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Risk of Readmission after Discharge from Skilled Nursing Facilities Following Heart Failure Hospitalization: A Retrospective Cohort Study

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Abstract

Objective: Discharge to skilled nursing facilities (SNF) is common in patients with heart failure (HF). It is unknown whether the transition from SNF to home is risky for these patients. Our objective was to study outcomes for the 30 days after discharge from SNF to home among Medicare patients hospitalized with HF who had subsequent SNF stays of 30 days or less.

Design: Retrospective cohort study.

Setting and Participants: All Medicare fee-for-service beneficiaries 65 and older admitted 2012 to 2015 with a HF diagnosis discharged to SNF then subsequently discharged home.

Measures: Patients were followed for 30 days following SNF discharge. We categorized patients by SNF length of stay: 1-6 days, 7-13 days, 14-30 days. For each group, we modeled time to a

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composite outcome of unplanned readmission or death after SNF discharge. Our model examined 0-2 days and 3-30 days post-SNF discharge.

Results—Our study included 67,585 HF hospitalizations discharged to SNF and subsequently discharged home. Overall, 16,333 (24.2%) SNF discharges to home were readmitted within 30 days of SNF discharge. The hazard rate of the composite outcome for each group was significantly increased on days 0-2 after SNF discharge compared to days 3-30, as reflected in their hazard rate ratios: for patients with SNF length of stay 1-6 days, 4.60 (4.23-5.00), SNF length of stay 7-13 days, 2.61 (2.45-2.78), SNF length of stay 14-30 days, 1.70 (1.62-1.78).

Conclusions/Implications—The hazard rate of readmission after SNF discharge following HF hospitalization is highest during the first 2 days home. This risk attenuated with longer SNF length of stay. Interventions to improve post-discharge outcomes have primarily focused on hospital discharge. This evidence suggests that interventions to reduce readmissions may be more effective if they also incorporate the SNF-to-home transition.

Brief summary:

Discharge from hospital to skilled nursing facility (SNF) is common in heart failure patients. The 30-day readmission risk during the transition from SNF to home is almost 25%. Readmission risk decreases as SNF length of stay increases.

Keywords

readmission; post-acute care; skilled nursing facility; heart failure; hospitalization

Introduction

Discharge from hospital to skilled nursing facility (SNF) is common in patients with heart failure (HF), occurring in 1 in 5 Medicare beneficiaries.[1] SNFs are often used as a transition from hospital to home to regain strength, function, and independence, particularly for medically complex patients. Discharge home from SNF is often the ultimate goal, as the vast majority of these patients were residing at home prior to hospitalization.[1] However, these are vulnerable patients,[1, 2] and SNF stays add another layer of complexity to the final transition back to the community. While the level of care at a SNF is less intense than in an inpatient facility, they are still medical settings with daily nursing care and physician oversight. During this SNF stay, new medications may be started, medication adjustments may occur, and lab tests may be obtained, which may be still pending at time of SNF discharge.

While several studies have examined the transition from hospital to home among patients with HF,[3–7] much less is known about transitions from SNF to home, including associated risks of readmission and mortality. As Medicare pays for SNF at full cost only for the first 20 days[8] after hospital discharge, many patients may be discharged on day 21, a time period within the 30-day readmission window of interest to health care systems trying to avoid readmission penalties. Furthermore, in October 2018, the Centers for Medicare and Medicaid (CMS) implemented the Skilled Nursing Facility Value-Based Purchasing Program, which offers Medicare incentive payments to SNFs paid under the SNF Prospective Payment System related to performance on specified measures of readmissions.[9]

Thus, understanding the risk trajectories associated with the transition from SNF to home is important on multiple fronts.

Accordingly, our objective was to study outcomes for the 30 days after discharge from SNF to home among Medicare patients hospitalized with HF who had subsequent SNF stays of 30 days or less. We hypothesized that this transition is associated with a risk of hospital readmission.

Methods

Study sample

This was a retrospective cohort study of all Medicare fee-for-service (FFS) beneficiaries 65 and older admitted from July 2012 to June 2015 with a principal discharge diagnosis of HF as defined by CMS for hospital quality measurement.[10, 11] Medicare Standard Analytic Files identified admissions to acute care hospitals and skilled nursing facilities, and provided readmission data for up to one year after discharge from each index hospitalization. These were merged with Medicare Denominator Files containing information on patient-level characteristics including date of birth, sex, and race.[12] American Hospital Association 2012 survey data were linked to provide information on hospital-level characteristics, such as size of index hospital. To focus on the transition to home that occurs after a temporary SNF stay, we excluded patients remaining in SNF more than 30 days after hospital discharge (n=13,139). We also excluded admissions with less than one day in SNF (n=17) and hospital admissions initially admitted from SNF (n=84), as the former often represents patients without a true SNF stay and the latter long-term SNF patients.

Outcomes

Readmission Timing: In order to examine readmission patterns among homogenous sets of patients to inform our final model, 30 cohorts were created for patients with SNF stays of 1 to 30 days, respectively. We then plotted the percentage of readmissions that occurred on each day (0-30) after discharge from SNF for each of these cohorts.

Readmission Risk: Our primary event of interest was time from SNF discharge to home to a composite outcome of unplanned readmission or death within 30 days after discharge from SNF to home. Planned readmissions as defined by Horwitz et al.[10] were censored. Secondary outcome was time to unplanned readmission as its own outcome. In this second model, planned readmission and death were considered competing risks.

Statistical Analysis

Study population characteristics were summarized with descriptive analyses. Next, for each of the 30 cohorts defined by the number of SNF days, we used violin plots to illustrate the probability density of 30-day readmissions that occurred on each day (0-30) after discharge from SNF to home for a descriptive analysis of the timing of readmission.

Readmission patterns qualitatively appeared to be different for patients with a SNF length of stay of 1-6 days, 7-13 days, and 14-30 days, respectively. We then visually examined

readmission risk in each of the three groups by plotting the log probability of being free of readmission over time. We observed two qualitatively different hazards for two separate time intervals (0-2 days and 3-30 days). As a result, we utilized piecewise exponential Bayesian models to partition the time scale in order to estimate baseline hazard of readmission for these time periods separately.[13–16] Thus in our main analysis of the composite outcome of readmission risk and death after discharge from SNF to home, multivariable piecewise exponential Bayesian models were estimated separately for those three groups. These models controlled for age, sex, race, Elixhauser comorbidity score, length of SNF stay, Medicaid dual-eligibility, bed size of index hospital, urban versus rural hospital, and teaching versus non-teaching hospital. Elixhauser comorbidity score was calculated using ICD codes associated with the index hospitalization. Medicaid dual-eligibility was calculated using patient-level data from the Medicare Denominator Files. Length of SNF stay was calculated using Medicare data from the associated SNF stay. We reported the hazard rate and credible interval of the composite outcome and readmission for each time interval. Analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC). The need to obtain informed consent was waived by our institutions, both of which provided approval for the overall study.

Results

Figure 1 illustrates a flow chart of our cohort selection. Our study included 67,585 HF hospitalizations that were discharged to SNF and subsequently discharged home (median age, 84 years [IQR; 78-89]; female, 61.0%); 13,257 (19.6%) were discharged from SNF with home care, 54,328 (80.4%) without. Median length of SNF admission was 17 days (IQR; 11-22) (Table 1). In total, 16,333 (24.2%) SNF discharges to home were readmitted within 30 days of SNF discharge; median time to readmission for those readmitted up to 30 days was 10 days (IQR; 3-18). Overall median time to readmission was 48 days (IQR; 14-121).

As noted in the methods, we qualitatively observed that readmission patterns appeared to be different for patients with a LOS of 1-6 days, 7-13 days, and 14-30 days, respectively (Figure 2). Next, our plot of the log probability of being free of readmission over time demonstrated two separate linear relationships in the 30 days after SNF to home discharge: at 0-2 days and 3-30 days (Figure 3). This represents two different readmission hazards for each of these time periods. Consequently, we created separate piecewise exponential Bayesian models for patients with a length of stay of 1-6 days, 7-13 days, and 14-30 days, respectively and examined the baseline hazard of readmission for each of these groups at 0-2 days after SNF to home discharge and at 3-30 days after SNF to home discharge.

We found the hazard rate of the composite outcome for each group was about 2-4 times higher on days 0-2 after discharge from SNF than on days 3-30 after discharge from SNF, regardless of SNF length of stay (Table 2). However, the ratio of the hazard rate of the first 0-2 days after discharge from SNF to the hazard rate during days 3-30 decreased as the length of stay in SNF increased (Table 3).

We observed similar hazard rates when modeling readmission risk alone (Table 2).

Discussion

In our analysis of Medicare claims data among all patients discharged to SNF after HF hospitalization, we found that almost a quarter were readmitted to the hospital within 30 days of SNF discharge. Risk for readmission was 2-4 times higher immediately after SNF to home discharge compared to later time periods and this early readmission risk dropped by half for patients with SNF stays of 1-2 weeks compared to those with shorter stays. However, even those patients had a twofold increase in the relative risk of readmission immediately following discharge from SNF to home. While this heightened risk of readmission immediately after discharge from SNF may be related to patient-level factors, the persistence of increased risk across multiple cohorts of patients suggests that the disruption in care continuity when a patient is transferred from SNF to home may be playing an important role.

Existing research has primarily focused on the care transition from hospital discharge to home[3–7] while evidence about the care transition from post-acute care to home is lacking. Though organizations have recently started publishing expert opinion based guidelines[17] for the SNF to home transition, there is no evidence that formal discharge practices occur routinely. HF patients discharged from hospital to SNF are more medically and functionally complicated than the overall Medicare HF population,[18, 19] the latter who have a readmission rate of 21.7%.[20] Therefore, patients discharged from SNF may benefit from discharge planning since during a SNF stay medications may be started or adjusted, diets may be monitored and lab tests may be obtained, which may need post-SNF discharge follow up.

Prior work on the transition from hospital to home provides useful lessons for institutional post-acute care, such as SNFs.[3–7] For example, studies on discharge practices have demonstrated the effectiveness of discharge instructions[21] and early outpatient physician follow up after hospital discharge.[22] Moreover, guidelines such as the Transitions of Care Consensus Conference (TOCCC)[23] have established standards on transitions between the inpatient and outpatient settings, while major organizations such as the Joint Commission mandate that specific elements be included in all U.S. hospital discharge summaries,[24] and have established medication reconciliation as a National Patient Safety Goal.[25] Similarly, organizations like the Society of Hospital Medicine have produced toolkits like Project BOOST (Better Outcomes by Optimizing Safe Transitions),[26] designed to improve discharge processes at hospitals.

Some of these programs have been modified and applied to the SNF-to-home transition to improve care coordination and minimize care disruption. Pre-post studies have examined implementation of comprehensive care transition checklists[27] and a transitional care clinic[28] during the SNF-to-home transition; while another study has piloted a team-based transitional care intervention for SNF patients.[29] Another secondary data analysis study using the Older Adults Transition Study database also demonstrated reduced hazard of readmission with those patients who have a home health visit within a week of SNF discharge.[30] However, given the complex interplay of drivers that affect readmission and death for older HF

patients during transitions, further evidence is needed to inform such practices as HF patients are at a particularly high risk for readmission.

Indeed, as hospital length of stay declines and uses of SNF rises,[31] the importance of identifying best practices for HF management in SNFs will become increasingly evident[32] particularly since HF is a chronic problem that requires ongoing disease management. It is necessary to target these high risk patients throughout their care continuum to optimize medical therapy, reinforce self-management skills, and ensure adequate services are in place to regularly assess volume and symptoms to facilitate outpatient provider management. Our finding that readmission risk is highest during the early discharge period, particularly in those with short SNF stays, could help guide when these interventions may be most efficacious.

Policy such as the Readmissions Reduction Program aim to reduce avoidable 30 day readmissions for HF patients.[33] While previous work has examined readmission patterns after hospital discharge,[34, 35] the health care continuum often includes post-acute care, such as SNFs. Most hospital-to-SNF patients lived at home prior to hospital admission and return home after a temporary SNF stay.[1] Consequently, many patients discharged to SNF incur a second transition, from SNF to home, within 30 days of hospital discharge. We found the risk of readmission after SNF discharge declines as SNF length of stay increases, which may be because patients have had more time to recover from their acute illness. However this finding is subject to survivor bias as we only include those who have survived to SNF discharge. Our study also builds on previous work on readmission patterns by studying how additional transitions experienced by patients after hospital discharge may affect their readmission risk. Processes used to allay readmissions may be made more effective if they take these additional risks into account.

Strengths and Limitations

This analysis differs from prior work in that it focuses on readmission and mortality after SNF discharge, not during SNF stay.[1, 36, 37] The few studies that have examined outcomes from SNF to home did not use national data.[38, 39] In addition, while previous work has examined state level data on SNF readmissions after any hospitalization and those with end-stage renal disease in North and South Carolina, it has not examined transitions specific to HF patients, who are particularly vulnerable to readmission[40] and may benefit from HF specific discharge care. Furthermore, the national data in this study examines most older HF patients in the United States, who are an important target of Medicare policy.

Our study is limited by its observational design, which precludes making causal inferences, though our aim was to illustrate risk trajectories over time. In addition, as this study examines an administrative database, there may be misclassification regarding accuracy of admission and discharge dates; however, there is no systematic reason why any particular dates would be erroneous and these fields in CMS data in general are reliable.[12] Furthermore, Medicare SNF claims data cannot account for disease severity or patient function (such as frailty or cognitive impairment), which may differ between patients with different SNF LOS. We also did not adjust for quality of discharge care at the SNF in this

study, as this study was intended to describe readmission risk for the SNF cohort in general. We plan to address SNF-level factors and post-discharge factors in our future work.

Conclusion/Relevance

Post-acute care skilled nursing facilities are common destinations from the acute care setting. We found discharge from SNF to home is associated with a risk of hospital readmission. Length of stay at SNF also has an effect on risk of readmission immediately after discharge from SNF; patients with a longer length of stay in SNF were less likely to be readmitted in the first 2 days after discharge from SNF. Transitions across the health care continuum must be enhanced in order to improve longitudinal care. Further work should examine if formal discharge practices currently used in hospitals could be applied to the transition from SNF to home.

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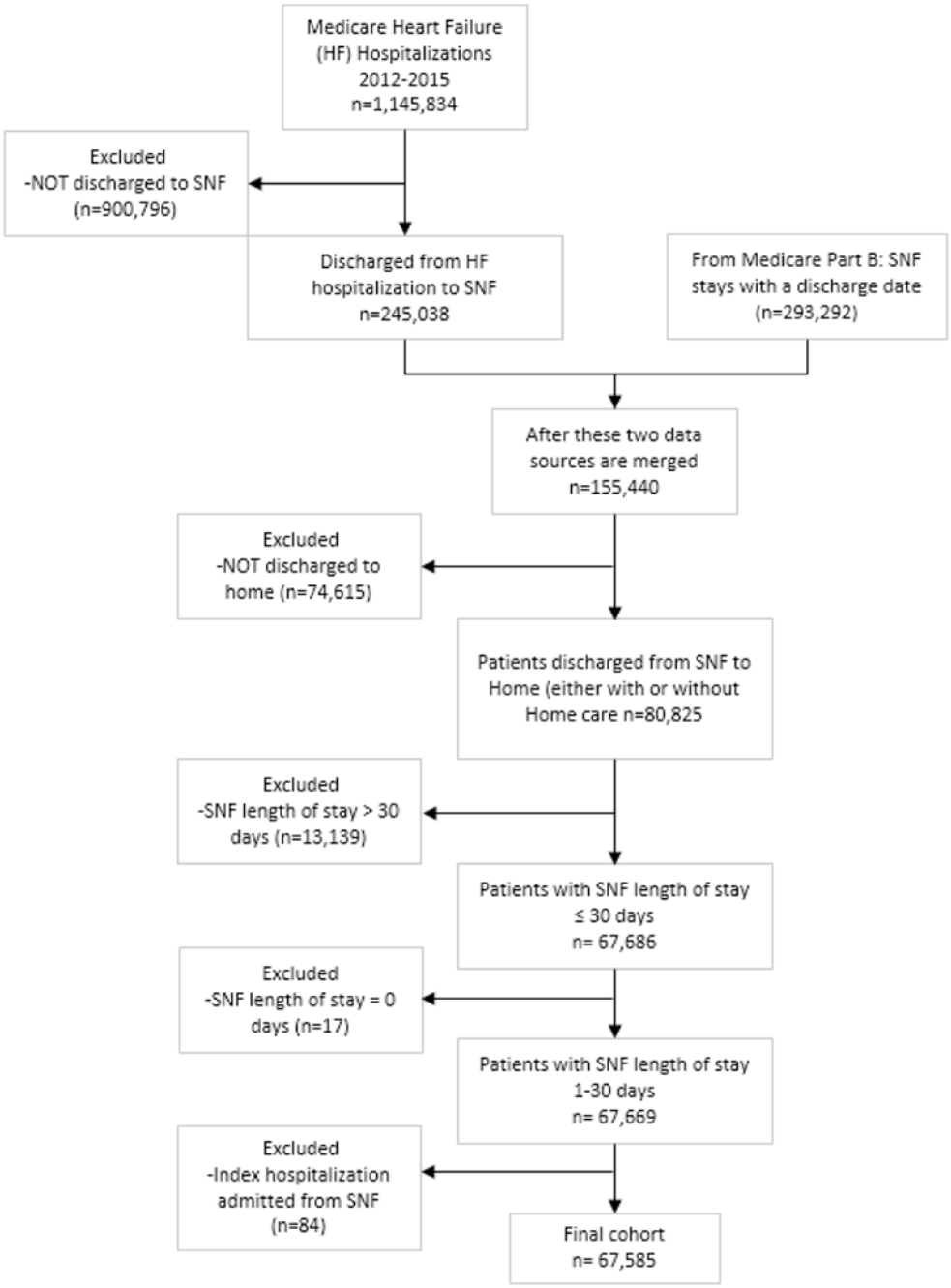

Figure 1:
Flow chart for cohort selection

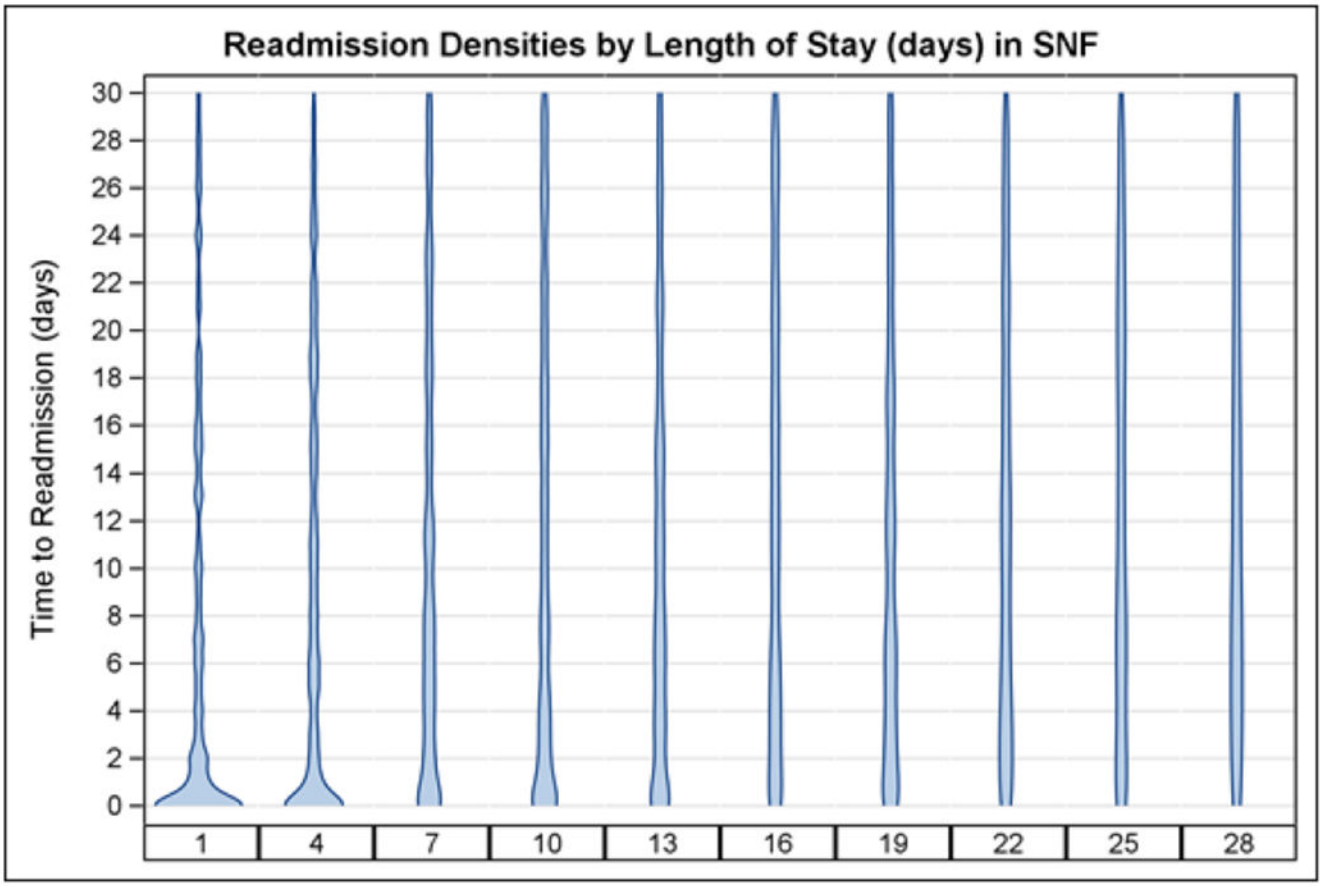

Figure 2:

Violin plots of Readmission Densities by Length of Stay in SNF.

We graphed out 30-day readmissions for patients based on SNF length of stay. On the horizontal axis are representative cohorts. The vertical axis represents the day after SNF discharge when readmission occurred. The density shows the relative number of 30-day readmissions that occurred on each day. This provides us a descriptive analysis of the timing of readmission. We qualitatively observed that proportion of readmissions appeared to be higher on days 0-3 after SNF discharge to home versus days 4-30 after SNF discharge to home We also qualitatively observed that readmission patterns appeared to be different for patients with a LOS of 1-6 days, 7-13 days, and 14-30 days, respectively. Depicted above are representative cohorts.

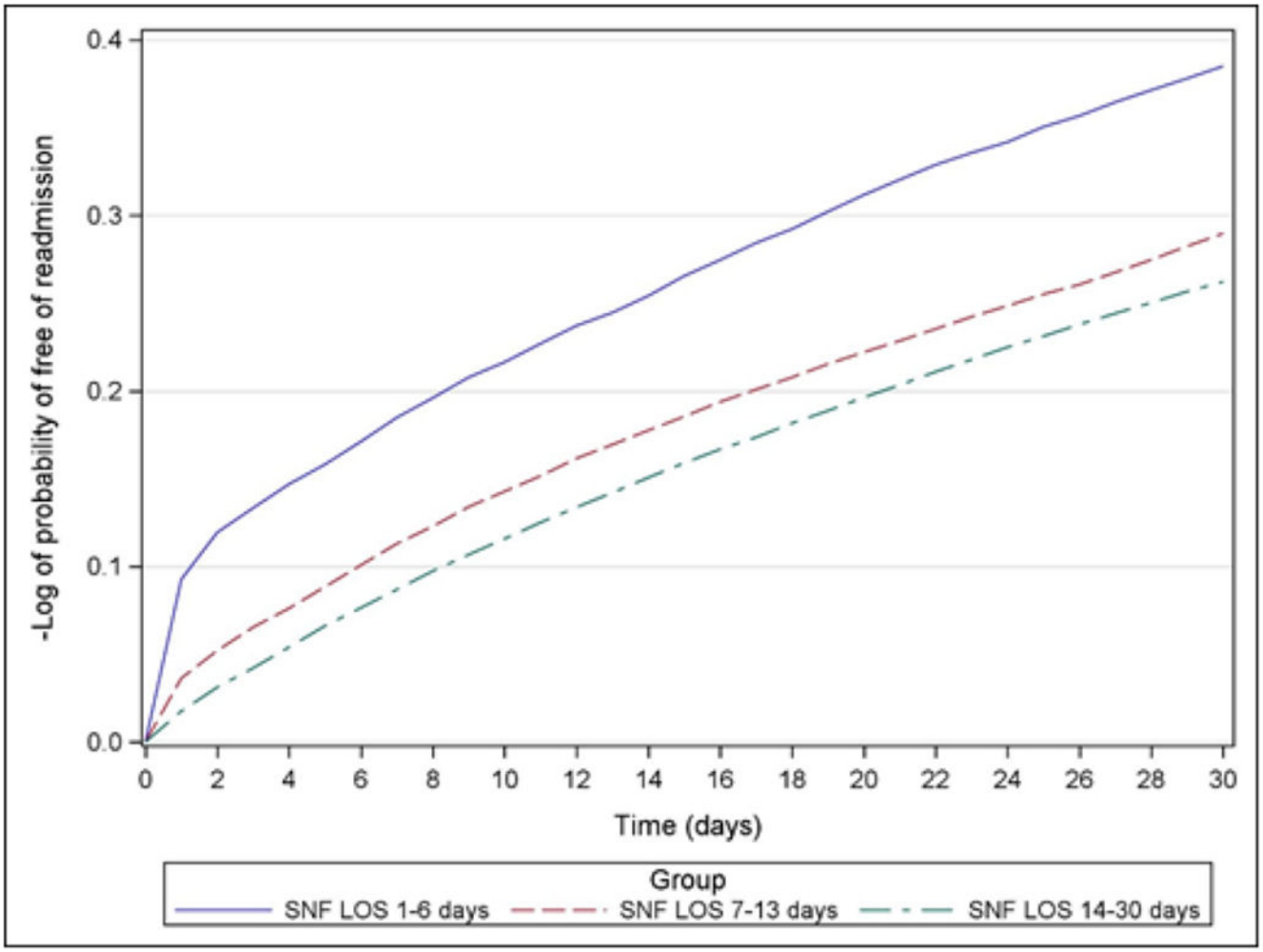

Figure 3:
Risk of first hospital readmission for 30 days after discharge from SNF to home following hospitalization for heart failure.

Table 1:

Characteristics of Those Discharged Home from SNF Following HF Hospitalization

Characteristic	n=67,585
Age, Median (IQR)	84 (78-89)
Male	26386 (39.0%)
Race	Race
White	60084 (88.9%)
Black	5467 (8.1%)
Other	2034 (3.0%)
Length of stay in hospital, Median (IQR)	7.0 (5.0-9.0)
Length of stay in SNF, Median (IQR)	17.0 (11.0 - 22.0)
Elixhauser comorbidity score, Median (IQR)	22.0 (12.0 - 32.0)
Dual eligible	9351 (13.8%)
Hospital beds	Hospital beds
1-99	7450 (11.0%)
100-199	14696 (21.7%)
200-299	13680 (20.2%)
300-399	10725 (15.9%)
400-499	5826 (8.6%)
500+	14617 (21.6%)
Hospital Location	
Urban	65280 (96.6%)
Rural	1714 (2.5%)
Teaching hospital	43338 (64.1%)

SNF: Skilled Nursing Facility

HF: Heart Failure

IQR: Interquartile Range

Table 2:

Risk of Composite Outcome [readmission or death] after Discharge from SNF Following HF Hospitalization

SNF Length of Stay	Hazard Rate of Composite Outcome on days 0-2 after SNF to home discharge (95% credible interval)	Hazard Rate of Composite Outcome on days 3-30 after SNF to home discharge (95% credible interval)	Ratio of Hazard Rates (95% credible interval)
1-6 days (n=6033)	0.051 (0.036 - 0.072)	0.011 (0.008 - 0.016)	4.60 (4.23 – 5.00)
7-13 days(n=16773)	0.027 (0.020 - 0.035)	0.010 (0.008 - 0.013)	2.61 (2.45 - 2.78)
14-30 days (n=44779)	0.013 (0.011 - 0.016)	0.008 (0.007 - 0.009)	1.70 (1.62 - 1.78)

SNF: Skilled Nursing Facility

HF: Heart Failure

Table 3:

Risk of Readmission after Discharge from SNF Following HF Hospitalization

SNF Length of Stay	Hazard Rate of Readmission on days 0-2 after SNF to home discharge (95% credible interval)	Hazard Rate of Readmission on days 3-30 after SNF to home discharge (95% credible interval)	Ratio of Hazard Rates (95% credible interval)
1-6 days (n=6033)	0.048 (0.033 - 0.069)	0.010 (0.007 - 0.015)	4.74 (4.31 - 5.20)
7-13 days (n=16773)	0.026 (0.019 - 0.034)	0.010 (0.007 - 0.013)	2.55 (2.37 - 2.73)
14-30 days (n=44779)	0.013 (0.011 - 0.016)	0.008 (0.007 - 0.010)	1.66 (1.58 - 1.75)

SNF: Skilled Nursing Facility

HF: Heart Failure