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Magnet Recognition (Mr) and Hospital Quality Outcomes in the U.S.A– Analysis Based on 2017 Hospital Data

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DEDICATION

Every challenging work needs efforts as well as guidance of elders especially those who were very close to our heart. My humble effort I dedicate to my sweet and mother, Modhi Alhammad, and loving father, Abdullah Alhammad. Whose affection, love, encouragement and prayers day and night made me able to get such success and honor.

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ABSTRACT

The American Nurse Credentialing Center (ANCC) introduced Magnet Recognition (MR) in the U.S.A in 1994. Magnet Recognition was adopted based on the findings of a comprehensive study (conducted in 1983) that tried to identify factors explaining high rates of nurses' retention in 41 hospitals in the U.S.A.

The objective is to compare MHs with the hospitals not recognized as "Magnet" (non-MHs) in terms of important outcomes of the health system and to examine whether the MHs themselves vary significantly in terms of the outcomes.

All the general specialty of MHs (367 hospitals) and their matched of non-MHs (380 hospitals) in 2017 were included in the analyses. Hospital characteristics were obtained from the 2017 American Hospital Association dataset. Hospital outcome and structure measures were obtained from the Center for Medicare & Medicaid Services. Forty-five measures from seven domains of hospital quality and Overall Hospital Quality Star Ratings were used in the analysis. Descriptive statistics and regression models were used to examine the differences between MHs and non-MHs and the variability within the MHs group.

The analysis showed that MHs were significantly different from the non-MHs in terms of hospital characteristics. It was an indication that not all hospital types in the U.S.A are interested in applying for Magnet Recognition. For example, Two-third of MHs was nongovernment-not-for-profit while 50% of the non-MHs were government-nonfederal and investor. After matching the non-MHs to the MHs, the analyses

confirmed that Magnet Recognition significantly improved three out of seven outcomes domains: "mortality, readmission, and patient experience." Within the group of MHs analyses, the results indicate significant variability among MHs. For example, the coefficient of variation of seven domain scores varied from 7.4% to 16%. The "overall hospital quality star ratings" also varied among MHs with 3.54%, 24.2%, and 20.7% in 1-star, 3-star, and 5-star categories, respectively. The variability of star rating among MHs was explained by hospital characteristics.

Our analysis found that it is possible that the flexibility of Magnet Recognition requirements, such as giving hospitals the option to choose national benchmark(s) to compete with for the required empirical-outcomes, may have created significant variability.

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LIST OF ABBREVIATIONS

MHs..... Magnet Hospitals

CMS ..... Center for Medicare & Medicaid Services

Non-MHs .....Non-Magnet Hospital

MR .....Magnet Recognition

OHQSR.....Overall Hospital Quality Star Rating

ANCC .....American Nurse Credentialing Center

U.S.A.....United State of America

AHA..... American Hospital Association

MM .....Magnet Model

TL..... Transformational Leadership

SE..... Structural Empowerment

EP..... Exemplary Professional Practice

NK..... New Knowledge, and Innovation & Improvements

EO .....Empirical Outcomes

FOM.....Forces of Magnetism

RN.....Registered Nurse

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

VBP..... Value-Based Purchase

NDNQI.....National Database of Nursing Quality

NQF..... National Quality Forum

MH ..... Magnet Hospital

AAN ..... American Academy of Nursing

TFN ..... Task Force on Nursing

MS ..... Magnet Study

CNOs ..... Chief Nursing Officers

COM ..... Commission on Magnet Recognition

MNSR ..... Magnet Nursing Service Recognition

PPM ..... Professional Practice Model

IOM ..... Institute of Medicine

IPPS ..... Inpatient Prospective Payment System

HC ..... Hospital Compare

EHR ..... Electronic Health Record

HIMSS ..... Healthcare Information and Management Systems Society

EMRAM ..... Analytics Electronic Medical Record

EMR ..... Electronic Medical Record

PS ..... Propensity Score

NSQIP ..... National Surgical Quality Improvement Program

PS ..... Propensity Score

HSS ..... Hospital Safety Score

HAIs ..... Health Associated Infections

MRSA ..... Methicillin-Resistance Staphylococcus Aureus

CDI ..... Clostridium Difficile Infection

SIR ..... Standardized Infection Rate

NHSM ..... National Healthcare Safety Network

AHRQ ..... Agency for Research in Healthcare Quality

PES-NWI .....Practice Environment Scale of the Nursing Work Index

HHI ..... Herfindahl-Hirschman Index

ICD-9-CM.International Classification of Diseases, Ninth Revision, Clinical Modification

HCUP .....Healthcare Cost and Utilization Project

NIS .....Nationwide Inpatient Sample

NHPPD ..... Nursing Hours Per Patient Per Day

RN-NHPPD..... Registered Nurse-Nursing Hours Per Patient Per Day

MIP ..... MR In Progress

ANOVAs.....Analysis of Variance

WHPPD.....Worked Hours Per Patient Day

TPS.....Total Performance Score

LPNs .....Licensed Practical Nurses

LOS .....Length of Stay

ICU..... Intensive Care Unit

SIU ..... Surgical Intensive Unit

Chi2..... Pearson's Chi-Squared

AMI.....Acute Myocardial Infarction

HF ..... Heart Failure

FFS.....Fee-For-Service

CMS ID.....Medicare Identification Number

VA..... Veterans Administration

HIT ..... Health Information Technology

CLABSI ..... Central Line-Associated Bloodstream Infections

CAUTI ..... Catheter-Associated Urinary Tract Infections

SD ..... Standard Deviation

CV ..... Coefficient of Variation

OLR ..... Ordered Logistic Regression

CHAPTER 1

MAGNET RECOGNITION PROGRAM AND OVERALL HOSPITAL QUALITY STAR RATING

1.1 Introduction

The purpose of this study is to compare Magnet Hospitals (MHs) with the hospitals not recognized as "Magnet" (non-MHs) in terms of important outcomes of the health system as defined by the Center for Medicare & Medicaid Services (CMS) and to examine whether the MHs themselves vary significantly in terms of the outcomes. Although Magnet Recognition (MR) is based on a number of processes, structures, and outcomes of the hospitals, the overlap between Magnet Recognition measures and CMS hospital quality measures is not high, which implies that there is a possibility that MHs vary significantly in terms of CMS quality outcomes, even though the purpose of Magnet Recognition is to improve the quality of hospital services delivered. This research intends to evaluate whether or not the MHs vary significantly in terms of CMS quality outcomes compared to other hospitals, as well as within the MH category. The outcomes are the seven domains defined by the CMS, which the CMS uses to derive the combined Overall Hospital Quality Star Rating (OHQSR). If the analysis shows a high variability among MHs in terms of CMS's quality outcomes, it will be an indication that improving structure and processes required by Magnet Recognition may not necessarily result in

improved quality outcomes in all the relevant dimensions. This would likely raise the issue of whether it is possible for hospitals to have high OHQSR without achieving good results in hospital structural and process dimensions of the Magnet Recognition or vice-versa.

As mentioned above, an important objective of the study is to compare the MHs and non-MHs in terms of outcome indicators. The hypothesis is that Magnet Recognition of hospitals is associated with better quality of hospital services offered than the non-MHs, because the Magnet Recognition process focuses on specific areas for improving outcomes of hospital services. The analysis will also identify specific areas of hospital outcomes, if any, the MHs should refocus or emphasize to ensure balanced improvements of all aspects or dimensions of hospital quality.

Since Magnet Recognition is based on a number of structural and process variables, controlling for these variables may explain some of the effects of or associations between MHs and the hospital outcome measures. Although a number of previous studies have examined the differences between MHs and non-MHs in terms of hospital quality, this study intends to go beyond the earlier studies by examining the hypothesis that MHs are better in hospital quality than the non-MHs after controlling for hospital characteristics and specific structure/process variables. A related relevant question is the difference between the hospital structure variables in MHs and non-MHs.

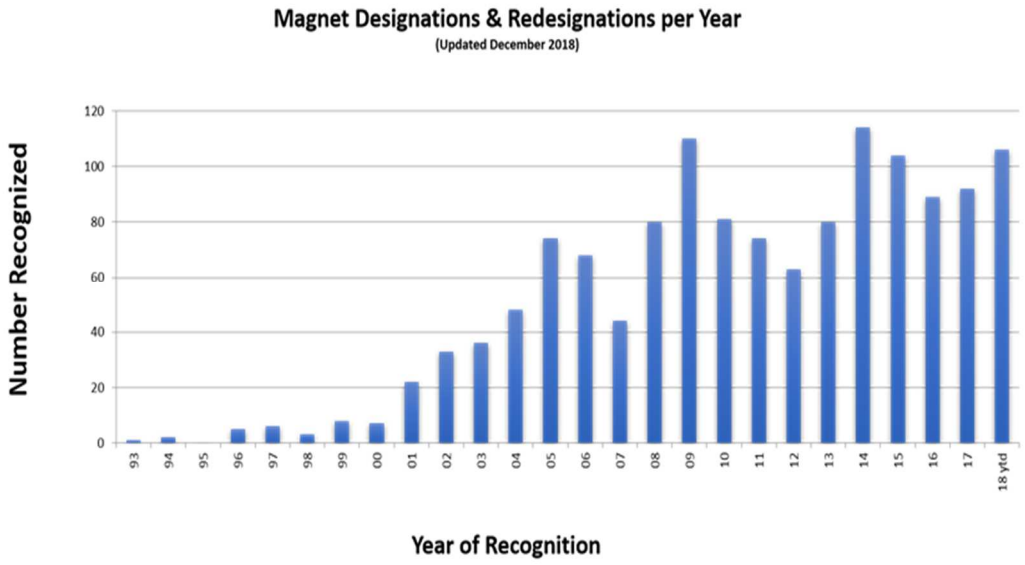
This study adds to the literature in a number of ways. First, many of the past studies compared MHs and non-MHs prior to the recent changes in Magnet Recognition criteria implying that MHs of today may be quite different from the MHs in the past. It will be worth repeating the earlier studies to see if the newly defined Magnet Recognition

criterion has affected the quality of services delivered compared to the non-MHs in the original study.

In addition to the analysis of the differences between MHs and non-MHs in hospital quality, this study will also examine the variability of hospital quality within the MH groups. Magnet Recognition, just like any other recognition or certification, does not represent one homogeneous category. Magnet Recognition does require the satisfaction of a number of good quality outcomes but beyond the dimensions used in Magnet Recognition, hospitals may vary significantly. Magnet Recognition itself is not as rigid as some of the standard accreditation and certification requirements. Therefore, we can expect to see some variability within the MHs group in terms of processes and quality outcome measures. In empirical analysis, it is possible that we will not find significant differences in quality within the MHs group but the possibility of variation in terms of CMS's quality dimensions remains likely. Magnet Recognition of hospitals does not use the same characteristics and processes used by CMS's measures and since Magnet Recognition allows some of the requirements to be selected and benchmarked by the hospitals themselves, in theory, the Magnet Recognition system leaves room for significant variability. This type of within group comparisons will help identify the specific quality outcomes that show relatively high disparity across MHs. The variability of hospitals in terms of quality outcomes is useful for identifying the MHs with relatively poor outcomes, as well as some of the characteristics and structural/process variables that can help explain the underlying reasons for variability.

The number of hospitals with Magnet Recognition reported by the American Nurse Credentialing Center (ANCC) website in 2017 was 465, which represents 7.5% of

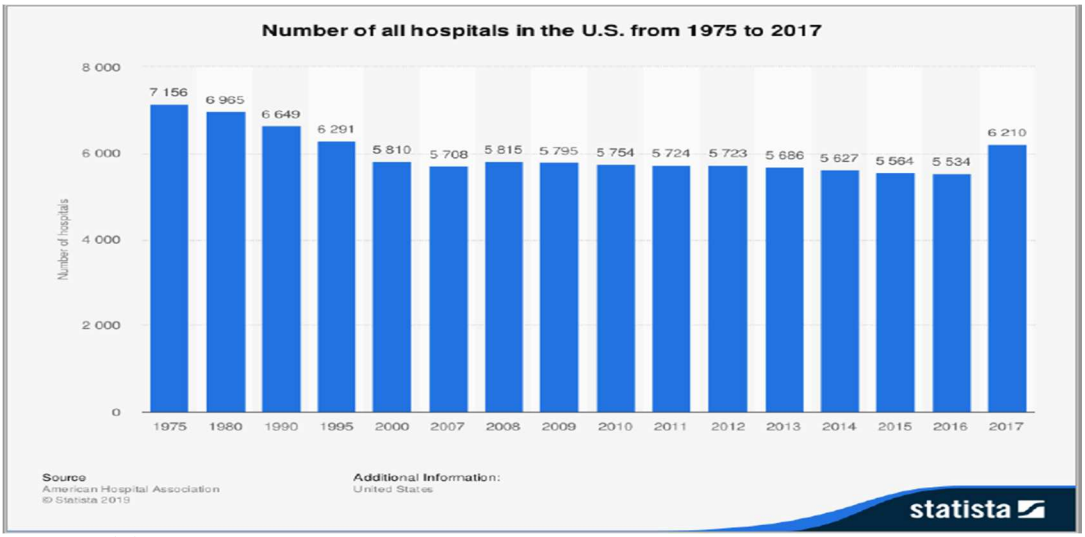
total hospitals in the U.S.A (6,283) in the year. Most of these hospitals are located in urban areas and are general acute care type hospitals. The ANCC is a subordinate of the American Nurses Association that promotes nursing related outcomes such as patient outcomes, safe practice, positive work environments, etc. (ANCC, 2019). During 2018, the ANCC published information on MHs trends since the establishment of Magnet Recognition (figure 1.1). The figure reports number of Magnet designations and re-designations per year since the introduction of Magnet Recognition. In 2019, the American Hospital Association (AHA) published information on the total number of hospitals per year in the U.S.A (figure 1.2) (AHA, 2019). From the two figures, we estimated the percentage of MHs to the total number of hospitals in the U.S.A. The estimation indicates that the percentages of MHs to the total number of hospitals in the U.S.A in 2000, 2010, and 2016 were 0.46%, 5.5%, and 7%, respectively.



Source: ANCC website

Figure 1.1: Number of Hospitals Obtaining Magnet Designation and Re-Designations by Year, 1993-2018

As of December 2017, and after twenty-four years of Magnet Recognition launching, there were around 465 Magnet recognized hospitals, 457 of which are in the U.S.A. It appears from figure 1.1 that since 2008 and after Magnet Recognition introduced its new Magnet model (MM), the number of Magnet designation and re-designations were higher than before, the number after 2008 per year had fluctuated between 80 to 115 hospitals except in 2011 and 2012; whereas, the number of Magnet designation and re-designations prior to 2008 were significantly lower than 80 hospitals per year. The Magnet Recognition requires that the hospitals have good standards of nurse related structures, processes, and outcomes but it does not mean that the non-MHs do not satisfy these requirements. The proportion of MHs among the U.S hospitals in 2017 is still quite low (7.5%) and it will not be surprising to find many good non-MHs in the country that are equally good in terms of nurse related structures, processes, and outcomes. Since the Magnet Recognition process takes about four years of complex, time consuming, and costly process improvement, some hospitals, especially the ones that have already established themselves as good quality hospitals, may not be interested in Magnet Recognition. In other words, not having Magnet Recognition does not necessarily mean that these hospitals are not as good as the MHs in terms of nurses' structures, processes, and outcomes. This is however, an empirical question and it will be important to examine whether the MHs are different from the non-MHs in terms of structures and outcomes.



Source: AHA website

Figure 1.2: Total Number of Hospitals in the U.S.A by Year, 1975-2017

In order to develop an appropriate empirical model for comparing the quality outcomes of MH and non-MH, it is important to discuss the processes and requirements of Magnet Recognition itself and the method of development of quality dimensions and overall quality measures of CMS. The following paragraphs will present these two aspects of the research: Magnet Recognition process and the measurement of seven domains included in the development of OHQSR. It is also important to discuss the degree of overlap of the measures used by Magnet Recognition and the OHQSR's seven domains.

1.2 Magnet Recognition (MR): Some Background

The Magnet Recognition initiative is the result of a study published in 1983, which investigated nationwide nurse retention rates in the U.S.A, while the nation struggled with a high turnover of nurses. In 1994, the ANCC launched Magnet Recognition, a hospital accreditation initiative to improve patient and hospital outcomes. In order to acquire a Magnet Recognition accreditation, hospitals have to undergo four

years of a complex, time consuming and costly process of improvement; hospitals must provide evidence of continuous improvement in identified measures used by the ANCC. The Magnet Recognition accreditation is granted for a period of four years, and it must be renewed every four years. After the initial recognition, hospitals must maintain the process of improvement in order to receive a re-designation at the end of eighth year.

Magnet Recognition is mainly designed for improving nursing related structures and processes as well as ensuring the improvement of outcomes. Prior to 2008, Magnet Recognition focused on improving nursing structures and processes in hospitals. After Magnet Recognition introduced its new MM in 2008, some empirical outcome measures were added. The MM consists of five components: Transformational Leadership (TL), Structural Empowerment (SE), Exemplary Professional Practice (EP), New Knowledge, and Innovation & Improvements (NK), and Empirical Outcomes (EO). These components were developed from fourteen Forces of Magnetism (FOM) important for enhancing nurse retention. The FOM are a group of common characteristics, which were found in the 41 hospitals that participated in the original Magnet study. The Magnet study was conducted between the mid-1970s and early 1980s. More information about the Magnet Recognition program has been presented in chapter 2 of this dissertation.

Magnet Recognition requires hospitals to report the source of evidence on eighty measures under TL, SE, EP, and NK components of MM and to determine and verify structures and processes that improve these measures (American Nurses Credentialing, 2013, p. 60; Dernkard et al., 2011, p. 95). Under the empirical-outcomes component, the Magnet Recognition requires five empirical measures to cover nurse, patient, clinical, and education outcomes. These measures are given specific names based on the related

model's components that they represent (American Nurses Credentialing, 2013, pp. 29–60). The empirical-outcomes measures are: (i) the organization supports nurses' continuous professional development (SE3EO), (ii) unit or clinic level nurse (RN) satisfaction (EP3EO), (iii) unit-or clinic-level nurse-sensitive clinical indicator (EP22EO), (iv) unit-or clinic-level patient satisfaction data related to nursing care (EP23EO), and (v) the organization supports the advancement of nursing research (NK1EO) (American Nurses Credentialing, 2013). For example, in the EP3EO measure, the EP represents the Exemplary Professional Practice component, the SE in SE3EO measure represent the Structural Empowerment component, etc. Two of the empirical-outcomes measures are likely to have some relationship with the OHQSR's seven domains. This aspect will be discussed further in a later section.

1.3 Background on CMS Overall Hospital Quality Star Rating (OHQSR)

The CMS's hospital quality initiative was started in 2007. The CMS extended its effort to broadly publish comprehensive quality measures and in July 2016, it introduced the OHQSR, publicly available information about hospital quality. The purpose of the quality measures is to help patients in the choice of hospitals for their needs. It has now become a nationwide comparison of hospitals available through the CMS' Hospital Compare website (Medicare, 2017). The OHQSR assigns a rating ranging from 1 to 5 depending on the safety and quality of hospitals, 5 being the best possible rating and 1 being the worst.

The quality measures include outcomes such as "mortality", "readmission", and a variety of clinical outcomes. The OHQSR was developed to summarize all of the quality measures considered in the analysis. The quality measures were grouped under seven

domains using specific weights for each of the measures in order to derive the aggregate values. The seven domains used in the development of the OHQSR are listed here with their weights: (i) Mortality 22%, (ii) Safety of Care 22%, (iii) Readmission 22%, (iv) Patient Experience 22%, (v) Effectiveness of Care 4%, (vi) Timeliness of Care 4%, and (vii) Outpatient Efficient Use of Medical Imaging 4% (Medicare, 2017). Each of these domains uses different variables or measures to obtain domain-specific quality values. For example, the "mortality" domain uses seven mortality-related measures. Similarly, eight variables are used for the "safety of care" domain, eight measures for the "readmission" domain, ten measures for the "patient experience" domain, sixteen for the "effectiveness of care" domain, seven measures are used for "timeliness of care", and five variables are used to derive the aggregate value for the "efficient use of outpatient medical imaging" (Medicare, 2017). In reference to outcomes mentioned above that make up the seven domains' score and weight, we have used a different calculation to come up with a weighted and aggregated average score for each domain, except for "patient experience". The CMS has assigned "patient experience" domain five-stars rating, just like in the OHQSR, 5 being the best possible rating and 1 being the worst, depending on patients' responses to the ten measures explaining their experiences during care in the hospitals. The average scores of the six domains, "patient experience" categories, and OHQSR categories are the final outcomes we employ for this research.

1.4 Study Aims, Research Questions and Hypotheses

1.4.1 Aims of the Study

The background information provided above serves as the basis for the principal aims of this study. The purpose of the study is to analyze the impact of the Magnet Recognition in improving the structure, processes, and outcomes it intends to improve as well as improvements in overall hospital quality. The principal aims of the study are listed below:

1. *To examine whether the hospitals that apply for and receive Magnet Recognition (MHs) are significantly different, in terms of hospital characteristics, from the hospitals that are not Magnet recognized (non-MHs).*
2. *To evaluate whether Magnet Recognition status affects hospital structure, processes and outcomes.*
3. *To examine the degree of homogeneity or heterogeneity among the MHs in terms of hospital outcome measures (reflecting hospital quality)*

Although a few studies have examined the quality differences between MHs and non-MHs using various measures of quality, a comprehensive evaluation of quality differences between MHs and non-MHs has not been done. It is important to find out if Magnet Recognition improves quality outcome measures, especially after the implementation of new MM in 2008. Since ANCC allows hospitals working towards Magnet Recognition to choose their own assessment measures in certain areas, it is possible that the MHs do not constitute one homogeneous group and they may differ significantly in terms of quality outcomes not considered in the Magnet Recognition process.

1.4.2 Primary Research Questions

Based on the aims of the study, the research questions are:

1. *Are the MHs different from the non-MHs in terms of major hospital characteristics and utilization?*
2. *Do the MHs differ significantly from the non-MHs in terms of structure and processes of hospitals as well as overall quality outcomes?*
3. *Is there significant variability in hospital quality outcomes among the Magnet-recognized hospitals?*

1.4.3 Hypotheses

This study will test the three specific hypotheses related to three different aspects of MHs and non-MHs.

Magnet recognition is a time consuming and costly process. It is also possible that several measures and processes relevant to Magnet Recognition may not be important for very specialized and small-sized hospitals. Because of the costs and complexity of the Magnet Recognition process, it is unlikely that small, rural hospitals will apply for Magnet Recognition. Therefore, we expect that the hospitals choosing to apply for Magnet Recognition are different in various characteristics than the hospitals not applying for Magnet Recognition. Therefore, hypothesis 1 can be written as:

Hypothesis 1: Hospitals receiving Magnet Recognition are larger in size, located in urban areas with other characteristics representing delivery of complex, tertiary-level care.

Magnet Recognition requires hospitals to benchmark for a comprehensive source of evidence and empirical outcomes that are, directly and indirectly, related to patients' and

nurses' outcomes. Since Magnet Recognition is based on unique requirements and processes for its hospitals, it is likely that the outcome measures will be significantly better for the MHs compared to similar non-MHs.

Hypothesis 2: Magnet recognition is associated with better structure/processes and outcome measures compared to similar non-MHs.

Although the requirements of Magnet Recognition are comprehensive, costly, and time-consuming, the requirements may not be the same for all MHs. For Magnet Recognition, hospitals can define their own specific targets and measures implying that the MHs may vary significantly in terms of quality scores. The MHs can choose and report on different benchmarks and measures. The flexibility the Magnet Recognition process provides can, in theory, produce variations in outcomes between the MHs. Accordingly, hypotheses 3 can be written as:

Hypothesis 3: The outcome scores of Magnet-recognized hospitals are likely to vary significantly after controlling for basic hospital characteristics.

1.5 Study Rationales

As indicated above, Magnet Recognition is becoming increasingly popular in the U.S.A and by the end of 2017 there were 465 hospitals accredited (approximately 8% of the total hospitals in the U.S.A) and the number of MHs have been slightly increasing every year. Most of the MHs are located in urban areas. Many are large or extra-large hospitals. Some are educational hospitals and general acute hospitals. Therefore, it is important to understand whether MHs are different from non-MHs in terms of hospital characteristics as well as to find if the long, comprehensive, time consuming, and costly process of Magnet Recognition accreditation is a worthwhile endeavor.

No studies were found that comprehensively compared quality measures of MHs and non-MHs as well as variability within the MH group. Several studies compared MHs and non-MHs in terms of their level of outcomes related to patients, financial situation, and structural and process aspects. In addition, some studies investigated the variability of patient experience scores between MHs and non-MHs using Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) (Smith, 2014). The next few paragraphs explain why it is important to conduct this study.

The ANCC introduced major revisions in Magnet Recognition in 2008 by defining the five-components of the MM. The majority of studies comparing MHs and non-MHs were conducted prior to 2008 and, therefore, do not reflect the relationship between Magnet Recognition and quality after the adoption of the new MM. Many of the earlier studies on MHs were focused on investigating nursing work environments and their related outcomes such as satisfaction, burnout, autonomy, etc. However, the latest MM is more focused on relating different nursing aspects to improve defined patient outcomes. Although prior studies provided comparisons of MHs and non-MHs, additional studies are needed to better understand the differences in outcomes between MHs and non-MHs after the adoption of the new MM in 2008. The new MM may imply that the MHs have better structure and nationwide outcomes than the comparable non-MHs. This study could provide stakeholders such as the ANCC, MHs, non-MHs, hospital leaders, policymakers a better understanding of the impact of the new MM and overall outcomes of care.

CMS OHQSR's seven domains and CMS's hospital structure measures are a fairly new concept, and there are no studies that compare these quality and structural measures across MHs and in between MH and non-MH. OHQSR's seven domains include comprehensive, important measures, and summarize more than 100 indicators that overlap with CMS's Value-Based Purchase (VBP) programs. Under VBP, there are different accountability programs that hold hospitals responsible for their outcomes, which can affect hospitals' payment. The benefit of using CMS' OHQSR measures in this study would be extended to indicate whether Magnet Recognition is associated with improvements of CMS's accountability programs such as the VBP. Future studies are suggested to investigate the relationship between CMS's different program and Magnet Recognition.

The selection and reporting of Magnet Recognition's empirical-outcomes and CMS's overall hospital quality star rating measures are different. For example, CMS includes ten measures of patients' experience, but Magnet Recognition requires hospitals to report only four out of nine measures. Therefore, one should carefully design a research study that would evaluate the relationship between Magnet Recognition and CMS's outcomes as some of the outcomes are directly used for Magnet Recognition. Because the remaining six measures of "patient experience" domain were not used by Magnet Recognition, the selection and the requirements for the similar measures are also different between the CMS and Magnet Recognition, we have included "patients experience" in this study.

The majority of previous studies that compared MHs and non-MHs used restricted data for specific regions and states on nursing and related outcomes. For example, the National Database of Nursing Quality (NDNQI) collects information on thirty-four safe practices (SP), which were introduced by the National Quality Forum (NQF). The NDNQI is not the most reliable data to use when comparing MHs and non-MHs because it does not represent the hospital population in the U.S.A. The data set does not include hospitals with less than 100 beds and focuses more on hospitals located in metropolitan areas (Staggs & Dunton, 2012). In 2017, 172 (39.9 %) MHs and 3,342 (57.1%) non-MHs had less than 100 beds, and 94 (21.8%) MHs and 1,932 (33.0%) non-MHs were located in rural areas. Our study used national datasets; CMS and AHA, both are not restricted resources. CMS's data contains the most comprehensive outcome measures and the AHA contains detailed information on hospital characteristics and structures. For comparing the MHs and non-MHs, it is important to select all MHs in the country so that national level comparisons can be made.

The design of Magnet Recognition itself may introduce wide variability among MHs in terms of quality. One of the most important requirements for Magnet Recognition is that hospitals are required to provide evidence on specific outcomes in which it must outperform a mean or median of a chosen national benchmark. This requirement gives hospitals the option to choose national benchmark(s) for comparison. Allowing self-selection for benchmark(s) may create variability among hospitals in terms of processes and quality outcomes. Given the flexibility in the choice of benchmarks, a Magnet hospital (MH) can choose one benchmark, while another MH chooses a different benchmark. The benchmarks chosen by the hospitals are unknown, as the ANCC does

not publish this information. This process can lead to differential outcomes and processes among the MHs.

Another issue with Magnet Recognition that may create variability in outcomes among MHs is the selection of measures and reporting criteria. The Magnet Recognition requires hospitals to report on five empirical outcomes. Three of the empirical-outcomes must be nationally benchmarked; four measurers of nurse satisfaction outcomes (EP3EO), six measures of unit-or clinic- level nurse-sensitive clinical outcomes (EP22EO), and four measures of unit-or clinic- level patient satisfaction (EP23EO). The MHs also require reporting for another four measures from a pool of seven measures of nurse satisfaction. Similarly, for EP22EO, MHs are required to report on four identified measures, two of which can be chosen from a pool of fourteen clinical outcomes; and for EP23EO, MHs are required to report on four measures from a pool of nine patient satisfaction measures. It is obvious that in the three empirical-outcomes, there are required sets of measures for Magnet Recognition and some of these measures are identified. In most cases, hospitals are given a choice to select from a pool of measures to complete empirical-outcomes requirements. Empirical-outcomes measures must be presented in the chosen benchmark(s). Moreover, MHs are given a choice to report the three empirical-outcomes in only one-to-four hospitals' units/clinics. For example, a MH can choose to report for EP22EO in one unit/clinic, while another MH chooses to report for four units/clinics, etc. Units/clinics are not announced by Magnet Recognition, which means that each MH is allowed to select their outcome set. In addition to the limitation of reporting outcomes of a few units/clinics in MHs, giving the self-selection for

units/clinics by Magnet Recognition, might drive MHs to only report for units or clinics with excellent outcomes leaving other important unit/clinic outcomes unreported.

Finally, this type of research is important for stakeholders such as CMS, ANCC, hospitals management, healthcare professionals, and patients to better understand hospitals structure, characteristics, and quality for MHs and Non-MHs. A comparative analysis of MHs and non-MHs shall provide healthcare stakeholders information on specific hospital structures and characteristics that might help improve patient outcomes.

1.6 Summary

The main purpose of Magnet Recognition is to improve nursing outcomes in healthcare facilities. The accreditation process is comprehensive and includes on-site inspection, requires monthly documentation, and takes at least four years to complete. Hospitals seeking Magnet Recognition must submit defined empirical outcomes and must outperform the mean or mode of chosen national benchmarks to receive Magnet accreditation (American Nurses Credentialing, 2013, p. 49). Given this rigorous process of accreditation, it is expected that the MHs should show relatively better hospital quality outcomes, even though the Magnet Recognition may not necessarily target these outcomes as part of the certification process. Improvements in hospital processes should ultimately improve the quality of hospitals. Therefore, the expectation is that MHs should be similar in terms of quality outcomes and the variability of quality measures within MHs should be low.

Literature indicates that almost all studies that compared MHs and non-MHs in terms of different structures, processes, and outcomes, were conducted prior to the launch of the OHQSR by the CMS and 2008 MM adopted by ANCC. The studies did find that

MHs show better quality outcomes than the non-MHs. This study is different from prior studies in two important aspects. First, it examines whether the new MM has improved the performance of MHs compared to non-MHs in terms of processes the Magnet Recognition intends to improve; non-MHs may already have incentives to improve structure, process, and outcomes irrespective of Magnet Recognition.

The CMS's quality measures are independently derived and these measures are supposed to indicate the level of hospital quality across different hospitals. The Magnet Recognition, through the recognition process, is likely to improve the processes compared to non-MHs. These processes, if effective in improving overall quality, should have positive effects on the quality of MHs. Comparing MHs and non-MHs in terms of overall quality measures defined by an independent entity (CMS) should indicate whether the Magnet Recognition did, in fact, improve all the seven aspects of overall hospital quality.

Second, this study will be able to test whether the new MM has made the MHs more or less similar in terms of overall hospital outcome measures. The hospital accreditation process intends to ensure that evidence-based structural aspects and service delivery processes are in place for achieving good outcomes, both in terms of care related outcomes as well as financial outcomes. To address this specific question, this study will examine variabilities within MHs in terms of externally defined hospital quality outcomes. Prior studies have not examined variabilities within MHs, implicitly assuming that the Magnet Recognition process improves hospital quality for all the MHs.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The number of Magnet hospitals (MHs) in the U.S.A has increased over the years. Although less than 8% of hospitals are recognized as Magnet Hospitals, it is important to evaluate outcome differences within MHs, and between MHs and non-MHs. The purpose of the study is to examine the differences between MHs and non-MHs in terms of characteristics, structure, and quality of patient outcomes.

To provide the context of this analysis, sections 2.2 and 2.3 describe the Magnet Recognition (MR) process and the Center for Medicare & Medicaid Services (CMS) outcome measures. Magnet Recognition is described in terms of its history, theoretical underpinnings, and research findings, as utilized by the American Nurse Credentialing Center (ANCC) in the original development of the standards. This chapter also provides details on the development of seven domains considered under the CMS's Overall Hospital Quality Star Ratings (OHQSR).

2.2 Magnet Recognition (MR)

The descriptions related to Magnet Recognition provided here are directly obtained from the ANCC website, 2014 Magnet application manual by the ANCC, and a book titled "Magnet®: The Next Generation: Nurses Making the Difference"(Dernkard et al., 2011).

Magnet Recognition History

In the1970s, the United States experienced a significant shortage of nurses. The nursing shortage created a high turnover among nurses in the hospital setting (Dernkard et al., 2011, pp. 1–2). In 1973, the American Academy of Nursing (AAN) set up the Task Force on Nursing (TFN) to tackle the problem of nurse shortages and high turnover. However, rather than looking at the causes of high turnover rates, the TFN decided to investigate the reasons for the high retention rate of nurses in some hospitals (Dernkard et al., 2011). In the mid-1970s, the TFN conducted a Magnet study (MS) that included forty-one hospitals in the U.S.A with high nurse retention rates (Dernkard et al., 2011). The task force divided the country into eight regions, and fellows from AAN were asked to choose six to ten hospitals from each region. AAN appointed fellows who were not employed by any of the chosen hospitals to avoid any conflicts of interest (Dernkard et al., 2011). The chosen hospitals were required to have low nurse turnover, be known as good places to work, and be in a position to compete with other hospitals in attracting hospital staff (McClure et al., 1983). Based on these criteria, 165 hospitals were chosen, and the TFN decided to name them Magnet Hospitals.

The TFN sent data collection forms to the chief nursing officers (CNOs) in the chosen hospitals to collect data on measures related to nursing. While waiting for feedback from the chosen hospitals, TFN piloted a study in one of the regions (Dernkard et al., 2011). The TFN realized that many of the 165 hospitals chosen were not qualified for the Magnet Status. Forty-one hospitals were selected from the 165 hospitals for the Magnet study. The selected hospitals had a mix of characteristics, and the hospital bed-

size ranged from 99 to 1000 beds, with occupancy rates ranging from 72% to 98%, and different types of ownerships (Dernkard et al., 2011).

The TFN found that the forty-one MS hospitals shared common characteristics, later known as the fourteen Forces of Magnetism (FOMs), good performance (McClure et l., 1983; McClure & Hinshaw, 2002). Each hospital's environment was "…a practice setting with the congruence of values at all levels of the organization, a clear vision and actualization of the roles of the professional nurse, and consistent administrative support regarding the value of staff and patients" (Dernkard et al., 2011).

In 1994, ANCC officially launched its first generation of Magnet Recognition, which was designed based on the fourteen FOMs from the original MS. The University of Washington Medical Center was the first and the only hospital from the original MS that was awarded the Magnet Recognition accreditation. In the early stages, Magnet Recognition focused only on nursing services such as structure, leadership, turnover rate, retention, education, practice, and nursing indicators. As a result, the Commission on Magnet Recognition (COM) renamed the Magnet Recognition program Magnet Nursing Service Recognition (MNSR) (Dernkard et al., 2011). Later, after adding more structure, process, and outcome measures to the MNSR process, the name was changed back to the Magnet Recognition program in 2002. As a result of these additional measures, the Magnet Recognition program was redesigned to focus on four primary areas, namely: nursing services; adherence to national standards; support of nurse proficiency; improved awareness for patient diversity; and provider autonomy (Dernkard et al., 2011).

In 2007, the COM held a summit that included thirty experts across the US to introduce the new Magnet model (MM) (Dernkard et al., 2011). In 2008, the ANCC

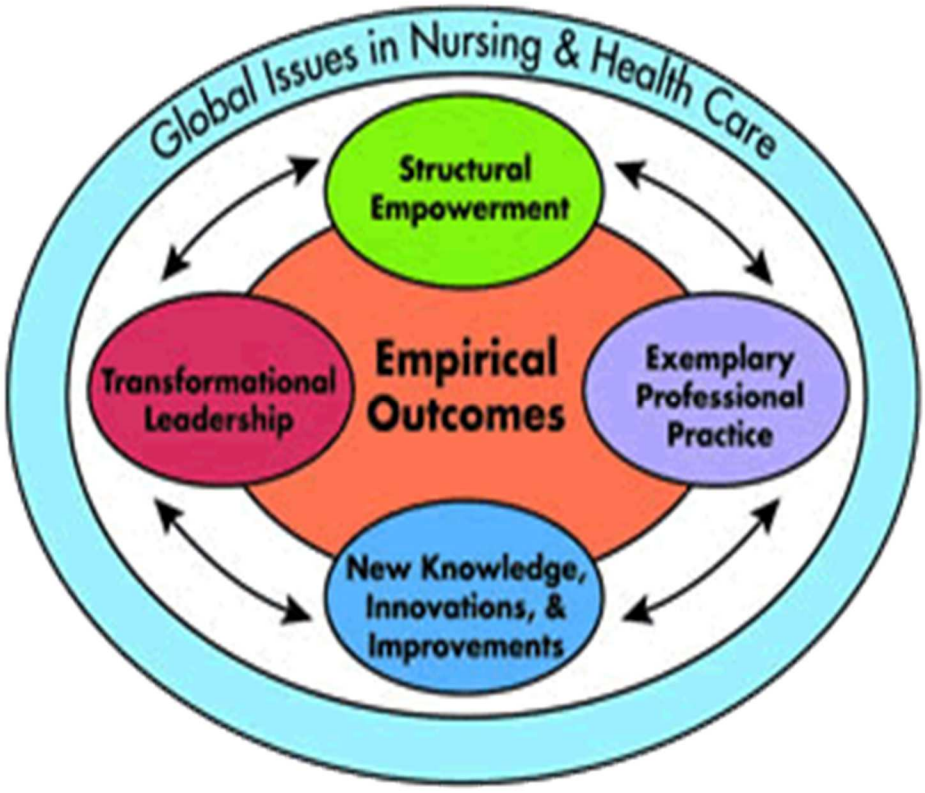
released its second and latest generation of Magnet Recognition with a new MM. Table 2.1 summarizes the historical timeline of Magnet Recognition.

Table 2.1: Magnet Recognition History Timeline

Year	Action
1983	The American Academy of Nursing (AAN) Task Force on Nursing Practice in Hospitals conducted a study to identify work environments that attract and retain well-qualified nurses who promote quality patient, resident, and client care. Forty-one of 163 institutions possessed qualities that enabled greater capacity to attract and retain nurses and were therefore described as "magnet" hospitals. The characteristics that distinguished these organizations from others are known to this day as the "Forces of Magnetism."
1990	**June:** The American Nurses Credentialing Center (ANCC) was incorporated as a subsidiary nonprofit organization through which the American Nurses Association (ANA) offers credentialing programs and services. **December:** The ANA Board of Directors approved a proposal for the Magnet Hospital Recognition Program for Excellence in Nursing Services, building upon the 1983 magnet hospital study conducted by the AAN.
1994	The University of Washington Medical Center, Seattle, WA, became the first ANCC Magnet-designated organization.
1997	The program became known as the Magnet Nursing Services Recognition Program and qualification criteria were revised using *The Scope and Standards for Nurse Administrators* (ANA, 1996).
1988	Magnet expanded to include long-term care facilities.
2000	Magnet expanded to recognize health care organizations outside the US.
2002	The program name officially changed to Magnet Recognition Program®.
2007	ANCC commissioned a statistical analysis of Magnet appraisal team scores from evaluations conducted using the *2005 Magnet Recognition Program ® Application Manual.* This analysis clustered the Standards of Excellence into more than 30 groups, yielding an empirical model for the Magnet Recognition Program.
2008	The Commission on Magnet introduced a new vision, and a new conceptual model that grouped the 14 Forces of Magnetism (FOM) into five key components: Transformational Leadership; Structural Empowerment; Exemplary Professional Practice; New Knowledge, Innovations, & Improvements; and Empirical Outcomes.
2011	Approximately 6.61% of all registered hospitals achieved ANCC Magnet Recognition® status, according to the American Hospital Association *Fast Facts on US Hospitals, 2011."*

Source: ANCC

The new MM consists of five components that are mainly related to nursing processes and outcomes. The five components of MM are Transformational Leadership (TL); Structural Empowerment (SE); Exemplary Professional Practice (EP); New Knowledge, Innovations, and Improvements (NK)- all of which lead to the component, Empirical Outcomes (EO)" (Dernkard et al., 2011). Figure 2.2 shows the MM components and how they relate to each other to solve global issues in nursing.



Source: ANCC, 2008

Figure 2.2: Five Components of Magnet Model

There are multiple sources of-evidence that are required under each component, and these requirements were created to allow hospitals to improve outcomes and maintain Magnet Recognition status (American Nurses Credentialing, 2013).

Transformational Leadership (TL)

MM designed the Transformational Leadership (TL) to transform organizations from the traditional leadership style to the new concept of leadership with different achievements; "Unlike traditional leadership, Transformational Leadership changes organizational values, beliefs, and behaviors to achieve an optimal level of success" (Dernkard et al., 2011). The new style of TL requires supporting clinical professions with appropriate tools to achieve its' goals.

Structure Empowerment (SE)

SE is the second component of the MM. The structure of healthcare in Donabedian's model includes human resources, policy, system, assets, environment, procedure, programs, the organization's environment, and any element that is needed to provide healthcare services (Avedis Donabedian, 1980). Empowerment was described as " …the giving or delegation of power or authority; the giving of ability, enablement or permission" (Dernkard et al., 2011, p. 44). Magnet Recognition focuses on empowering nurses at all levels of practice using a horizontal structure of management to enhance and expedite vertical communications within an organization to maximize nurses' autonomy and nurses' outcomes.

Exemplary Professional Practice (EP)

EP is the third component in the MM. Magnet Recognition relies on available evidence from the literature that supports the EP concept and demonstrates the

generalizing of EP to different organizations (Dernkard et al., 2011). One of the EP's elements is the Professional Practice Model (PPM) for nursing. Magnet Recognition requires nurse leadership in hospitals to ensure its PPM is aligned with the organization's vision and mission. The concept of a nursing PPM consists of management governance, care delivery, professional relationships, recognition reward (development), and professional values, all of which must adhere to the organizations' mission and vision (Hoffart & Woods, 1996; Wolf & Greenhouse, 2007).

Under the EP component, there are six frameworks where Magnet Recognition requires hospitals to present measurable structure, process, and outcomes for each framework to reach the desired outcomes (Dernkard et al., 2011). The six frameworks are:

1. Frameworks for ensuring autonomy, accountability, and peer review
2. Frameworks for ensuring and supporting competence and ethical practice
3. Frameworks for ensuring privacy, security and confidentiality, workplace advocacy, and diversity
4. Approaches to building a culture of safety
5. Frameworks for interdisciplinary collaboration and leadership
6. Methods for quality care monitoring and improvement

New Knowledge, Innovation, and Improvements (NK)

NK is the fourth component of the MM. Magnet Recognition defined evidence-based practice in its 2008 Magnet manual as, "The conscientious use and integration of the best research evidence with clinical expertise and patient preferences" (Sackett et al., 2000). While innovation was defined as "a novel set of behaviors, routines, and ways of

working that are directed at improving health outcomes, administrative efficiency, cost-effectiveness, or users' experience and that are implemented by planned and coordinated actions" (Greenhalgh et al., 2004). Factors such as education, innovation, and evidence-based practice impact nursing practices and help create a culture of continuous quality improvement (Funk et al., 1995; Retsas, 2000; Titler & Everett, 2006).

Empirical Outcomes (EO)

Empirical-outcomes are the fifth component of the MM. The empirical-outcomes integrates and continuously measures five sources-of -evidence that are derived from TL, SE, EP, and NK to optimize healthcare outcomes related to nursing (Dernkard et al., 2011). The process of measuring and following up on health outcomes after receiving health care was introduced by Florence Nightingale and Ernest Codman (Avedis Donabedian, 1989; Nightingale, 1860).

The COM captures specific nurse-sensitive indicators such as patients, nurses, and organizations, relying on the fourteen FOMs, the Institute Of Medicine (IOM) reports, and the National Quality Forum (NQF) (Dernkard et al., 2011). Since 2008, Magnet Recognition has focused on measuring outcomes. It also requires hospitals to demonstrate structures and processes that lead to specific empirical-outcomes (American Nurses Credentialing, 2013; Dernkard et al., 2011).

Table 2.3 lists the fourteen FOMs and their numbers, which are given by the ANCC and the eight domains of evidence, which all are classified under each of the five MM components.

Table 2.3: Force of Magnetism and Related Magnet Model Components

Forces of Magnetism	Empirical Domains of Evidence	Magnet Model Components
Quality of Nursing Leadership (#1) Management Style (#3)	Leadership	Transformational Leadership (TL)
Organizational Structure (#2) Personnel Policies and Programs (#4) Community and the Healthcare Organization (#10) Image of Nursing (#12) Professional Development (#14)	Resource Utilization and Development	Structural Empowerment (SE)
Professional Model of Care (#5) Consultation and Resources (#8) Autonomy (#9) Nurses as Teachers (#11) Interdisciplinary (interprofessional) Relationships (#13) Quality of Care: Ethics, Patient Safety, and Quality infrastructure (#6) Quality Improvement (#7)	Professional Practice Model Safe and Ethical Practice Autonomous Practice Quality Process	Exemplary Professional Practice (EP)
Quality of Care: Research- and Evidence-Based Practice (#6) Quality Improvement (#7)	Research	New Knowledge, Innovation & Improvements (NK)
Quality of Care (#6)	Outcomes	Empirical Quality Outcomes (EO)

Source: ANCC

Magnet Recognition Process, and Requirements

Magnet Recognition requires specific eligibility criteria. Hospitals are required to have specific nursing structures and processes to ensure that hospitals can achieve Magnet Recognition requirements. Some of these requirements consist of involving nurses in leadership, defining the responsibilities of nurses, and requiring specific education (Dernkard et al., 2011).

The ANCC awards Magnet Recognition, and the recognition as a Magnet Hospital (MH) requires a hospital going through a comprehensive process using the Magnet Recognition model for improving the nursing work environment and hospital outcomes. The processes could be financial, patient, or organizational outcomes. Magnet Recognition requires hospitals to show proof of improvements for selected outcomes throughout the initial four years and compare those outcomes against available external national benchmarks. Hospitals are allowed to choose the national benchmarks with which they wish to be compared (Dernkard et al., 2011). If an external benchmark is not available for specific measures, hospitals have to benchmark themselves internally (Dernkard et al., 2011). In both external and internal benchmarks options, hospitals have to outperform the chosen national benchmark for the selected measures (Dernkard et al., 2011). For example, a hospital can choose to externally benchmark their outcomes with other hospitals using the National Database of Nursing Quality Indicator (NDNQI). Most hospitals seeking or maintaining magnet recognition use this benchmark because it provides facility-level measures on specific nursing outcomes (Dernkard et al., 2011).

The Magnet Recognition accreditation process is comprehensive and takes at least four years. Hospitals must submit defined empirical outcomes and must outperform the

mean or mode of chosen national benchmarks, to get recognized as a Magnet Hospital (American Nurses Credentialing, 2013).

2.3 CMS' Overall Hospital Quality Star Rating's (OHQSR) Seven Domains

The publication of quality matrices in hospital settings by the CMS is a relatively new phenomenon in the U.S.A. CMS started the initiative of star ratings by emphasizing patient satisfaction in a hospital setting. The measure and collection of data related to patient satisfaction were initiated by the CMS and became a requirement for hospitals in 2007 (CAHPS, 2016). Since 2007, all hospitals receiving payment under the Inpatient Prospective Payment System (IPPS) are required to conduct the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey. If a hospital receiving payments under IPPS refuses to participate, a 2% penalty is imposed on the hospital's annual payment (Medicare, 2014). In 2008, HCAHPS scores became the first patient satisfaction tool in the U.S.A. (Medicare, 2014). The HCAHPS measures were used for the first time in CMS history to generate comparable star ratings for hospitals in the U.S.A. (Medicare, 2017).

In 2015, the CMS started to publicly announce hospital star ratings using HCAHPS outcomes (Medicare, 2017). In July 2016, the CMS introduced OHQSR, which includes transparent and publicly available information about hospital quality, to help patients choose the right hospital. It is now a nationwide comparison of hospitals available through the CMS' Hospital Compare (HC) website (Medicare, 2017). Star ratings make it easier for consumers to understand the relative quality of hospitals in their local areas and nationwide (Medicare, 2017).

2.4 Theoretical Approach

Hospitals are of different sizes, locations, and service specialties, and each has its strategies for utilizing its resources and setting their own processes to generate desired outcomes. Consequently, variations in hospital structures, processes, and outcomes are expected across different hospitals. Hospitals intend to improve financial, organizational, and patient-related outcomes. This section describes the underlying theoretical model that can help explain the processes hospitals are likely to follow to achieve the intended outcomes.

2.4.1 Theoretical Framework: Donabedian's Structure, Process, and Outcome (SPO) Model

Structure is defined by Donabedian a being "… concerned with such things as the adequacy of facilities and equipment; the qualifications of medical staff and their organization; the administrative structure and operations of programs and institutions providing care; fiscal organization and the like." Structural elements include material resources, human resources, and organizational structures needed by health care facilities to provide quality care (A. Donabedian, 1988; Avedis Donabedian, 1966).

The process is the actual care provided to patients. This could include evidence-based practice, diagnostic tests, treatments, protocols, or other medically necessary treatments (A. Donabedian, 1988; Avedis Donabedian, 1966).

Health outcomes can be positive or negative after patients receive care in the healthcare facility. Health outcomes include mortality, surgical outcomes, satisfaction, etc. Health outcomes are broadly defined to describe the health status of patients and the population. Outcomes may include helping patients to change their behavior and

empowering patients with knowledge regarding their health or even something as simple as patient satisfaction (A. Donabedian, 1988; Avedis Donabedian, 1966).

Donabedian argued that using quality framework components such as structure, process, and outcomes, without knowing the science of the relationship between these components, would cause the assessment of quality to be inaccurate. He stated that "It has the major limitation that the relationship between structure and process or structure and outcome, is often not well established." In addition, some relevant factors to outcomes were not taken into account when improving healthcare outcomes such as patient satisfaction, patient attitude, and social factors (A. Donabedian, 1988; Avedis Donabedian, 1966). Donabedian suggests focusing on measuring defined structures or processes and relating them with specific outcomes as a reliable way to improve the quality of care (A. Donabedian, 1988; Avedis Donabedian, 1966).

Donabedian believed that structure, process, and outcomes could be used to judge the healthcare quality (A. Donabedian, 1988). According to Donabedian, available science was weak in identifying specific structures that lead to better processes or specific processes that lead to better outcomes. Further investigation is needed to better understand the healthcare quality of assessment (A. Donabedian, 1988).

2.5 Literature Search on Studies Comparing MHs to Non-MHs

The following sections describe some studies that used Donabedian's framework (SPO) to compare outcomes between MHs and non-MHs.

2.5.1 Hospital Characteristics, Structure/Process, and Outcomes SPO Model

Researchers used hospital mortality rates among the Medicare population to compare hospital quality (Aiken et al., 1994). This research used Medicare cross-

sectional data from 1988, which included 39 MHs, and their matched of 195 non-MHs. Aiken et al. included the MHs (41) that the ANCC used for the original Magnet study in 1982, except for two hospitals. The authors utilized the Propensity score (PS) to match 1 Magnet hospital to 5 non-MHs (195 non-MHs) from a pool of 5,053 hospitals. A propensity score is a logistic regression to predict the logit. The study included non-MHs with 100 or more Medicare discharges. The matching criteria were based on twelve hospital characteristics such: ownership, hospital size, including average daily census, number of beds, financial status, teaching status (Aiken et al., 1994). These characteristics, in addition to nursing human resources indicators, were used to explain the differences in mortality outcomes between 39 MHs and 195 non-MHs. T-tests paired along with ANOVA, were utilized for analysis (Aiken et al., 1994). The findings after adjusting for differences in expected mortality within 30 days of admission was significantly lower by 4.6% in MHs compared to the non-MHs (Aiken et al., 1994). Also, the findings before adjusting for mortality revealed that MHs were significantly lower by 7.7% compared to the non-MHs (Aiken et al., 1994).

In addition to the healthcare quality requirements by the CMS, hospitals make themselves accountable by applying to non-profit and private institutions such as Leapfrog's hospital Safety Score (HSS) and ANCC's Magnet Recognition for healthcare quality improvements. These programs measure the quality of patient outcomes and hold hospitals accountable for overall healthcare outcomes (Dupree et al., 2014; Pakyz et al., 2017). One set of measures used by both Leapfrog and Magnet Recognition is health-associated infections (HAIs). HAIs are preventable, and they usually occur during hospitalization due to the lack of good patient safety infrastructures, poor working

environment, or prescription abuse, especially broad-spectrum antibiotics (Pakyz et al., 2017). Hospitals can improve HAI rates by having the right resources and processes. For example: using gloves and gowns, adoption of antiseptic processes, hand hygiene, and antibiotics stewardship (Pakyz et al., 2017). In the U.S.A, HAI rates and costs are considered high. One in twenty-five inpatients contracts a HAI and 10.7% of patients experience multidrug resistance such as methicillin-resistance Staphylococcus aureus (MRSA). About 12.1% of hospitalized patients experienced Clostridium difficile infection (CDI) (Pakyz et al., 2017).

Pakyz et al. investigated the association between MHs and hospitals with high HSS and a lower number of HAIs (Pakyz et al., 2017). The author used five data sets to analyze CDI and MRSA bloodstream infections across hospitals. The five data sets were: CMS hospital compare 2013 data; standardized infection rate (SIR) from the Centers for Disease Control and Prevention's National Healthcare Safety Network (NHSM); Magnet status; 2012 of AHA data; and 2013 Leapfrog HSS. It should be noted that Leapfrog did not include CDI and MRSA bloodstream infection in the HSS calculation, HSS includes thirty different measures (Pakyz et al., 2017). The sample included nonfederal and acute care hospitals, excluding both Maryland and long-term hospitals, because they did not participate in the 2013 NHSN (Pakyz et al., 2017). The total sample of hospitals, which were reported to SIR for CDI, was 2266, including 15 MHs. Also, the total sample for hospitals reporting MRSA was 1701, including 19 MHs (Pakyz et al., 2017).

A multivariate ordered probit regression analysis revealed that HSS's grade A, B, and C found to be negatively associated with the mean of CDI compared to hospitals with grades "D and F". The mean CDI in hospitals with grad "A" were better by (-16%;

p<0.01) and hospital with grades "B and C" were better by (-14%; P<0.05). in contrast, this was not the case for MRSA, as there was no difference between HSS's grade A, B, C, D, and F for MRSA (Pakyz et al., 2017). In terms of Magnet status, the mean of MRSA bloodstream infections was larger (worse) and associated with MHs. The mean MRSA of MHs compared to non-MHs was higher by 0.74 (P<0.001); on the other hand, the mean of CDI was smaller (better) and associated with MHs. The mean CDI was lower by (-0.21) (P<0.01) in MHs compared to non-MHs (Pakyz et al., 2017).

A recent study by Lippincott et al., which utilized Donabedian's framework, compared between 330 MHs and 4939 non-MHs on better utilizing Electronic Health Record (EHR) Incentive Program by the CMS, both MHs and non-MHs were eligible (Lippincott et al., 2017). Also, the author compared 393 MHs and 6419 who were both qualified for evaluation in Healthcare Information and Management Systems Society (HIMSS) Analytics Electronic Medical Record (EMRAM) (Lippincott et al., 2017). Medicare's EHR incentive program is an initiative that CMS started in 2009 and become effective in 2015 (Lippincott et al., 2017). CMS incentivizes hospitals that implemented, adopted and meaningful use EHR and penalizes them if the participating hospitals did not fulfill the requirements (Lippincott et al., 2017). In terms of the EMRAM, HIMSS evaluates hospitals "on an eight-point scale, from zero to seven in ascending order, based on their level of the electronic medical record (EMR) adoption" (Lippincott et al., 2017). The study explained how by changing their structure, process, MHs used EHR to gain better CMS's financial incentives and HIMSS' rankings compared to non-MHs. (Lippincott et al., 2017).

Only a few articles explored the relationship between CMS's seven domains. A recent study compared 44 MHs and 415 non-MHs across CMS's star ratings in the Southwest of the U.S.A (Arizona, Californian, Hawaii, Nevada, and New Mexico) (Robbins, 2017). Most of the 44 MHs were located in metropolitan areas, mostly teaching hospitals or hospitals affiliated with teaching programs and relatively large hospitals. The result of the comparison was that MHs received higher CMS star ratings compared to non-MHs (3.34 stars vs. 2.86 stars, $P<0.001$).

2.5.2 Nurse Related Structures/Process and Outcomes SPO Model

A study by Kanlich and Lee focused more on analyzing care units rather than a large hospital sample, compared missing nursing care in 124 care units. The study measured "medical-surgical, intermediate, intensive care, and rehabilitation units" between four MHs and seven non-MHs located in the West and Midwest of the U.S. (Kalisch & Lee, 2012). Missed nursing care is a concept developed by Kalisch in 2006. The author defined twenty-four measures of missed nursing care as "ambulation, turning, delayed or missed feedings, patient teaching, discharge planning, emotional support, hygiene, intake and output documentation, and surveillance." Using these criteria, Kalisch identified seven reasons reported from nursing staff underlining the causes of the missing nursing care (Kalisch, 2006). Overall, missed nursing care was statistically significantly less in MHs than non-MHs (Kalisch & Lee, 2012).

Generally, literature shows that when comparing between MHs and non-MHs, MHs had better work environments and patient outcomes. Goode et al. found that some nurse staffing and patient outcomes were better in non-MHs than MHs (Goode et al., 2011). This author provided a comparison for the effect of operational factors such as

nurse staffing and patient outcomes on the general unit and ICUs between 19 MHs and 35 non-MHs. He used the University Health Systems Consortium data from 2005 as a source of measures (Goode et al., 2011). The selected patient outcomes in this study were developed by the Agency for Research in Healthcare Quality (AHRQ. The AHRQ calculated its outcomes by dividing observed outcomes by expected outcomes to get the ratio of risk-adjusted outcome rates (Goode et al., 2011). Goode et al.'s findings showed that the rates of postoperative sepsis in ICUs/general units and the rate of postoperative metabolic derangements in ICUs were significantly higher in MHs than non-MHs (Goode et al., 2011).

The Goode et al. findings were criticized by Craig Luzinski, the director of Magnet Recognition, and raised three major issues (Ponte & Luzinski, 2012). First, this study used data from 2005 to investigate patient outcomes. This does not take into account that Magnet Recognition has been in effect since 2008 or that the ANCC reengineered the Magnet recognition and required more standards than those that existed in 2005. If more recent data had been used, the outcomes are likely to be more favorable (Ponte & Luzinski, 2012). Second, when the study was conducted, there were 391 MHs; however, the sample used included only 19 MHs, which is considered a minimal sample size to generalize when compared to the overall number of MHs (Ponte & Luzinski, 2012). Finally, the last issue was the sample selection. The sample included only educational hospitals, which created a bias since educational hospitals are excellent facilities that applied evidence-based practice (Ponte & Luzinski, 2012). Thus, non-MHs selected for the study could share the same characteristics as the MHs (Ponte & Luzinski,

2012). Two years after the Goode et al. study, 13 hospitals from the non-MHs became MHs (Ponte & Luzinski, 2012).

A study by McHugh et al. investigated risk-adjusted 30-day inpatient mortality rates and failure-to-rescue for surgical patients aged 21-85 experiencing general orthopedic or vascular surgery (McHugh et al., 2013). The sample for this study was collected in 2006-2007 from general and acute hospitals in four large states: Pennsylvania, New Jersey, Florida, and California. The selected hospitals held >20% of the total hospitalizations in the nation, which makes the sample representable (McHugh et al., 2013). The authors used three logistic models to compare 56 MHs with matched 508 non-MHs using propensity scores from four states to find the odds ratio of the chosen outcomes (McHugh et al., 2013). McHugh et al. went beyond Magnet Recognition requirements and investigated whether MHs had better mortality rates, as found by Aiken in 1994 using different explanatory variables (McHugh et al., 2013). The author used the Practice Environment Scale of the Nursing Work Index (PES-NWI) and focused on variables related to nursing measures and selected outcomes, which included staffing levels, education, the level of support for nursing practices, and nurse' work environment (McHugh et al., 2013).

The study found that MHs were associated with a better working environment, education, and specialty certification, which explained the 12% lower odds of failure-to-rescue (odds ratio was 0.88 and *P*-Value= 0.07), and 14% lower odds of mortality rates (odds ratio was 0.77 and *P*-Value= 0.02), after controlling for nursing, hospitals, and patients factors (McHugh et al., 2013). Although McHugh et al. accounted for measures and sample limitations by Aiken et al. and included more related nursing explanatory

variables, both studies found that MHs were better than non-MHs in terms of adjusted 30-day mortality.

Another study by McHugh et al. compared between 25 Kaiser Permanente hospitals (all non-MHs), 56 MHs, and 483 non-MHs, "The Kaiser Permanente model of integrated health delivery is highly regarded for high quality and efficient health care. Efforts to reproduce Kaiser's success have mostly failed" (McHugh et al., 2016). The study found that the non-MHs from Kaiser Permanente system performed better than the non-MHs on investing in nursing issues such as nurse burnout, job satisfaction, and intent-to-leave) and their effect on patient outcomes like mortality and failure-to-rescue (McHugh et al., 2016). Also, when comparing between the Kaiser's non-MHs, MHs, and non-MH, the findings indicated that factors like nursing characteristics, education, and work environment were associated with better outcomes in Kaiser's non-MHs and MHs compared to the non-MHs (McHugh et al., 2016).

Andrew and colleagues investigated two of the nurse indicators in 2013. They merged retrospective data from 2001-2005 from Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS), AHRQ, and AHA to investigate the occurrence of pressure ulcers and failure-to-rescue. Comparisons were made between eight MHs and 80 matched non-MHs in 22 states based on the covariates of twelve hospital characteristics such as geographic region, patient discharges, bed size, ownership, teaching status, etc. (Mills & Gillespie, 2013). Mills et al. found that there were no differences between MHs and non-MHs on the selected outcomes (Mills & Gillespie, 2013). Interpreted Mills et al. findings suggest that Magnet Recognition

focused on nurse practice environments, but it did not focus on specific nurse-patient related outcomes.

Since the start of Magnet Recognition in 1994, the MHs showed better financial outcomes and nursing job outcomes such as satisfaction and burnout (Friese et al., 2015). Friese et al. argued and criticized some of the previous studies and claimed that although it is mentioned on ANCC's website, the findings of three cross-sectional studies that were published (Aiken et al. on lower morality of Medicare patients, Lake et al. on neonates mortality, and McHugh et al. on mortality due to surgical complications) showed the promise of improving patient outcomes, it was not clear whether or not Magnet Recognition had improved patients outcomes (Friese et al., 2015). The author's justification was "First, these findings have not been replicated with nationally representative longitudinal data. Second, previous studies have not determined whether patient outcomes improve after Magnet recognition is obtained" (Friese et al., 2015).

In 2015, Friese et al. focused on Magnet Recognition to investigate the differences between MHs and non-MHs on specific causes of patient mortality (Friese et al., 2015). Friese et al. analyzed Medicare's hospitalized patients data between 1998-2010 to compare both risk-adjusted 30-day mortalities and failure to rescue (death after postoperative complication) between MHs and matched non-MHs (Friese et al., 2015). Patients who underwent coronary artery bypass graft surgery, colectomy, or lower extremity bypass for the selected period were chosen for the analyses except for patients who died on the first day of admission (Friese et al., 2015). The sample of this study included 5,057,22 patients, 65 years old and older, with Medicare fee-for-service access, and treated in 5,222 hospitals during the study period (Friese et al., 2015). After matching

each of the MHs with two non-MHs, the sample was limited to 1,897,014 patients in 993 hospitals (331 MHs and 662 non-MHs) (Friese et al., 2015). Failure to rescue is a desirable measure for quality of care because it addresses a hospitals' ability to identify complications as well as having the willingness and readiness to treat them rather than just the existence of complications (Friese et al., 2015). Also, researchers related failure-to-rescue as the cause of death for patients with pneumonia, sepsis, acute renal failure, deep vein thrombosis due to pulmonary embolus, shock due to cardiac arrest, and gastrointestinal hemorrhage due to acute ulcer (Mills & Gillespie, 2013).

The findings were that MHs had better outcomes than non-MHs for surgical patients for both 30-day mortality rates and death after postoperative complications. MHs 30-day mortality rate (7.7%) and death after postoperative complications (8.6%) were less than non-MHs, respectively (Friese et al., 2015). However, during the study period, patient outcomes at Magnet Recognition hospitals did not improve after they became recognized (Friese et al., 2015). Moreover, even though the Magnet original study in 1983 declared that MHs had a better nurse to staff ratio than non-MHs, Friese et al. findings showed that the nurse staffing level had no effect on MHs for both 30-day mortality rates and failure to rescue. This observation may be explained by hospital size effect, as the majority of MHs are considered big hospitals (Friese et al., 2015). Evidence from McHugh et al. supported the findings of Friese et al. concerning Magnet Recognition by stating that nursing quality rather than nursing ratio was important and most associated with lower mortality rates in hospitals (Friese et al., 2015). It is important to emphasize that within Friese et al. study period, Magnet Recognition had undergone many changes in their process. In 2008 Magnet Recognition included more requirements

and accountability for patient outcomes, which could enhance patient outcomes in the future (Friese et al., 2015).

In literature, little is known about specialty hospitals such as Magnet Children's Hospitals. A study investigated if there was any association between registered nurses (RN) characteristics such as RN staffing and RN skill mix, and Magnet Recognition status to the organizational volume in the number of patient mortality resulting from congenital heart surgery in children's hospitals (Hickey et al., 2010). One of the RN staffing measures is "worked hours per patient day" (WHPPD), and it was defined as "the average number of productive and nonproductive hours of nursing care per patient day provided by RNs for congenital heart surgery patients in the ICU" (Hickey et al., 2010). The RN skill mix was defined as "Nursing skill mix was defined as the percentage of RNs versus clinical assistants and non-RNs in the staffing models of these ICUs (Hickey et al., 2010).

The sample consisted of 38 of children's hospitals, 16 of which were MHs (Hickey et al., 2010). Descriptive statistics indicated that the range of the WHPPD in the 38 hospitals' ICUs were between (14.96-32.31), median was 25.80, the variation of the nursing skill mix in the 38 hospitals' ICUs was between (80%-100%), and the median was 98% (Hickey et al., 2010). Among the 38 hospitals, 16 (42.1%) hospitals were Magnet-recognized hospitals (Hickey et al., 2010). Besides, the median of nursing skill mix in MHs was significantly lower than non-MHs, 92% for MHs and 100% for non-MHs (*p-value*=. 02) (Hickey et al., 2010). WHPPD was not significant with Magnet Recognition (Hickey et al., 2010). Also, risk-adjusted mortality rates were not associated with both Magnet Recognition and any of the nursing characteristics, but high hospital

volume was statistically significant with lower mortality rates, which was also consistent with the findings of previous studies (Hickey et al., 2010).

Upenieks et al. utilized Donabedian's model to examine two hospitals that were in the process of acquiring Magnet Recognition (Upenieks & Abelew, 2006). After interviewing the hospitals staff, it showed that maintaining specific structures such as staffing, supporting, and engaging nurses in the decision-making and care process leads to satisfying the desired Magnet Recognition outcomes and becoming a MH (Upenieks & Abelew, 2006).

Patient satisfaction is measured by Consumer Assessment of Healthcare Providers and Systems (CHHPS) through surveys that cover both ambulatory services and facility providers such as hospitals, physicians' offices, health plans including mental health, and nursing homes (CAHPS, 2016). HCAHPS' survey consists of thirty-two questions that cover three major areas: "21 substantive items that encompass critical aspects of the hospital experience, four screening questions to skip patients to appropriate questions, and seven demographic items that are used for adjusting the mix of patients across hospitals for analytical purposes" (Medicare et al., 2017). The hospital experience includes information such as "communication with doctors, communication with nurses, the responsiveness of hospital staff, cleanliness of the hospital environment, quietness of the hospital environment, pain management, communication about medicines, discharge information, the overall rating of the hospital, and recommendation of the hospital" (Medicare et al., 2017).

Researchers used different approaches to compare between MHs and non-MHs and to identify factors that affect HCAHPS scores. Chen et al. sampled 110 hospitals, 20

MHs, and 90 non-MHs in Illinois (Chen et al., 2014). They used a combination of hospital, patient, and nurse characteristics to investigate whether Magnet Recognition explained a higher HCAHPS score (Chen et al., 2014). Teaching status, not-for-profit, number of beds, percentage of African American patients, percentage of Medicare payments, nursing hours per patient per day (NHPPD), registered nurse nursing hours per patient per day (RN-NHPPD), and RN-turnover were the study characteristics (Chen et al., 2014). They found that the mean of teaching hospitals, the number of beds, the percentage of Medicare payments, NHPPD, and RN-NHPPD were higher and statistically significant in MHs compared to non-MHs. (Chen et al., 2014). Second, Chen et al. included seven HCAHPS measures that were directly related to nursing care. Communication with physicians and cleanliness and quietness of the patients' room was excluded (Chen et al., 2014). The mean of all the seven selected measures were found to be higher and statistically significant in MHs than non-MHs (Chen et al., 2014). The study showed that both Magnet status and the hospital and nursing characteristics explained up to 57% of individual HCAHPS score variations (Chen et al., 2014). African American patients were the highest contributor, and hospitals with a higher number of African American patients were associated with lower HCAHPS scores. Magnet status, the second factor, explained up to 13% of the seven HCAHPS measures except "patients always received help as soon as they wanted" (Chen et al., 2014). While, both RN-NHPPD and RN-turnover explained 5% of HCAHPS score variations. Hospitals with higher RN-NHPPD and lower RN-turnover were associated with higher HCAHPS, and the rest of the hospital and nursing characteristics were not associated with HCAHPS score variations (Chen et al., 2014). The dataset used by Chen et al. was limited and

restricted to 110 hospitals in the state of Illinois with 100 bed-size or more. However, we used for this dissertation is nationwide and includes a larger sample of MHs and non-MHs.

Another study by Sarah Smith in 2014 used Donabedian's model to examine the relationship between hospitals' structure/process and patient satisfaction as an outcome. In theory, Donabedian's model is embedded in the process of the Magnet Recognition; therefore, hospitals that are in the process of receiving Magnet Recognition or became MHs should have better outcomes (Dernkard et al., 2011). Smith used the 2012 AHA, 2012 ANCC, and 2011 HCAHPS datasets. The sample size of the study consisted of 2,001 hospitals: 160 MHs, 99 Magnet Recognition in progress (MIP), and 1,742 non-MHs. Smith claimed that since both MHs and Magnet-in-progress underwent a comprehensive improvement of specific structure/process related to healthcare quality outcomes, they showed better patient satisfaction compared to non-MHs in six of seven HCAHPS measures (Smith, 2014).

For the analyses, Magnet status was defined as the dependent variable, and the independent variables were HCAHPS measures that relate to nursing and overall hospital experience. These included: "nurses always communicate well, always received help when wanted, the pain was always controlled, medications were always explained, information was given concerning recovery time, rated hospital as 9-10 on 1/10 scale, and would definitely recommend hospital" (Smith, 2014). This study did not perform any matching technique between MHs and non-MHs (Smith, 2014). Smith employed a multiple univariate analysis of variance (ANOVAs) to conduct multivariate analysis to investigate the effect of explanatory variables on every dependent variable (Smith, 2014).

The author uses the Bonferroni correction method to control type one errors usually associated with using multiple ANOVAs, which is a well-known method used by previous researchers (Smith, 2014). In Smith's study, there were two main findings. First, when using multiple one-way ANOVAs to find any significance between HCAHPS's highest-ranked rating and Magnet status, the Welch ANOVA analysis reported that HCAHPS measures were better and statistically significant (p-value < 0.001) with Magnet status. One of the HCAHPS measures "always received help when wanted" reported smaller p-value (p-value = 0.009). Second, when a Games-Howell post hoc analysis was run, the differences in the mean of the HCAHPS measures were better and statistically significant in MHs and Magnet Recognition in progress hospitals compared to the non-MHs (p-value < 0.001) (Smith, 2014). To confirm the findings, Smith utilized the Kruskal-Wallis Test; all findings were confirmed and significant except for one HCAHPS measure "pain was always controlled," which was not significant (p-value = 0.054) (Smith, 2014).

Stimpfel et al. conducted a study investigating the association between MHs and patient satisfaction. Stimpfel et al. used three sources of data from 2010: HCAHPS, AHA, and Magnet Recognition data (Stimpfel et al., 2015). There are two main steps that Stimpfel et al. performed for the study. First, the author matched 212 MHs with 212 non-MHs using propensity scores from a pool of 1886 non-MHs. Based on previous studies, Stimpfel et al. selected eleven major hospital characteristics as matching identifiers that might be associated with MHs: a mix of structural, ownership, financial, and geographic characteristics (Stimpfel et al., 2015). The eleven measures were "total bed size, occupancy rate, the percentage of patients with Medicare as their primary payer, the

percentage of patients with Medicaid as their primary payer, teaching status, high technology status, ownership, Catholic affiliation, average payroll expenses per bed, core-based statistical area, and rural referral center status" (Stimpfel et al., 2015).

For the analyses, Stimpfel et al. investigated the effect of having Magnet Recognition by comparing patient satisfaction outcomes before and after matching. Unadjusted pre-matching results showed that within the ten chosen patient satisfaction outcomes from HCAHPS, seven out of the ten outcomes were better and significantly associated with MHs (Stimpfel et al., 2015). Adjusted pre-matching results showed that MHs were better for six out of ten patient satisfaction measures (Stimpfel et al., 2015). Unadjusted and adjusted post-matching analysis indicated that MHs were better in four and five patient satisfaction measures, respectively (Stimpfel et al., 2015). The patient experience domain measures account for 22% of the OHQSR. They concluded that because MHs had undergone improvements in structure, process, and outcomes (Donabedian's framework), the MHs were able to achieve better HCAPHS outcomes than the non-MHs (Stimpfel et al., 2015).

A study by Ausserhofer et al. found that nurses in proper work environments were associated with more patients and family assessment and education, which may correlate with MHs receiving good patient feedback on HCAHPS (Ausserhofer et al., 2014). MHs are known to have proper environments for nurses and giving nurses support. In addition, they invest in resources needed to provide better care processes and communication with other disciplines and patients, which impacts patient outcomes and satisfaction (Carthon et al., 2015; Lasater et al., 2016).

Bartlett Ellis et al. conducted a study to investigate the effect of hospital characteristics and two of the HCAHPS measures related to physician and nurse communications on how well "always" explanation of new medication communication was given to patients, which is also one of the HCAHPS' measures. Hospital characteristics that were used in the study were Magnet status, ownership, hospital type, availability of emergency services, and hospital HCAHPS survey numbers (Bartlett Ellis, Bakoyannis, Haase, Boyer, & Carpenter, 2016). The author merged the 2015 ANCC Magnet list and the 2013 HCAHPS. After the merging, the sample became 300 of MHs and 3,120 of non-MHs; the author did not use matching strategy in the analysis (Bartlett Ellis et al., 2016). From the defined measures above, new medication communication measures were the dependent variable, and the rest of the measures were the explanatory variables (Bartlett Ellis et al., 2016).

Bartlett Ellis et al. utilized a univariate and multivariable regression analyses. In the univariate regression analysis, the results indicate that nurse and physician communications were strongly associated with medication communication (Bartlett Ellis et al., 2016). The means of the "nurses always communicated well," "physicians who always communicated well," physician type of ownership, number of the hospital "between 100-299" who completed HCAHPS survey, and hospital type "critical access hospitals" were statistically significant and higher by 9.12, 8.73, 8.67, 4.37 and 4.81 (p-value < .001), respectively (Bartlett Ellis et al., 2016). In contrast, the means of "proprietary" type of ownership and hospital who said "yes" they have "emergency services" were statistically significant and lower by (-1.03) and (-6.17) (p-value < .001), respectively (Bartlett Ellis et al., 2016). The multivariate regression reported indicated

that there of the predictors were statistically significant. The results reported that the means of the "nurses always communicated well", "physicians who always communicated well" were statistically significant and higher by 7.00 and 2.71 (p-value < .001), respectively (Bartlett Ellis et al., 2016). Also, the mean of "government/federal" type of ownership hospitals compared to "voluntary non-profit private" type of ownership hospitals was higher by 2.36 (p-value < .001) (Bartlett Ellis et al., 2016). In both analyses, MHs were not significant in the study outcome (Bartlett Ellis et al., 2016). Bartlett et al. mentioned that maintaining a patients' new medication communications before and after discharge, are important to achieve better patient care and satisfaction (Bartlett Ellis et al., 2016). Finally, Ellis et al. cited three studies published by Kutney-Lee et al. (2009), Clark, Leddy, Drain, and Kaldenberg (2007), and Boev (2012), which revealed that hospital characteristics such as the type of hospital, and ownership of the hospital; as well as, the associated effects by Magnet Recognition such as hospital work environment, better quality nurse work environments, better nurse staffing, and high nurse job satisfaction, were found to associated with enhancing new medication communications and patient satisfaction (Bartlett Ellis et al., 2016)

2.6 Important Impact of the CMS's Star Rating Measures Different CMS's Quality Programs

We have mentioned earlier that CMS's hospital compare measures include important outcomes for the U.S.A healthcare system, and they overlap with different CMS's quality programs such as CMS's star rating and VBP. Most of the measures, this study used (star rating measures), are overlapped with CMS' VBP. CMS's VBP pays and incentivizes hospitals based on healthcare quality. Comparisons between MHs and non-MHs in other CMS's quality programs such as the CMS's VBP programs that provide

insight into hospitals' quality performance, and the measures are used in our study. Because there are not many studies comparing between MHs and non-MHs in terms of CMS's star rating measures and since there is overlapping between CMS' quality programs measures, it is useful to report some of those studies in the next few paragraphs.

A recent study was conducted by Lasater et al., using hospital VBP from FY 2015, and ANCC Magnet recognized hospitals list in 2014, and 2014 AHA (Lasater et al., 2016). Lasater et al. investigated whether MHs performed better than non-MHs on VBP outcomes (Lasater et al., 2016). VBP in FY 2015 contained four domains with different weights including clinical process (20%), patient experience (3%), outcomes (30%), and efficiency (20%), and these domains are aggregated to give a total performance score (TPS) for each hospital (Lasater et al., 2016). Also, under each domain, there are different sets of measures that are aggregated to give the domain's weight.

The study sample consisted of 3,021 of Medicare providers, 323 MHs and 2,698 non-MHs (Lasater et al., 2016). To avoid any bias, MHs were matched with non-MHs with the selected hospital characteristics using genetic matching, a method employed to determine the best match criteria across the covariates (Lasater et al., 2016). For matching, the author used major hospital characteristics "matching identifiers" like size, market competition, and case-mix index that measures patient acuity, teaching status, technology status to determine if hospitals were able to perform organ transplants and open-heart surgery, ownership, and population density, were chosen based on existing studies (Lasater et al., 2016). Also, methods from previous researches were applied for

different research objectives, which consist of the propensity score for matching and Herfindahl-Hirschman index for market competition (Lasater et al., 2016). The result of this matching lead to a sample size of 323 MHs and 253 matched non-MHs (Lasater et al., 2016).

Lasater et al. conducted both linear and logistic analyses for pre-matching and post-matching analyses, and before and after adjusting for hospitals' characteristics, "the matching identifiers." Most of the post-matching findings before and after adjusting for the hospital characteristics proved that MHs had better and statistically significant in terms of the TPS as well as for the sub-domains score compared to the matched non-MHs with few exceptions (Lasater et al., 2016). Before and after adjusting for hospital characteristics, MHs' TPS was higher and statistically significant by 1.6 compared to non-MHs and better (Lasater et al., 2016). When breaking down the TPS to the four domains, analyses before and after adjusting for the hospital characteristics indicate that "clinical process" and "patient experience" domains were found to be better and statistically significant in MHs compared to the non-MHs (Lasater et al., 2016). The differences of means values between MHs and non-MHs for the clinical process and patient experience were almost the same at 1.6 (p-value < .05) and 3 (p-value < .05) respectively; however, "outcomes" domain was not significant (Lasater et al., 2016). In contrast, the analysis before adjusting for hospital characteristics for the "efficiency" domain indicated that the mean of MHs was lower and statistically significant by (-0.45) compared to non-MHs, and the analysis after adjusting for hospital characteristic was not significant (Lasater et al., 2016). More information about the pre-matching analyses' results is available in Lasater et al. article. Both significances in the clinical process and

patient experience were not surprising as they were consistent with previous researches and additionally, proves the goal of acquiring Magnet Recognition. One of the Magnet Recognition model elements is exemplary professional practice (Lasater et al., 2016; Stimpfel et al., 2015). Moreover, the author explains that the insignificant values in the outcome's domain were inconsistent with the previous research findings. MHs should have better outcomes in mortality rates and medical-surgical patients than non-MHs (Lasater et al., 2016).

Kahn et al. conducted a study in 2015 using CMS' VBPs data from FY 2015 (Kahn et al., 2015). Although Kahn et al. did not compare MHs to non-MHs; it gave an essential understanding of different CMS programs and their impact in the U.S.A hospitals. Many outcomes of these programs are overlapping with CMS's OHQSR, which is the outcome measure for this dissertation.

The author used logistic regression analysis to test the effect of specific hospital characteristics; bed size, ownership, teaching status, urban/rural designation, and the Medicare DSH patient percentage, on the performance of HVBP, HACRP, and HRRP; and to find whether or not hospitals received penalties that are imposed by VBPs when they did not meet their goals (Kahn et al., 2015). The first program is HVBP. In FY 2015, the payment withheld from the base operation payment was 1.5%. Based on the HVBP pool of performance, there was $126 million that was redistributed between 3,089 hospitals (Kahn et al., 2015). Among those hospitals, 44.4% (1375 hospitals) were penalized and 55% (1713 hospitals) received bonuses (Kahn et al., 2015). The penalties were not immense and the incentives gave motivation; the penalty's mean was 2% ($92,000) and the incentives' mean was 4% ($73,000) of the hospitals' total operating

payments (Kahn et al., 2015). The CMS changes the domain weights every FY. An example is that outcomes and efficiency have more weight in FY 2016 than in FY 2015, which may change the financial equation for hospitals, and the penalties increase as well as the bonuses (Kahn et al., 2015).

The second program is HACRP. Hospitals under this program are facing a 1% reduction if their performance scores in the 75th percentile (Kahn et al., 2015). Khan et al. found that 21.9% (724) of the 3,300 hospitals were subjected to the reduction. It was also observed that 589 hospitals had scores that were concentrated around the cutoff point (Kahn et al., 2015).

The third program is HRRP. CMS Hospital Comparisons began to be transparent, and in 2009 publicly published Medicare patient information on the readmission rate (Kahn et al., 2015). In fact, it was noted that readmission rates were decreased before the HRRP started in 2013. There is justification for the possibility that transparency created more competition between hospitals to have a good reputation for low readmission rates (Kahn et al., 2015). The study declared that 75.8% (2.673) of 3.478 hospitals were penalized and the mean of the penalty was 0.5%, which equals $161,000 ($424 million in total) (Kahn et al., 2015). In fact, HRRP is not budget-neutral like HVBP, which was more aggressive in hospital payments than HVBP (Kahn et al., 2015).

Finally, when the three programs (HVBP, HACRP, and ARRP) were combined across all hospital characteristics, the mean of the adjusted penalty was 0.5; the range was between 0.3 and 0.9 (Kahn et al., 2015). The study found that the penalties' mean for teaching status and bed size characteristics were significantly the highest by 0.9 for major teaching hospitals and by 0.8 for hospitals with 400 beds or more. The odd ratios of

receiving penalties for hospitals with major teaching characteristics were 1.60 for HVBP, 2.58 for HRRP, and 4.04 for HACRP, compared to nonteaching hospitals (Kahn et al., 2015). Moreover, hospital ownership, specifically investor-owned hospitals, had a significant odd ratio that explained the variation of having higher penalties by 1.31 compared with the reference, which was governmental hospitals, only in HVB programs (Kahn et al., 2015).

CMS's Value-Based Purchase measures overlap with CMS's star rating, which we have used in our study. Since there are not many studies published in this area, it is crucial to explore studies that compare between MHs and non-MHs in different CMS's programs. Dupree at el. conducted one of the earliest studies on CMS' Value-Based Purchase to identify which of the comparable groups (MHs and non-MHs) are having better performance in the CMS's Value-Based Purchase programs. The study investigated the association between hospital characteristics, including Magnet status and outcomes, after the recent healthcare system reform in the U.S.A (Dupree et al., 2014). The study included 3,030 hospitals (210 MHs and 2820 non-MHs) using the 2008-2010 CMS performance data and the 2009 AHA data to test composite surgical performance outcomes (Dupree et al., 2014). Dupree et al. used multivariable linear regression, *t*-test, chi-square, and ANOVA for the analyses (Dupree et al., 2014). The author examined major hospital characteristics such as hospital size teaching status, region, network membership, location, annual surgical volume, the status of enrollment of hospitals for both the Surgeons National Surgical Quality Improvement Program (NSQIP), and Magnet status (Dupree et al., 2014).

There were two main findings from the study. First, the mean of the hospital characteristics such as "small hospital size, private, for-profit funding status, nonteaching status, Northeast and South regions, and nonrural locations" for surgical composite performance score was higher and statistically significant ((p-value < .05) (Dupree et al., 2014). However, Magnet status did not report a significant effect on the surgical composite performance score (Dupree et al., 2014). Second, after breaking down the surgical composite score to a percentage of performance scores based on achievement and improvement, most of the explanatory variables reported higher means and significant values for the achievement compared to the improvement scores for all hospitals (MHs and non-MHs), which it was explained by hospital size, ownership status, region, and NSQIP and Magnet status (Dupree et al., 2014). On the other hand, only the mean scores for the achievement in the nonfederal public hospitals compared to the other type of ownership and hospitals were located in the west region compared to the other region of the U.S.A, had lower means and statistically significant compared to the improvement score (Dupree et al., 2014). Also, MHs reported higher and significant mean in terms of performance scores based on achievement compared to the non-MHs; however, the mean of the performance scores based on improvement was lower and significant in MHs compared to the non-MHs (Dupree et al., 2014).

2.7 Literature Search on Non-MHs' Characteristics, Structure/Process, and Outcomes

Because there were not many studies comparing between MHs and non-MHs in terms of similar outcomes, which we have used in our study, the subsequent studies did not compare between MHs and non-MHs. However, it indicated a possible association

between hospital characteristics, structures/processes, and outcomes other than studies in the previous sections above.

Bond et al. described the mortality rate as an insufficient quality indicator. However, when mortality was combined with different factors like staff level, they found that the mortality rate was lower among hospitals with more staffing for all jobs such as medical residents, registered nurses, and registered pharmacists, except in medical licensed practical nurses (LPNs) (Bond et al., 1999). On the other hand, many researchers believed that hospital characteristics served as good explanations for risk-adjusted mortality or measuring the quality if the hospital (Lundstrom et al., 2002). For instance, meta-analysis for researches between 1990 and 1998 related lower mortality rates with a high volume of board-certified physicians (van Servellen & Schultz, 1999). Also, patient outcomes like reduced mortality, length of stay (LOS), and less were associated with the existence of trained physicians at the intensive care unit (ICU) (Lundstrom et al., 2002). Provider qualifications and experiences are very crucial factors when investigating mortality outcomes at hospitals (van Servellen & Schultz, 1999).

Besides, there are more factors the affect mortality rates in hospitals. Several studies showed that adopting technology and using it properly is associated with lower mortality rates (Aiken et al., 1994; Manheim, Feing lass, Shortell, & Hughes, 1992; Silber, Williams, Krakauer, & Schwartz, 1992). Moreover, important factors based on many studies stated that nursing care and the ratio of RNs to patients were significantly associated with lower adjusted-mortality at hospitals after controlling other factors like structural and financial variables of the hospital (Aiken et al., 1994; Farley & Ozminkowski, 1992; Manheim et al., 1992).

Two multivariate analyses showed the effect of staff mix on different outcomes. One study found that the increasing number of registered nurses (RN) had lower patient falls and medication errors but did not affect cardiopulmonary arrests (Blegen, 1993). The second study found that having no change in the total staffing level, and using more nurses from a nursing pool at the surgical intensive unit (SIU), was associated with lower bloodstream-infections (Robert et al., 2000).

Whittington and Briones conducted a national study in 2004 using six years of sequential acute care data and found that nurse care interventions like having a schedule for moving and rotating patients had an impact on both prevalence and incidence of pressure ulcers (Whittington & Briones, 2004). They found that pressure ulcer incidents ranged from a low of 7% (2001, 2003, 2004) to a high of 9% (2000), and the prevalence ranged from a low of 14% (2001 and 2002) to a high of 17% (1999).

Ellis et al. compiled some evidence from works of literature on patient satisfaction reported by an HCAHPS survey. Ellis et al. reported that Coleman & Berenson (2004) revealed that insufficient communication with patients regarding new medications during the transition of care for patients "at the discharge point," increases the chance of errors of using the prescribed medication/s (Bartlett Ellis et al., 2016). Another study by Olson & Windish (2010) stated that among the patients who participated in the HCAHPS survey, there were 66% of the discharged patients were given new medication; however, 90% of those patients were never given information about the side-effect of the new medications they had received. However, another study by Barber, Parsons, Clifford, Darracott, and Horne (2004), revealed that among discharged patients, 30% of the patients did not adhere to instruction for their new

medications, and 60% of patients preferred to have more instructions about side effects and drug interactions within ten days after discharge (Bartlett Ellis et al., 2016). Moreover, Ellis et al. cited two studies by Cooper et al. (2009) and Zolnierek and Dimatteo (2009) that described effective communication, which might help patients to adhere to the instructions for their new medication. Communication is also associated with better patient outcomes such as "listening skills, being courteous and respectful, and explaining things in a way that patients can understand" (Bartlett Ellis et al., 2016).

CHAPTER 3

METHODOLOGY

This chapter presents the methodology adopted for addressing the three research questions. This study is designed to understand better the differences between Magnet hospitals (MHs) and non-Magnet Hospitals (non-MHs) in terms of hospital characteristics and structures and outcomes. Since the Magnet recognition (MR) process is not the same for all MHs, the possibility of variations in outcomes exists among the MHs. The main outcomes were derived from the Centers for Medicare & Medicaid Services' (CMS) seven domains that make up the overall hospital quality star rating (OHQSR). The study hypothesizes that "since MHs are different from non-MHs in terms of various hospital characteristics and outcomes, and the same outcomes measures should also vary significantly between the MHs group."

3.1 Study Framework

3.1.1 Theoretical Framework

The study framework is derived from Donabedian's framework, three components (structure-process-outcome) with minor changes. Donabedian's framework assumed that implementing specific hospital structures can affect the specific process of healthcare, and the process itself can also affect the quality of specific healthcare outcomes. This study slightly modified Donabedian's framework to test if the structure and process, together, can affect the quality of healthcare outcomes. a schematic of the modified

framework is shown in figure 3.1. It is explained in figure 3.1 below that the main hospital characteristics affect hospital structure and process. The figure also assumes that the major hospital characteristics can drive hospitals to make different choices, such as applying for Magnet recognition. The main objective is to find if Magnet recognition is successfully changing the hospital's structure/process as well as affecting hospital quality measures.

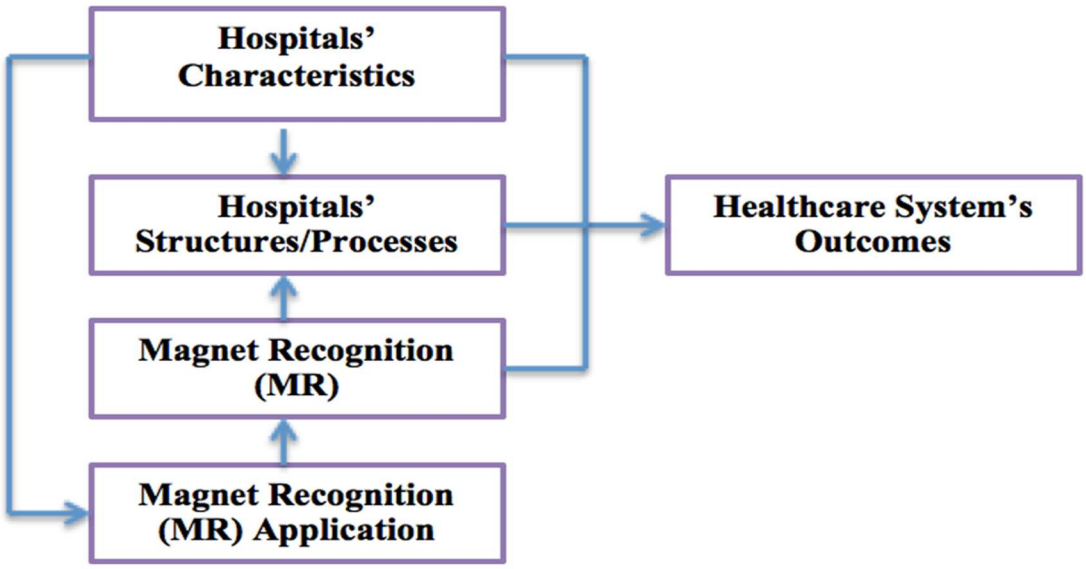


Figure 3.1: Theoretical Framework

3.2 Data Source

Two cross-sectional secondary data sets were merged to generate a national sample of general acute care hospitals. The first data set is the CMS datasets on hospital structure/process measures and hospital outcome measures (extracted from the latest information published by CMS in October 2018). The CMS's data sets are publicly available on the CMS's Hospital Compare (HC) website. The second data set is the 2017 American Hospital Association (AHA) data for hospital characteristics measures. For

MHs, we extracted the list of Magnet-recognized hospitals from the American Nurse Credentialing Center (ANCC) information up to December 2017.

The measures of hospital outcomes were obtained from CMS overall hospital quality star rating (OHQSR). The OHQSR has seven domains derived from fifty-nine different measures. The CMS used the latent variable models to aggregate the domain score into five-star ratings. The CMS also reported the outcomes in three categories: above the national average, no different than the national average, and below the national average (Medicare, 2017b). Hospitals under the Inpatients Prospective Payment System (IPPS) are required to fulfill the value-based program (VBP) and the overall hospital quality star rating requirements. The OHQSR requires participating hospitals to meet a defined threshold to be included in OHQSR's scoring for each domain. If a hospital cannot submit the required measures, the weights of the domain's missing measures are redistributed equally to other domains (Medicare, 2017b).

Hospital Compare (HC) relies on two sources of data for OHQSR. The first data source is Medicare's fee-for-service (FFS) hospital claims data, which provides information on mortality, readmission, complications, PSI-90, and imaging efficiency (Medicare, 2017b). The second source is the data from healthcare payers, such as insurance companies, which provide information on the process of care, healthcare-associated infection (HAI), and Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) "patient experience" measures (Medicare, 2017b). CMS collects and releases OHQSR quarterly only for eligible hospitals that meet the requirements. Moreover, OHQSR's domains have different collection periods per quarter. For example, in 2017, the data collection for mortality measures was from July 1, 2014, to June 30,

2017, but the "safety of care" measures were collected from January 1, 2017, to December 31, 2017 (Medicare, 2017b).

This dissertation also used CMS's hospital structure/process, seven measures. "As part of the general information available through CMS, structural measures reflect the environment in which providers care for patients. Examples of structural measures can be inpatient (participation in general surgery registry) or outpatient (tracking clinical results between visits) service-related. Hospitals submit structural measure data using an online data entry tool made available to hospitals and their vendors" (Medicare, 2017). The 2018 seven-hospital structure measures were collected from January 1, 2016, to December 31, 2016. The structure measures are reported as dichotomous (Yes/No) variables for each of the hospitals. Both OHQSR's seven domains and hospital structure information data were obtained from CMS's HC website for 2018. More details are available on CMS's website (Medicare, 2017).

The AHA distributes an annual survey instrument to hospitals in the U.S.A in October. The survey is comprehensive and consists of about 1,000 data fields "covering organizational structure, personnel, hospital facilities and services, and financial performance" (Medicare, 2016). From the AHA dataset, we used both categorical and numerical hospital information for the analyses. The AHA data set is publicly available at a cost. This dissertation utilized the 2017 data.

The last data set used in this dissertation is the ANCC data. The ANCC offers Magnet recognition accreditation for hospitals. Hospitals who seek Magnet recognition must undergo four years of comprehensive and rigorous processes: on-site appraisals, benchmarking for specific required measures, and the implementation of the Magnet

model (MM). ANCC's website releases a monthly report that provides a list of MHs, the year of designation, and the year of re-designation. Included is the MH list that is available up to December 31, 2017, which was manually extracted from the ANCC website. Details on study measures are provided in section 3.2 above.

3.3 Study Measures

Based on the study framework and the empirical models we have developed in section 3.1 above, the sub-sections below provide details on the dependent and independent variables this study has utilized.

3.3.1 Dependent Outcomes Measure

This study focuses on major healthcare system outcomes. The healthcare outcomes "dependent measures" this study uses are the fifty-nine measures. These measures are defined under the seven domains were the CMS aggregates them to get the overall hospital quality star rating (OHQSR). Also, this study uses the aggregated OHQSR itself as another hospital quality indicator in the analyses.

We mentioned earlier that there is a minor overlapping between CMS's overall hospital quality star rating and Magnet recognition's empirical outcomes. Six measures of the Magnet recognition's empirical outcomes were overlapped with the forty-five measures of the CMS's seven domains. Two of these measures were from the "safety of care" domain, and four measures were from the "patient experience" domain. Table 3.2 displays the overlapping between Magnet recognition's outcomes and the CMS's measures used by each of the seven domains, which were included in the calculation of the average score for each domain. The seven domains are: (i) "Mortality," (ii) "Safety of Care," (iii) "Readmission," (iv) "Patient Experience," (v) "Effectiveness of Care," (vi)

"Timeliness of Care," and (vii) "Outpatient Efficient Use of Medical Imaging." Aggregating several variables have derived the value of each domain. Table 3.2 shows the CMS's forty-five measures and its distribution under each domain. These outcomes are derived from the CMS's hospital compare, which by definition, are essential outcomes to the U.S healthcare system. In addition to the seven outcomes domains, and for the third research question analyses, we have utilized CMS's star rating categories (1-star to 5-stars).

From the measures, which are reported for each domain in the CMS's data source, we only included measures that the CMS used to develop the "overall hospital quality star rating," forty-five measures listed in table 3.2. However, for this study, a slightly modified scoring method has been developed. We obtained the aggregated average scores for the measures under the seven domains, except for the "patient experience" domain and the original "overall hospital quality star rating." The CMS' defines the "patient experience" domain and the original "overall hospital quality star rating" as categorical star rating from 1 to 5 stars; 1 being the worst hospital outcome and 5 being the best possible outcome.

For the numerical six domains, measures are scaled so that the scores range from 0-100; 0 being the worst possible value and 100 being the best possible outcome. The problem is that some measures show better outcomes with higher values, while others indicate better outcomes by lower values. When scaling the variables from zero to 100, the best values were considered to be equal to 100 irrespective of whether the best value was the lowest or highest value. For example, elapsed time for giving aspirin to a patient with chest pain who appeared in the emergency room is a quality indicator and the lower

is the elapsed time, the better is the outcome. Similarly, the higher the mortality, the lower is the quality. Also, a high rate of early identification of sepsis and provide appropriate care can decrease the risk of death caused by sepsis; the higher rate of intervention, the higher is the quality. The method followed for scaling the variables is presented below:

- The best possible outcome is assigned a value of 100 and the worst possible outcome has been assigned a value of zero. If a higher value is associated with a better outcome, the calculation of the scaled values would be:

  (Score –Minimum score) *100/ (Maximum Score-Minimum score)

- However, if lower values are associated with better outcomes, the calculation of scaled values will follow the process:

  (Maximum Score-Score) *100/ (Maximum Score-Minimum score)

After calculating the scaled scores, the missing values were addressed. If the missing values were more than 15% of the total observations, the variable was excluded. It was decided not to impute the missing values with (>15% of the total observations) due to the potential of introducing errors in missing value calculations. From all the measures (fifty-nine) in the six domains, fourteen measures were excluded from the calculations. We imputed the missing values for each of the measures using regression models if the missing values were less than 15% of the total observations. For imputation, we obtained the regression model with the highest R-square. For each domain, we calculated the average of the weighted scores and each hospital was assigned a numeric weighted and average score. These calculated average scores for the six domains and the five categories

of the "overall hospital quality star rating" categories and "patient experience" are the final outcome measures for this research.

For the "overall hospital quality star rating" and "patient experience," we used the same 1 to a 5-star rating that the CMS published, and because the 1 to a 5-star rating in the "overall hospital quality star rating" and "patient experience" based model fails to identify factors affecting hospital quality, we used the top star rating to define a binary outcome.

It should be mentioned that not all outcomes were risk-adjusted. "Mortality," "readmission," "patient experience," and "safety of care" are risk-adjusted outcomes. The CMS's risk adjustment for these measures was based on the case-mix and service-mix. On the other hand, "efficient use of imaging," "timeliness of care," and "effectiveness of care" are not risk-adjusted. However, for the "efficient use of imaging", the CMS did not include cases where there were clear medical reasons for performing a test for the efficient use of imaging. The score for the un-adjusted outcomes is the average of the national score for the hospitals. The CMS calculated the six outcomes by dividing the predicted score by the expected score for each measure under each domain.

Table 3.2: List of Dependent Variables and Magnet Recognition Measures Overlapping Clarification

Dependent Variables	**Overlapping with MR Measures?**
1-Mortality:	
1-Death rate for heart attack patients	No
2-Death rate for COPD patients	No
3-Death rate for heart failure patients	No
4-Death rate for pneumonia patients	No
5-Death rate for stroke patients	No
6-Deaths among Patients with Serious Treatable Complications after Surgery	No
2-Safety of Care:	

7-Central line-associated bloodstream infections (CLABSI)	Yes
8-Catheter-associated urinary tract infections (CAUTI)	Yes
9-Surgical site infections from colon surgery (SSI: Colon)	No
10-Methicillin-resistant Staphylococcus Aureus (MRSA) Blood Laboratory-identified Events (Bloodstream infections)	No
11-Clostridium difficile (C.diff.) Laboratory-identified Events (Intestinal infections)	No
3-Readmission Domain Measures:	No
12-Hospital return days for heart attack patients	No
13-Hospital return days for heart failure patients	No
14-Hospital return days for pneumonia patients	No
15-Rate of unplanned readmission after discharge from hospital (hospital-wide)	No
16-Rate of unplanned readmission for chronic obstructive pulmonary disease (COPD) patient	No
17-Rate of unplanned readmission after hip/knee surgery	No
18-Rate of unplanned readmission for stroke patients	No
19-Rate of unplanned hospital visits after an outpatient colonoscopy	No
4-Effectiveness of Care:	
20-Patients assessed and given influenza vaccination	Yes
21-Healthcare workers given influenza vaccination	Yes
22-Percentage of patients who left the emergency department before being seen	No
23-Percentage of patients receiving appropriate recommendation for follow-up screening colonoscopy	No
24-Percentage of patients with history of polyps receiving follow-up colonoscopy in the appropriate timeframe	No
25-Percent of mothers whose deliveries were scheduled too early (1-2 weeks early), when a scheduled delivery was not medically necessary	No
26-Patients who developed a blood clot while in the hospital who *did not* get treatment that could have prevented it	No
27-Percentage of patients who received appropriate care for severe sepsis and septic shock	No
5-Timeliness of Care:	
28-Average (median) time patients spent in the emergency department, before they were admitted to the hospital as an inpatient	No
29-Average (median) time patients spent in the emergency department, after the doctor decided to admit them as an inpatient before leaving the emergency department for their inpatient room	No
30-Average (median) time patients spent in the emergency department before they were seen by a healthcare professional	No

31-Average (median) time patients who came to the emergency department with broken bones had to wait before getting pain medication	No
6-Efficient Use of Medical Imaging:	
32-Abdomen CT Use of Contrast Material	No
33-Thorax CT Use of Contrast Material	No
34-Outpatients who got cardiac imaging stress tests before low-risk outpatient surgery	No
35-Outpatients with brain CT scans who got a sinus CT scan at the same time	No
7-Patients Experience:	
36-Cleanliness of Hospital Environment	No
37-Nurse Communication	Yes
38-Doctor Communication	No
39-Responsiveness of Hospital Staff	Yes
40-Communication About Medicines	Yes
41-Discharge Information	Yes
42-Care transition	No
43-Patient Overall hospital rating	No
44- Quietness of Hospital Environment	No
45-Willingness to Recommend Hospital	No
Overall Hospital Quality Star Rating (OHQSR)	
Aggregated the seven domains score listed above in this table	No

Source: CMS's hospital compare data 2018

Magnet recognition requires hospitals to report and benchmark for empirical outcomes. The requirements for these outcomes, in the Magnet recognition's 2014 manual was not precise, or Magnet recognition decided not to publicly provide details on its' measures' requirements unless hospitals start the process of Magnet recognition. For example, Magnet recognition required hospitals to report information on "acute myocardial infarction" (AMI), and "heart failure" (HF); however, it was not apparent if Magnet recognition required information on the mortality rate, number of patients, or to report for care the process were taken to treat patient with these diseases. Therefore, we cannot confirm if these measures were overlapping with the CMS's overall hospital quality star rating measures reported in Table 3.2. Table 3.3 lists measures that were required by the Magnet recognition, but due to the unclear requirements, we were not

sure if these measures were overlapping with the CMS's overall hospital quality star rating measures. Although these measures are not too many, it is important to define them as they can be somehow related to the CMS outcomes. Measures in table 3.3 fall under one of the empirical outcomes (EP22EO) that Magnet recognition requires MHs to outperform the mean or median of the national database.

Table 3.3: Magnet Recognition Outcomes with Possible Overlapping with the CMS's Overall Hospital Quality Star Rating Outcomes

Unit-or clinic-level nurse-sensitive clinical indicator
1- Acute Myocardial Infraction (AMI)
2- Emergency Department (ED)
3- Heart Failure (HF)
4- Hospital Outpatient Department (OP)
5- Perinatal Care (PC)
6- Pneumonia Measures (PN)
7- Stroke (STK)
8- Venous Thromboembolism (VTE)

Source: ANCC Application Manual for 2014

As indicated in chapter one, the CMS overall hospital quality star rating and the Magnet recognition's measures are independently designed, measured, and collected. There are three empirical outcomes for which Magnet recognition requires hospitals to compete with the national benchmark(s). It is important to check the similarities and differences between the CMS and Magnet recognition outcomes to avoid any bias when investigating the association between Magnet-status and health care outcomes. Although some outcomes overlap between Magnet recognition and CMS outcomes, the requirements of ANCC and CMS for these outcomes are significantly different. The outcomes used for Magnet recognition are not publicly available. Table 3.2 lists the outcomes used in this study as well as the similar empirical-outcomes required by the Magnet recognition.

3.3.2 Independent Variables Measures

This study used four independent variables, which are Magnet-status, hospital characteristics, utilization measures, and CMS structure measures. Among these variables' groups, Magnet-status is the primary independent variable this study focuses on. The study used major hospitals' characteristics such as hospital location, bed size, teaching affiliation status, etc. Several studies use these major hospital characteristics to compare hospitals in terms of different healthcare outcomes, we reported some of these studies in chapter two of this dissertation such as Aiken et al. and Dupree et al. Other criteria for comparison between hospitals are utilizations measures. Utilization measures like total admissions per bed and total discharges per bed are important indicators that may affect the quality of care. Since the dependent outcomes are derived from CMS's measures, this study focuses on hospitals' utilization for CMS's population as well as some general hospital utilization measures. The last group of controlling variables is CMS's structure measures. These measures can be associated with quality and safety, and because they did not bias the effect of Magnet-status and have some effect on hospital outcomes, we have included them in the analyses.

Table 3.4 below describes three groups of measures. The first group consists of five hospital characteristics, and the second group contains six hospital unitization measures for CMS and three measures for hospitals in general. The source of the two groups is the 2017 AHA dataset. The last group is the seven CMS structures/process indicators, which are related to the foundation and utilization of health information technology. For Magnet-status, the list of MHs for 2017 was extracted from the American Nurse Credentialing Center (ANCC) and incorporated the information with the

following data set, which are reported in table 3.4, are assigned to be the characteristic, structure and process components of the study framework.

Table 3.4: Independent Variables by Data Source

Hospital Characteristics by AHA 2017	Hospital Utilization Measures by AHA 2017	Structures/Process by CMS 2018
Type of Ownership: Government, Nonfederal Nongovernment, Not-for-profit Investor-owned, for-profit **Location of Hospital:** -Rural -Urban **Hospital Bed Size:** 100.0 or less 101 – 300 301 – 500.0 501 – 2,915 **Teaching Affiliated:** -No -Yes **Type of Service:** -Acute long-term care hospital -General acute care hospitals -Psychiatric hospitals - Other specialty hospital	**Medicare:** 1-Medicare Total Discharges 2-Medicare Total Discharges Per Bed 3-Medicare Total Days Per Bed **Medicaid:** 4- Medicaid Total Discharges 5- Medicaid Total Discharges Per Bed 6- Medicaid Total Days Per Bed **General Hospital Ratios:** 7- Hospital Total Admissions 8- Hospital Total Admissions Per Bed 9- Hospital Total Days Per Bed	1-Nursing care registry 2-General surgery registry 3- Uses inpatient safe surgery 4-Uses hospital survey on patient safety culture 5-Able to receive lab results electronically (HIT measure) 6-Able to track patients' lab results, tests, and referrals electronically between visits (HIT measure) 7-Uses outpatient safe surgery checklist (outpatient)

Source: AHA 2017 and CMS's hospital compare data 2018

3.4 Empirical Models and Framework

3.4.1 Empirical Models

Our study is designed to estimate the effect of Magnet recognition on healthcare outcomes after controlling characteristics and structure/process components. Based on the theoretical framework (figure 3.1), for each research question, we designed one empirical model. For the first empirical model, the differences between MHs and all non-MHs in the U.S.A in terms of hospital characteristics and utilization measures were evaluated before and after applying the matching method. For matching, the study used the Propensity Score (PS) method considering essential factors such as type of ownership, location, service type, number of beds, and teaching status; such factors can create bias in the comparison between hospitals. To eliminate the possibility of bias, it is essential to apply the matching before comparing outcomes between MHs and non-MHs. In the second empirical model, we tested the effect of Magnet recognition on specific structure/process as well as the effect of Magnet recognition on hospital quality measures after controlling for many factors. The third model aims to find the variability within-group for MHs in terms of the seven healthcare outcomes and CMS star rating and factors that can explain significant variations if exist. Below are each research question and its related empirical model as follows:

Empirical model 1:

Are the MHs different from the non-MHs in terms of major hospital characteristics and utilization?

- Pearson's Chi-squared (Chi-square) to investigate the relative differences of characteristics between MHs and non-MHs is conducted.

- For quantitative outcomes, a set of simple regression models were used:

*Y (Utilization Measures) = b0 + b1*X1 (Magnet status)*

Empirical model 2:

Do the MHs differ significantly from the non-MHs in terms of structure and processes of hospitals as well as overall quality outcomes?

For Structure and Processes measure:

For binary structure/process, a set of simple regression models were used:

*Y (CMS's structure/process) = b0 + b1*X1 (Magnet status)*

For of Healthcare Outcomes measure:

For all outcomes, a set of multivariate simple regression models were used:

*Y (Healthcare Outcomes) = b0 + b1*X1 (Magnet status) +b2*X2 (characteristics)+b3*X3 (CMS structure/process)*

Empirical model 3:

Is there significant variability in hospital quality outcomes among the Magnet-recognized hospitals?

- Descriptive statistics: outcomes summary, correlation, and tercile tabulations of MHs' quality outcomes
- For quantitative outcomes, a set of multivariate simple regression models were used:

*Y (Healthcare Outcomes for MHs) = b0 +b1*X1 (characteristics)+b2*X2 (CMS structure/process)*

- For hospital "five-star" outcomes, an ordered logistic model was used. Star rating, by definition, is ordered— from low-quality one-star hospitals to high-quality five-star hospitals:

$$\ln\left(\frac{P(Y_i = s)}{P(Y_i = 1\ star)}\right) = \alpha_s + \sum_{i=1}^{n} \beta_{si} X_{si} + \sum_{i=1}^{n} \gamma_{sj} Z_{sj} + u, \forall s, s = 2 \dots 5$$

- Because the star rating-based model fails to identify factors affecting hospital quality, top star rating is used to define a binary outcome (hospitals with a star rating of s* or higher compared to others) to run a simple binary or logistic regression:

Y (Hospitals with rating ≥s) = b0+b1*X1 (characteristics)+b2*X2 (CMS structure/process)*

3.4.2 Snapshot of Empirical Framework

Our empirical framework is mainly derived from the theoretical model, structure, process, and outcome measures. Figure 3.5 below is the empirical framework that explains the flow of the three empirical models we have listed above. The three empirical models in figure 3.5 followed steps of analyses, and the required variables for each model are reported in figure 3.5.

In the first model, differences between MHs and all non-MHs in the U.S.A in terms of hospital characteristics and utilization measures were evaluated before applying the matching method. We have mentioned earlier that it is essential to consider major hospital characteristics before comparing between MHs and non-MHs. Such factors can create bias in the comparison between hospitals. Afterward, the matching method was applied to prepare unbiased matches of general acute non-MHs to general acute MHs as:

- Propensity score (PS) matching was employed using hospital characteristics such as location, size, type of ownership, and teaching status as matching variables.
- In the analysis, only the acute care general hospitals were kept in the data set. The final sample size was 367 MHs and 380 of non-MHs. Note that 87% of all MHs in the U.S.A were successfully matched.

The CMS defines the general acute hospitals as "A hospital that provides inpatient medical care and other related services for surgery, acute medical conditions or injuries (usually for a short term illness or condition)." (Medicare, 2017b).

For the second model, we investigated the effect of Magnet-status on the CMS structure/process measures to determine whether MHs have better structures/processes than non-MHs. Then, we tested the effect of Magnet-status on the healthcare outcomes after controlling for hospital characteristics and CMS structure/process.

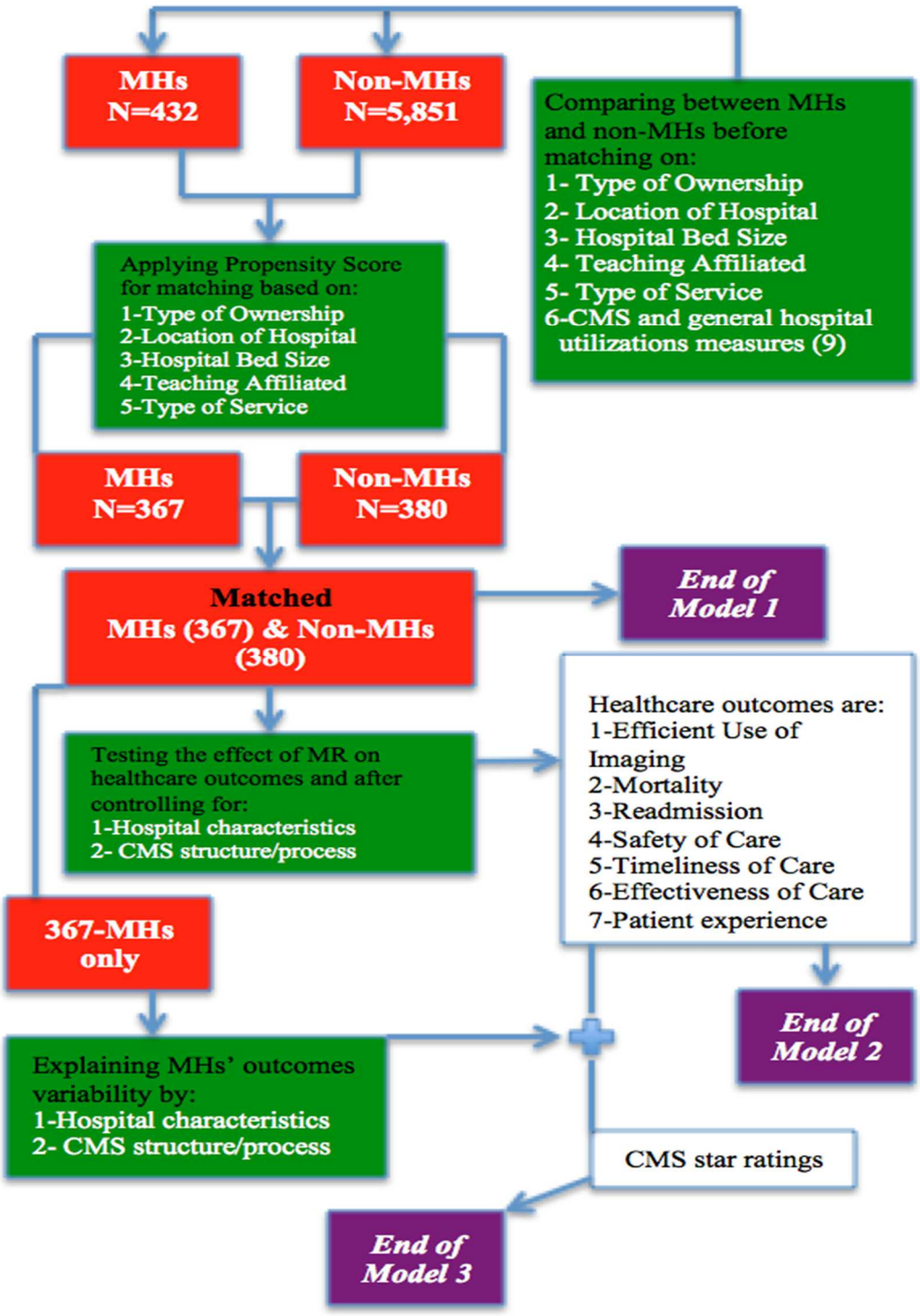


Figure 3.5: Empirical Framework Components

The final empirical model is replicated to the second empirical model; however, the analysis was done on only 367 MHs. Besides using the seven domains to compare within MHs' score, we have added CMS's star rating as another criterion of comparison. This model aimed to evaluate if within the group MHs is varied in terms of different outcomes we obtained for this model, which are: the CMS's overall hospital quality star rating seven and domains and CMS's star ratings. The CMS's aggregated scoring method for the five stars might pick up some of the variations between MHs; therefore, MHs' outcomes might become unvaried. It is ideal for investigating whether the same MHs would have the same variation on different outcomes if there were any. STATA 14.0 was used for all analysis's activities.

CHAPTER 4

ANALYSES AND RESULTS

The purpose of this study is to compare the differences between Magnet hospitals (MHs) and non-MHs using some different characteristics and measures as well as to explore variability within the MHs. Based on the study aims; we have developed three research questions. The first question is whether MHs differ from non-MHs in terms of specific hospital characteristics and utilization. Second, we investigated whether MHs have better outcomes than non-MHs using the structure/process and the outcome measures defined by the Centers for Medicare & Medicaid Services (CMS). Lastly, we wanted to examine the variability within MHs themselves and explore the degree of effectiveness the Magnet recognition (MR) has on ensuring service quality and outcomes.

Although some of the CMS outcome measures are used directly in the process of Magnet Recognition, it would still be useful to examine how the externally defined outcome measures vary for the MHs and the non-MHs. Since not all outcome measures are used in the Magnet Recognition process, the overall start rating of MHs may vary significantly even though they fulfill conditions to be recognized as "Magnet". In chapters one and two, it is explained that the designation of Magnet Recognition does not necessarily mean that all the MHs will show a high level of outcomes. MHs will likely show significant variability in terms of specific measures, especially the ones that are not explicitly considered in the Magnet Recognition process.

To start the analysis between MHs and non-MHs, the first step is to compare the MHs in the data set with all the non-MHs in the data set. Since hospitals self-select to apply for Magnet Recognition, the hospitals that decide to apply for Magnet Recognition may vary significantly from the hospitals that do not apply for Magnet Recognition. Therefore, this study focuses on the comparison of MHs and non-MHs to identify specific hospital characteristics that are more likely to be associated with the acquisition of a Magnet Recognition accreditation.

4.1 Are the MHs Different from the Non-MHs in Terms of Major Hospital Characteristics and Utilization?

The AHA data from 2017 was used to compare the MHs with the non-MHs in the data set. The total number of hospitals in the AHA data set from 2017 was 6,283 and the number of MHs from the American Nurse Credentialing Center (ANCC) website in 2017 was 465. The Medicare identification number (CMS ID) was used for merging MHs with hospitals in the AHA data. It was possible to identify 432 MHs in the AHA data set implying that less than 7% of total hospitals in the U.S.A received a Magnet Recognition in 2017. Since MHs represent a relatively small group, the MHs and non-MHs may differ significantly in terms of various hospital characteristics. Veterans Administration (VA) hospitals were not included in the analysis. This resulted in the exclusion of four MHs. Table 4.1 shows the distribution of MHs and non-MHs by various hospital characteristics**.**

The Table also reports Pearson's chi-squared (chi2) values to indicate how different the distribution of MHs was from the non-MHs in terms of the characteristics included in the Table. The chi-square results in Table 4.1 shows that the relative

distribution of MHs and non-MHs are statistically significant for all the hospital characteristics listed here. The first characteristic listed in the Table is ownership type, and it shows that 65% of MHs were not-for-profit non-government hospitals compared to 49% for non-MHs. The relative importance of public hospitals and investor-owned hospitals are also significantly lower for MHs compared to non-MHs. In terms of location, 78% of MHs are located in urban areas while about two-thirds of non-MHs are in urban areas. Also, the distribution of MHs was relatively higher than non-MHs for teaching affiliation with 47% of MHs being teaching hospitals compared to only 25% for non-MHs. The distribution of hospitals by bed-sizes indicate that MHs are more likely to be slightly larger than the non-MHs. Finally, if we consider the hospital type, 84% of MHs and about three-quarters of the non-MHs are general acute care hospitals. The likelihood of being an MH is lower for both the long-term acute care and psychiatric hospitals.

Table 4.1: Distribution of MHs and Non-MHs by Hospital Characteristics

Hospital Characteristics	Non-MHs (N=5,851)	MHs (N=432)	P-value*
Type of Ownership:			
Government, Nonfederal	1,365 (23.3%)	80 (18.6%)	**<0.001**
Nongovernment, Not-for-profit	2,874 (49.1%)	281 (65.2%)	
Investor-owned, for-profit	1,612 (27.6%)	70 (16.2%)	
Location of Hospital:			
Rural	1,932 (33.0%)	94 (21.8%)	**<0.001**
Urban	3,919 (67.0%)	337 (78.2%)	
Hospital Bed Size			
100.0 or less	3,342 (57.1%)	172 (39.9%)	**<0.001**
101 – 300	1,695 (29.0%)	190 (44.1%)	
301 – 500.0	520 (8.9%)	43 (10.0%)	
501 – 2,915	294 (5.0%)	26 (6.0%)	
Teaching Affiliated:			
No	4,385 (74.9%)	230 (53.4%)	**<0.001**
Yes	1,466 (25.1%)	201 (46.6%)	

Type of Service: General acute care hospitals	4,340 (74.2%)	367 (84.9%)	
Acute long-term care hospital	375 (6.4%)	16 (3.7%)	
Psychiatric hospitals	510 (8.7%)	16 (3.7%)	**<0.001**
Other specialty hospital	626 (10.7%)	33 (7.6%)	

Source: AHA 2017 and ANCC 2017 and * Significant at (P-value < 0.05)

It may also be useful to examine the differences between MHs and non-MHs in terms of patient admission and other related variables. Bivariate simple linear regression models were estimated for each of the admission-related variables with a Magnet status dummy as the independent variable. The results are reported in Table 4.2 below. The results in the Table indicate that Medicare discharges, on average, were higher for MHs than for non-MHs. The difference is statistically significant. This is also true for Medicaid discharges and total hospital admissions. The result may be biased due to the differential size of the MHs and non-MHs in the sample. However, when the MHs and non-MHs are compared using Medicare and Medicaid discharges per hospital bed, the numbers remain significantly higher for the MHs compared to the non-MHs. Per bed discharges for Medicare and Medicaid were higher by about 2.0 for the MHs compared to non-MHs. Total hospital admission per bed for non-MHs was 32.4 compared to 37.1 for MHs. The difference between these two means was found to be statistically significant. The same conclusion is true for the CMS and hospital total days per bed; the averages of total days were higher and statistically significant for MHs compared to non-MHs. The MHs show higher days per bed on the average by 44.2%, 23.8%, and 15.1% for Medicaid, hospital, and Medicare admissions respectively.

Table 4.2: Total Medicare, Medicaid discharges and Total Hospital Admissions by Magnet Status

Service-related measures	Constant	Coefficient of MH	Standard Deviation	T-stat	P > |t|*	R-Squared
Medicare Total Discharges	2467.0	804.2	3877.2	4.16	**0.00**	0.0028
Medicare Total Discharges Per Bed	15.05	2.082	10.61	3.93	**0.00**	0.0025
Medicare Total Days Per Bed	88.09	13.32	56.33	4.75	**0.00**	0.0036
Medicaid Total Discharges	1241.1	638.1	2433.9	5.26	**0.00**	0.0044
Medicaid Total Discharges Per Bed	6.023	1.872	6.116	6.15	**0.00**	0.0060
Medicaid Total Days Per Bed	39.80	17.65	45.62	7.79	**0.00**	0.0096
Hospital Total Admissions	5753.0	1727.4	9037.5	3.83	**0.00**	0.0023
Hospital Total Admissions Per Bed	32.44	4.741	19.36	4.91	**0.0.0**	0.0038
Hospital Total Days Per Bed	197.8601	47.19018	82.34929	11.60	**0.000**	0.0210

Source: AHA 2017 and ANCC 2017 and * Significant at (P-value < 0.05)

4.1.1 Need for Selecting Matched Non-MHs for MH-Non-MH Comparisons

The analyses presented in the previous section indicate that the MHs are quite different from the non-MHs in the U.S.A. Since the MHs differ significantly from the non-MHs in terms of hospital characteristics, outcomes of the MHs cannot be compared to the outcomes of the non-MHs without controlling for the relevant hospital characteristics. To test the hypothesis that MHs have better hospital outcomes than non-MH hospitals, it is important to select a sample of non-MHs that are similar to the MHs

in observable hospital characteristics. Therefore, we employed Propensity Score (PS) matching which is a method to match non-MHs to each of the MHs in our data set.

The matching was performed in steps. After the Magnet status was identified in the AHA data file, the number of non-MHs in the data set became 5,851. Since the majority of the hospitals in the U.S.A are general acute hospitals and since hospital behavior is likely to be quite different for other specialized hospitals, for this study, the focus is on the general acute care hospitals only. The number of hospitals in the sample after restricting it to general acute care hospitals becomes 367 MHs and 4,340 non-MHs. To carry out the matching, hospital characteristics like location, size, type of ownership, and teaching status are used as matching variables based on the results of MH-non-MH comparisons presented in Table 4.1. The result of the matching exercise generated 380 non-MHs for the 367 MHs in the sample. Once matching is carried out, the non-MHs should be similar to the MHs in terms of those specific characteristics defining the control group for the empirical analysis.

4.1.2 Testing the Validity of the Matching Exercise

In the absence of experimental, randomized controlled trials, the best way to examine the effect of Magnet Recognition on hospital outcomes would be to select similar non-MHs from the list of all non-MHs in the national data set. Since the MHs represent only about 7% of all hospitals, the matching identifies non-MHs that are similar to the MHs in basic observable characteristics.

To test the validity of the matching exercise, the characteristics of MHs are compared with the matched non-MHs. Table 4.3 shows the distribution of MHs and non-MHs by various hospital characteristics. The Table also reports chi-squared values to

indicate how different the distributions of MHs are from the matched non-MHs in terms of the characteristics included in the Table. The chi-square results in Table 4.3 show that the relative distributions of MHs and non-MHs were not statistically significant for all the hospital characteristics listed here, except for the type of ownership. In terms of the type of ownership, 88% of MHs were not-for-profit non-government hospitals compared to 76% for matched non-MHs. The relative importance of public hospitals and investor-owned hospitals are also significantly lower for MHs compared to non-MHs. In terms of geographic location, the matched group is comparable with the MHs in the sample. The relative distribution of hospitals by bed-sizes indicates that both MHs and the matched non-MHs were similar.

The ownership status after matching varies between MHs and non-MHs. This may underestimate the effect of Magnet status if ownership is entered as one of the independent variables. The significant difference between the MHs and matched non-MHs in terms of hospital ownership type is a concern but it is not unusual to observe differences in a few dimensions when the matching is carried out using propensity scoring. The matching process does not identify a perfectly comparable sub-sample. The differences, hopefully, will not create significant differences in outcomes between MH and matched non-MHs, although the possibility of bias cannot be ruled out.

Table 4.3: Comparison of Basic Hospital Characteristics Between the MHs and the Matched Non-MHs

General Acute Hospitals Characteristics	Non-MHs (N=380)	MHs (N=367)	P-value*
Type of Ownership: Government, Nonfederal	51 (13.4%)	30 (8.2%)	**<0.001**
Nongovernment, Not-for-profit	292 (76.8%)	325 (88.6%)	

Investor-owned, for-profit	37 (9.7%)	12 (3.3%)	
Location of Hospital: Rural	21 (5.5%)	16 (4.4%)	0.46
Urban	359 (94.5%)	351 (95.6%)	
Hospital Bed Size 100.0 or less	30 (7.9%)	16 (4.4%)	
101 – 300	109 (28.7%)	123 (33.5%)	0.15
301 – 500.0	121 (31.8%)	112 (30.5%)	
501 – 2,915	120 (31.6%)	116 (31.6%)	
Teaching Affiliated: -No	111 (29.2%)	110 (30.0%)	0.82
-Yes	269 (70.8%)	257 (70.0%)	

Source: AHA 2017 and ANCC 2017 for general acute hospitals only
* Significant at (P-value < 0.05)

Unfortunately, when you ran the multivariate simple regression analyses including the "type of ownership" in the next section, the result indicated that the "type of ownership" underestimated the effect of Magnet status when was entered as one of the independent variables. Therefore, we have excluded the "type of ownership" from the analyses to avoid the undesirable bias.

4.2 Do the MHs Differ Significantly from the Non-MHs in Terms of Structure and Processes of Hospitals as well as Overall Quality Outcomes?

This question explores the comparison of MHs and "unbiased" matched non-MHs in terms of hospital structures/processes and outcomes. The hypothesis is that the Magnet Recognition will improve hospital structures/processes and outcomes. The sample of hospitals used in the analysis has already been defined above.

4.2.1 Comparison of Hospital Structure by Magnet Status

The analysis of this section examined the effect of Magnet Recognition on some specific structure measures. The objective is to explore whether the MHs are significantly different from the matched non-MHs in terms of specific CMS structure/process

measures for general acute care hospitals. These specific measures are fairly new in the U.S.A and the measures should be associated with the quality and safety of services rendered by the hospitals. These measures are mainly focused on the utilization of health information technology (HIT), the use of different types of registries, and the use of different types of safety processes. For the analysis, the CMS's structure data set for 2018 (n= 4,806) was used, and the data set was merged with 367 MHs and 380 matched non-MHs using CMS ID. All of the 747 hospitals (MHs and non-MHs) were successfully merged.

Bivariate simple linear regression analysis was carried out for each of the CMS's structure/process measures with MH as the independent variable (MH=1 or 0). Table 4.5 reports the regression results with an MH status dummy as the independent variable and the process and structure measures as the dependent variables. The structure measures are also dichotomous and therefore, the regression model indicates the differences between MH and non-MHs on the average. The regression results indicate that the average values of structure and process measures were significantly different between the MHs and non-MHs for all measures except the item "use of safe surgery checklist for inpatients". The mean values of the structure and process measures were higher in general for MHs than those for non-MHs. General surgery registry availability was lower for MHs than the matched non-MHs. It is not clear why the MHs should differ from the matched non-MHs in terms of this process measure.

The Magnet Recognition has been designed to comprehensively improve nursing care and its related outcomes. The analysis suggests that the average use of a nursing care registry was higher for MHs by 27% compared to the average value for the matched non-

MHs. The average values of the processes exceeded the values for matched non-MHs by at least 5% for the measures "able to receive lab results electronically", "able to track patients lab results", and "patient safety culture". For "safe surgery checklist uses in an outpatient setting", the mean for MHs was higher and statistically more significant than that for matched non-MHs by 3%. For the item, "general surgery registry", the average value of MHs compared to the matched non-MHs was lower by –8%. In general, we can conclude that the Magnet Recognition does improve hospital structure and processes that are likely to be associated with improved quality and safety.

Table 4.4: Effect of Magnet Status on CMS's Structure and Process Measures

Structure and process measures	Constant	Coefficient of MH	T-stat	P > |t|*	R-Squared
Able to receive lab results electronically (HIT measure)	.9421053	.0497203	3.81	**0.000**	0.0191
Able to track patients' lab results, tests, and referrals electronically between visits (HIT measure)	.9210526	.0516994	3.15	**0.002**	0.0132
General Surgery Registry	.4894737	-.080008	2.19	**0.029**	0.0064
Nursing care registry	.7289474	.2710526	11.67	**0.000**	0.1545
Patient Safety Culture	.8263158	.056518	2.19	**0.029**	0.0064
Safe surgery checklist use (outpatient)	.9631579	.0313925	2.98	**0.003**	0.0118
Safe surgery checklist use (inpatient)	.9815789	.0102467	1.22	0.224	0.0020

Source: AHA 2017, ANCC 2017, and CMS 2018 for general acute hospital only
* Significant at (P-value < 0.05)

4.2.2 Comparison of Hospital Outcomes by Magnet Status

Since the comparison of outcomes requires the data on well-defined hospital performance measures, seven different CMS outcomes were used. These outcomes were collected independently by the CMS and the outcomes can be merged with our hospital

sample. Although there are some similarities between the outcome measures used by the Magnet Recognition process and the CMS, the CMS outcomes represent the most comprehensive outcome measures available. Seven groups of outcomes were included in the comparison. These outcomes are: "efficient use of outpatient imaging", "mortality", "readmission", "patient experience", "safety of care", "timeliness of care", and "effectiveness of care". Each outcome consists of a defined set of measures and all these measures were used by the CMS for the development of the aggregated star rating. Since this study uses disaggregated outcomes for comparative purposes, the outcomes must be defined in a way that higher or better outcomes would be reflected by a higher quantitative value than a lower outcome. In this sense, our treatment of the outcome variables deviates from the approach used by the CMS.

To facilitate comparison for each outcome, the best possible outcome is defined as 100 and the worst possible outcome as zero, except for the "patient experience" domain. Therefore, taking averages of the variables will not assign a higher weight to anyone over another due to the variability of the scale of measurement. It was also observed that the CMS outcome data had a significant number of missing values. An effort made to predict the percent of missing values did not exceed 15% of all hospitals in the sample. After treating the missing values in the data set, calculated the average score for each domain's outcomes, and these average scores have been used to interpret the analyses of this research; as a result, higher outcome scores mean better quality. More information is provided in chapter three (Methodology).

For the "patient experience" domain, it is explained in chapter three that the CMS assigns star rating categories from 1 to 5-star. In the analyses, we have used the same

"patient experience" star rating categories, which are assigned by the CMS. Table 4.5 below provides a summary statistic that shows you the distribution of MHs and non-MHs in terms of their "patient experience" star rating.

The distribution of the star rating for MHs and non-MHs does not show high variability among the MHs and non-MHs. More than 95% and 78% of MHs and non-MHs have a star rating of three or better in this dimension, respectively. Therefore, we have defined a dummy variable to define "good patient experience" with categories 4 and 5 as 1 and zero otherwise.

Table 4.5: Tabulation of patient experience star rating by Magnet-status

Patient Experience Stars	MHs Frequency	MHs Percentage %	Non-MHs Frequency	Non-MHs Percentage %
1	0	0	6	1.58
2	18	4.93	73	19.31
3	239	65.48	235	62.16
4	106	29.1	61	16.13
5	2	0.54	3	0.70
Total	**365**	**100%**	**378**	**100%**

Source: AHA 2017, ANCC 2017, and CMS 2018 for general acute hospital only

This analysis followed two steps to examine the differences between MHs and non-MHs in terms of outcomes and factors that might explain those differences. The same 747 hospitals were used as in the previous section, which are the general acute of 367MHs and 380 are non-MHs. The 747 were successfully identified in different CMS outcome data sets. The hypothesis is that the MHs significantly outperformed the non-MHs in terms of specific outcomes.

As a first step, a bivariate simple linear regression analysis was carried out to better understand the relationship between the Magnet Recognition and the considered outcomes. The simple linear regression analysis provides information on how different

the MHs are from the non-MHs in terms of outcomes. In the second step, a multivariate simple linear regression adds controlling measures to the bivariate analysis above hospital characteristics, seven of CMS's structure/process measures.

Bivariate Analyses

Table 4.6 shows the bivariate analysis for each of the outcomes described earlier. The independent variable for the analysis is the Magnet status where Magnet status is shown by a dummy variable Magnet status that takes the value of 1 if it is a MH and zero if it is a non-MH. The dependent variables are numeric values scaled between zero and 100 for each of the six patient outcome variables as well as zero one and one for the "patient experience" domain. Note that the value of each of the outcomes has been derived by aggregating many variables related to them. The lists of these variables are provided in chapter 3 (Methodology).

Table 4.6: Effect of Magnet Status on Hospital Outcomes: Bivariate Regression Results

Outcome variables	Constant	Coefficient of MH	T-test	P > |t|	R-Squared
Outpatient Efficient Use of Imaging	80.89	.0181	0.04	0.969	0.0000
Mortality based outcome index	55.23	3.631	5.26	**0.00****	0.0359
Readmission based outcome index	59.33	1.568	2.35	**0.01****	0.0074
Safety of Care	79.97	0.136	0.29	0.770	0.0001
Timeliness of Care	86.11	0.530	1.08	0.282	0.0016
Effectiveness of Care	44.58	-0.449	-1.55	0.121	0.0032
Patient Experience	0.169	0.126	4.13	**0.00****	0.0225

Source: ANCC 2017 and CMS 2018 for general acute hospitals
**= Significant (P-value < 0.05)

Among the seven aggregated outcomes, the bivariate regressions indicate that the average values for the "mortality", "readmission", and "patient experience" based outcome indices were significantly better in MHs compared to the non-MHs. The mean values in MHs of were higher by 3.63 for "mortality", 1.56 for "readmission", and 0,126 for "patient experience" compared to non-MHs. The rest of the outcomes did not show significant differences between MHs and non-MHs. Although Magnet Recognition should improve various outcomes, the result of the bivariate analysis showed improvement for mortality and readmission only. Magnet Recognition does not require hospitals to specifically prove a decrease in "mortality" and "readmission", but it requires hospitals to demonstrate better outcomes for some of the measures that are directly/indirectly related to "mortality", "readmission", and "safety of care" such as Central line-associated bloodstream infections (CLABSI), Catheter-associated urinary tract infections (CAUTI), heart failure, stork, and pneumonia measures.

Multivariate Analyses

Table 4.6 above showed that Magnet status alone did not explain the differences between MHs and non-MHs in four out of the seven outcome domains: "efficient use of outpatient imaging", "safety of care", "timeliness of care", and "effectiveness of care". To better understand the differences between MHs and non-MHs, a multivariate simple linear regression analysis was carried out after controlling for other factors that might affect the variability of outcome measures. Other variables that we have added in the model are various hospital characteristics and specific CMS structures/process. Table 4.7 reports the multivariate simple linear regression results for each of the outcome index. The seven patients' outcomes are the dependent variables for the analysis. The results

indicate that the associations between the outcomes and Magnet status after controlling for different factors were varied. For example, the "efficient use of outpatient imaging", "mortality", and "safety of care" were explained by one explanatory variable. On the other hand, the "timeliness of care", "readmission", and "patient experience" were explained by three explanatory variables. The "effectiveness of care" outcome was explained by four explanatory variables. It should be noticed that the bivariate analyses results reported in Table 4.6 above and the multivariate analyses results reported in table 4.7 showed similar number of significant associations of Magnet status with the same outcome measures.

In terms of the "efficient use of outpatient imaging", by investigating the different hospital sizes measured by the number of beds, the average score of the "efficient use of outpatient imaging", increases by (-2.85) in extra-large hospitals (501-2,915 beds) compared to small hospitals (100 beds <). It means that hospitals become less efficient in the use of outpatient imaging facility in the large hospitals, vice versa.

In terms of the "mortality", the results showed that MHs compared to non-MHs were higher and the p-value was significant by 3.456. Although hospitals may gain more money by not utilizing their imaging center, the CMS incentivizes hospitals in different ways for saving with better quality outcomes such as the value-based program (VBP) for lowering the cost and improving quality of outcomes. In this case, hospitals may earn more money by utilizing their outpatient imaging facilities, but they may also loose CMS's incentives for being inefficient for unnecessary utilizations.

For the "readmission" outcomes, the result indicated that MHs improved the average of the "mortality" by 1.50 compared to the non-MHs. By looking to the

differences in hospital sizes, the readmission in medium, large, and extra-large hospitals compared to small hospitals, the average decreased "worst" by (-4.11), (-5.85), and (-8.34) respectively. It is clear that the greater number of hospitals bed-size, the more readmission rate they scored, which is in theory, a logic conclusion. From the CMS's structure/process measures, only the "general surgery registry" measure is associated with the readmission outcomes; hospitals that implement "general surgery registry" compared to the other hospitals that do not implement the same measure would have a higher and more significant value by 1.43 in the readmission score.

In terms of the "safety of care" domain, the multivariate simple regression indicates that the average value of the "safety of care" was associated with one predictor only. One of the CMS structure/process "Able to track patients' lab results, tests, and referrals electronically between visits (HIT measure)" for hospitals that use technology to track their patients' health issues compared to those hospitals that do not use similar technology showed significantly lower "safety of care" score by (-3.79).

In terms of the "timeliness of care", the regression analyses results show that the "safe surgery checklist (outpatient)" measure used reported the highest value of coefficients among the significant predictors. The result reports that hospitals that use "safe surgery checklist (outpatient)" had a higher score of timeliness of care by 7.84. By examining the differences of hospital size measured by number of beds, medium size hospitals (101-300-bed) and large size hospitals (301-500-bed) compared to small hospitals reported higher and significant scores of the "timeliness of care" by 4.40 and 3.17, respectively. Also, the result indicated that the hospitals that are affiliated with

medical schools compared to those without medical school affiliation decreased the average value of the "timeliness of care" by (-1.408).

In terms of the effectiveness of care domain and looking at the differences of hospital size in comparison to small hospitals, the score of the effectiveness of care decreased by (-4.66), (-4.50) and (-4.97) in medium, large, and extra-large hospitals respectively.

Table 4.7: Multivariate regression results explaining variability of hospital outcome measures with Magnet Status and other hospital specific characteristics after excluding "type of ownership" (P-values are reported below the estimated coefficients)

	Efficient Use of Imaging	Mortality	Readmission	Safety of Care	Timeliness of Care	Effectiveness of Care	Patient Experience
Magnet Status: Non-MHs=0*							
MHs=1	-0.253 0.591	**3.456** **0.000****	**1.507** **0.033****	0.113 0.823	0.481 0.335	0.143 0.617	**0.129** **0.000***
Hospital Bed Size* 100.0 or less*							
101 – 300	-1.616 0.164	2.950 0.080	**-4.112** **0.009****	1.917 0.092	**4.409** **0.000****	**-3.666** **0.000****	**-0.395** **0.000**
301 – 500.0	-1.971 0.100	2.117 0.223	**-5.854** **0.000****	1.356 0.247	**3.172** **0.008****	**-4.505** **0.000****	**-0.471** **0.000**
501 – 2,915	**-2.859** **0.022***	2.968 0.101	**-8.348** **0.000****	0.647 0.595	2.074 0.096	**-4.978** **0.000****	**-0.556** **0.000**
Location of Hospital: -Rural*							
-Urban	-1.535 0.210	2.263 0.203	-0.550 0.741	-0.074 0.951	-0.929 0.446	-1.242 0.066	**-0.185** **0.014***

							*
Teaching Affiliated: -No*							
-Yes	-0.047 0.936	0.085 0.920	-1.166 0.145	-0.320 0.578	**-1.408** **0.017****	**-0.697** **0.032****	0.050 0.163
Able to receive lab results electronically	-1.571 0.487	-1.601 0.626	-5.362 0.081	1.448 0.512	1.208 0.593	0.563 0.651	0.159 0.253
Able to track patients' lab results, tests, and referrals electronically between visits	1.202 0.412	-3.991 0.061	0.723 0.717	**-3.798** **0.008**** *	-0.241 0.869	0.227 0.778	0.035 0.697
General surgery Registry	0.253 0.626	0.612 0.418	**1.432** **0.043****	-0.492 0.334	-0.869 0.096	-0.528 0.067	0.047 0.136
Nursing care registry	1.124 0.163	0.746 0.523	1.161 0.289	0.457 0.561	-1.046 0.194	**-1.520** **0.001****	0.018 0.712
Patient Safety Culture	-0. 062 0.928	0.697 0.487	-1.542 0.101	-1.189 0.079	-0.068 0.921	-0.012 0.974	-0.036 0.389
Safe surgery checklist use (outpatient)	-0. 317 0.895	-2.128 0.542	2.049 0.531	2.436 0.300	**7.845** **0.001****	0.549 0.679	0.112 0.434
Safe surgery checklist use (inpatient)	1.053 0.690	1.636 0.670	-0.005 0.999	0.995 0.700	3.814 0.147	**-3.208** **0.028****	-0.180 0.255
Constant Coefficients	83.15	54.85	68.51	78.76	73.99	53.54	0.625

Source: ANCC, AHA, and CMS 2018 for general acute hospitals
*= Reference group
**= Significant (P-value < 0.05)

Also, the hospitals that are affiliated with medical schools compared to those without medical school affiliation showed a decreased in effectiveness of care scores by (-0.69). Moreover, two significant association values were found between the CMS structure/process measures and the "effectiveness of care" domain of the. In hospitals that utilized "nursing care registry" and "safe surgery checklist use (inpatient)", the average values of the "effectiveness of care" surprisingly decreased by (-1.52) and (-3.20), respectively. The question becomes, could the usage of the technologies in the healthcare process decrease the effectiveness of care? This might be true and be a serious issue in introducing specific or complicated technology at the point of receiving healthcare.

Lastly, for the "patient experience" star rating, the result indicated that the average of MHs that have "patient experience" good star rating (4 and 5-star) compared to the non-MHs was higher on average by 0.12. By looking to the differences in hospital sizes, the result indicated that medium, large, and extra-large hospitals compared to small hospitals lowered the average of having "patient experience" good star rating (4 and 5-star) by (-4.11), (-5.85), and (-8.34), respectively. Also, hospitals that are located in urban areas in the U.S.A lowered the average score of "patient experience" good star rating (4 and 5-star) compared to those hospitals that are located in rural areas by (-0.15).

Magnet status is the main factor this study focuses on, and the multivariate analyses results shown in table 4.7 declared that the Magnet status was positively associated with "mortality", "readmission", and "patient experience" only.

Variability of Hospital Quality Outcomes within the MHs

In questions one and two the differences between MHs and non-MHs in different aspects was discussed. For the first time, this question establishes a comparison within a

group of MHs to investigate different healthcare outcomes while carrying the same recognition. The purpose of this comparison is to better understand whether MHs are significantly varied in terms of outcomes, and examine specific factors that could explain the variation, if they exist.

It was explained in chapter one that the designation of Magnet Recognition allows hospitals self-selection in terms of reporting outcomes and choosing different benchmarks, etc. This flexible strategy can create the variability of outcomes score. Since the American Nurse Credentialing Center (ANCC) does not have categories for Magnet Recognition based on the achievement level of outcomes, it allows flexibility so that MHs can be significantly varied in terms of their major outcomes. To test whether Magnet Recognition creates variability or not, major patient outcomes were examined such as "mortality", "readmission", 'safety of care", "efficient use of outpatient imaging", "timeliness of care", "effectiveness of care", and "patient experience" and the CMS's star rating categories. The hypothesis is that the MHs vary significantly in terms of different hospital outcomes.

4.3 Is there Significant Variability in Hospital Quality Outcomes Among the Magnet-Recognized Hospitals?

This analysis examines the differences between MHs in terms of outcomes and factors that might explain those differences. We have used the same sample we analyzed in research question two; however, we restricted the sample for this question for the 367-general acute MHs only. Analyses were carried out to compare within groups of MHs in terms of the CMS outcomes and aggregate star ratings.

4.3.1 Descriptive Analysis of MHs Outcomes

Table 4.8 shows the average of the aggregated score for each of the six outcomes, which we have calculated for general acute MHs. The Table reports the dispersion values around the center of the aggregated average score of each outcome. After corrections for the directions of the outcomes, except for "patient experience" and the CMS's star rating categories, the values were presented as a high score for better outcomes and a low score for the worst outcomes. The score scaling for the outcomes was calculated to be from 0 to 100%. Measures, which were included under each outcome's calculations, were the same measures that were aggregated by the CMS to make up the star ratings.

The statistical summary in Table 4.8 shows that the average score in percentage for MHs in terms of the six outcomes was highest (better) at 86.65 % in the "timeliness of care"; on the other hand, the average value was remarkably low (worst) at 44.14% in the "effectiveness of care" outcomes. In terms of the standard deviation (SD), "mortality" and "readmission" were highest at 9.42 and 8.93; on the other hand, the lowest SD reported for "effectiveness of care" and "safety of care" were 3.42 and 6.00 respectively. Table 4.8 also reports the coefficient of variation (CV) of the outcomes. Comparing the outcomes in terms of the percentage of the scores' distribution around the mean, it is clear that "outpatient efficient use of imaging", "safety of care", "timelines of care", and "effectiveness of care outcomes" reported very similar CV (7.50%), while the "mortality" and "readmission" were higher at 16.0% and 14.6 % respectively. The Table also indicates that the MHs' "mortality" reported the lowest of the minimum average score among the outcomes at 22.31%, while "timeliness of care" outcome in MHs reported the highest average of the minimum score among the outcomes at 54.62%. Also, the average

score of "readmissions" was the lowest among the outcomes average scores at 84.05, while "timeliness of care" outcomes in MHs reported the highest average scores at 99.29%.

Table 4.8: Summary statistics of outcome indices for the MHs

Outcomes	Mean	Standard Deviation	Minimum Value	Median	Maximum Value	Coefficient of variation % (CV)
Outpatients Efficient Use of Imaging	80.91	6.10	53.12	81.71	94.07	7.5411334
Mortality	58.87	9.42	22.31	58.93	93.48	16.005624
Readmission	60.90	8.93	34.54	61.69	84.05	14.661711
Safety of Care	80.12	6.00	46.97	80.47	94.25	7.490145
Timeliness of Care	86.65	6.43	54.62	87.96	99.29	7.4210977
Effectiveness of Care	44.14	3.42	28.44	43.73	62.98	7.7393526

Source: ANCC and CMS 2017 for general acute hospitals

In conclusion, a summary of the statistics (Table 4.8) shows variation across the outcomes among the MHs. Reported statistics like the mean, SD, and CV as well as the minimum and maximum score indicated that the variations between MHs within each outcome were high. Therefore, further investigation is suggested to better understand the variance.

For the next step of the analysis, Table 4.9 clearly outlines the correlation values between the outcomes from different MHs. This correlation analysis tells if certain outcomes are strongly or weakly associated with MHs in order to find if there are any patterns of association between MHs and outcomes. Generally, Table 4.9 shows that the outcome domains were weakly correlated with the MHs; the correlation summary reported positive and negative correlation with MHs. The correlation coefficients

between outcome scores of MHs do not show significant results. The outcomes of MHs are not correlated implying that good outcome in one dimension does not imply good outcome in another dimension. Mortality outcomes were negatively correlated and statistically significant with the "efficient of care" at (-0.17) and "readmission" outcomes at (-0.15). In addition, the "readmission" outcomes were positively correlated and statistically significant with "safety of care" at 0.11, "efficiency of care" was 0.21, and 0.11 in "effectiveness of care". Finally, the "timeliness of care" was found to be positively and significantly correlated at 0.14 in the "safety of care" domain. Both of the statistics summary and correlation tests declared that MHs were varied in their outcomes.

Table 4.9: Outcomes Correlations of MHs

	Efficient Use of Imaging	Mortality	Readmission	Safety of Care	Timeliness of Care
Mortality	**-0.1743***				
Readmission	**0.2323***	**-0.1543***			
Safety of Care	0.0127	0.0088	**0.1161***		
Timeliness of Care	0.0103	-0.0483	**0.2132***	**0.1488***	
Effectiveness of Care	0.0747	-0.0292	**0.1100***	0.0163	0.0370

Source: ANCC and CMS 2017 for general acute hospitals
*= Significant (*P-value* < 0.05)

Although MHs haven't shown strong correlations with each other, more evidence is required to determine whether MHs are varied in terms of selected outcomes; therefore, this study has gone a step further to explore the variability in MHs outcomes. The variability of scores by a small amount may not represent the variability of quality. In such a situation, it would be better to categorize hospitals into groups, such as three equal groups: low, medium and high- quality hospitals. MHs outcomes have been divided (367

MHs) into terciles, both the first (1) and the second (2) terciles include 122 MHs outcome scores, while the third (3) tercile includes 123 MHs outcome scores. MHs outcome terciles 1, 2, and 3 represent the range of variety within the outcome scores from the lowest (worst), middle, and highest (best), respectively. Table 4.10 provides cross-matched between outcome terciles for the MHs. For example, if the cross-matched between outcomes in tercile (3) includes 123 MHs, or close to this number, it means that MHs are not varied in terms of in their outcome scores available within tercile (3), and since tercile (3) includes the higher averages (best outcomes), it means that one-third of all MHs have good quality outcome scores.

After dividing outcomes to terciles, cross-matched tabulations have been utilized between outcome terciles, *i.e.*, a cross-matched was calculated between "mortality" terciles (1) and the rest of the outcome terciles (1). The overlapping of terciles with other dimensions was found to be significantly low. For example, only 18% of hospitals in the "highest" tercile for "mortality" are also in the highest tercile of "efficient use of imaging", while the cross-matched was 27% for tercile (1) "worst" and 31% "middle" for tercile (2) of the total MHs available in each of these terciles.

Table 4.10: Testing the Hypothesis of Interrelationships Between and Among Outcome Indices for the Magnet Hospitals

Outcome used to define terciles	Outpatient Efficient Use of Imaging	Mortality	Readmission	Safety of Care	Timeliness of Care
Mortality 1=122 2=122 3=123 Total=367(100%)	*1=33 (27%) *2=38 (31%) *3=23 (18%) Total=94(25%)				

Readmission 1=122 2=122 3=123 Total=367(100%)	1= 53 (43%) 2=40 (32%) 3= 51 (41%) Total=144(39%)	1= 36 (29%) 2= 34 (27%) 3= 31(25%) Total=101(27%)			
Safety of Care 1=122 2=122 3=123 Total=367(100%)	1= 42 (34%) 2= 42 (34%) 3= 43 (34%) Total=125(34%)	1= 48 (39%) 2= 44 (36 %) 3= 44 (35%) Total=136(37%)	1= 52 (42%) 2= 36 (29%) 3= 46 (37%) Total=134(36%)		
Timeliness of Care 1=122 2=122 3=123 Total=367(100%)	1= 42 (34%) 2= 46 (37%) 3= 40 (32%) Total=128(3%)	1= 42 (34%) 2= 39 (31%) 3= 34 (27%) Total=115(3%)	1= 56 (45%) 2= 46 (37%) 3= 49 (39%) Total=151(4%)	1= 50 (40%) 2= 41 (33%) 3= 47 (38%) Total=138(3%)	
Effectiveness of Care 1=122 2=122 3=123 Total=367(100 %)	1= 40 (32%) 2= 48 (39%) 3= 47 (38%) Total=135(36%)	1= 43 (35%) 2= 33 (27%) 3= 37 (30%) Total=113(30%)	1= 47 (38%) 2= 35 (28%) 3= 44 (35%) Total=126(34%)	1= 48 (39%) 2= 44 (36%) 3= 45 (36%) Total=137(3%)	1=40 (32%) 2=40 (32%) 3=45 (36%) Total=125 (34%)

Source: ANCC and CMS 2017 for general acute hospitals
1= First tercile, 2=Second tercile, and 3=Third tercile

Similarly, the overlapping between "readmission" and "efficient use of imaging" was better but still not very high. The cross-matched terciles between "readmission" and "efficient use of imaging" indicated that 53 MHs includes tercile (1) "worst" score, which is 43% of the total MHs available in tercile (1). Tercile (2), the "middle" score, included 40 MHs, which is (32%) of the total MHs available in tercile (2); and in tercile (3), the "highest" score, included 41 MHs, which is (41%) of the total MHs available in tercile (3). It should be noticed that the highest number of MHs in the cross-matched existed in

tercile 1 “worst” scores, and it was found in the cross-matched between “timeliness” of care and “readmission” outcomes for 56 out of 122 MHs, and the highest number of MHs in the cross-matched existed in tercile 3 “highest” scores, and it was found in the cross-matched between “outpatient efficient use of imaging” and “readmission” for 49 out of 123 MHs. You may find more cross-matching results available in table 4.10.

The terciles cross-matched descriptions (available in Table 4.10) showed that approximately, in the total of the terciles, one-third of MHs sample (367) existed in each cross-match of outcomes’ terciles. Therefore, it can be concluded that two-thirds of the MH samples (122 and 123) in each tercile were varied. Consequently, approximately two-thirds (244 MHs) of the total sample of MHs (367) is varied in the defined outcomes. The descriptive results of the terciles in table 4.10 support the previous statistical findings in terms of MHs’ outcomes variation, which were explained earlier.

In short, hospitals ranked highest in one dimension does not imply high ranking in another dimension. Therefore, we confirm that MHs are varied in terms of the six outcome domains.

4.3.2 Analysis of Outcomes by Hospital Characteristics and CMS Structure Measures for MHs

The descriptive analyses in the previous section confirmed that MHs are varied in terms of the healthcare outcomes. This section provides analyses of two different outcomes; the six domains score we have calculated as wells as the “patient experience” star rating, and the aggregated scores of the CMSs (star ratings), by hospital characteristics and the CMS’s structure/process measures. For the analyses, we used the 367general acute, which we have prepared earlier.

The main purpose of this analysis is to better understand what factor(s) from those listed in Table 4.11 would explain the variation of the MH outcomes. Table 4.11 below reported multivariate SLR analysis results that might explain the association between the mean of the outcomes and different predictors (10). As shown in each cell of Table 4.11, p-values are reported below the coefficient for each outcome.

The results in Table 4.11 indicate that the associations between the outcomes and the predictors including the subcategories were varied between negative and positive associations. The ten predictors in MHs were able to significantly explain some of the variability of outcomes within the MHs in fifteen positions. The multivariate simple regression analysis indicates that the ten predictors showed weak and significant association with all the outcomes, except for "safety of care" domain.

In terms of the type of ownership, the average "readmission" and "patient experience" scores were lower (worse in our scale) in investor-owned MHs by (-9.15) and (-0.34) compared to government MHs, while it was higher (better in our scale) in average in the "timeliness of care" by 8.36.

Table 4.11: Regression Model to Explain Hospital Outcomes by Various Hospital Characteristics for the MHs in the Sample (P-values are Reported Below the Estimated Coefficients)

	Efficient Use of Imaging	**Mortality**	**Readmission**	**Safety of Care**	**Timeliness of Care**	**Effectiveness of Care**	**Patient Experience**
Type of Ownership: Government, Nonfederal*							
Nongovernment, Not-for-profit	**2.556** **0.034****	**4.243** **0.022****	-1.377 0.419	1.059 0.372	**3.635** **0.002****	0.794 0.186	**-0.176** **0.042****

Investor-owned, for-profit	0.521 0.808	6.370 0.054	**-9.156** **0.003****	0.830 0.696	**8.369** **0.000****	1.528 0.156	**-0.349** **0.025****
Hospital Bed Size 100.0 or less *							
101 – 300	-2.258 0.201	3.915 0.148	-2.006 0.422	2.812 0.107	3.062 0.081	**-4.598** **0.000****	**-0.456** **0.001****
301 – 500.0	-2.263 0.216	2.122 0.449	-4.462 0.085	2.375 0.188	1.295 0.476	**-5.762** **0.000****	**-0.537** **0.000****
501 – 2,915	-2.810 0.144	4.160 0.158	**-7.152** **0.009****	1.334 0.481	-0.117 0.951	**-6.165** **0.000****	**-0.673** **0.000****
Location of Hospital: -Rural*							
-Urban	-2.447 0.150	2.566 0.325	-4.051 0.093	-2.022 0.228	-2.318 0.170	-0.194 0.818	-0.150 0.223
Teaching Affiliated: -No*							
-Yes	1.045 0.206	0.735 0.562	0.081 0.945	0.377 0.644	-0.440 0.592	-0.724 0.080	0.100 0.092
Able to receive lab results electronically (HIT measure)	-2.967 0.522	1.075 0.880	-6.688 0.308	-2.727 0.551	-2.632 0.567	2.321 0.315	0.342 0.304
Able to track patients' lab results, tests, and referrals electronically between visits	-0.025 0.991	-3.295 0.362	2.374 0.478	-0.001 1.000	-0.222 0.924	-1.059 0.368	-0.012 0.942
General Surgery Registry	-0.173 0.814	0.908 0.421	1.000 0.338	-0.533 0.463	-0.645 0.378	-0.402 0.274	0.082 0.119
Patient Safety Culture	0.387 0.703	2.308 0.139	0.093 0.948	0.654 0.514	0.315 0.755	-0.056 0.268	-0.003 0.959
Safe surgery checklist use (outpatient)	-6.280 0.124	0.427 0.946	0.257 0.964	-0.629 0.876	1.715 0.672	0.468 0.818	0.257 0.382
Safe surgery checklist use (inpatient)	7.390 0.167	-1.632 0.842	2.507 0.741	-2.75 0.601	**11.65** **0.029****	-4.229 0.114	-0.042 0.912
Constants	84.18	49.43	71.45	84.53	73.92	52.524	0.483
R-squared	0.037	0.050	0.097	0.030	0.1430	0.236	0.112

Source: ANCC, AHA, and CMS 2018 for general acute hospitals
*= Reference group
**= Significant (P-value < 0.05)

Moreover, looking to the differences between nongovernment-not-for-profit MHs compared to government, nonfederal MHs type of ownership, the analyses indicates that the nongovernment-not-for-profit MHs increased the average scores of "efficient use of imaging", "mortality", "timeliness of care" by 2.55, 4.24, and 3.63, respectively, while decreased the average score of the "patient experience" by (-0.17).

Investigating different sizes of hospitals, the average values of the "readmission", "effectiveness of care", and "patient experience" were decreased (worse) by (-7.15), (-6.16), and (-0.67), respectively in the extra-large MHs (>500 beds) compared to the small size MHs (101<beds). Similarly, for the large-size MHs (301-500), the result showed that the smaller in bed size, the average values became slightly better. It is shown in the analyses that the average values for "effectiveness of care", and "patient experience" were lower by (-5.76) and (-0.53) compared to the small size of the hospitals (<101 beds), and the same conclusion was for the medium-size MHs.

From the CMS structure/process measures, only the "safe surgery checklist use (inpatient)" reported the highest and significant coefficient in table 4.11. The analysis indicated that hospitals that utilized "safe surgery checklist use (inpatient)" increased the average value of "timeliness of care" by 11.65 compared to those hospitals that did not utilize the same process. It is noticed that the highest R-squared in the analyses was reported for the "Effectiveness of Care" by 0.23.

4.3.3 Comparison between MHs' by CMS Star Ratings and Controlling Factors

One of the aims of this question is to find out if MHs are varied in terms of the aggregated scores reported by the CMS. The star rating by the CMS is a category that ranks hospitals from one to five stars, with one star indicating the worst rating and five

stars indicating the best. Table 4.12 provides a summary of the CMS star ratings for the 367 MHs and 380 non-MHs, general acute hospitals only. The Table also declared that there are variations in their star ratings, which is the same conclusion that is drawn from earlier analyses. The CMS aggregated around 59 outcome scores to develop the star rating. Table 4.12 indicates that 3.54 %, 31.61%, and 20.71 % of MHs sample were categorized as 1-star, 4-star, and 5-star, respectively.

Also, Table 4.12 showed that non-MHs were varied as well. However, in comparison with the non-MHs, star ratings were higher for the MHs. For example, only 24.2% and 9.2% of the non-MHs were categorized as 4-star and 5-star, respectively. Also, 14% of non-MHs were found to be having 1-star category compared to 3.5% of MHs. This indicates that both MHs and non-MHs are varied in CMS star ratings, but it is also pointing to the fact that MHs have better star ratings compared to non-MHs. This is not surprising; previous analyses declared that the MHs outperformed non-MHs in "mortality", "readmission", and "patient experience" dimensions. The total weight of these dimensions in the derivation of the star rating is 66%.

Table 4.12: CMS Star Rating for the MHs and Matched Non-MHs

CMS stars	MHs Frequency	MHs Percentage %	Non-MHs Frequency	Non-MHs Percentage %
1	13	3.54	53	13.9%
2	73	19.89	90	23.68%
3	89	24.25	110	28.9%
4	116	31.61	92	24.21%
5	76	20.71	35	9.21%
Total	**367**	**100%**	**380**	**100%**

Source: ANCC and CMS 2017 for general acute hospitals

Moreover, another study aim is to find factors (predictors) that could explain the variation of MHs' star ratings as reported in Table 4.12. For the analysis, this section used the same approach of multivariate analyses form as in the previous section.

However, the purpose here is to examine the differences in the MHs when compared to each other in terms of the CMS 's aggregated star rating, and test factors that may explain the variation. Since the CMS's aggregated star ratings are categorical outcomes, ordered logistic regression (OLR) was utilized.

Because the outcomes of this analysis are categorical and ordered (from 1 to 5 stars), it is important to test for an essential assumption of the OLR before accepting the analysis model by using (proportional odds assumption by (omodel) command in STATA). The OLR assumes that the relations between each pair of the star rating are the same and show an insignificant chi2 score. In other words, the coefficients that describe the relationship by going from 1 to 5 stars, 2 to 5 stars, 3 to 5 stars, and 4 to 5 stars are similar and the differences in the relationship represented by the chi2 are insignificant. The result of testing the proportional odd assumption showed that the relationship between each pair of the star rating was insignificant, approximate likelihood-ratio test of proportionality of odds across star ratings categories chi2, (42) = 50.40 and Prob > chi2 = 0.1754; otherwise, we would use a different type of OLR to obtain one model for each of the four paired outcomes. Since the relationships were the same between the four pairs of star ratings, one model of OLR that includes one group of coefficients has been conducted and accepted. Table 4.13 below reports the result of the OLR.

From the findings of the OLR analyses shown in Table 4.13, we can say that the selected variables somewhat failed to explain the variability of the star ratings of the MHs. As it shown in table 4.12 above, because only a few MHs are categorized in CMS's star rating category-1 (only 13 of the MHs sample) and the majority in categories 3 and 4, it may explain the inability of the order logistic model to identify any relevant

explanatory variables. It is possible that the lack of significance of the explanatory variables is due to a small percentage of hospitals in category 1 (one star) and most being in categories 3 and 4-star. To test the idea that the top two-star ratings should be in the same category, a dummy variable was created with stars 4 and 5 as one category. Assuming that finer categorization does not imply underlying differences in quality or outcome measures, a dummy variable was defined by combining categories (categories 4 and 5 as 1 and zero otherwise). This model worked better than the ordered logistic model.

Table 4.13: Estimated Odd Ratios for Star Ratings Among MHs by Various Hospital Specific Characteristic

CMS's Star Ratings	Odds Ratio	P-Value
Type of Ownership: Government, Nonfederal*		
Nongovernment, Not-for-profit	1.018509	0.960
Investor-owned, for-profit	0.542308	0.359
Hospital Bed Size 100.0 or less*		
101 – 300	0.866841	0.769
301 – 500.0	0.436557	0.106
501 – 2,915	0.444241	0.134
Location of Hospital: -Rural*		
-Urban	0.795352	0.616
Teaching Affiliated: -No*		
-Yes	0.9862272	0.955
Able to receive lab results electronically (HIT measure)	0.079351	0.071
Able to track patients' lab results, tests, and referrals electronically between visits	1.356205	0.628
General Surgery Registry	0.957246	0.841
Patient Safety Culture	1.037505	0.901
Safe surgery checklist use (outpatient)	2.058976	0.569
Safe surgery checklist use (inpatient)	0.284272	0.466
Cut1 **Cut2** **Cut3** **Cut4**	-6.907003 -4.747057 -3.610245 -2.120343	

Source: ANCC 2017, AHA 2017, and CMS 2018 for general acute hospitals of MHs

*= Reference group
**= Significant (P-value < 0.05)

The results of the regression analyses shown in Table 4.14 showed that similar major hospital characteristics and structure/process measures have been used. Those used are CMS's structure measures and utilization measures, many of which were able were able to explain variation within MHs in terms of the six outcome domains.

Table 4.14: Regression Model to Explain MHs Star Rating (Binary Outcome) by Various Hospital Characteristics (P-values are Reported below the Estimated Coefficients)

	CMS's Star Rating (binary outcome)
Type of Ownership: Government, Nonfederal*	
Nongovernment, Not-for-profit	0.016 0.862
Investor-owned, for-profit	-0.050 0.773
Hospital Bed Size 100.0 or less *	
101 – 300	-0.140 0.324
301 – 500.0	**-0.313** **0.035****
501 – 2,915	**-0.316** **0.042****
Location of Hospital: -Rural*	
-Urban	-0.159 0.247
Teaching Affiliated: -No*	
-Yes	0.005 0.929
Able to receive lab results electronically (HIT measure)	**-0.736** **0.050****
Able to track patients' lab results, tests, and referrals electronically between visits	0.260 0.174
General Surgery Registry	0.016 0.777
Patient Safety Culture	0.041 0.617

Safe surgery checklist use (outpatient)	-0.068 0.837
Safe surgery checklist use (inpatient)	-0.198 0.646
Constants	1.597
R-squared	0.060

Source: ANCC, AHA, and CMS 2018 for general acute hospitals
*= Reference group and **= Significant (P-value < 0.05)

The analysis in the table 4.14 reported that the explaining of the MHs' star rating variation remained relatively low, but some variables appear significant in explaining the overall outcome. Larger hospital size (in terms of the number of beds more than 300) is more likely to be in the lower star ratings than the smaller hospitals. Moreover, from the CMS structure/process measures, only one the "able to receive lab results electronically" was negatively significant; it reduces the likelihood of being in star rating 4 or 5. This is not consistent with a prior hypothesis but this process measure and hospital-size may be related.

Finally, table 4.12 above indicated that MHs and non-MHs are varied in terms of the CMS star rating; also, it showed that MHs were having better star rating categories than non-MHs. It was not clear if there is a pattern between the seven domains outcomes and the CMS star rating categories.

Table 4.15: Patient Experience and CMS Star Rating for the MHs and Non-MHs

Patient Experience Stars	**CMS Star Rating**				
	1	**2**	**3**	**4**	**5**
1	66.67%	33.33%	00.00%	00.00%	00.00%
2	36.26%	36.26	19.78%	6.59%	1.10%
3	5.91	23%	31.01%	27.22%	12.87%
4	0.60%	11.38%	19.16%	41.32%	27.54%
5	00.00%	00.00%	00.00%	40%	60%

Source: CMS 2018

To better understand about the relationship between the seven domains and CMS star rating, we have created terciles for the numerical outcomes (six domains) for the entire sample (367 MHs and 380 non-MHs), then, we have performed a set of tabulations between each of the six domains and CMS five star ratings, and the findings indicate that the terciles of each of the six domains were distributed around the CMS five star ratings. However, when tabulating the "patients experience" five-star ratings and the CMS five-star ratings as it is shown in table 4.15 above, the result shows that if the "patient experience" star rating is 1 –star, the CMS star rating are 1&2-star for the same hospitals. Moreover, if the "patient experience" rating is 5 –stars, the CMS star rating is found in 4&5-stars for the same hospitals. It appears that these measures are highly correlated.

4.4 Summary

The analyses conducted above examined MHs and non-MHs from a number of different perspectives. In research question one, the analysis focused on the differences between MHs and non-MHs in terms of general hospital characteristics like bed-sizes, location, ownership, teaching status, etc. The results of the analysis indicate that the hospitals receiving Magnet Recognition are significantly different from the hospitals not recognized as Magnet. Therefore, hospitals that apply for and receive Magnet Recognition are significantly different from the hospitals that are not Magnet Recognition. This implies that the comparison of hospital outcomes between MHs and non-MHs will not be valid unless the non-MHs chosen for the comparison are similar to the MHs. Otherwise, it will become impossible to conclude whether the hospital outcome differences are due to magnet recognition or differences in characteristics of hospitals. For comparative purposes, it is important to select similar hospitals from the non-Magnet

group so that the effect of Magnet Recognition on processes and outcomes can be evaluated. In this analysis, similar non-MHs were selected from the list of all non-MHs by one-to-one matching of a MH with a non-MH using variables like location, size, type of ownership, and teaching status to estimate the propensity scores. The propensity score matching ensured that the set of MHs is similar to the non-MHs selected for the analysis in terms of hospital characteristics. An initial analysis indicates that the MHs outperformed the non-MHs on average for most of the CMS structure/process measures. Although it is an initial indication that Magnet Recognition improves hospital performance, more rigorous analysis is needed to see whether Magnet Recognition positively affects outcomes of hospitals.

In research question two, MHs were found to be significantly different from non-MHs in terms of different hospital outcomes and processes. The comparison of the differences between MHs and non-MHs in terms of seven domains of patient outcomes were carried out using bivariate and multivariate analyses. Both analyses results showed that Magnet Recognition was significantly associated with better outcomes for "mortality", "readmission," and "patient experience" domains. Furthermore, the controlling variables in the multivariate model explained more in the differences between MHs and non-MHs than the major explanatory variable "Magnet status." Because the "type of ownership" became significant after applying the PS method, we have excluded this variable because ownership status is correlated with magnet status, and therefore, inclusion of the variable underestimates the effects of Magnet status on hospital outcomes in the multivariate model.

In the last research question, we tested the variability of hospital quality within the Magnet group, i.e., whether MHs vary significantly among themselves in terms of hospital outcomes. Simple descriptive statistics, correlation test, tercile cross-matching between outcome-combinations were carried out to understand the nature and degree of differences or similarities within the Magnet group. The section also analyzed differences in overall star ratings of the MHs. When testing the variability of MHs' outcomes, multivariate simple regression model explained the variations better than the ordered logistic regression model. The ordered logistic regression could not identify any specific factors that can explain the variability of MHs in terms of overall star ratings.

Interestingly, the analysis observed that the overall hospital star rating is very closely aligned with the patient experience ratings. Such a high overlap between these two ratings probably implies that patient experience rating is the principal driving force in determining the overall star rating of hospitals. This happens even though the patient experience carries only 22% weight in overall star rating. Therefore, this high degree of overlap is quite surprising and unexpected. It will be important to understand the reasons for this significant level of correspondence between overall star rating and patient experience. A number of hypotheses may be proposed, but all these require further empirical analyses. The dissertation research has not examined this specific aspect of patient experience and overall star rating correlations, but future studies should explore these. The potential theoretical explanations could be: (a) hospitals vary widely in terms of the other seven quality dimensions implying that a hospital good in one dimension may not be good in another dimension. Such variability will imply that if the seven dimensions excepting the patient experience dimension are considered, hospitals vary

more or less in a random manner. If that is the case, irrespective of the weights assigned to these seven dimensions, hospitals will show random variability. (b) Narrow variability of hospitals in terms of the other seven dimensions could be another factor. Even though hospitals vary in terms of the seven dimensions, the quantitative scores may be within a narrow range so that one dimension with significant variability tends to dominate. (c) The methodology of calculating patient experience by design allows significantly higher variability than the estimation of other dimensions.

If it is, in fact, the case that the patient experience dimension is the dominant dimension in the final star rating of hospitals, it may create significant disincentives for the hospitals to focus on the other six dimensions of hospital quality and emphasize patient experience aspect more. The CMS needs to identify potential issues with the derivation of hospital star rating to avoid this intended consequence of star rating and incentives/ disincentive structures it may create.

CHAPTER 5

DISCUSSION, POLICY IMPLICATIONS, AND CONCLUSION

The objective of this research is to test whether hospitals that acquired Magnet recognition (MR), known as Magnet hospitals (MHs), are different from non-MHs in terms of hospital structure/processes and outcomes. Outcome measures used in the analysis are the ones used by the CMS to develop the five categories of Overall Hospital Quality Star Ratings (OHQSR). The objective of this dissertation is to identify the factors that might help healthcare stakeholders in improving healthcare quality outcomes. The results may also help guide patients to review important elements of hospital outcomes when trying to identify the right facility to visit or receive services from for specific health concerns they have.

5.1 Are the MHs Different from the Non-MHs in Terms of Major Hospital Characteristics and Utilization?

As discussed in the previous chapters, the Magnet Recognition process was initiated to improve nurse experiences in hospitals. Later, it became more generalized and started examining some hospital outcome variables as well. The modern Magnet Recognition process is broader than nurse experience-based indicators, but it still retains important nurse related factors. However, since its inception in 1980s, the proportion of hospitals obtaining Magnet Recognition remains relatively low, around 10%, in the

U.S.A. Low participation in the Magnet Recognition process raises a number of questions to better understand the utility or value of Magnet Recognition. First, even though Magnet Recognition tries to improve nurse retention in hospitals, it is possible that there are hospitals in the market that are not Magnet Recognition but have equally good or better nurse outcomes than the MHs. Second, since the proportion of hospitals with Magnet Recognition is quite low, hospitals with specific characteristics are probably more likely to apply for the recognition, creating self-selection bias in the Magnet Recognition process. It is possible that hospitals with specific characteristics are relatively well-prepared to meet the requirements of Magnet Recognition and they are the ones who tend to apply for Magnet Recognition. It is also possible that there are a number of non-MHs that fully satisfy the requirements for being "Magnet," but they decide not to apply for Magnet Recognition due to cost and other considerations. These hospitals may feel that Magnet Recognition will not bring any additional market value to the hospital and decide against Magnet Recognition application.

To better understand the effect of Magnet Recognition and its direct effect on hospital outcomes, this research included all 6,283 hospitals in the U.S.A in the analysis (as of December 2017). In December of 2017, the U.S.A had 432 MHs and 5851 non-MHs. The national-level focus of the analysis will help identify whether Magnet Recognition helps the hospitals improve their quality compared to other non-MHs. Since application to become Magnet recognized is unlikely to be a random event, the first step would be to compare the MHs and non-MHs in the U.S.A in terms of major hospital characteristics like location, bed-size, teaching affiliation, ownership status, and type of services offered.

The analysis indicated that MHs were significantly different from non-MHs in the country. Two-third of MHs were nongovernment-not-for-profit ownership type, while it was 49% for non-MHs. Similarly, 18.6% of MHs were government-nonfederal compared to 23.3% for non-MHs. Also, 78.2% and 67% of MHs and non-MHs were located in urban areas respectively. Hospital characteristics differences between MHs and non-MHs were also noticed in the teaching affliction status and type of services provided. 46.6 % of MHs were teaching affiliated with associated medical schools compared to 25% for non-MHs. Similarly, 85% and 74.2% of MHs and non-MHs, respectively, were general acute care hospitals. The findings of this comparison between MHs and non-MH indicated significant differences between the two groups. However, there are many non-MHs that have similar characteristics as the MHs but they did not apply for Magnet Recognition. It is not clear why these hospitals do not apply for Magnet Recognition but high cost of the Magnet Recognition process or the time required to get the certification may discourage some hospitals to get Magnet Recognition.

The consequences of the differences between MHs and non-MHs are reflected in primary utilization measures. The findings indicate significant differences in utilization measures between MHs and non-MHs. For example, the MHs had higher Medicare discharges on the average from the non-MHs by 32%. Similarly, total discharges per bed and total days per bed were also higher for MH by 13% and 14.7% respectively from the non-MHs. Medicaid utilization measures were also higher for the MHs. Hospital bed utilization rates were higher for MHs than the non-MHs implying that the fixed assets like hospital beds are used more intensively in MHs than in the non-MHs.

5.2 Why it is Important to Apply Propensity Score Matching?

Comparison of characteristics of non-MHs and MHs indicated that the hospital-types were significantly different from each other. Essential characteristics and utilization measures like hospital-size, location, teaching-affliction, and utilization measures can be directly/indirectly related to the final outcomes considered in the analysis. One of the objectives of this research is to identify if the Magnet Recognition is associated with better overall outcomes than the non-MHs. To carry a comparison between the MHs and the non-MHs in terms of hospital outcome variables, it is important to ensure that the MHs and non-MHs being compared are similar in characteristics. Therefore, the Propensity Score (PS) matching was utilized to select "similar" non-MHs from the list of all non-MHs in the country so that each MH can be matched with one non-MH. We restricted the matching by using the characteristics like type-of-ownership, hospital-size, location, and teaching-afflicted with the medical school. The propensity score matching was successful in identifying matched non-MHs for each MH in the sample. Although the matching was successful, MHs and matched non-MHs still differed significantly in terms of ownership. It is not unusual to observe differences in one or two dimensions when the matching is carried out using propensity scoring. The matching process may not be able to identify an entirely comparable sub-sample for a number of reasons. First, propensity scores of two hospitals may be very close to each other even though they vary in terms of one or two characteristics in such a way that the score differences offset each other. Another possibility is that due to the differences in characteristics between the hospital types, best matching is achieved by keeping one characteristic not matched properly. Since the MHs and matched non-MHs remain different based on hospital ownership

status, this should be considered in any analysis of hospital outcomes. It is possible that this specific characteristic may bias the effect of MH status on outcomes.

5.3 Do the MHs Differ Significantly from the non-MHs in Terms of Structure and Processes of Hospitals as well as Overall Quality Outcomes?

The results indicate that MHs have better structure/process measures than the matched non-MHs in all dimensions except for the "general surgery registry." The estimated coefficient of MH for the dimension was found to be negative (-8%). Because Magnet Recognition focuses mainly on improving nursing outcomes, the results confirmed that MHs were better than the non-MHs in terms of nursing-related measures. The conclusion of the analysis was that Magnet Recognition status did improve the structure/process measures of MHs compared to measures observed for similar non-MHs. It should be noted that these measures are relatively new and no study has examined the effect of MH status on these measures. However, more rigorous analysis of structure and processes are needed to better understand the pathways through which MHs show better outcomes than the non-MHs.

In terms of healthcare outcomes, this study employed the outcomes reported by the Centers for Medicare & Medicaid Services (CMS). One of the potential problems would be if the Magnet Recognition uses the same measures as the CMS outcomes to recognize a hospital as "Magnet" but comparison of Magnet Recognition measures with CMS imply that the overlap between the two is quite small; only six out of forty-five CMS measures overlap with Magnet Recognition system. Despite this minor overlap, it should also be noted that Magnet Recognition requirements allow flexibility in defining hospital's own national benchmarks.

The bivariate analysis showed that MHs outperformed the non-MHs in terms of "mortality," "readmission," and "patent experience" domains. Several studies compared mortality rates between MHs and non-MHs. Three studies by Aiken et al. in 1994, McHugh et al. in 2013, and Friese et al. in 2015, had used risk-adjusted "mortality" and the findings, in general, are consistent with the findings of this study. This study supports the earlier results that "mortality" outcomes are better in the MHs compared to the non-MHs. However, more studies are needed to examine if the implementation of new Magnet model (MM) changed the effect of Magnet Recognition on "mortality" outcomes. This study did not test the degree of improvement in "mortality" observed before and after the implementation of new MM.

The findings of the multivariate regression after controlling for hospital characteristics and structure/ process factors were consistent with the bivariate model in terms of the effect of Magnet status on the outcome measures. The findings confirmed that Magnet Recognition improved "mortality," "readmission," and "patent experience" Outcomes. The Magnet Recognition requires hospitals to report a number of measures that are directly or indirectly related to readmission rates. For example, Magnet Recognition requires hospitals to report different "safety of care" measures and empower patients with essential information about their follow up and medication uses at discharge. More studies are needed to confirm the importance of Magnet Recognition in reducing the rate of the "readmission."

It is important to emphasize that the Magnet Recognition requires MHs not only to report the "safety of care measures" (two of these measures overlapped with CMS's measures) but also to benchmark these measures nationally. Magnet Recognition

classifies "safety of care measures" as an empirical outcome in its requirement. For these measures, it was expected that MHs would have better "safety of care" domain scores (named HAI in Magnet Recognition). Surprisingly, both bivariate and multivariate regression indicate that Magnet Recognition was not associated with better "safety of care" as well as other outcome domains like "efficient use of outpatient imaging," "timeliness of care," and "effectiveness of care." Under the five components of the new MM, a comprehensive set of requirements are defined, around eighty-one measures in total. Even though Magnet Recognition does not require hospitals to nationally benchmark its "non-empirical outcomes", these measures are important as they cover many areas of healthcare structure and process.

The hospitals that receive Magnet Recognition go through a time consuming and costly process. If the outcomes are better for the MHs, these additional costs would be worth incurring. The findings of this study indicated that the MHs were better than the non-MHs in terms of three critical dimensions, and the overall star rating of MHs were also much better than the comparable non-MHs. Therefore, Magnet Recognition may be a worthy process to go through to improve hospital quality. The question, however, remains why the Magnet Recognition remains relatively low even after twenty-seven years of its introduction. In the U.S.A, MHs represents less than 10% of total hospitals in the country.

5.4 Is there Significant Variability in Hospital Quality among the Magnet-Recognized Hospitals Themselves?

The Magnet Recognition requires hospitals to report on eighty measures, which are distributed under twenty-one categories. For these measures, Magnet Recognition requires hospitals to benchmark empirical outcomes in three categories, which include

thirty-four measures. The hospitals are also required to report the source-of-evidences on eighteen categories of non-empirical outcomes, which include forty-six measures. The structure, the designation, and the requirements on these measures may cause significant variations within MHs in terms of healthcare outcomes. The Magnet Recognition process allow hospitals the flexibility to self-select the national benchmarks against which the hospital should be compared. Hospitals are required to outperform the mean or the median of the chosen national benchmarks but given that they have the flexibility of choice of benchmarks, it may lead to significant variability within the MH group. Also, it is important to point out that most of the Magnet Recognition outcomes are non-empirical and for these non-empirical outcomes, hospitals compare itself with its previous status or situation. Since each Magnet hospital competes with itself for the non-empirical outcomes, this becomes another source of variability among hospitals.

Investigations on MHs' outcomes- CMS six domains- indicated that the MHs were remarkably varied. Summary statistics showed that the averages of MHs for the CMS six domains varied from low to high scores. The statistics indicated that the lowest average score was for "effectiveness of care," and the highest was for "the timeliness of care". Moreover, the coefficient of variation (CV) implies large variability of the scores across MHs; the CV for MHs outcome varied between 7.5% and 16%. The "mortality" and "readmission" were the highest in terms of CV at 16% and 14.6%, respectively. Also, the score of the MHs' six-domains outcomes were not highly correlated, implying that good outcome of a MH in one dimension does not necessarily imply good outcome in another dimension. For the categorical domain, overall patient experience star ratings, the

MHs did not show high variability. More than 95% of MHs had a star rating of three or better in this dimension.

One possible explanation of variability could be that the measures themselves are not that specific and sensitive and rather than using the absolute measures of the outcomes, it would be better to use categories of outcomes by subdividing the outcome measures into discrete categories, similar to what has been done for star rating. Using the values of the outcomes, we have defined three equal groups: low, medium and high-quality hospitals. Even after defining the terciles, the overlapping of terciles with other dimensions was found to be weak. For example, only 18% of hospitals in the highest tercile for "mortality" are also in the highest tercile of "efficient use of imaging." Overlapping between "readmission" and "efficient use of imaging" was better but still not very high. The terciles' cross-matched between the score of MHs' six-domains outcomes indicate that hospitals ranked highest in one dimension does not imply high ranking in another dimension.

We have used CMS's star rating as another measure to compare variability across MHs. The result indicated that MHs vary significantly in terms of CMS star ratings as well; 20.7% of MHs had five-star rating but 24.25% had three starts while 3.54% had one star. For comparative purposes, we compared the star rating of matched non-MHs with the star rating of MHs. The comparison clearly indicates that the proportion of MHs in the four- and five-star groups (the top or best two categories) was significantly higher than the proportion of matched non-MHs. This is not unexpected; the findings indicated that MHs outperformed non-MHs in "mortality," "readmission," and "patient experience"

dimensions. The total weight of these dimensions in the derivation of the star rating is 66%.

A number of hypotheses may be advanced at this stage based on the results of empirical analysis. First, the variations among the MHs in terms of outcomes of seven domains and star rating may be the result of flexible requirements of the Magnet Recognition. However, the MHs performed much better than the comparable non-MHs in terms of star rating. To explain the variation across the MHs in terms of CMS's seven-domains outcomes and star rating, we have used hospital characteristic and structure/process as possible explanatory variables. Simple multivariate regression model indicated that hospital characteristics and structure/processes explain only a small proportion of the variability of seven-domains scores among the MHs. The highest R-square value (0.23) was found for the model explaining "effectiveness of care" scores but in that model, only the hospital size groups became significant. Large hospitals (number of beds more than 500) showed lower scores in three dimensions: "readmission," "effectiveness of care," and "patient experience." For the CMS star-rating, the results of the ordered logistic regression (OLR) with star rating 1 as the comparator, failed to explain the variations in star ratings of the MHs. It is possible that the lack of significance of the explanatory variables was due to the very small proportions of hospitals in category 1 (one star) and most being in categories 3 and 4. Assuming that finer categorization does not really imply underlying differences in quality, a dummy variable was defined by combining star ratings 4 and 5 together as one category. This model turns out to be better than the five-category model but explained variability remained relatively low. It appears that larger hospital size (in terms of the number of beds more than 300) is

more likely to have lower star ratings than the smaller hospitals. More studies are needed to identify the reasons for relative disadvantage of larger hospitals.

5.5 Policy Implications

The Magnet Recognition commits to design and build the right structure/processes for hospitals to improve hospital outcomes. This is not limited to the improvement of patient outcomes alone but also to improve other outcomes like financial and organizational outcomes such as nurse's satisfaction, autonomy, retention, and shared decision-making. For example, one important aspect is to involve nurses in hospital leadership to facilitate the goals, visions, and missions of the organization.

Because Magnet Recognition requires a great deal of complex, costly, and time-consuming processes to improve nurses-related issues, this study confirms that these improvements did make the MHs better than the comparable non-MHs. MHs were better than the non-MHs in terms of three important dimensions as well as overall star-rating. Therefore, Magnet Recognition is a worthy process to go through to improve hospital quality. However, Magnet Recognition's flexible in terms of standards and benchmarks to be used may lead to inter-MH variability. It appears that focusing more narrowly on CMS seven-domain outcomes can strengthen the Magnet Recognition processes.

In the U.S.A, CMS is one of the most important payors for hospital care. Since all MHs in the U.S.A are authorized to receive CMS patients, incorporating CMS outcomes in MH requirements may help in improving quality outcomes as well as financial outcomes of the hospitals. In the last decade, the CMS has become more rigid in defining its requirements. The CMS now prioritizes patients' satisfaction as an indicator of quality, and it has reformed the payment system to become value-based services rather

than volume-based. Though Magnet Recognition has adopted some measures that are included in the CMS outcomes, the CMS and Magnet Recognition are independent institutions with different requirements. The Magnet Recognition should carefully evaluate if it will be worth for it to make the process more consistent with the CMS's outcome domains including the "safety of care" domain of CMS in which the MHs did not perform that well. Hospitals and healthcare quality agencies should focus on the CMS outcomes because the CMS Hospital Compare (HC) quality measure data includes more than 100 of the most important health outcomes, and these outcomes are used in different CMS value-based purchase (VBP) programs as well as for the star rating categories. Adopting CMS's outcomes by the Magnet Recognition may help strengthen the accreditation of Magnet Recognition.

Another issue of the Magnet Recognition is the provision of self-selected benchmarking for non-empirical outcomes, which represent about 95% of all Magnet Recognition requirements. Both self-benchmarks for non-empirical outcomes and self-selected national benchmarks for empirical outcomes in Magnet Recognition create variability across MHs in terms of final quality outcomes Based on the findings of the study, the following recommendations may be proposed:

- In the new payment system, hospitals struggle to fulfill the CMS requirements. They become accountable and incentivized for the cost and the quality of patient outcomes. Magnet Recognition should reconsider its requirements to focus more on the empirical outcomes related to patients and to examine the extent to which it covers the major outcomes that are nationally measured and made available to the

public. Magnet Recognition should require the same set of requirements for all hospitals to reduce within MH variability.

- The benchmarks for the empirical outcomes and the source of evidence for non-empirical outcomes are the most important aspects of Magnet Recognition accreditation. As mentioned before, the current requirements create significant variability among MHs on major patient outcomes. It is quite unexpected that after four years of costly and time-consuming Magnet Recognition process 47.75% of MHs were in the 1, 2, and 3 categories of the CMS star rating and only 20.71% were in the fifth category. We also found that the Magnet Recognition Magnet Recognition was moderately associated with better outcomes in three domains. Magnet Recognition should include more empirical outcomes and unify the benchmarks for all MHs to help improve the outcome measures.
- The U.S.A healthcare providers have become accountable for the service they provide, i.e., CMS' value-based payment programs link the outcomes with financial reward and payment. Magnet Recognition contends that MHs should have "business growth and financial success" once accredited. In reality, none of the Magnet Recognition requirements contain outcomes related to financial aspects of hospitals, such as guidance to increase revenue and profit or decrease costs. One study by Jayawardhana et al. cited in the Magnet Recognition website investigated 141 MHs from 1998 to 2006 and 2541 non-MHs in terms of financial outcomes and found that MHs showed better and significant impacts on inpatient cost and revenue compared to the non-MHs. Although it is an encouraging result for Magnet Recognition, the Jayawardhana et al. study should have used matched

non-MHs for comparative purposes. Without proper matching, the results are subject to significant bias. Therefore, it is proposed that further investigations be carried out to compare the financial performance measures of MHs with matched non-MHs.

- In general, our findings indicated that larger hospital-sizes experience problems with improving the outcome measures. It is important to identify whether the result is due to problems of measurement with the outcome measures or the larger hospitals, for some reasons, are disadvantaged. It is possible that the normalization process followed to define the outcomes fail to account for the variability of patient mix and mix of services rendered by the larger hospitals. The outcome measures should be reexamined to see if the measurements themselves are biased.

It is interesting to note that the overall hospital star rating is found to be very closely aligned with the patient experience ratings. Such a high overlap between these two ratings may indicate issues with the measurement of overall star rating itself. Since the weight of the patient experience rating is not that high, such high correlation implies that other dimensions in the star rating show high variability across hospitals to cancel out the independent effects of those outcomes on final outcome by a significant margin. The CMS should examine the reliability and usefulness of the overall star rating so that it does not create disincentives on hospitals by ignoring the six other dimensions of hospital quality.

5.6 Study Limitations

Although the primary purpose of the Magnet Recognition is to improve nursing structure, process, and outcomes in healthcare facilities, this study did not compare the MHs and non-MHs in terms of nurses' related measures. For example, we have not included measures like nurse to patient, education and training of nurses, hand hygiene practices, and nurse retention ratio and turnover rates among nurses in the hospitals. In theory, these measures are available in data sets of American Hospital Association (AHA), the Leapfrog, and the National Database of Nursing Quality (NDNQI). However, due to substantial missing information in the AHA and the Leapfrog datasets for these measures, and since the NDNQI data is highly restricted, it was not possible to include these nurse-related variables in the analysis. If we decided to include these variables from the AHA data set, half of the hospitals would have missing values, severely reducing the sample size for the analysis. Excluding these important measures, especially for the MHs, may be considered an important limitation of this study.

This study has used cross-sectional dataset for a relatively small sample compared to the total number of hospitals in operation in the U.SA. In 2017, total number of hospitals in the U.S.A was 6,283. Our study included only 747 of general acute hospitals, 367 MHs and 380 non-MHs. Clearly, the sample of hospitals we have used is a relatively small proportion of U.S.A hospitals, about 11.8% of all hospitals or 15.8% of general-acute hospitals. However, this problem is unavoidable because the focus of the study is the acute care general hospitals that are Magnet recognized. We have included all the MHs in this category. Since the total numbers of MHs are so small, with one-to-one

matching with non-MHs, the sample size remained less than 800. If the number of MHs in the U.S.A increases in the future, it will be possible to estimate the effect of Magnet Recognition itself on different hospital types and ownership categories.

5.7 Conclusions

The Magnet Recognition program was created by a group of researchers when investigating the cause of high level of nurse retention at some hospitals, which they called MHs. While majority of hospitals in the U.S.A were struggling with severe nurse turnovers in 1970s, few hospitals were doing well. The original study of "Magnet" aimed to highlight the causes of nurse retention, and it included only 41 hospitals. The criteria of the selection were low rate of nurse turnover, having a reputation as 'good places to work,' and competing with other hospitals for attracting hospital staff. Magnet's study team identified fourteen reasons for the nurse-retention rate in these 41 hospitals, which they called "Forces of Magnetism (FOM)." The FOM became the basis of Magnet Recognition.

In this study, we have matched all the general acute care Magnet recognized hospitals in the U.S.A (as of December 2017) to comparable non-MHs to estimate the effect of Magnet Recognition on hospital outcomes. For this analysis, we have utilized more comprehensive healthcare outcomes to compare the MHs with the non-MHs. Three research questions were addressed. A simple comparison of MHs with non-MHs in the U.S.A indicated that the MHs were significantly different from the non-MHs in terms of major hospital characteristics. This possibly implies that not all hospital types apply and get recognized as Magnet and hospitals with specific characteristics choose to obtain Magnet Recognition. This is an important observation because this means that if we are

examining the effect of Magnet Recognition on hospital quality, we must compare MH with similar non-MHs.

The reasons for not seeking Magnet Recognition could be many but we have not explored this point. Possible reasons could be cost of going through the Magnet Recognition process, financial and time costs. In 2017 only about 7.5% of the hospitals in the U.S.A were Magnet-recognized. Regardless of the reasons, it is essential to correct for the significant differences between MHs and non-MHs in terms of the major characteristics. We have adopted propensity score matching to select similar non-MHs to compare with the MHs.

After matching non-MHs with MHs, we examined the effect of Magnet Recognition on hospital quality outcomes. The analysis indicates that Magnet Recognition improves the CMS structure and processes of MHs compared to the matched non-MHs. The comparison of outcomes shows that the MHs outperformed the non-MHs in measures related to "mortality," "readmission," and "patient experience" dimensions. Since the weight of the outcomes in these three dimensions is 66% in the overall CMS star rating, we concluded that Magnet Recognition improves critical dimensions of healthcare outcomes. For other outcomes, effect of Magnet Recognition was quite low (indicated by relatively low coefficients of Magnet Recognition). Also, we found that size of hospitals affects hospital quality with size more than 500 beds did not fare better than the smallest hospital size in terms of "efficient use of imaging," "readmission" "effectiveness of care," and "patient experience."

Finally, we examined the variability of quality outcomes within the Magnet category only. The outcome measures used were CMS star rating and average outcomes for each of the seven-domains. We found that the MHs vary widely in terms of various outcome scores. This is possibly caused by the flexibility allowed by the Magnet Recognition in the selection of specific requirements and benchmarks by the hospitals applying for Magnet Recognition. The variabilities among MHs in terms of seven domains can be explained by the "hospital characteristics" and "structure and processes" measures, although the explanatory power was very weak. The "type of ownership" and "hospital bed size" showed some effect on outcomes. The effect of "hospital bed size" in explaining variability of domain scores was the most consistent compared to other hospital characteristics. Moreover, hospital characteristics, structure, and/or processes cannot explain the variability of the star rating for MHs; only the bed size showed some effect. Because only a few MHs are categorized in CMS's star rating category-1 (only 13 of the MHs sample) and the majority in categories 3 and 4, it may explain the inability of the order logistic model to identify relevant explanatory variables explaining star rating of hospitals.

In conclusion, Magnet Recognition is a worthy process to go through to improve hospital quality; yet, improvements in Magnet Recognition process should be able to improve hospital outcomes more effectively. Based on the results of the analysis, it has been proposed that the Magnet Recognition should incorporate more directly measurable CMS-type outcome measures. The CMS outcome measures is still going through adaptation and changes and the Magnet process can help improve CMS outcome

measures by proposing more robust and relevant hospital quality indicators based on nurse and patient-sensitive measures.

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