Determining the Effect of Depression on Geriatric Heart Failure Readmissions: A Retrospective Cohort Study

Thesis

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By

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Abstract

Background:

Healthcare institutions are facing higher care standards from insurers such as Medicare due to rampant cost increases. A focus of the Patient Protection and Affordable Care Act of 2010 is controlling costs while improving patient care, and an above average readmission rate for patients is seen as a failure to coordinate and perform standardized care. Healthcare institutions are given reduced payments by Medicare when excess readmissions occur. Independently, heart failure, depression, and geriatric status all have a relationship to increased readmission rates. The purpose of this study was to evaluate whether individuals already identified as geriatric heart failure patients at an academic heart hospital in the Midwest are at are at higher risk for readmission if they have a depression diagnosis.

Design and methods:

In this study, the independent variable for the geriatric heart failure patient sample was depression. A retrospective cohort study was used to evaluate heart hospital patient discharges and 30-day readmission rates from two select hospital services for the period July 1, 2012 through June 30, 2018. The data were also used to assess geriatric heart failure readmission risk's association with socioeconomic status using dual eligible or

Medicaid insurance. County Health Rankings were compared between depressed and non-depressed patients to examine if depressed patients lived in counties with poor health factors and outcomes. Deidentified patient data were used from this academic medical center's Information Warehouse.

Results:

In the heart failure cohort, 129 patients had readmissions during the study period and 331 did not have a readmission. Among the readmitted patients, 12.1% (n = 15) had a depression diagnosis, but it was not more prevalent in this group than the not readmitted patients (p = .164, OR = 1.61). County Health Rankings were not associated with rates of depression, but the proportion of dual eligible and Medicaid patients among the readmitted patients compared to not readmitted was significant (p = .015, OR = 3.01).

Heart hospital medicine had 137 patients readmitted and a rate of depression of 8.03% (n = 11). Of the 474 patients not readmitted, 8.02% (n = 38) had a depression diagnosis. There was not a significant difference in the proportion of depressed patients in this cohort (p = .996, OR = 1.00). County Health Rankings did not have an association with depression, and Medicaid or dual eligible insurance was not associated with higher readmission rates (p = .908, OR =0.96).

Conclusion

This study found limited evidence of depression having a significant relationship to geriatric heart failure readmissions at this academic heart hospital in the Midwest. The prevalence of depression diagnosis in all groups was lower than expected, perhaps due to the use of claims data. The County Health Rankings did not show statistical significance related to health outcomes or factors in depressed patients. Dual eligible or Medicaid insurance – a substitute for low socioeconomic status – was observed at a higher proportion in the heart failure cohort, but it was not in the hospital medicine group. Future studies may benefit from using physician notes, more specific patient areas such as zip codes, and examining secondary insurance of geriatric heart failure patients.

Dedication

For my family, friends, coworkers, and teachers

Acknowledgments

My interest in this subject stemmed from the support I had during my time with the Medication Assistance Program to learn about readmissions. I'd like to thank pharmacists Sarah Hudson-DiSalle, Megan Marchal, Danielle Blais, and Erik Abel for encouraging me in my prior readmission projects. Pharmacist Amanda Sabol provided encouragement and feedback on my research as well, and I appreciate her time and efforts on both this project and my past ones. I am thankful for the advice and support of my advisor Dr. Rinehart-Thompson and Dr. Clutter during this project and my academic career.

Vita

2008-2013	Technician, Giant Eagle Pharmacy
2011	B.A. in History, The Ohio State University
2013-2018	Medication Assistance Coordinator, The Ohio State University Wexner Medical Center
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Field of Study

Major Field: Allied Medicine – Health and Rehabilitation Management

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Chapter 1: Problem Statement and need for study

President Barack Obama signed the Patient Protection and Affordable Care Act into law in 2010, in which Section 3025 establishes the Hospital Readmission Reduction Program. The Centers for Medicare and Medicaid Services (CMS) began to monitor hospital readmission rates, using the ratio of predicted to expected readmissions. Failure to complete courses of therapy and coordinate patient transitions to home and other care settings is seen as a patient care issue. Medicare has previously penalized institutions millions of dollars for exceeding their readmission rate benchmarks for acute myocardial infarction, heart failure, and pneumonia (Boccuti, Casillas, 2017). In an effort to improve patient care and avoid reduced reimbursement, it is important for hospitals to investigate ways of reducing readmissions. Nearly one in four heart failure patients is readmitted within 30 days (Suter et al., 2014, pg. 4), and previous studies indicate that depression is also linked to emergency room visits and readmissions (Berges et. al., 2015; Mitchell et. al., 2015; Singh et. al., 2016). However, depression and readmissions in the geriatric heart failure population has not been specifically studied. In 2010, patients 65 and over comprised 71% of hospitalizations for heart failure (Hall, Levant, DeFrances, 2012), and it is the second most common admission diagnosis of patients over 75 years old and third most common admission diagnosis of those 65-75 years old

(McDermott, Elixhauser, Sun, 2017). A retrospective cohort study of depression diagnosis associated with readmissions in geriatric heart failure patients would potentially identify a population in need of readmission prevention interventions to reduce unnecessary hospitalizations at an academic heart hospital in the Midwest.

Problem statement:

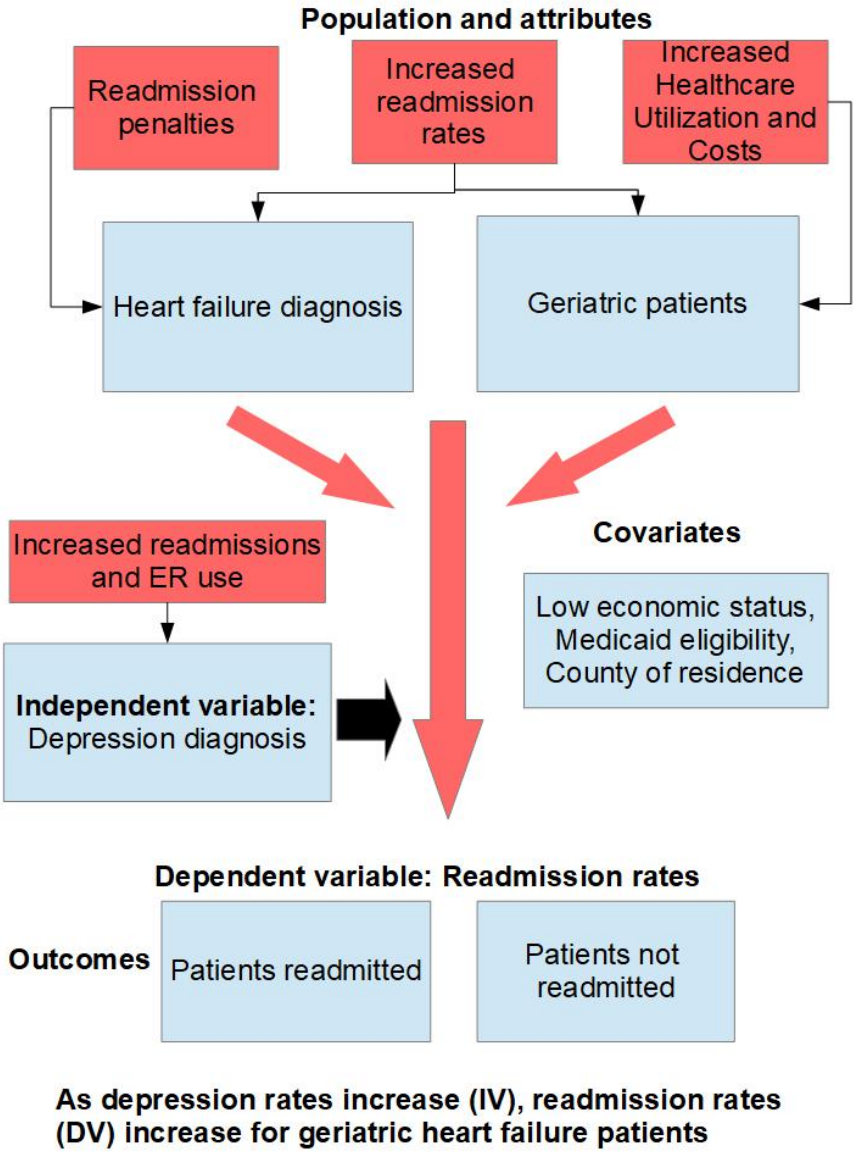
Readmissions are a contentious issue in hospitals. Medicare and other insurers reduce their payments to hospitals for what they consider excess readmissions, where patients are readmitted to the hospital more often than necessary. Medicare uses a ratio of predicted to expected readmissions, where the predicted rate is how many readmissions the hospital will have and the expected rate is what the readmission rate would be at an average hospital. Readmissions that are preventable through better hospital discharge planning and other interventions are the target of these reduced payments. On the other hand, hospitals often view the reduction in reimbursement system as flawed due to regional and demographic differences between hospitals (American Hospital Association, 2018). Insurers consider this a patient care issue, and nearly 528 million dollars in penalties are estimated to be enforced for fiscal year 2017 by Medicare (Kaiser Family Foundation, 2017). While it is important for hospitals to avoid reductions in reimbursement, it is also important to reduce preventable readmissions in an effort to

improve patient care, as readmissions can be the result of failure to coordinate patient transitions from an inpatient to outpatient setting.

Purpose of the study:

This study attempted to identify if depression had a relationship with readmissions for geriatric heart failure patients at an academic heart hospital in the Midwest. If identified as a factor, formal interventions could be pursued to decrease unnecessary readmissions to the heart hospital. Currently heart failure navigators assist high-risk patients, but their resources are finite and tools to identify patients at risk for readmission are not used. Patient case managers ask patients about depression in their admission flowsheet, which is a series of questions to assess the patient's medical and personal needs during their hospital stay and at discharge. However, physicians must decide to administer screening tools to identify depression diagnosis, and the situation is unclear as to when a positive screening is acted upon. A retrospective cohort study was a way to identify issues without using hospital resources unnecessarily. The following conceptual model visualizes the study:

Figure 1: Conceptual Model



Significance of the study:

This academic heart hospital in the Midwest is a safety-net hospital with a disproportionate share of Medicaid and uninsured patients (Medicare, 2018), and analyzing the patient population provided valuable insight into the patients served. The geriatric heart failure population had not been specifically studied with regard to depression contributing to readmissions in literature, so this cohort study filled a gap in knowledge. It also specifically studied this academic medical center's population, and the results could assist targeting interventions to reduce unnecessary readmissions. Further, the study results are potentially ecologically valid to other academic medical centers in readmission reduction identification and strategies, in part because the standard Medicare eligibility age of 65 was used in this study.

Research questions:

The research questions were as follows:

- Does depression have a statistically significant relationship to geriatric heart failure readmissions in an academic heart hospital in the Midwest?
- What is the prevalence of depression in the discharge population of an academic heart hospital in the Midwest?

- Are demographic factors such as insurance and county of residence related to readmission risk for geriatric heart failure patients?

Definition of terms:

The following table provides definitions for terms used to define this study. All International Classification of Disease (ICD) codes are obtained from ICD10data.com (ICD10data, 2018). In October, 2015 ICD codes changed from ICD 9th revision to ICD 10th revision, so both revisions were used because this study data spanned 2012-2018.

Table 1: Definitions

Term name	Definition
Depression	ICD diagnoses of: ICD-9 296.2 - Major depressive disorder single episode ICD-9 296.3 - Major depressive disorder recurrent episode ICD-9 300.4 – Dysthymic disorder ICD-9 301.12 – Chronic depressive personality disorder ICD-9 311 – Depressive disorder, not elsewhere classified ICD-10 F32 – Major depressive disorder, single episode ICD-10 F33 – Major depressive disorder, recurrent ICD-10 F34.1 – Dysthymic disorder
Geriatric patient	Patient 65 years of age or older for the purposes of this study
Heart failure	ICD diagnosis of: ICD-9 428 – Heart failure ICD-10 I50 – Heart failure
Population criteria	All patients aged 65 or older discharged from the heart hospital heart failure service or heart hospital medicine services 7-1-12 to 6-30-18 with a discharge diagnosis including heart failure. The readmitted patients must be readmitted to the heart failure, heart hospital medicine A, heart hospital medicine B, or

	heart hospital general management service
Poverty level	A measure of income used to determine qualification for social programs such as Medicaid and food stamps
Qualifying discharge	Patients must not have left Against Medical Advice (AMA), not discharged to hospice, and have a discharge diagnosis of heart failure
Readmission	An unplanned patient admission to the heart hospital within 30-days of the initial hospitalization discharge.

Definition notes:

ICD-10 depression diagnoses selected for this study included recurrent single episode of major depressive disorder, recurrent major depressive disorder, and persistent depressive disorder. The International Classification of Disease, 9th revision is often less specific and not as organized as the 10th revision, but code 296 includes most major depressive disorders. ICD-9 code 311 – depressive disorder, not classified elsewhere includes everything from chronic depression to feeling lost to severe depression. This diagnosis was included in order to identify some less specifically coded depression diagnoses. A diagnosis of depression related to other diagnoses, such as bipolar (296.5), dementia (290.2), or drug induced (292.84) diagnoses, were not included in this study. Additionally, other psychiatric diagnoses such as schizophrenia contributing to readmissions were beyond the scope of this retrospective cohort study.

The definition of readmission in this study varies from Medicare, which uses “all cause” readmissions, meaning readmission for any reason is counted. In this study’s model,

only heart failure readmissions were considered. Restricting readmissions to the heart hospital heart failure and heart hospital medicine services virtually eliminated reasons other than cardiac readmissions. Patients admitted to these services were most likely to have heart failure compared to other services in this academic hospital. Patients that were admitted for an unrelated reason to heart failure – such as hip fracture or hernia repair – were not counted as readmissions because this study focused on the cardiac services and readmissions. Further, by restricting to the specific services of the heart hospital it excluded patients with scheduled admissions for surgery services.

The Federal Poverty Level (FPL) was used to determine eligibility for extra assistance for Medicare recipients. The 2018 Federal Poverty Level for a household of one was $12,140 (Healthcare.gov, 2018). In the state where this academic medical center resides , these extra assistance programs include:

- Low Income Subsidy (LIS): reducing drug costs through prescription benefits
- Qualified Medicare Beneficiary (QMB) and Subsidized Low Income Medicare Beneficiary (SLMB): paying patient copayments and deductibles

Qualifying discharge criteria of excluding those who left against medical advice aimed to exclude patients who did not receive the full course of therapy. The criteria of not discharged to hospice excludes those receiving end of life care. Both these types of

discharges result in frequent readmissions that are potentially unavoidable. Prisoners were also excluded due to the complex legal environment and health care of the prison system, and that some patients may purposefully necessitate their readmission.

The age range for the definition of geriatric patient varied in the literature. For the purposes of this study, an age of 65 or older was used because it coincided with traditional Medicare eligibility and was then generalizable to other institutions in the United States. Individuals under 65 who have Medicare coverage obtained it through receiving Social Security Disability payments for 2 years, having end-stage renal disease (ESRD), or Lou Gehrig's disease (Health and Human Services, 2018). This population was not the focus of this study due to lack of geriatric status.

Chapter 2: Literature review

Introduction:

This chapter reviews literature that addresses a variety of important factors related to readmissions, including the diagnoses of heart failure, depression, and geriatric status individually as well as in combinations. Literature used in this review was gathered primarily using PubMed, university libraries, and Medicare.gov. Studies from the last 15 years were strongly preferred due to changes in healthcare, especially since the implementation of the Patient Protection and Affordable Care Act in 2010. Preferred primary locations for studies were North America. Reasons for readmission are numerous and important factors outside the scope of this study are included in the "Other Considerations" section. Each section is evaluated from a primary lens of readmission reasons. Institutions focus on reducing readmissions due to the reduction in reimbursement from Medicare if their readmissions exceed an allowable ratio of predicted to expected readmissions. Through reducing payments, Medicare is encouraging hospitals to engage in more effective transitions of care and complete treatment of issues prior to discharge. Beyond the hospital perspective of cost, readmissions are inconvenient and potentially dangerous for patients, and reduce hospital patient capacity. Of note, readmission risk for any patient is not static; it

constantly changes with disease progression, treatment, and management (Chamberlain, Sond, et al., 2018). Hospitals need a dynamic and complete response in order to reduce readmissions.

Heart failure:

Heart failure is an irreversible disease process mainly affecting older adults. It can be a natural result of the aging process, or a secondary result of coronary artery disease, high blood pressure, or a myocardial infarction. One in five adults will develop heart failure during their lifetime (American Heart Association, 2018), and approximately 14% of Medicare patients had heart failure in 2014 according to the Centers for Medicare and Medicaid Services (CMS, 2014). Heart diseases – including heart failure – remain the leading cause of mortality in the United States (Murphy, Xu, Kochanek, Curtin, Arias, 2017). In their published 2013 qualitative study, Rectrum et al. identified themes of health system failures, economic factors, and distressing physical symptoms as reasons for readmissions. Patients reported that worsening heart failure symptoms led to readmissions, but comorbidities such as pulmonary disease, diabetes, and renal disease related directly to their readmissions. Of the 28 patients that received in-depth interviews, 15 indicated financial stress and 6 stated financial constraints occasionally kept them from obtaining needed care or medications. From a clinical perspective,

Gheorghiade, Vaduganathan, Fonarow, and Bonow summarized that prevention of congestion is essential to reducing readmissions, and sodium restrictions are the cornerstone of managing fluids in the post-discharge period.

Compliance with treatment in this population is low. A 2006 U.K. study of 501 patients involving questionnaires and clinical review of heart failure patients found that compliance with exercise and daily weights were low (39%, 35%) (van der Wal, Jaarsma, Moser, Veeger, Gilst, van Veldhuisen, 2006). Application of the Dutch HF Scale – a questionnaire assessing knowledge of disease management – demonstrated that increased knowledge of the disease was related to compliance (Odds Ratio = 5.67).

This academic heart hospital's 30-day readmission rate for heart failure patients was approximately 22.4% from July, 2013 – June, 2016 (Data.gov, 2017). While this was on par with the national Medicare rate of 21.6%, it is still more than one-in-five patients readmitted within 30 days (Medicare, 2017). The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) – a Medicare survey of patient experiences at hospitals – rated the hospital as 3 stars out of 5 for the period 2017-2018 (Medicare.gov, n.d.). Lowering the readmission rates could potentially alleviate issues of bed availability at the hospital, decreasing wait times for beds and potentially increasing patient satisfaction through less wait times for care.

A study of interest is Fonarow, Konstam, and Yancy's *The Hospital Readmission Reduction Program Is Associated With Fewer Readmissions, More Deaths: Time to Reconsider.* This study interprets that after implementation of reimbursement reductions the linear heart failure trend for mortality increased from 7.9% in 2008 to 9.2% in 2014, while readmissions decreased from 23.5% to 21.4%. It also voices concerns over potential readmission mitigation strategies, including holding patients in the ED unnecessarily and using observation status even when admission is clinically indicated. Their study adapts data from an analysis of more than 5-million Medicare hospitalizations from 2008-2014, which reported that increasing post-discharge mortality rates have not seen mortality reductions during hospitalization (Dharmarajan et al., 2017).

Depression:

Depression is defined as a mood disorder with loss of interest and feelings of sadness. Individuals with depression may have slow thinking, trouble making decisions, lack energy, or difficulty remembering things. Older adults may have fatigue, memory difficulties, or suicidal thoughts (Mayo Clinic, 2018). The National Institute of Mental Health (NIMH) defines depression as a consistent mood lasting at least 2 weeks of sadness, pessimism, or hopelessness with issues such as loss of interest, decreased

energy, or restlessness. Risk factors for depression include family history, major life changes or stress, physical illnesses, and medications. Individuals who experience depression for more than two years qualify for the NIMH definition of dysthymia: persistent depressive disorder. Depression presents challenges because it can be an episodic condition, and the definitions have changed over time. It can be difficult to capture without evaluating multiple sources of claims (Fiest, Jette, Quan, Germaine-Smith, Metcalfe, et al., 2014).

A common tool to assess if patients are experiencing depression is the Patient Health Questionnaire (PHQ-9), which uses a scoring matrix to determine if patients have depression and if so what severity. Kroenke, Spitzer, and Williams found the PHQ-9 to have 88% specificity and 88% sensitivity in their study of 6,000 patients 1997-1999. Medicare medical insurance (part-B – outpatient) covers one depression screening per year, and this uses the PHQ-9 (Medicare.gov, n.d.).

In the state where this academic heart hospital resides, approximately 4.9% of adults annually have a diagnosable serious mental illness annually that results in serious functional impairment of major life activities, such as inability to go to work or school (SAMHSA, 2015). The Substance Abuse and Mental Health Services Administration (SAMHSA) broadly defines treatment for major depressive episodes as seeing a health

professional – such as a primary care physician – or using a prescription. Of the 15.7 million adults 18 or over who had a major depressive episode in 2013, only 10.7 million (68.6%) received treatment (SAMSHA, 2014). However, of those 50 and older 81.3% received treatment, 57.2% saw a general practitioner, and 35% saw a psychiatrist.

Several works link depression to increased hospital readmission risk (Mitchell et al., 2015; Smith, Stock, Santora, 2015; Berges, Amr, Abraham, Cannon, Ostir, 2015). A study of 164,544 hospital admission patients from 2007-2009 found a depression rate of 37.9% of patients as either a primary or secondary diagnosis (Smith, Stock, Santora, 2015). Screening for depressive symptoms may identify patients at risk for readmission, as they can diminish a patient's ability to cope with physical symptoms, resulting in increased health care utilization and costs. Depression can also contribute to non-adherence to treatment plans, leading to rehospitalization due to failure to manage the disease outpatient. Mitchell et al. found in their study of an urban, academic, safety-net hospital that a lack of insurance was an indicator for depression ($p<0.001$), and not working as an indicator of depression and readmission ($p<0.001$). Those with depression had a 73% higher hospital utilization rate within 30 days than those who did not. They concluded that well-coordinated depression therapy interventions at the time of discharge planning are needed to reduce readmissions, or if depression is the result of a high disease burden then treating the disease may be the most appropriate response.

Analysis of the results from the World Health Organization (WHO) Health Survey of 142,755 respondents showed that the need to timely diagnose and treat depression is imperative for public health, as comorbidity of depression with any disease significantly worsens the state of patient health (Moussavi, Verdes, Tandon, Patel, 2007). Having depression is associated with the lowest health scores either alone or with other comorbidities ($p<0.001$), and people with chronic diseases are more likely to suffer from depression than those without ($p<0.001$).

Geriatric status:

Geriatric patients often have highly variable characteristics, with some individuals being significantly more active and healthy than others of the same age (WHO, 2015). Deschodt, Devriendt, Sabbe, Knockaert, and Deboutte found in their study of 442 patients that older patients hospitalized through the Emergency Department had dependence for instrumental activities of daily living (IADL), instances of malnutrition, cognitive defects, and a high number of comorbidities. Those discharged from the Emergency Department rather than admitted had less ADL dependence ($p<0.045$), financial issues ($p<0.014$), and required less shopping assistance ($p<0.009$). Shopping assistance was a statistically significant link to both one and three month readmissions to the ED ($p<0.006$ and $p<0.018$, respectively). Cognitive impairment, delirium,

polypharmacy, and comorbidities subject to frequent exacerbations make geriatric patients frequent users of the Emergency Department. At the time of discharge, primary care physicians should be engaged and home-based services should started patients for those at high risk for readmission to the ED (Salvi, Morichi, Grilli, Giorgi, De Tommaso, 2007). Since 2011, approximately 10,000 baby-boomers – those born 1946-1964 – have turned 65 every day and will continue to do so until 2030, at which time individuals over 65 will compose 18% of the population of the United States (Heimlich, 2010). One point of note is that readmission risk is not a clear function of age. For acute myocardial infarction the risk of readmission is higher with age, but it is lower after hospitalization for heart failure and pneumonia (Dharmarajan, Hsieh et al., 2017).

Combinations of heart failure, depression, and geriatric status:

Heart failure and depression affecting readmissions:

New heart failure diagnosis often leads to admissions to the hospital, and depression is a contributing factor to these admissions. A study spanning 1989-1999 and hospitalizations through 2009 found depression independently associated with hospitalization and mortality in heart failure patients (Chaudhry, McAvay, Chen,

Whitson, Newman, 2012). The diagnosis of depression is prevalent in this population due to an incurable disease status. Since depressive symptoms may be modifiable, routinely assessing patients with newly diagnosed heart failure for depression is prudent. In *Heart Failure: Problems and Perspectives*, Gheorghiade, Vaduganathan, Fonarow, and Bonow et al. concluded that a comprehensive approach of understanding social circumstances and identifying comorbidities such as depression is needed to prevent unnecessary rehospitalization. A 2015 study of 160,169 hospitalizations found heart failure patients with a psychiatric diagnosis are 4% more likely to have a readmission than those without a psychiatric diagnosis (Ahmedani et al., 2015). The overall all-cause readmission rate of the study was 18.1%, with patients with a psychiatric diagnosis being readmitted 21.7% of the time versus 16.5% for patients without psychiatric comorbidity ($p<0.001$). A U.K. study of 261 patients 75 or older found that long-term mortality was significantly lower in those admitted once compared with those readmitted ($p<0.001$) (Parmar, Xiu, Chowdhurt, Patel, Cohen, 2015). With regards to another common readmission diagnosis, Singh, Zhang, and Sharma reviewed 135,498 Medicare hospitalizations 2001-2011 and found depressive symptoms are independently associated with 30 day readmission rates for chronic obstructive pulmonary disease (COPD) patients. Those with psychiatric comorbidities were

readmitted at a rate of 23.8% compared to 16.25% without psychiatric issues. The rate of depression for those readmitted was 24.15%, and was 14.24% overall ($p<0.001$).

Heart failure and geriatric status:

A variety of factors contribute to geriatric heart failure readmissions. Noncompliance, high age, comorbidities, and early hospital discharge are some of the factors affecting readmission rates (Nieminen et al., 2015). Increased adverse side-effects to medications can severely limit the treatment options for geriatric patients, diminishing the ability for clinicians to prevent hospitalizations and mortality. Donze, Lipsitz, and Schnipper reviewed 10,275 discharges in their study, and 534 had potentially avoidable readmissions due to end of life care issues, validated through review of 80 patient charts. Geriatric patients with terminal heart failure, a malignancy, or end-stage renal disease (ESRD) were all at risk for potentially avoidable readmissions, as the terminal disease process was not fully addressed during the admission prior to rehospitalization. Hospital admissions in the last year, Elixhauser score, neoplasm, and opiate use – a proxy for illness – were all indicators of potentially avoidable readmission ($p<0.001$). Geriatric status patients benefit from a multidisciplinary approach by cardiologists and geriatricians due to specialized patient care (Parmar, Xiu, et al., 2015). Dharmarajan et

al. found in their study of 414,720 patients that the increasing age decreased the risk of heart failure rehospitalization ($p<0.001$). Compliance with disease management is also lower for those with depression compared to those without, especially in terms of exercise ($p<0.01$) (van der Wal, Jaarsma, Moser, Veeger, van Gilst, van Veldhuisen, 2006). Analysis of a standard 5% sample of Medicare patients of all ages indicated that heart failure contributed to 39% of the annual Medicare deaths in 2011 (Fitch, Pelizzari, Pyenson, 2015).

Geriatric status and depression:

Depression is often not identified and treated in the geriatric population. Individuals may be reluctant to seek or accept treatment due to perceived public stigma against the depressed. Internalized stigma – stigmatized individuals holding negative attitudes about one selves – can also affect whether patients seek treatment. A study of older adults found that African-American elders in particular had negative attitudes towards depression treatment (Connor et al., 2010).

Fuller and Atkinson et al. found an association between ages of 85+ years old and mental health issues leading towards higher readmission rates. In their study of the Emergency Department, Deschodt, Devriendt, Sabbe, Knockaert, and Deboutte found

that depression was linked to both one and three month readmissions to the Emergency Department ($p<0.006$ and $p<0.005$, respectively). Prine, Deeg, Brayne, Beekman, and Huisman studied the elderly spanning 1995-2006 and hospitalizations until 2009, with 8,560 observations and interviews. Two years after the interviews, 27% of adults with depression were admitted at least once versus 23% of the non-depressed, which was statistically significant at both 6 and 12 months post interview ($p<0.001$). Depressed adults also died while in the hospital at twice the rate of non-depressed adults ($p<0.05$). Albrecht et al. in a study of 765 patients over 65 did not find a link between depression and readmission in their individual study of geriatric patients. They did observe that age and comorbidities contributed towards readmissions. Comorbidities occurred at 3.1 for readmitted patients versus 2.4 for others ($p<0.004$).

A study of interest is by Barry, Abou, Simen, and Gill of 754 patients 70-years or older with interviews from years 1998-2007. *Under-treatment of Depression in Older Persons* found that approximately 1/3 of patients with clinically significant symptoms were not taking antidepressants or receiving treatment from a healthcare professional. Among participants, age was inversely related to receiving treatment in all except those with persistent depression. Financial burdens on patients during the study may have been alleviated recently. The copayment for mental health services was 50% for Medicare beneficiaries, and it dropped to 20% in 2014. Dementia is also sometimes diagnosed in

place of depression, so a neuropsychological assessment should be performed to accurately diagnose and treat the patient conditions (Wright and Persad, 2007).

Geriatric status, depression, and heart failure together

This area has a lack of specific studies; literature tends to focus on broad characteristics and narrow down to individual diagnoses that contribute to readmission. Body mass index (BMI) is linked to depressive symptoms in geriatric heart failure patients even after adjusting for medical and demographic covariates ($p = .004$) (Hawkins et al., 2015). Within the same sample of 339 patients, female patients had greater depression severity, scoring 32% higher on the PHQ-9 assessment. In males, age and PHQ-9 were both associated with increase BMI ($p<0.05$). The Hawkins et al. study did not investigate readmission rates for their sample of geriatric heart failure patients, however they did indicate that it is important for clinicians to screen and monitor for depression. Chamberlain and Sond evaluated the performance of a Readmission After Heart Failure tool that includes diagnoses of heart failure and depression, but they found patients under 65 to be more at risk for readmission.

Current readmission reduction identification tools:

Since the implementation of readmission penalties by Medicare, hospitals and researchers developed several readmission reduction tools for inpatient use. These are available as reference points at this academic medical center, but are not presented in an actionable format. Paired with readmission reduction strategies discussed later they can be effective at identifying the patients in need of assistance. A theme is that there is a lack of demographics data utilized, as clinicians often view it as difficult to obtain or unavailable. Important to this study, depression is often not emphasized in the systems even though it is an indicator of readmission risk.

LACE:

One of the first tools in use was the LACE score, which evaluates patients based on their length of stay (L), acute admission (A), Charlson Comorbidity Index score (C), and recent emergency room visits (E). Spiva, Hand, VanBrackle, and McVay found it has a reasonable prognostic ability to predict readmissions. In a review of 253 congestive heart failure patients, Wang and Robinson et al. found the LACE tool more accurate at predicting ED visits rather than readmissions post-discharge. One item of note is that the comorbidities score is weighted depending on diagnosis, but depression is not included.

LACE-rt:

In an effort to adapt the LACE score to teaching hospitals, it was revised to include "real time" data for use at admission, such as the number of days admitted in the last 30 days at admission and not discharge. The LACE-rt reasonably differentiates between low and high readmission risk patients (El Morr, Ginsburg, et al., 2017). The authors noted that implementation of the scoring system alone made no difference in the readmission rates, and that formalized interventions are needed to reduce readmissions.

HOSPITAL score:

Burke and Schnipper et al. evaluated the HOSPITAL score and found the tool to be useful in identifying preventable readmissions. The system uses Hemoglobin levels, discharge from Oncology service, Sodium level at discharge, Procedure during hospital stay, Index admission type, number of Admissions in the last year, and Length of stay (HOSPITAL). A common limitation of validating these scoring systems is that the results may not be able to be generalized to other hospitals due to regional or demographic differences, and that patients readmitted to other hospital systems may skew the readmission rates observed at the study hospital. An important distinction for the HOSPITAL tool is that it focuses on preventable readmissions, specifying patients who may have avoidable readmissions. Not all patients can be prevented from returning to the hospital, and the

HOSPITAL tool aims to identify those specific patients. A weakness of this tool is that length of stay and laboratory studies must be available shortly before discharge, and inaccurate values may result in patients being triaged into the wrong risk pool.

Readmission After Heart Failure scale:

Chamberlain and Sond et al. published a study validating the Readmission After Heart Failure scale using inpatient data of about 1 million patients from 2006-2011. Unlike other readmission risk assessment tools, the scale includes demographic information such as income, race, and insurance. Comorbidities such as renal failure, diabetes, and depression are also included in the scoring system. A total score of 100 is possible, with the highest point factors coming from African-American race (10), Medicaid insurance (21), Medicare insurance (10), drug abuse (19), and renal failure (11). Depression is weighted at two points (Odds ratio = 1.05 univariate & 1.08 multivariate). If race, income, and insurance are available, this tool is effective at predicting readmission.

Other considerations related to geriatric, heart failure, and depression patients in literature:

Social factors:

There are a variety of social factors that impact readmissions. Joynt and Jha found that poor social support and poverty are drivers of readmission in addition to mental illnesses. Navathe and Zhong et al. investigated physician notes rather than diagnosis related claims and found that depression, housing instability, and poor social support were all underreported and associated with increased readmission risk. Several other studies found links between poverty and educational status among the reasons for readmission (Hu, Gonsahn, Nerenz, 2014; Herrin, St. Andre, et al., 2015; Barnett, Hsu, Mcwillians, 2015). Additionally, indicators of disability such as difficulties performing instrumental activities of daily living (IADL) and activities of daily living (ADL) are linked with higher readmission rates (Meddings, Reichert, et al., 2016; Barnett, Hsu, Mcwillians, 2015). Saab and Nisenbaum et al. found that homeless patients in Toronto were four times as likely to be readmitted once controlling for covariates. If the patients left against medical advice (AMA), then they were double the odds of being readmitted.

Costs for geriatric patients:

Readmissions are also associated with a large portion of Medicare expenses, and are the main focus of the readmission reduction program. Neuman, Cubanski, Huang, and Damico in their 2015 analysis observed that patients 80 and older comprised 24 percent of the Medicare population, but accounted for 33 percent of spending in 2011. Spending per capita increases significantly with age, as an individual of 66 years-old averages $5,562 in spending compared to $13,466 for an 85-year-old or $15,732 per capita for 95-year-olds. Individuals who died in 2011 also accrued four times more expenses than those who lived the entire year. The increase of per-capita spending can be partially explained by the high cost of end of life care. Some of the issues resulting in increased costs are under-treatment of pain, failure to coordinate advance directives, and over-treatment (Donze, Lipsitz, Schnipper, 2014). In 2010, 11% of the Medicare population had heart failure, but incurred 34% of the Medicare spending (Fitch, Pelzzari, Pyenson, 2015). Often geriatric issues are put into a negative light as costs, but they may be better observed from a perspective of investing in the geriatric population (WHO, 2015). .

Health literacy:

Health literacy is defined as individuals who have the capacity to communicate, process, understand, and obtain health information to make appropriate health decisions (CDC, 2016). It is an important facet of patient care, as it helps patients understand their conditions and how to manage them. Language barriers are integral to overcome for health literacy. Medicare enacted the Strategic Language Access Plan (LAP) in 2014 to ensure that all patients can receive appropriate care regardless of their English language proficiency.

In terms of readmissions for heart failure patients, McNaughton, Cawthon, Kripalani, Liu, Storrow, and Romie in their study of 1,379 patients found that it was not associated with readmissions or emergency department visits within 90 days, but it was associated with death after discharge ($p = 0.02$). In a study of 614 rural patients with heart failure that included interventions of educational assistance and counseling, health literacy level was indicative of mortality or readmission risk ($p=0.003$ and $p=0.006$, respectively) (Moser et al., 2015). Literature in this area often focuses on mortality and has mixed conclusions on whether health literacy influences readmission risk.

Discharge planning:

Discharge planning assists patients at the critical transition between inpatient and outpatient care. Failure to address patient's concerns and questions, set up follow-up appointments, and reconcile medications creates a situation where readmissions become more likely. Evidence based tools providing decision support at discharge can reduce readmission rates (Bowles, Hanlon, Holland, Potashnik, Topaz 2014). One of the most widely used and accepted methods of improving discharge planning is Boston Medical's Project RED (Re-Engineered Discharge). It incorporates 12 steps to improve the outcomes of the discharge process, including language assistance, follow-up appointments, labs, developing a plan that the patient can understand, education, and medicine reconciliation (Boston University, 2014).

Medicare recipients have the opportunity to respond to the HCAHPS survey indicating some of their experiences with health literacy. The 2017-2018 national average of patients who strongly felt that they understood their care when they left the hospital was only 53% (Medicare.gov, n.d.).

Chapter 3: Methods

Research design:

The purpose of this retrospective cohort study was to determine if there was a statistically significant relationship between readmission rates in geriatric heart failure patients and clinically diagnosed depression at an academic heart hospital in the Midwest. The independent variable was defined as active depression diagnosis at time of discharge prior to rehospitalization. The dependent variable was defined as a readmission to the heart hospital. Covariates were low economic status, indicated by Medicaid eligibility or living in a county with poor health rankings. Low economic status was determined through the Robert Wood Johnson Foundation County Health Rankings and Medicaid eligibility through the data obtained.

The County Health Rankings data were assessed via matching the patient's county against that specific year of admission and readmission. Each county's rank changes yearly. A patient's first hospital admission date was used to calculate the County Health Rankings.

Population and sample design:

Inability to manipulate the independent variable of depression due to ethical considerations means a retrospective cohort design was followed.

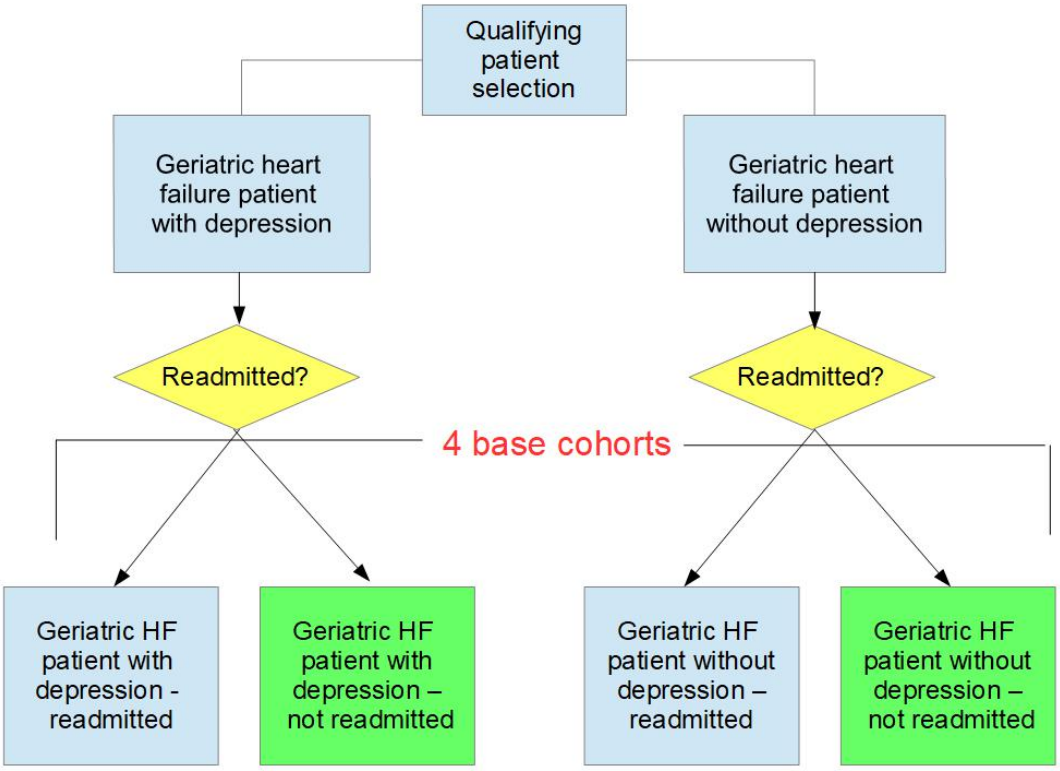
The sample was obtained through this academic medical center's Information Warehouse using a deidentified data system. The Information Warehouse includes data extracted from the hospital electronic health record Epic (Verona, Wisconsin). The sample included patients discharged from specific heart hospital services from July 1st, 2012 through June 30th, 2018. Inclusion criteria for the study were individuals discharged from the heart hospital heart failure or heart hospital medicine service with a diagnosis of heart failure. To be included in the readmitted patient pool, patients needed to be readmitted to the same services or general non-surgical heart management within 30 days. Patients who were not readmitted were included in the not readmitted comparison pool. This time frame was selected in an effort to review as much recent data as possible since the Affordable Care Act instituted the Hospital Readmission Reduction Program (HRRP) in 2012.

The geriatric heart failure sample will be sorted into cohorts

Patients will fall into one of four base cohorts:

1. Geriatric heart failure patients without a depression diagnosis that are readmitted
2. Geriatric heart failure patients without a depression diagnosis that are not readmitted
3. Geriatric heart failure patients with a depression diagnosis that are readmitted
4. Geriatric heart failure patients with a depression diagnosis that are not readmitted

Figure 2: Cohorts



The following data points were collected from each patient medical record:

Table 2: Data points

Data point	Options
Admission and discharge departments of admission(s)	Heart failure Heart hospital medicine A Heart hospital medicine B General cardiac management services
Age at discharge	65 or greater
Body mass index	Nominal value (Weight in kg. / height in meters squared) at time of initial discharge
Discharge diagnoses	ICD-9 of 428 (heart failure) or ICD-10 of I50 with or without a diagnosis of depression (ICD-9: 296.2, 296.3, 300.4, 301.12, 311; ICD-10: F32, F33, F34.1)
Discharged to	Home, skilled nursing facility, cancer center, psychiatric facility, long term care, etc. Not hospice due to end of life rehospitalization, against medical advice due to incomplete treatment, prison due to their healthcare system and patient population, or deceased on index admission because readmission is not possible.
Gender (legal sex)	Male, female
Hospital admission type	Emergent, readmission. Not scheduled
Hospital service	Heart failure Heart hospital medicine A Heart hospital medicine B General cardiac management services
Primary insurance coverage	Commercial, Medicare, Medicare Advantage, Medicaid, dual eligible (Medicare and Medicaid)
Problem list	Includes ICD-9 and ICD-10 diagnoses
County of residence	

Validity and Reliability:

The data obtained through the deidentified data program are populated by extracts from this academic medical center's health record system. The Information Warehouse that provides the deidentified data are the consolidated database of many of this academic medical center's systems.

Statistics:

All data were first entered into Microsoft Excel for sorting and basic evaluation, and then entered into StataCorp Stata . A Wilcoxon rank-sum Mann-Whitney was used for calculating significance of the ordinal County Health Rankings. A Chi-squared test was calculated for the rates of depression between those readmitted and not by service. Odds ratios for depressed patients were also calculated. Chi-squared tests were also used to determine the significance of the dual eligible and Medicaid patient rates between readmitted and not readmitted patients. P-values were considered significant if <.05.

Data collection:

Deidentified data were obtained through the deidentified data program provided by the Information Warehouse. A request for the data was made and reviewed by committee before the report was generated and released.

Limitations:

There are limitations to this study design. This academic medical center's hospital is publically funded and disproportionate share, meaning that the results are unlikely to be applicable to hospitals that do not treat a similar population of patients. Additionally, because the study population is from one specific hospital system, the results may not be able to be generalized. Multiple confounding factors, such as a high number of comorbidities, may be more significant factors to readmission the depression diagnosis being studied. Deidentified data prevent validation of collected data through chart review and also restricts some information from being collected, including patients over 90 years old, zip code, secondary insurance coverage, and financial information.

Chapter 4: Results

Sample population cohorts:

The first data set of readmitted patients was received on November 9th, 2018 for review. Several modifications were made to the data set to adapt for study review:

- Patients with admission dates outside of study time frame of July 1st, 2012 through June 30th, 2018. This removed 17 patients
- Individuals transferred between hospital departments, such as the heart hospital to the rehabilitation hospital, were removed from the data. This removed 26 patients
- Prisoners were removed from the data. This was determined by reviewing the patient insurance coverage and individuals discharged to "Court/Law Enforcement" were also removed. This removed 11 patients.

Altogether 54 patients were removed initially, leaving 529 patients for review for each service.

From the heart failure service, 77 additional patients were removed:

- 40 patients discharged from a heart failure service and readmitted to another non-heart hospital service within 30 days.
- 37 patients were readmitted to an alternate heart hospital service such as open heart surgery or electrophysiology were not included in this study

129 patients directly matched the criteria of being admitted to a heart failure service and being readmitted to the heart failure, heart hospital medicine, or cardiac management services within 30 days. These patients were included.

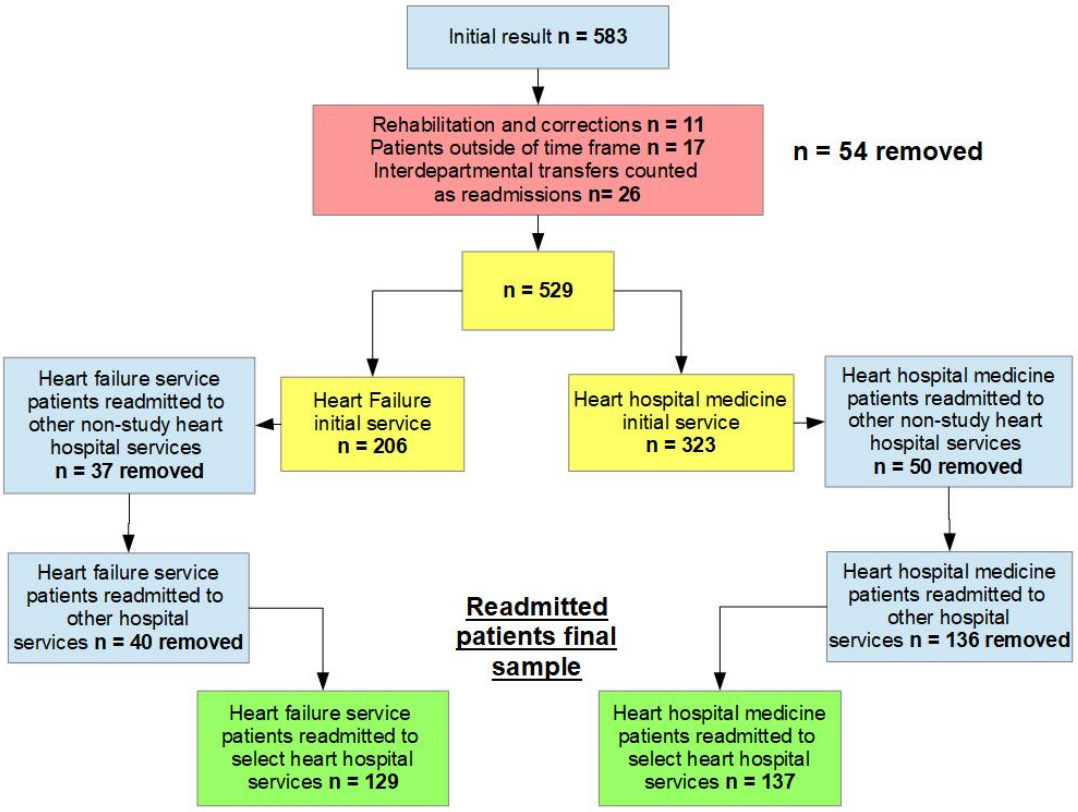
From the heart hospital medicine service:

- 50 readmitted to a non-study heart hospital service
- 136 readmitted to a non-heart hospital service within 30 days.

The heart hospital medicine had 137 patients readmitted within 30 days to a select heart hospital service, qualifying for inclusion.

A total of 266 readmissions were reviewed, with selection visualized in the figure below:

Figure 3: Readmitted Patients Sample



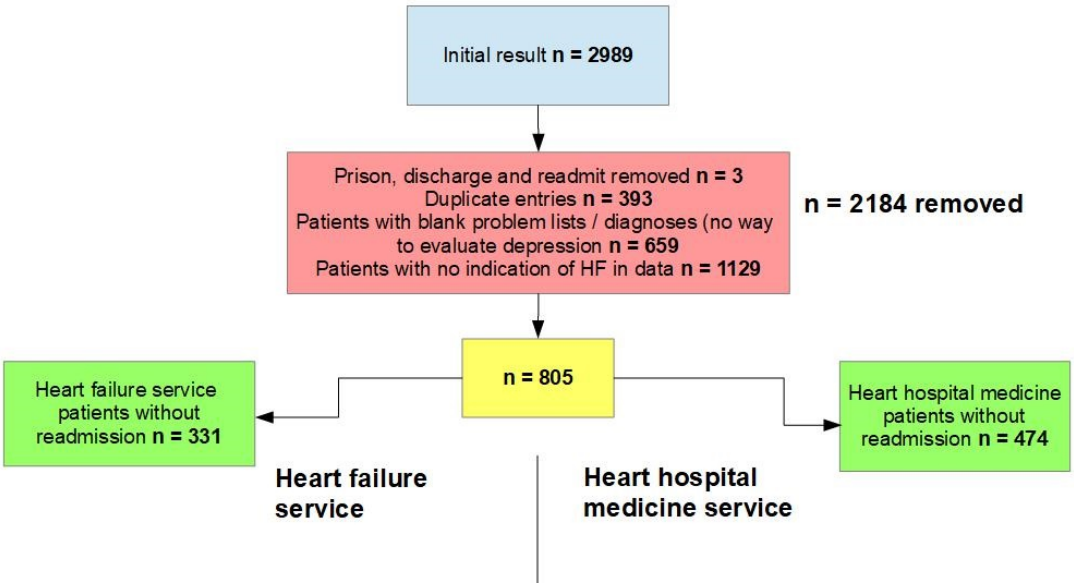
The data describing patients not readmitted were received on January 3rd, 2019 for review. A variety of changes were necessary to adapt the data for the purposes of this study:

- The first entry for each patient was taken and subsequent entries were removed from the dataset (393 entries).

- Three patients discharged to prison or listed as discharge and readmit were removed. Discharge and readmit indicates a patient discharged from one academic hospital and readmitted to another in the system, such as from the heart hospital to a rehabilitation hospital. Prisoners healthcare and social situations are complex, and they cannot be adequately compared to this study's primary population of Medicare and Medicaid patients
- Patients with blank problem lists and diagnoses lists were removed, as there was no way of evaluating if a patient had depression or not. This removed 659 patients
- Patients without an indication of heart failure were removed from the data (1129 patients)
    - Although some patients were on the congestive heart failure service, without an indication of heart failure it is not possible to assume their diagnosis

Altogether 2184 entries were removed from the dataset, 805 unique patients that had heart failure and documented diagnoses remained. The following figure visualizes the selections:

Figure 4: Not readmitted patients sample



Sample population characteristics:

Table 3: Heart failure service statistics by depression diagnosis

	Heart failure service patients readmitted to specific services by depression diagnosis (n=129)		**Heart failure service patients NOT readmitted to specific services by depression diagnosis (n=331)**	
	Depression diagnosis	No depression diagnosis	Depression diagnosis	No depression diagnosis
Number of patients	15 (12.1%)	114 (91.9%)	25 (7.55%)	306 (92.45%)
Average days to readmission	13.6	12.7		
Average patient age	71.67	72.46	72.96	74.23
Average patient BMI at original admission	29.57	28.76	33.13	29.02
Primary insurance				
Traditional Medicare A+B	8 (53.33%)	66 (57.89%)	10 (40.00%)	179(58.50%)
Medicare Advantage	5 (33.33%)	33 (28.95%)	10 (40.00%)	102(33.33%)
Medicaid		7 (6.14%)	2 (8.00%)	2(0.65%)
Dual eligible insurance (Medicare + Medicaid)	2 (13.33%)	1 (0.88%)	1 (4.00%)	4(1.31%)
Private insurance / other		7 (6.14%)	2 (8.00%)	19(6.21%)
Initial discharge disposition				
Cancer center				1(0.33%)
Home with home health care	5 (33.33%)	36 (31.58%)	7(28.00%)	88(28.76%)
Home with self-care	4 (26.67%)	54 (47.37%)	13(52.00%)	157(51.31%)
Intermediate care facility				
Long term care		1 (0.88%)		5(1.63%)
Psychiatric facility				
Rehab facility				2(0.65%)
Short term hospital		2 (1.75%)		
Skilled nursing facility	6 (40.00%)	21 (18.42%)	5(20.00%)	53(17.32%)

County Health Rankings				
County information available	15 (100%)	106 (92.98%)	24 (96%)	293 (88.52%)
Capital county residents	8 (53.33%)	48 (45.28%)	13 (54.17%)	125 (42.66%)
County Health Outcomes Rank (specific year of admission)	46.80%	52.79%	43.61%	55.55%
County Health Factors Rank (specific year of admission)	45.73%	47.30%	39.87%	49.36%

Table 4: Heart Failure significance tests

Factor	Samples compared	Significance	Odds ratio
Overall depression significance	All readmitted and not readmitted patients	p = .164	OR = 1.61
Medicaid and dual eligible rates	All readmitted compared not readmitted patients	p = .015	OR = 3.01
County Health Rankings Outcomes	Readmitted depressed compared to non-depressed	p = .1121	
County Health Factors	Readmitted depressed compared to non-depressed	p = .9747	
County Health Rankings Outcomes	Not readmitted depressed compared to non-depressed	p = .1177	
County Health Factors	Not readmitted depressed compared to non-depressed	p = .1750	

Readmissions after discharge from the Heart Failure service result notes:

- Two patients did not have county data, so they were removed from the County Health Rankings statistics
- Six patients were from other states and were excluded from County Health Rankings data

- One patient had no insurance information available and was excluded from the insurance statistics
- Races observed:
    - 103 White
    - 21 African-American/Black
    - Two African–Other patients
    - One Asian-Cambodian patient
    - One Asian-Other patient
    - One patient marked as “Other” race

Regarding depression, the following ICD codes were observed in readmitted patients:

Table 5: Heart failure service readmitted patient depression codes

ICD code	**Prevalence**
F32.9 – Major depressive disorder, single episode	14 of 15 patients
F33.1 - Major depressive disorder, recurrent, moderate	3 of 15 patients with F32.9
F33.2 - Major depressive disorder, recurrent severe without psychotic	1 of 15 patients

Patients not readmitted after discharge from Heart Failure service notes:

- 317 of 331 patients had County Health Rankings data available
- 329 of 331 had race information available

- Whites comprised 80.24% and African-American race 15.2% of the patients
- 15 patients (4.56%) were other races or unknown

The following ICD codes were observed:

Table 6: Heart failure service patients not readmitted depression codes

ICD code	**Prevalence**
F32.5 – Major depressive disorder, single episode, in full remission	1 of 25 patients
F32.9 – Major depressive disorder, single episode	22 of 25 patients
F33.0 – Major depressive disorder, recurrent, mild	1 of 25 patients
F33.2 - Major depressive disorder, recurrent severe without psychotic	1 of 25 patients

Results overview of the Heart Failure service patients:

Depression rates were relatively low in this sample at 12.1% (n = 15 of 129) for those readmitted, and 7.55% (n = 25) for those not readmitted. Combining both pools of patients, the overall readmission rate for heart failure patients for the period 2012-2018 was 28.04% (129 readmitted patients / 460 total patients). F32.9 – Major depressive disorder, single episode – was the most prominent ICD-10 code for patients readmitted, with 14 of 15 having this code in their diagnoses list. It was also the most common in patients readmitted with 22 of 25 patients having the F32.9 ICD-10 code.

Of those readmitted, 40% of depressed patients discharged to a skilled nursing facility (n = 6) compared to 18.42% for non-depressed (n = 21). This result was lower in those not readmitted, as those with depression discharged to a skilled nursing facility at a rate of 20% (n = 5) and those without depression at 17.32% (n = 53). The majority of patients discharged to home with home-health or home with self-care (99 of 126).

Patients with Medicaid or dual eligible Medicare and Medicaid insurance were represented in the sample with 10 of 129 readmitted patients and 9 of 331 not readmitted patients. There was a significant difference in the proportions between the readmitted and not readmitted groups ($p = .015$, OR = 3.01)

The not readmitted patients (n = 331) discharged to home or home with self-care at a high rate (265 of 331). In those with depression, 40% had traditional Medicare compared to 58.5% of those without depression.

Readmitted depressed patients had better County Health Rankings in outcomes (46.8% versus 52.79%) and factors (45.73% versus 47.30%). For reference, the capital city of the state has a health outcomes percentage of about 55% and health factors of 47%. The result was not statistically significant for factors ($p = 0.9747$) or outcomes ($p = 0.1121$). In patients not readmitted, depressed patients had better rankings in both outcomes and factors, but the results were not statistically significant ($p = 0.1177$ and $p = 0.1750$,

respectively). Patients with depression had better outcomes and factor rankings in every category.

Table 7: Hospital medicine results by depression diagnosis

	Heart hospital medicine service patients readmitted to specific services by depression diagnosis (n=137)		**Heart hospital medicine service patients NOT readmitted to specific services by depression diagnosis (n=474)**	
	Depression diagnosis	No depression diagnosis	Depression diagnosis	No depression diagnosis
Number of patients	11 (8.03%)	126 (91.97%)	38 (8.02%)	436 (91.98%)
Average days to readmission	13.91	12.06		
Average patient age	73	75.13	74.08	75.03
Average patient BMI at original admission	28.71	29.42	31.62	30.07
Primary insurance				
Traditional Medicare A+B	7 (63.64%)	81 (64.29%)	21 (55.26%)	258 (59.17%)
Medicare Advantage	2 (18.18%)	29 (23.02%)	13 (34.21%)	119 (27.29%)
Medicaid		6 (4.76%)	2 (5.26%)	17 (3.90%)
Dual eligible insurance (Medicare + Medicaid)		4 (3.17%)	1 (2.63%)	16 (3.67%)
Private insurance / other	2 (18.18%)	6 (4.76%)	1 (2.63%)	26 (5.96%)
Initial discharge disposition				

Cancer center				1 (0.23%)
Home with home health care	4 (36.36%)	35 (27.78%)	13 (34.21%)	94 (21.56%)
Home with self-care	5 (45.45%)	75 (59.52%)	22 (57.89%)	274 (62.84%)
Intermediate care facility				1 (0.23%)
Long term care				
Psychiatric facility				1 (0.23%)
Rehab facility				
Short term hospital				1 (0.23%)
Skilled nursing facility	2 (18.18%)	16 (12.70%)	5 (13.16%)	64 (14.68%)
County Health Rankings				
County information available	11 (100%)	122 (96.83%)	38 (100%)	418 (95.87%)
Capital county residents	7 (63.64%)	49 (40.16%)	24 (63.16%)	205 (49.04%)
County Health Outcomes Rank (specific year of admission)	53.27%	46.80%	50.66%	55.16%
County Health Factors Rank (specific year of admission)	52.27%	44.27%	47.25%	52.05%

Table 8: Heart Hospital Medicine significance tests

Factor	**Samples compared**	**Significance**	**Odds ratio**
Overall depression significance	All readmitted and not readmitted patients	p = .996	OR = 1.00
Medicaid and dual eligible rates	All readmitted compared not readmitted patients	p = .908	OR = 0.96
County Health Rankings Outcomes	Readmitted depressed compared to non-depressed	p = .8050	
County Health Factors	Readmitted depressed compared to non-depressed	p = .0672	
County Health Rankings Outcomes	Not readmitted depressed compared to non-depressed	p = .4130	
County Health Factors	Not readmitted depressed compared to non-depressed	p = .3863	

Patients readmitted after discharge from the Heart Hospital Medicine services result notes:

- Four patients with counties outside of state of study were excluded from County Health Rankings
- Race results were as follows:
    - 24 African American race (17.52%)
    - 111 White race (81.02%)
    - One patient of race “African-Other”
    - One patient of “Other”

The following ICD codes for depression were observed:

Table 9: Heart hospital medicine patients readmitted depression codes

ICD code	**Prevalence**
F32.9 – Major depressive disorder, single episode	10 of 11 patients
F33.1 - Major depressive disorder, recurrent, moderate	2 of 11 patients with F32.9
F33.41 - Major depressive disorder, recurrent, in partial remission	1 of 11 patients

Patients not readmitted after discharge from the Heart Hospital Medicine services notes:

- 456 of 474 (96.2%) patients had County Health Rankings information available

- 455 of 474 (96.39%) patients were either White (77.64%) or African-American (18.75%) race

A wide variety of depression ICD codes were observed in 38 of the 474 patients:

Table 10: Heart hospital medicine patients not readmitted depression codes

ICD code	**Prevalence**
F32.1 – Major depressive disorder, single episode, moderate	1 of 38 patients
F32.3 – Major depressive disorder, single episode, severe with psychotic features	1 of 38 patients
F32.5 – Major depressive disorder, single episode, in full remission	2 of 38 patients
F32.9 – Major depressive disorder, single episode	28 of 38 patients
F33.1 - Major depressive disorder, recurrent, moderate	2 of 38 patients
F33.2 Major depressive disorder, recurrent severe without psychotic feature	1 patient of 38 who also had F32.9
F33.42 – Major depressive disorder, recurrent, in full remission	1 of 38 patients
F33.9 – Major depressive disorder, recurrent, unspecified	1 of 38 patients
Depression – uncoded	1 of 38 patients

Results overview of the Heart Hospital Medicine patient readmissions:

Depression diagnosis in readmitted patients did not reveal any major group differences ($p = .996$, OR = 1.00), but only 11 of 137 patients (8.03%) had an ICD code of depression on their problem list at initial discharge. When the pools of readmitted and not readmitted patients are considered, the overall readmission rate was 22.42% for the heart hospital medicine service (137 readmitted patients / total of 611 patients). The

most prevalent ICD-10 code was F32.9 in 10 of 11 readmitted patients and 28 of 38 not readmitted patients. The overall rate of depression was low and not well represented in either hospital medicine patient sample.

Patients that were readmitted seemed to favor traditional Medicare (n = 88 of 137) and discharged to home with home health care or home with self-care (n = 119 of 137). Depressed patients discharged to home with home health care at higher rates in both readmitted and not readmitted patients.

Neither group had high rates of dual-eligible Medicare and Medicaid patients or Medicaid alone patients (10 of 137 readmitted, 36 of 474 not readmitted). The readmitted and not readmitted group did not have a significant difference in the number of dual eligible or Medicaid patients ($p = .908$, OR = 0.96)

Readmitted depressed patients did have worse County Health Rankings than non-depressed patients in both factors (52.27% versus 44.27%) and outcomes (53.27% versus 44.27%), but the results were not statistically significant ($p = .0672$ and $p = 0.8050$, respectively). Depressed patients that were not readmitted actually had better rankings in both County Health Rankings factors and outcomes. These results were not statistically significant ($p = 0.4130$ and $p = 0.3863$). Depressed patients tended to live in the capital county at a higher rate than the non-depressed in both samples.

Chapter 5: Discussion

Discussion of overall results:

Depression rates were low in readmitted patients at 11 patients of 137 (8.03%) overall for Hospital Medicine and 15 of 129 (11.63%) for Heart Failure. Between both services this is a rate of 26 patients in 266 (9.77%), significantly lower than the 20-40% commonly reported (Smith, Stock, Santora, 2015; Ahmedani et al., 2015). The use of claims data – as opposed to documentation from patient charts – could have resulted in a low rate. If a diagnosis of depression was not deemed related to the reasons for admission or discharge, it was possible it is not captured. Additionally, the reluctance of older adults to seek and accept treatment due to perceived stigma may have affected the rates of depression. Neither the heart failure nor heart hospital medicine service had statistically significant differences in rates of depression between readmitted and non-readmitted patients ($p = .164$ & $p = .996$, OR = 1.61 & OR = 1.00).

Overall the readmission rates were 28.04% for heart failure and 22.42% for heart hospital medicine. This is somewhat higher than the Medicare 2017-2018 rate of 21.7%, especially considering that Medicare uses all cause readmissions and this study focused on heart failure readmissions only. It is also high because only heart failure service readmissions at this academic medical center's readmissions were counted in this study,

as Medicare's rate includes patients readmitted to other institutions for any reason. Because Medicare readmission rates include those under 65 the sample of this study cannot be compared to the Medicare population rate.

In terms of ICD-10 diagnoses, by far the most prevalent was F32.9 – Major depressive disorder, single episode – presented in 74 of 89 total patients with a depression diagnosis. This could be due to if the physicians on the study services evaluated the patient at only one instance, so they did not apply a long term code.

As Navathe and Zhong et. al found, review of physician notes may have helped identify more patients with depression that claims data did not capture. If depression is underdiagnosed overall, organizational initiatives may be needed to more effectively identify patients in need of treatment. Application of the PHQ-9 questionnaire consistently may help alleviate this issue. Coupling administrative data from multiple sources – such as inpatient and outpatient – may assist in more effectively identifying depression (Fiest, Jette, Quan, Germaine-Smith, Metcalfe, et al., 2014)

The representation of Medicaid and dual eligible Medicare and Medicaid patients in these samples were relatively low. Of those readmitted, 20 of 266 (7.52%) had either Medicaid or dual eligible insurance between the heart failure and heart hospital medicine services. Patients who were not readmitted had a rate of 45 of 805 (5.59%).

This was likely due to a limitation in the data set of only returning primary insurance. In the state where this academic medical center resides, there are only two scenarios where a patient can have primary payer of Medicaid coverage after turning 65. First, they may not be a legal resident that has paid into Medicare enough quarters or able to afford Medicare benefits. Second, they may have qualified for Medicaid until they were 65, at which time their coverage either became secondary to Medicare (QMB or SLMB), or their income exceeded the threshold for retaining Medicaid. The use of Medicaid or dual eligible insurance was an inconsistent proxy for associating lower income level or disability with readmission. In the heart failure group there was a significant difference in the number of patients with dual eligible or Medicaid insurance between the readmitted and not readmitted group ($p = .015$, $OR = 3.01$), but there was not a significant difference in the heart hospital medicine group ($p = .908$, $OR = 0.96$).

The County Health Rankings were inconsistent across services and lacked statistical significance. Readmitted hospital medicine depressed patients had worse County Health Rankings in both factors and outcomes, but depressed heart failure service patients had better rankings. With depressed patients having worse health outcomes (Moussavi, Verdes, Tandon, Patel, 2007), one would expect depressed patients to have worse County Health Rankings. It is possible that county rankings are not precise enough. A county may have a good rank, but have smaller localities where health

outcomes are poorer. Using deidentified data prevented the use of zip codes to represent socioeconomic status, and those may have been more specific and revealing than county level information.

In conclusion, this study found limited evidence of depression having a significant relationship to geriatric heart failure readmissions at this academic heart hospital in the Midwest. The prevalence of depression diagnosis in all groups was lower than expected, perhaps due to the use of claims data and stigma towards mental health treatment in the geriatric population. Using physician notes through chart review may yield more accurate rates of depression. The County Health Rankings did not show statistical significance related to health outcomes or factors in depressed patients. Zip codes could have yielded different results. Dual eligible or Medicaid insurance – a substitute for low socioeconomic status – was observed at a higher proportion of readmitted patients in the heart failure cohort, but it was not in the hospital medicine group. Special attention to geriatric heart failure patients with Medicaid insurance could be recommended to identify those at high risk for readmission.

Limitations:

This study was from one academic hospital in the Midwest, and the results may not be applicable to other institutions. Also, the use of deidentified data prevents chart

review, which would confirm validity of the data or allow for additional information about potential depression diagnoses to be obtained. A common risk factor for readmissions is disability, and determining disability in geriatric patients without chart review or patient interaction is not possible.

Implications for research and practice:

Future research studies may benefit from the use of physician notes or other documentation in the medical record to identify if patients have depression. Claims data are often easier to access and analyze, but it is limited to what is submitted to insurance companies at discharge. Further, in studies examining the links between depression and readmission risk, it may be prudent to use more specific assessments of health and poverty than the County Health Rankings. Census information based on zip codes might be more accurate in identifying localities with a high rate of depression or readmissions, particularly where there is a wide range among zip codes within one county. Examining secondary insurance for Medicaid eligibility could also yield more consistent results than primary insurance alone in assessing socioeconomic status of geriatric patients.

In terms of practice, there is a longstanding stigma relative to mental health diagnoses Because of this stigma, geriatric patients relevant to this study may have avoided

depression diagnosis and treatment. Encouraging institutions to apply the PHQ-9 assessment to patients may help in diagnosis and documentation of depression. Special attention should be given to Medicaid patients, who do not have the financial means of most insured patients. As a result, they may be at an increased risk of depression. The use of tools such as the Readmission After Heart Failure scale could assist clinicians in identifying patients that are at high risk for readmission. Once patients are identified, implementing a comprehensive discharge process – such as Project RED – and developing discharge plans that a patient can understand could help improve (ie, decrease) readmission rates while increasing patient satisfaction.

Bibliography:

Ahmedani, B.K., Solberg, L.I., Fang, Y., Stewart, C., Hu, J., Nerenz, D., … Simon, G.E. (2015) Influence of psychiatric comorbidity on 30-day readmissions for heart failure, myocardial infarction, and pneumonia, *Psychiatr Serv* 66(2): 134-140. doi:10.1176/appi.ps.201300518.

Albrecht, J.S., Gruber-Baldini, A.L., Hirshon, J.M., Brown, C.H., Goldberg, R., Rosenberg, J.H., Comer, A.C., Furuno, J.P. (2014) Depressive Symptoms and Hospital Readmission in Older Adults, *J Am Geriatr Soc*, 62(3): 495-499. doi:10.1111/jgs.12686

American Hospital Association (2018) *Hospital Readmissions Reduction Program Fact Sheet.* Retrieved from: https://www.aha.org/system/files/2018-01/fs-readmissions.pdf

American Heart Association (2018) Heart Failure Causes and Risks. Retrieved from: https://www.heart.org/en/health-topics/heart-failure/causes-and-risks-for-heart-failure/understand-your-risk-for-heart-failure

Barnett, M.L., Hsu, J., McWilliams, J.M. (2015) Patient Characteristics and Differences in Hospital Readmission Rates, *JAMA Intern Med*, doi:10.1001/jamainternmed.2015.4660

Barry, L.C., Abou, J.J., Simen, A.A., Gill, T.M. (2012) Under-treatment of Depression in Older Persons, *J Affect Disord*, 136(3): 789-796, doi:10.1016/j.jad.2011.09.038

Berges, I.M., Amr, S., Abraham, D.S., Cannon, D.L., Ostir, G.V. (2015) Associations between Depressive Symptoms and 30-day Hospital Readmission among Older Adults, *J Depress Anxiety,* 4:2, doi:10.4172/2167-1044.1000185

Boccuti, C., Casillas, G. (2017) Aiming for Fewer Hospital U-turns: The Medicare Hospital Readmission Reduction Program. *Kaiser Family Foundation,* retrieved from: https://www.kff.org/medicare/issue-brief/aiming-for-fewer-hospital-u-turns-the-medicare-hospital-readmission-reduction-program/

Boston University Components of Re-Engineered Discharge (2014) Retrieved from: https://www.bu.edu/fammed/projectred/components.html

Bowles, K., Hanlon, A., Holland, D., Potashnik, S., Topaz, M (2014) Impact of Discharge Planning Decision Support on Time to Readmission Among Older Adult Medical Patients. *Prof Case Management* , 19(1): 29–38. doi:10.1097/01

Burke, R.E., Schnipper, J.L., Williams, M.V., Robinson, E.J., Vasilevskis, E.E., Kripalani, S., … Donze, J.D. (2017) The HOSPITAL Score Predicts Potentially Preventable

30-Day Readmissions in Conditions Targeted by the Hospital Readmissions Reduction Program. *Hospital Care*, 55:3, 285-290

Centers for Disease Control and Prevention (CDC) (2016) What is health literacy? Retrieved from: https://www.cdc.gov/healthliteracy/learn/index.html

Chamberlain, R.S., Sond, J., Mahendraraj, K., Lau, C.S.M., Siracuse, B.L. (2018) Determining 30-day readmission risk for heart failure patients: the Readmission After Heart Failure scale. *International Journal of General Medicine* 2018:11 127–141

Chaudhry, S.I., McAvay, G., Chen, S., Whitson, H., Newman, A.B., Krumholz, H.M., Gill, T.M. (2012) Risk Factors for Hospitalization Among Older Persons Newly Diagnosed with Heart Failure: The Cardiovascular Health Study. *J Am Coll Cardiol*. 2013 February 12; 61(6): 635–642. doi:10.1016/j.jacc.2012.11.027.

CMS (2014) Chronic Conditions data. Retrieved from http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Chronic-Conditions/index.html

Conner, K.O., Copeland, V.C., Grote, N.K., Koeske, G., Rosen, D., Reynolds III, C.F., Brown, C. (2010) Mental Health Treatment Seeking Among Older Adults with

Depression: The Impact of Stigma and Race. *Am J Geriatr Psychiatry,* 18(6): 531-543. doi:10.1097/JGP.0b013e3181cc0366

Data.gov (2017) Heart failure readmission data. Retrieved from: https://data.medicare.gov/Hospital-Compare/Hospital-Readmission-Rates/92ps-fthr/data

Deschodt, M., Devriendt, E., Sabbe, M., Knockaert, D., Deboutte, P., Boonen, S., Flamaing, J., Milsen, K. (2015) Characteristics of older adults admitted to the emergency department (ED) and their risk factors for ED readmission based on comprehensive geriatric assessment: a prospective cohort study. *BMC Geriatrics*, 15:54. DOI 10.1186/s12877-015-0055-7

Dharmarajan, K., Hsieh, A., Dreyer, R.P., Welsh, J., Qin, L., Krumholz, H.M. (2017) The relationship of Age with Trajectories of Rehospitalization Risk Among Older Patients. *J Am Geriatr Soc.* 65(2): 421–426. doi:10.1111/jgs.14583.

Dharmarajan, K., Wang, Y., Lin, Z., Normand, S. T., Ross, J. S., Horwitz, L. I., Desai, N. R., Suter, L. G., Drye, E. E., Bernheim, S. M., … Krumholz, H. M. (2017). Association of Changing Hospital Readmission Rates With Mortality Rates After Hospital Discharge. *JAMA*, *318*(3), 270-278. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5817448/

Donze, J., Lipsitz, S., Schnipper, J.L. (2014) Risk Factors for Potentially Avoidable Readmissions due to End-of-life Care Issues. *J Hospital Medicine,* 9:5, 310-315. DOI 10.1002/jhm.2173

El Morr, C., Ginsburg, L., Nam, S., Woollard, S. (2017) Assessing the Performance of a Modified LACE Index (LACE-rt) to Predict Unplanned Readmission After Discharge in a Community Teaching Hospital. *Interact J Med Res,* 6:1:e2. doi 10.2196/ijmr.7183

Emory Healthcare, Inc. (2018) Heart Failure Statistics. Retrieved from: https://www.emoryhealthcare.org/heart-vascular/wellness/heart-failure-statistics.html

Fiest, K.M., Jette, N., Quan, H., St. Germaine-Smith, C, Metcalfe, A., et al. (2014) Systematic review and assessment of validated case definitions for depression in administrative data. *BMC Psychiatry,* 14:289. doi:10.1186/s12888-014-0289-5

Fitch, K., Pelizzari, P.M., Pyenson, B. (2015) The High Cost of Heart Failure for the Medicare Population: An Actuarial Cost Analysis. *Milliman.* Retrieved from: http://www.milliman.com/insight/2015/The-high-cost-of-heart-failure-for-the-Medicare-population-An-actuarial-cost-analysis/

Fonarow, G.C., Konstam, M.A., Yancy, C.W. (2017) The Hospital Readmission Reduction Program Is Associated With Fewer Readmissions, More Deaths: Time to

Reconsider. *J Am Col Cardiology,* 70:15, 131-134. http://dx.doi.org/10.1016/j.jacc.2017.08.046

Fuller, R.L., Atkinson, G., McCullough, E., Hughes, J.S., (2013) Hospital Readmission Rates: The Impacts of Age, Payer, and Mental Health Diagnoses, *J Ambulatory Care Manage*, 36:2, 147-155. doi: 10.1097/JAC.0b013e3182866c1c

Gheorghiade, M., Vaduganathan, M., Fonarow, G.C., Bonow, R.O. (2013) Rehospitalization for Heart Failure: Problems and Perspectives, *J Amer College of Cardiology,* 61(4) doi: http://dx.doi.org/10.1016/j.jacc.2012.09.038

Hall, M.J., Levant, S., DeFrances, C.J. (2012) Hospitalization for Congestive Heart Failure: United States, 2000–2010. *National Center for Health Statistics Data Brief.* 2012 Oct;(108):1-8.

Hawkins, M.A.W., Goldstein, C.M., Dolansky, M.A., Gunstad, J., Redle, J.D., Josephson, R., Hughes, J.W. (2015) Depressive symptoms are associated with obesity in adults with heart failure: An analysis of gender differences. *Eur J Cardiovasc Nurs.* 14(6): 516–524. doi:10.1177/1474515114542558.

Healthcare.gov Federal Poverty Level (FPL) (2018). Retrieved from: https://www.healthcare.gov/glossary/federal-poverty-level-fpl/

Health and Human Services (HHS) Who is eligible for Medicare? Retrieved from: https://www.hhs.gov/answers/medicare-and-medicaid/who-is-elibible-for-medicare/index.html

Heimlich, R. (2010) Baby Boomers Retire. *Pew Research Center.* Retrieved from: http://pewrsr.ch/T4o2Hs

Herrin, J., St. Andre, J., Kenward, K., Maulik, S.J., Audet, A.J., Hines, S.C. (2015) Community Factors and Hospital Readmission Rates, *Health Services Research.* DOI: 10.1111/1475-6773.12177

Hu, J., Gonsahn, M.D., Nerenz, D.R., (2014) Socioeconomic status and readmissions: evidence from an urban teaching hospital. *Health Affairs,* 33:5, pg. 778-785. doi: 10.1377/hlthaff.2013.0816

ICD-10 data (2018) *ICD-10-CM/PCS Medical Coding Reference.* Retrieved from: https://www.icd10data.com/

Joynt, K.E., Jha, A.K. (2012) Thirty Day Readmissions – Truth and Consequences. *N Eng J Med,* 366:15, 1366-70. Doi 10.1056/NEJMp1201598

Kroenke, K., Spitzer, R.L., Williams, J.B. W. (2001) Validity of a Brief Depression Severity Measure. *J Gen Intern Med*, 16:606-613

Mayo Clinic (2018) Depression (major depressive disorder). Retrieved from: https://www.mayoclinic.org/diseases-conditions/depression/symptoms-causes/syc-20356007

McDermott, K.W., Elixhauser, A., Sun, R. (2017) Trends in Hospital Inpatient Stays in the United States, 2005–2014. *AHRQ,* statistical brief 225. Retrieved from: https://www.hcup-us.ahrq.gov/reports/statbriefs/sb225-Inpatient-US-Stays-Trends.pdf

McNaughton, C., Cawthon, C., Kripalani, S., Liu, D., Storrow, A., Roumie, C. (2015) Health Literacy and Mortality: A Cohort Study of Patients Hospitalized for Acute Heart Failure**.** *J Amer Heart Association,* 4:e001799 doi: 10.1161/JAHA.115.001799

Meddings, J., Reichert, H., Smith S.N., Iwashyna, T.J., Langa, K.M., Hofer, T.P., McMahon, L.F. (2016) The Impact of Disability and Social Determinants of Health on Condition-Specific Readmissions beyond Medicare Risk Adjustments: A Cohort Study, *J Gen Intern Med* 32(1), pg. 71-80. doi:10.1007/s11606-016-3869-x

Medicare.gov depression screenings coverage (n.d.). Retrieved from: https://www.medicare.gov/coverage/depression-screenings

Medicare.gov disproportionate share hospital data (2018). Retrieved from: https://www.cms.gov/Research-Statistics-Data-and-Systems/Downloadable-Public-Use-Files/Cost-Reports/Hospital-2010-form.html

Medicare.gov hospital readmission data (2017). Retrieved from: https://www.medicare.gov/hospitalcompare/profile.html#profTab=4&ID=360085&Distn=0.4&dist=25&loc=43210&lat=39.9990626&lng=-83.0173386

Mitchell, S.E., Martin, J.M., Krizman, K., Sadikova, E., Culpepper, L., Stewart, S.K., Brown, J.R., Jack, B.W. (2015) Design and Rationale for a Randomized Controlled Trial to Reduce Readmissions among Patients with Depressive Symptoms, *Contemp Clin Trials,* 45(0 0): 151-156. doi:10.1016/j.cct.2015.08.016

Mitchell, S.E., Paasche-Orlow, M.K., Forsythe, S.R., Chetty, V.K., O'Donnell, J.K., Greenwald, J.L., Culpepper, L., Jack, B.W. (2010) Post-Discharge Hospital Utilization Among Adult Medical Inpatients With Depressive Symptoms. *Journal of Hospital Medicine* 2010;5:378–384

Moser, D.K., Robinson, S., Biddle, M.J., Pelter, M.M, Nesbitt, T., Southard, J., Cooper, C., Dracup, K. (2015) Health Literacy Predicts Morbidity and Mortality in Rural Patients with Heart Failure: Moser Health Literacy Outcomes. *J Card Fail*. 2015 August ; 21(8): 612–618. doi:10.1016/j.cardfail.2015.04.004

Moussavi, S., Verdes, C.S., Tandon, A., Patel, V., Ustun, B. (2007) Depression, chronic diseases, and decrements in health: results from the World Health Surveys. *Lancet.* 2007 Sep 8;370(9590):851-8.

Murphy, S.L., Xu, J., Kochanek, K.D., Curtin, S.C., Arias, E. (2017) Deaths: Final Data for 2015. *National Vital Statistics Reports (CDC).* 66:6

National Institute of Mental Health (2018) Depression. Retrieved from: https://www.nimh.nih.gov/health/topics/depression/index.shtml

Navathe, A.S., Zhong, F., Lei, V.J., Chang, F.Y., Sordo, M., Topaz, M., Navathe, S.B., Rocha, R.A., Zhou, L. (2016) Hospital Readmission and Social Risk Factors Identified from Physician Notes. *Health Services Research*, DOI: 10.1111/1475-6773.12670

Nieminen M.S., Dickstein K., Fonseca C., Serrano J.M., Parissis J., Fedele F., … Zymliński R.(2015) The patient perspective: Quality of life in advanced heart failure with frequent hospitalisations. *Int J Cardiol*. Jul 15;191:256-64. doi: 10.1016/j.ijcard.2015.04.235

Neuman, T., Cubanski, J., Huang, J., Damico, A. (2015) The Rising Cost of Living Longer: Analysis of Medicare Spending by Age for Beneficiaries in Traditional Medicare, *Kaiser Family Foundation*

Parmar, K.R., Xiu, P.Y., Chowdhurt, M.R., Patel, E., Cohen, M. (2015) In-hospital treatment and outcomes of heart failure in specialist and non-specialist services: a retrospective cohort study in the elderly. *Open Heart,* 2015;2:e000095. doi:10.1136/openhrt-2014-000095

Prine, M., Deeg, D., Brayne, C., Beekman, A, Huisman, M. (2012) The Association between Depressive Symptoms and Non-Psychiatric Hospitalisation in Older Adults. PLoS ONE 7(4): e34821. doi:10.1371/journal.pone.0034821

Rectrum, J.H., Boggs, J., Hersh, A., Wright, L., Main, D.S., Magid, D.J., Allen, L.A. (2013) Patient-Identified Factors Related to Heart Failure Readmissions. Circ Cardiovasc Qual Outcomes. 2013 March 1; 6(2): 171–177. doi:10.1161/CIRCOUTCOMES.

Saab, D., Nisenbaum, R., Dhalla, I., Hwang, S.W. (2015) Hospital readmissions in a community-based sample of homeless adults: a matched cohort study. *J Intern Med,* 31(9): 1011-1018. doi 10.1007/s11606-016-3680-8

Salvi, F., Morichi, V., Grilli, A., Giorgi, R., De Tommaso, G., Dessi-Fulgheri, P. (2007) The elderly in the emergency department: a critical review of problems and solutions. *Intern Emerg Med.* 2:292–301. DOI 10.1007/s11739-007-0081-3

Singh, G., Zhang, W., Kuo, Y.F., Sharma, G. (2016) Association of Psychological Disorders With 30-Day Readmission Rates in Patients With COPD. *CHEST,* 149(4): 905-915. Doi http://dx.doi.org/10.1378/chest.15-0449

Smith, M.W., Stock, C., Santora, P.B. (2015) Hospital Readmission Rates and Emergency Department Visits for Mental Health and Substance Abuse Conditions. *Community Mental Health J,* 51:190-197. DOI 10.1007/s10597-014-9784-x

Spiva, L., Hand, M., VanBrackle, L., McVay, F. (2014) Validation of a Predictive Model to Identify Patients at High Risk for Hospital Readmission. *Journal for Healthcare Quality,* 0:0, 1-7. doi: 10.1111/jhq.12070

Substance Abuse and Mental Health Services Administration (2014) Results from the 2013 National Survey on Drug Use and Health: Mental Health Findings. Retrieved from: https://store.samhsa.gov/product/Results-from-the-2013-National-Survey-on-Drug-Use-and-Health-Mental-Health-Findings/SMA14-4887

Substance Abuse and Mental Health Services Administration (2015) Behavioral Health Barometer. Retrieved from: https://store.samhsa.gov/product/Behavioral-Health-Barometer-2015/SMA16-BARO-2015

Suter, L.G., Li, S., Grady, J., Lin, Z., Wang, Y., Bhat, K.R., Turkmani, D., Spivack, S.B., Lindenauer, P.K., Merrill, A.R., Drye, E.E., Krumholz, H.M., Bernheim, S.R. (2014) National Patterns of Risk-Standardized Mortality and Readmission After Hospitalization for Acute Myocardial Infarction, Heart Failure, and Pneumonia: Update on Publicly Reported Outcomes Measures Based on the 2013 Release, *J Gen Intern Med,* 29(10) 1333-40. doi: 10.1007/s11606-014-2862-5

van der Wal, J.H., Jaarsma, T., Moser D.K., Veeger, N.J.G.M., van Gilst, W.H., van Veldhuisen, D.J. (2006) Compliance in heart failure patients: the importance of knowledge and beliefs. *European Heart Journal,* 27, 434-440. doi:10.1093/eurheartj/ehi603

Wang, H., Robinson, R.D., Johnson, C., Zenarosa, N.R., Jayswal, R.D., Keithley, J., Delaney, K.A. (2014) Using the LACE index to predict hospital readmissions in congestive heart failure patients. *BMC Cardiovascular Disorders,* 2014, 14:97

World Health Organization: World Report on Ageing and Health Summary (2015) Retrieved from: http://www.who.int/ageing/events/world-report-2015-launch/en/

Wright, S.L., Persad, C. (2007) Distinguishing between depression and dementia in older persons: Neuropsychological and Neuropathological Correlates, *Journal of Geriatric Psychiatry and Neurology*, 20:4. Doi: 10.1177/0891988707308801