2017

Association of Provider Communication and Inpatient Hospital Readmissions

Jeremy Dean Faulkenburg
University of South Carolina

ASSOCIATION OF PROVIDER COMMUNICATION AND INPATIENT HOSPITAL READMISSIONS

by

Jeremy Dean Faulkenburg

Bachelor of Science
Limestone College, 2007

Master of Business Administration
Winthrop University, 2009

Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Public Health in

Health Services Policy and Management

The Norman J. Arnold School of Public Health

University of South Carolina

2017

Accepted by:

Zaina Qureshi, Major Professor

Ronnie Horner, Committee Member

Robert Valois, Committee Member

Cheryl L. Addy, Vice Provost and Dean of the Graduate School

DEDICATION

To my mother, Lisa Veatch, who was always my greatest champion.

“I love you more.”

ACKNOWLEDGEMENTS

I would like to thank the members of my dissertation committee who have gone above and beyond what anyone could ask of them. I am truly grateful for their suggestions and guidance in the completion of this study. I could not ask for more supportive and encouraging members. I will be forever grateful for your input and assistance.

I would also like to thank my wife, Catherine, and our wonderful children, Harrison, Clark, Reid, and Stella Rose, for your support throughout these years. I love you all!

ABSTRACT

Introduction: Inpatient hospital readmission rates represent an important clinical and economic problem. Clinical interventions have shown significant decreases in preventable readmissions, but are costly to implement. Another approach is to better equip patients with the knowledge and resources to manage their care after discharge. Patients receive instruction from both nurses and physicians, as well as information pertaining to post-discharge care and instructions for care while at home. This study examines the association between provider communication and inpatient hospital readmissions.

Methods: This study used survey data from the 2013 and 2014 Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). The sample included all inpatient facilities (n=4,063) for demographic and patient experience data, and a subset (n=MIN 1,906 MAX 2,283) of facilities where hospital acquired infections data were available. Shapiro-Wilk test and ordinary least squares (OLS) regression analysis were performed to analyze the data. The key communication variables tested were Nurse Communication, Physician Communication, Information for Recover, and Understood Care for Recovery.

Results: Physician Communication, and Information for Recovery were found to have significant association with readmission rates, while Nurse Communication and Understood Care for Recovery were found not significantly associated with readmissions. Physician Communication was found to have a negative correlation with readmissions (β=

-0.032, 95% CI -0.053 - -0.011, $p < .003$), as did Information for Recovery ($\beta = -0.062$, 95% CI -0.082 - -0.043, $p < .000$).

Conclusions: Physician Communication is directly tied to a decrease in readmissions, with each percentage point (scale of 0 to 100) where patients identify the physician communication well relating to a decrease of .032% in inpatient 30-day readmission rates. Patients who indicate they had proper information for recovery at home were found to have a significant decrease of .062% in admissions using the same scale.

One additional finding in the study that was not part of the study, yet warrants future research, is the significant positive correlation between methicillin-resistant staphylococcus aureus infections (MRSA) and readmissions. Each 1% increase in MRSA rates resulted in an increase in readmissions by 0.11%. Also of note is the positive correlation between bed size and readmissions with each bed increasing readmissions by .001% and the significant indicator of facilities in the Northeast having a .772% increase in readmissions

While the findings were all statistically significant, with p-values well below 0.05 for the discussed variables, one limitation of this study is the R2 value. With the infection rates and hospital demographic information added into the regression, the R2 maxed out at 0.2490 with an adjusted R2 of 0.2386. However, many studies for behavioral sciences, including Jacob Cohen's widely-cited 1988 study, found an R2 of .13 to be the minimum required to explain a moderate effect and .26 to explain a large effect, giving this study's outcomes considerable explanatory power.

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LIST OF ABBREVIATIONS

ACA ..... Affordable Care Act

CAUTI ..... Catheter-Associated Urinary Tract Infection

CLABSI ..... Central Line-Associated Blood Stream Infection

CMS ..... Centers for Medicare and Medicaid Services

HCAHPS ..... Hospital Consumer Assessment of Healthcare Providers and Systems

MRSA ..... Methicillin-Resistant Staphylococcus Aureus infection

RRP ..... Readmissions Reduction Program

CHAPTER 1

INTRODUCTION

1.1 RATIONALE FOR STUDY

Inpatient hospital readmission rates represent an important clinical and economic problem. High readmission rates indicate that hospitals might have failed to provide either the correct clinical care or the correct post-discharge information to a patient; in either case, hospitals open themselves to legal liability (Kessler & McClellan, 2002) and also fail to execute their mission of care (Berkowitz et al., 2013; Polster, 2015; White, Garbez, Carroll, Brinker, & Howie-Esquivel, 2013; Zapatero et al., 2013). High readmission rates represent an economic problem for patients and hospitals, insofar as readmitted patients lose time from work and also represent avoidable costs to an already heavily burdened American healthcare system (Whitehouse, Friedman, Kirkland, Richardson, & Sexton, 2002). Therefore, the Centers for Medicare and Medicaid hold health systems with high readmission rates financially accountable (Zapatero et al., 2013).

Hospitals take numerous steps to reduce avoidable readmissions (Avram, Petruccelli, Winemaker, & de Beer, 2014). The two most important and relevant steps are to (a) ensure a high quality of clinical care during hospitalization and (b) better equip patients with the knowledge and other resources necessary to manage their care after discharge. Of these steps, clinical care improvement is more expensive to achieve. Improvements in clinical care might require hospitals to expand their physician staff

levels, purchase expensive equipment, or otherwise increase spending in a manner likely to improve treatment and thereby lower readmission rates.

By contrast, taking steps to better equip patients with the knowledge and other resources necessary to manage their care after discharge is simpler and less expensive (Bodenheimer, Wagner, & Grumbach, 2002). After discharge, and depending on the nature of the underlying medical complaint or complaints, patient outcomes are largely dependent on the patient's own behaviors—such as taking medicine at the appropriate times, engaging in the appropriate dietary practices, obtaining appropriate levels of exercise, reducing stress, and so forth. Some patients are more informed than others about how to engage in appropriate self-care; however, in many cases, patients need specialized guidance from healthcare authorities, especially nurses and physicians, about how to best take care of themselves after discharge (Ditewig, Blok, Havers, & van Veenendaal, 2010).

Therefore, in theory, there would appear to be a significant link between both the quantity and quality of communication between healthcare personnel and patients and the outcomes experienced by patients, as measurable by variables such as the readmission rate. However, the link between the quantity and quality of communication between healthcare personnel and patients and the outcomes obtained by patients appears to have been measured largely in the context of local and regional data (Jaarsma et al., 1999; Lazarus & Hamlyn, 2005; Williams & Fitton, 1988), preventing scholars from estimating the nationwide magnitude of the relationship, if any, between communication and readmission rates. This absence of information constitutes the main problem addressed in the study.

There is not yet a scholarly consensus on the statistical significance and magnitude of the relationship between communication and readmission rates considered in light of nationwide data, as opposed to local or regional hospital data. The existing studies, as described and discussed in the second chapter, report the existence of a relationship, but not on the basis of national data. In the absence of such information, hospitals do not know the extent to which improvements in the communication training of personnel should be prioritized in their attempts to reduce readmission rates. Therefore, in terms of building a business case for improving communication, hospitals could benefit from knowing that there are national, as well as local studies where, correlations between good communication and lower readmission rates. Separately, high readmission rates continue to be a problem in hospitals, particularly in the United States (Forster, Murff, Peterson, Gandhi, & Bates, 2003), where the overall readmission rate is over 15% (Avram et al., 2014). To the extent that high admission rates could be reduced through communication improvement, the low quality of communication can also be considered as a discrete problem in the study.

The purpose of this quantitative, survey-based, secondary research study was to measure the relationship between communication and readmission rates on the basis of data from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). This purpose was achieved through an ordinary least squares regression model whose dependent variable was readmission rate; whose independent variables were key dimensions of provider-patient communication: the percentage of patients who reported that their nurses always communicated well (Comp1_AP), the percentage of patients who reported that their physicians always communicated well (Comp2_AP), the

percentage of patients who reported that they were given information about what to do during their recovery at home (Comp6_YP), and the percentage of patients who strongly agreed that they understood their care when they left the hospital (Comp7_SA); and whose covariates were proxy indicators of hospital quality of care: the percentage of patients who reported that their room and bathroom were always clean (Clean_AP), the percentage of patients who gave their hospital a rating of 9 or 10 on a scale from 0 (lowest) to 10 (highest) (Rating_910), the percentage of patients who agreed that the area around their room was always quiet at night (Quiet_AP), whether or not a hospital provided emergency services (Emergency_Services), whether a hospital was an acute care hospital or a critical care hospital (Hospital_Type), and whether a government was government-owned, physician-owned, proprietary, or voluntary non-profit (Hospital_Ownership).

1.2 THEORETICAL MODEL

Hypothesizing a negative correlation between communication (either in terms of quantity or quality) and readmission rates requires an appropriate theoretical basis to inform and justify empirical analysis. The theoretical framework of this study is Orem's self-care theory (Orem, 1991). According to Orem, most people are strongly motivated to care for themselves to the extent rendered possible by their ordinary level of health and other strengths and limitations. Thus, according to Orem, the ultimate goal of healthcare ought to be return the patient to a realistic and usual level of self-care. Orem's theory implicitly assumes that, because patients are equally motivated to achieve an appropriate standard of self-care, the failure of such self-care—as reflected in avoidable readmission to the hospital—is likely to be due to either (a) the hospital's initial failure to take the

clinical steps necessary to return the patient to self-care or (b) the hospital's subsequent failure to inform patients about how they can best care for themselves after discharge.

The use of a dataset such as HCAHPS has limitations in that it is not possible to directly measure the quality of inpatient care. However, HCAHPS' overall patient rating of hospitals (the Rating_910 variable) along with other covariates provide some level of proxy measurement of overall inpatient quality of care, and the communication quality variables in HCAHPS are of sufficient usefulness to counterbalance the absence of clinical information. Thus, HCAHPS can be utilized to test a key aspect of Orem's (1991) theory, namely the prediction that improved communication will lead to improved patient self-care after discharge, ultimately resulting in a lower readmission rate. Therefore, Orem's self-care theory was adopted as an appropriate theoretical framework for the current study.

1.3 RESEARCH QUESTIONS

The intent of this study is to investigate the possible association in the well-documented problem of high readmission rates in American hospitals and to examine the application of reducing these rates through improving communication quantity and quality between hospital personnel and patients about to be discharged. The theoretical basis of this relationship is grounded in Orem's self-care theory (Orem, 1981). The main identified gap in the literature was the absence of measurement of the relationship between communication in healthcare settings and readmission rates as calculated on the basis of national-level data rather than local or regional data, less likely to be generalizable.

The four research questions and associated hypotheses of the study are as follows:

Research Question 1: Is there a statistically significant and inverse relationship between quality of nurse communication and the readmission rate, after controlling for patient perceived cleanliness of hospital, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate?

Hypothesis 1: There is a statistically significant relationship and inverse between quality of nurse communication and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate.

Research Question 2: Is there a statistically significant and inverse relationship between quality of physician communication and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate?

Hypothesis 2: There is a statistically significant and inverse relationship between quality of physician communication and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate.

Research Question 3: Is there a statistically significant and inverse relationship between information for recovery and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate?

Hypothesis 3: There is a statistically significant relationship and inverse between information for recovery and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, and hospital ownership, and hospital-acquired infection rate.

Research Question 4: Is there a statistically significant and inverse relationship between understanding care for recovery and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate?

Hypothesis 4: There is a statistically significant and inverse relationship between understanding care for recovery and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate.

The level of statistical significance for hypothesis testing purposes was .05.

1.4 FORMAT OF THE DISSERTATION

The second chapter contains the review of literature relevant to the study topic. In Chapter 2, particular attention has been paid to both theoretical considerations and previous empirical findings related to the topic of study. The third chapter contains a description and defense of the relevant elements of study methodology and design, with particular attention paid to the use of a qualitative methodology and survey-based research design grounded in secondary research. The fourth chapter consists of the empirical findings of the study as derived from the HCAHPS database. These findings are presented through the use of both ordinary least squares and robust standard error

regressions, and they also include log-transformed data to render the regression findings more reliable in terms of meeting the assumption of heteroscedasticity. The fifth and concluding chapter of the study contains a summary of the findings in terms of a hypothesis-testing table, a discussion of the findings, an acknowledgement of study limitations, and suggestions for improved hospital practice on the basis of study findings.

CHAPTER 2

LITERATURE REVIEW

2.1 PREVENTABLE READMISSIONS

The federal government estimates nearly 20% of elderly patients who have been hospitalized are readmitted within 30 days of their discharge (Goodman, Fisher & Chang, 2013). Some of these subsequent admissions are associated with elements of the preventive treatment plan that may not have been adhered to by the patient or closely monitored by hospital personnel. Yet, other cases of readmission are not easily identifiable and, therefore, much more difficult to prevent. In many cases, discharged patients return home only to face new and unexpected challenges as they are no longer under supervised care by a healthcare professional. Whether preventable or not, these readmissions are not only burdens on the patients, but result in significant additional spending in healthcare dollars (Navarro, Enguídanos & Wilber, 2012).

There are numerous contributing factors to unnecessary hospital readmissions though the majority can be attributed to a single root cause- the American healthcare system is heavily fractured with little continuum of care and often leaves the discharged patients struggling to take care of themselves (Goodman, Fisher & Chang, 2013).

The Centers for Medicare and Medicaid Services (CMS) estimate the cost of preventable readmission at $26 billion each year for patients in the Medicare program alone. Of this amount, it is further estimated that nearly $17 billion (65%) is attributable to readmissions that could have been avoided if discharged patients had followed proper

post-discharge care instructions (Goodman, Fisher & Chang, 2013). Failure to adhere to post-discharge instructions is not only the costliest of factors, but also accounts for the majority of readmissions in volume, although Goodman et al. (2013) did not quantify this effect. In an effort to reduce preventable readmissions, CMS has begun penalizing hospitals with high rates of readmissions or their failure in providing quality care to patients, particularly focusing on original discharges for those patients with pneumonia, heart attack, and heart failure (Lindenauer et al., 2011).

Reducing these avoidable readmissions has been an ongoing initiative for numerous years, but was finally pushed to the forefront with passing of the Affordable Care Act. A key provision of the ACA was the Readmissions Reduction Program (RRP) (Blumenthal, Abrams & Nuzum, 2015). The RRP initiative armed CMS with new powers to impact reimbursement to hospitals based on readmission rates. The payment reductions for readmissions began in 2014 and that year saw 2,600 hospitals forfeit approximately $428 million of inpatient revenue from CMS for failure to meet the threshold for 30-day readmissions. On average, fines represented about 0.6% of the total payments by Medicare. However, approximately 500 hospital facilities were faced with cuts greater than 1% (Blumenthal, Abrams & Nuzum, 2015).

Another CMS initiative is Partnership for Patients, which in addition to consumer education has an objective of reducing preventable hospital readmissions by 80% of their 2010 levels. The Partnership for Patients initiative focuses on providing guidelines to assist healthcare providers in learning how to collaborate with patients on treatment plans, increase communication and allow for streamlined transition of care plans when

transferring facilities. By 2013, Partnership for Patients was more than halfway successful in its goal (NCHA, 2013).

These initiatives have proven successful and readmissions have decreased in 49 states from 2008 to 2014, with Vermont being the lone state to see increases in preventable readmissions, though the increase was miniscule at less than a tenth of a percent (Whitman, 2016). Eleven states have seen decreases in preventable readmissions in the double-digits, with New Jersey and Hawaii leading the way with 13.4% and 13.3%, respectively (HCPro, 2016).

Significant decreases in readmissions have been realized by many facilities that have instituted greater communication with recently discharged patients. Kaiser Permanante saw decreases of nearly 20% when they began proactively reaching out to discharged patients via telephone calls during the first week after leaving the hospital. Similarly, the State of Michigan via teams of social workers to perform home visits and follow-up calls to discharged Medicaid patients has seen decreases in preventable readmissions of 17% (Linden, et al., 2014).

2.2 HOSPITAL CONSUMER ASSESSMENT OF HEALTHCARE PROVIDERS AND SYSTEM (HCAHPS)

The earliest known instance of patient surveys was carried out by Abraham Flexner in the early 1900's, in what would eventually become the American Medical Association's first report on poor quality of health care facilities in 1910 (Forrestor, 1986). Independently, Earnest Codman would incorporate patient feedback into his "end result idea" in the 1910s that furthered the concept of using the opinion and feedback of patients in improving the quality of health care (MacGee, et al., 1993). The driving force

of improving the quality of care in International Health service became a major priority in the 1970s, specifically with the World Health Assembly's result to enhance "Health for All" by the year 2000 (MacGee et al, 1999).

The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) is the most widely used survey in the United States and seeks to examine patient's perspective of hospital care. The survey, which is also known as the CAHPS Hospital Survey, asks consumers and patients to report on their experiences following discharge from an inpatient facility. The survey focuses on topics that are important to consumers and quality metrics that are easy to assess, ranging from communication methods of providers and accessibility of health services from different providers. Originally, HCAHPS stood for the Hospital Consumer of Health Plans Study, but has evolved overtime to ensure it includes a wider range of entities (Enyimma, 1988). To increase the usefulness of the survey, all findings of the HCAHPS survey are made available and readily accessible via public domain enabling individuals to download and utilize in the assessment of their health care experiences.

The HCAHPS survey consists of 32 questions that measure perceptions of patients who are randomly recruited for participation in the survey. Although many hospitals had previously gathered information on patient satisfaction for their individual use, since its introduction in 2008, HCAHPS has provided a common metrics and national standards to be used in the collection and public reporting of information in regard to patient experience in health care. The use of such a standardized system also allows for enhanced comparison of hospitals both locally and nationally.

HCAHPS is based on three broad goals which include standardizing and implementing protocols to ensure that data produces objective and meaningful comparisons of hospitals based on subject areas that matter most to both patients and consumers (Coldstein et al 2005). The survey works under the principles of enabling patients to report on actual experiences. It focuses on aspects of quality by assuming that individuals who received care are the best source of information. As such, it does not gather information through other means or sources such as electronic medical records or provider reporting (Bender & Garfinkel, 2000).

The public nature of the survey results provides many incentives for hospitals to improve their quality of care, or at least the patient's perspective of such. Additionally, public reporting improves the level of accountability and transparency by enabling comparison on the quality of care provided, something that many facilities would not do independently. Hospitals and health facilities that invest in the completion of the HCAHPS process will be better equipped to meet their mission, protect their bottom line, and enhance their reputation as well as improve patient care by being more dedicated to offering safe, quality initiatives that align with the findings of the survey (Enyimma, 1988).

CHAPTER 3

METHODOLOGY

3.1 STUDY DESIGN

The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) is the most widely used survey in the United States and seeks to examine patient's perspective of hospital care nationally. As an annual, cross-sectional survey, also known as the CAHPS Hospital Survey, it asks consumers and patients to report on their experiences following discharge from an inpatient facility. Conducted by the Agency for Healthcare Research and Quality, the survey focuses on topics important to consumers and quality metrics that are easy to assess, ranging from communication methods of providers and accessibility of health services from different providers. To increase usefulness of the survey, all findings of the HCAHPS survey are made available and readily accessible to the public domain enabling citizens to download and use these data in their assessment of health care experiences. This allows stakeholders to utilize the data to make informed decisions. Individuals such as patients, quality monitors and regulators, health plans, community collaboratives, and buyers of health care packages have proven to benefit the most from the HCAHPS surveys.

The goal of this study is to characterize the relationship between patient-provider communication and hospital readmission rates. This goal can be achieved quantitatively, as the variables of communication and hospital readmission are both numerically defined,

and the ability of communication to predict readmission rates is an explicitly mathematical relationship. Thus, a quantitative methodology was chosen for the study. In addition, the study can be completed efficiently owing to previously collected data and dissemination in a survey format by HCAHPS. Consequently, the study is a secondary analysis rather than primary in nature, as no original data collection was conducted.

3.2 VARIABLES FROM HCAHPS DATASET

Within the HCAHPS dataset, the following variables were utilized. Missing values associated with each variable were omitted from analysis.

DEPENDENT VARIABLE

- Readmission rate (dependent variable, ratio). The readmission rate was measured as a ratio—specifically, a percentage—variable bounded between a theoretical minimum of 0 and a theoretical maximum of 100. A hospital that reported a readmission rate of 0 would have had 0% of its patients readmitted within 30 days, while a hospital that reported a readmission rate of 100 would have had 100% of its patients readmitted within 30 days.

KEY COMMUNICATION VARIABLES

- Comp1_AP (independent variable, ratio): The percentage of patients who reported that their nurses always communicated well. To help with ease of reading, this may be referenced as "Nurse Communication" throughout the remainder of this paper.
- Comp2_AP (independent variable, ratio): The percentage of patients who reported that their physicians always communicated well. To help with ease of reading, this may be referenced as "Physician Communication" throughout the remainder of this paper.

- Comp6_YP (independent variable, ratio): The percentage of patients who reported that they were given information about what to do during their recovery at home. To help with ease of reading, this may be referenced as "Information for Recovery" throughout the remainder of this paper.
- Comp7_SA (independent variable, ratio): The percentage of patients who strongly agreed that they understood their care when they left the hospital. To help with ease of reading, this may be referenced as "Understood Care for Recovery" throughout the remainder of this paper.

CONTROL VARIABLES

- Clean_AP (independent variable, control variable, ratio): The percentage of patients who reported that their room and bathroom were always clean. To help with ease of reading, this may be referenced as "Clean Facilities" throughout the remainder of this paper.
- Rating_910 (independent variable, control variable, ratio): The percentage of patients who gave their hospital a rating of 9 or 10 on a scale from 0 (lowest) to 10 (highest). To help with ease of reading, this may be referenced as "High Hospital Rating" throughout the remainder of this paper.
- Quiet_AP (independent variable, control variable, ratio): The percentage of patients who agreed that the area around their room was always quiet at night. To help with ease of reading, this may be referenced as "Quiet Hospital" throughout the remainder of this paper.
- Emergency_Services (independent variable, control variable, categorical / dichotomous): Whether or not a hospital provided emergency services (1=yes, 0=no).

- Hospital_Type (independent variable, control variable, categorical / dichotomous): Whether a hospital was an acute care hospital or a critical care hospital.
- Hospital_Ownership (independent variable, control variable, categorical / polytomous): Whether a government was government-owned, physician-owned, proprietary, or voluntary non-profit.
- MRSA (independent variable, control variable, ratio): The standardized infection ratio of all methicillin-resistant staphylococcus aureus infections acquired at the hospital.
- CAUTI (independent variable, control variable, ratio): The standardized infection ratio of all catheter-associated urinary tract infections acquired at the hospital.
- CLABSI (independent variable, control variable, ratio): The standardized infection ratio of all central line-associated bloodstream infections acquired at the hospital.

3.3 VARIABLES FROM PROVIDER OF SERVICES DATASET

Within the CMS Provider of Services dataset, the following variables were utilized. Missing values associated with each variable were omitted from analysis.

CONTROL VARIABLES

- Beds (independent variable, control variable, count): The number of beds certified for inpatient stays at the hospital.
- Region (independent variable, control variable, categorical / polytomous): The region of the United States that each hospital is located in, based regional mapping from the US Census Bureau.
- Rural (independent variable, control variable, categorical / dichotomous): Whether or not a hospital is located in a rural setting.

3.4 DATA ANALYSIS

Data analysis has been discussed separately for each research question of the study. It should be noted that Stata / SE 14.2 was utilized for all data analysis and graph generation in the study. In addition, the regression type chosen for each of the research questions of the study was Ordinary Least Squares Regression.

Research Question 1:

The first research question was as follows: Is there a statistically significant and inverse relationship between quality of nurse communication and the readmission rate, after controlling for patient perceived cleanliness of hospital, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate? The null hypothesis of the first research question was that there was not a statistically significant relationship and inverse between quality of nurse communication and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate.

The first research question was answered by measuring the *p* value of Nurse Communication, treated as a predictor, when the variable of Nurse Communication and the other predictors were regressed on the dependent variable of readmission rate. If the *p* value of Nurse Communication was observed to be below .05, then the null hypothesis of the first research question would be rejected.

Research Question 2:

The second research question was as follows: Is there a statistically significant and inverse relationship between quality of physician communication and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital,

the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate?

The null hypothesis of the second research question was that there was not a a statistically significant and inverse relationship between quality of physician communication and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate. The second research question was answered by measuring the *p* value of Physician Communication, treated as a predictor, when other predictors were regressed on the dependent variable of readmission rate. If the p value of Physician Communication was observed to be below .05, then the null hypothesis of the second research question would be rejected.

Research Question 3:

The third research question was as follows: Is there a statistically significant and inverse relationship between information for recovery and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate? The null hypothesis of the third research question was that there was not a statistically significant relationship and inverse between information for recovery and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, and hospital ownership, and hospital-acquired infection rate.

The third research question was answered by measuring the p value of Information for Recovery, treated as a predictor, when other predictors were regressed on the dependent variable of readmission rate. If the *p* value of Information for Recovery

was observed to be below .05, then the null hypothesis of the third research question would be rejected.

Research Question 4:

The fourth research question was: Is there a statistically significant and inverse relationship between understanding care for recovery *and readmission* rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate?

The null hypothesis of the fourth research question was that there was not a statistically significant and inverse relationship between understanding care for recovery and the readmission rate, after controlling for hospital cleanliness, patient rating of the hospital, the presence of emergency services, hospital type, hospital ownership, and hospital-acquired infection rate.

The fourth research question was answered by measuring the *p* value of Understood Care for Recovery, treated as a predictor, when the other predictors were regressed on the dependent variable of readmission rate. If the *p* value of Understood Care for Recovery was observed to be below .05, then the null hypothesis of the fourth research question would be rejected.

3.5 ASSESSMENT OF MODEL ASSUMPTIONS

A number of steps were taken to ensure that the underlying statistical assumptions of modeling were met above. First, normality testing was carried out (using the Shapiro-Wilk statistic) to ensure the normality of distribution of the variables (Altman, 1991; Jackson, 2015; Kremelberg, 2010; Moore & McCabe, 2009; Natrella, 2013; Oja, 1983;

Vogt & Johnson, 2011). Second, the appropriateness of the ordinary least squares regression models was tested through the use of heteroscedasticity testing in the Breusch-Pagan / Cook-Weisberg test (Li & Valliant, 2015). Third, multicollinearity testing was utilized to ensure the correct inclusion of predictor variables in the regression models. Fourth, log-transformation and robust standard errors regression were utilized in order to address any detected problems of heteroscedasticity in ordinary least squares regression. Because the HCAHPS data are aggregated data, standard measurements of reliability testing (such as the calculation of Cronbach's α) and validity testing (such as principal components analysis) cannot be carried out on these data. Therefore, the only reliability and validity testing procedures that are available for HCAHPS data are those procedures that can be applied to address specific statistical problems, such as the problem of heteroscedasticity as it arises in the context of ordinary least squares regression. In the absence of individual-level data from HCAHPS, no other forms of reliability or validity testing are possible.

One concern related to the validity of survey-based study findings is the relationship between the sample and the population. In the case of HCAHPS, data are obtained from over 4,000 American hospitals. Hospitals themselves make HCAHPS surveys available to every inpatient; thus, the sample of HCAHPS respondents is random, because every participant had an equal chance of being included in the study. Cumulatively, 1.1 million patients per year complete HCAHPS surveys. In this study, the entire HCAHPS dataset—not a subset thereof—was utilized. Therefore, results of the study apply to the entire HCAHPS dataset, and, because of close overlap between HCAHPS and all American hospitals, the entire American healthcare system as well.

3.6 ETHICAL ISSUES

Because HCAHPS data are made publicly available by the US government, there were no ethical issues pertaining to obtaining permission for data use. The HCAHPS data identify hospitals by name; however, the HCAHPS data do not identify any individual patients or personnel in hospitals. Thus, the HCAHPS maintains both privacy and anonymity of individuals while disclosing the performance levels of individual hospitals—a level of transparency to which hospitals agree. Because of the use of HCAHPS data within a secondary research approach, the current study did not have to manage ethical issues related to data collection or data use.

CHAPTER 4

RESULTS

The results are presented in two sections. First, descriptive statistics and normalcy tests for all variables have been presented. Second, the research questions of the study have been answered through the application of ordinary least squares (OLS) regression.

4.1 DESCRIPTIVE STATISTICS AND NORMALCY TESTS

Table 4.1 contains basic descriptive statistics for the twelve variables of the study that were continuous. Four of these variables (clabsi, cauti, mrsa, and beds) were used in subsequent models in an effort to increase explanatory power.

Table 4.1. Descriptive Statistics of Ratio Variables

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Readmissions	4,063	15.2274	0.8688	11	19.8
Nurse Communication	4,063	79.1718	5.4714	54	100
Physician Communication	4,063	81.7367	5.1960	60	100
Received Information	4,063	86.0396	4.4003	49	100
Understood Information	4,063	51.8833	7.0532	23	100
CLABSI	2,006	0.4973	0.5194	0	4.213
CAUTI	2,283	1.0619	0.9165	0	6.957
MRSA	1,906	0.9148	0.8310	0	10.04
Clean Facilities	4,063	73.6416	7.6574	42	100
Quiet Hospital	4,063	61.5228	9.9336	25	100
Overall Hospital	4,063	70.8184	8.8458	37	100
Number of Beds	4,650	175.7176	213.9010	2	2449

In addition, the Shapiro-Wilk test of normalcy was conducted on all continuous variables in the study. Results, presented in Table 2 below, indicate that no continuous

variables in the study were, at an α of .05, normally distributed. The non-normality of the data strongly suggested the use of log-transformation if heteroscedasticity proved to exist in the OLS models for the study.

Table 4.2. Normalcy of the Continuous Variables

Shapiro-Wilk W test for normal data

Variable	**Obs**	**W**	**V**	**z**	**Prob>z**
Readmissions	4,063	0.97458	57.214	10.549	0
Nurse Communication	4,063	0.98857	25.736	8.466	0
Physician Communication	4,063	0.99291	15.958	7.22	0
Received Information	4,063	0.93903	137.243	12.829	0
Understood Information	4,063	0.97585	54.358	10.415	0
CLABSI	2,006	0.87011	154.465	12.822	0
CAUTI	2,283	0.93758	83.489	11.31	0
MRSA	1,906	0.88743	127.791	12.316	0
Clean Facilities	4,063	0.99509	11.043	6.261	0
Quiet Hospital	4,063	0.99478	11.75	6.423	0
Overall Hospital	4,063	0.99428	12.872	6.66	0
Number of Beds	4,650	0.72625	695.264	17.132	0

4.2 IMPORTANCE OF COMMUNICATION ON READMISSIONS

Results of the first OLS regression are presented in Table 4.3 below. The regression's dependent variable was readmission rate; the eight continuous predictors were High Nurse Communication, High Physician Communication, Information for Recovery, Understood Care for Recovery, Clean Facilities, High Hospital Rating, and Quiet Hospital. In addition, dummy variables were generated for hospital types (acute and critical), hospital ownership (physician, proprietary, government, and voluntary non-profit), and whether or not emergency services existed in the hospital. Thus, there were 14 predictors in the first OLS model. The correlation table appears below.

Table 4.3. Correlation Matrix

	Readmissions	Nurse Communication	Physician Communication
Readmissions	1		
Nurse Communication	-0.22	1	
Physician Communication	-0.2105	0.6978	1
Received Information	-0.3347	0.6383	0.435
Understood Information	-0.2883	0.7692	0.6366
CLABSI	0.0987	-0.0709	0.0176
CAUTI	-0.009	0.0006	0.0318
MRSA	0.1672	-0.1009	-0.0419
Clean Facilities	-0.2076	0.605	0.4117
Quiet Hospital	-0.0636	0.4279	0.5552
Overall Hospital	-0.3084	0.7894	0.6433
Voluntary Non-Profit	-0.0899	-0.0876	-0.1061
Proprietary Ownership	0.0654	0.1168	0.1311
Physician Owned	0.0488	0.0517	0.0792
Government Owned	0.0376	-0.0079	-0.0051
Critical Care	-0.0457	0.0471	0.0568
Emergency Room	0.0457	-0.0471	-0.0568
Region	-0.1218	-0.2396	-0.0665
Rural Hospital	-0.0479	0.0197	0.0868
Number of Beds	0.1641	-0.0102	0.0095

	Received Information	Understood Information	CLABSI
Received Information	1		
Understood Information	0.6662	1	
CLABSI	-0.1603	-0.1162	1

	Received Information	Understood Information	CLABSI	CAUTI
CAUTI	-0.016	0.0244	0.2186	1
MRSA	-0.1511	-0.114	0.1477	0.0354
Clean Facilities	0.3763	0.5235	-0.0257	-0.05
Quiet Hospital	0.1806	0.398	0.0768	-0.0389
Overall Hospital	0.6348	0.8427	-0.1128	0.0478
Voluntary Non-Profit	-0.023	-0.0727	-0.026	0.0361
Proprietary Ownership	0.1272	0.1209	-0.0052	0.0785
Physician Owned	0.0308	0.0324	-0.0024	-0.0356
Government Owned	-0.0853	-0.0236	0.0346	-0.0969
Critical Care	0.0496	0.0613	-0.0181	0.0058
Emergency Room	-0.0496	-0.0613	0.0181	-0.0058
Region	-0.1741	-0.0967	0.0099	0.0243
Rural Hospital	0.0198	-0.0321	0.0075	-0.0996
Number of Beds	-0.0301	0.0939	-0.0127	0.1113

	MRSA	Clean Hospital	Quiet Hospital	Overall Hospital
MRSA	1			
Clean Facilities	-0.1444	1		
Quiet Hospital	0.0599	0.3567	1	
Overall Hospital	-0.1333	0.5706	0.466	1
Voluntary Non-Profit	-0.038	-0.0277	-0.2435	-0.0588
Proprietary Ownership	0.0277	-0.0185	0.089	0.0663
Physician Owned	0.0309	0.0146	0.0666	0.0172
Government Owned	0.0133	0.0433	0.1898	0.0089
Critical Care	-0.0252	0.0546	0.0401	0.0643
Emergency Room	0.0252	-0.0546	-0.0401	-0.0643
Region	0.0537	-0.1418	-0.0134	-0.049
Rural Hospital	-0.0131	0.1038	0.0678	-0.0788
Number of Beds	0.0078	-0.1401	0.0098	0.1192

	Voluntary Non-Profit	Proprietary Ownership	Physician Owned	Government Owned
Voluntary Non-Profit	1			
Proprietary Ownership	-0.5074	1		
Physician Owned	-0.1314	-0.0427	1	
Government Owned	-0.6983	-0.2268	-0.0587	1
Critical Care	0.0119	-0.0024	-0.0107	-0.0091
Emergency Room	-0.0119	0.0024	0.0107	0.0091
Region	0.3156	-0.2414	0.0458	-0.1752
Rural Hospital	-0.0004	0.0479	0.0448	-0.0497
Number of Beds	0.0065	-0.0027	0.0351	-0.0138

	Critical Care	Emergency Room	Region	Rural Hospital	Number of Beds
Critical Care	1				
Emergency Room	-1	1			
Region	0.025	-0.025	1		
Rural Hospital	-0.029	0.029	0.0013	1	
Number of Beds	-0.0523	0.0523	-0.0433	-0.1635	1

The first OLS model was significant, $F(12, 4{,}050) = 44.21$, $p < .0001$. Eleven of the predictors were significant at an α of .05; the predictors of emergency services and physician-owned hospitals were omitted because of collinearity. The coefficient of determination of the regression was .1158, indicated that 11.58% of the variation in the dependent variable of admission rate was predicted through variation in the chosen independent variables in the first regression. Thus, the explanatory power of the first regression was somewhat low, even though the regression was statistically significant. Unfortunately, because only hospital-level data were tracked in HCAHPS, and because the hospitals in the dataset do not appear to be provide further details about their clinical

measures, the explanatory power of the regression could not be expanded by adding other hospital-level predictors.

Table 4.4. OLS Regression Results

Source	SS	df	MS
Model	355.063	12	29.588
Residual	2710.823	4,050	0.669
Total	3065.885	4,062	0.755

Number of obs	4,063
F (14, 1755)	44.21
Prob > F	0.0000
R-squared	0.1158
Adj R-squared	0.1132
Root MSE	0.81813

Readmissions	Coef.	Std. Err.	t.	P>|t|	95% Lower	95% Higher
Nurse Communication	0.011	0.005	2.280	0.023	0.002	0.020
Physician Communication	-0.008	0.004	-2.000	0.046	-0.016	0.000
Received Information	-0.034	0.004	-9.060	0.000	-0.041	-0.026
Understood Information	-0.002	0.003	-0.730	0.468	-0.009	0.004
Clean Facilities	-0.007	0.002	-2.930	0.003	-0.012	-0.002
Overall Hospital	-0.018	0.003	-6.700	0.000	-0.023	-0.013
Quiet Hospital	0.004	0.002	1.960	0.050	0.000	0.007
Acute Hospital	-0.049	0.036	-1.370	0.170	-0.120	0.021
Critical Care	-0.160	0.070	-2.300	0.021	-0.297	-0.024
Government Owned	-0.520	0.118	-4.440	0.000	-0.749	-0.290
Proprietary Ownership	-0.373	0.117	-3.160	0.002	-0.604	-0.142
Voluntary Non-Profit	-0.587	0.115	-5.100	0.000	-0.812	-0.361
Constant	20.192	0.377	53.580	0.000	19.453	20.931

note: emergency and physician variables were omitted due to collinearity

The first regression was heteroscedastic, $\chi^2 = 56.81$, $p < .001$ (note that the null assumption of the Breusch-Pagan Cook-Weisberg test is homoscedasticity, so rejecting

the null means that errors were heteroscedastic). The heteroscedasticity of the regression might be resolved through log-transformation of the independent variables; however, this log-transformation was only carried out after further fine-tuning and interpretation of the original regression.

A second model was created by expanding the original to include hospital acquired infection rates at the hospital level. The infection rates included CAUTI, CLABIS, and MRSA.

Without the addition of three infection rates, three of the four types of communication were identified as significant predictors of readmission. These three communication types remained significant predictors with the inclusion of the infection rates. Of the infection types, MRSA infections were significant. Each 1% increase in the MRSA infection rate was associated with a 0.12% increase in the readmission rate, suggesting that hospital-acquired MRSA infections influenced readmissions. It should be noted that the addition of the covariates of infection rate raised the R^2 of the original regression for RQ1 from .1158 to .1815, indicating the substantial important of infection rate as a covariate.

An examination of the *b* coefficient values in Table 4.4 indicates the following relationships of interest:

- Each 1-point increase in High Nurse Communication increased the readmission rate by 0.054%.
- Each 1-point increase in High Physician Communication decreased the readmission rate by 0.033%.

Table 4.5. Second OLS Regression Results: Infection Rates Added

Source	SS	df	MS
Model	335.639	14	23.974
Residual	1513.786	1,755	0.863
Total	1849.426	1,769	1.045

Number of obs	1,770
F (14, 1755)	27.79
Prob > F	0.0000
R-squared	0.1815
Adj R-squared	0.175
Root MSE	0.92874

Readmissions	Coef.	Std. Err.	t.	P>|t|	95% Lower	95% Higher
Nurse Communication	0.055	0.010	5.480	0.000	0.035	0.074
Physician Communication	-0.033	0.010	-3.440	0.001	-0.052	-0.014
Received Information	-0.072	0.009	-7.980	0.000	-0.090	-0.055
Understood Information	-0.005	0.008	-0.660	0.511	-0.022	0.011
CLABSI	0.048	0.047	1.020	0.307	-0.044	0.139
CAUTI	-0.014	0.026	-0.520	0.601	-0.064	0.037
MRSA	0.121	0.029	4.240	0.000	0.065	0.177
Clean Facilities	-0.017	0.005	-3.130	0.002	-0.027	-0.006
Quiet Hospital	0.010	0.004	2.560	0.011	0.002	0.017
Overall Hospital	-0.030	0.006	-4.650	0.000	-0.042	-0.017
Voluntary Non-Profit	-0.054	0.056	-0.960	0.339	-0.164	0.056
Proprietary Ownership	0.243	0.078	3.120	0.002	0.090	0.396
Physician Owned	0.521	0.220	2.370	0.018	0.091	0.952
Critical Care	-0.010	0.204	-0.050	0.961	-0.411	0.391
Constant	22.787	0.782	29.130	0.000	21.253	24.322

note: acute, gov and emergency variables were omitted due to collinearity

- Each 1-point increase in Information for Recovery decreased the readmission rate by 0.072%.
- Each 1% increase in MRSA infection rates raised readmissions by 0.12%.

The only change made to the model was to log-transform ratio variables and compute the regression again in order to determine whether heteroscedasticity disappeared (with CAUTI and CLABSI infections dropped, as they were not significant). The log-transformed results resulted in a decline in heteroscedasticity, $\chi^2 = 14.81$, $p = .0001$, but not its absence. Therefore, heteroscedasticity remained as one of the limitations of the study.

Further efforts were made to increase explanatory power and variables representing hospital demographics were included in a third model. These variables were also obtained from CMS and are found in the Provider of Services dataset (Provider of Services, 2017). This served as the final model and brought in the number of certified hospital beds, whether or not the facility is located in an urban setting, and the region of the United States where the facility is located. Hospitals outside of the 50 states (i.e. Puerto Rico, Guam, etc.) were used as the reference category, thus creating coefficients for each of the four regions.

4.3 SUMMARY OF RESULTS

Of the new variables, only the number of certified beds and the Northeast region proved to be significant predictors of hospital readmissions. Additionally, High Nurse Communication is no longer statistically significant as a communication predictor. An examination of the *b* coefficient values in Table 4.4 indicates the following relationships of interest:

- Each 1-point increase in High Physician Communication decreased the readmission rate by 0.032%, after the inclusion of other predictors and control variables.
- Each 1-point increase in Information for Recovery decreased the readmission rate by 0.062%, after the inclusion of other predictors and control variables.
- Each 1% increase in MRSA infection rates raised readmissions by 0.11%, after the inclusion of other predictors and control variables.
- Each certified bed in the facility raised readmissions by 0.001%, after the inclusion of other predictors and control variables.
- Hospitals located in the Northeast had a rate of readmissions 0.772% higher than facilities located in other regions of the county.

Table 4.6. Third OLS Regression Results: Hospital Attributes Added

Source	SS	df	MS
Model	388.590	20	19.430
Residual	1172.01	1,442	0.813
Total	1560.603	1,462	1.067

Number of obs	1,463
F (14, 1755)	23.91
Prob > F	0.0000
R-squared	0.249
Adj R-squared	0.2386
Root MSE	0.90154

Readmissions	Coef.	Std. Err.	t.	P>|t|	95% Lower	95% Higher
Nurse Communication	0.018	0.012	1.560	0.119	-0.005	0.042
Physician Communication	-0.032	0.011	-2.990	0.003	-0.053	-0.011
Received Information	-0.062	0.010	-6.340	0.000	-0.082	-0.043
Understood Information	-0.004	0.009	-0.410	0.679	-0.022	0.014
CLABSI	0.064	0.051	1.240	0.215	-0.037	0.164
CAUTI	-0.044	0.029	-1.540	0.124	-0.101	0.012
MRSA	0.109	0.031	3.520	0.000	0.048	0.170
Clean Facilities	-0.009	0.006	-1.440	0.150	-0.020	0.003
Quiet Hospital	0.015	0.005	3.110	0.002	0.005	0.024
Overall Hospital	-0.021	0.007	-2.890	0.004	-0.036	-0.007
Voluntary Non-Profit	-0.101	0.067	-1.510	0.131	-0.232	0.030
Proprietary Ownership	0.152	0.083	1.820	0.069	-0.012	0.316
Physician Owned	0.506	0.234	2.160	0.031	0.047	0.966
Critical Care	-0.053	0.235	-0.220	0.823	-0.514	0.409
Number of Beds	0.001	0.000	6.590	0.000	0.000	0.001
Midwest	0.355	0.349	1.020	0.309	-0.329	1.039
Northeast	0.772	0.350	2.200	0.028	0.085	1.459
South	0.272	0.347	0.780	0.434	-0.409	0.954
West	0.034	0.348	0.100	0.921	-0.648	0.717
Rural Hospital	-0.099	0.094	-1.050	0.296	-0.284	0.086
Constant	22.608	0.971	23.280	0.000	20.703	24.513

note: acute, gov and emergency variables were omitted due to collinearity

Table 4.7. Results of Hypothesis Testing

Research Question	Null Hypothesis	Results
RQ1: Is there a statistically significant relationship between High Nurse Communication and the readmission rate, after controlling for Clean Facilities, High Hospital Rating, Quiet Hospital, Emergency, Hospital Type, and Ownership?	There is not a statistically significant relationship between High Nurse Communication and the readmission rate, after controlling for Clean Facilities, High Hospital Rating, Quiet Hospital, Emergency, Hospital Type, and Ownership?	The null hypothesis could not be rejected, b = -0.018, t = 1.560, p = .119.
RQ2: Is there a statistically significant relationship between High Physician Communication and the readmission rate, after controlling for Clean Facilities, High Hospital Rating, Quiet Hospital, Emergency, Hospital Type, and Ownership?	There is not a statistically significant relationship between High Physician Communication and the readmission rate, after controlling for Clean Facilities, High Hospital Rating, Quiet Hospital, Emergency, Hospital Type, and Ownership.	The null hypothesis was rejected, b = -0.032, t = -2.99, p = .0003.
RQ3: Is there a statistically significant relationship between Information for Recovery and the readmission rate, after controlling for Clean Facilities, High Hospital Rating, Quiet Hospital, Emergency, Hospital Type, and Ownership?	There is not a statistically significant relationship between Information for Recovery and the readmission rate, after controlling for Clean Facilities, High Hospital Rating, Quiet Hospital, Emergency_Services, Hospital_Type, and Hospital_Ownership.	The null hypothesis was rejected, b = -0.062, t = -6.340, p < .000.
RQ4: Is there a statistically significant relationship between Understood Care for Recovery and the readmission rate, after controlling for Clean Facilities, High Hospital Rating, Quiet Hospital, Emergency, Hospital Type, and Ownership?	There is not a statistically significant relationship between Understood Care for Recovery and the readmission rate, after controlling for Clean Facilities, High Hospital Rating, Quiet Hospital, Emergency, Hospital Type, and Ownership.	The null hypothesis could not be rejected, b = -0.004, t = -0.410, p = .679.

These findings have been discussed further in chapter 5 of the study.

CHAPTER 5

DISCUSSION

5.1 CONCLUSIONS

Study results indicated that there was a very small, but statistically significant, negative correlation between Physician Communication and readmission rates, and also between Information for Recovery and admission rates. Thus, physician communication was likely to have been a factor in reducing readmissions, as was all communication related to the management of home care. These relationships appear to be theoretically supported, in that both physician communication and general communication relating to home care ought to result in an improvement in relative post-discharge outcomes, leading to a reduced rate of readmissions. In addition, it was determined that reach 1% increase in MRSA infection rates raised readmissions by 0.11%, after the inclusion of other predictors and control variables in the analysis.

In addition, two hospital demographic variables proved to be significant indicators. The coefficient for number of beds appears small on the surface at a rate of only .001, however it is important to note that this increase is for each bed. The mean for all hospitals is 175 beds, which would result in a .175% increase in readmissions. With a standard deviation of over 200 beds, this variable becomes an important contributor to readmission rates.

If Orem's (Orem, 1981) self-care theory is correct, then post-discharge patients are highly motivated to return to the level of self-care possible for them on the basis of medical condition and other limiting factors. Given the existence of such motivation, Orem's theory predicts that post-discharge patients are likely to make appropriate use of the healthcare information that they are given in order to engage in the appropriate self-care activities. In this study, the existence of a statistically significant relationship between (a) two types of communication (physician and nurse communication) and readmission rates; and (b) one communication outcome (being given information about what kinds of care activities to carry out at home) and readmission rates were broadly compatible with Orem's theory. However, the direction of the *b* coefficients in these three regression models indicated that Orem's theory appeared to be functioning differently for physicians and nurses. The fact that the *b* coefficient for physician communication was negative, while nurse communication was not significant, supports the inference that physician communication is somehow more instrumental in lowering readmission rates. This finding is broadly compatible with previous findings (Bodenheimer et al., 2002; Ditewig et al., 2010; Fonarow et al., 1997; Forster et al., 2003; Frankl et al., 1991; Hansen et al., 2011; Healy et al., 2013; Jaarsma et al., 1999; Koehler et al., 2009; Koelling et al., 2005; Marcantonio et al., 1999; Merkow et al., 2015; Michalsen et al., 1998; Rich et al., 1993; Strömberg, 2005) that physician-designed and –managed communication is useful in giving patients the quantity and quality of information that they require in order to minimize their chances of readmission.

5.2 LIMITATIONS

The study was limited by the aggregated nature of the data. Because the HCAHPS data pertain to hospitals, not individual patients, interpretation of results is also limited. The use of hospitals—rather than patients, nurses, or physicians—as the unit of analysis in the HCAHPS data means that numerous potentially relevant variables (such as experience level of nurses, education level of patients, etc.) cannot be included in data analysis. Thus, explanatory power is lost by treating hospitals as the unit of analysis, limiting the scope of the current study's findings. The R^2 of the model was .249, indicating that around 75% of variation in readmission rates is not accounted for.

However, any study that explores behavior will have challenges in accounting for all potential variances. In his widely-cited 1988 study, Jacob Cohen found that for behavioral science studies, an R^2 of .13 was the minimum required to explain a moderate effect and an R^2 of .326 was the minimum required to explain a large effect (Cohen, 1988). Additional studies have shown that R^2 as low as .10 are adequate for use when human behavior is the primary focus (Falk & Miller, 1992).

Therefore, while this study may only explain approximately 25% of the variation in readmissions, it falls well within established ranges for the area of study.

5.3 SUGGESTIONS FOR PRACTICE

On the surface, the primary finding of the study is that proper communication between the patient and the physician can lead to decreased readmission rates. Unfortunately, this is not easy to implement. There are many limitations on a physician's time and it may be hard to justify spending more time on a task that has commonly been delegated to support staff. However, the findings of this study clearly indicate that doing

so has no benefit to the patient as there was no significant correlation between nurse communication and readmissions.

One challenge to increase communication between the physician and the patient is the lack of reimbursement for doing so. One of the primary tools for calculating physician reimbursement is the RVU, which does not allot much (if any) weight for communication. Given the directive from CMS to reduce readmissions, in the form of severe penalties, a case could be made for additional reimbursement for physicians who have better communication practices as these are tied to lower readmission rates.

Another area for practices to explore is understanding why nurse communication did not have a significant impact on readmissions. It is possible that nurses are not providing discharged patients with the kind of information necessary for them to better manage their home care, which, in theory, would result in a higher percentage of readmissions.

5.4 SUGGESTIONS FOR FUTURE STUDY

Future scholarship on the relationship between communication and readmission rates could be improved through the use of more specific patient demographics in the study. While this study did attempt to capture these variables via proxy by the use of rural status and regional location, patient statistics such as gender, race, and education level could be valuable in further study.

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APPENDIX A: HCAHPS SURVEY FORM

YOUR CARE FROM NURSES

1.During this hospital stay, how often did nurses treat you with courtesy and respect?
1. Never
2. Sometimes
3. Usually
4. Always

2.During this hospital stay, how often did nurses listen carefully to you?
1. Never
2. Sometimes
3. Usually
4. Always

3.During this hospital stay, how often did nurses explain things in a way you could understand?
1. Never
2. Sometimes
3. Usually
4. Always

4.During this hospital stay, after you pressed the call button, how often did you get help as soon as you wanted it?
1. Never
2. Sometimes
3. Usually
4. Always
9. I never pressed the call button

YOUR CARE FROM DOCTORS

5. During this hospital stay, how often did doctors treat you with courtesy and respect?
1. Never
2. Sometimes
3. Usually
4. Always

6. During this hospital stay, how often did doctors listen carefully to you?
1. Never
2. Sometimes
3. Usually
4. Always

7. During this hospital stay, how often did doctors explain things in a way you could understand?
1. Never
2. Sometimes
3. Usually
4. Always

THE HOSPITAL ENVIRONMENT

8. During this hospital stay, how often were your room and bathroom kept clean?
1. Never
2. Sometimes
3. Usually
4. Always

9. During this hospital stay, how often was the area around your room quiet at night?
1. Never
2. Sometimes
3. Usually
4. Always

YOUR EXPERIENCES IN THIS HOSPITAL

10. During this hospital stay, did you need help from nurses or other hospital staff in getting to the bathroom or in using a bedpan?

1. Yes
2. No If No, Go to Question 12

11. How often did you get help in getting to the bathroom or in using a bedpan as soon as you wanted?
1. Never
2. Sometimes
3. Usually
4. Always

12. During this hospital stay, did you need medicine for pain?
1. Yes
2. No If No, Go to Question 15

13. During this hospital stay, how often was your pain well controlled?
1. Never
2. Sometimes
3. Usually
4. Always

14. During this hospital stay, how often did the hospital staff do everything they could to help you with your pain?
1. Never
2. Sometimes
3. Usually
4. Always

15. During this hospital stay, were you given any medicine that you had not taken before?
1. Yes
2. No If No, Go to Question 18

16. Before giving you any new medicine, how often did hospital staff tell you what the medicine was for?
1. Never
2. Sometimes
3. Usually
4. Always

17. Before giving you any new medicine, how often did hospital staff describe possible side effects in a way you could understand?
1. Never
2. Sometimes
3. Usually
4. Always

WHEN YOU LEFT THE HOSPITAL

18. After you left the hospital, did you go directly to your own home, to someone else's home, or to another health facility?

1. Own home
2. Someone else's home
3. Another health facility If Another, Go to Question 21

19. During this hospital stay, did doctors, nurses or other hospital staff talk with you about whether you would have the help you needed when you left the hospital?
1. Yes
2. No

20. During this hospital stay, did you get information in writing about what symptoms or health problems to look out for after you left the hospital?
1. Yes
2. No

OVERALL RATING OF HOSPITAL

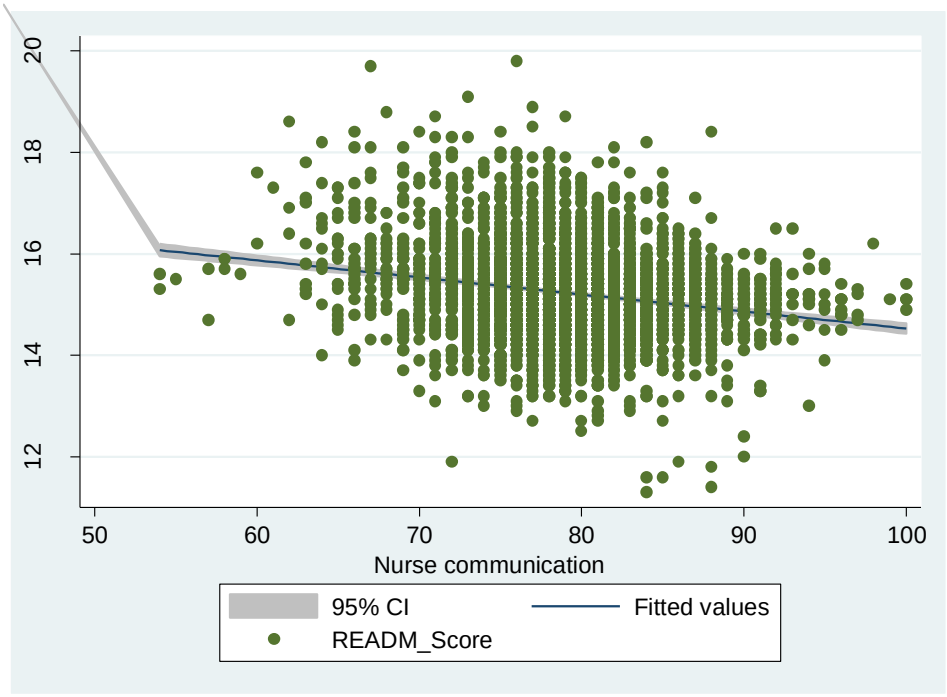
Please answer the following questions about your stay at the hospital named on the cover letter. Do not include any other hospital stays in your answers.

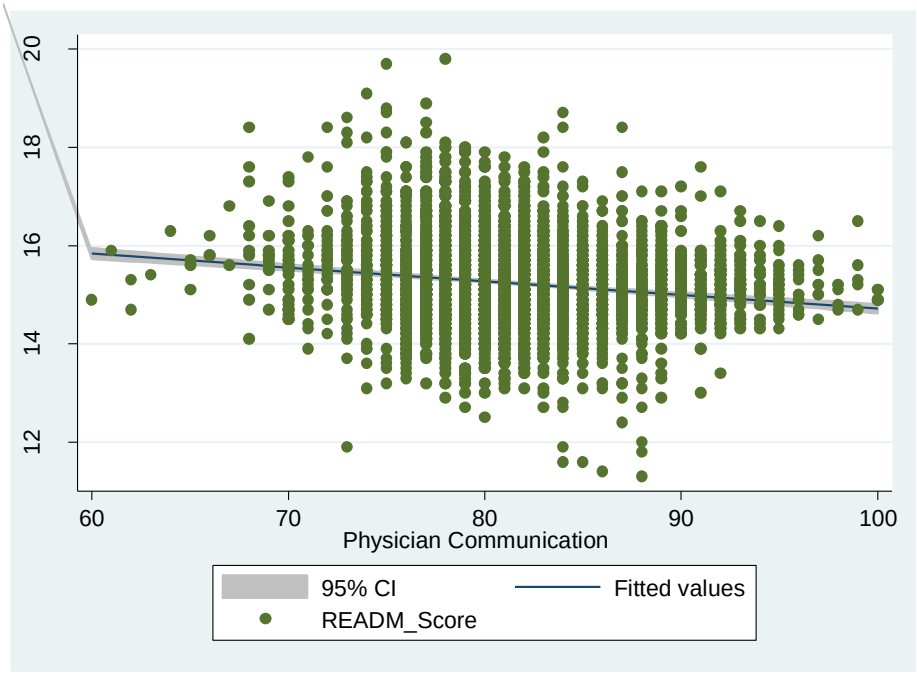
21. Using any number from 0 to 10, where 0 is the worst hospital possible and 10 is the best hospital possible, what number would you use to rate this hospital during your stay?
0 Worst hospital possible
1
2
3
4
5
6
7
8
9
10 Best hospital possible

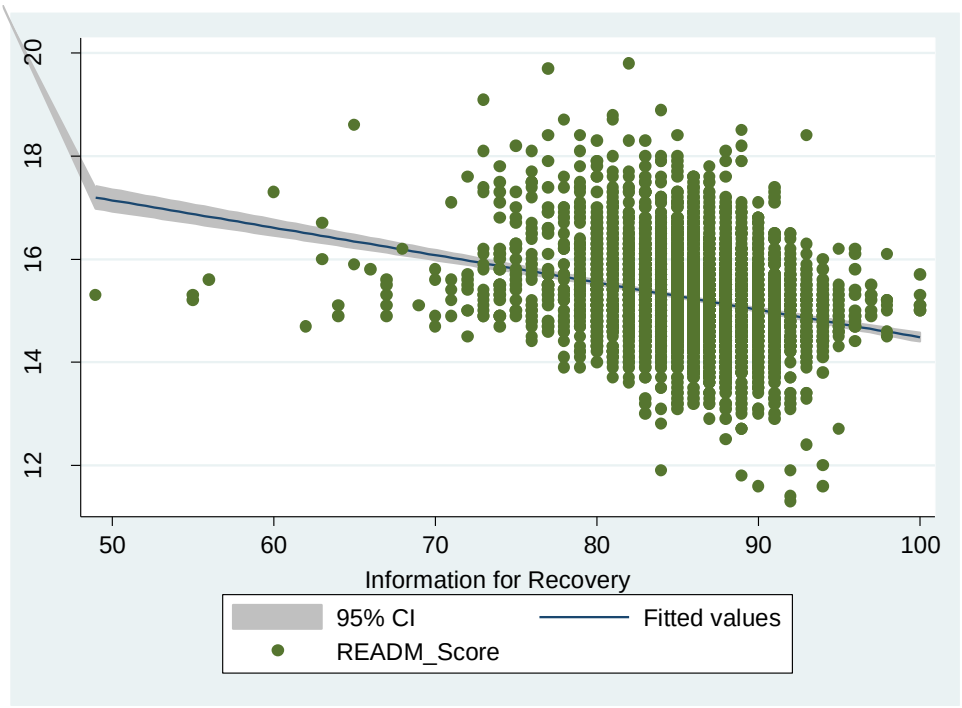
22. Would you recommend this hospital to your friends and family?

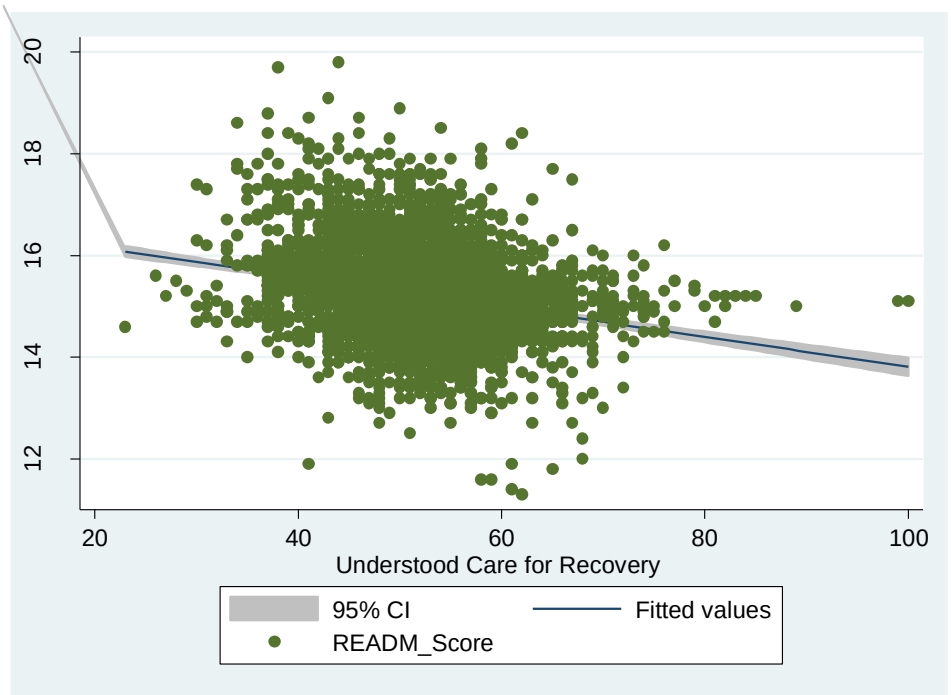
1. Definitely no
2. Probably no
3. Probably yes
4. Definitely yes

APPENDIX B: SCATTERPLOTS






20
18
16
14
12
50
60
70
80
90
100
Information for Recovery
95% CI
Fitted values
READM_Score


20
18
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40
60
80
100
Understood Care for Recovery
95% CI
Fitted values
READM_Score