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Review Article

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Nurse-Driven Zone-Based Heart Failure Protocol in Skilled Nursing Facilities: A Retrospective Cohort Study

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ABSTRACT

Background: Heart failure (HF) remains a leading cause of morbidity, mortality, and healthcare utilization among older adults, with skilled nursing facilities (SNFs) experiencing disproportionately high 30-day readmission rates owing to multimorbidity, cognitive impairment, and limited specialty access. Nurse-driven zone-based protocols provide an opportunity to standardize HF management and improve early symptom recognition in post-acute care settings.

Objective: To evaluate the effect of a nurse-driven, zone-based HF protocol on 30-day rehospitalization rates and demonstrate the feasibility of implementing standardized, evidence-based HF management within the SNF environment using a retrospective cohort design.

Methods: This retrospective cohort study compared residents with documented HF hospitalizations during the 12-month pre-implementation period (2023) and 12-month post-implementation period (2024). The primary outcome was the 30-day readmission rate, calculated as the number of readmissions within 30 days of hospital discharge divided by the total number of hospitalizations. Secondary analyses included assessment of absolute and relative risk reductions with 95% confidence intervals (CI). Descriptive comparisons and effect size calculations were performed using prespecified statistical approaches.

Results: Pre-intervention analysis encompassed 907 hospitalizations, with 653 readmissions (72.0% readmission rate). Following the protocol implementation, 567 hospitalizations resulted in 295 readmissions (52.0% readmission rate). This represented an absolute reduction of 20 percentage points and a 27.8% relative reduction in readmission risk (RR=0.72; 95% CI: 0.67–0.78). The number of patients required to prevent one readmission was 5. Protocol fidelity metrics demonstrated 89% adherence to zone-based assessments and 94% completion of mandatory HF specific variables during the implementation period.

Keywords: Heart Failure, Nurse-Driven Protocol, Zone-Based Management, Skilled Nursing Facility, 30-Day Readmissions

Introduction

Heart failure is one of the most prevalent and costly chronic conditions affecting older adults in the United States. It is a major driver of hospital readmissions, functional decline, and mortality in the post-acute care continuum. The epidemiological burden of Heart Failure (HF) is particularly acute in skilled nursing facilities, where residents often present with advanced HF stages, multiple comorbidities, and complex medication regimens which create substantial management challenges. Among adults aged > 50 years, HF is a leading cause of hospital admission and readmission, with the prevalence of HF increasing substantially with age--- from less than 2% in those younger than 60 years to > 10% in those older than 75 years. Admission rates for patients over 50 years of age with congestive heart failure vary substantially based on care setting, disease severity, and comorbidity burden. SNFs experience readmission rates ranging from 18% to 24% within 30 days across the general population, with rates as high as 31% among patients with HF diagnoses, which are disproportionately high compared with other postacute settings.[12] Multiple systematic factors contribute to this clinical reality, including the prevalence of multimorbidity and polypharmacy among SNF residents, cognitive impairment that may limit patient self-management capacity, limited access to specialty care including cardiology and HF nurse specialists, and significant variation in clinical monitoring practices and protocols across and within facilities [1-3].

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The consequences of frequent HF-related readmissions extend beyond individual patient outcomes and include substantial economic burden on healthcare systems, increased utilization of emergency departments and inpatient resources, and opportunities for preventable complications and functional deterioration. The current literature underscores the critical need for standardized, evidence-based, and reproducible management frameworks that can be operationalized at scale in SNF environments. Given the central role of nursing in direct patient care, symptom monitoring, and care coordination, nurse-driven interventions and protocols have emerged as particularly promising strategies for improving HF outcomes in post-acute settings. Prior research has demonstrated that nurse-driven HF interventions improve multiple domains, including symptom monitoring, quality of life, clinical decision-making, and readmission reduction. Meta-analyses have demonstrated that nurse-led transitional care interventions result in a 9% reduction in all-cause readmissions and a 29% reduction in HF-specific readmissions compared to usual care, with comprehensive nursing care programs showing odds ratios of 0.77 for HF-related readmissions [4-5].

Zone-based or color-coded HF management protocols represent a specific implementation strategy designed to enhance early symptom recognition, standardize escalation pathways, and empower nursing staff to intervene in the earliest signs of HF decompensation proactively. These protocols stratify patients into risk zones (typically green for stable status, yellow for early warning signs requiring increased monitoring and possible intervention, and red for critical decompensation requiring immediate provider notification and escalation) based on objective clinical parameters, including weight changes, vital signs, and a constellation of HF symptoms. The conceptual framework underlying zone-based protocols aligns with contemporary principles of cardiac nursing science, emphasizing the timely recognition of subtle clinical changes that precede acute decompensation and immediate coordinated escalation to prevent unnecessary hospitalizations.

This study evaluated the effect of implementing a standardized, nurse-driven, zone-based HF protocol on 30-day readmission rates within a large SNF system. This study addresses a significant gap in the post-acute care literature regarding the effectiveness and feasibility of protocol-driven HF management in SNF settings. We hypothesized that the implementation of the zone-based protocol would be associated with meaningful reductions in 30-day readmissions through mechanisms of enhanced early detection, standardized clinical responses, and improved coordination between nursing staff and providers.

Methods

Study Design and Theoretical Framework

This study employed a retrospective cohort design comparing outcomes 12 months before and 12 months after protocol implementation, consistent with (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational research. The study was designed as a quality improvement initiative informed by the principles of implementation science and nursing-led care redesign. The intervention was grounded in contemporary HF management guidelines, which emphasize early symptom recognition, medication optimization, and coordinated care pathways. The study protocol was received and approved by the facility's Institutional Review Board. It was documented under protocol number QI-2024-HF-001, with determination of exemption from full IRB review as a quality improvement initiative. [3–5]

Setting and Population

This study was conducted within a skilled nursing facility serving a diverse population of older adults with complex chronic conditions. The facility includes multiple units that provide post-acute care services to residents following hospitalization, rehabilitation stays and extended skilled care needs. All SNF residents with documented HF diagnoses and at least one hospitalization during the study period (January 2023 to December 2024) were eligible for inclusion. The specific inclusion criteria were as follows:

- Documented HF diagnosis in the medical record using International Classification of Diseases (ICD-10) codes or clinical documentation
- At least one hospitalization during the study period
- Complete hospitalization and readmission data available within the facility's electronic health record system

Exclusion Criteria were:

- Missing or incomplete HF documentation,
- Incomplete hospitalization records, and
- Inability to verify 30-day readmission status.

This inclusive approach allowed evaluation of the protocol across a diverse population, reflecting real-world SNF populations.

Intervention: Zone-Based HF Management Protocol

The zone-based HF protocol represents a comprehensive multimodal intervention involving standardized assessment, stratified risk classification, and protocol-driven nursing interventions. Residents were assigned to one of the three risk zones based on a combination of clinical parameters and symptom assessment. Green Zone (stable): Residents demonstrating clinical stability with absence of new or progressive HF symptoms, stable weight (±2–3 lbs from baseline), normal vital signs, adequate diuresis, and no signs of volume overload on physical examination. Residents in the Green Zone received standard HF monitoring, including twice-weekly vital sign assessments and weight monitoring. Yellow Zone (Caution—Early Warning): Residents exhibiting early warning signs requiring intensified monitoring and potential intervention, including new or progressive dyspnea, weight gain of 3–5 lbs over 1–2 days, elevated blood pressure, decreased urine output, new or worsening peripheral edema, or emerging orthopnea. Yellow Zone residents received daily vital signs and weight monitoring, daily nursing assessment for HF symptoms, and provider notification with consideration for medication adjustments (particularly diuretic titration) under established standing orders. This zone triggered nurse-initiated interventions within the scope of the nursing practice and facility protocols.

Red Zone (critical —Immediate Attention): Residents presenting with signs of acute HF decompensation or clinical deterioration requiring immediate provider evaluation, including acute dyspnea, orthopnea, or paroxysmal nocturnal dyspnea, significant weight gain (>5 lbs in 1–2 days), hypotension, significant vital sign changes, signs of acute pulmonary or peripheral edema, altered

mental status, or decreased level of consciousness. Red Zone assignments triggered mandatory and immediate (same-day) provider contact, urgent clinical assessment, and consideration for hospital transfer when clinically appropriate. Nursing staff were empowered to initiate standing orders for diuretic dose escalation, fluid restriction, and intensified monitoring prior to provider evaluation when permitted by protocols.

The intervention included mandatory HF-specific variables including body weight (with daily trending), assessment of edema (location, severity, and progression), dyspnea evaluation (at rest, with activity, orthopnea, and paroxysmal nocturnal dyspnea), and vital sign monitoring (heart rate, blood pressure, respiratory rate, and oxygen saturation). Additional domains integrated into the protocol included current HF medications and any recent changes, comorbid conditions and their stability, cognitive and functional status, social support and discharge planning considerations, and any post-readmission debriefings or quality review discussions following hospital stay.

Implementation and Nurse Empowerment

Critical to the intervention design was the explicit empowerment of nursing staff to initiate evidence-based HF interventions within established protocols and the scope of practice. Nurses were trained to recognize zone transitions, interpret protocol-driven assessments, and implement standardized responses without requiring prior provider approval for certain interventions (subject to facility policies and standing orders). This approach reflects contemporary nursing science principles that emphasize nurse autonomy, clinical decision-making capacity, and leadership in implementing quality improvement initiatives. Nursing staff received comprehensive orientation to the protocol including recognition of HF symptoms and zone indicators, appropriate documentation of clinical findings in the electronic health record, protocols for provider communication and escalation, and familiarity with standing orders permitting nurse-initiated interventions such as diuretic dose adjustments within specified parameters [7-8].

Variables and Data Collection

Data elements were extracted from the facility's electronic health record system and organized into pre-specified categories. Demographic variables included age, sex, race/ethnicity, and length of hospital stay. Clinical variables included HF classification (HFrEF vs. HFpEF, where documented), current HF medications with dosages, comorbid conditions (hypertension, diabetes, chronic kidney disease, atrial fibrillation), ejection fraction when available, and NYHA functional class documentation. Process variables included the frequency of HF assessments, zone assignments over time, documentation of provider communications and escalations, nursing interventions initiated, and adherence to protocol elements. Outcome variables included 30-day readmission status, length of hospital stay, time from discharge to readmission for readmission, and readmission diagnoses where available.

Protocol Fidelity and Implementation Metrics

Protocol fidelity was assessed through a systematic chart review of a random sample of 150 patients during the post-implementation period. Fidelity metrics included:

- Completion of zone-based assessment within 24 hours of admission or status change (89% adherence)
- Documentation of all mandatory HF-specific variables including weight, edema assessment, dyspnea evaluation, and vital signs (94% completion rate)
- Appropriate zone assignment based on clinical criteria (92% concordance with independent expert review)
- Timely notification of yellow and red zone assignments (87% within specified time frames)
- Initiation of protocol-driven interventions per zone criteria (85% adherence). These fidelity metrics demonstrate high implementation quality and suggest that the observed outcomes reflect genuine protocol effects rather than incomplete or inconsistent implementations.

Primary and Secondary Outcomes

The primary outcome was the 30-day readmission rate, defined according to the national HF quality standards as the proportion of residents readmitted to the hospital within 30 days of discharge following an index hospitalization. Readmission was verified through a review of hospital records, facility readmission documentation, and insurance claims records when available. The specific calculation was as follows: (total number of 30-day readmissions) ÷ (total number of index hospitalizations) × 100 = 30-day readmission rate [8].

Secondary outcomes included absolute reduction in readmission rate (pre- vs. post-intervention percentages), relative risk reduction comparing post-intervention to preintervention readmission rates, number needed to treat (NNT) to prevent one readmission, time to readmission for those readmitted, hospital length of stay during index admissions, and any adverse events or unintended consequences documented during the study period. Safety outcomes included monitoring for evidence of missed diagnoses, inadequate escalations, or harm related to protocol implementation.

Statistical Analysis

Descriptive statistics were calculated for the demographic characteristics, clinical variables, and outcomes. The primary outcome analysis compared pre- and postintervention 30-day readmission rates using descriptive comparisons and relative risk calculations. Effect sizes were calculated, including absolute risk reduction (ARR), relative risk reduction (RRR), and number needed to treat (NNT), with 95% confidence intervals. Ninety-five percent confidence intervals for the relative risk were calculated using the log-transformation method, which linearizing the exponential scale and provides an accurate interval estimation for ratio measures in cohort studies. Specifically, the standard error of the log relative risk was calculated as: $SE(\log RR) = \sqrt{[(1-p_1)/(n_1 \times p_1) + (1-p_2)/(n_2 \times p_2)]}$, where p_1 and p_2 represent the readmission proportions in the postintervention and pre-intervention groups respectively, and n_1 and n_2 represent the total hospitalizations in each group. The 95% confidence interval was then constructed on a log scale and exponentiated to obtain the final confidence interval [9-10].

Missing data were handled using listwise exclusion for primary analyses Sensitivity analyses incorporating alternative assumptions about missing data were conducted to assess the

robustness of the findings. To address potential unmeasured confounding, sensitivity analyses were performed using the E-value methodology to quantify the minimum strength of association an unmeasured confounder would need with both the intervention and the outcome to fully explain the observed effect. The Evalue for the observed relative risk of 0.72 was calculated as 2.11, indicating that an unmeasured confounder would need to be associated with both protocol implementation and readmission outcome by a risk ratio of at least 2.11-fold each, above and beyond the measured confounders, to explain the observed association. This suggests a reasonable robustness to unmeasured confounding factors [11-12].

Subgroup analyses examining potential differential effects by demographic characteristics (age, sex, race) and clinical factors (HF type, comorbidities) were conducted when adequate sample sizes were available. Given the retrospective design and real-world implementation context, statistical inference was approached conservatively with an emphasis on effect sizes and confidence intervals rather than hypothesis testing. All analyses were conducted using standard statistical software with pre-specified analytical approaches documented in a statistical analysis plan developed before detailed data analysis.

Results

Sample Characteristics and Study Flow

The pre-intervention cohort (2023) included residents with 907 documented HFrelated hospitalizations. The post-intervention cohort (2024) included residents with 567 documented HF-related hospitalizations. The reduction in the number of hospitalizations between the study periods reflects natural fluctuations in the patient census and case distribution within the SNF system. Table 1 presents the detailed demographic and clinical characteristics of the study population across both the time periods. The mean age of participants was 78.4 ± 8.3 years in the pre-intervention period and 79.1 ± 7.9 years in the post-intervention period, reflecting a population of predominantly older adults. Sex distribution remained relatively consistent, with females comprising 58% of the preintervention cohort and 59% of the post-intervention cohort. Racial and ethnic compositions included both white and non-white residents across both periods, reflecting the diversity of the SNF population.

Table 1: Demographic and Clinical Characteristics of Skilled Nursing Facility Residents with Heart Failure Before and After Protocol Implementation

Characteristic	Pre-intervention (2023) (n = 907 hospitalizations)	Post-intervention (2024) (n = 567 hospitalizations)
Age, mean ± SD, y	78.4 ± 8.3	79.1 ± 7.9
Female sex, No. (%)	526 (58)	335 (59)
HFrEF, No. (%)	472 (52)	289 (51)
HFpEF, No. (%)	317 (35)	204 (36)
HF classification not specified, No. (%)	118 (13)	74 (13)
Ejection fraction, mean ± SD, %	38.2 ± 15.1	39.8 ± 14.6
Hypertension, No. (%)	789 (87)	499 (88)
Diabetes mellitus, No. (%)	526 (58)	340 (60)
Chronic kidney disease, No. (%)	472 (52)	306 (54)
Atrial fibrillation, No. (%)	408 (45)	266 (47)

Clinical characteristics were comparable between the cohorts with respect to HF classification, comorbidity burden, and medication profiles. Heart failure with reduced ejection fraction (HFrEF) represented 52% of documented HF cases in the preintervention period versus 51% in the post-intervention period, while heart failure with preserved ejection fraction (HFpEF) accounted for 35% and 36%, respectively. In approximately 13-14% of cases, the HF classification was not specified in the available documentation. Comorbid conditions were highly prevalent in both cohorts, with hypertension affecting 87-88% of residents, diabetes present in 58-60%, chronic kidney disease in 52-54%, and atrial fibrillation in 45-47%. Mean ejection fraction values where documented averaged 38.2 ± 15.1% in the pre-intervention cohort and 39.8 ± 14.6% in the post-intervention cohort. NYHA functional class distribution was similar between the groups, with approximately 40% Class II, 35% Class III, and 25% Class IV at baseline assessment.

Primary Outcome: 30-Day Readmission Rates.

The pre-intervention analysis encompassed 907 hospitalizations with 653 documented readmissions within 30 days of discharge, yielding a 30-day readmission rate of 72.0% (95% CI: 69.0%-74.9%). Following the implementation of the nurse-driven zone-based HF protocol, the post-intervention period demonstrated a substantial reduction in readmission rates. During the 12-month post-implementation period (2024), 567 hospitalizations resulted in 295 readmissions within 30 days, corresponding to a 30day readmission rate of 52.0% (95% CI: 48.0%-56.0%). This represents an absolute reduction of 20 percentage points in readmission rates. The relative risk reduction comparing post-intervention to pre-intervention rates was 27.8%, with a relative risk of 0.72 (95% CI: 0.67-0.78). The number needed to treat (NNT) to prevent one readmission was five, indicating that implementation of the protocol would prevent one 30-day readmission for every five hospitalized patients managed under the protocol.

Secondary Outcomes and Readmission Characteristics

Analysis of the secondary outcomes revealed additional clinically meaningful improvements beyond the primary readmission outcomes. Mean time to readmission for those who were readmitted was 18.3 ± 8.5 days in the pre-intervention period versus 21.1 ± 9.2 days in the post-intervention period, suggesting that while readmissions did occur post-implementation, they tended to occur somewhat later in the post-discharge course. Hospital length of stay during index admissions (the initial hospitalization) averaged 5.2 ± 2.8 days pre-intervention and 5.0 ± 2.5 days post-intervention, indicating that the intervention did not inadvertently prolong index lengths of stay. Readmission diagnoses in the preintervention period included acute decompensated HF (68% of readmissions), acute coronary syndrome (12%), pneumonia/respiratory infection (9%), and other causes (11%). Post-intervention readmission diagnoses showed similar proportions, with acute decompensated HF

accounting for 67% of readmissions, suggesting that the protocol effectively targeted the primary drivers of readmissions.

Protocol Fidelity and Implementation Metrics

The assessment of protocol fidelity during the post-implementation period demonstrated high levels of adherence and implementation quality across all measured dimensions. A systematic chart review of a random sample of 150 patient encounters during the 12-month post-implementation period revealed: (1) completion of zone-based assessment within 24 hours of admission or significant clinical status change: 89% adherence (134/150 encounters); (2) documentation of all mandatory HF-specific variables including body weight with trending, edema assessment, dyspnea evaluation, and vital signs: 94% completion rate (141/150 encounters); (3) appropriate zone assignment based on pre-specified clinical criteria: 92% concordance with independent expert review (138/150 encounters); (4) timely provider notification for Yellow and Red zone assignments within specified time frames (within 4 hours for yellow, same-day for red), 87% compliance (130/150 encounters), and (5) initiation of protocol-driven interventions per zone-specific criteria: 85% adherence (127/150 encounters). These fidelity metrics collectively demonstrate high-quality implementation and suggest that the observed clinical outcomes reflect genuine protocol effects rather than incomplete or inconsistent implementations. Nurses reported high satisfaction with the protocol and greater confidence in clinical decision-making regarding the escalation of HF symptoms.

Subgroup Analyses

Preliminary subgroup analyses examining potential differential effects by demographic characteristics revealed consistent benefits across age groups, sex, and major racial/ethnic categories. Readmission rate reductions were observed in patients aged <75 years (RR=0.71; 95% CI: 0.63-0.81) and those aged ≥75 years (RR=0.73; 95% CI: 0.66-0.81), with no statistically significant interaction by age. Gender-stratified analyses showed similar relative risk reductions in female residents (RR=0.70; 95% CI: 0.62-0.79) and male residents (RR=0.75; 95% CI: 0.65-0.87). Clinical subgroups defined by HF type (HFrEF vs. HFpEF) demonstrated protocol benefits in both populations, although the magnitude of relative risk reduction was slightly larger in HFrEF (RR=0.68; 95% CI: 0.59-0.78) compared to HFpEF (RR=0.77; 95% CI: 0.66-0.90). These subgroup findings suggest that the protocol benefits generalization across diverse patient populations, rather than being confined to specific demographic or clinical subgroups.

Safety Outcomes and Adverse Events

Safety monitoring during the implementation period included systematic assessment of potential adverse events or unintended negative consequences related to protocol implementation. No serious adverse events attributable to protocol implementation were identified. A chart review found no documentation of missed diagnoses, inappropriate delays in escalation, or patient harm related to zone assignments or nurse-initiated interventions. Two instances of over-escalation (residents assigned to the red zone who did not require hospital transfer) were identified in the chart review, reflecting appropriate, conservative clinical judgment given the goal of preventing readmission. No protocol-related medication errors or adverse events were observed. Overall, safety monitoring confirmed that implementation of the zone-based protocol was accomplished without identifiable patient safety concerns or unintended negative consequences.

References

1. Cline L Implementing a zone-based Congestive Heart Failure Protocol in a Skilled Nursing Facility: A Retrospective study on hospital utilization outcomes. J Cardiovasc Nurs. 2025.
2. Weerahandi H, Li L, Bao H. Skilled nursing facility quality and hospital readmissions among Medicare beneficiaries with heart failure. J Am Med Dir Assoc. 2019. 20: 432-437.
3. Neuman MD, Wirtalla C, Werner RM. Association between skilled nursing facility quality indicators and hospital readmissions. JAMA. 2014. 312: 1542-1551.
4. Ouslander JG, Diaz S, Hain D, Tappen R. Frequency and diagnoses associated with 7- and 30-day readmission of skilled nursing facility patients to a nonteaching community hospital. J Am Med Dir Assoc. 2011. 12: 195-203.
5. Li M, Li Y, Meng Q, Xiaomeng T, Yinyin L et al. Effects of nurse-led transitional care interventions for patients with heart failure on healthcare utilization: A meta-analysis of randomized controlled trials. PLoS One. 2021.16.
6. Zhang W, Wang X, Wu X, Tang S. Influence of comprehensive nursing care on heart failure patient management: A systematic review and meta-analysis. Cardiology. 2024. 149: 535-548.
7. Qiu X, Lan C, Li J, Xiao X, Li J. The effect of nurse-led interventions on readmission and mortality for congestive heart failure: A meta-analysis. Medicine (Baltimore). 2021. 100.
8. Bamforth RJ, Chhibba R, Ferguson TW. Predictors of readmission among patients discharged to skilled nursing facilities. PLoS One. 2021.16.
9. Pu B, Wang W, Yu Y, Peng Y, Lei L, et al. Characteristics and factors of 30-day readmissions after hospitalization for acute heart failure in China. Rev Cardiovasc Med. 2024;25(8):279.
10. Andrade C. How to understand the 95% confidence interval around the relative risk, odds ratio, and hazard ratio: As simple as it gets. J Clin Psychiatry. 2023. 84.
11. Fagerland MW, Newcombe RG. Comparison of two methods for calculating confidence intervals for the difference between independent proportions. Stat Med. 2013. 32. 2823-2836.
12. Blecker S, Herrin J, Li L, et al. Association of race and ethnicity with clinical outcomes in patients hospitalized with acute conditions. J Am Coll Cardiol. 2019. 73:1004-1012.