

**Distribution Agreement**

In presenting this thesis as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis in whole or in part in all forms of media, now or hereafter known, including display on the World Wide Web. I understand that I may select some access restrictions as part of the online submission of this thesis. I retain all ownership rights to the copyright of the thesis. I also retain the right to use in future works (such as articles or books) all or part of this thesis.

Signature:

---

Lakshmi P Peddareddy

---

Date

**A Retrospective Analysis of all-cause 30-day readmissions among patients with Heart Failure at Emory University Hospitals**

By

Lakshmi P Peddareddy  
Degree to be awarded MPH

Executive MPH Program

---

Dr. Alvaro Alonso, MD, PhD  
Thesis Committee Chair

Date

---

Dr. Faisal Merchant, MD  
Thesis Advisor

Date

---

Dr. Laurie Gaydos, PhD  
Associate Chair for Academic Affairs EMPH Program

Date

**A Retrospective Analysis of all-cause 30-day readmissions among patients with Heart Failure at  
Emory University Hospitals**

By

Lakshmi P Peddareddy

MBBS, NTR University of Medical Sciences, 2000  
CCRC, Association of clinical Research Professionals, 2016

Thesis Committee Chair: Dr. Alvaro Alonso MD, PhD

An abstract of  
a thesis submitted to the faculty of the  
Rollins School of Public Health of Emory University  
in partial fulfillment of the requirements for the degree of  
Master of Public Health  
in Executive MPH  
2017

**Abstract**  
**A Retrospective Analysis of all-cause 30-day readmissions among patients with Heart Failure at Emory University Hospitals**

By Lakshmi Peddareddy

**Background:**

Heart Failure (HF) is a serious concern in the United States as it carries huge financial burden and high patient morbidity and mortality. One in 4 patients with HF diagnosis are readmitted within 30 days of discharge. As excessive readmissions tend to indicate suboptimal care, the Hospital Readmission Reduction Program (HRRP) was introduced to make hospitals responsible. Through this program since 2013, Medicare started to penalize the hospitals that exceed the national average readmission rates by reducing the Medicare reimbursements for inpatient services from 1% to a maximum of 3%. Despite reduction in readmission rate, multiple concerns were raised by hospitals and other stakeholders, like the American Hospital Association (AHA), that not all readmissions are preventable, readmission rate alone does not indicate the quality of care of a hospital, the formula to calculate readmission rate does not take factors like socioeconomic status into consideration, and the rate is a national average rate and not specific to hospitals. To verify some of these concerns we wanted to evaluate the all-cause 30-day readmissions among a subset of heart failure patients at Emory University Hospitals and to identify the predictors for preventable vs non preventable readmissions.

**Objective:**

To evaluate the all-cause 30-day readmissions among the heart failure patients and to identify predictors for preventable and non-preventable readmissions.

**Methods:**

We retrospectively examined the electronic charts of patients admitted to Emory Hospitals (Emory University Hospital at Clifton; Emory University Hospital at Midtown) with primary diagnosis of HF since January 1, 2012, until 100 consecutive subjects with all-cause 30-day readmission were identified. We collected data on patients' demographic variables, cause of admission, treatment and discharge at the time of admission, prior admissions, and presence of comorbid conditions. For study purposes, we classified Preventable Causes for Readmission as readmissions resulting from inadequate treatment of HF during initial admission, inadequate care for other comorbid conditions during hospitalization like diabetes and lack of adequate discharge teaching /Plan, and Non-Preventable Causes for Readmission as readmissions resulting from natural progression of HF, worsening of comorbid conditions despite adequate treatment during discharge of initial admission, subjects noncompliance to diet and medication and subjects socioeconomic status, lack of social support. We used odds ratios from univariate logistic regression analysis using SAS (9.4) to examine the association of factors for preventable readmissions and compare to non-preventable readmissions.

**Results:**

Of 100 readmissions in patients with HF, we classified 14 as preventable and 86 as non-preventable. The characteristics of patients with preventable and non-preventable were similar except for Insurance. 86% of preventable readmission patients carried Medicare insurance compared to 62% among non-preventable readmission patients. Among the 14 preventable readmissions, 8 (57%) readmissions were because of inadequate treatment of HF during initial admission; 1 (7%) because of inadequate care for other comorbid conditions during hospitalization; and 5 (36%) because of lack of discharge teaching /plan.

**Conclusion:**

The results are consistent with existing literature showing that inadequate treatment and inadequate discharge plan at the time of discharge are 2 major causes for preventable readmissions in HF. In this study patients that carried Medicare insurance were more likely to have higher readmission rates than patients that carried commercial insurance.

**A Retrospective Analysis of all-cause 30-day readmissions among patients with Heart Failure at  
Emory University Hospitals**

By

Lakshmi P Peddareddy

MBBS, NTR University of Medical Sciences, 2000  
CCRC, Association of clinical Research Professionals, 2016

Thesis Committee Chair: Dr. Alvaro Alonso MD, PhD

An abstract of  
a thesis submitted to the faculty of the  
Rollins School of Public Health of Emory University  
in partial fulfillment of the requirements for the degree of  
Master of Public Health  
in Executive MPH  
2017

### Acknowledgements

I would like to acknowledge and thank Dr. Faisal Merchant, MD, Dr. Alvaro Alonso, MD PhD and Dr. Laurie Gaydos, PhD for their time input and support to complete my thesis.

## Table of Contents

<b>1. Introduction</b> .....	1
Statement of the Problem .....	3
Theoretical Framework .....	6
Statement of Purpose.....	7
Research Question.....	8
Statement of Significance .....	8
Protocol Definitions .....	9
<b>2. Methods</b> .....	11
Design.....	11
Population.....	11
Data Acquisition and Storage.....	12
Protection of Human Subjects.....	12
Data Analysis .....	13
<b>3. Results</b> .....	15
<b>4. Discussion</b> .....	18
Findings.....	18
Strengths and Limitations.....	20
Recommendations for Future and Conclusion .....	21
<b>Appendices</b> .....	23
<b>References</b> .....	27

## **Introduction**

Heart Failure (HF) is a serious concern in the United States as it carries huge financial burden and high patient morbidity and mortality. The number of HF cases is predicted to increase from 5.1 million in 2012 to over 8 million by 2030.<sup>1</sup> The total direct medical costs for HF were estimated at \$20.9 billion in 2012, and are expected to increase to \$53.1 billion by 2030. A majority of these costs were related to HF hospitalizations apart from costs for health care services, medications, and missed days of work.<sup>1</sup>

HF is the primary diagnosis in 875,000 hospitalizations annually in the US(?) and is the most common diagnosis among people aged 65 and older.<sup>2</sup> The CDC also reports that the proportion of patients hospitalized with HF under the age of 65 has significantly increased from 23% in the year 2000 to 29% in 2010.<sup>3</sup> More than 25% of patients hospitalized for HF are readmitted to hospital within 30 days of discharge.<sup>4</sup> Literature suggests that main causes for readmissions among HF patients are noncompliance with medications or diet, inadequate discharge planning and follow-up, inadequate treatment during the hospitalization, failed social support system and failure to seek medical attention promptly when symptoms recurred.<sup>5,30</sup> These readmissions within 30 days following initial hospitalization are costly and are mostly preventable.

According to published CMS data, during 2003-2004 over 2.3 million Medicare patients with diagnosis of HF (1 in 5) were readmitted within 30 days of discharge. The estimated Medicare costs for these readmissions were \$17 billion dollars annually.<sup>4</sup> As reported by a

Commonwealth Fund report in 2006, Medicare would save 1.9 billion dollars annually if national readmission rates were lowered to the levels achieved by the top-performing regions.<sup>6</sup>

As excessive readmissions tend to indicate suboptimal care and reduction in readmission rates will reduce costs and improve quality of care, government payers like Medicare and commercial

private payers are targeting readmissions as a quality measure for hospitals and are concentrating on pay-for-performance initiatives to make hospitals responsible.<sup>11</sup>

The 2010 Patient Protection and Affordable Care Act (PPACA) intends to increase access to outpatient care, preventive services and improve the quality of care with evidence-based outpatient management systems and strategies thus reducing hospital admissions. The Hospital Readmissions Reduction Program (HRRP), created by the Affordable Care Act, was designed to make hospitals accountable for all-cause 30-day readmissions and pay attention to the care of people after their discharge. Through this program, Medicare penalizes hospitals that have higher than national average readmission rate for particular diagnoses like Acute Myocardial Infarction (AMI), Pneumonia, HF, Chronic Obstructive Pulmonary Disease (COPD), Coronary Artery Bypass Graft (CABG), and Hip and Knee replacement by reducing Medicare reimbursements for inpatient services.<sup>11</sup> The HRRP payment penalties took effect in fiscal year 2013, with the penalties ranging from 1% reduction to as much as 3% reduction in Inpatient Prospective Payment System (IPPS) payments.<sup>11</sup>

Readmission rates started to fall in 2012 even before the HRRP implementation, which might be because of early measures taken by hospitals before enactment to avoid penalties. For Fiscal years 2013, 2014, 2015 and 2016; 64%, 66%, 78% and 78% of hospitals were penalized nationwide and per program Medicare reduced payments of an estimate of \$290 million; \$227 million, \$428 million and \$528 million respectively.<sup>11</sup>

However, hospitals and other stakeholders such as the American Hospital Association have raised concerns about the program, and have proposed improvements, especially in the calculation of the risk adjustment score. The key issues are lack of risk adjustment for key socio demographic factors; consideration of role of other healthcare providers; unavoidable

readmissions; and scaling methodology. Hospitals that have low mortality rates but higher readmission rates than national average are getting penalized although they have better quality of care. There is a necessity to take a closer look at data since implementation of the program and make appropriate changes to the risk score calculation.<sup>13, 30</sup>

Since the implementation of HRRP program in 2013, a conflict between Medicare / commercial payers and hospital systems exists about the causes for readmissions and whether readmission rate alone actually reflects hospital's quality. Existing literature supports Medicare perspective that readmission rate is a quality indicator, but also supports hospitals concerns.

### **Statement of the Problem**

Heart Failure (HF) is seen among all ages, from children and young adults to the middle-aged and the elderly. The incidence of HF is 10 per 1,000 population after 65 years of age which is approximately 550,000 new cases in the U.S. each year.<sup>2</sup> HF also carries high morbidity and mortality among the patients. 1 in 9 deaths in 2009 had heart failure as the leading cause.<sup>7</sup> HF ranks high among the hospital admissions rates for those aged 65 and above, with 1 million hospitalizations in 2000 and in 2010.<sup>8</sup> Despite the advancements in treatment, readmissions following HF hospitalization remains high, with  $\geq 50\%$  patients readmitted to hospital within 6 months of discharge and about 25% within 30 days.<sup>9</sup> HF is ranked high among the all-cause 30-day readmissions in 2013 with 782,079 initial admissions leading to 183,534 readmissions costing \$2.7 billion.<sup>10</sup>

According to data from the Center for Health Information and Analysis (CHIA), in 2013, HF topped the charts for all cause 30-day readmissions with 23.5% compared to 13.9% for total index readmissions for any cause. About 37% of total Medicare spending is towards inpatient

services and 18% of this is for all cause 30-day readmissions that accounts to \$15 billion annually. These readmissions are costly and a majority of them are preventable.<sup>10</sup> Through the HRRP program, CMS wants to make hospitals accountable by imposing a penalty and reducing the Medicare payments for inpatient services.

CMS developed the 30-day risk-standardized claims-based, risk adjusted Hospital-Wide Readmission (HWR) measure with a team of clinical and statistical experts through a transparent process that included input from multiple national Technical Expert Panels and public comments. CMS maintains the readmission measures and recalculates the rates annually to include updates made in response to public comments and policy considerations.<sup>12</sup>

*Definition for Readmission:* All-cause unplanned 30-day inpatient admissions to any acute care facility after the discharge for the conditions mentioned above is considered a readmission.

Planned readmissions are excluded.<sup>12</sup> CMS has posted the specific formulas to Calculate the Readmission Adjustment Factor on their website. CMS gives hospitals a 30-day review and corrections period to examine their HSR (Hospital Specific Readmission) data to ensure that the Excess Readmission Ratios (ERRs) are correctly calculated. CMS notifies hospitals of the exact dates of the Review and Corrections period, and posts these dates on QualityNet once they are finalized. During this period, hospitals can review the data provided in their HSRs and can submit requests for corrections to their ERRs during the 30-day review period.<sup>12</sup>

Since the implementation of HRRP in 2013, the maximum penalty increased from 1% in 2013 to 3% in 2015 and the percentage of the hospitals penalized increased from 64% in 2013 to 78% in 2016. The CMS estimate of total penalties was \$290 million in 2013 to \$528 million for 2017.

The national Medicare readmission rates started to fall in 2012 and the readmission rates for HF

diagnosis for initial hospitalization fell from 24.7% (July 2008-June 2011) to 22.0% (July 2011-June 2014).<sup>13</sup>

There has been a reduction in readmissions since the implementation of the program and the aggregate costs for readmissions for HF decreased by 20% among index stays paid by Medicare insurance and by 9% among those paid by private insurance.<sup>10</sup> Despite the reduction in number of hospital admissions since the enactment of the program, the penalties have increased because of increase in number of conditions and because penalty calculations are based on national average score, rather than fixed targets, as required by law. Hospitals raised questions about the penalties, readmission risk score calculation and asked for some improvements.<sup>13</sup>

Studies have shown that patients living in high poverty neighborhoods have about 24% higher readmission rates after controlling the other comorbid conditions.<sup>14</sup> Hence the hospitals in low socioeconomic areas have higher readmission rates compared to the other hospitals in high socioeconomic areas. This demands for adjustment of socioeconomic factors although CMS opposed this because it may bring up disparities.

Some hospitalizations are out of Hospitals control especially among patients with multiple comorbid chronic conditions. Prior studies show that Medicare beneficiaries with six or more chronic comorbid conditions have higher readmission rate of 25 percent, compared to 9 percent with one or no comorbid condition.<sup>14</sup> Among the subjects with multiple comorbid conditions, translational providers play a major role in the subject's progression of the disease and management of chronic conditions. The management of these comorbid conditions is out of the hospitals control and the other providers should be made accountable for the readmission. Also the hospitals that manage patients with multiple chronic conditions should not be adversely penalized for higher readmission rates as it is expected with these patients.<sup>13</sup>

CMS readmission rate is based on national average and not specific for hospital, so a hospital can be penalized even with lower readmission rate as it is compared to national average that is changing each year. It is suggested that Hospitals should have fixed targets instead of comparing to national average, but others argue that fixed targets might limit the hospitals performance as it defines the minimum expectation. The HRRP risk score does not take into account the readmissions that are unrelated.<sup>13</sup>

### **Theoretical Framework**

HF is ranked high for readmission rates with approximately 1 million readmissions annually.<sup>16</sup>

The main causes for readmissions among HF patients are mainly noncompliance with medications or diet, inadequate discharge planning or follow-up, inadequate treatment during the hospitalization, failed social support system and failure to seek medical attention promptly when symptoms recurred.<sup>17</sup> Previous literature suggests that the majority of these readmissions (1 in 5) are preventable.<sup>18</sup>

According to policy researchers and health care practitioners relatively, high readmission rates among patients with chronic illness like HF are because of diverse reasons like lack of proper discharge plan due to inadequate relay of information by hospital discharge personnel to patients, caregivers, and to transitional care providers; patient noncompliance with care instructions; inadequate follow-up visits with post-acute and long-term care providers; change in hospital bed supply; lack of social and family support; worsening and natural progression of disease; and preventable medical errors.<sup>19</sup>

Among the causes for readmission with initial HF admission, recurrent HF and related cardiovascular conditions account for only about half, whereas other comorbid conditions account for the rest.<sup>20</sup> The causes for readmissions are multiple but can be broadly classified as

preventable and non-preventable causes. Preventable cause is where the hospital is accountable for readmission and non-preventable cause is where readmissions are beyond the scope of the hospital.

In 2012 Kaiser Permanente conducted a study among 18 hospitals in Northern California to study causes for preventable readmissions. A total of 532 readmissions were evaluated of which 47% (250) of readmissions were assessed as potentially preventable; 11% (55) were assessed as completely preventable; and 36% (195) as moderately preventable. The factors for 250 potentially preventable readmissions were related to inadequate treatment during stay (in 143 cases, 57%), the discharge plan (168, 67%), and follow-up transitional care (197, 79%).

About 8 factors contributed as main causes for preventable readmissions were mostly related to improving quality of care; transitional care planning and care coordination, clinic visits, follow up plan, advance treatment planning and terminal care and medication management.<sup>21</sup>

Since the implementation of the HRRP program, many hospitals are focusing on reducing readmissions and improve the quality of care by having proper discharge plan and follow up and also by introducing transitional care programs. However, literature is limited about the percentage of preventable vs non-preventable causes for readmissions since the implementation of HRRP.

### **Statement of Purpose and Description**

The study conducted was a retrospective analysis of electronic charts of patients admitted to Emory Hospitals (Emory University Hospital at Clifton; Emory University Hospital at Midtown) with primary diagnosis of HF from 01-01-2012 to 02-15-2017, until 100 consecutive subjects with 30-day all-cause readmission are identified. The purpose of the study is to examine 30-day all-cause readmissions at Emory University Hospitals, evaluate the number of preventable vs

non- preventable causes and to test the hypothesis that only about 10% of the readmissions are preventable because of improved quality of care since implementation of HRRP program at Emory Hospitals.

### **Research Question**

The following questions are studied in this study

1. What is the prevalence of preventable vs non-preventable causes for all-cause 30-day readmissions among HF patients?
2. What are the causes for preventable vs non-preventable causes for readmissions?

### **Statement of Significance**

Per American Heart Association Statistics Committee and Stroke Statistics one in 9 deaths is because of HF, accounting for 287,000 deaths per year. The prognosis for patients after the diagnosis is grave with about 50% patients having <5 year survival rate.<sup>7</sup> Major risk factors for HF include Hypertension, Diabetes, coronary artery disease, obesity, and dyslipidemia. Subjects with the diagnosis of HF also have multiple comorbidities like chronic kidney disease, chronic obstructive pulmonary disease, sleep apnea that makes management of HF complex and requiring constant supervision.<sup>14</sup>

HF is the leading cause for readmissions with  $\geq 50\%$  patients readmitted to hospital within 6 months of discharge and about 25% within 30 days.<sup>9</sup> These readmissions carry high morbidity and mortality among the HF patients and impose a huge financial burden to the US health care system. Since high hospital readmission rates are often indicated as poor quality of care, commercial payers and Medicare wants hospitals to be responsible for excess readmissions. However concerns are raised by hospitals and other stakeholders like American Hospital

Association as mentioned above. Major critique being that it did not adequately account for differences in socioeconomic status between hospitals (76% "agree" or "strongly agree " that is a hospital with low socioeconomic population has higher readmissions that is not accounted)[?]. The other concerns included that the penalties were large (68% agree), and factors that are out of hospitals control (64% agree).<sup>22</sup> Not all admissions are preventable. Factors that are beyond hospitals control that play role in readmissions include patients' diet and medication noncompliance despite adequate follow up after discharge. It is important to evaluate the readmissions and distinguish between the preventable vs non-preventable causes to make improvements and reduce readmissions.

### **Protocol Definitions:**

For this study's purpose the following definitions were used:

*30-day all-cause readmission:* Any readmission within 30 days of discharge from hospital

*Discharge Diagnosis:* The first listed diagnosis in the dated discharge summary report

*Preventable Causes for Readmission:* Readmission resulting from one of following reason

Inadequate treatment of HF during initial admission

Inadequate care for other comorbid conditions during hospitalization like diabetes

Lack of adequate discharge teaching / plan

*Non-Preventable Causes for Readmission:* Readmission resulting from one of following reason

Natural progression of HF

Worsening of comorbid conditions despite adequate treatment during discharge of initial admission

Subjects noncompliance to diet and medication

Subjects socioeconomic status, lack of social support.

## **Methods**

### **Design:**

The purpose of the study is to study the prevalence of preventable readmissions and to evaluate the causes for preventable vs non-preventable all-cause 30-day readmissions among HF patients. To achieve the objective we reviewed retrospectively the electronic charts of patients admitted to Emory Hospitals (Emory University Hospital at Clifton; Emory University Hospital at Midtown) with primary diagnosis of HF since January 1<sup>st</sup>, 2012. We had to review approximately 750 patient charts to identify 100 subjects with 30-day all-cause readmission. Data in regards to patient's demography, cause of admission, treatment and discharge at the time of admission, prior admissions and presence of comorbid conditions like diabetes, hypertension, kidney disease, COPD, Ejection Fraction (EF) are collected for analysis. The data was previously collected as part of usual clinical care and abstracted for this study.

### **Patient Population:**

Patients are identified by searching the Emory electronic medical record system (Powerchart) that includes data on all patients followed at Emory University Hospitals. We reviewed the electronic charts of all patients admitted to the Emory Hospitals age  $\geq 18$  with primary diagnosis of worsening HF since January 2012. First consecutive eligible 100 subjects that had an all cause 30-day readmission are included in analysis for the study. The data in regards to patients demography, cause of admission, treatment and discharge at the time of admission, prior admissions and presence of comorbid conditions like diabetes, hypertension, Kidney disease, COPD, Ejection Fraction (EF) are collected and analyzed for preventable vs non preventable causes of readmission .

**Data Acquisition and Storage:**

Data was collected using the Emory electronic medical record (Powerchart). Patients admitted at Emory University Hospitals with primary diagnosis of HF are screened and the first 100 patients that had all cause 30-day readmission are identified and are included in the study. Data collected from Powerchart also included demographic factors, cause of admission, treatment and discharge at the time of admission, prior admissions and presence of comorbid conditions like diabetes, hypertension, Kidney disease, COPD, Ejection Fraction (EF), date of initial admission, date of readmission. Patients with all cause 30-day readmission were analyzed for their cause for readmission. The preventable causes for this study included inadequate treatment during the prior hospitalization, inadequate discharge plan and follow up and inadequate treatment of the comorbid conditions that might have precipitated the readmission. The non-preventable causes included unavoidable progression of chronic disease, patient's non-compliance to diet and drugs due to socio economic and psychological factors like insurance, depression and lack of social support.

All stored data is encrypted and organized with the use of a coding system in an excel spreadsheet. The excel spread sheet was stored in a shared drive that had restricted access with user id and password and also in an encrypted computer.

**Protection of Human Subjects:**

The study was conducted after approval of Emory University Institutional Review Board (IRB). The study qualified for a complete HIPAA waiver from Emory IRB because the study is a retrospective chart review study. Children (under the age of 18 years old) are not included in the study. This is a minimal risk study, as the only risks to those who participate was the potential

for a breach in confidentiality of patient records. Every effort was made to ensure patient confidentiality including following appropriate HIPAA guidelines and de-identifying stored patient data. All members of the study team that had access and store PHI are fully trained to Emory's confidentiality standards.

### **Data Analysis:**

To obtain the study data, we reviewed approximately 750 medical records of subjects' age  $\geq 18$  yrs, hospitalized at Emory University Hospitals with a primary diagnosis of HF since January 1<sup>st</sup>, 2012. The first 100 patients identified who had 30-day readmission were included for study analysis. The data collected was categorized as: age ( $<50$ ,  $50-75$  and  $>75$ ), gender, race (White, Black, Other), Ejection Fraction ( $\leq 35\%$  or  $>35\%$ ), Insurance (Medicare, Medicaid, Commercial), time since HF diagnosis ( $\leq 12$  months or  $> 12$ months), Hypertension, Diabetes, Chronic kidney Disease, Ischemic or Non Ischemic cardiomyopathy, Date of initial admission, Date of readmission, length of stay during admission ( $\leq 5$ days or  $> 5$  days), cause of readmission (preventable or non-preventable), preventable readmission (inadequate treatment of HF, inadequate follow up of Chronic condition, inadequate discharge plan/teaching), non-preventable readmission (progression of HF, worsening of other comorbid conditions, dietary medication noncompliance). Literature suggests that age, race, comorbid conditions and insurance play role in HF admissions, we wanted to evaluate their association in the readmissions hence these covariates are included in the study<sup>27, 30</sup>. The primary outcome variable is cause for readmission (preventable vs non preventable). The independent variables for the study included Insurance (Medicare, Medicaid, Commercial), time since HF diagnosis ( $\leq 12$  months or  $>12$ months), Hypertension, Diabetes, Chronic kidney Disease, Ischemic or Non Ischemic cardiomyopathy, Date of initial admission, Date of readmission, length of stay during admission ( $\leq 5$  days or  $> 5$

days), cause of readmission (preventable or non-preventable), preventable readmission (inadequate treatment of HF, inadequate follow up of Chronic condition, inadequate discharge plan/teaching), non-preventable readmission (progression of heart failure, worsening of other comorbid conditions, dietary medication noncompliance). The covariate variables included are age (<50, 50-75 and >75), gender race (White, Black, Other).

Data analysis was done using SAS version 9.4 (SAS Inc., Cary, NC, USA). Continuous variables are reported as mean  $\pm$  Standard Deviation (SD) and categorical variables are reported as frequency or percentage. Collinearity test done did not show any statistically significant collinearity among the independent variables. Exploratory analysis of the covariates and unadjusted odds ratio (OR) are used to show the association of covariates with causes for preventable readmission (the main outcome measure). Bivariate tests (Chi Square, t-test and Wilcoxon rank sum, as appropriate) were used to compare variables between preventable and non-preventable readmissions. Logistic regression was used to calculate the crude odds ratios. The level of significance for p value is set at <0.05.

## **Results**

### **Descriptive analysis of Patient Characteristics:**

We screened over 700 charts to identify 100 subjects that had all-cause 30-day readmission for HF admitted at Emory University Hospitals since January 2012. Among the 100 readmissions, mean±standard deviation age for patients was 64±15 years. For the study, we divided the age in 3 categories < 50yrs (19%); 50-75yrs (59%); >75yrs (22%). The most common race was Black with 81 (81%) and white constituted rest with 19 (19%). 53% of the patients were male and 47% female. Medicare was the most common insurance with 60%; Medicaid 15% and commercial 16%. Nine subjects out of the 100 readmissions did not have any insurance. (Table 1)

Among the exposure variables, 91% had hypertension, 17% had COPD, 82% had CKD, 48% had diabetes; 75% had non-ischemic cardiomyopathy, and 25% had ischemic cardiomyopathy. (Table 1)

There were no significant differences between those with preventable and non-preventable readmissions for all variables in the study except subjects with preventable readmission had higher prevalence of Medicare insurance.

### **Covariates and Exposures among Preventable Readmission:**

The characteristics of subjects with preventable readmissions matched the full sample causes for readmissions. For age, majority were between 50-75yrs 9 (64%), <50yrs 3 (21%) and >75yrs 2 (14%). For race, majority were black 12 (86%) and White were 2 (14%). Males constituted 8 (57%) and females 6 (43%); 12 (86%) had the diagnosis of HF greater than 12 months; 10 (71%) had LVEF≤35%; 14 (100%) had hypertension; only 2 (14%) had COPD; 5 (36%) had diabetes; 12 (86%) had CKD; majority had non ischemic CMP 10 (71%); 7 (50%) had an outpatient visit

in between the initial discharge and readmission and majority carried Medicare insurance 12 (84%), Medicaid 1 (7%) and commercial 1 (7%). (Table 1)

### **Covariates and Exposures among Non-Preventable Readmission:**

The characteristics of subjects with non-preventable readmissions matched the full sample causes for readmissions. For age majority were between 50-75yrs 50 (58%), <50yrs 16 (19%) and >75yrs 20 (23%). For race majority were black 69 (80%) and White were 17 (20%). Males constituted 45 (52%) and females 41 (48%); 76 (88%) had the diagnosis of HF greater than 12 months; 56 (65%) had LVEF $\leq$ 35%; 77 (90%) had hypertension; only 15 (17%) had COPD; 43 (50%) had diabetes; 70 (81%) had CKD; majority had non ischemic CMP 65 (76%); 50 (58%) had an outpatient visit in between the initial discharge and readmission and majority carried Medicare insurance 48 (62%), Medicaid 14 (18%) and Commercial 15 (20%). (Table 1)

### **Prevalence of Preventable and Non-Preventable readmissions**

Among the 100 readmissions 14% of readmissions were preventable, 86% were non-preventable. I duplicated the criteria for preventable and non-preventable readmissions for easy access.

*Preventable Causes for Readmission:* Readmission resulted because of one of following 3 reason

Inadequate treatment of HF during initial admission

Inadequate care for other comorbid conditions during hospitalization like diabetes

Lack of discharge teaching /plan

*Non-Preventable Causes for Readmission:* Readmission resulted because of one of following 3 reasons

Natural progression of heart failure

Worsening of comorbid conditions despite adequate treatment during discharge of initial admission

Subjects noncompliance to diet and medication and socioeconomic status, lack of social support

Among the 14 preventable readmissions, 8 (57%) readmissions were because of inadequate treatment of HF during initial admission, 1 (7%) is because of inadequate care for other comorbid conditions during hospitalization, and 5 (36%) because of lack of discharge teaching /plan.

Among the 86 non preventable readmissions, 35 (41%) of readmissions is because of subjects noncompliance to diet and medication and socioeconomic status, lack of social support, 25 (29%) is because of Natural progression of HF and 26 (30%) is because of worsening of comorbid conditions despite adequate treatment during discharge for initial admission. (Table 2)

*Regression analysis of characteristics for preventable causes for readmission*

We did an unadjusted regression analysis of characteristics for preventable causes for readmission. Black race (OR 1.4), age <50yrs (OR 1.9), male gender (OR 1.2), HF diagnosis <12 months (OR 1.3), presence of hypertension, chronic kidney disease (OR 1.4), non-ischemic cardiomyopathy (OR 1.2), having Medicare insurance (OR 3.9) compared to commercial insurance, and not having ambulatory visit (OR 1.4) are important predictors and carry higher incidence of preventable readmissions. Absence of Diabetes (OR 1.8), and COPD (OR 1.3) indicated the higher risk for readmissions (Table 3).

## **Discussion:**

### **Findings:**

Substantial published literature shows that readmissions impose a huge financial burden to the US Health Care System. Some of these readmissions can be prevented.<sup>30</sup> This study was conducted to assess the prevalence and causes for preventable readmissions among patients admitted at Emory University Hospitals with diagnosis of HF. Existing literature suggests that 1 in 5 readmissions (20%) are preventable. Our findings showed that 14% of readmissions were preventable readmissions that support the reduction in readmission rate from 20% to 14% since the HRRP implementation although it rejects the hypothesis as the reduction was not 10%. This might be because of the sample size. These findings are similar to the previous findings that readmission reduction rates started to fall since 2012 even before HRRP implementation.<sup>10</sup>

Our findings again supported the literature that main cause for preventable readmissions are inadequate treatment of diagnosis during hospitalization (57%) followed by lack of or inadequate discharge plan (36%) (Table 2). This is important because adequate discharge plan with follow up with transitional care providers can help reduce the preventable readmissions and reduce the costs. According to the Healthcare Cost and Utilization Project (HCUP) Statistical Brief that examined the trends from 2009 through 2013, there has been 7% reduction among index stays with Medicare for CHF along with other conditions. Medicare was the only expected payer for which the rate of readmission decreased for all four conditions. Despite the concerns of hospitals HRRP did help hospitals to look closer at their discharge patients and implement programs to improve the quality of care resulting in reduction of readmissions since implementation.

Based on the previous discharge data from hospitals in New York, Pennsylvania, Tennessee, and Wisconsin, race and type of insurance are important factors for readmissions, and the main cause for preventable readmissions is mainly because of complexity of the diagnosis.<sup>30</sup> A study done at Kaiser hospitals in Northern California the factors that contributed as main causes for preventable readmissions were mostly related to improving quality of care; transitional care planning and care coordination, clinic visits, follow-up plan, advance treatment planning and terminal care and medication. Our findings also echo the hospitals concerns that not all readmissions are preventable and Medicare and commercial payers should consider this when adjusting the factors to calculate the readjustment score.

We looked at predictors for readmissions and compared them for preventable and non-preventable readmissions to assess any correlation and differences in predictors. Again supporting the existing literature, the unadjusted analysis showed Black race, age <50yrs, male gender, HF diagnosis <12months, presence of hypertension, chronic kidney disease, non-ischemic cardiomyopathy, having Medicare insurance compared to commercial insurance, and not having ambulatory visit as important predictors, carrying higher incidence of preventable readmissions. On the contrary, absence of Diabetes and COPD indicated the higher risk for readmissions (Table 3). This might be again because of limited sample size. This shows that there is still room for improvement of quality of care for patients especially during their discharge. Also our study supported the finding that Medicare patients have higher readmission rates especially for preventable readmissions (86%). Among 100 readmissions 86 (86%) were non-preventable readmissions, supporting the claims that hospitals should not be penalized for all readmissions as not all readmissions are preventable. Also black race (OR 1.4) is associated with higher readmission, validating the concern raised by hospitals about adjusting the

calculation of risk score to include socioeconomic factors and other ethical concerns. The study provides an insight regarding prevalence, causes and predictors for preventable readmissions after the implementation of HRRP program and confirms the concerns of hospitals. This supports the HRRP in that hospitals are responsible if not for all but for some of the readmissions that can be addressed with quality of care improvement programs. The study also supports the hospitals view in that the risk score needs to be adjusted for sociodemographic factors and readmissions alone does not measure the quality of care of hospitals.

### **Strengths and Limitations:**

The main strength of the study is the data collection and accuracy. Information collected regarding patient's demography, hospitalization, readmissions and causes for readmission comes from the Powerchart system, and was confirmed by hospital admission reports and discharge reports.

There are several limitations for the study, main one is sample size. We could not query Emory's Electronic database for readmissions or for admissions so we have to manually screen all the patients to check if they had admission for the diagnosis and, if so, whether there was a readmission. We had to manually screen over 700 patient charts to find 100 hundred readmissions. Of 100, only 14 readmissions were preventable. The process was tedious and time consuming. The study was done mainly as a pilot study to support the literature and to be a reference for future studies. Although study lacks power and statistical significance, odds ratios with narrow confidence intervals leads to assumption that statistical significance will be achieved if the sample size is increased. Another limitation is lack of generalizability of patient population admitted at Emory University Hospitals. Emory University Hospital is located in the midtown of

Atlanta and the patient population might not represent the national population. Socioeconomic status of the patients was not collected because of inaccurate capture in Powerchart and missing nature although it is an important predictor.

### **Future Recommendations and Conclusion:**

The primary purpose of the HRRP program was to improve the quality of care of the hospitals, decrease the number of preventable readmissions, thus reducing health care costs and burden. Findings from our analysis confirm the published literature on HRRP, causes for readmissions and hospital concerns. There has been a reduction in hospital readmission rates since the implementation of program. Through the program, 78% of hospitals of nation's hospitals are penalized up to 3% of Medicare reimbursements. However measuring the quality of care is a complex process and multifactorial and cannot be assessed by a single measure of readmission rate. Also the calculation of readmission risk score raises some concerns, such as not taking socioeconomic status into consideration, comparing to national average instead of fixed targets for hospitals, and considering all 30-day readmissions, since most readmissions are not preventable. Some of the hospitals are unfairly affected by the penalties and there is a necessity for modification to prevent these adversities. Study results echoed the concerns in that only 14 of the readmissions were preventable. The formula should only be used to penalize the hospitals that have excess avoidable and related admissions to initial admission. Currently the risk formula used by CMS to calculate the readmissions does not capture or consider all the factors for readmissions and the factors that are out of hospitals control. There need to be modification of risk calculation score to include sociodemographic factors and specific targets for the hospitals are to be established instead of comparing to national average. Also the formula should be adjusted to accommodate the hospitals serving in low income areas and treating the patients with

no insurance and multiple chronic conditions. Additional research should be done to find measures for appropriate calculation of quality of care for hospitals and risk-adjustment readmission rates. Also Medicare and commercial insurance companies should consider incentives for hospitals that employ quality care measures like transitional care facilities and appropriate discharge plan and follow ups. Together this would reduce the inappropriate penalties for hospitals that would in turn help to initiate quality measures to reduce the readmission in hospitals.

An additional criticism is that it may be easier and more economical for hospitals to pay penalties than implement the measures to reduce readmissions and meet the national average risk adjustment score. Also, if we continue using readmission as the quality measure, we may reach a point where to reduce readmissions the care delivered can be viewed as suboptimal.

Medicare/Commercial payers should consider these possibilities and address the concerns by making changes to the risk score calculation in future and by providing incentives to the hospitals that made improvements.

**Table 1. Characteristics of patients with all cause 30day hospitalization with Heart Failure at Emory University Hospitals**

Characteristics	Full sample (N = 100) N (%)	Preventable Causes (N=14) N (%)	Non Preventable causes (N=86) N (%)	P value
<b>covariates</b>				
<b>Age, years</b>				<0.0001
<50	19(19)	3(21)	16(19)	
50-75	59(59)	9(64)	50(58)	
>75	22(22)	2(14)	20(23)	
<b>Race</b>				<0.0001
White	19(19)	2(14)	17(20)	
Black	81(81)	12(86)	69(80)	
Other	0(0)	0(0)	0(0)	
<b>Sex</b>				0.55
Female	47(47)	6(43)	41(48)	
Male	53(53)	8(57)	45(52)	
<b>Exposure variables</b>				
<b>HF Diagnosis</b>				<0.0001
>12 months	88(88)	12(86)	76(88)	
≤12Months	12(12)	2(14)	10(12)	
<b>LVEF</b>				0.001
≤ 35%	66(66)	10(71)	56(65)	
	34(34)	4(29)	30(35)	
<b>HTN</b>				<0.0001
yes	91(91)	14(100)	77(90)	
no	9(9)	0(0)	9(10)	
<b>COPD</b>				<0.0001
yes	17(17)	2(14)	15(17)	
no	83(83)	12(86)	71(83)	
<b>Diabetes</b>				0.69
yes	48(48)	5(36)	43(50)	
no	52(52)	9(64)	43(50)	
<b>CKD</b>				<0.0001
yes	82(82)	12(86)	70(81)	
no	18(18)	2(14)	16(19)	
<b>Cardiomyopathy Type</b>				<0.0001
Non-Ischemic	75(75)	10(71)	65(76)	
Ischemic	25(25)	4(29)	21(24)	

Characteristics	Full sample (N = 100) N (%)	Preventable Causes (N=14) N (%)	Non Preventable causes (N=86) N (%)	P value
<b>Ambulatory Visit</b>				0.16
no	43(43)	7(50)	36(42)	
yes	57(57)	7(50)	50(58)	
<b>Insurance*</b>				<0.0001
Medicare, (%)	60(60)	12(86)	48(62)	
Medicaid, (%)	15(15)	1(7)	14(18)	
Commercial, (%)	16(16)	1(7)	15(20)	

Abbreviations: HTN, Hypertension; LVEF, Left Ventricular Ejection Fraction; COPD, Chronic Obstructive Pulmonary Disease; CKD, Chronic Kidney Disease; HF, Heart Failure

\*Missing data: 9 subjects did not have insurance.

**Table 2 Causes for Preventable and non-preventable readmissions**

Causes for Readmission	Full sample (N = 100) N (%)
<b>Preventable Causes</b>	14(14%)
1	8(57%)
2	1(7%)
3	5(36%)
<b>Non Preventable Causes</b>	86(86%)
1	25(29)
2	26(30%)
3	35(41%)

**Preventable Causes for Readmission:**

1. Inadequate treatment of HF during initial admission
2. Inadequate care for other comorbid conditions during hospitalization like diabetes
3. Lack of discharge teaching /Plan.

**Non-Preventable Causes for Readmission:**

1. Natural progression of heart failure
2. Worsening of comorbid conditions despite adequate treatment during discharge of initial admission
3. Subjects noncompliance to diet and medication and socioeconomic status, lack of social support.

Table 3: Unadjusted odds ratio of covariates and exposures for preventable readmissions

Characteristics	Odds Ratio	95% CI	
<b>covariates</b>			
<b>Age, years</b>			
<50	1.9	0.3	12.6
50-75	1.8	0.4	9.0
>75	ref		
<b>Race</b>			
White	0.7	0.1	3.3
Black	ref		
Other	0	0	
<b>Sex</b>			
Female	0.8	0.3	2.6
Male	ref		
<b>Exposure variables</b>			
<b>HF Diagnosis</b>			
>12 months	ref		
≤12Months	1.3	0.2	6.5
<b>LVEF</b>			
≤= 35%	ref		
	1.3	0.4	2.4
<b>HTN**</b>			
yes	ref		
no			
<b>COPD</b>			
yes	ref		
no	1.3	0.3	6.3
<b>Diabetes</b>			
yes	ref		
no	1.8	0.6	5.8
<b>CKD</b>			
yes	ref		
no	0.7	0.1	3.6
<b>Cardiomyopathy Type</b>			
Non-Ischemic	ref		
Ischemic	0.8	0.2	2.8

Characteristics	Odds Ratio	95% CI	
<b>Ambulatory Visit</b>			
no	1.4	0.4	4.3
yes	ref		
<b>Insurance*</b>			
Medicare, (%)	ref		
Medicaid, (%)	0.3	0.03	2.4
Commercial, (%)	0.3	0.03	2.2

Abbreviations: HTN, Hypertension; LVEF, Left Ventricular Ejection Fraction; COPD, Chronic Obstructive Pulmonary Disease; CKD, Chronic Kidney Disease; HF, Heart Failure CI-Confidence interval

\*Missing data: 9 subjects did not have insurance.

\*\* Odds ratio could not be calculated because all the subjects had HTN

## References

1. Heidenreich PA, Albert NM, Allen LA et al. Forecasting the impact of heart failure in the United States: a policy statement from the American Heart Association. *Circulation. Heart Failure*. May 2013; 6(3):606-619.
2. O'Connell JB, Bristow MR. Economic impact of heart failure in the United States: time for a different approach. *J Heart Lung Transplant* 1994; 13:S107-12.
3. Hospitalization for Heart Failure: United States 2000-2010. Centers for Disease Control and Preventions Web site. [www.cdc.gov/nchs/data/databriefs/db108.pdf](http://www.cdc.gov/nchs/data/databriefs/db108.pdf). Published October 2012. Accessed March 15, 2014.
4. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the medicare fee-for-service program. *The New England journal of medicine*. 2009; 360:1418–1428.
5. Gooding J, Jette AM (1985) Hospital readmissions among the elderly. *J Am Geriatr Soc* 33:595–601.
6. *Why Not the Best? Results from a National Scorecard on U.S. Health System Performance*. Harrisburg, PA: The Commonwealth Fund; 2006.
7. Mozaffarian D, Benjamin EJ, Go AS, et al. on behalf of the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2016 update: a report from the American Heart Association. *Circulation*. 2016; 133:e38-e360.
8. Hall MJ, DeFrances CJ, Williams SN, et al. National Hospital Discharge Survey: 2007 summary [PDF – 403 KB]. National health statistics reports; no 29. Hyattsville, MD: National Center for Health Statistics. 2010.

9. Z, Straube BM, Rapp MT, Normand SL, Drye EE. Patterns of hospital performance in acute myocardial infarction and heart failure 30-day mortality and readmission. *Circ Cardiovasc Qual Outcomes*. 2009; 2:407–413.
10. Fingar K (Truven Health Analytics), Washington R (AHRQ). Trends in Hospital Readmissions for Four High Volume Conditions, 2009–2013. HCUP Statistical Brief # 196. November 2015. Agency for Healthcare Research and Quality, Rockville, MD.
11. Centers for Medicare and Medicaid Services. Readmissions reduction program. [Accessed June 20, 2017]; <http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html>.
12. Hospital Readmissions Reduction Program Overview. (n.d.). [Accessed June 20, 2017 ]; <https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic/Page/OneTier2&cid=1228772412458>
13. Boccuti C, Casillas G. Aiming for Fewer Hospital U U-turns: The Medicare Hospital Readmission Reduction Program. Mar 10, 2017 [Accessed June 20, 2017]; <http://www.kff.org/report-section/aiming-for-fewer-hospital-u-turns-the-medicare-hospital-readmission-reduction-program-issue-brief/>.
14. Ahmed A, Jones L, Hays CI. DEFEAT heart failure: assessment and management of heart failure in nursing homes made easy. *J Am Med Dir Assoc*. 2008; 9(6):383-389.
15. Hu, J., Gonsahn, M. D., & Nerenz, D. R. (2014). Socioeconomic Status and Readmissions: Evidence from an Urban Teaching Hospital. *Health Affairs*, 33(5), 778-785. doi:10.1377/hlthaff.2013.0816.

16. Hospitalization for Heart Failure: United States 2000-2010. Centers for Disease Control and Preventions Web site. [www.cdc.gov/nchs/data/databriefs/db108.pdf](http://www.cdc.gov/nchs/data/databriefs/db108.pdf). Published October 2012. Accessed June 20, 2017.
17. 3. Retrum JH, Boggs J, Hersh A, Wright L, Main DS, Magid DJ, Allen LA. Patient-identified factors related to heart failure readmissions. *Circ Cardiovasc Qual Outcomes*. 2013 Mar 1; 6(2):171-7. Doi: 10.1161/CIRCOUTCOMES.112.967356.
18. Ashton, Carol M., Deborah J. Del Junco, Julianne Soucek, Nelda P. Wray, and Carol L. Mansyur. "The Association between the Quality of Inpatient Care and Early Readmission." *Medical Care* 35.10 (1997): 1044-059. Web.
19. Julie Stone, Geoffrey J. Hoffman: Medicare Hospital Readmissions: Issues, Policy Options and PPACA. September 21 2010.
20. Setoguchi S, Stevenson LW. Hospitalizations in patients with heart failure: who and why. *J Am Coll Cardiol*. 2009; 54:1703–1705.
21. Feigenbaum, P., Neuwirth, E., Trowbridge, L., Teplitsky, S., Barnes, C. A., Fireman, E., Bellows, J. (2012). Factors Contributing to All-cause 30-day Readmissions. *Medical Care*, 50(7), 599-605. doi:10.1097/mlr.0b013e318249ce72.
22. Joynt KE1, Figueroa JE, Oray J, Jha AK. 2016 Aug 1; 22(8):e287-94. Opinions on the Hospital Readmission Reduction Program: results of a national survey of hospital leaders.
23. Linden, A., & Adler-Milstein, J. (n.d.). Medicare Disease Management in Policy Context. Retrieved June 23, 2017, from [http://www.bing.com/cr?IG=D449061E8E53445E8F81AED7D849DBA8&CID=0F0805B309EB6DA1177B0F1908ED6CB9&rd=1&h=e6NLzOsqYI6ZX6RORRktuaTrI\\_HGY3vieYuzuEOK\\_LE&v=1&r=http%3a%2f%2fwww.cms.gov%2fResearch-Statistics-Data-](http://www.bing.com/cr?IG=D449061E8E53445E8F81AED7D849DBA8&CID=0F0805B309EB6DA1177B0F1908ED6CB9&rd=1&h=e6NLzOsqYI6ZX6RORRktuaTrI_HGY3vieYuzuEOK_LE&v=1&r=http%3a%2f%2fwww.cms.gov%2fResearch-Statistics-Data-)

[andSystems%2fResearch%2fHealthCareFinancingReview%2fdownloads%2f08Springpg1.pdf&p=DevEx,5062.1.](#)

24. Vinson JM, Rich MW, Sperry JC, Shah AS, McNamara T : Early readmission of elderly patients with Heart Failure. 1990 Dec; 38(12):1290-5.
25. Setoguchi S, Stevenson LW. Hospitalizations in patients with heart failure: who and why. *J Am Coll Cardiol.* 2009; 54:1703–1705.
26. . Hospitalizations in patients with heart failure: who and why. *J Am Coll Cardiol.* 2009; 54:1703–1705.
27. Patterns of hospital performance in acute myocardial infarction and heart failure 30-day mortality and readmission. *Circ Cardiovasc Qual Outcomes.* 2009; 2:407–413.
28. Bui, A. L., Horwich, T. B., & Fonarow, G. C. (2011). Epidemiology and risk profile of heart failure. *Nature Reviews. Cardiology*, 8(1), 30–41.  
<http://doi.org/10.1038/nrcardio.2010.165>
29. Retrum, Jessica H. et al. “Patient-Identified Factors Related to Heart Failure Readmissions.” *Circulation. Cardiovascular quality and outcomes* 6.2 (2013): 171–177. PMC. Web. 3 July 2017.
30. Friedman, B., & Basu, J. (2004). The Rate and Cost of Hospital Readmissions for Preventable Conditions. *Medical Care Research and Review*, 61(2), 225-240.  
doi:10.1177/1077558704263799