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Research Paper

Impact of nurse-led interprofessional work in older patients with heart failure and multimorbidity: A retrospective cohort study



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ABSTRACT

Background: The number of patients with multimorbidity has increased due to the aging of the global population. Although the World Health Organization has indicated that multimorbidity will be a major medical problem in the future, the appropriate interventions for patients with multimorbidity are currently unknown. This study aimed to investigate whether nurse-led interprofessional work is associated with improved prognosis in heart failure patients with multimorbidity aged ≥ 65 years who were admitted in an acute care hospital.

Methods: Patients who were admitted to the cardiovascular medicine ward of an acute care hospital in Osaka, Japan, and underwent nurse-led interprofessional work from April 1, 2017 to March 31, 2020, and from April 1, 2014 to March 31, 2016, were included in this retrospective cohort study. The patients were matched by age, sex, and New York Heart Association classification. The nurse-led interprofessional work was based on a three-step model that incorporates recommendations from international guidelines for multimorbidity. The primary outcome was all-cause mortality.

Results: The mean age of the participants was 80 years, and 62 % were men. The nurse-led interprofessional work group showed a significant difference in all-cause mortality compared with the usual care group (hazard ratio, 0.45; 95 % confidence interval [CI], 0.29–0.69; $P < 0.001$). Compared with the usual care group, the nurse-led interprofessional work group exhibited a 7 % difference in mortality rate at 1-year post-discharge ($P < 0.001$).

Conclusions: Nurse-led interprofessional work may reduce the all-cause mortality in older patients with heart failure and multimorbidity.

1. Introduction

Despite the increasing number of patients with multimorbidity in the aging global population, many clinical studies have mainly focused on investigating a single disease-specific care, and effective intervention methods for managing multimorbidity have not been identified. In the United States (US), 50 % of adults have one or more chronic diseases [1], and the number of patients with multiple diseases is increasing owing to the aging population [2]. In Scotland, ≥ 40 % of the total population have one or more chronic diseases, while 25 % have two or more chronic diseases [3]. In Japan, 52 % of the older population, aged 65 years and older, have multimorbidity [4]. Multimorbidity increases the mortality

rate [5] and medical expenses [6], decreases the quality of life [7] and physical function [8], and results in polypharmacy [9,10]; therefore, an effective intervention strategy is required for patients with multimorbidity.

In patients with multimorbidity, heart failure (HF) is one of the most important diseases [11]. With the aging of the global population, the prevalence of HF has increased worldwide, along with the clinical importance of its management. Recently, the number of inpatients and rehospitalizations due to HF have increased [12]. In addition, almost 40 % of the rehospitalization cases related to HF were early rehospitalizations due to insufficient discharge support [13].

Published guidelines on the appropriate interventions for patients

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with multimorbidity, including those from the United Kingdom National Institute of Health and Care Excellence [14] and the American Society of Gerontology [15], highlight the importance of collaboration of experts from multiple related fields. In 2018, the first large-scale randomized controlled trial to use a patient-centered care model for multimorbidity was proven ineffective [16]. No studies to date have demonstrated that multidisciplinary work improves the survival rates. These negative findings are likely related to the lack of studies that include “multidisciplinary collaboration.” Multidisciplinary collaboration refers to the involvement of healthcare professionals who specialize in different fields, although it does not always mean they work together. This approach is useful when managing patients with a single disease, where the role of each profession is patterned. However, it may not be applicable for managing complex patients, such as those with multimorbidity, who require “interprofessional work” whereby patients and professionals work together.

The nurse-led interprofessional work strategy has increasingly attracted attention. Nurses are the largest proportion of medical professionals in hospitals; they care for patients 24 h a day and are involved in many interprofessional relationships. They are also the only healthcare providers with roles in improving the daily living and medical aspects of patients. The role of nurses is important to ensure better health outcomes for chronic diseases and multiple pathological conditions [17]. Previous studies have reported the effectiveness of several nurse-led interventions, such as medication management [18], home visits after patient discharge, and telephonic physical health management [19]. However, the optimal treatment for patients with multimorbidity has not been reported.

This study aimed to clarify whether a nurse-led interprofessional work strategy can improve the survival and emergency hospitalization rates among hospitalized patients aged ≥ 65 years with HF and multimorbidity.

2. Material and methods

2.1. Study design and setting

We conducted a retrospective cohort study in patients with multimorbidity, aged ≥ 65 years, with concurrent HF, and who were admitted in a single acute care hospital in Osaka Prefecture between April 1, 2014, and March 31, 2020. This study was approved by the National Hospital Organization Osaka National Hospital, the target institution for

this research (approval number: 21-015). The data were collected from the electronic hospital medical records, which were anonymized to protect the privacy of the patients.

2.2. Nurse-led interprofessional work

The nurse-led interprofessional work was implemented at the study site in May 2016 (Fig. 1). Further details of Fig. 1 are presented in Supplementary Fig. 1 (Supplementary Fig. 1).

2.2.1. Step 1: screening

Nurses conducted a screening within 3 days of hospitalization, assessing for potential post-discharge issues such as the need for home healthcare services, the risk of decline in the performance of activities of daily living (ADLs), the necessity for medical and social welfare systems, and economic concerns. Step 2 was performed on patients who met at least one of the screening criteria.

2.2.2. Step 2: standard strategy

In the standard strategy, nurses collected information within 7 days of hospitalization on medical issues currently experienced by patients and their families, medical history, ADLs, housing environment, and the use of medical and welfare systems. In addition, nurses and medical social workers held conferences to discuss different strategies for achieving therapeutic goals and decisions regarding the necessity of discharge support. After formulating the discharge objectives and obtaining consent from the patient and their family, interventions were executed to accomplish these goals. This process of interprofessional work in goal setting and intervention, led by nurses, was defined as nurse-led interprofessional work. Step 3 was performed in patients for whom the standard strategy was deemed insufficient as determined by the nurse.

2.2.3. Step 3: optional strategy

This optional strategy included the involvement of doctors, pharmacists, physiotherapists, occupational therapists, speech therapists, nutritionists, and nurses. Furthermore, nurses collaborated with home doctors and visiting nurses to manage patients with a high risk of rehospitalization or who required home health services, such as intravenous treatment, a urinary catheter, pressure ulcer treatment, or home oxygen therapy. Before hospital discharge, professionals from the hospital treatment and home care fields discussed the progress of the patient

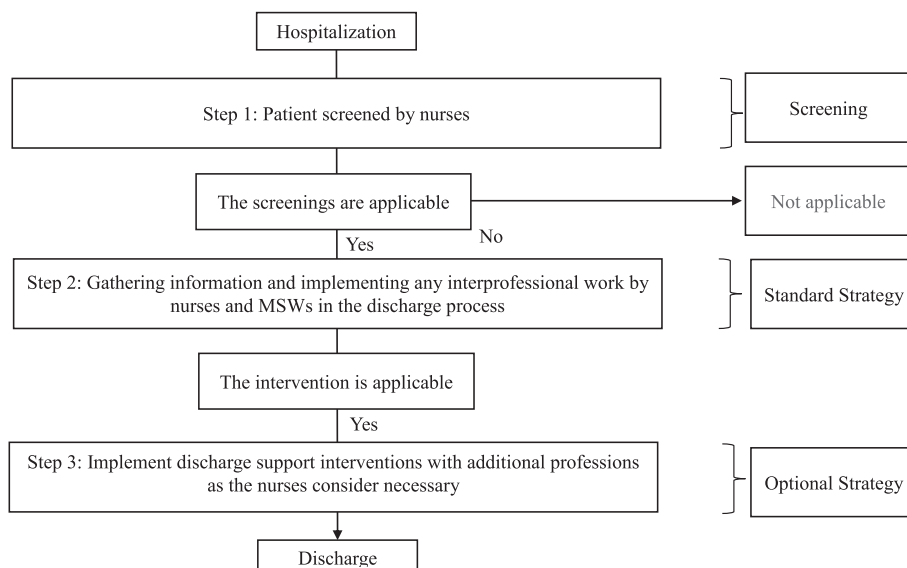


Fig. 1. The nurse-led interprofessional work.

and coordinated home services after discharge.

This nurse-led interprofessional work was carried out jointly by nurses with specialized knowledge in discharge support (discharge support nurses) and ward nurses. One discharge support nurse was assigned to two wards.

2.3. Participants

All 351 patients with HF aged ≥ 65 years and admitted in the cardiovascular medicine ward at an acute hospital in Osaka, Japan, from April 1, 2017, to March 31, 2020, were assigned in the nurse-led interprofessional work group; meanwhile, 412 patients with HF who were hospitalized in the same ward from April 1, 2014, to March 31, 2016, were assigned as the usual care group. We matched 200 patients from each group according to age, sex, and New York Heart Association (NYHA) classification. None of the patients had missing data, and all patients were included in the final analysis. Patients aged ≤ 64 years, with a Charlson Comorbidity Index (CCI) score of ≤ 1 , and who died during hospitalization were excluded.

There is no standard definition of multimorbidity used worldwide. Previous studies have defined multimorbidity as having ≥ 2 chronic diseases [20] and using CCI scores [21–24], an index used for assessing the severity of multimorbidity. This measure was developed in an inpatient US population to predict mortality and includes 19 conditions that have been selected and weighted in relation to their association with mortality risk [25].

Therefore, this study defined patients with HF with a CCI score of ≥ 2 as individuals with multimorbidity. The primary outcome was all-cause mortality. This study included patients with HF as a part of their multimorbidity profile. Thus, we assessed the all-cause mortality rate instead of examining a specific disease.

2.4. Variables

The World Health Organization defines polypharmacy as the daily use of more than five different drugs [26]. Since polypharmacy in Japan is often defined as taking more than six different drugs, we defined polypharmacy as patients taking more than six medicines [27]. The certified long-term care levels were evaluated and graded by severity, from mild to severe, on an 8-point scale: not applicable, requiring help 1, requiring help 2, long-term care level 1, long-term care level 2, long-term care level 3, long-term care level 4, and long-term care level 5. This study used the certified long-term care levels instead of the Barthel Index (BI) to measure ADLs. The correlation coefficient between certified long-term care levels and BI was $r = -0.70$, showing a strong correlation and suggesting the validity of certified long-term care levels as an indicator of ADLs [28]. In this study, not applicable, requiring help 1, and requiring help 2 were defined as ADLs independence; long-term care levels 1–3 as partial ADLs assistance; and long-term care levels 4–5 as full ADL assistance. Data collection started on July 26, 2021 and ended on August 29, 2021.

2.5. Statistical analysis

Univariate analysis was used to clarify the effects of the nurse-led interprofessional work. We divided the patients into the nurse-led interprofessional work and usual care groups. Student's *t*-test was used for comparing non-compliant continuous variables, Mann–Whitney *U* test for the corresponding continuous variables, and χ^2 for nominal variables. We conducted a Cox proportional hazards regression analysis to investigate the association between the primary outcome, all-cause mortality, and nurse-led interprofessional work. To determine the independent variables, the participants were divided into two groups based on the all-cause mortality rate, and univariate analysis was conducted. Subsequently, the independent variables were selected by identifying variables with significant differences in the univariate

analysis and considering previous studies. A Cox proportional hazards regression analysis was conducted with all-cause mortality as the dependent variable. Next, we conducted a log-rank test, dividing the participants into nurse-led interprofessional work groups and usual care groups, with the event being all-cause mortality after 1 year of discharge. Considering the different entry periods of nurse-led interprofessional work and usual care, the censoring period was set to the last day of data collection, and the follow-up period was evenly divided for analysis.

We conducted a Cox proportional hazards regression analysis to investigate the association between emergency hospitalization within 6 weeks after discharge and nurse-led interprofessional work. To identify the independent variables, the participants were divided into two groups based on the emergency hospitalization status within 6 weeks post-discharge, and a univariate analysis was conducted. The independent variables were selected by determining the variables with significant differences in the univariate analysis and considering previous studies. A Cox proportional hazards regression analysis was conducted with emergency hospitalization within 6 weeks post-discharge as the dependent variable.

All statistical analyses were performed using the EZR software (64-bit ver. 1.42, Saitama Medical Center, Jichi Medical University, Saitama, Japan), a modified version of the R commander (R Foundation for Statistical Computing, Vienna, Austria) designed to add statistical functions often used in biostatistics. The significance level was set to 5 %.

3. Results

From April 1, 2014, to March 31, 2020, 400 out of 763 patients with HF aged ≥ 65 years who were admitted to the cardiology ward were selected. They were divided into the nurse-led interprofessional work and usual care groups and were matched in a 1:1 ratio based on age, sex, and NYHA classification. The mean age of the patients was 80 years, of whom 62 % were men and 38 % were women. The NYHA classification distributions were as follows: Class 1, 32.5 %; Class 2, 46.5 %; Class 3, 20.5 %; and Class 4, 0.5 %. The mean CCI was 6. No significant differences were observed between the two groups in terms of the level of care required or duration of hospitalization, indicating that the characteristics of both groups were similar. However, the incidence of polypharmacy and involvement of medical social workers were significantly lower in the nurse-led interprofessional work group. Furthermore, this group showed significantly higher rates of transition care measures such as visiting nursing and home-based physicians (Table 1). Results of the Cox proportional hazard regression analysis are presented in Table 2 (Table 2). The nurse-led interprofessional work group showed a significant difference in all-cause mortality compared with the usual care group (hazard ratio, 0.45; 95 % confidence interval [CI], 0.29–0.69; $P < 0.001$). Moreover, patients who required long-term care levels 1–3 (hazard ratio, 2.00; 95 % CI, 1.23–3.28; $P = 0.006$), as well as those who required long-term care levels 4 and 5 (hazard ratio, 3.52; 95 % CI, 1.89–6.58; $P < 0.001$) had higher mortality rates, indicating a trend toward higher all-cause mortality as the ADL functioning declined. Furthermore, patients with polypharmacy (hazard ratio, 2.18; 95 % CI, 1.01–4.75; $P = 0.05$) or those on home oxygen therapy (hazard ratio, 2.58; 95 % CI, 1.46–4.55; $P < 0.001$) tended to have higher all-cause mortality rates. The dependent variable, all-cause mortality within 1-year post-discharge, as demonstrated in a Log-rank test, is presented in Fig. 2 (Fig. 2). Compared with the usual care group, the nurse-led interprofessional work group exhibited a 7 % difference in mortality rate at 1 year post-discharge ($P < 0.001$). Furthermore, the difference in mortality rates increased with time, showing a 3 % difference at 100 days post-discharge, a 5 % difference at 200 days post-discharge, and a 7 % difference at 300 days post-discharge. Results of the Cox proportional hazard regression analysis with emergency hospitalization within 6 weeks post-discharge as the dependent variable are presented in Supplementary Table 1. The nurse-led interprofessional work group

Table 1
Univariate analysis of nurse-led interprofessional work.

Characteristics	Nurse-led interprofessional work (n = 200)	Usual care (n = 200)	P-value
Age, years	80.00 (±5.0)	80.00 (±5.0)	1
Sex			
Male	124 (62.0)	124 (62.0)	1
Female	76 (38.0)	76 (38.0)	
Body mass index	20.8 (3.8)	20.9 (±4.0)	0.77
Level of care required			
Not applicable – support needed level 2	149 (74.5)	150 (75.0)	0.13
Care levels 1–3	34 (17.0)	42 (21.0)	
Care levels 4–5	17 (8.5)	8 (4.0)	
New York Heart Association class			
1	65 (32.5)	65 (32.5)	1
2	93 (46.5)	93 (46.5)	
3	41 (20.5)	41 (20.5)	
4	1 (0.5)	1 (0.5)	
HEpEF	105 (52.5)	92 (46.0)	0.23
HErEF	95 (47.5)	108 (54.0)	
LVEF	47.5 (31.0–65.0)	51.0 (32.0–64.0)	0.63
CCI	6.0 (5.0–8.0)	6.0 (5.0–8.0)	0.2
BNP	280.0 (128.7–520.0)	313.0 (137.9–637.0)	0.21
ALB	3.5 (3.2–3.8)	3.5 (3.2–3.8)	0.48
Polypharmacy	160 (80.0)	178 (89.0)	0.02
Dementia	21 (10.5)	10 (5.0)	0.06
Emergency hospitalization	149 (74.5)	154 (77.0)	0.56
Length of hospital stay	19.0 (14.0–27.3)	20.5 (15.0–32.0)	0.06
Emergency admission within 6 weeks post-discharge	17 (8.5)	55 (27.5)	<0.001
Multidisciplinary conference prior to discharge	31 (15.0)	13 (6.5)	1.01
HOT	12 (6.0)	17 (8.5)	0.44
Medical social worker	15 (7.5)	34 (17.0)	0.006
Home service	62 (31.0)	49 (24.5)	0.18
Home-based physician	21 (10.5)	6 (3.0)	0.004
Day service	24 (12.0)	19 (9.5)	0.52
Helper	30 (15.0)	31 (15.5)	1
Visiting nursing	34 (17.0)	16 (8.0)	0.01

Abbreviations: ALB, albumin; BNP, brain natriuretic peptide; CCI, Charlson Comorbidity Index; HOT, home oxygen therapy. All data are expressed as the means (±SD) or median (quartile 1–quartile 4), unless indicated otherwise.

Table 2
Association between nurse-led interprofessional work and all-cause mortality.

	HR (95 % CI)	P-value
Age, years	1.01 (0.98–1.05)	0.41
Sex		
Male	1 (Reference)	
Female	0.69 (0.45–1.07)	0.1
Level of care required		
Not applicable – support needed level 2	1 (Reference)	
Care level 1–3	2.00 (1.23–3.28)	0.006
Care level 4–5	3.52 (1.89–6.58)	<0.001
ALB	0.81 (0.56–1.18)	0.28
CCI	1.06 (0.99–1.15)	0.11
Nurse-led interprofessional work	0.45 (0.29–0.69)	<0.001
Visiting nursing	1.05 (0.59–1.86)	0.88
Polypharmacy	2.18 (1.01–4.75)	0.05
HOT	2.58 (1.46–4.55)	<0.001

Abbreviations: ALB, albumin; CCI, Charlson Comorbidity Index; HOT, home oxygen therapy; HR, hazard ratio; CI, confidence interval.

showed a significant difference in emergency hospitalization within 6 weeks post-discharge compared with the usual care group (hazard ratio, 0.16; 95 % CI, 0.08–0.30; $P < 0.001$). Additionally, those who required long-term care levels 1–3 (hazard ratio, 3.20; 95 % CI, 1.71–5.97; $P < 0.001$), as well as those who required long-term care levels 4 and 5 (hazard ratio, 4.74; 95 % CI, 2.23–10.70; $P < 0.001$) had higher emergency hospitalization rates within 6 weeks post-discharge, indicating a trend toward higher emergency hospitalization within 6 weeks post-discharge as the ADL functioning declined. Furthermore, patients on home oxygen therapy (hazard ratio, 5.11; 95 % CI, 2.71–9.66; $P < 0.001$) tended to have higher emergency hospitalization rates within 6 weeks post-discharge.

4. Discussion

We investigated the impact of nurse-led interprofessional work on patients aged ≥ 65 years with HF and multimorbidity admitted in an acute care hospital. This intervention was associated with decreased all-cause mortality and emergency hospitalization rates within 6 weeks post-discharge. The interventions in our study differed from the conventional interventions in three ways. First, we included nurse-led interprofessional interventions characterized by the identification of various patient problems related to daily life after hospital discharge and collaboration with the appropriate professionals at the appropriate time. Within the framework of interprofessional work, nurses possessing specialized expertise in discharge support are posited to have served pivotal roles as facilitators. The nurse-led interprofessional work model used in our study strengthened the interactions among professions and demonstrated better results. Despite having similar CCI scores and length of hospital stay between the nurse-led interprofessional work and usual care groups, the nurse-led interprofessional work group demonstrated a significantly lower prevalence of polypharmacy. This finding may be related to the collaboration of nurses with pharmacists and physicians. Second, our study began in the early stages of hospitalization and continued until discharge. Although previous studies often involve the application of transient interventions before discharge [29], our study ensured that sufficient time was allotted to implement the measures, such as nutrition guidance, enhancing ADL functioning, and self-care interventions, necessary for improving the patients' outcomes due to the long-term and continuous involvement of nurses. Third, ward nurses, upon determining that a patient required further interventions post-discharge, obtained consent from the patient and proceeded with information sharing with home-visiting nurses, home-based physicians, pharmacists, and other local professionals. These professionals also provided post-discharge interventions. This comprehensive nurse-led interprofessional work from early hospitalization to post-discharge is not observed in previous studies and serves as the strength of our study. Although numerous studies have examined the discharge support provided to patients with HF, effective intervention strategies still need to be clearly identified. Approximately 40 % of early readmission cases among patients with HF were deemed preventable and attributable to suboptimal transitional care caused by insufficient care coordination and noncontinuity of care as patients transferred between healthcare settings or providers [30]. More intricate and intense nurse-led transitional care programs may yield greater benefits in reducing HF-related readmissions. This suggests that the complexity and intensity of the intervention are likely key determinants of patient outcomes [31]. Our study facilitated seamless, complex, and intense nurse-led interprofessional work from the period of hospitalization, thus improving the self-care capabilities of patients and reducing the emergency hospitalization rates within 6 weeks post-discharge. HF is characterized by recurrent acute exacerbations of chronic HF, eventually leading to death. Therefore, reduction in the emergency hospitalization rates within 6 weeks post-discharge—thus preventing HF relapses through nurse-led interprofessional work—was also linked to the observed decrease in all-cause mortality.

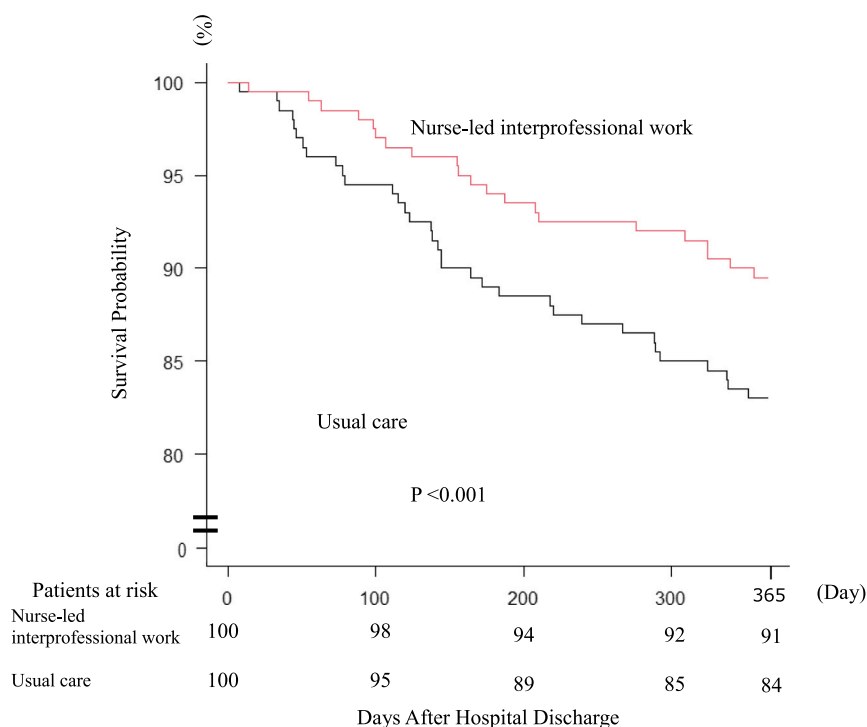


Fig. 2. Kaplan–Meier survival curves: survival curves within 1-year after discharge with nurse-led interprofessional work and usual care.

Our study has some limitations. First, this was a retrospective cohort study with a 6-year observation period. Although the guidelines were revised during this period [32], no modifications were observed in the treatment protocols that directly affect the mortality or emergency hospital admission rates. Second, the sample size was small as we only used 200 matched pairs of participants. Third, the variability of the interventions within the nurse-led interprofessional work is also considered a limitation, as it is unclear which specific interventions were associated with the observed outcomes. The standard strategy was uniformly implemented in all patients within the nurse-led interprofessional work group; however, the extent of the optional implementation remained uncertain. Consequently, future research should focus on the optional strategy to elucidate which interventions directly correlate with the outcomes.

To our knowledge, this study is the first to demonstrate the impact of nurse-led interprofessional work on improving the life expectancy of patients with multimorbidity. Many studies have demonstrated the impact of multimorbidity on the risk of rehospitalization and prognosis [33–35]; moreover, the longer the life expectancy, the greater the number of patients with multimorbidity. Although many randomized controlled trials have been conducted, no studies have demonstrated clear patient benefits, such as extended life expectancy. In our study, we focused on the role of nurses and proposed a nurse-led interprofessional work strategy. In the future, we will conduct a randomized controlled trial to further contribute to the evidence regarding an intervention model for multimorbidity.

5. Conclusions

Nurse-led interprofessional work may reduce the all-cause mortality and emergency hospitalization within 6 weeks post-discharge in older patients with HF and multimorbidity.

Ethical conduct of research

This study was approved by the National Hospital Organization Osaka National Hospital (approval number: 21-015). All research

methods were conducted in accordance with applicable laws, regulations, and guidelines.

Data handling

The privacy of participants and the confidentiality of data were strictly protected at all stages. Identifiable personal information was anonymized or pseudonymized, except when necessary.

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Data statement

The following data was used in this study: data.csv.

CRediT authorship contribution statement

Yuichiro Saizen: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Kasumi Ikuta:** Conceptualization, Methodology. **Mizuki Katsuhisa:** Conceptualization, Methodology. **Yuko Takeshita:** Conceptualization, Methodology. **Yuki Moriki:** Conceptualization, Methodology. **Misaki Kasamatsu:** Conceptualization, Methodology. **Mai Onishi:** Conceptualization, Methodology. **Kiyoko Wada:** Data curation. **Chiharu Honda:** Data curation. **Kyoko Nishimoto:** Data curation. **Yoshiko Nabetani:** Supervision. **Tomoyuki Iwasaki:** Supervision. **Eriko Koujiya:** Supervision. **Miyae Yamakawa:** Supervision. **Yasushi Takeya:** Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ahjo.2024.100361>.

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