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ORIGINAL RESEARCH

Risk Factors and Clinical Outcomes of Nonhome Discharge in Patients With Acute Decompensated Heart Failure: An Observational Study

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BACKGROUND: No clinical studies have focused on the factors associated with discharge destination in patients with acute decompensated heart failure.

METHODS AND RESULTS: Of 4056 consecutive patients hospitalized for acute decompensated heart failure in the KCHF (Kyoto Congestive Heart Failure) registry, we analyzed 3460 patients hospitalized from their homes and discharged alive. There were 3009 and 451 patients who were discharged to home and nonhome, respectively. We investigated the factors associated with nonhome discharge and compared the outcomes between home discharge and nonhome discharge. Factors independently and positively associated with nonhome discharge were age ≥80 years (odds ratio [OR],1.76; 95% CI,1.28–2.42), body mass index ≤22 kg/m^2 (OR,1.49; 95% CI,1.12–1.97), poor medication adherence (OR, 2.08; 95% CI,1.49–2.88), worsening heart failure (OR, 2.02; 95% CI, 1.46–2.82), stroke during hospitalization (OR, 3.74; 95% CI, 1.75–8.00), functional decline (OR, 12.24; 95% CI, 8.74–17.14), and length of hospital stay >16 days (OR, 4.14; 95% CI, 3.01–5.69), while those negatively associated were diabetes mellitus (OR, 0.69; 95% CI, 0.51–0.94), cohabitants (OR, 0.62; 95% CI, 0.46–0.85), and ambulatory state before admission (OR, 0.25; 95% CI, 0.18–0.36). The cumulative 1-year incidence of all-cause death was significantly higher in the nonhome discharge group than in the home discharge group. The nonhome discharge group compared with the nonhome discharge group was associated with a higher adjusted risk for all-cause death (hazard ratio, 1.66; P<0.001).

CONCLUSIONS: The discharge destination of patients with acute decompensated heart failure is influenced by factors such as prehospital social background, age, body mass index, low self-care ability, events during hospitalization (worsening heart failure, stroke, etc), functional decline, and length of hospital stay; moreover, the prognosis of nonhome discharge patients is worse than that of home discharge patients.

REGISTRATION INFORMATION: clinicaltrials.gov. Identifier: NCT02334891.

Key Words: clinical outcome ■ heart failure ■ home discharge ■ prospective

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CLINICAL PERSPECTIVE

What Is New?

- This is the first large multicenter observational study focusing on home discharge as an outcome in patients with acute decompensated heart failure (HF).
- We demonstrated that patients with acute decompensated HF who were not discharged to home had a higher risk of all-cause, cardiovascular, and noncardiovascular death at 1 year than patients who were discharged to home.
- We found that the discharge destination of acute decompensated HF patients is influenced by factors such as prehospital social background, age, body mass index, low self-care ability, events during hospitalization, functional decline, and length of hospital stay.

What Are the Clinical Implications?

- Discharge to home is an important goal in patients hospitalized for HF.
- To promote home care for patients with HF, it is important to provide cardiac rehabilitation from the early stage of hospitalization, shorten the length of hospital stay, prevent events during hospitalization, and improve the care environment for those who require nursing care.
- Further studies are needed to generalize the results in each country or region.

Nonstandard Abbreviations and Acronyms

ACS	acute coronary syndrome
ADHF	acute decompensated heart failure
BMI	body mass index
BNP	Brain natriuretic peptide
CIs	confidence intervals
eGFR	estimated glomerular filtration rate
HRs	hazard ratios
IQRs	interquartile ranges
JROAD	the Japanese Registry of Cardiovascular Disease
KCHF	Kyoto Congestive Heart Failure
LVEF	left ventricular ejection fraction
NT-proBNP	N-terminal pro-BNP
ORs	odds ratios
QoL	quality of life

Heart failure (HF) is a terminal stage of heart disease and is on the rise, as medical developments have improved the survival rate of patients with heart disease. The number of patients with HF is estimated to be 26 million worldwide, and the rapid increase in the proportion of patients with HF has led to the condition being termed a pandemic.[1] The incidence of HF is rapidly increasing in Japan—the country with the world's leading super-aged society. Based on the JROAD (Japanese Registry of Cardiovascular Disease), there were a total of 260 157 HF admissions in 2017, 3.5 times the number of patients with acute myocardial infarction.[2] Additionally, the number of patients with HF is predicted to increase each year, despite the dwindling population. The increase in the number of patients with HF will continue to be a heavy burden in the aging society.[3]

Heart failure is a chronic illness characterized by periods of exacerbation and remission and often results in death. Patients experience a decline in their physical function and quality of life.[4,5] Extension of a patient's healthy life expectancy is a major goal in super-aged societies. Thus, appropriate care is required for the prevention of repeated HF exacerbations and decline in patients' physical function and quality of life, whenever possible. In a community-based integrated care system, it is important to coordinate the development of home health care and allow patients with acute HF to be discharged to their homes.[6] Some studies have investigated discharge destination as the primary outcome in the fields of vascular, orthopedic, thoracic, and abdominal surgeries.[7–10] However, no clinical studies have focused on discharge destination as a goal in the acute decompensated heart failure (ADHF) setting. Therefore, this study aimed to identify the factors associated with nonhome discharge among patients with ADHF hospitalized from home and to compare the clinical outcomes between the 2 groups of patients with ADHF, one including patients who were discharged to their homes and the other including patients discharged to nonhome facilities or hospitals.

METHODS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Study Design, Setting, and Population

The KCHF (Kyoto Congestive Heart Failure) registry is a physician-initiated, prospective, observational, multicenter cohort study that enrolled consecutive patients who were hospitalized for ADHF between October 1, 2014, and March 31, 2016. These patients were admitted to secondary and tertiary hospitals in 19 rural and urban areas, as well as large and small facilities nationwide. The details of the KCHF study design and patient enrollment have been described elsewhere.[11–13] Briefly, we enrolled consecutive patients with ADHF, as defined by the modified Framingham criteria, who were admitted to the participating hospitals and patients who received HF-specific treatment involving intravenous drugs within 24 hours of hospitalization. Clinical follow-up data at 1 year were collected in October 2017.

In the present study, we evaluated the discharge destination of the patients and compared the baseline characteristics and clinical outcomes between 2 groups of patients with ADHF, one including patients who were discharged to their homes and the other to nonhome facilities or hospitals. Of the 4056 patients enrolled in the KCHF registry, we excluded 271 patients who died during the index hospitalization period, 64 with no information on their postdischarge residence type, 226 who had been admitted to a nursing home before hospitalization, and 35 with no information on their prehospitalization residence status. Therefore, the final study population consisted of 3460 patients hospitalized from home (Figure 1). Patients were divided into 2 groups on the basis of their discharge destination: the home discharge group and nonhome discharge group (discharged to a nursing home or transferred to another hospital).

Institutional Review Board Information

The study was approved by the institutional review boards of Kyoto University Graduate School of Medicine (approval number: E2311), Shiga General Hospital (approval number: 20141120-01), Tenri Hospital (approval number: 640), Kobe City Medical Center General Hospital (approval number: 14094), Hyogo Prefectural Amagasaki General Medical Center (approval number: Rinri 26-32), National Hospital Organization Kyoto Medical Center (approval number: 14-080), Mitsubishi Kyoto Hospital (approved 11/12/2014), Okamoto Memorial Hospital (approval number: 201503), Japanese Red Cross Otsu Hospital (approval number: 318), Hikone Municipal Hospital (approval number: 26-17), Japanese Red Cross Osaka Hospital (approval number: 392), Shimabara Hospital (approval number: E2311), Kishiwada City Hospital (approval number: 12), Kansai Electric Power Hospital (approval number: 26-59), Shizuoka General Hospital (approval number: Rin14-11-47), Kurashiki Central Hospital (approval number: 1719), Kokura Memorial Hospital (approval number: 14111202), Kitano Hospital (approval number: P14-11-012), and Japanese Red Cross Wakayama Medical Center (approval number: 328).

Ethics

The investigation conformed with the principles outlined in the Declaration of Helsinki. The study protocol was approved by the ethical committees in the Kyoto University Hospital (local identifier: E2311) and in each participating hospital. A waiver of written informed consent from each patient was granted by the institutional review boards of Kyoto University and each participating center as the study met the conditions of the Japanese ethical guidelines for medical and health research involving human subjects.[14] We disclosed the details of the present study to the public as an opt-out

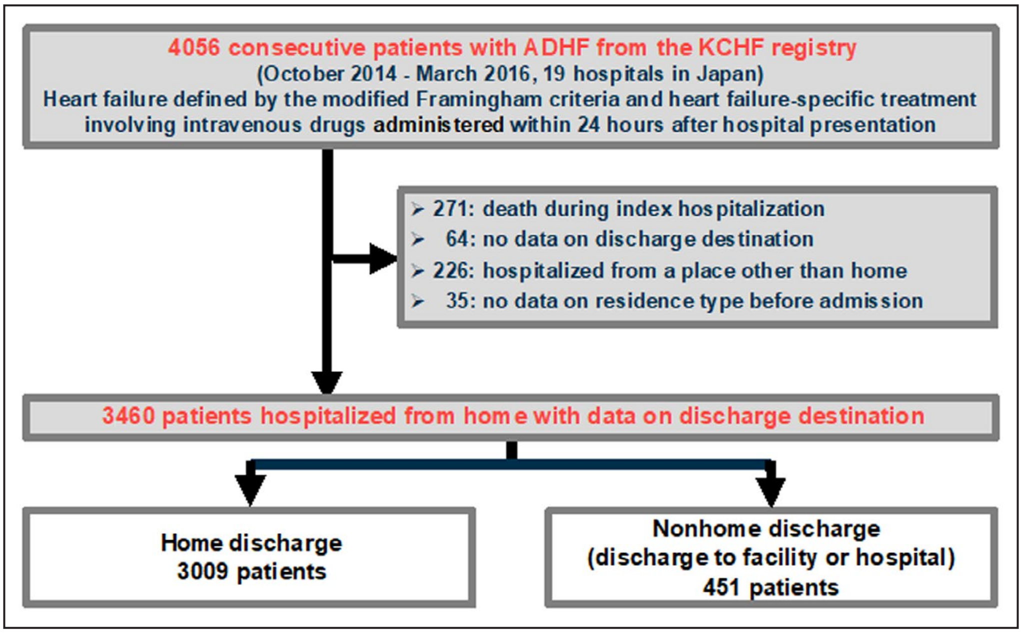


Figure 1. Study flowchart.
ADHF indicates acute decompensated heart failure; and KCHF, Kyoto Congestive Heart Failure.

method, and the notice clearly informed patients of their right to refuse enrollment.

Definitions

Based on the 4 levels of living independence used in Japanese long-term care insurance, we classified patients' physical activity into 4 classes: (1) ambulatory: patients handle their daily activities almost independently and do not require a wheelchair; (2) wheelchair for outdoor use: patients require a wheelchair and some assistance to go outdoors; (3) wheelchair dependent indoors and outdoors: patients require a wheelchair and assistance when indoors as well; and (4) bedridden status: patients require assistance for eating, changing clothes, and to use the restroom.[12]

Functional decline was defined as a decline in at least 1 activity stage at discharge compared with that in the preadmission period.[15] In-hospital worsening HF was defined as the additional administration of intravenous drugs for HF, hemodialysis, or requirement of mechanical circulatory or respiratory support >24 hours after therapy initiation.[11,12] Medication adherence and cognitive dysfunction were subjectively judged by the attending physician. The attending physician confirmed information from medical records on whether the patient was discharged to home, to a facility, or transferred to another hospital. Detailed definitions of the baseline clinical characteristics, including the signs and symptoms of HF, have been described previously.[11,12]

Outcome Measures

The primary outcome measure was all-cause death. The secondary outcome measures were cardiovascular and noncardiovascular deaths. Death was regarded as cardiovascular in origin unless obvious noncardiovascular causes could be identified.[11] Cardiovascular death included death related to HF, sudden death, death related to stroke, and death from other cardiovascular causes. Sudden death was unexplained death in a previously stable patient. Stroke was either ischemic or hemorrhagic and required either acute or prolonged hospitalization with symptoms lasting for >24 hours.[11]

Statistical Analysis

We compared the backgrounds, in-hospital characteristics, and clinical outcomes of the study patients based on whether they had a home discharge or nonhome discharge status. Categorical variables were presented as numbers with percentages and were compared using the χ^2 test. Continuous variables were expressed as means with SDs or medians with interquartile ranges and were compared using Student's *t*-test when normally distributed or Wilcoxon rank-sum test when not normally distributed. As a supplementary analysis, we also compared the backgrounds of patients who were discharged to nursing homes and those who were transferred to other hospitals, which are both nonhome discharges.

The factors independently associated with nonhome discharge were assessed using multivariable logistic regression models including all potential candidate factors with *P* values <0.05 when we tested the difference between the 2 groups of patients—one group including those who were discharged to home and the other to nonhome locations (Table 1). In the multivariable analyses, continuous variables were dichotomized using clinically meaningful reference values or medians: age ≥80 years based on the median; body mass index (BMI) ≤22 kg/m^2; body temperature ≥37.5°C; left ventricular ejection fraction <40%; estimated glomerular filtration rate <30 mL/min per 1.73 m^2; serum albumin level <3.0 g/dL; and serum sodium level <135 mEq/L, according to a previous study.[15] Length of hospital stay >16 days was based on the median. B-type natriuretic peptide (BNP) >707 pg/mL and NT-proBNP (N-terminal pro-B-type natriuretic peptide) >5316 pg/mL were based on the median, and NT-proBNP values were adopted if no BNP values were measured. The interval association was expressed as odds ratios with their 95% CIs. As a supplementary analysis, we also performed a multivariate analysis using 27 variables that were consistent with the main analysis, using continuous variables instead of binary variables: Age was treated as a continuous variable with an increase by 5-year intervals, BMI with a decrease by 5 kg/m^2 intervals, body temperature with an increase by 1°C intervals after presentation, BNP with an increase by 100 pg/mL intervals after admission, estimated glomerular filtration rate with a decrease by 5 mL/min per 1.73 m^2 intervals after admission, albumin with a decrease by 1 mg/dL intervals after admission, sodium decrease by 1 mEq/L intervals after admission, and length of hospital stay with an increase by 1-day intervals.

We used the Kaplan–Meier method for the estimation of the cumulative 1-year incidence of the outcome measures and assessed the differences with a log-rank test. We expressed the risk of the nonhome discharge group relative to the home discharge group for all outcome measures as hazard ratios with their 95% CIs. For this, we used multivariable Cox proportional hazard models, incorporating 27 clinically relevant risk-adjusting variables (Table 1) in accordance with previous studies.[12,13] We also showed the adjusted Kaplan–Meier curves to estimate the cumulative 1-year incidence of all-cause, cardiovascular, and noncardiovascular mortality in the home discharge and nonhome discharge groups, after adjusting for the 27 clinically relevant risk variables indicated in Table 1.

Table 1. Patient Characteristics, Laboratory Test Results, and Medications

Variables	Home Discharge (N = 3009, 87%)	Nonhome Discharge (N = 451, 13%)	*P* Value	Number of Data Analyzed
Clinical characteristics				
Age, y	79 (70–85)	84 (79–89)	<0.001	3460
Age ≥80 y*,†	1388 (46.1)	328 (72.7)	<0.001	3460
Women*,†	1265 (42.0)	231 (51.2)	<0.001	3460
BMI (kg/m^2)	22.7 (20.3–25.4)	21.3 (18.8–23.9)	<0.001	3313
BMI ≤22 kg/m^2*,†	1254 (43.0)	230 (57.6)	<0.001	3313
Cause			<0.001	3460
Acute coronary syndrome*,†	165 (5.5)	36 (8.0)		
Coronary artery disease other than acute coronary syndrome	828 (27.5)	108 (24.0)		
Cardiomyopathy	484 (16.1)	55 (12.2)		
Hypertensive heart disease	757 (25.2)	95 (21.1)		
Valvular disease	539 (17.9)	124 (27.5)		
Others	236 (7.8)	33 (7.3)		
Medical history				
Heart failure hospitalization†	1058 (35.2)	153 (33.9)	0.61	3460
Atrial fibrillation or flutter†	1249 (41.5)	188 (41.7)	0.94	3460
Hypertension†	2179 (72.4)	327 (72.5)	0.97	3460
Diabetes mellitus*,†	1165 (38.7)	150 (33.3)	0.02	3460
Insulin users	235 (7.8)	32 (7.1)	0.63	3460
Chronic lung disease†	389 (12.9)	64 (14.2)	0.46	3460
Myocardial Infarction*,†	704 (23.4)	84 (18.6)	0.02	3460
Stroke†	453 (15.1)	74 (16.4)	0.46	3460
Cognitive dysfunction*	378 (12.6)	135 (29.9)	<0.001	3460
Current smoking*,†	425 (14.3)	30 (6.8)	<0.001	3415
Social background				
Poor medication adherence*	475 (15.8)	111 (24.6)	<0.001	3460
Living alone†	671 (22.3)	129 (28.6)	0.004	3460
Living with others*	2338 (77.7)	322 (71.4)		3460
Living with spouse	1437 (47.8)	162 (35.9)		3460
Living with a child	1186 (39.4)	170 (37.7)		3460
Public assistance	173 (5.8)	24 (5.3)	0.71	3460
Functional status before admission				
Physical activity			<0.001	3436
Ambulatory state*†	2560 (85.7)	305 (68.1)		
Use of wheelchair (outdoors only)	178 (6.0)	58 (13.0)		
Use of wheelchair (outdoors and indoors)	184 (6.2)	52 (11.6)		
Bedridden state	66 (2.2)	33 (7.4)		
Vital signs and symptoms on presentation				
Systolic BP <90 mm Hg†	74 (2.5)	13 (2.9)	0.60	3460
HR <60 beats/min†	192 (6.4)	27 (6.0)	0.76	3460
BT ≥37.5°C*	160 (5.6)	42 (9.8)	0.001	3305
NYHA class IV*	1363 (45.5)	239 (53.4)	0.002	3447
Test on admission				
LVEF			<0.001	3450
HFrEF (LVEF <40%)*†	1172 (39.1)	128 (28.4)		
HFmrEF (40% ≤ LVEF <50%)	556 (18.5)	101 (22.4)		

(*Continued*)

Table 1. Continued

Variables	Home Discharge (N = 3009, 87%)	Nonhome Discharge (N = 451, 13%)	*P* Value	Number of Data Analyzed
HFpEF (LVEF ≥50%)	1272 (42.4)	221 (49.1)		
Hemoglobin (g/L)	11.7 ± 2.4	11.0 ± 2.1	<0.001	3453
Anemia (Men <13 g/L, Women<12 g/L)* †	1911 (63.7)	344 (76.3)	<0.001	
BNP (pg/mL)	694 (385–1216)	802 (417–1546)	0.002	3066
NT-proBNP (pg/mL)	4809 (2420–11042.5)	8250.5 (3244.5–17157)	0.03	595
BNP >707 (pg/mL) or NT-proBNP >5316 (pg/mL)[*,‡]	1309 (44.2)	225 (50.2)	0.02	3413
Creatinine (mg/dL)	1.1 (0.8–1.6)	1.2 (0.9–1.9)	<0.001	3455
eGFR (mL/min per 1.73 m^2)	45.6 (30.1–61.7)	37.7 (24–53.1)	<0.001	3455
eGFR <30 mL/min per 1.73 m^2[*,†]	741 (24.7)	170 (37.7)	<0.001	
Albumin (g/L)	3.5 ± 0.5	3.3 ± 0.5	<0.001	3365
Albumin <3.0 g/L[*,†]	341 (11.7)	99 (22.3)	<0.001	
Sodium (mEq/L)	139 ± 4	139 ± 5	0.002	3448
Sodium <135 mEq/L[*,†]	319 (10.6)	71 (15.8)	0.002	
Treatment after admission				
Respiratory management by intubation[*]	47 (1.6)	14 (3.1)	0.03	3460
Events during hospitalization				
Worsening heart failure[*,†,§]	476 (15.8)	137 (30.4)	<0.001	3460
An increase in serum creatinine levels ≥0.3 mg/dL[*,†]	981 (33.0)	216 (48.0)	<0.001	3419
Acute coronary syndrome	31 (1.0)	6 (1.3)	0.58	3460
Stroke[*,†]	23 (0.8)	29 (6.4)	<0.001	3460
Infection[*,†]	243 (8.1)	98 (21.7)	<0.001	3460
Open heart surgery	56 (1.9)	13 (2.9)	0.17	3460
Condition at discharge				
Functional status				
Physical activity			<0.001	3428
Ambulatory state	2512 (84.2)	130 (29.2)		
Use of wheelchair (outdoors only)	241 (8.1)	69 (15.5)		
Use of wheelchair (outdoors and indoors)	195 (6.5)	176 (39.6)		
Bedridden state	35 (1.2)	70 (15.7)		
Functional decline[*,¶]	199 (6.7)	190 (43.0)	<0.001	3405
Medications at discharge				
Beta blocker[†]	2097 (69.7)	253 (56.1)	<0.001	3460
ACEI or ARB[†]	1841 (61.2)	201 (44.6)	<0.001	3460
Length of hospital stay, d	15 (11–22)	29 (18–42)	<0.001	3460
Length of hospital stay >16 d[*,**]	1275 (42.4)	360 (79.8)	<0.001	3460

Continuous variables are presented as means ± standard deviations or medians with interquartile ranges.

Categorical variables are presented as numbers (percentages).

ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; BMI, body mass index; BNP, B-type natriuretic peptide; BP, blood pressure; BT, body temperature; eGFR, estimated glomerular filtration rate; HFmrEF, heart failure with midrange ejection fraction; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; HR, heart rate; LVEF, left ventricular ejection fraction; NT-proBNP, N-terminal pro-B-type natriuretic peptide; and NYHA, New York Heart Association.

*Potential factors associated with nonhome discharge selected in the multivariable logistic regression models.

†Risk-adjusting variables selected for the multivariable Cox proportional hazard models.

‡BNP >707 pg/mL and NT-proBNP >5316 pg/mL were based on the median in the entire study population, and NT-proBNP values were adopted if no BNP values were measured.

§Worsening heart failure was defined as the additional administration of intravenous drugs for heart failure, hemodialysis, or requirement of mechanical circulatory or respiratory support occurring >24 h after therapy initiation.

¶Functional decline was defined as a decline in at least 1 activity stage at discharge compared with that in the preadmission period.

**Length of hospital stay >16 days was based on the median in the entire study population.

All statistical analyses were conducted by three investigators (K.W., T.K., and N.O.) and a statistician (T.M.) using JMP Pro V.13.0 and EZR.[16] Two-tailed *P* values <0.05 were considered statistically significant.

RESULTS

Baseline Clinical Characteristics

Of the enrolled 3460 patients, 3009 (87%) were discharged to home and 451 (13%) were not discharged to home (Figure 1). The median length of stay was 16 (interquartile range, 11–24) days in the overall cohort; 15 (interquartile range, 11–22) days in the home discharge group, and 29 (interquartile range, 18–42) days in the nonhome discharge group ($P<0.0001$). Patients in the nonhome discharge group were older, more likely women, and more likely had BMI ≤22 kg/m^2. The etiologies of HF in nonhome discharged patients were more often acute coronary syndrome and valvular disease but less often coronary artery disease other than acute coronary syndrome and hypertensive heart disease than those in home-discharged patients. In addition, the nonhome-discharged patients had a significantly lower prevalence of previous myocardial infarction and diabetes mellitus, significantly higher prevalence of anemia, higher BNP or NT-proBNP levels and renal dysfunction, lower albumin levels, more fever on presentation, preserved left ventricular ejection fraction, and hyponatremia, and included fewer current smokers and more New York Heart Association class IV candidates than the home-discharged patients. Furthermore, the nonhome-discharged patients had higher prevalence of cognitive dysfunction and poor medication adherence and were less likely to live with others and be ambulatory before admission than the home-discharged patients (Table 1).

Of the 451 patients with nonhome discharge, 50 (11.1%) were discharged to nursing homes, and 401 (88.9%) were transferred to other hospitals to continue the treatment and undergo rehabilitation in the chronic phase after completing the treatment in the acute phase (Table S1). No transferred patients required a higher level of treatment for HF. Those who were discharged to nursing homes had lower BMIs and higher requirement of public assistance and were less likely to live with others than those transferred to other hospitals at discharge, although other baseline features were similar (Table S1).

In-Hospital Management, InHospital Events, and Status at Discharge

At admission, the prevalence of respiratory management by intubation was significantly higher in the nonhome discharge group than in the home discharge group (Table 1). The nonhome discharge group had higher incidences of worsening HF, increases in serum creatinine levels ≥0.3 mg/dL, stroke, and infection during hospitalization than the home discharge group. The length of hospital stay was longer in the nonhome discharge group than in the home discharge group. During discharge, the nonhome discharge group were prescribed angiotensin-converting enzyme inhibitors/angiotensin receptor blockers and beta blockers less frequently and had a lower percentage of patients in ambulatory status and a higher percentage of patients with functional decline than the home discharge group (Table 1).

Factors Independently Associated With Nonhome Discharge

The factors independently and positively associated with nonhome discharge were age ≥80 years, BMI ≤22 kg/m^2, poor medication adherence, worsening HF, functional decline, stroke during the hospital stay, and length of hospital stay >16 days, while the factors negatively associated with nonhome discharge were diabetes mellitus, living with others, and ambulatory status before admission (Table 2). When factors associated with nonhome discharge were adjusted for continuous rather than binary variables, the results were mostly consistent with the present analysis, except for the history of myocardial infarction, body temperature, and BMI (Table S2).

Long-Term Outcomes: Home Discharge Group Versus Nonhome Discharge Group

The follow-up rate at 1 year was 95%. The cumulative 1-year incidence of all-cause death in the nonhome discharge group was significantly higher than that in the home discharge group (33.4% versus 13.2%; $P<0.001$) (Figure 2A and Figure S1A).

After adjustment for confounders, the higher risk of the nonhome discharge group relative to the home discharge group remained significant (hazard ratio, 1.66; 95% CI, 1.35–2.03; $P<0.001$) (Table 3). The nonhome discharge group compared with the home discharge group was also associated with higher unadjusted and adjusted risk for cardiovascular and noncardiovascular death (Figures 2B and 2C, Figure S1B and 1C, Table 3).

DISCUSSION

The main findings of the present study are as follows: (1) among patients who were hospitalized for ADHF from home, 13% of patients were not discharged to home; (2) factors independently and positively associated with nonhome discharge were age ≥80 years, BMI ≤22 kg/m^2, poor medication adherence, worsening HF

Table 2. Factors Independently Associated With Nonhome Discharge

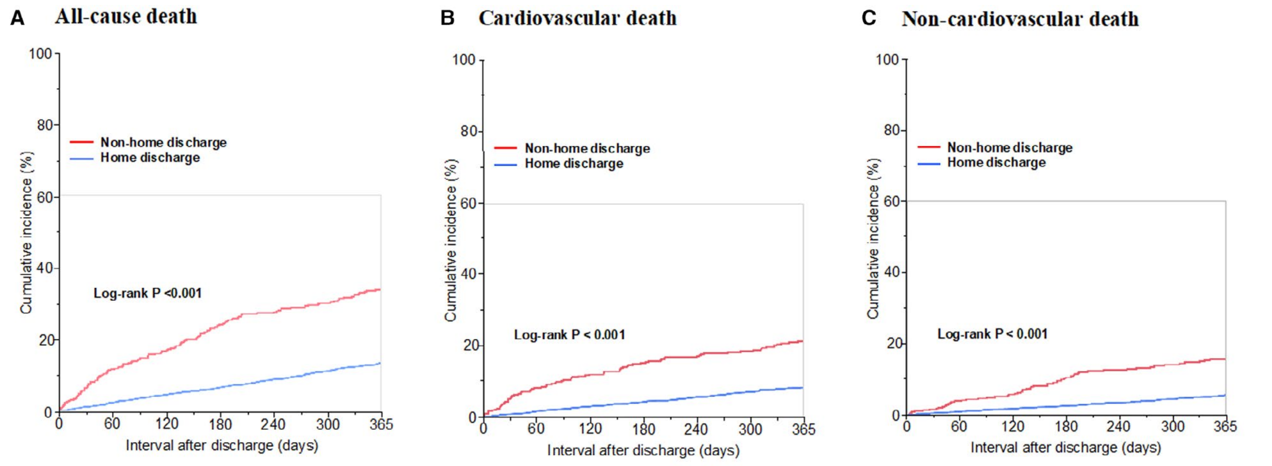
Variables	Adjusted OR	95% CI	*P* Value
Age ≥80 y	1.76	(1.28–2.42)	<0.001
Women	0.91	(0.69–1.21)	0.54
BMI ≤22 kg/m^2	1.49	(1.12–1.97)	0.006
Acute coronary syndrome	1.26	(0.71–2.24)	0.42
Diabetes mellitus	0.69	(0.51–0.94)	0.02
Previous myocardial infarction	0.74	(0.53–1.03)	0.08
Cognitive dysfunction	1.31	(0.94–1.82)	0.11
Current smoking	0.72	(0.43–1.21)	0.21
Poor medication adherence	2.08	(1.49–2.88)	<0.001
Living with other person(s) before admission	0.62	(0.46–0.85)	0.003
Ambulatory state before admission	0.25	(0.18–0.36)	<0.001
BT ≥37.5°C on presentation	1.23	(0.77–1.98)	0.38
NYHA class IV	0.92	(0.69–1.21)	0.53
HFrEF	0.76	(0.56–1.03)	0.08
Anemia on admission	1.10	(0.79–1.53)	0.58
BNP >707 pg/mL or NT-proBNP >5316 pg/mL on admission	0.84	(0.63–1.12)	0.24
eGFR <30 mL/min/1.73m^2 on admission	1.23	(0.92–1.67)	0.17
Albumin <3.0 g/L on admission	1.19	(0.84–1.69)	0.31
Sodium <135 mEq/L on admission	1.31	(0.90–1.90)	0.15
Respiratory management by intubation on admission	1.01	(0.33–3.08)	0.98
Worsening heart failure status during hospital stay	2.02	(1.46–2.82)	<0.001
An increase in serum creatinine levels ≥0.3 mg/dL during hospital stay	1.09	(0.82–1.45)	0.53
Stroke during hospital stay	3.74	(1.75–8.00)	<0.001
Infection during hospital stay	1.28	(0.89–1.86)	0.19
Functional decline during hospitalization	12.24	(8.74–17.14)	<0.001
Length of hospital stay >16 d	4.14	(3.01–5.69)	<0.001

We explored the factors independently associated with nonhome discharge in the multivariable logistic regression models. We included those potential candidate factors that had a *P* value <0.05 in the univariate analysis. OR indicates odds ratio; BMI, body mass index; BT, body temperature; NYHA, New York Heart Association; HFrEF, heart failure with reduced ejection fraction; BNP, B-type natriuretic peptide; and eGFR, estimated glomerular filtration rate.

and stroke during the hospital stay, functional decline during hospitalization, and length of hospital stay, while factors negatively associated with nonhome discharge were diabetes mellitus, living with other people, and ambulatory status before admission; (3) the nonhome discharge group compared with the home discharge group was associated with a higher risk of all-cause, cardiovascular, and noncardiovascular death.

There is a regional difference in the rates of home or nonhome discharges. In Canada, Eastwood et al[17] reported a home discharge rate of 64.8% and a home discharge with home care of 24.8%. They also reported the length of hospital stay to be 7 days (median).[17] In a cohort study of 1218 patients with HF at 8 centers in Hiroshima, Japan, the home discharge rate for the entire cohort was 74.2%.[18] In a study of the posttransfer outcomes of 166 patients with ADHF in Musashino, Tokyo, the transfer rate was as high as 31.9%, although home discharge rates were not investigated.[19] Differences in home discharge rates may be dependent on the geographic environment and domestic health care system.

This is the first large multicenter study in Japan to investigate the factors associated with nonhome discharge in patients hospitalized for ADHF. In this study, factors independently associated, either positively or negatively, with nonhome discharge suggest that the presence of frailty, self-care ability, and caregiver availability determined the discharge destination of patients with ADHF. In addition, discharge destination might be affected by the course of treatment for HF, the presence of complications, and functional decline during hospitalization. Diabetes mellitus was negatively associated with nonhome discharge. Patients with diabetes mellitus might have been younger, had no muscle weakness, and had less probability of cognitive dysfunction. These characteristics may be confounded by factors that were associated with home discharge.



A

Interval	0-day	60-day	180-day	1-year
Nonhome discharge				
N of patients with event		49	97	138
N of patients at risk	451	375	316	234
Cumulative incidence		11.5%	23.1%	33.4 %
Home discharge				
N of patients with event		66	188	384
N of patients at risk	3009	2894	2744	2297
Cumulative incidence		2.2%	6.4 %	13.2 %

B

Interval	0-day	60-day	180-day	1-year
Nonhome discharge				
N of patients with event		34	60	82
N of patients at risk	451	375	316	234
Cumulative incidence		8.1%	14.8 %	21.2 %
Home discharge				
N of patients with event		43	119	234
N of patients at risk	3009	2894	2744	2297
Cumulative incidence		1.5%	4.1 %	8.2 %

C

Interval	0-day	60-day	180-day	1-year
Nonhome discharge				
N of patients with event		15	37	56
N of patients at risk	451	375	316	234
Cumulative incidence		3.7%	9.8 %	15.5 %
Home discharge				
N of patients with event		23	119	150
N of patients at risk	3009	2894	2744	2297
Cumulative incidence		0.8%	2.4 %	5.4 %

Figure 2. Kaplan–Meier curves for the mortality outcomes: home discharge versus non-home discharge groups
(**A**) All-cause death, (**B**) cardiovascular death, and (**C**) noncardiovascular death.

Another possible reason is that patients with diabetes mellitus might be more aware of the health care system because of accessing it more frequently for diabetes mellitus treatment before getting admitted for HF; they might have also participated in rehabilitation.

Hauck et al[20] reported a 17.6% risk of infection with hospitalization, with the risk rate increasing by 1.6% for each additional day of hospitalization. Avoiding infections as well as other in-hospital complications, such as worsening HF, may lead to shorter hospital stays and discharges to home. The factor that showed the strongest effect on nonhome discharge was functional decline. As we previously reported, independent risk factors related to functional decline were frailty and the severity of HF, which were also associated with prognosis.[15] Patients who are hospitalized are less active, depending on others for mobility.[21] Not only the severity of the disease but also the hospitalization environment itself reduces activity and contributes to functional decline. The establishment of early circulatory stabilization and early cardiac rehabilitation may be necessary to reduce the time spent lying in bed during hospitalization and prevent functional decline, which would make discharge to home more likely.

The present study found that poor medication adherence before admission was a risk factor for nonhome discharge. Poor adherence was identified as an independent risk factor, suggesting that self-care ability before admission is an important factor in determining home discharge regardless of cognitive dysfunction. Since inadequate HF self-care has been identified as an independent prognostic factor,[22,23] behavioral interventions for nonadherence are important for improving the outcomes and quality of self-care in patients with HF.[24] Motivational interviews and guided reflection on past behaviors, in this context, have been reported to play a role in the promotion of self-care.[25,26] In addition, if proper HF self-care is difficult to implement, it may be possible to facilitate discharge to home by creating a home healthcare environment to compensate for the lack of self-care.

In our study, the nonhome discharge patients were at higher risk for the 1-year all-cause, cardiovascular, and noncardiovascular deaths. Therefore, establishing cardiac rehabilitation early after hospitalization to prevent functional decline and avoiding in-hospital complications might lead to not only home discharge but also improvement of their prognosis.

The medical system in Japan may be different from that in other countries. All Japanese people have public medical insurance, and people can always get low-cost medical services when they need them. Hospitalized patients can be discharged to home with or without home medical care; transferred to another hospital that provides the chronic phase treatment,

Table 3. Primary and Secondary Outcomes

	Home Discharge	Nonhome Discharge				
	Number of Patients With Event /Number of Patients at Risk (Cumulative 1-Year Incidence [%])	Number of Patients With Event /Number of Patients at Risk (Cumulative 1-Year Incidence [%])	Unadjusted Hazard Ratio (95% CI)	*P* Value	Adjusted Hazard Ratio (95% CI)	*P* Value
All-cause death	384/3009 (13.2%)	138/451 (33.4%)	2.68 (2.26–3.19)	<0.001	1.66 (1.35–2.03)	<0.001
Cardiovascular death	234/3009 (8.2%)	82/451 (21.2%)	2.57 (2.05–3.22)	<0.001	1.56 (1.19–2.03)	0.001
Noncardiovascular death	150/3009 (5.4%)	56/451 (15.5%)	2.85 (2.18–3.74)	<0.001	1.80 (1.30–2.47)	<0.001
Stroke	18/3009 (0.9%)	18/451 (1.8%)	2.53 (1.15–5.55)	0.02	1.52 (0.62–3.71)	0.36

such as rehabilitation; or discharged to a nursing home. The results of this research were derived from Japan and hence cannot be generalized for the international community. However, the results of this first multicenter large-scale observational study focusing on home discharge as an outcome for patients with ADHF are potentially important considering the increasing number of aged patients in developed countries. Further research in various countries and regions would be needed to generalize the study results and customize the best care for home-discharged patients in each country or region.

LIMITATIONS

This study has several limitations. First, there might be a selection bias in this study. The participating facilities in this study are specialized cardiovascular facilities that provide acute care, and patients who were originally residing in nursing homes and did not wish to receive acute care were likely admitted to other hospitals. Second, we have no data on the final discharge status of the patients transferred to another hospital. Third, the present analysis was biased toward data on the patients' physical aspects because we did not collect sufficient data on their psychological and social aspects, such as patients' anxiety, their wish to be discharged home, patient's home environment, and the status of supply and demand for home health care including the availability of a home nurse, as well as their family's wishes and family support status. Fourth, the healthcare providers assessed medication adherence, which was not objectively validated. Fifth, the nonhome discharge patient group included both institutionalized and transferred patients. The postdischarge medical and living backgrounds might be different between the institutionalized and transferred patients. Furthermore, even among patients discharged to home, the home healthcare environment, such as postdischarge visits by home nurses and frequency of medical care, might have affected the outcomes of the study. Sixth, this study did not evaluate 30-day readmission for patients with HF, because the nonhome discharge patients included patients who were transferred to another hospital. Thirty-day readmissions for patients with HF are used to assess hospital performance in the United States,[27] and are an important outcome that led the Centers for Medicare and Medicaid Services to create the Hospital Readmission Reduction Program.[28] Although the 30-day readmission for patients with HF in Japan is low, at around 5%,[29] it is necessary to evaluate whether there is any difference between home and nonhome discharges.

CONCLUSIONS

Discharge destination might be affected by preadmission backgrounds and in-hospital factors, such as functional decline, reduced self-care ability, worsening HF, stroke during hospitalization, and length of hospital stay, in patients with ADHF.

ARTICLE INFORMATION

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Disclosures

None.

Supplementary Material

Tables S1–S2, Figure S1.

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Supplemental Material

Table S1. Non-home discharge patient characteristics, laboratory test results, and medications.

Variables	Discharge to nursing home (N=50, 11.1%)	Discharge to hospital (N=401, 88.9%)	P value	Number of data analyzed
Clinical characteristics				
Age (years)	84 (78–89.25)	84 (79–89)	0.69	451
Age ≧80 years	35 (70.0)	293 (73.1)	0.65	451
Women	28 (56.0)	203(50.6)	0.47	451
BMI (kg/m^2)	20.1 (18.35–22.28)	21.4 (18.82–24.16)	0.046	399
BMI ≦22 kg/m^2	33 (75.0)	197 (55.5)	0.011	399
Etiology			0.94	451
Acute coronary syndrome	3 (6.0)	33 (8.2)		
Coronary artery disease other than acute coronary syndrome	12 (24.0)	96 (23.9)		
Cardiomyopathy	5 (10.0)	50 (12.5)		
Hypertensive heart disease	13 (26.0)	82 (20.5)		
Valvular disease	14 (28.0)	110(27.4)		
Others	3 (6.0)	30 (7.5)		
Medical history				
Heart failure hospitalization	14 (28.0)	139 (34.7)	0.35	451
Atrial fibrillation or flutter	19 (38.0)	169 (41.7)	0.58	451
Hypertension	36 (72.0)	291 (72.6)	0.93	451
Diabetes mellitus	13 (26.0)	137 (34.2)	0.25	451
Chronic lung disease	5 (10.0)	59 (14.7)	0.37	451
Myocardial Infarction	11 (22.0)	73 (18.2)	0.52	451

Stroke	4 (8.0)	70 (17.5)	0.07	451
Cognitive dysfunction	17 (34.0)	118 (29.4)	0.51	451
Current smoking	3 (6.0)	27 (6.9)	0.80	440
Social background				
Poor medication adherence	11 (22.0)	100 (24.9)	0.65	451
Living alone	21 (42.0)	108 (26.9)	0.03	451
Living with others	29 (58.0)	293 (73.1)		451
Living with spouse	15 (30.0)	147 (36.7)	0.35	451
Living with a child	16 (32.0)	154 (38.4)	0.37	451
Public assistance	6 (12.0)	18 (4.5)	0.048	451
Functional status before admission				
Physical activity			0.63	448
Ambulatory state	37 (74.0)	268 (67.3)		
Use of wheelchair (outdoors only)	5 (10.0)	53 (13.3)		
Use of wheelchair (outdoors and indoors)	6 (12.0)	46 (11.6)		
Bedridden state	2 (4.0)	31 (7.8)		
Vital signs and symptoms on presentation				
Systolic BP <90 mmHg	0 (0.0)	13 (3.3)	0.08	450
HR <60 beats/min	2 (4.0)	25 (6.3)	0.49	447
BT ≧ 37.5℃	4 (8.7)	38 (10.0)	0.78	428
NYHA class I	25 (50.0)	214 (53.8)	0.61	448
Test on admission				
LVEF			0.70	450
HFrEF (LVEF <40%)	12 (24.0)	116 (29.0)		
HFmrEF (40% ≤ LVEF <50%)	13 (26.0)	88 (22.9)		

HFpEF (LVEF ≥50%)	25 (50.0)	196 (49.0)		
Hemoglobin (g/L)	11.26 ± 2.07	11.0 ± 2.13	0.43	451
Anemia (Men <13 g/L, Women<12 g/L)	37 (74.0)	307 (76.6)	0.69	451
BNP (pg/mL)	782.2 (315.8–1282.2)	820.9 (422.5–1563.4)	0.39	398
NT-proBNP (pg/mL)	7714.5 (2566.25–14920.5)	8769.5 (3341–19794.75)	0.03	50
BNP >707 (pg/mL) or NT-proBNP >5316 (pg/ml) *	30 (60.0)	228 (57.3)	0.71	448
Creatinine (mg/dL)	1.1 (0.81–1.67)	1.27 (0.89–1.91)	0.09	451
eGFR (mL/min/1.73 m^2)	41.5 (26.68– 56.23)	36.9 (23.75–52.45)	0.15	451
eGFR <30 mL/min/1.73 m^2	15 (30.0)	155 (38.7)	0.23	
Albumin (g/L)	3.44 ± 0.46	3.32 ± 0.52	0.13	444
Albumin <3.0 g/L	7 (14.6)	92 (23.2)	0.16	
Sodium (mEq/L)	139.16 ± 4.47	138.6 ± 4.84	0.44	450
Sodium <135 mEq/L	7 (14.0)	64 (16.0)	0.71	
Treatment after admission				
Respiratory management by intubation	0 (0.0)	14 (3.5)	0.07	451
Events during hospitalization				
Worsening heart failure†	11 (22.0)	126 (31.4)	0.16	451
Increase in serum creatinine levels ≥0.3 mg/dL	19 (38.0)	197 (49.3)	0.13	451
Acute coronary syndrome	0 (0.0)	6 (1.3)	0.23	451
Stroke	4 (8.0)	25 (6.2)	0.64	451
Infection	7 (14.0)	91 (22.7)	0.14	451
Open heart surgery	2 (4.0)	11 (2.7)	0.63	451
Condition at discharge				
Functional status				

Physical activity			0.19	445
Ambulatory state	20 (40.0)	110 (27.9)		
Use of wheelchair (outdoors only)	7 (14.0)	62 (15.7)		
Use of wheelchair (outdoors & indoors)	19 (38.0)	157 (39.8)		
Bedridden state	4 (8.0)	66 (16.7)		
Functional decline §	19 (38.0)	171 (43.6)	0.45	442
Medications at discharge				
β-blocker	26 (52.0)	227 (56.6)	0.54	451
ACE-I or ARB	26 (52.0)	175 (43.6)	0.26	451
Length of hospital stay(days)	24.5 (16.75–35.25)	29 (18–43)	0.10	451
Length of hospital stay >16 days#	38 (76.0)	322 (80.3)	0.48	451

Continuous variables are presented as means ± standard deviations or medians with interquartile ranges.

Categorical variables are presented as numbers (percentages).

*BNP >707 pg/ml and NT-proBNP >5,316 pg/ml were based on the median in the entire study population, and NT-proBNP values were adopted if no BNP values were measured.

†Worsening heart failure was defined as the additional administration of intravenous drugs for heart failure, hemodialysis, or requirement of mechanical circulatory or respiratory support occurring >24 hours after therapy initiation.

§ Functional decline was defined as a decline in at least one activity stage at discharge compared to that in the preadmission period.

Length of hospital stay >16 days was based on the median in the entire study population.

ACE-I, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; BMI, body mass index; BNP, brain-type natriuretic peptide; BP, blood pressure; BT, body temperature; eGFR, estimated glomerular filtration rate; HFmrEF, heart failure with mid-range ejection fraction; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; HR, heart rate; LVEF, left ventricular ejection fraction; NT-proBNP, N-terminal-proBNP; NYHA, New York Heart Association.

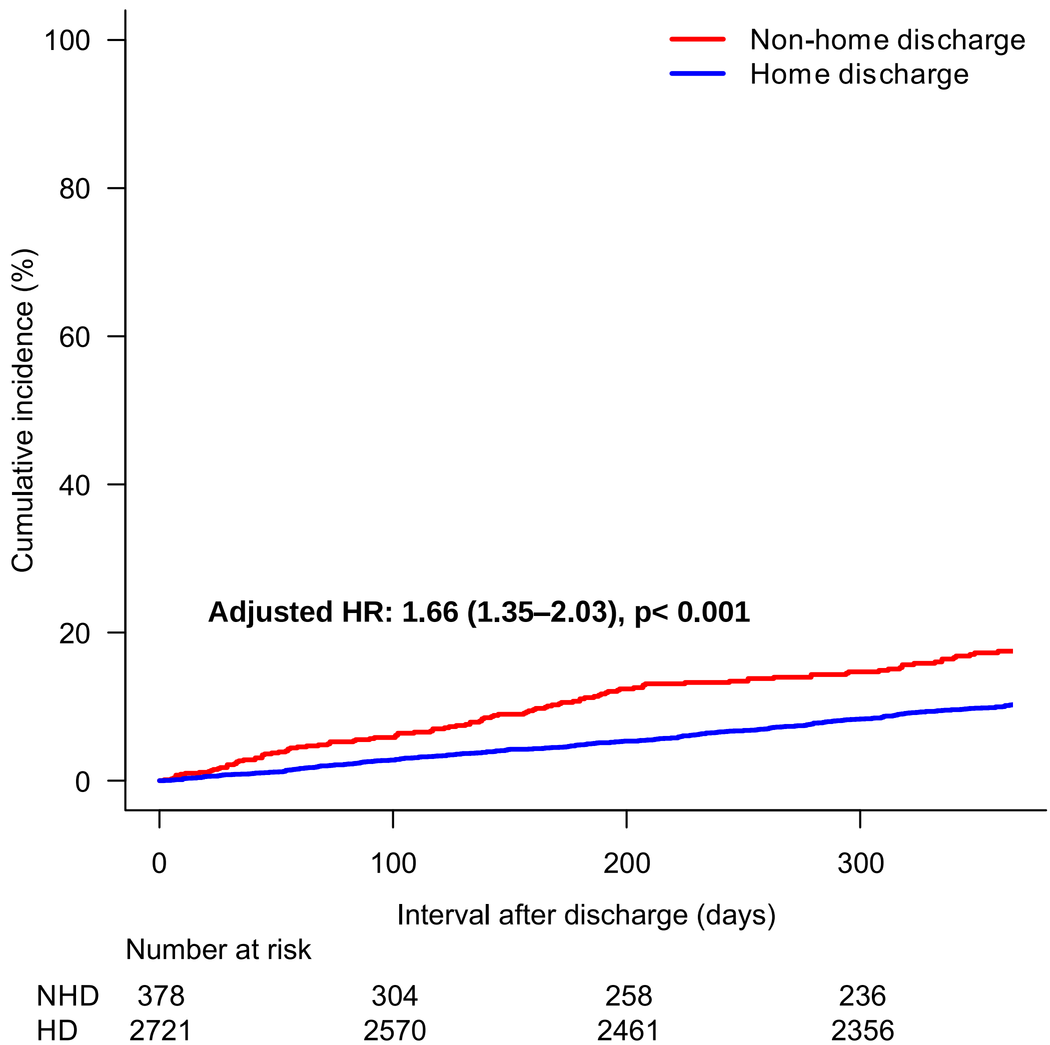
Table S2. Factors independently associated with non-home discharge.

Variables	Adjusted OR	95% CI	P value
Age (increase by 5 years intervals)*	1.19	(1.09–1.30)	<0.001
Women	0.96	(0.70–1.30)	0.77
BMI (decrease by 5 kg/m^2 intervals)*	1.15	(0.95–1.39)	0.14
Acute coronary syndrome	1.31	(0.71–2.39)	0.38
Diabetes mellitus	0.71	(0.51–0.99)	0.04
Previous myocardial infarction	0.68	(0.47–0.98)	0.04
Cognitive dysfunction	1.39	(0.98–1.98)	0.06
Current smoking	0.83	(0.47–1.45)	0.50
Poor medication adherence	2.27	(1.60–3.23)	<0.001
Living with other person(s) before admission	0.67	(0.48–0.93)	0.018
Ambulatory state before admission	0.35	(0.24–0.52)	<0.001
BT on presentation* (increase by 1℃ intervals)	1.35	(1.08–1.68)	0.008
NYHA class IV	1.03	(0.77–1.39)	0.82
HFrEF	0.85	(0.61–1.18)	0.33
Anemia on admission	1.13	(0.79–1.62)	0.51
BNP on admission (increase by 100 pg/mL intervals)*	1.00	(0.98–1.01)	0.88
eGFR on admission (decrease by 5 mL/min/1.73m^2 intervals)*	1.01	(0.98–1.04)	0.60
Albumin on admission (decrease by 1 mg/dL intervals)*	1.09	(0.81–1.47)	0.59
Sodium on admission (decrease by 1 mEq/L intervals)*	1.03	(1.00–1.07)	0.04
Respiratory management by intubation on admission	1.22	(0.38–3.93)	0.74
Worsening heart failure status during hospital stay	1.86	(1.29–2.67)	<0.001
Increase in serum creatinine levels ≥0.3 mg/dL during hospital stay	1.13	(0.83–1.52)	0.45
Stroke during hospital stay	3.61	(1.53–8.51)	0.003
Infection during hospital stay	1.04	(0.68–1.58)	0.87
Functional decline during hospitalization	9.51	(6.67–13.6)	<0.001
Length of hospital stay (increase by 1 day intervals)*	1.03	(1.03–1.04)	<0.001

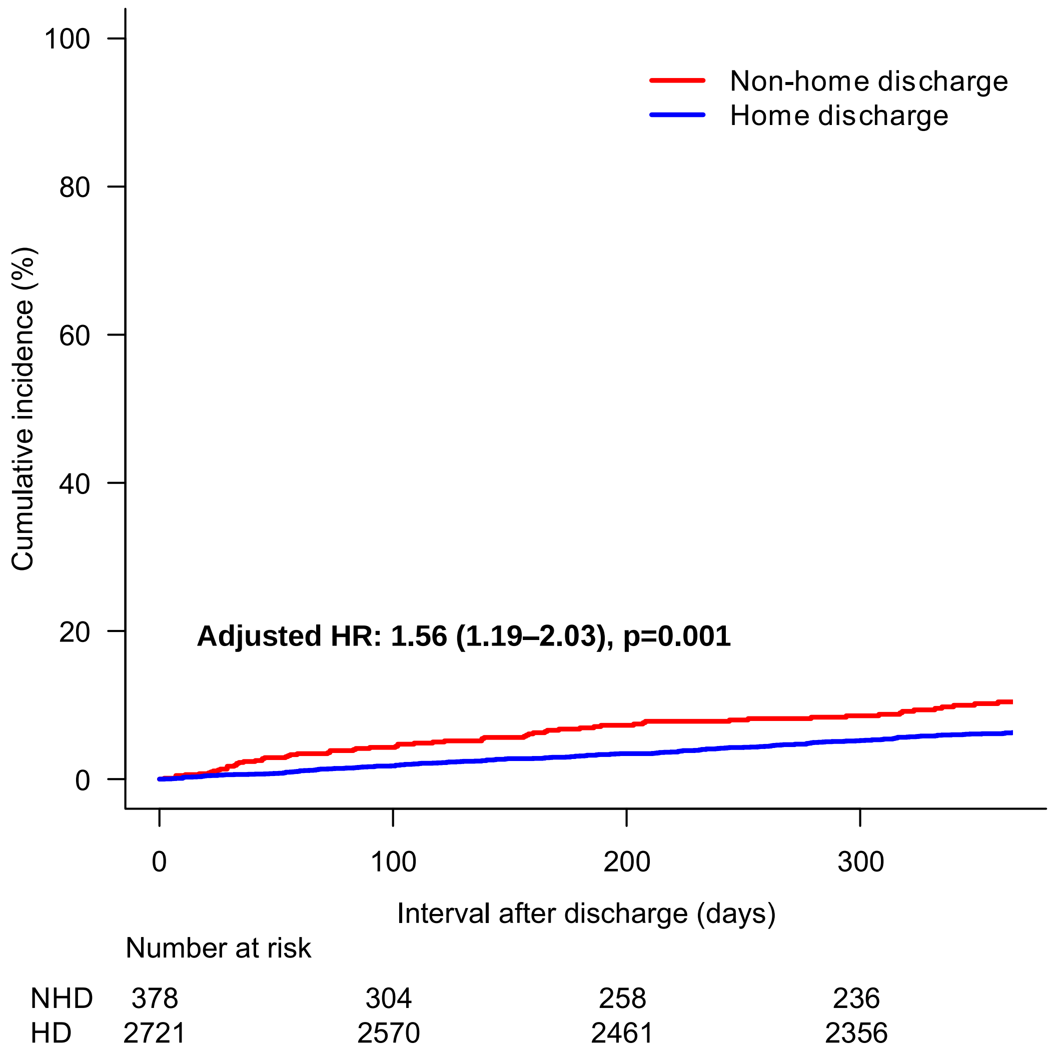
We explored the factors independently associated with non-home discharge in the multivariable logistic regression models. We included those potential candidate factors that had P value <0.05 in the univariate analysis. OR, odds ratio; CI, confidence interval; BMI, body mass index; BT, body temperature; NYHA, New York Heart Association; HFrEF, heart failure with reduced ejection fraction; BNP, brain natriuretic peptide; eGFR, estimated glomerular filtration rate. *continuous variables

Figure S1. The adjusted Kaplan–Meier curves for the mortality outcomes: Home discharge versus Non-home discharge groups.

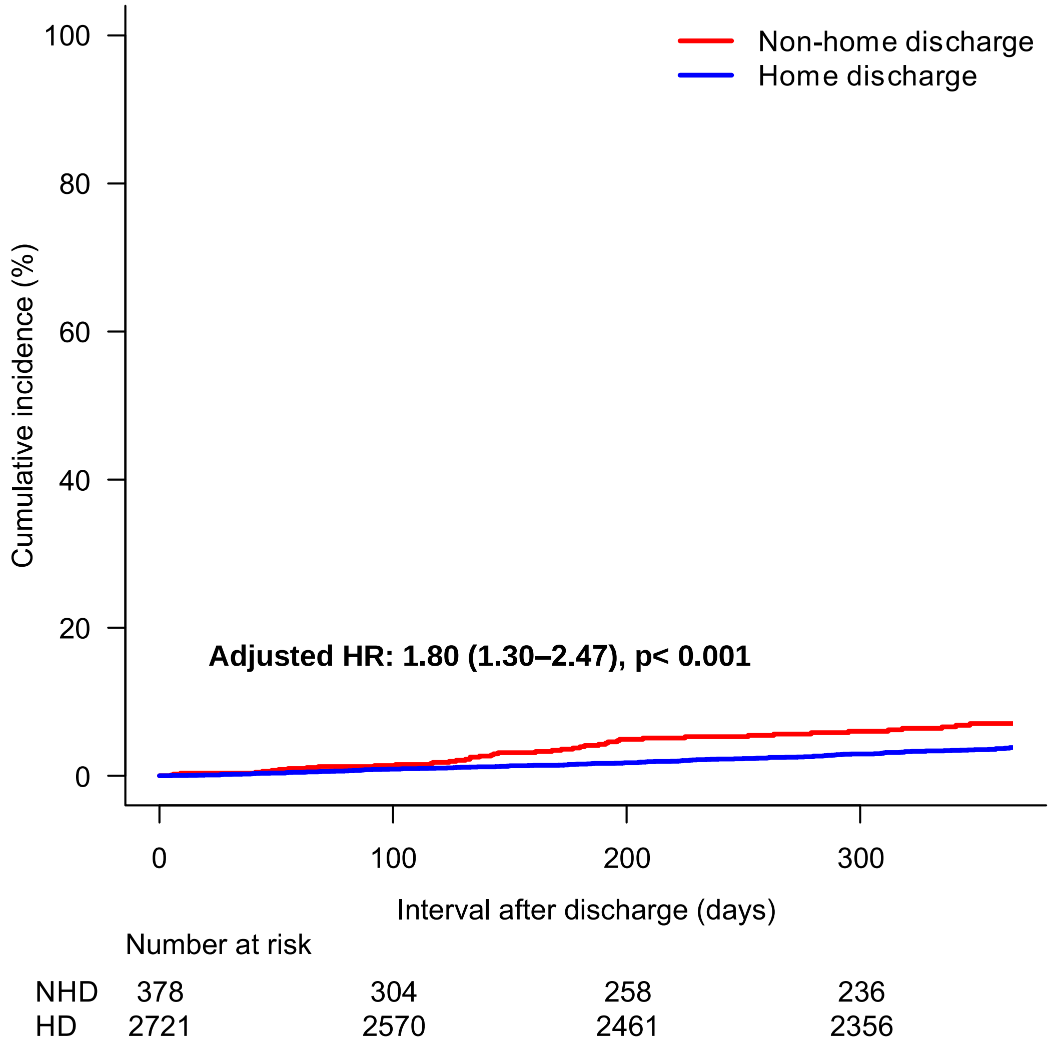
(A) All-cause death



(B) Cardiovascular death



(C) Non-cardiovascular death



(A) All-cause death, (B) Cardiovascular death, and (C) Non-cardiovascular death. Adjusting covariates were as follows: age ≥80 years, women, BMI ≤22 kg/m^2 at admission, acute coronary syndrome as the etiologies of heart failure, history of heart failure hospitalization, and myocardial Infarction, prevalence of atrial fibrillation or flutter, chronic lung disease, hypertension, diabetes mellitus, stroke, reduce EF, anemia and current smoking, living alone, and ambulatory before admission, systolic BP <90 mmHg, HR <60 beats/min, eGFR <30 mL/min/1.73 m^2, albumin <3.0 g/L, sodium <135 mEq/L on presentation, incidences of worsening heart failure, increase in serum creatinine levels ≥ 0.3 mg / dL, stroke, and infection during hospitalization, prescribed angiotensin-converting enzyme inhibitors /angiotensin receptor blockers and beta-blockers at discharge.