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Factors Associated with Heart Failure Readmissions from Skilled Nursing Facilities

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Abstract

Background: Despite guideline-driven pharmacological therapies and careful transitional care, the rates of preventable hospital re-admission of heart failure patients and associated costs remain unacceptably high in the SNF populations. Transfer to SNF is one strategy to limit hospitalizations. As such, 25% of patients are still symptomatic at time of discharge.

Purpose: The objective of this study is to identify patient factors affecting re-admissions of HF patients residing in SNF within 30-days. Methods: A retrospective electronic chart review was completed on patients >65 years with HF who were admitted into large medical center between 2012 and 2014. Descriptive statistics and univariate analyses using the chi-square test or Fisher's exact test for categorical variables and the Mann-Whitney test for continuous data was used to compare patients readmitted within 30 days vs. those who were not readmitted within 30 days. Significant factors associated with readmission in the univariate analysis ($p<0.10$) were included for a multivariate logistic regression model. A receiver operating characteristic (ROC) curve was constructed to look at the final model's ability to predict the outcome. A numerical measure of the accuracy of the model was obtained from the area under the curve (AUC), where an area of 1.0 signifies near perfect accuracy. The analysis of LOS was accomplished by applying standard methods of survival analysis, i.e., computing the Kaplan-Meier product limit curves, where the data were stratified by readmission within 30 days (Yes vs. No). No data were considered 'censored'. The groups were compared using the log-rank test. The median rates for each group were obtained from the Kaplan-Meier/Product-Limit Estimates and their corresponding 95% confidence intervals were computed, using Greenwood's formula to calculate the standard error. Unless otherwise specified, a result was considered statistically significant at the $p<0.05$ level of significance.

Results: Fifteen variables: creatinine, weight difference, CKD, Angina, Arrhythmia, VHD, Tobacco, ADL, independent in bathing, independent in the toilet, S3 Heart sounds present, HJR, AF, Nitrates, and Hydralazine, were identified for the multivariate logistic regression as potential risk factors associated with "readmission within 30 days". Based on 23 readmissions within 30 days, our final model included only 2 predictor variables. Creatinine and ADLs were included in the final model as this subset of predictors was found to be the best for prediction of "readmission within 30 days". Creatinine ($p<0.0087$) and ADLs ($p<0.0077$) were both significantly associated with readmission within 30 days in the final logistic regression model. Every 1-unit increase in creatinine is associated with an 87% increase in the odds of being readmitted within 30 days (OR = 1.87). Those patients who require assistance with ADLs are over 9 times more likely to be readmitted within 30 days (OR=9.25) as compared to patients who are independent.

Keywords: Heart Failure, Re-Admissions, Skilled Nursing Facilities (SNF), Nursing Homes (NH), Factors

Introduction

Background and Significance

Heart failure (HF) affects more than 5 million patients in the United States and by 2030, >8 million people in the United States (1 in every 33) will have HF (Jencks, Williams, & Coleman, 2009). Annually, more than 1 million patients are hospitalized with a primary diagnosis of heart failure, accounting for a total Medicare expenditure exceeding $17 billion with > 50% patients readmitted to hospital within 6months of discharge. Annual expenditures for both primary and secondary diagnosis of heart failure have been estimated to be as high as $38 billion of which $23 billion is for hospital stay. Between 2012 and 2030, total direct medical costs of HF are projected to increase from $21 billion to $53 billion. (Heidenreich et al., 2013). The rates of readmissions to the hospital for HF are high and expected to increase with an estimated yearly incidence of 550,000 readmissions and 658,000 annual ED encounters (Yancy et al., 2013).

The financial implications of readmission are significant. Advanced heart failure is characterized by progressive clinical deterioration reflected in frequent hospital admissions. In order to decrease costs, the National Quality Forum has endorsed hospital risk-standardized readmission rates (RSRRs) as performance measures (Yancy et al., 2013). The patient protection Affordable Care Act 2010 created incentives to reduce readmission, with penalties for hospitals including no reimbursement for services provided and/or loss of revenue if the HF patient is readmitted within 30 days (Walsh et al., 2012). Hospitals with high readmission rates can lose ~3% of their Medicare reimbursement by 2015 (Yancy et al., 2013).

In order to reduce readmissions, patients may be referred to skilled nursing facilities (SNF) and Nursing Homes (NH) for recuperative care and maximizing pharmacological therapies after hospitalization. This has increased to serve as a potential strategy for reducing readmissions (Desai & Stevenson, 2012). However, in spite of the pharmacological and transitional care from hospital to SNFs, the rates of preventable re-admission remain unacceptably high. Investigators evaluated 557 heart failure patients that were readmitted within six months after hospitalization and reported a 40% readmission rate (Hamner & Ellison, 2005). Similar findings were reported: readmission or death rates of 40% in 114 patients studied, with these events occurring within six months of discharge (Logeart et al., 2004).

Reducing HF hospital readmission rates from SNF and NH has become a national priority because approximately 20% of these patients are Medicare beneficiaries and are readmitted within 30 days (Walsh et al., 2012). The Readmissions are multifactorial and problematic in this unique population because of high rate of incidences, cost, and disruptions in care, disease progression, and increased mortality. HF readmissions are a complex problem and a single solution has not been sufficient in decreasing the readmission risk. Identification of heart failure predictors in patients from SNFs and NH could lead to an improved referral pattern and an improved 30 day outcome (Ouslander et al., 2009; Unroe, Greiner, Colon-Emeric, Peterson, & Curtis, 2012).

The objective of this study is to identify patient specific factors affecting readmissions of HF patients from SNFs within 30-days.

Literature review

Almost one quarter of older hospitalized adults with HF are discharged to SNFs (Jung, Yeh, & Pressler, 2012). Nearly half of the 164,672 patients with HF that were discharged to SNFs, were readmitted to a hospital within 90 days after discharge, and 30% died within 90days (Unroe et al., 2012). Heart Failure is a heterogeneous condition, with many causes. Accurate classification of patient factors that affect readmissions may have positive impact on outcomes of patients that resides in SNFs.

There are many factors that may contribute to readmission of HF patients. These factors include comorbidities such as diabetes and decreased renal function at discharge. (Krumholz et al., 2000). Other factors influencing readmission in HF patients include **dyspnea, increasing age, renal problems, fluid status/weight, anemia, LOS, ADLs, BNP, hypotension, and comorbidities**. The proportion of patient factors responsible for avoidable readmissions varied extensively between studies reviewed.

Numerous studies have identified **dyspnea** as the strongest predictor of readmission (Allen et al., 2011; Altice & Madigan, 2012; Anderson, 2014; Fonarow & Committee, 2003; Mentz et al., 2013; Mentz et al., 2014; Mentz et al., 2015). Up to 77% of patients who were admitted for acute episodes of heart failure initially presented to the emergency department with dyspnea (Fonarow & Committee, 2003). A majority of patients who require re-admission for HF have shortness of breath. Patients are dyspneic with exertion and at rest. Fatigue is also present in this group of patients. However, dyspnea is the primary factor for seeking care by patients and for referral of patients to hospitals for admission by health care providers (Fonarow & Committee, 2003). Ninety three percent of the SNFs population studied reports dyspnea as breathing related problems that predicts re-admission (Allen et al., 2011).

Timeliness in reporting of symptoms of dyspnea has been associated with decreased risk of re-admission. Researchers found a correlation between relieving of dyspnea and decreased risk of 30 day re-admission in 45% HF patients (Mentz et al., 2013) Breathing related problems reported by 93% of HF patients led to them seeking care early and thereby preventing re-admission (Altice & Madigan, 2012). A delay in reporting symptoms and seeking care, which can range from 6 hours to 3 days, appears to correlate with deterioration and re-admission (Friedman & Quinn, 2008). Studies of symptom monitoring and response training appeared to have an early but not sustained benefit resulting in no difference in 90-day event-free survival (Jurgens, Lee, Reitano, & Riegel, 2013).

Consistently, researchers report **increasing age** as one of the many factors that accounts for avoidable re-admissions. This non-modifiable risk factor is often associated with cognitive deficits. Older age, disability status and increased LOS were associated with re-admission (Muus et al., 2010). Social and environmental factors may influence the severity and adaptability of aging process in older HF patients. Advanced age has been implicated as predictor of re-admissions (Boxer et al., 2012; Dolansky et al., 2010; Hammill et al., 2011). In 161 elderly patients that had four or more HF admissions, it was found that one of the predictors of readmission was increasing age (Vinson, Rich, Sperry, Shah, & McNamara, 1990). Advanced age has been identified as a cause of frequent re-admissions in the SNFs population. The re-admission rate was increased from 23% to 27% within 30days (Allen et al., 2011). In addition, advanced age was identified as a significant contributor to re-admission among US veterans residing at SNFs (Muus et al., 2010). Likewise, there were high correlation between increasing age and readmission within 30 days and 90days (Schrager et al., 2013).

Worsening renal function which is shown as an increase in BUN/Creatinine **is a strong predictor of re-admission** (Allen et al., 2011; Allen, Smoyer Tomic, Smith, Wilson, & Agodoa, 2012; Fonorow, 2005; Hutt, Frederickson, Ecord, & Kramer, 2003; Lazzarini, Mentz, Fiuzat, Metra, & O'Connor, 2013; Mentz et al., 2013; Tamhane, Voytas, Aboufakher, & Maddens, 2008; Wang, Lin, Lee, & Wu, 2011; Y. Wang et al., 2011) Improved assessment of BUN/Cr, BP, and heart rate monitoring may lower hospital re-admission rates. However, the management of HF may precipitate decreased renal function because of the use of ACE inhibitors and diuretics that are often prescribed for HF patients. Guideline-driven therapies include ACEi optimization and neuro-hormonal antagonists, which may further worsen the BUN/Cr and lower the blood pressure. This can lead to hypotension and worsening of the renal function, and diuretics that are often administered for symptoms relief of dyspnea may leads to hyponatremia (Desai & Stevenson, 2012).

Fluid **volume status or weight gain** is usually associated with and serves as hallmark of congestion during acute HF exacerbation. Treatment guidelines include the recommendation to optimize euvolemic status. Congestion encompasses indicators of volume overload: orthopnea, jugular venous distention, congested on chest X-ray, a gain of greater than or equal to two pounds in the previous week, edema, and the need to increase diuretic dosing at a visit. Patients that were not congested had an 87% survival, compared 41% of patients with major congestion. As such, this leads to higher re-admission rate (Lucas et al., 2000).

On the contrary, in a retrospective analysis of the randomized clinical trial -Diuretic Optimization Strategy Evaluation in Acute Heart Failure (DOSE-AHF) studied markers of decongestion at 72 hours: weight loss and net fluid loss level and found no correlation between either weight gain or re-admission. Thus, fluid retention has not been reliable as a sole entity in detecting early decompensation. Increased appetite may result in weight gain and can mimic fluid retention (Kociol, Liang, et al., 2013).

Anemia can be prevalent in the SNFs population due to dental problems, decreased appetite and poor nutrition. Anemia makes HF worse and has been shown to impact readmission rates. Readmission of patients with heart failure and anemia as secondary diagnoses, were significant ($p<0.001$) in SNFs population. Patients with heart failure and anemia had increased LOS (7.3 versus 5.1 days) and unplanned readmission ($p<0.001$). In a retrospective study of 127 elderly SNF population with HF, anemia (71%) led to higher readmission (Tamhane et al., 2008). This suggests reduced hemoglobin may merely be a marker for the epiphenomena of advanced heart failure. Furthermore, anemia was an independent predictor of re-admission and mortality in heart failure patients with reduced left ventricular dysfunction (Al-Ahmad et al., 2001).

Length of stay (LOS) and number of ED visits have been shown to provide additional information regarding re-admission. A significant proportion of patients are discharged to SNFs (Hutt, Elder, Fish, & Min, 2011). In a retrospective study of more than 10,000 patients admitted with HF, 30% were discharged to SNFs (Hutt et al., 2011). This may be in an attempt to decrease length of stay in the hospital. In a simulated study of the relationship between LOS and readmission within 7 days and 30 days, it was reported that if there was a 1 day increase in LOS, reductions in readmission rates could be estimated in the 1% to 8% range for HF patients (Carey, 2014). Therefore increasing LOS for some patients may be a means of decreasing readmission and improving quality of care.

However, other investigators found no associations between LOS and readmission (Kaboli et al., 2012). Patients and hospitals with longer length of stay showed reduced readmission rate in HF patients (Eapen et al., 2013). Alternatively, individuals hospitalized for heart failure, had no increase in 30-day re-hospitalization when LOS was decreased by a day (Unruh, Trivedi, Grabowski, & Mor, 2013).

Functional status/ADL. Frailty, mobility, disability, and impaired ADLs status are associated with readmissions. According to Heart Failure Society of America (2013), functional capacity is defined in terms of ambulation. Patients who present with exacerbation of heart failure are typically dyspneic and fatigued on presentation. Consequently, patients will often limit their physical activity in order to compensate for their worsening heart failure symptoms. Anderson (2014) found that individuals with HF who require assistance with ADLs were significantly more likely to be readmitted for heart failure within 60days (Anderson, 2014).

Elevated Serum biomarkers, such as Brain Natriuretic peptide (BNP) has been associated with increasing rate of readmissions (Mentz et al., 2013). Reduction in NT-proBNP was significantly associated with symptom relief ($r=0.13$, $P = 0.04$) in a retrospective analysis of 308 elderly HF subjects, suggesting that positive relationship exist between commonly used markers of decongestion and patient reported symptom relief and less chance of readmission. (Kociol, McNulty, et al., 2013). Similarly, early dyspnea relief in 2984 patients studied was associated with lower BNP value with resultant reduced readmissions (Mentz et al., 2013).

Hypotension is associated with readmission and patients that are hypotensive, had previous SNF's stay, or decompensated during the night, and tend to have higher re-admissions (Hutt et al., 2003). Systolic BP of less than 115 was associated with 15% risk of readmission and death (Fonorow, 2005). The hypotensive episodes in the SNFs population may be attributable to administration of Guideline Directed Medical Therapy, such as the ACEi and ARBs that often prescribed lowers the blood pressure. Fifty three percent cases of HF following MI, and HF following uncontrolled hypertension were deemed avoidable (Vinson et al., 1990) This findings led to the move toward further research into identification of high risk patients and avoidable readmission.

Comorbidites increase the risk of re-admissions in older HF patients. Associated diagnosis of anemia, hypertension, and diabetes confer higher risk and are likely indicator of disease progression and are predictors of re-admissions and mortality (Allen et al., 2011; Chen et al., 2012; Hutt et al., 2003; Ouslander et al., 2009; Tamhane et al., 2008). Comorbidity has been shown as a predictor of unplanned readmission (Hallerbach et al., 2008). In addition, comorbidities were associated with increasing re-admission in >80year old within 30 days with comorbidities odds ratio = 2.6; 95% CI, 1.5-4.7 (Marcantonio et al., 1999). Comorbidities were found to be frequently associated with 7 & 30 day readmission of SNF patients (Ouslander & Berenson, 2011). Older HF patients from SNFs residents who had acute episode leading to readmission had higher level of comorbidities with acute HF (Hutt et al., 2003).

This study identified patient factors affecting re-admission of elderly patients with Heart failure within 30 days who were discharged to SNFs. The identified factors may predict patient related mediators of early re-admissions and may assist with the development of interventions that may reduce 30 days re-admissions.

Methodology

Design

A retrospective chart review was conducted to examine patterns and factors affecting readmission of SNF patients with HF. Eligible patient records were identified from a tertiary institution's Electronic Medical Record as unplanned or emergent, general or direct re-admissions as from 2012 to 2014 until the 128 subjects obtained.

Sample/Patient selection

Medical records of 128 consecutive elderly patients, admitted to an 800-bed tertiary institution were reviewed. Inclusion criteria included the following: Patients with a heart failure diagnosis (DRG 428) and subsequently discharged to NH or SNF. All patients had to be insured by Medicare or Medicaid to increase generalizability. SNF patients admitted through the ED, admitted electively or from the outpatient settings were included. SNF patients transferred from other hospitals were excluded from the chart review.

Medical records of eligible patients were reviewed to confirm diagnosis of HF using Framingham criteria and DRG coding. Data collection was performed using a standardized data extraction tool. Follow-up data includes information on subsequent hospital readmission, survival status, heart transplantation, and visits to the emergency department using the electronic medical record. All patients' data were reviewed for 180-days following discharge and to account for 30-day readmissions and readmission patterns over

Inclusion Criteria	*Exclusion Criteria*
• Age 65years or >	- Age <65 years
• NYHA II-III	-NYHA I, IV
• Heart Failure diagnosis/DRG 428	-Severe Aortic Stenosis
• Patients discharged to SNF	-Patients discharged home
	-Major psychiatry illness
	-Hyperthyroidism
	-severe cognitive impairment
	- Terminal illnesses.
	-Severe COPD
	-CKD on dialysis

Sample size including power analysis

Approximately 128 patients that met the inclusion criteria as described above were included in the study. A power analysis indicated that a sample size of 128 patients was sufficient (power .80) with an alpha of .05 to detect statistically significant results. Oversampling of patients was done to allow for exploratory statistical analysis. One hundred and nine (n-109) patients with 15% (n=19) oversampling included for a total N=128. Multiple regression analysis included eight independent variables of interest identified from the theoretical framework and previous studies.

Operational definition of Independent variables and dependent variables

Patient associated factors such as **dyspnea, increasing age, renal problems, fluid status/weight, anemia, LOS, ADLs, BNP, hypotension, and comorbidities** age were identified as predictors and were continuous variables. The dependent variables were clinical events, such as re-admission within 30 days or ED admissions.

Data collection procedures

Eligible patients were identified using the inclusion criteria as described above. Data collection tool was used to obtain relevant information. Data was collected on Heart Failure patients, 65 years or older, that were discharged from a tertiary institution in the Northeastern US to Nursing Homes and Skilled Nursing facilities from 2012 to 2014 until the target subject number of 128 was reached. Data about patient's health from the electronic medical record were obtained.

- Demographic data: age, sex, race etc. will be obtained
- Symptoms: Dyspnea, wt/fluid status, swelling/edema, fatigue,
- Diagnosis: Systolic or diastolic Heart failure, NYHA classification,
- Vital signs: Blood pressure, HR, height, weight
- Medications: ACEi, BB, Mineralocorticoids
- Blood tests results: BUN/Cr, BNP, sodium, hematocrit, HBa1c (if applicable)
- Number of re-admissions
- Length of Stay

Data/statistical Analysis

Baseline patient characteristics were expressed as mean, standard deviation (SD) for continuous variables and as proportions for categorical variables. Subgroup comparisons were done with non-paired t-test for continuous variables or chi-square test for categorical variables. A survival curve was constructed according to the method of Kaplan and Meir 13. The effect of relevant covariates on cause specific readmissions was evaluated by Cox proportional hazardous regression models. Quantitative Data Analysis was performed and Chi-square used. Multivariable logistic regression model was used to assess which of the patient specific variables were independently associated with 30-day re-admission by adjusting for variables known to impact re-admission. Statistical Significance (SD) was calculated using Statistical Package for Social Sciences (SPSS). Alpha level of .05 was considered statistically significant for all analyses. The critical value of 3.841 or greater was considered statistically significant.

Analysis

The data collected and analyzed in this study included socio-demographic information, medical conditions, symptoms, guideline directed medical therapy (GDMT), functional capacity, and significant test and clinical findings upon assessment. The sample size of participants in the study was one twenty eight, (n=128) elderly subjects with heart failure (HF) readmission from SNF. The dependent variable was hospital readmission. All patients studied were patients discharged to SNFs, of age 65 years or older, with primary or secondary diagnosis of CHF, and experiencing multiple chronic conditions. Hospital readmission was defined as any readmission within 30 days after hospital discharge to SNF's. The independent variables were patient factors such as renal functional status, anemia, functional status, medical conditions, to mention a few. The categorical data was defined as yes and no. The guideline directed medications were measured by yes=taking the medication and no=not taking the medication. Age was defined as the elderly person's chronological years of life.

Statistical analysis.

Descriptive statistics (frequencies and percentages for categorical data; mean ± standard deviation and median for continuous data) and univariate analyses using the chi-square test or Fisher's exact test, as deemed appropriate, for categorical variables and the Mann-Whitney test for continuous data was used to compare patients readmitted within 30 days vs. those who were not readmitted within 30 days. Those factors that appeared to be associated with readmission in the univariate analysis ($p<0.10$) were included in the selection process for a multivariate logistic regression model.

Best subsets selection was used as a screening method to identify the best set of predictor variables for the logistic regression model. A receiver operating characteristic (ROC) curve was constructed to look at the model's ability to predict the outcome of HF readmission. A numerical measure of the accuracy of the model was obtained from the area under the curve (AUC), where an area of 1.0 signifies near perfect accuracy, while an area of less than 0.5 indicates that the model is worse than just flipping a coin. The following was used as a guide for AUC: 0.9-1.0 Excellent, 0.8-0.9 Very good, 0.7-0.8 Good, 0.6-0.7 Average, 0.5-0.6 Poor.
The analysis of LOS was accomplished by applying standard methods of survival analysis, i.e., computing the Kaplan-Meier product limit curves, where the data were stratified by readmission within 30 days (Yes vs. No). No data were considered 'censored'. The groups were compared using the log-rank test. The median rates for each group were obtained from the Kaplan-Meier/Product-Limit Estimates and their corresponding 95% confidence intervals were computed, using Greenwood's formula to calculate the standard error. Unless otherwise specified, a result was considered statistically significant at the p<0.05 level of significance.

Sample characteristics/Results (See table 1)

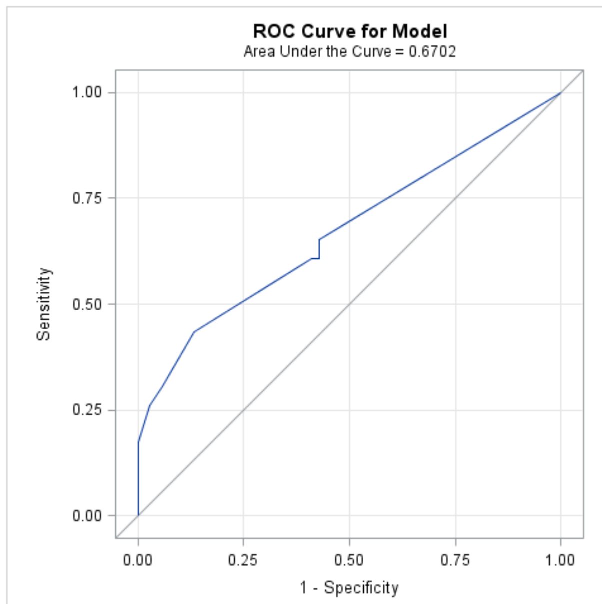
The datasets included patients with HF with mean age 83.46 years. Twenty three (18%) of the patients had at least one re-admission. The baseline social-demographic distribution N (%) showed the patients were distributed as 60 (46.9.9%) males and 68 (53.1%) females with the majority (56 (43.8%)) in the age category greater than 85 years (Table 1). Given the location of the study hospital, 122 patients (95.3%) were Caucasian, 2 (1.6%) were black/African American, and 2 (1.6%) were Asian. Fifty two (40.6%) of the patientswere widowed and 50 (39.1%) were married. Subjects that were studied had a mean heart rate of 79.18, mean systolic blood pressure of 131.5 mmHg and mean diastolic blood pressure of 68.6 mmHg. The mean brain natriuretic protein (BNP) was 1174.89, mean BUN was 40.12 with mean creatinine of 1.60. The average hematocrit was 33.99, Left ventricular ejection fraction (LVEF) was 47.22, and differences in weight measurements was 9.91. The mean length of days (LOS) for the first admission was 9.22 days while the LOS for the readmission was 10.91days.
The associated medical conditions and co-morbidities showed 70(54.7%) patients had history of renal disease and 89 (69.5%) patients had history of hypertension. Most of the patients had no history of CAD 67(52.3%), no history of angina 120 (93.8%) and no history of MI 108 (84.4%). In spite of patients residing at SNF, only 4 (3.1%) had additional meds administered prior to admission to relieve symptoms.
The subjects experienced high level of functional limitations. About 107 (83.6%) required assistance with toileting, 123 (96.1%) required assistance with bathing and 121 (94.5%) required assistance with ADLs. Despite the high level of limitations, only 38 (29.7%) used assistive devices.
Fifteen candidate variables, creatinine, weight difference, CKD, Angina, Arrhythmia, VHD, Tobacco, ADL, independent in bathing, independent in the toilet, S3 Heart sounds present, HJR, AF, Nitrates, and Hydralazine, were included in the selection process for the multivariate logistic regression as they were potential risk factors associated with "readmission within 30 days". Since there were only 23 readmissions within 30 days, based on the rule-of-thumb that for every one predictor variable included in a multivariate model there needs to be 10 "events", our final model included only 2 predictor variables. Creatinine and ADLs were included in the final model as this subset of predictors was found to be the best for prediction of "readmission within 30 days".

Logistic regression model

Parameter	Estimate	Standard Error	Odds Ratio	95% Confidence Interval		Pr > ChiSq
Intercept	-1.69	0.57				0.0029
Cr	0.63	0.24	1.87	1.17	2.99	0.0087
ADL	1.11	0.42	9.25	1.80	47.49	0.0077

** Hosmer and Lemeshow Goodness-of-Fit Test (χ^2= 2.56, df=3, p<0.4652)

Creatinine (p<0.0087) and ADLs (p<0.0077) were both significantly associated with readmission within 30 days in the final logistic regression model. Every 1-unit increase in creatinine was associated with an 87% increase in the odds of being readmitted within 30 days (OR = 1.87). Those patients who required assistance with ADLs were over 9 times more likely to be readmitted within 30 days (OR=9.25) as compared to patients who are independent



Receiver Operating Characteristic (ROC) curve

A receiver operating characteristic (ROC) curve was constructed to look at the final model's ability to predict the outcome. A numerical measure of the accuracy of the model was obtained from the area under the curve (AUC), where an area of 1.0 signifies near perfect accuracy.

Discussion

There were fifteen variables that were significant to readmissions within 30days in the SNFs population studied. However, there were only 23 readmissions within 30 days, thus, our final model included only 2 predictor variables. Creatinine and ADLs were included in the final model as this subset of predictors was found to be the best for prediction of "readmission within 30 days".

Increased creatinine revealed that many of the patients who were readmitted into the hospital had decreased renal functioning. Although this has been shown as a predictor of readmissions and GDMT has been shown to improve morbidity, a significant proportion of the studied population were not on therapy. About 72% of the populations studied were not on Angiotensin Converting enzyme inhibitor (ACEi), 86% were not on angiotensin receptor blocker (ARBs), 30% were not on betablocker, and 88% were not on mineralocorticoids. These are medications that can help improve HF condition and has been shown to decrease mortality and reduce re-admissions yet most of the patients were not placed on these medications.

However, 60 percent of the patients studied were receiving symptom relief using diuretics. Diuretics have not been shown to reduce readmissions, decrease mortality and are not evidence based because research did not show that diuretics reduce morbidity, mortality, and they do not change the outcome (Yancy et al., 2013). The lack of use of the evidence based medications such as betablockers and Angiotensin Receptor Inhibitors (ACEi) in the population studied might be a contributing factor to re-admission. The evidence based therapies were not prescribed for 60% of the population studied.

Findings of decreased renal function are significant in the SNFs population. Worsening renal function was reported as the strongest indicator for readmissions in the SNFs population. (Allen et al., 2011; Allen et al., 2012; Fonorow, 2005; Hutt et al., 2003; Lazzarini et al., 2013; Mentz et al., 2013; Tamhane et al., 2008; S. P. Wang et al., 2011; Y. Wang et al., 2011) As such, assessment of intolerance of neurohormonal antagonists and its antecedent hypotension with worsening renal function is of utmost importance. Patients with chronic kidney disease represented a unique sub-population in this cohort. They constitute challenges to maintenance of fluid volume status since the management goal is focused on preservation of the remaining renal function.

The second finding, ambulatory status, showed that patients with a decreased functional status were more likely to be readmitted. The study findings suggest that patients requiring assistance with ADLs were more likely to be re-admitted. The older the HF patients, the more likely the need for assistance, and the higher re-admission rate. Patients with limitations in their day to day functioning as evidenced by impairment in their ability to perform activities of daily living are more likely to be re-admitted. This finding supports the recent study that shows patients with HF who require assistance with ADLs were significantly more likely to be readmitted for heart failure within 60days (Anderson, 2014). The SNFs may need to invest more in the improvement and maintenance of functionality of the patients.

The heterogeneity of the patient factors examined may be attributable to demographic changes. However, subtle changes in status need to be recognized in view of the multiple co-morbidities in the elderly population with HF. Investigators may find better discrimination for predicting re-admission in patients that are discharged after heart failure hospitalizations by including cognitive impairment and care-seeking behaviors. It may be interesting to find out if certain predictors are paramount to gender or race. There is clearly a need for better discrimination of which predictors of re-admission is of significance in certain cohorts of HF patients.

There is no consensus as to what the predictors of HF are at the present time. Complex interaction of many patient factors may lead to readmission. Further investigation and refinement of the patient factors affecting readmissions may lead to consensus.

Limitations

Study population was limited to retrospective study using electronic medical record (EMR) from a large sub urban teaching hospital. This may limit the generalizability of the results. The study sample was small, it was racially and ethnically limited to primarily caucasian and representative of the population in the community. The distribution of participants on some variables was uneven and would have led to biased findings. From a statistical perspective, and in order to build a more complex multivariate model, a larger sample size would be necessary. As a result, future studies should be conducted with larger and more diverse samples to prevent biased findings.

EMR may exclude patient features that were unmeasurable that could affect the results of the research findings. It is worth noting that the lack of significant findings on blood pressure and lipid control as factors affecting CHF patient's readmission may be related to the EMR. If EMRs are to fulfill their promise as an effective tool, it should be possible to measure factors differently when distributed across all groups studied.

Collection of data from an EMR for research purpose is not novel. However, for the most part, it is using EMR to answer broader questions of science. The quality of the data collected from the EMR may vary due to the knowledge and expertise of the staff. I was unable to capture everything when compared with experimental controlled setting.

In spite of the limitations in this study, the results demonstrated methodological strengths as several confounding key variables were explored.

Implication and Conclusion

The study findings provide insight into the patient factors that affects readmission rates in the population of older adult from SNFs in a sub-urban region in the North Eastern part of USA. Findings from this study adds stregnth to previous findings that poor renal function and ADLwere among several factors that affect readmission rates. Since the study finding suggest that worsening renal function contributes to readmission, close monitoring of renal function at discharge and post-discharge period may be useful in reducing risk of hospital readmission. Health care professionals should emphasize close monitoring of renal function. Effects of limitations in the performance of ADL on readmissions should be studied to find out if improvement in functional abilities of HF patients in SNF may reduce readmissions. Future study with larger samples is indicated to verify the current findings for generalization.

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Table 1: Baseline Distribution of the social-demographic information of the Study Population.

Variable	N	%	Variable	N	%
Gender			**Ethnicity**		
male	60	46.9	Hispanic or Latino	1	0.8
Female	68	53.1	Not Hispanic or non-Latino	127	99.2
Race			**Marital status**		
Caucasian	122	95.3	Married	50	39.1
Black or African-American	2	1.6	Single	21	16.4
Asian	2	1.6	Widowed	52	40.6
Unknown or not reported	2	1.6	Divorced	4	3.1
			Separated	1	0.8
Age Category					
65-75 yrs	22	17.2			
76-85 yrs	50	39.1			
>85 yrs	56	43.8			

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	60	46.9	46.9	46.9
	Female	68	53.1	53.1	100.0
	Total	128	100.0	100.0	

Race

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Caucasian	122	95.3	95.3	95.3
	Black or African-American	2	1.6	1.6	96.9
	Asian	2	1.6	1.6	98.4
	Unknown or not reported	2	1.6	1.6	100.0
	Total	128	100.0	100.0	

Table 2: Activity of Daily Living (ADL)

Variable	N	%	Variable	N	%
CAD			**Myocardial**		
N0 Hx of CAD	67	52.3	N0 Hx of MI	108	84.4
HX OF CAD	61	47.7	hx of MI	20	15.6
Hypertension			**Renal disease**		
No Hx of hypertension	39	30.5	N0 Hx of renal disease	58	45.3
hx of hypertension	89	69.5	hx of renal disease	70	54.7
Anemia			**Hypercholesteremia**		
N0 Hx of anemia	64	50.0	N0 Hx of hypercholesteremia	60	46.9
history of anemia	64	50.0	hx of hypercholesteremia	68	53.1
Hypothyroidism			**Angina**		
N0 Hx hypothyroidism	91	71.1	N0 hx of Angina	120	93.8
history of hypothyroidism	37	28.9	hx of Angina	8	6.3
Arrhythmias			**Valvular Heart**		
N0 hx of arrhythmias	59	71.1	N0 hx of valvular disease	77	60.2
hx of arrhythmias	69	28.9	history of valvular disease	51	39.8
Pulmonary			**Meds prior to**		
N0 hx of pulmonary	87	71.1	Did not take additional meds	123	96.1
hx of pulmonary	40	28.9	took additional meds prior to	4	3.1

Missing	1	0.8	Missing	1	0.8
Tobacco			**ETOH**		
N0 smoking history or	123	96.1	N0 hx or current ETOH	126	98.4
yes smoking history or	5	3.9	yes hx or current ETOH	2	1.6
Illicit Drugs					
No hx or current illicit	126	98.4			
current or hx of illicit drug	1	0.8			
Missing	1	0.8			

Table 3: Guideline Directed Medical Therapy (GDMT)

Variable	N	%	Variable	N	%
Beta blocker			**Mineralocorticoids**		
Not on beta blocker	39	30.5	Not on mineralocorticoid	112	87.5
On betablocker	89	69.5	On mineralocorticoids	16	12.5
Diuretics			**Angiotensin Receptor Blockers**		
Not on diuretics	51	39.8	Not on ARBs	110	85.9
On diuretics	77	60.2	On ARBs	18	14.1
Digoxin			**Nitrates**		
Not on Digoxin	113	88.3	Not on nitrates	105	82.0
On Digoxin	15	11.7	On Nitrates	23	18.0
Hydralazine			**Angiotensing Converting**		
Not on Hydralazine	106	82.8	Not on ACEi	91	71.1
On Hydralazine	22	17.2	On ACEi	36	28.1
			Missing	1	0.8

Table 4: Findings of subjective and objective assessment

Variable	N	%	Variable	N	%
Cough			**Dyspnea**		
No cough	89	69.5	No dyspnea	16	12.5
cough present	39	30.5	Dyspnea present	112	87.5
Orthopnea			**Fatigue**		
No orthopnea	113	88.3	No fatigue	73	57.0
orthopnea present	15	11.7	Fatigue present	55	43.0
Heart Sounds			**Hepatojugular Reflux**		
No S3	125	97.7	No hepatojugular reflex	125	97.7
S3 Heart sounds present	3	2.3	Hepatojugular reflex present	3	2.3
Lower extremity Edema			**Ascites**		
No lower extremity edema	32	25.0	No ascites	120	93.8
LE edema present	96	75.0	Ascites present	8	6.3
Normal Sinus Rhythm			**Atrial Fibrillation**		
Not in normal sinus rythm	72	56.3	No AFib	72	56.3
Normal Sinus Rhythm	56	43.8	AFib present	56	43.8
Breath Sounds			**Jugular Venous Distension**		
No crackles	64	50.0	No JVD	98	76.6
crackles present	63	49.2	JVD Present	29	22.7
10	1	0.8	Missing	1	0.8
Sinus Bradycardia			**Sinus Tachycardia**		

No Sinus bradycardia	120	93.8	No sinus tachycardia	121	94.5
Sinus Bradycardia present	8	6.3	Sinus Tachycardia present	7	5.5
Implantable Cardioverter Defibrillator			**Pacemaker**		
No ICD	112	87.5	No Pacemaker	92	71.9
ICD present	16	12.5	Pacemaker present	36	28.1
Chest X-ray			**Biventricular**		
No congestion on Chest Xray	35	27.3	No BiV	117	91.4
Chest Xray with congestion	93	72.7	BiV present	11	8.6

Table 5: Guideline Directed Medical Therapy (GDMT) and device

Variable	**N**	**%**	**Variable**	**N**	**%**
Beta blocker			**Mineralocorticoids**		
Not on beta blocker	39	30.5	Not on mineralocorticoids	112	87.5
On betablocker	89	69.5	On mineralocorticoids	16	12.5
Diuretics			**Angiotensin Receptor Blockers**		
Not on diuretics	51	39.8	Not on ARBs	110	85.9
On diuretics	77	60.2	On ARBs	18	14.1
Digoxin			**Nitrates**		
Not on Digoxin	113	88.3	Not on nitrates	105	82.0
On Digoxin	15	11.7	On Nitrates	23	18.0
Hydralazine			**Angiotensing Converting**		
Not on Hydralazine	106	82.8	Not on ACEi	91	71.1
On Hydralazine	22	17.2	On ACEi	36	28.1
			Missing	1	0.8
Readmission within 30 days			**weight gain loss**		
No readmission within 30 days	105	82.0	weight gain	42	32.8
yes readmission within 30 days	23	18.0	weight loss	65	50.8
			weight even	20	15.6
			Missing	1	0.8

Table 6. Univariate Screen	No readmission within 30 days (n=105)	Yes readmission within 30 days (n=23)	p-value
Race: Caucasian	99 (96.1%)	23 (100.0%)	1.000
Black/AA	2 (1.9%)	0 (0.0%)	
Asian	2 (2.0%)	0 (0.0%)	
Ethnicity (Non-Hispanic/Non-Latino)	104 (99.1%)	23 (100.0%)	1.000
Marital Status: Married	40 (38.1%)	10 (43.5%)	0.890
Single	18 (17.1%)	3 (13.0%)	
Widowed	436 (40.9%)	9 (39.1%)	
Divorced	3 (2.9%)	1 (4.4%)	
Separated	1 (1.0%)	0 (0.0%)	
History of CAD	49 (46.7%)	12 (52.2%)	0.632
History of MI	17 (16.2%)	3 (13.0%)	1.000
History of hypertension	74 (70.5%)	15 (65.2%)	0.620
History of renal disease	53 (50.5%)	17 (73.9%)	0.041
History of anemia	50 (47.6%)	14 (60.9%)	0.250
History of hypercholesteremia	54 (51.4%)	14 (60.9%)	0.409
History of hypothyroidism	31 (29.5%)	6 (26.1%)	0.742
History of Angina	4 (3.8%)	4 (17.4%)	0.034
History of arrhythmias	61 (58.1%)	8 (34.8%)	0.042
History of valvular disease	36 (34.3%)	15 (65.2%)	0.006
History of pulmonary disease	30 (28.9%)	10 (43.5%)	0.172
Took additional meds prior to admission to relieve symptoms	0 (0.0%)	4 (17.4%)	0.001
Yes, smoking history or current	2 (1.9%)	3 (13.0%)	0.040
Yes, history or current ETOH	1 (1.0%)	1 (4.4%)	0.328
Current or history of illicit drug use	0 (0.0%)	1 (4.4%)	0.181
Ambulation	60 (57.1%)	9 (39.1%)	0.117
Uses assistive devices	30 (28.6%)	8 (34.8%)	0.555
ADLs	3 (2.9%)	4 (17.39%)	0.020
Independent with bathing	2 (1.9%)	3 (13.0%)	0.040
Independent with toileting	14 (13.3%)	7 (30.4%)	0.061
Chest x-ray with congestion	74 (70.5%)	19 (82.6%)	0.237
cough present	31 (29.5%)	8 (34.8%)	0.620
Dyspnea present	93 (88.6%)	19 (82.6%)	0.486
Orthopnea present	10 (9.5%)	5 (21.7%)	0.145
Fatigue present	44 (41.9%)	11 (47.8%)	0.603
Weight gain	35 (33.3%)	13 (56.5%)	0.106
loss	59 (56.2%)	9 (39.1%)	
even	11 (10.5%)	1 (4.4%)	
S3 Heart sounds present	1 (1.0%)	2 (8.7%)	0.083
JVD Present	23 (22.1%)	6 (26.1%)	0.681
Hepatojugular reflex present	1 (1.0%)	2 (8.7%)	0.083
LE edema present	78 (74.3%)	18 (78.3%)	0.690
Ascites present	5 (4.8%)	3 (13.0%)	0.154
Normal Sinus Rhythm	44 (41.9%)	12 (52.2%)	0.369
AFib present	50 (47.6%)	6 (26.1%)	0.059
Sinus Bradycardia present	5 (4.8%)	3 (13.0%)	0.154
Sinus Tacchycardia present	6 (5.7%)	1 (4.4%)	1.000
ICD present	11 (10.5%)	5 (21.7%)	0.164
Pacemaker present	28 (26.7%)	8 (34.8%)	0.433
BiV present	7 (6.7%)	4 (17.4%)	0.110

Angiotensing Converting Enzyme inhibitor	27 (26.0%)	9 (39.1%)	0.205
Beta blocker	70 (66.7%)	19 (82.6%)	0.133
Mineralocorticoids	12 (11.4%)	4 (17.4%)	0.486
Diuretics	63 (60.0%)	14 (60.9%)	0.939
Angiotensin Receptor Blockers	16 (15.2%)	2 (8.7%)	0.526
Digoxin	12 (11.4%)	3 (13.0%)	0.733
Nitrates	15 (14.3%)	8 (34.8%)	0.033
Hydralazine	14 (13.3%)	8 (34.8%)	0.028
Age	83.9±8.1 (84.0)	81.7±8.9 (85.0)	0.346
HR	79.9±22.0 (79.0)	76.0±14.3 (70.0)	0.464
SBP	132.4±31.9 (130.0)	127.2±28.8 (121.0)	0.441
DBP	69.3±15.5 (70.0)	65.3±13.7 (61.0)	0.203
Temp	36.7±0.8 (37.0)	36.7±0.5 (37.0)	0.817
BNP	1156.6±1263.4 (741.0)	1263.8±1019.8 (965.5)	0.361
Na	138.7±4.4 (139.0)	138.2±3.7 (138.0)	0.417
BUN	37.4±17.3 (34.0)	52.7±40.5 (33.0)	0.297
Cr	1.5±0.8 (1.0)	2.0±1.3 (2.0)	0.057
HbHct	34.4±5.7 (34.0)	32.3±4.9 (31.5)	0.112
EF	47.3±16.1 (50.0)	47.7±15.8 (45.0)	0.993
WtDiff	-4.4±18.0 (-2.0)	3.9±12.2 (3.0)	0.029
LOS*	7 (5, 9)	8 (5, 13)	0.289

Figure 1: Renal disease

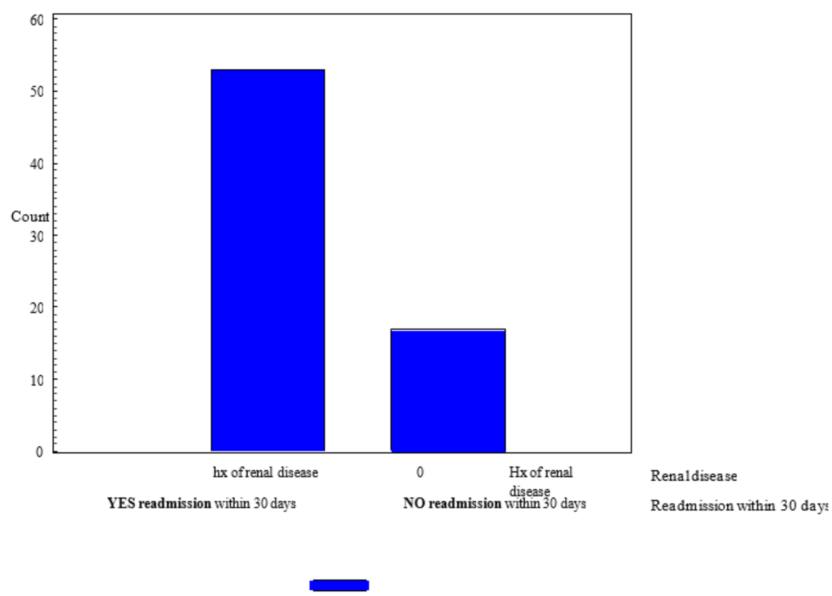

Figure 2: ADLs