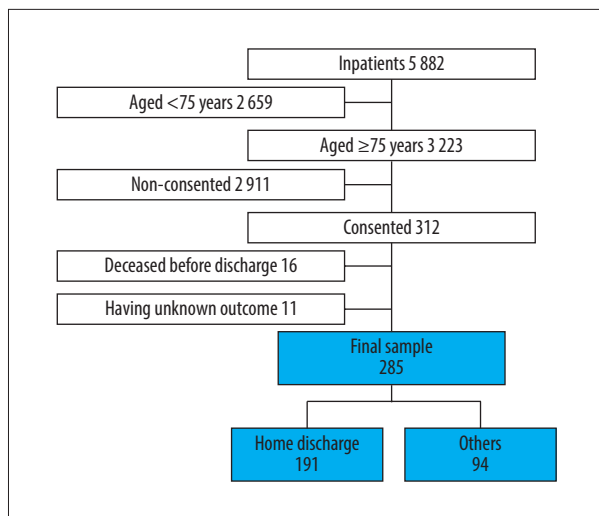
family relationship to the patient; how often the patient's behavioral and psychiatric symptoms of dementia (BPSD) appeared (none, once a month, once a week, 2 or 3 days/week, almost daily); distance between where the patient and caregiver lived (same house, different house but within 5-minute walk, more distant but same city, more distant but same prefecture, outside the prefecture); weekly time available for caregiving (hours); monthly financial expense for the patient (under 7.2 USD, 7.2-71 USD, 72-216 USD, 217-360 USD, 361 USD or more, did not wish to answer); previous experience of caregiving (experience or no experience); whether a second caregiver was present (present or absent); how much the caregiver preferred to let the patient stay at the 3 kinds of places (home, LTC facility, another hospital) at 3 time points (immediately after discharge, during LTC life, or at the end stage of life; VAS, 0-100); caregiver's knowledge of home-visit medical care, home-visit nursing care, home-visit rehabilitation, home-visit LTC, care managers [29,30], and Japan's LTC insurance system [5,27,28] (had never heard about the service, had heard the term, was well informed, had experience of use); caregiver's knowledge of cost of home-visit medical care, home-visit nursing care under medical insurance, home-visit nursing care under LTC insurance, home-visit rehabilitation, and home-visit LTC (had never heard the cost, had heard the cost, had experience of using the service); 12-item short-form health survey (SF-12) v2, which is a measure of physical and mental health related to quality of life [31]; and burden index of caregivers (BIC)-11, which is a measure of the caregiver's burden from 5 domains (time-dependent, emotional, existential, physical, and service-related) [32]. The score 50 of SF-12 signifies a standard deviation for each of the 8 categories: a higher score indicates higher quality. The total BIC-11 score ranges from 0 to 44: a higher score indicates greater caregiver burden.

### Sample Size

Owing to the exploratory nature of this study, we did not calculate a formal sample size. A convenience sample size could not be determined because no previous study had indicated a significant relationship among caregivers' gender and home discharge or home death, which would have been required for calculation.

### Statistical Analysis

We present the categorical and continuous variables as absolute numbers (percentage) and medians (interquartile range). We compared each variable between the Home and the Other groups by univariable analysis using the chi-square test for categorical variables and Mann-Whitney U test for continuous variables. To validate the independent factors for home discharge, we conducted multivariable analysis using binary logistic regression with the forced-entry method. First, only



**Figure 1. Data flow.** Of the 5 882 patients admitted to the hospital during the study period, 3 223 patients were aged  $\geq 75$  years. Among them, 312 consented to participate and responded to the questionnaire; 285 patients were available for analysis after excluding 27 patients for whom information was lacking about their place of residence for 30 days after discharge. This figure was created using Microsoft® PowerPoint® for Microsoft 365 MSO (version 2208 build 16.0.15601.20148).

4 factors are reportedly related to home discharge – place where the patient was admitted from, living alone, Barthel index, and cognitive function scores – which we used as covariables [13,15,16,19]. Second, for each factor that showed significant difference between the 2 groups by univariable analysis, we conducted multivariable analysis using binary logistic regression with the forced-entry method to identify the factors related to home discharge. We adjusted the above 4 covariables in the analysis. We set the statistical significance level at  $P < 0.05$ .

## Results

During the study period, 5 882 patients were admitted to the hospital; of them, 3 223 were aged  $\geq 75$  years, and 312 consented to participate. After excluding 27 patients with no recorded outcome, we included 285 in this study (Figure 1). The median age of patients was 86 (81-91) years; there were 158 women (58%). The median hospital stay was 13 (8-21) days, and the Home group comprised 191 patients (67%; Table 1). The distribution of the top 10 main diagnoses is presented in Table 2.

### Univariable Analysis

Univariable analysis for each factor showed that the Home group had a significantly higher proportion of patients with

the following factors: men (47% versus 33%;  $P = 0.038$ ); living with other family members (93% versus 74%;  $P = 0.001$ ); living with spouse (46% versus 24%;  $P = 0.009$ ); living with child's spouse (22% versus 6.5%;  $P = 0.025$ ); owning the home (97% versus 92%;  $P = 0.003$ ); no need for ongoing medical treatment after discharge (71% versus 40%;  $P = 0.001$ ); no need for ongoing sputum aspiration after discharge (96% versus 81%;  $P = 0.010$ ); life expectancy greater than 6 months (96% versus 85%;  $P = 0.001$ ); and caregivers being women (69% versus 57%;  $P = 0.044$ ). The Home group showed the following: significantly younger patients (85 versus 88 years;  $P < 0.001$ ); higher Barthel index (85 versus 30;  $P < 0.001$ ); fewer of episodes of patient's BPSD ( $P < 0.001$ ); shorter hospital stays (10 versus 20 days;  $P < 0.001$ ); stronger preference for staying home after discharge (100 versus 100;  $P < 0.001$ ); poorer understanding of the LTC insurance system ( $P = 0.002$ ), cost of home-visit medical care ( $P = 0.050$ ), cost of home-visit nursing care under medical insurance system ( $P = 0.050$ ), and cost of home-visit LTC ( $P = 0.048$ ); caregiver being older ( $P = 0.044$ ); closer distance between patient's and main caregiver's residence ( $P < 0.001$ ); more time for caregiving (70 versus 7 hours/week;  $P < 0.001$ ); stronger preference for caregiver to let patient stay home after discharge (100 versus 50;  $P < 0.001$ ); and poorer understanding by caregiver about care manager in hospital ( $P = 0.034$ ). There were significant differences between the Home and the Other group for the following: bedriddenness rank ( $P < 0.001$ ); cognitive function scores ( $P < 0.001$ ); place where the patient was admitted from ( $P < 0.001$ ); and family relationship of patient with primary caregiver ( $P < 0.001$ ). The Home group showed higher proportions for the following: normal bedriddenness rank on admission (34% versus 4.4%); normal cognitive function scores (47% versus 14%); admission from home (97% versus 50%); and spouse as primary caregiver (30% versus 5.5%; Tables 1, 3).

### Multivariable Analysis with 4 Covariables

We conducted multivariable analysis with 4 covariables: where the patient was admitted from; living alone; Barthel index; and cognitive function scores. We found that apart from cognitive function scores, the covariables had a significant relationship with home discharge: admission from home (admission from LTC facility, regression coefficient [B] -3.11, 95% confidence interval [CI] of odds ratio [OR] 0.01-0.23,  $P < 0.001$ ; admission from hospital, B -3.29, 95% CI of OR 0.01-0.27,  $P = 0.001$ ); living alone (B -1.65, 95% CI of OR 0.05-0.69,  $P = 0.012$ ); and Barthel index (B 0.03, 95% CI of OR 1.01-1.05,  $P = 0.003$ ) (Table 4).

### Multivariable Analysis Using Each Factor Adjusted by 4 Covariables

Table 5 shows the results of the multivariable analysis for each factor in which a significant difference existed between the 2 groups in the univariable analysis adjusted by the 4 covariables

**Table 1.** Comparison between the Home group and the Other group concerning the factors on the side of the patient.

Variable, category (unit)	Available cases	All patients 285	Home group 191	Other group <sup>†</sup> 94	P
Age (years)	272	86 (81-91)	85 (81-90)	88 (84-93)	<0.001*
Gender, man	272	114 (42%)	84 (47%)	30 (33%)	0.038*
Number of family members (number)	182	1 (1-2)	2 (1-2)	1 (0-2)	0.005*
Family member, living with other family members	182	161 (89%)	127 (93%)	34 (74%)	0.001*
Family member, living with spouse	182	74 (41%)	63 (46%)	11 (24%)	0.009*
Family member, living with child	182	123 (68%)	93 (68%)	30 (65%)	0.718
Family member, living with child's spouse	182	33 (18%)	30 (22%)	3 (6.5%)	0.025*
Barthel index on admission	268	65 (30-100)	85 (55-100)	30 (5-51)	<0.001*
Bedriddenness rank on admission, Normal	271	65 (24%)	61 (34%)	4 (4.4%)	<0.001*
J1		12 (4.4%)	8 (4.4%)	4 (4.4%)	
J2		19 (7.0%)	19 (11%)	0 (0.0%)	
A1		17 (6.3%)	11 (6.1%)	6 (6.6%)	
A2		34 (13%)	27 (15%)	7 (7.7%)	
B1		38 (14%)	20 (11%)	18 (20%)	
B2		33 (12%)	19 (11%)	14 (15%)	
C1		21 (7.7%)	9 (5.0%)	12 (13%)	
C2		32 (12%)	6 (3.3%)	26 (29%)	
Cognitive function scores on admission, Normal	270	98 (36%)	85 (47%)	13 (14%)	<0.001*
1		44 (16%)	33 (18%)	11 (12%)	
2a		20 (7.4%)	9 (5.0%)	11 (12%)	
2b		27 (10%)	16 (8.9%)	11 (12%)	
3a		67 (25%)	33 (18%)	34 (38%)	
3b		9 (3.3%)	3 (1.7%)	6 (6.7%)	
4		5 (1.9%)	1 (0.6%)	4 (4.4%)	
M		0 (0.0%)	0 (0.0%)	0 (0.0%)	
How often the patient's BPSD appeared, 0: none, 1: once a month, 2: once a week, 3: two or three days/week, 4: almost daily	266	0 (0-1)	0 (0-0)	0 (0-4)	<0.001*
Place where the patient was admitted from, home	212	177 (84%)	147 (97%)	30 (50%)	<0.001*
Place where the patient was admitted from, LTC facility		28 (13%)	3 (2.0%)	25 (42%)	
Place where the patient was admitted from, another hospital		7 (3.3%)	2 (1.3%)	5 (8.3%)	
Whether the patient had talked with other family members about where and how to live at the end of their lives, had talked	162	38 (24%)	28 (22%)	10 (31%)	0.252
Requiring continuous medical treatment after discharge <sup>‡</sup> , absent	125	74 (59%)	55 (71%)	19 (40%)	0.001*



**Table 1 continued.** Comparison between the Home group and the Other group concerning the factors on the side of the patient.

Variable, category (unit)	Available cases	All patients 285	Home group 191	Other group <sup>†</sup> 94	P
Requiring continuous sputum aspiration after discharge, absent	125	113 (90%)	74 (96%)	39 (81%)	0.010*
Necessity of home remodeling to stay home after discharge, necessary	71	13 (18%)	8 (17%)	5 (21%)	0.751
Facility to which the certified care manager belonged, hospital where the present study was conducted	101	55 (55%)	36 (61%)	19 (45%)	0.156
Main diagnosis on discharge <sup>a</sup>	285	— <sup>a</sup>	— <sup>a</sup>	— <sup>a</sup>	0.462
Life expectancy, longer than 6 months	285	264 (93%)	184 (96%)	80 (85%)	0.001*
Length of hospital stay (day)	272	13 (8-21)	10 (7-17)	20 (11-31)	<0.001*
Preference for staying home after discharge (VAS) <sup>§</sup>	178	100 (100-100)	100 (100-100)	100 (25-100)	<0.001*
Preference for staying at LTC facility after discharge (VAS) <sup>§</sup>	176	0 (0-0)	0 (0-0)	0 (0-50)	<0.001*
Preference for staying at another hospital after discharge (VAS) <sup>§</sup>	175	0 (0-0)	0 (0-0)	0 (0-40)	0.001*
Preference for staying home during LTC life (VAS) <sup>§</sup>	160	100 (50-100)	100 (50-100)	70 (0-100)	0.087
Preference for staying at LTC facility during LTC life (VAS) <sup>§</sup>	156	0 (0-50)	0 (0-50)	50 (0-100)	0.012*
Preference for staying at another hospital during LTC life (VAS) <sup>§</sup>	154	0 (0-0)	0 (0-0)	0 (0-5)	0.955
Preference for staying home at the end stage of life (VAS) <sup>§</sup>	163	100 (50-100)	100 (50-100)	95 (0-100)	0.039*
Preference for staying at LTC facility at the end stage of life (VAS) <sup>§</sup>	159	0 (0-50)	0 (0-20)	0 (0-50)	0.018*
Preference for staying at another hospital at the end stage of life (VAS) <sup>§</sup>	158	0 (0-50)	0 (0-50)	5 (0-50)	0.194
Whether the patient owned the place of residence, owned	170	163 (96%)	129 (97%)	34 (92%)	0.003*
Rented		4 (2.4%)	4 (3.0%)	0 (0.0%)	
No response		3 (1.8%)	0 (0.0%)	3 (8.1%)	
How long the patient lived at the residence (years)	139	59 (42-72)	58 (39-71)	68 (47-81)	0.119
Patient's knowledge of home-visit medical care, 4 levels <sup>¶</sup>	170	2 (1-2)	2 (1-2)	2 (1-2)	0.633
Patient's knowledge of on home-visit nursing care, 4 levels <sup>¶</sup>	170	2 (1-2)	2 (1-2)	2 (1-3)	0.556
Patient's knowledge of home-visit rehabilitation, 4 levels <sup>¶</sup>	171	2 (1-2)	1 (1-2)	2 (1-2)	0.640
Patient's knowledge of home-visit LTC, 4 levels <sup>¶</sup>	171	2 (1-3)	2 (1-3)	2 (1-3)	0.466
Patient's knowledge of care manager, 4 levels <sup>¶</sup>	171	1 (1-2)	1 (1-2)	1 (1-2)	0.930
Patient's knowledge of care manager in the hospital, 4 levels <sup>¶</sup>	171	1 (1-1)	1 (1-1)	1 (1-1)	0.919
Patient's knowledge of LTC insurance system, 4 levels <sup>¶</sup>	170	2 (2-3)	2 (1-3)	3 (2-4)	0.002*

**Table 1 continued.** Comparison between the Home group and the Other group concerning the factors on the side of the patient.

Variable, category (unit)	Available cases	All patients 285	Home group 191	Other group <sup>†</sup> 94	P
Patient's knowledge of the cost of home-visit medical care, 3 levels <sup>#</sup>	169	1 (1-1)	1 (1-1)	1 (1-1)	0.050*
Patient's knowledge of the cost of home-visit nursing care under medical insurance system, 3 levels <sup>#</sup>	169	1 (1-1)	1 (1-1)	1 (1-1)	0.050*
Patient's knowledge of the cost of home-visit nursing care under LTC insurance system, 3 levels <sup>#</sup>	169	1 (1-1)	1 (1-1)	1 (1-1)	0.387
Patient's knowledge of the cost of home-visit rehabilitation under LTC insurance, 3 levels <sup>#</sup>	169	1 (1-1)	1 (1-1)	1 (1-1)	0.488
Patient's knowledge of the cost of home-visit LTC, 3 levels <sup>#</sup>	168	1 (1-1)	1 (1-1)	1 (1-1)	0.048*

Categorical variables are presented as absolute numbers (percentage) and are compared using the chi-square test. Continuous variables are presented as medians (interquartile range) and are compared using Mann-Whitney U test. <sup>†</sup> The other group includes the patient who stayed or deceased at either LTC facilities or another hospital after discharge. <sup>‡</sup> Necessary medical treatment was defined as follows: presence of pressure ulcer, skin wound, or gastric, colonic, or urinary stoma; necessity for applying ointment, self-injection, sputum aspiration, or respirator, urethral catheter, intravenous infusion, or administration of oxygen; or self-monitoring of blood glucose. <sup>§</sup> Preference was asked by VAS ranging from 0 to 100. <sup>¶</sup> The knowledge of each service was asked by 4 levels, 1: had never heard about the service, 2: had heard the term, 3: was well informed, 4: had experience of use. <sup>#</sup> The knowledge of the cost of each service was asked by 3 levels; 1: had never heard the cost, 2: had heard the cost, 3: had experience of using the service. <sup>ª</sup> The Distribution of the top 10 main diagnosis is presented in Table 2. \*  $P < 0.05$ . LTC – long-term care; BPSD – behavioral and psychiatric symptoms of dementia; VAS – visual analog scales.

**Table 2.** Top 10 main diagnoses.

Main diagnosis	All patients 285	Home group 191	Other group <sup>†</sup> 94
Congestive heart failure	14 (4.9%)	7 (3.7%)	7 (7.4%)
Dehydration	11 (3.9%)	7 (3.7%)	4 (4.3%)
Acute pneumonia	10 (3.5%)	5 (2.6%)	5 (5.3%)
Aspiration pneumonia	10 (3.5%)	6 (3.1%)	4 (4.3%)
Bronchial pneumonia	7 (2.5%)	5 (2.6%)	2 (2.1%)
Acute bronchiectasis	6 (2.1%)	5 (2.6%)	1 (1.1%)
Urinary tract infection	6 (2.1%)	3 (1.6%)	3 (3.2%)
Chronic heart failure	5 (1.8%)	3 (1.6%)	2 (2.1%)
Herpes zoster	5 (1.8%)	3 (1.6%)	2 (2.1%)
Bacterial pneumonia	4 (1.4%)	4 (2.1%)	0 (0.0%)

<sup>†</sup> The other group comprised patients discharged to long-term care (LTC) facilities, were transferred to another hospital, deceased in hospital, or deceased in LTC facilities. The  $P$  value for the chi-square test of all 165 kinds of diagnosis was 0.462.

(from where the patient was admitted, living alone, Barthel index, and cognitive function scores). Some factors showed a significant relationship with home discharge: life expectancy under 6 months ( $B$  -2.13, 95% CI of OR 0.02-0.65,  $P=0.014$ ); length of hospital stay ( $B$  -0.06, 95% CI of OR 0.90-0.98,

$P=0.002$ ); understanding LTC insurance system ( $B$  -0.70, 95% CI of OR 0.30-0.82,  $P=0.006$ ); understanding cost of home-visit medical care ( $B$  -1.00, 95% CI of OR 0.14-0.97,  $P=0.042$ ); understanding cost of home-visit nursing care under medical insurance system ( $B$  -0.99, 95% CI of OR 0.14-0.99,  $P=0.047$ );

**Table 3.** Comparison between the Home group and the Other group concerning the factors on the side of patient's caregiver.

Variables, category (unit)	Available number	All patients 184	Home group 191	Other group <sup>†</sup> 94	P	
Caregiver's age (years)	230	63 (55-71)	64 (55-75)	61 (53-67)	0.044*	
Caregiver's gender, woman	271	176 (65%)	124 (69%)	52 (57%)	0.044*	
Family relationship to the patient, spouse	270	58 (22%)	53 (30%)	5 (5.5%)	<0.001*	
Child	140 (52%)	84 (47%)	56 (62%)			
Parent	3 (1.1%)	2 (1.1%)	1 (1.1%)			
Grande child	4 (1.5%)	3 (1.7%)	1 (1.1%)			
Sibling	7 (2.6%)	3 (1.7%)	4 (4.4%)			
Child's spouse	46 (17%)	31 (17%)	15 (17%)			
Others	12 (4.4%)	3 (1.7%)	9 (9.9%)			
Distance between where the patient and caregiver lived, 1: same house, 2: different house but within 5-minute walk, 3: more distant but in the same city, 4: more distant but same prefecture, 5: outside the prefecture	267	1 (1-3)	1 (1-1)	3 (1-4)		<0.001*
Weekly time available for caregiving (hours)	193	42 (7-120)	70 (15-168)	7 (3-48)		<0.001*
Monthly financial expense for the patient, under 7.2 USD	253	7 (2.8%)	4 (2.4%)	3 (3.5%)	0.068	
7.2-71 USD	27 (11%)	17 (10%)	10 (12%)			
72-216 USD	64 (25%)	37 (22%)	27 (31%)			
217-360 USD	31 (12%)	21 (13%)	10 (12%)			
361 USD or more	39 (15%)	26 (16%)	13 (15%)			
Did not wish to answer	85 (34%)	62 (37%)	23 (27%)			
SF-12 <sup>‡</sup> , physical function	254	56 (42-56)	56 (29-56)	56 (43-56)	0.809	
SF-12 <sup>‡</sup> , role of daily life on physical	255	43 (30-56)	43 (30-56)	43 (30-56)	0.510	
SF-12 <sup>‡</sup> , pain	251	46 (35-57)	46 (35-57)	46 (35-57)	0.833	
SF-12 <sup>‡</sup> , feeling of health	257	52 (36-52)	52 (36-52)	52 (36-52)	0.208	
SF-12 <sup>‡</sup> , vitality	253	48 (39-57)	48 (39-57)	48 (39-57)	0.137	
SF-12 <sup>‡</sup> , social function	248	45 (34-57)	45 (34-57)	45 (34-57)	0.390	
SF-12 <sup>‡</sup> , role of life on psychiatry	255	44 (32-56)	44 (32-56)	44 (32-56)	0.285	
SF-12 <sup>‡</sup> , mental health	256	46 (40-52)	46 (40-52)	46 (40-52)	0.330	
Total score of BIC-11 <sup>§</sup> , ranging from 0 to 44	218	13 (9-20)	13 (9-20)	15 (10-19)	0.437	
Previous experience of caregiving, experience	262	113 (43%)	74 (43%)	39 (44%)	0.896	
Whether a second caregiver was present, present	262	156 (60%)	103 (60%)	53 (59%)	0.895	
Preference to let the patient stay home after discharge (VAS) <sup>¶</sup>	255	80 (50-100)	100 (50-100)	50 (0-55)	<0.001*	
Preference to let the patient stay at LTC facility after discharge (VAS) <sup>¶</sup>	254	50 (0-76)	10 (0-50)	80 (50-100)	<0.001*	
Preference to let the patient stay at another hospital after discharge (VAS) <sup>¶</sup>	243	0 (1-50)	0 (0-50)	50 (0-50)	<0.001*	



**Table 3 continued.** Comparison between the Home group and the Other group concerning the factors on the side of patient's caregiver.

Variables, category (unit)	Available number	All patients 184	Home group 191	Other group <sup>†</sup> 94	P
Preference to let the patient stay home during LTC life (VAS) <sup>‡</sup>	186	50 (0-70)	50 (10-80)	10 (0-50)	0.001*
Preference to let the patient stay at LTC facility during LTC life (VAS) <sup>‡</sup>	188	50 (30-100)	50 (30-81)	88 (58-100)	0.001*
Preference to let the patient stay at another hospital during LTC life (VAS) <sup>‡</sup>	189	50 (3-70)	50 (0-70)	50 (15-70)	0.666
Preference to let the patient stay home at the end stage of life (VAS) <sup>‡</sup>	250	50 (25-80)	50 (50-90)	50 (0-70)	0.006*
Preference to let the patient stay at LTC facility at the end stage of life (VAS) <sup>‡</sup>	246	50 (0-50)	50 (0-50)	50 (3-50)	0.066
Preference to let the patient stay at another hospital at the end stage of life (VAS) <sup>‡</sup>	244	50 (30-70)	50 (30-50)	50 (35-88)	0.171
Caregiver's knowledge of home-visit medical care, 4 levels <sup>#</sup>	259	2 (2-3)	2 (2-3)	2 (2-3)	0.061
Caregiver's knowledge of home-visit nursing care, 4 levels <sup>#</sup>	265	3 (2-3)	3 (2-3)	3 (2-3)	0.690
Caregiver's knowledge of home-visit rehabilitation, 4 levels <sup>#</sup>	263	2 (2-3)	2 (2-3)	2 (2-3)	0.640
Caregiver's knowledge of home-visit LTC, 4 levels <sup>#</sup>	264	3 (2-3)	3 (2-3)	3 (2-3)	0.250
Caregiver's knowledge of care manager, 4 levels <sup>#</sup>	265	3 (2-3)	3 (2-3)	3 (2-3)	0.214
Caregiver's knowledge of care manager in the hospital, 4 levels <sup>#</sup>	263	2 (1-2)	2 (1-2)	2 (2-3)	0.034*
Caregiver's knowledge of LTC insurance system, 4 levels <sup>#</sup>	261	3 (3-4)	3 (2-4)	3 (3-4)	0.211
Caregiver's knowledge of the cost of home-visit medical care, 3 levels <sup>‡</sup>	260	1 (1-2)	1 (1-2)	1 (1-2)	0.612
Caregiver's knowledge of the cost of home-visit nursing care under medical insurance, 3 levels <sup>‡</sup>	260	1 (1-2)	1 (1-2)	1 (1-2)	0.542
Caregiver's knowledge of the cost of home-visit medical care under LTC insurance, 3 levels <sup>‡</sup>	257	1 (1-2)	1 (1-2)	1 (1-2)	0.542
Caregiver's knowledge of the cost of home-visit rehabilitation under LTC insurance, 3 levels <sup>‡</sup>	259	1 (1-2)	1 (1-2)	1 (1-2)	0.345
Caregiver's knowledge of the cost of home-visit LTC, 3 levels <sup>‡</sup>	255	1 (1-1)	1 (1-1)	1 (1-2)	0.311

Categorical variables are presented as absolute number (percentage) and were compared using the chi-square test. Continuous variables are presented as medians (interquartile range) and were compared using Mann-Whitney U test. <sup>†</sup> The other group includes the patient who stayed or deceased at either LTC facility or another hospital. <sup>‡</sup> SF-12, 12-item short-form health survey, is a measure of physical and mental health related to quality of life. The score 50 of SF-12 signifies a standard deviation for each of the eight categories: a higher score indicates better quality. <sup>§</sup> BIC-11, Burden index of caregivers, is a measure of the caregiver's burden from five domains (time-dependent, emotional, existential, physical, and service-related) The total BIC-11 score ranges from 0 to 44: a higher score indicates greater caregiver burden. <sup>¶</sup> Preference was asked by VAS ranging from 0 to 100. <sup>#</sup> The knowledge of each service was asked by 4 levels, 1: had never heard about the service, 2: had heard the term of, 3: was well informed, 4: had experience of use. <sup>‡</sup> The knowledge of the cost of each service was asked by 3 levels; 1: had never heard the cost, 2: had heard the cost, 3: had experience of using the service. \* P<0.05. USD – US dollar; LTC – long-term care; VAS – visual analog scales.

**Table 4.** Multivariable analysis with 4 covariables reportedly related to home discharge.

Variable, category (unit)	Regression coefficient	Lower limit of the 95% CI for odds ratio	Upper limit of the 95% CI for odds ratio	P
Place where the patient was admitted from, home		Reference		<0.001*
Place where the patient was admitted from, LTC facility	-3.11	0.01	0.23	<0.001*
Place where the patient was admitted from, another hospital	-3.29	0.01	0.27	0.001*
Family member, living alone	-1.65	0.05	0.69	0.012*
Barthel index on admission	0.03	1.01	1.05	0.003*
Cognitive function scores on admission, Normal		Reference		0.390
1	-0.94	0.10	1.50	0.172
2a	-1.60	0.04	1.13	0.068
2b	0.20	0.17	9.01	0.845
3a	-0.17	0.19	3.82	0.825
3b	20.06	0.00	–	1.000

Multivariable analysis using binary logistic regression for home discharge with forced entry method was conducted to validate the independent factors for home discharge. Only 4 factors reportedly related to home discharge – place where the patient was admitted from, living alone, Barthel index, Cognitive function scores, were used as covariables. \*  $P < 0.05$ . CI – confidence interval; LTC – long-term care.

understanding cost of home-visit LTC ( $B$  -1.08, 95% CI of OR 0.15-0.78,  $P=0.010$ ); distance between patient and caregiver ( $B$  -0.62, 95% CI of OR 0.34-0.84,  $P=0.006$ ); and caregiver being a woman ( $B$  1.08, 95% CI of OR 1.06-8.23,  $P=0.038$ ) (Tables 5, 6).

## Discussion

The following factors are reportedly characteristic of patients discharged home after hospitalization: living with other family members [14,16]; being admitted from home [13]; having independent ADLs before admission [12]; higher Barthel index or Functional Independence Measure [14,19]; able to stand within 5 days after admission [12]; lower Acute Physiology and Chronic Health Evaluation (APACHE) II score [12]; cardiovascular disease as a main pathophysiological condition on day 3 of admission [14]; lower Charlson comorbidity index [13]; and normal or only slight cognitive impairment [14]. Similar to previously reported factors, we identified admission from home, not living alone, and higher Barthel index as factors associated with home discharge. We conducted our study in Kashima city, which has one of the highest age levels in Japan: 33% of the population is aged  $\geq 65$  years. In Japan, medical and welfare budgets are limited, and the need for home-visit LTC services has increased more than in other countries. We also found the following 5 characteristics to be associated with home discharge: being poorly informed about home-visit LTC

services; life expectancy longer than 6 months; shorter hospital stay; closer distance between the patient and caregiver; and primary caregiver being a woman.

A key finding of the present study is that the patients who were discharged home were less informed about both home-visit medical care and home-visit LTC services. The relationship between death at home and knowledge or experience of home death has been examined [23]; however, the relationship between home discharge and knowledge of home-visit services has hitherto been unreported. Our findings were contrary to our expectations about well-informed patients tending to be discharged home: knowledge of services was not a facilitator of home discharge in the present study. Patients discharged to LTC facilities or transferred to another hospital would have been familiar with home-visit services; thus, patients should be provided with knowledge about such services before using LTC facilities. Patients discharged home tended to have poorer knowledge about home-visit services, which could indicate that achieving home discharge was possibly due to work overload among informal caregivers. Despite the high need for professional LTC upon discharge [33], the patients in our study had poor knowledge of home-visit services. Generally, patients are less familiar with home-visit services than with LTC facilities [34]. Admission to some hospitals could be a good opportunity to acquire knowledge about home-visit services under Japan's medical or LTC insurance system, which would improve both patients' and caregivers' quality of life with LTC.

**Table 5.** Multivariable analysis using each factor adjusted by 4 covariables (on the side of patients).

Variable, category (unit)	Regression coefficient	Lower limit of the 95% CI for odds ratio	Upper limit of the 95% CI for odds ratio	P
Age (years)	-0.18	0.90	1.07	0.666
Gender, woman	0.50	0.61	4.50	0.326
Number of family members (number)	-0.41	0.35	1.28	0.221
Family member, living with spouse	-0.20	0.28	2.41	0.715
Family member, living with child's spouse	0.28	0.29	6.02	0.713
How often the patient's BPSD appeared, 0: none, 1: once a month, 2: once a week, 3: two or three days/week, 4: almost daily	0.04	0.73	1.47	0.834
Whether the patient owned the place of residence, owned		Reference		1.000
Rented	19.48	0.00	–	0.999
No response	-20.09	0.00	–	0.999
Requiring continuous medical treatment after discharge <sup>†</sup> , present	-1.87	0.02	1.07	0.058
Requiring continuous sputum aspiration after discharge, present	-21.21	0.00	–	0.999
Life expectancy, under 6 months	-2.13	0.02	0.65	0.014*
Length of hospital stay (day)	-0.06	0.90	0.98	0.002*
Preference for staying home after discharge (VAS) <sup>‡</sup>	0.01	0.99	1.03	0.254
Preference for staying at LTC facility after discharge (VAS) <sup>‡</sup>	-0.01	0.97	1.01	0.186
Preference for staying at another hospital after discharge (VAS) <sup>‡</sup>	-0.02	0.97	1.00	0.036*
Preference for staying at LTC facility during LTC life (VAS) <sup>‡</sup>	0.00	0.99	1.02	0.998
Preference for staying home at the end stage of life (VAS) <sup>‡</sup>	0.00	0.99	1.01	0.926
Preference for staying at LTC facility at the end stage of life (VAS) <sup>‡</sup>	0.00	0.98	1.01	0.664
Patient's knowledge of LTC insurance system, 4 levels <sup>§</sup>	-0.70	0.30	0.82	0.006*
Patient's knowledge of the cost of home-visit medical care, 3 levels <sup>¶</sup>	-1.00	0.14	0.97	0.042*
Patient's knowledge of the cost of home-visit nursing care under medical insurance system, 3 levels <sup>¶</sup>	-0.99	0.14	0.99	0.047*
Patient's knowledge of the cost of home-visit LTC, 3 levels <sup>¶</sup>	-1.08	0.15	0.78	0.010*

With adjustment by 4 factors (where the patient was admitted from, residing with other family members, cognitive function scores, Barthel index), multivariable analysis using each factor identified as relevant by univariable analysis were conducted. Each Factors listed are the factors on the side of patients. <sup>†</sup> Necessary medical treatment was defined as follows: presence of presence of pressure ulcer, skin wound, or gastric, colonic, or urinary stoma; necessity for applying ointment, self-injection, sputum aspiration, or respirator, urethral catheter, intravenous infusion, or administration of oxygen; or self-monitoring of blood glucose. <sup>‡</sup> Preference was asked by VAS ranging from 0 to 100. <sup>§</sup> The knowledge of each service was asked by 4 levels, 1: had never heard about the service, 2: had heard the term, 3: was well informed, 4: had experience of use. <sup>¶</sup> The knowledge of the cost of each service was asked by 3 levels; 1: had never heard the cost, 2: had heard the cost, 3: had experience of using the service. \*  $P < 0.05$ . CI – confidence interval; LTC – long-term care; BPSD – behavioral and psychiatric symptoms of dementia; VAS – visual analog scales.

**Table 6.** Multivariable analysis using each factor adjusted by 4 covariables (on the side of caregivers).

Variable, category (unit)	Regression coefficient	Lower limit of the 95% CI for odds ratio	Upper limit of the 95% CI for odds ratio	P
Caregiver's age (years)	0.04	0.99	1.09	0.131
Caregiver's gender, woman	1.08	1.06	8.23	0.038*
Family relationship to the patient, spouse		Reference		0.819
Family relationship to the patient, child	-1.89	0.02	1.36	0.091
Family relationship to the patient, parent	-22.36	0.00	–	1.000
Family relationship to the patient, grand child	18.00	0.00	–	0.999
Family relationship to the patient, sibling	-1.89	0.02	13.38	0.409
Family relationship to the patient, child's spouse	-1.57	0.20	2.18	0.191
Family relationship to the patient, others	-22.75	0.00	–	0.999
Distance between where the patient and caregiver lived, 1: same house, 2: different house but within 5-minute walk, 3: more distant but in the same city, 4: more distant but same prefecture, 5: outside the prefecture	-0.62	0.34	0.84	0.006*
Weekly time available for caregiving (hours)	0.01	1.00	1.02	0.159
Caregiver's preference to let the patient stay home after discharge (VAS) <sup>†</sup>	0.02	1.00	1.04	0.016*
Caregiver's preference to let the patient stay at LTC facility after discharge (VAS) <sup>†</sup>	-0.02	0.97	1.00	0.052
Caregiver's preference to let the patient stay at another hospital after discharge (VAS) <sup>†</sup>	-0.02	0.97	1.00	0.035*
Caregiver's preference to let the patient stay home during LTC life (VAS) <sup>†</sup>	0.01	0.99	1.03	0.282
Caregiver's preference to let the patient stay at LTC facility during LTC life (VAS) <sup>†</sup>	-0.01	0.97	1.01	0.283
Caregiver's preference to let the patient stay home at the end stage of life (VAS) <sup>†</sup>	0.00	0.99	1.01	0.899
Caregiver's knowledge of care manager in the hospital, 4 levels <sup>‡</sup>	-0.68	0.25	1.05	0.068

With adjustment by 4 factors (where the patient was admitted from, residing with other family members, cognitive function scores, Barthel index), multivariable analysis using each factor identified as relevant by univariable analysis were conducted. Each Factors listed are the factors on the side of caregivers. <sup>†</sup> Preference was asked by VAS ranging from 0 to 100. <sup>‡</sup> The knowledge of each service was asked by 4 levels, 1: had never heard about the service, 2: had heard the term of, 3: was well informed, 4: had experience of use. \*  $P < 0.05$ . CI – confidence interval; LTC – long-term care; VAS – visual analog scales.

This study is the first to examine the relationship between home discharge and caregiver factors. We found that home discharge was associated with the following: primary caregiver being a woman; closer distance to the patient; caregiver strongly preferring home discharge; and caregiver less preferring discharge to another hospital. Concerning the primary caregiver being a woman, several reasons could explain why male caregivers

hinder home discharge: younger male caregivers' tendency to be under financial strain [35]; tendency of caregivers spending over 10 hours/week on caregiving to leave employment [36]; socially accepted gender role consciousness of the man being the breadwinner [37]; and longer paid working hours for men than women [38]. Patients using home-visit services tend to die at home [23]; thus, using those services would help male

caregivers accept home discharge by reducing the caregiving time or alleviating the patients' financial burden. It is essential to provide knowledge about home-visit services through the LTC insurance system to caregivers who live far from the patient and to male caregivers: home-visit services reportedly reduce the caregivers' burden [39]. Information about subsidy programs, which could help caregivers live closer to patients or rebuild patients' house to accommodate caregivers, must also be provided.

In light of reports about the relationship between caregivers' preferences for patients' home death and achieving it [21,22,40], their preferences for home discharge appear crucial toward bringing it about. Caregiver preferences having greater weight than those of the patient for home discharge is similar to the situation with home death [21,40]. We found that caregiver preferences for home discharge were independent of the patient living alone, physical and cognitive functions, and where the patient resided before admission; however, further research needs to elucidate the influence of those preferences.

We observed that admission from home was associated with home discharge. This finding is consistent with previous reports: patients aged  $\geq 20$  years admitted from another acute- or chronic-care hospitals or chronic nursing care facilities could not be discharged home [18]; admitted patients aged  $\geq 20$  years who had changed hospitals had longer hospital stays with a higher probability of discharge to post-acute-care medical facilities [17]. Our multivariable analysis showed that admission from another hospital and longer hospital stays were independent of home discharge (Table 4). Therefore, to help patients undergo LTC at home and achieve home death, it is necessary for medical staff to make efforts to shorten their hospital stays and avoid transfer to another facility after completing acute-care treatment. Conversely, it may be that home discharge itself helps reduce the length of hospital stays. Organizing patient transfers through negotiations with other hospitals is reportedly a reason for longer stays in the emergency department [41]: such transfers are unnecessary in the case of home discharge. Providing home-visit services to complement home discharge would help patients or caregivers achieve earlier discharge [42]; that would avoid some of the disadvantages caused by shorter hospital stays [43].

In this study, we observed that not having other resident family members was a factor against home discharge, which is consistent with previous results [15,17]. It is almost impossible for health-care providers to address the problems of not residing with other family members or patients' short life expectancy; however, it would be useful to give such providers appropriate information on various support systems for helping aged patients living alone or at home at their end stage of life. The following factors reportedly help achieve home

death: 24-hour-availability of home-visit nursing care services [44]; clinics that provide end-of-life home treatment to patients [45]; having plentiful local care workers [45]; and physicians or nurses with positive attitudes toward home death [44]. Providing aged patients with positive information could promote home discharge.

The present study has some limitations. It was conducted at only 1 facility: it was a middle-scale hospital in a rural city in Japan with 111 beds and low numbers of patients undergoing advanced surgical operation or chronic rehabilitation. That could limit the generalizability of this study. We did not obtain details of the following: the environment of medical or LTC for individual patients, such as the number of nursing facilities providing 24-hour home-visit nursing care service, clinics providing home treatment for end-of-life patients, number of local care workers in the area, and physicians or nurses having positive attitudes for the home death of aged patients. In addition, the relatively low number of subjects (Figure 1) may have caused selection bias. Because we performed multiple comparisons for each factor by both univariable analysis and multivariable analysis, the risk of type I error may have increased. Additionally, because we adjusted for only 4 factors in the multivariable analysis, a further study with a larger sample size is desirable to determine whether the factors that were found to be significant in the present study are in fact independently associated with home discharge.

## Conclusions

Caregivers living far from the patient or being male had a negative effect on home discharge of inpatients aged  $\geq 75$  years; providing appropriate support, including information about the LTC insurance system and home-visit support to such caregivers, could facilitate home discharge. It is also necessary to provide appropriate information about various kinds of support for the following: home discharge to patients admitted from home; those having a higher Barthel index or having other resident family members; closer distance between the patient and caregiver; the main caregiver being female; caregivers' stronger preference for home discharge; and life expectancy of over 6 months. That would help improve both patients' and caregivers' quality of life at home with LTC.

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## Declaration of Figures' Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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