THE MAGNET RECOGNITION PROGRAM: WHAT ARE THE EFFECTS ON FINANCIAL PERFORMANCE?

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ABSTRACT

Saleema A. Karim: The Magnet Recognition Program:
What are the Effects on Financial Performance?
(Under the direction of George H. Pink)

Information asymmetry is defined as an imbalance of information between two parties where one party has more information than another party. In health care, information asymmetry impairs the ability of hospitals to compete effectively because customers are unable to evaluate the quality of health care, which then influences customer selection of hospitals. In order to reduce information asymmetry, some hospitals attain quality designations from external parties as signals of their commitment to health care quality and quality management to patients, providers, and payers. One particular quality designation in health care is the Magnet Recognition Program.

Magnet Recognition has been promoted as a signal for nursing excellence and quality patient care over the past two decades. Despite the financial investment required to attain the designation, there has been limited research investigating Magnet Recognition as an effective signal of quality. The purpose of this study is to evaluate the effectiveness of the Magnet Recognition signal by examining its effect on various dimensions of hospital financial performance: reimbursement, market share, cost inefficiency and ultimately profitability.

A pre-post research design, using control hospitals, was used to measure the effect of the signal. Secondary data from the Medicare Cost Reports, Area Resource File, American Hospital Association and American Nurses Credentialing Center were used. The sample consisted of a

longitudinal, unbalanced panel of hospitals located in urban areas between 2000 to 2010. The empirical analysis consists of two phases: (1) propensity score analysis and (2) difference-in difference analysis using fixed effects and a stochastic frontier panel model with random effects.

The Magnet Recognition signal was found to have no effect on either hospital reimbursement or market share. The lack of signal effectiveness on reimbursement and market share may be attributed to either the signal strength, interpretability of the signal or responsiveness to the signal. However, the signal was associated with a significant reduction of cost inefficiency. Overall, the signal resulted in a significant increase in profitability. In addition to affecting the appeal and demand for the designation, these results present hospital managers and policy makers with the pathway by which the signal may impact hospital profitability.

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For any errors or inadequacies that may remain in this work, of course, the responsibility is entirely my own.

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LIST OF ABBREVIATIONS

AHA	American Hospital Association's Annual Survey of Hospitals
ANCC	American Nurses Credentialing Center
ARF	Area Resource File
HCRIS	Healthcare Cost Report Information System
MR	Magnet Recognition
SFA	Stochastic Frontier Analysis

CHAPTER 1: INTRODUCTION

Problem Statement

Information asymmetry is defined as an imbalance of information between two parties, where one party has more information than another party. This imbalance can result in misinformation and an imbalance of power in transactions. One way to mitigate this imbalance is via signaling theory. Various types of signals are utilized to reduce information asymmetry. Examples of signals commonly used by organizations include branding[1-3], advertising[3], reputation[4], research and development[5], profit status[6] and quality designations.[7-9]

In health care, information asymmetry impairs the ability of hospitals to compete effectively in health care markets[10] because customers are unable to evaluate the quality of health care services. This incomplete information influences consumer selection of hospitals.[8] In order to reduce information asymmetry, hospitals sometimes attain quality designations from external parties as signals of their commitment to health care quality and quality management to patients, providers and payers.[9] One particular quality designation in health care is the Magnet Recognition (MR) Program®.

This MR designation is an example of a signal employed by hospitals to communicate to patients, providers and payers, the hospital's commitment to health care quality and quality management via nursing service excellence.[9] MR can be considered a symbol of distinction[11]; indeed, Karkos et al. viewed MR as a signal of nursing excellence and quality patient care.[12] MR signals to consumers and to health care providers about the quality of care, and in particular

nursing care, which they can expect to receive in a MR hospital[13-15], which in today's competitive market place is an important hospital characteristic.[16, 17]

The American Nurses Credentialing Center (ANCC) confers the MR designation to hospitals and long term care facilities.[18, 19] The MR process is an external professional peer review of a hospital's environment[20], with a focus on nursing, that requires the commitment of time and the investment of substantial human and financial resources.[21, 22] Hospitals seeking MR are required to meet stringent criteria related to excellence in patient satisfaction, nurse satisfaction and nurse sensitive clinical outcomes.[23]

MR designation has gained widespread attention in both research[24, 25] and practice[26] over the past two decades. A MR hospital is acknowledged as a gold standard for quality nursing care[27] and is the highest level of recognition a health care organization can receive for excellence in nursing services.[14] The program has also been promoted and recommended by popular media as a signal for nursing excellence. For example, in 2005, the U.S. News & World Report added MR hospital designation to its set of criteria used in the selection of the best hospitals in the U.S.[20, 28] In 2010, nine of the 14 hospitals listed on the U.S. News & World Report's Best Hospitals Honor Roll were MR hospitals.[29]

Despite the financial investment required to attain the MR designation, there has been limited research investigating MR as an effective signal of unobserved quality. The ANCC has promoted MR as a mechanism to improve hospital financial performance[30] and rationalized the improvement through signaling to patients and clinicians that the hospital is a center for nursing excellence and the provider of quality patient care[12] leading to increased volume of patients and corresponding increases in hospital market share[15, 18, 31] and revenue.[32] Unfortunately the

evidence in the literature about the impact of MR on hospital financial performance is largely anecdotal in nature and lacks scientific rigor.[33]

Given the endorsements and increasing interest in the MR program, despite the lack of evidence on its effectiveness, there is a notable gap in knowledge that is highly relevant in the hospital marketplace. The purpose of this study is to evaluate the effectiveness of the MR signal by examining its effect on the various dimensions of hospital financial performance.

What We Know about MR as a Quality Signal

Much has been published on MR and its impact on hospital, nursing and patient outcomes.[24, 25] MR hospitals are noted for their success in recruiting and retaining nurses by creating environments that foster empowerment, autonomy, responsibility, control over environment and positive collaborative nurse-physician relationships.[34, 35] Overwhelming research evidence demonstrates positive outcomes of MR for hospitals[36], specifically related to job satisfaction, retention of nurses, hospital marketability and patient outcomes.[37] However, there is minimal research on the association between MR and indicators of financial performance.

The hypothesized financial benefits associated with MR have been rationalized through the potential for cost savings[38], increased volume of patients leading to increased hospital market share[15, 18, 31] and better reimbursement rates.[32] However, MR requires substantial investment of both time and resources[39] thus, it is an expensive proposition for organizations interested in the designation.[40] Moreover, a recent study by Jayawardhana et al. (2014) found that inpatient costs are higher for MR hospitals than non-MR hospitals, although MR hospitals were also found to have higher net inpatient revenues.[41] Because the costs of pursing and maintaining MR are high,

more research is needed to understand the effectiveness of the MR signal as it relates to hospital financial performance.

How this Study Fills the Gap in Knowledge

Previous studies assessing the effect of signaling on firm performance have utilized small sample sizes, cross-sectional study designs, single-site evaluations, and convenience samples of firms, therefore limiting external validity of the results. To overcome some of these limitations, this dissertation uses a longitudinal panel data set (addressing issues of sample size, selection bias and omitted variable bias), and externally reported administrative and financial information, applies a robust methodological approach, and employs innovative analytical techniques to investigate the effectiveness of the MR signal as measured by changes in various aspects of hospital financial performance. Importantly, the approaches used in this study control for the fact that MR hospitals differ from non-MR hospitals. This more rigorous methodological approach provides stronger empirical evidence of the effectiveness of the MR signal on hospital financial performance.

The central hypothesis of this dissertation is that the MR signal will increase hospital financial performance through increasing hospital reimbursement, market share and efficiency of designated hospitals. The three specific aims are as follows:

- Aim 1: Determine the effect of the MR on hospital reimbursement and market share (Chapter 4).
- Aim 2: Determine the effect of the MR on hospital cost inefficiency (Chapter 5).
- Aim 3: Determine the effect of the MR on hospital financial performance (Chapter 6).

Relevance of the Question for Policy and/or Practice

Although the primary purpose of the MR is not to improve financial performance of hospitals, with the current economic climate, fiscal constraints, healthcare workforce shortages, and reduced payer reimbursements for healthcare services, hospitals may pursue this strategy to increase competitiveness in the health care market and to improve financial performance and viability. The pursuit of the MR is an important organizational decision that requires substantial modifications to the structure and culture of organizations and considerable investment of time and resources, initially and ongoing as the process continues.

The results of this dissertation have important implications for the various stakeholders involved with MR, including the MR program, hospital managers, the nursing profession and policy makers. The empirical evidence of the effect of the MR signal on hospital financial performance may affect the appeal, demand and marketability of the MR program to currently designated MR hospitals and potentially interested hospitals. Hospital managers and decision makers may use the results as a deciding factor for undertaking the MR endeavour. The value and contribution of the nursing profession to hospital financial performance may be recognized as an essential component to the financial viability of hospitals. Finally, policy makers may be interested in the cost-quality trade-offs and financial effects related to MR as other signals of quality (e.g. Hospital Compare) are incentivized through payment policy.

Organization of the Dissertation

The sections of the dissertation are organized as follows: Chapter 2 provides background on the MR program, a conceptual model on information asymmetry and signaling theory, and discusses current literature on the effect of signaling on performance of corporate firms and

health care organizations in particular. Chapter 2 concludes by presenting the limitations of existing studies and justification for this dissertation research. Chapter 3 describes the methods used in the dissertation, including study design and rationale, sample, data sources, hypotheses, and analytical approaches. Chapters 4 to 6 are manuscripts corresponding to Aims 1 to 3, respectively, and are intended for submission to peer-reviewed journals. Chapter 7 synthesizes the multiple findings of the dissertation, discusses its policy implications, and proposes future potential research opportunities.

CHAPTER 2: LITERATURE REVIEW

Overview

This literature review serves two main purposes. First, it reviews the literature on signaling theory and its role in reducing information asymmetry in corporate and health care settings and presents evidence on the effectiveness of signaling unobserved quality in health care settings. Second, it introduces MR as a signal utilized by hospitals to distinguish themselves from competitors. Background information on MR is provided to support the application of signaling theory to this dissertation. This includes the impetus for hospitals pursuing MR and the journey to achieving MR. In addition, research evidence on nursing, patient and organizational outcomes for MR hospitals is discussed, and the gaps in the MR literature are identified. The principles of signaling theory are applied to explain the role of MR as a signal of unobserved quality.

Theoretical Background

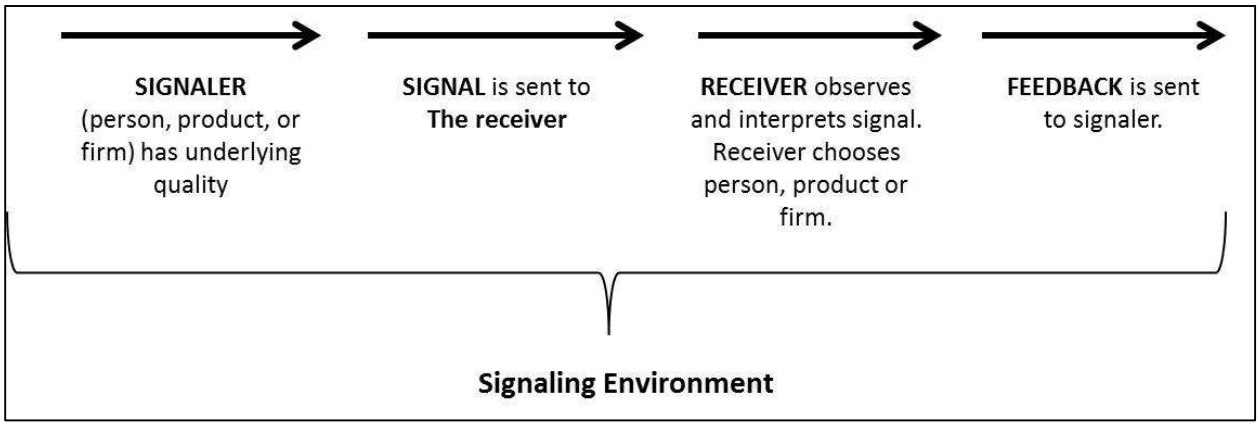
The Role of Signals in Information Asymmetry

Information asymmetry arises when there is imperfect information between two parties.[42] For instance, information asymmetry exists when firms know more than consumers about the services and products they sell and due to imperfect information, consumers are unable to evaluate the product or service quality.[2] If consumers are unable to distinguish high quality firms from low quality firms, they may shift their demand to substitute products and/or services

or else pay a non-discriminatory price to all firms.[7] Signaling is used to reduce the imbalance of information between two parties. The quality information conveyed by signals leads consumers to update their perceptions[2, 43] about product and service quality within the context of market conditions.[44]

As described by Connelly et al. (2011), the signaling process consists of four elements: (1) the signaler, (2) the signal, (3) the receiver and (4) feedback (Figure 1). The signalers are insiders or firms who have access to information about the product, service, or the organization that is not available to outsiders.[43]

Figure 1. Signaling Timeline (Adapted from Connelly et al., 2011)



The signaler undertakes a decision or action (the signal) that communicates information regarding some type of unobservable quality to outsiders or consumers, to express positive organizational characteristics.[43] There are two characteristics of effective signals: (1) signal observability, or the extent to which outsiders are able to notice the signal, and (2) signal cost. The credibility of a signal is linked with signal cost[45]; the costlier the signal, the less likely imposters will imitate quality signals and the more meaningful the signal.[2] Signals become ineffective if they can be imitated by firms that do not have valid information to communicate.[46]

The receivers are outsiders or consumers who have limited information, but would like to receive this information to make informed decisions. When signaling is effective, the signaler benefits from an action taken by the receiver that the receiver would not have otherwise performed. This usually involves selection of the signaler over other alternatives. In turn, receivers gain by making more informed decisions. Lastly, feedback is the information sent back to signalers regarding the effectiveness of their signals.[43]

Signaling Unobservable Firm Quality

There are a number of studies that have examined the use of specific signals to communicate information about unobservable firm characteristics or firm quality to consumers. These signals can take on many forms, including corporate name changes[46], quality designations[7], management quality[47, 48], product branding[1-3], advertising expenditures[3], pricing strategies[49], and warranties.[3] Firms use these and other signaling strategies to communicate unobservable quality to other firms and consumers. The effectiveness of signals depends on various factors[49] and is usually determined by examining the corresponding changes in firm performance. According to the research literature the impact of signals on firm performance is varied.

For instance corporate names have been known to signal a firm's quality and reputation[49] and are linked directly to its' successes and failures. Firms considering corporate name changes usually make large financial investments to ensure the name is consistent with the firm's image and strategic priorities. Corporate name changes usually result from mergers and acquisitions or firms' decisions to enter a new line of business. Firms may also take on a new name to signal to customers, competitors and investors of a new approach to doing business. In order to be an

effective signal, the name change must be a positive signal. Previous research on corporate name changes has demonstrated either no significant market reactions or positive but statistically weak effects on firm performance.[46] However, a study by Koku (1997), which investigated the effects of name change in the service industry, found that corporate name change signaling, on average, was an effective marketing strategy for firms in the service industry as measured through increases in the firm's mean price per earnings ratio.[46]

Firms may also pursue quality designations such as Total Quality Management, Business Process Reengineering, the Malcolm Baldrige Award Criteria, Six Sigma and more recently ISO 9000, to signal unobservable attributes to stakeholders.[50] For example, one study showed that implementing the ISO 9000 Quality Management Standard, created by the International Organization for Standardization, may act like a market signal of superior quality – such as in supply chains where buyers are so far removed from suppliers, it is difficult for buyers to identify high quality suppliers. Since ISO 9000 requires compliance with a wide range of quality system standards and participation in an external audit and review, firms that complete the management steps needed to certify with this designation signal desirable organizational attributes, such as management commitment to ongoing improvements, lean production practices and consistent product quality. These signals have been shown to communicate guaranteed product quality and service from the supplier to the buyer. Research evidence indicates that ISO 9000 designated firms' grow faster after designation and that operational improvements from ISO 9000 do not account for the increased growth.[7]

Research literature also indicates that quality and reputation of a firm's management team is a signal of firm quality and a predictor of its future financial performance. The quality of the management team has been theorized to improve the ability of the firm to obtain lower cost of

capital, to increase investor interest, and signal future expected performance.[47] However, the relationship between management quality and future financial performance has received minimal attention in the literature.[47, 48] In a research study by Chemmanur et al. (2009), reputable managers were shown to credibly signal firm value to outsiders, therefore reducing information asymmetry facing the firm in the equity market. This in turn resulted in improved access to the equity markets and impacted firm financial policies. The findings also indicated that quality management teams are more likely to select higher net present value projects and implement them more successfully, thereby affecting the firm's investment policy.[48]

Advertising expenditures and brand names are also examples of signals used by firms to convey unobserved quality to consumers. Both these types of signals require an initial financial investment, with the belief that the returns on investment will be recouped at a later time. Firms that incur large advertising expenditures signal to consumers that the unobservable quality must be valid else the firm would not be able to recover this expenditure. Similarly brand names are supposed to communicate unobservable quality since large investments are made to build brand equity, such as advertising, product design, and packaging modifications.[3] These signals are considered to be credible since they are associated with a commitment to high quality, thereby increasing the consumer's perceived quality.[2] If low quality sellers were to imitate these signaling strategies, their subsequent low quality would be revealed resulting in a loss of investment because future sales will decrease. Therefore there is no incentive for low quality sellers to invest in either of these signaling strategies.[3] There have been various research studies examining the relationship between unobserved quality and advertising[51-53] and brand names, and their findings regarding the effectiveness of signaling are mixed.[2, 54, 55]

Signaling Unobserved Quality in Health Care

Information asymmetry has also been shown to be a challenge for health care providers who often struggle to effectively communicate the quality of their services to prospective patients and/or employees.[9] In order to communicate unobserved quality to both patients and providers, hospitals use various signaling strategies. For instance, hospitals are known to use both advertising and their status as centers of excellence as a signal to distinguish themselves and attract patients and providers.[56] In addition, health care providers also use public reporting of quality of care information to inform patients about the large variation between providers in quality of care and to motivate patient participation by enabling patients to make informed choices about their health care providers.[10]

Not-for-profit status has also been theorized to be a signal of quality. Unlike for-profit status, not-for-profit status is not associated with profit maximization; therefore not-for-profits are unlikely to shirk on quality in order to reduce costs. As a result, the not-for-profit status may be a signal that a firm will provide the quality products or services. On the contrary, Malani and David (2008) investigated the not-for-profit signal in hospital, nursing home and child care industries and concluded that not-for-profit status may not be an effective signal of quality.[57]

Hospital report cards have also been utilized as a strategy to address information asymmetry in health care markets. Public reporting of quality information has been utilized by policy makers to improve health care quality. Public report cards provide patients with information to help them differentiate between quality providers and give providers incentives to improve their quality so they can increase demand for their services. A recent study by Werner et al. (2012) investigated the relationship between report card scores and patient choice for nursing homes. They discovered a statistically significant, yet weak positive relationship

indicating that public reporting may result in a small increase in consumer choice of high-scoring facilities.[8]

As an alternative to reporting quality information directly, hospitals may make decisions that serve to indirectly communicate, or "signal", unobservable information to consumers. This would be accomplished by attaining a coveted quality designation which patients, providers and payers would interpret as the hospital's commitment of resources to quality management.[58] In the UK, the Patient's Charter, introduced by government, defined a set of standards for public health service with regards to service quality. If the targets identified by the Charter are met, the providers can apply for accreditation awarded by the government – the Charter Mark. The Charter Mark can be used to signal service quality to users of services and/or to purchasers acting on their behalf.[9] Research indicates that these types of signals affect patient's perceptions of hospital quality and are hypothesized to have an impact on financial performance.[59] Evidence indicates that the Charter Mark was shown to provide definite signals of service quality.[9]

Magnet Recognition Signaling Unobserved Quality

MR is considered to be a signal used by hospitals to communicate to consumers and health care providers about the quality of care which they can expect to receive in a MR hospital.[13-15] MR is proposed to reduce the information asymmetry by signaling to various stakeholders, the hospitals' commitment to nursing excellence and quality management strategies. It is hypothesized to be an effective signal of quality because it meets the two conditions previously described. First, MR is directly observable by consumers because hospitals have been shown to strongly promote receipt of the designation through marketing,

public display of banners, and other advertising.[16, 60-62] Second, MR is costly[63] and therefore difficult to imitate for providers that do not have meaningful quality information to convey.[64]

The following sections present information on the MR program. It is intended to explain and support the claim that MR is considered to be a signal used by hospitals to communicate their commitment to quality and nursing excellence. The different interpretations of the MR signal by patients, providers and payers and the expected responses to the signal are discussed. The principles of signaling theory are applied to evaluate the effect of the MR signal on the various dimensions of hospital financial performance.

Background of the Magnet Recognition Program

Over the past twenty years, there has been a growing body of evidence on the MR program and on MR hospitals, ranging from understanding how a hospital is designated, to evaluating the outcomes in MR hospitals. MR is a symbol of distinction[11] and the highest level of recognition that a health care organization can achieve that specifically recognizes excellence in nursing practice.[17, 65, 66] MR has also been promoted and recommended by various advocates. In 2002, the Nurse Investment Act included provisions for grants to encourage facilities to implement the MR to improve nurse retention. Also in 2002, the Joint Commission for the Accreditation of Healthcare Organizations recommended the adoption of characteristics of MR. In 2005, the U.S. News & World Report added MR to its set of criteria used in the selection of the best hospitals in the U.S.[20, 28] In 2010, nine of the 14 hospitals listed on the U.S. News & World Report's Best Hospitals Honor Roll were MR hospitals.[29]

The MR program began in 1993, with the first hospital receiving MR in 1994. Since this time, the program has experienced substantial growth.[39] Applications for MR have grown at an

average of 32% per year for the past five years.[67] Although the number of MR hospitals has increased from 18 in 2000 to 391 in 2012[30], only eight percent of the 5,815 U.S. hospitals are designated as MR hospitals and only five hospitals internationally have earned the designation.[68]

MR is a credential granted by the ANCC to health care organizations demonstrating a commitment to high standards in the delivery of nursing care and support for nursing practice throughout the organization.[18, 19] The MR program is structured on quality indicators and standards of nursing practice as defined in the American Nurses Association's Scope and Standards of Nurse Administrators.[18] The goals of the MR program are to promote quality in a setting that supports professional practice, to identify excellence in the delivery of nursing services to patients and residents, and to provide a mechanism for the dissemination of 'best' practices in nursing services.[17, 69, 70] These principles aim to foster excellence in nursing care services through the development of a professional nursing practice environment[71], which in turn empowers staff, endorses evidence based care, and expands the role of the nurses in the delivery of patient care.[72, 73]

MR hospitals are characterized by their professional work environments, promotion of growth and development of nurses[74] and environments conducive to innovation.[24] MR organizations are considered unique because of their organizational characteristics[75] and distinctive culture, which encompass values of empowerment, pride, mentoring, nurturing, respect, integrity, and team work.[18, 66, 76] MR organizations demonstrate strong leadership and advocacy for nursing service administration and effective communication among nurses, physicians, and administrators.[28, 77, 78] All these attributes combine to provide an environment that enhances nurse and patient satisfaction[79] and interdisciplinary relationships that contribute to the achievement of quality clinical outcomes.[79, 80]

Impetus for Magnet Recognition

There are various reasons that motivate health care organizations to pursue MR. These reasons include, but are not limited to, the need to attract and retain professional nurses, to reduce costs and improve financial outcomes[64], to distinguish themselves in the market place[81], to improve quality of care[82] and to produce superior patient and organizational outcomes.[83] A growing body of evidence confirms the positive organizational, nursing and patient benefits associated with MR.[83, 84] As a result, health care organizations are becoming increasingly interested in the designation as a means of accomplishing these goals.[82]

Instead of pursuing MR, some organizations have selectively used the MR criteria as a guide to achieve the benefits expected from becoming a MR-like organization.[12, 64] Benefits of this approach are noted; however they do not appear to be as substantial as undergoing the scrutiny of the application process.[64] The critical self-assessment of the organization along with the thorough review and evaluation by external appraisers provides an additional value that selective implementation of MR criteria alone would less likely achieve.[64]

Although MR is focused on the achievement of excellence in nursing practice, the organization as a whole often experiences the benefits.[25] Because of these benefits, many organizations are undertaking the challenging process of becoming recognized as a MR facility. This next section will discuss the reasons that motivate health care organizations to pursue MR.

Recruitment and Retention of Nurses and Other Health Professionals

The shortage of nurses has impacted many health care organizations in the U.S. The shortage has affected hospital operations, the level of services provided and driven wage costs up by 5-8% annually.[85] Nurses deliver 95% of hospitalized patient care[16], however hospitals are

unable to maintain a supply of qualified nurses because of high turnover rates and low retention.[86] As one strategy to address these concerns, hospitals have pursued MR as a way to recruit and retain valuable nursing staff.[17] Research also indicates that MR may be a solution to deal with the nursing shortage. The designation has been shown to give hospitals an advantage in terms of recruiting and retaining nurses[83] by creating professional practice environments where nursing is valued. The designation is used as a recruiting tool to attract nurses seeking employment in the best clinical practice settings.[87] In addition to nurses, MR hospitals are also acknowledged as good places to work for all employees.[87] While the MR started as a way to attract and retain nurses, it is now also used to recruit other health professionals, such as physicians, pharmacists, and laboratory technicians.[88]

Patient Outcomes

As hospitals and health care systems seek strategies to improve patient safety, more are considering the MR program as a framework for transforming nursing practice and the quality of patient care.[89] The underlying philosophy of MR is the existence of a work environment that appreciates nursing practice and values nurses, which in turn will result in positive patient outcomes.[90] In fact, there is convincing evidence that MR organizations produce better outcomes and demonstrate improvements in patient satisfaction.[87]

Marketability & Competition

MR is an effective tool in marketing services to patients, nurses and the community.[16] Some organizations have placed ads in their local newspapers touting their MR designation.[60] The designation provides an opportunity to promote the institution's success and it conveys to

the public that it is recognized as a place to receive high quality care[16, 61, 62] and that nursing services make a positive contribution to patient outcomes.[91] Organizations can also capitalize on the designation by promoting the facility as a center for excellence, which appeals to consumers and generates more revenue.[25]

In addition to marketability, MR has also been demonstrated to provide organizations with a competitive advantage. The changing health care environment is promoting competition between health care organizations in their acquisition of insurance contracts, qualified physicians and the retention of qualified nurses.[92] In order to survive in the competitive marketplace, hospitals are restructuring and redesigning healthcare delivery, specifically focusing on quality care and creating excellent nursing practice environments. MR has been shown to have a distinct advantage in recruiting nurses and in strategic marketing to the community and may be the key for being recognized as the community's center for nursing excellence, which is an important attribute in today's competitive market place.[16, 17]

Quality Validation & Quality Improvement

Health care organizations may also consider MR as a means to highlight their quality accomplishments, specifically quality care and quality of nursing department.[17] The designation provides external validation of an organization's quality achievements[93] and is used to distinguish the organization in the health care market place.[81] Health care organizations also consider engaging in MR as a mechanism to improve quality outcomes.[94] The MR program provides a framework that helps organizations focus on establishing initiatives that improve quality outcomes in the organization.[94, 95]

Societal Demand

Health care consumers have an expectation for quality patient care. They are more educated due to the internet[92], more involved in their own health[16] and are eager to find the hospital with the best quality of service.[18] MR provides consumers with a way to help them judge the quality of care in hospitals.[96] The designation signals superior performance, and an obligation to sustain this performance so expectations of consumers are fulfilled.[18]

Workplace Environment

Organizations also consider pursuing MR because the designation has been associated with the creation of positive work environments.[69, 74] MR organizations have reported the presence of a high level of collegiality between nurses and physicians, a strong presence of nurses in decision making about patient care, and a culture of collaboration and team work, where creativity and innovation is encouraged.[16]

Financial Returns

Many health care organizations are feeling the financial pressures associated with reduced reimbursements, nursing shortages, increased competitiveness and the changing health care environment.[12] In response, hospitals are implementing widespread innovations, such as MR to redesign work organization, roles, processes, and practices to conserve financial resources.[33] MR is an expensive endeavour and most organizations consider the required financial commitment a barrier to pursuing the designation. However despite the costs, some organizations make the choice to pursue the designation as a means to improve financial health and sustainability of their facility. These organizations state that they could not afford not to

pursue MR.[97] The designation has been linked with higher measureable financial returns[98], improved bond ratings[99] and cost savings.[38]

The Costs of Achieving Magnet Recognition

The achievement of MR is often referred to as a continuing journey, not a destination.[100] This journey is a rigorous and lengthy process[101] that requires continued investment and commitment.[20] The process requires a thorough examination and revamping of an organization's structure, process and delivery methods[93] and involves the integration of research and evidence-based practice into the delivery of care at every level.[102] While MR is focused on nursing practice and the pursuit of nursing excellence, it is an organization's journey, therefore commitment and support from the entire organization is needed in order to succeed.[103]

MR is also an expensive endeavour, with those desiring to achieve MR spending thousands of dollars on the process. While there has been no consensus regarding the amount of financial investment required, it has been reported that an organization can spend from about $50,000 to $120,000 just in preparing for MR[39] and up to a maximum of $600,000 annually for maintaining the designation.[40] Many organizations hesitate to pursue MR because they are concerned about the financial investment, which is sometimes a barrier for health care organizations contemplating the decision to pursue MR, despite the positive benefits associated with the designation.[63]

The costs associated with the MR can be divided into three categories: (1) Costs of the MR Application, (2) Costs of the MR Journey, and (3) Financial Investment in the Nursing and Organizational Infrastructure. These costs vary from facility to facility, and are dependent upon

the organization's existing infrastructure, culture, readiness, size of the facility and support available to the institution.[104] Each of these costs is described in detail below.

Costs of the Magnet Recognition Application

To achieve MR, a hospital is required to submit an application and comprehensive documentation that confirms the organization's eligibility to become a MR facility.[87] There are various costs specifically associated with the MR application and these costs vary depending on the applicant organization. During the application process, a health care organization incurs the following expenses: an application fee of $3,900, $100 per committee member for manuals, appraisal fees ranging from $14,000 to $58,000 depending on hospital size, documentation review and site visit fees of approximately $10,000, and $4,000 per year for two years' membership in American Nursing Association's National Database of Nursing Quality Indicators program.[39, 104] These fees are paid directly to the ANCC. These costs are incurred every four years when the organization re-applies for re-designation.[39]

Costs of the Magnet Recognition Journey

A large portion of the costs related to the MR journey can be attributed to the costs involved in the preparation of the application and relevant documentation and making modifications to meet the standards of MR.[105] During the application process, organizations are required to either designate a staff member to manage the project or hire a MR Coordinator.[87] On average, the MR Coordinator salaries range from $60,000 to $70,000 per year.[97] In addition to the MR Coordinator, the MR process also requires the involvement of nursing staff,

management and hospital personnel.[76] In many organizations, part or full-time secretarial support has also been utilized to leverage time of the MR Coordinator.[32]

Many hospitals also hire external consultants to oversee the process. Their responsibilities include consultation about the MR application and implementation of the standards of the MR program. Consultant time has been noted to be a large expense for those who used consultants.[99] For a fee, the ANCC also makes available consultants who provide support for the self-assessment phase as well as the application and site visit preparation process.[87]

Organizations also incur additional expenses related to the increased involvement of nurses in all aspects of hospital operations, especially during the application process. While the salaries of nurses and advanced practice nurses are not usually recorded as MR expenses, nurses are valuable to the preparation of the organization and to the maintenance of the designation. These costs associated with nursing staff involvement in the MR journey are significant. The expenses are related to paying nursing staff for participating on MR committees and consequently having to replace them on units, thereby also adding to the total salary expenses.[99]

Costs are also incurred for conferences, luncheon events, site visits, and committee time.[32] Events such as a 24-hour Magnet fair to raise awareness for an organization costs $3,000 to $4,000 per event for food and entertainment.[32] One organization estimated spending $100,000 in non-salary expenses, which included conference fees, educational and celebratory events, promotional items and awards, and graphic design supports for their communications campaign.[32] Once hospitals have been awarded MR, publicizing success is another major expense, which consists of a full page newspaper advertisement, billboards, and television spots.[99]

Finally, sustaining MR requires continued dedication and commitment by the nursing department. In order to retain the designation, organizations are required to sustain the culture and continue to exceed the standards set by the MR Program. Along with fulfilling these responsibilities, nurses are required to be innovative and implement evidence based practice in the hospital environment and provide new infrastructures for providing and improving nursing care.[106] The focus on these activities requires the commitment of resources, such as time, expertise, knowledge and money. Organizations cannot continue to maintain the designation without a continued commitment of human and financial resources.[107]

Financial Investment in the Nursing and Organization Infrastructure

In addition to the MR application costs and the costs associated with the MR journey, other organizational expenses must also be incurred to ensure compliance with the MR standards.[32] The costs consist of establishing the organizational infrastructure to support the principles of MR, such as a revised governance structure, professional development programs, nursing research programs, and capital infrastructure, such as the implementation of information technology.

Within most MR organizations, nurses play an influential role with extensive involvement in committees, governance and organizational-decision making. Nurses are expected to be represented at the senior executive level and to be able to participate in organizational governance meetings. Thus organizations must be willing to provide nurses with time out of clinical work and support nurse attendance at committee and council meetings.[108] This may be one of the most significant expenses for the process, given the cost of labour.[68]

The MR program values education and nurse staff training. Organizations must demonstrate support for professional development of nurses through the creation of educational infrastructure to promote and support learning and training opportunities. In order to accomplish this endeavour, organizations are required to invest both human and financial resources to support both nurse-staff education and an environment that encourages continual learning.[109] Organizations also support continuing education through flexible scheduling to accommodate classroom hours.[110] In addition to the management and delivery of professional development program, expenses incurred are related to continuing education opportunities, learning partnerships, tuition reimbursements, and professional development grants.[109]

The MR program also places a strong emphasis on nursing research, which requires a substantial financial investment.[68] This includes expanding journal clubs to all nursing units, establishing a nursing research council and creating a nursing research center.[111] The costs associated with establishing and maintaining a hospital based research center are related primary to personnel. Other costs include the materials to support the work of the research center and the availability of the research internship, quarterly grand rounds and other educational programs. Computer, printer and software costs are also associated with the research infrastructure, including statistical analysis software to allow for more extensive data management and analysis procedures.[112] Some organizations have established a Nursing Research Fellowship program to further advance nursing research in the clinical practice setting.[111] Nurses are also encouraged and assisted with the submission of manuscripts, and publications and abstracts for conference presentations. Registration, travel and hotel expenses are paid in full for nurses invited to present at national conferences.[76]

While the MR program does not require investment in capital infrastructure, such as medical equipment, buildings or other capital equipment, some MR organizations are investing in information technology support when pursuing the MR designation. The MR program does not explicitly require that organizations use information technology; however, many of the organizations that have achieved MR are making use of information technology, especially electronic charting for nurses.[90]

Outcomes of the Magnet Recognition Program

MR has caught the interest of nurse administrators and hospital management in the U.S. and internationally for over 20 years. While the MR was initially aimed at focusing efforts on nurse recruitment and retention and targeting strategies for improving nursing work environments[113], it has also been associated with multiple, measureable benefits to the entire organization.[103] Numerous research studies have found statistical evidence of significant differences between the MR and non-MR organizations.[66] In addition to the research based evidence, anecdotal evidence also exists that confirms the benefits of the designation.

Nursing Outcomes

MR hospitals have been found to have characteristics that promote and sustain professional nursing practice.[114] Nurses in MR hospitals describe their work environment as providing greater autonomy[115], allowing more control over the practice setting[81], increasing level of empowerment[18] and having adequate support services to provide high-quality care.[114-116] The work environment is perceived as collaborative, as evidenced by positive nurse-physician relationships[19, 117, 118] and positive relationships among fellow nurses.[28]

In addition to the effects on working environment, the MR designation has also been associated with a positive impact on nurse satisfaction. Nurses in MR hospitals are more satisfied with their current jobs.[18, 28] Research evidence shows that compared to non-MR hospitals, nurses in MR hospitals have statistically significant decreases in emotional exhaustion[26] and lower rates of burnout.[28] MR also appear to positively affect nurses' health by way of low incidence of needle stick injuries, decreased staff turnover, decreased work related injuries, decreased fatigue and burnout, and increased career and employment satisfaction.[28, 33] Occupational health injuries, musculoskeletal injuries and blood and body fluid exposures are also lower in MR hospitals.[38, 72]

MR hospitals have significantly better nurse staffing, reflected in nurses caring for fewer patients each.[34, 39] Nurses at MR hospitals reported caring for one fewer patient per shift than did the nurses in the original magnet hospitals (i.e. hospitals identified in the 1983 study[119]).[96] Data from the 1997 Annual Hospital Survey of the American Hospital Association (AHA) showed that MR hospitals employed 190 full time equivalent registered nurses per 100 patients compare to 109 registered nurses per 100 patients in community hospitals.[96]

MR has been associated with reduced overtime and flexible staffing schedules. RNs employed in MR organizations reported that overtime was more often strictly voluntary, whereas nurses in non-MR hospitals reported higher levels of overtime and felt like it was required.[28, 86, 120] Another study also examined satisfaction with scheduling, including hours and flexibility and found that MR nurses reported higher satisfaction, although comparison of hours worked and other schedule factors were not reported.[86]

Patient Outcomes

Patient outcome is one of the most important indicators of quality care in health care institutions.[18] Improvements in nursing, through MR, are being recognized as having a major contribution to quality and safety in patient care.[38] MR has been associated with numerous positive patient outcomes[121], which include lower patient mortality and morbidity rates, decreases in the incidence of adverse patient outcomes[122] and higher overall patient satisfaction.[28, 105] A recent study showed that in MR hospitals, patients received care based on the best and most current evidence.[108]

MR has demonstrated lower mortality rates and a positive influence on patient satisfaction, which has key implications for hospitals in the current fiscally driven environment. Patient satisfaction is considered a prime indicator of quality care[123] and is of great importance for hospital leaders, because winning and keeping consumers is fundamental for survival in the current health care market.[33] Consumers are able to use the MR designation as a reliable way to choose a good hospital that will provide quality care.[105]

Organizational Outcomes

The success of MR hospitals can be attributed to the existence of an organizational framework that promotes and sustains nursing practice. These hospitals are described as having flat organizational structures, unit-based decision making processes, evidence based practice, a culture of collaboration and team work, powerful nurse executives and highly qualified nurses.[114] In addition to influencing nursing and patient outcomes, these organizational features have been found to be associated with positive organizational outcomes including improved nurse recruitment and retention, increased productivity and distinction in the health care market.

One of the most promoted benefits of MR is the positive effect on nurse recruitment and retention. According to research evidence, the structural components in MR hospitals result in high levels of nursing work satisfaction, which in turn leads to lower vacancy and turnover rates. One MR facility reported a reduction in nursing turnover from 30% in 2000 to 12% in 2008.[124] Another MR facility reported a decrease in nursing vacancy rates from 19% in 2000 to 5% in the first quarter of 2007.[125] Nurses who work at MR hospital are also more likely to stay than those who do not work in non-MR hospitals. According to the ANCC, the average length of employment of RNs on staff in a MR hospital is 8.35 years.[126]

In addition to nurse recruitment, physician and administrative recruitment has been influenced by the MR designation. New hires have noted that MR is associated with highly competent and coordinated staff.[81] Furthermore, physician satisfaction scores are higher at MR hospitals compared to non-MR hospitals, which also influences physician recruitment.[110]

MR hospitals have also been noted for recruiting highly educated nurses. A research study conducted by Aiken et al. found that RNs working in MR have significantly higher educational preparation. About 50% of nurses working in MR hospitals had a baccalaureate degree as their highest level of education, compared to 34% in non-MR hospitals. Moreover, according to the ANCC, nurses at MR hospitals are more likely to be certified in specialty areas, maintain continuing education and participate in community programs.[18]

Compared to non-MR hospitals, MR hospitals have decreased utilization of agency nurses. Most hospitals utilize agency nurses because there is both an insufficient supply of nurses currently employed at their respective facilities and a demand for nursing care by patients. Agency nurses are not as familiar with hospital specific policy, are not long-standing members of the nursing unit or team, and their practices may be different than those of nurses who have

worked in hospitals for an extended period of time. The increased use of agency nurses is considered a risk factor that could potentially lead to negative patient outcomes.[104]

The MR designation provides an increased opportunity for hospitals to market themselves to the patients, physicians and potential nursing personnel.[105, 127] Designated organizations have reported an increase in market share since receiving MR, attributed to increased physician referrals and consumer preference for quality patient care.[110]

Patients in MR hospitals were also found to have significantly shorter lengths of stay and lower utilization of intensive care days.[22, 26, 126] One study found that length of stay declined from 4.86 days to 4.73 days in a MR hospital.[128] The reduction in the average length of stay leads to use of fewer pharmaceuticals and fewer tests[116], which results in cost savings.[40]

Financial Outcomes

Quantifying the costs and financial benefits of MR has been a difficult task for most organizations; one that requires further research.[32] Although the ANCC website and Drenkard argue the long-term cost savings from MR, there is no consensus that MR is a cost saving innovation, and as discussed previously, the cost of application and sustaining MR is high.[30, 38] Although there is also no evidence that overall MR hospitals cost more than non-MR hospitals[129], a recent study by Jayawardhana et al. (2014) found that inpatient costs for MR hospitals are higher than non-MR hospitals.[41]

Aiken et al. states that despite the higher nurse-staffing ratios, MR hospitals will save money. The shorter lengths of stay and fewer adverse events will lead to reduced use of high-cost intensive care units, use of fewer pharmaceuticals, performing fewer tests – all of which are supposed to increase efficiency and contribute to cost effective care.[127, 129] A study by McCue et

al. (2003) found that increasing nursing staff resulted in increased operating expenses, but no statistically significant effect on profitability.[130]

Proponents of MR rationalize the potential financial benefits of MR by linking the positive organizational, nursing and patient outcomes to cost savings and improved financial performance.[38] According to the research literature, needle stick injuries, morbidity, mortality, and turnover are lower in MR hospitals compared to non-MR hospitals; each of these variables has an associated cost savings.[32] For instance, studies have reported up to a one-third decrease in needle stick injuries at a cost of $405 per event.[38] In terms of savings from recruitment and retention, one MR hospital reported a reduction in labour costs of $4 million each year since 2007.[124] These cost savings have been attributed to a reduction in recruitment costs, reduction in orientation costs, productivity gains, and reduced usage of agency nurses.[38]

According to anecdotal reports, MR may increase bond ratings for borrowing, and reduce insurance and legal fees.[125] The designation is also believed to affect an organization's ability to negotiate better reimbursement rates with managed care organizations, and increase endowments.[32] A descriptive study by Tuazon (2007) found that on aggregate, the MR hospitals outperform the non-MR hospitals in terms of operating margin, total margin, and return on total assets. However, the analysis of the data was descriptive with no statistical tests conducted when comparing mean scores of MR and non-MR hospitals.[36]

Summary

Signaling Research

Although this is not a comprehensive review of the research on signalling, the preceding literature review provides valuable insight into some of the signaling strategies used in the

corporate and hospital setting to signal unobservable firm or product quality to consumers and other firms. The effect of signaling on financial ratios, firm growth, product demand, consumer choice, and consumer perception has been assessed and shows mixed results. The concept of signaling in hospitals has also been studied previously. The focus has been specifically on patient response to hospital signals, such as the patient perceptions of quality and patient selection of provider, as measures of signal effectiveness. This outcome measure provides an indication of the effectiveness of the signal as determined by the patient; however it does not provide the hospital with any indication of the effect of the signal on hospital performance.

The limitations of the reviewed literature include focusing only on publicly traded firms, small sample sizes, case studies or single site evaluations, cross-sectional study design, data collected from surveys, and the application of simple statistics instead of empirical analysis controlling for relevant factors. While the effect of signaling on firm performance in the corporate setting using various outcomes has been studied previously, there is minimal research focusing on the effect of signaling on hospital performance. Specifically, there is an absence of research examining the relationship between a hospital's signal of unobserved quality and the effect of the signal on the dimensions of financial performance, such as reimbursement, market share, efficiency and profitability.

Signaling Magnet Recognition

Previous research suggests that the MR designation may signal quality information important to multiple stakeholders including patients, payers and providers. First, MR designation has been associated with better patient outcomes[28, 105], increases in quality care[27, 38], and increases in nurse to patient ratios.[34, 39] Patients are expected to interpret the MR signal and

respond by seeking care at or referring family and friends to the designated hospital, or by remaining loyal to the designated facility through repeated visits. Payers (i.e. government and insurers) are expected to interpret the MR signal and respond by steering patients to designated hospitals to receive quality patient care[18] or increasing reimbursement for health services accordingly.[32] In addition, the actions of patients and payers in response to the signal are expected to increase the volume of patients to MR designated hospitals.[15, 18, 31] Therefore, the MR signal is believed to affect the hospital's ability to negotiate better reimbursement rates and shift towards a more profitable payer mix[32] and increase market share through increases in physician referrals and patient preference for quality patient care.[110]

MR has also been associated with the promotion of excellence in nursing care[86] and professional nursing practice[131], emphasis on collaboration and team work[34, 35], and creation of a positive culture and work environment.[33] Nurses and providers are expected to interpret the MR signal and respond by seeking or maintaining employment in designated hospitals resulting in reduced nursing turnover, reduced recruitment[118, 132] and orientation costs[38], reduced usage of agency nurses[38] and increased provider satisfaction.[33, 60] These positive labour outcomes have been associated with cost savings and efficiency.[15, 133]

The combined proposed effect of the MR signal on increasing revenue, through increasing reimbursement and market share, and decreasing expenses, through decreasing hospital cost inefficiency, may culminate to result in an expected improvement in financial performance for the hospital. Signaling theory is used to develop a framework to explain the role of MR as a signal used by hospitals to indirectly communicate the underlying quality of a hospital's products and services.[4] MR hospitals have been theorized to signal to patients and clinicians that the hospital is a center for nursing excellence and the provider of quality patient

care.[12] Unfortunately, there is no clear consensus on the effectiveness of the MR signal on the various dimensions of hospital financial performance.

CHAPTER 3: STUDY DESIGN AND METHODS

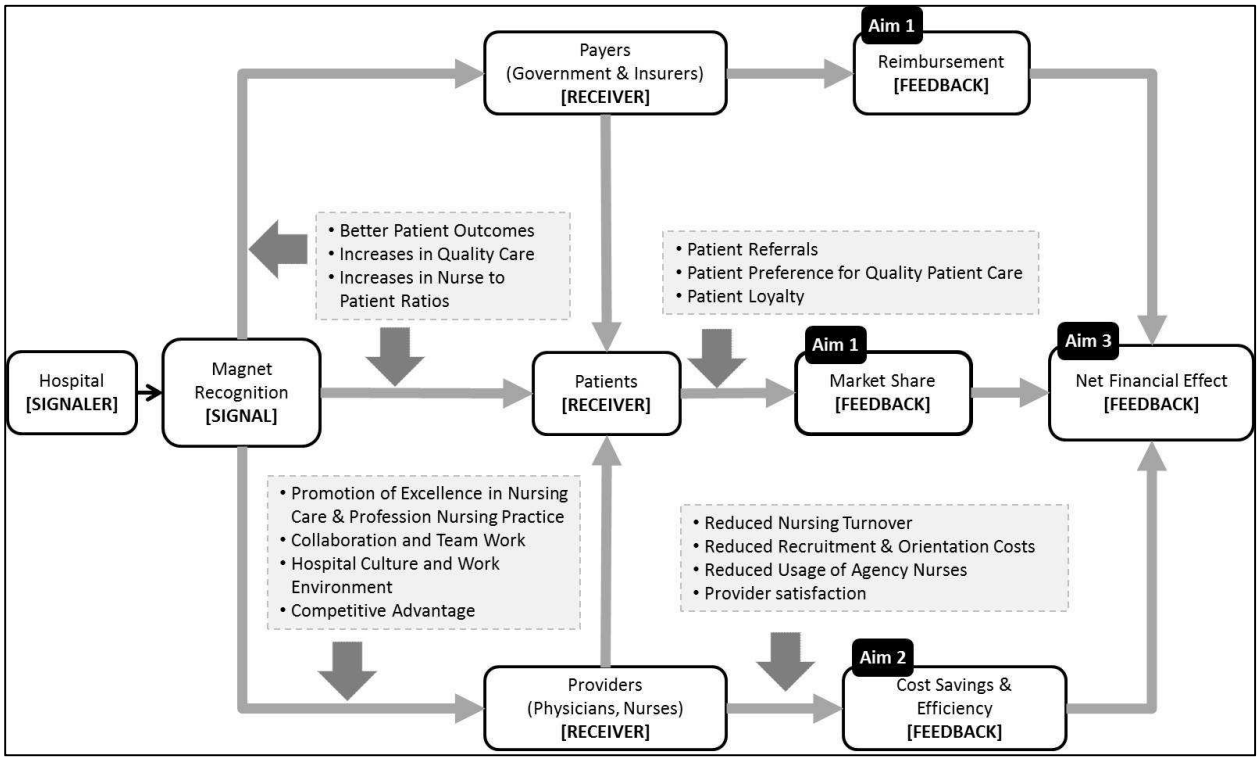
Overview and Rationale

This study uses a pre-post research design using retrospective administrative panel data from 2000 to 2010. MR hospitals are matched to never MR hospitals using market and hospital characteristics. The matched hospital sample is then used to conduct the various statistical analyses to test each hypothesis. The empirical analysis includes a difference-in-difference model using hospital fixed effects and a stochastic frontier analysis with random effects. The dependent variables of interest are hospital reimbursement, hospital market share, hospital cost inefficiency and hospital financial performance. The key explanatory variable is the MR signal. The analyses examine the impact of the MR signal on hospital reimbursement, market share, cost inefficiency and ultimately on financial performance, while controlling for hospital and market characteristics.

Conceptual Framework

The conceptual framework used in this dissertation is shown in Figure 2. The signaler is the MR hospital, the signal is the MR designation, the receivers are the patients, payers and providers, and the feedback is the changes in hospital outcomes that are attributed to the signal. The MR designation reduces the information asymmetry by signaling the hospitals' commitment and dedication to health care quality and quality management strategies to the various stakeholders.

Figure 2. A conceptual framework illustrating the pathway of the Magnet Recognition signal from the signaler to the receiver and the resulting hospital outcomes.



MR is hypothesized to be an effective signal of quality because it is: 1) directly observable by consumers through marketing, public display of banners, and other advertising by hospitals[16, 60-62], and 2) costly[63] and therefore difficult to imitate for providers that do not have meaningful quality information to convey.[64]

Research Questions & Hypotheses

Research Question 1: Does the MR signal increase reimbursement and market share of designated hospitals compared to non-designated hospitals, controlling for known covariates?

MR designation has been associated with better patient outcomes[28, 105], higher overall patient satisfaction[28, 105], increases in quality care[27, 38], and increases in nurse to patient ratios.[34, 39] As a result, patients are expected to interpret the MR signal and respond by seeking care at a

MR facility, referring family and friends to a MR designated hospital, or by remaining loyal to the designated facility through repeated visits. Payers (i.e. government and insurers) are expected to interpret the MR signal and respond by steering patients to designated hospitals to receive quality patient care[18] or by adjusting reimbursement for health services accordingly.[32] Therefore the actions of patients and payers in response to the signal are expected to increase both the health care reimbursement[32] and the volume of patients to MR designated hospitals.[18, 31, 134]. These findings lead to hypotheses 1a and 1b:

Hypothesis 1a: The MR signal will increase reimbursement of designated hospitals when compared to non-designated hospitals. MR is believed to affect the hospital's ability to negotiate better reimbursement rates with managed care organizations or result in a shift towards a more profitable payer mix.[32]

Hypothesis 1b: The MR signal will increase market share of designated hospitals compared to non-designated hospitals. MR provides an opportunity for hospitals to market themselves[105, 127] and MR is theorized to signal to patients and clinicians that the hospital is a center for nursing excellence and the provider of quality patient care.[12] The MR signal is proposed to increase market share through increases in both physician referrals and patient preferences for receiving quality patient care.[110]

Research Question 2: Does the MR signal decrease hospital inefficiency in designated hospitals compared to non-designated hospitals, controlling for known covariates?

In addition to positive patient-level outcomes[121], MR has also been associated with the promotion of excellence in nursing care[86] and professional nursing practice[131], emphasis on collaboration and team work[34, 35], and creation of a positive culture and work environment.[33] Providers are expected to interpret the MR signal and respond by seeking or maintaining

employment in designated hospitals resulting in reduced nursing turnover, reduced recruitment[118, 135] and orientation costs[38], reduced usage of agency nurses[38] and increased provider satisfaction.[33, 60] These positive labour outcomes have been proposed to be associated with cost savings and operating efficiency.[15, 133] These findings lead to hypothesis 2:

Hypothesis 2: The MR signal will decrease hospital cost inefficiency in designated hospitals. MR proposes to reduce hospital cost inefficiency by increasing productivity[38] and reducing costs through nurse autonomy[33], promotion of innovation[131] and discovery of quality improvements[13], and the delivery of evidence based care.[127, 129] The combination of all these outcomes will result in a decrease in hospital cost inefficiency.

Research Question 3: Does the MR signal improve financial performance of designated hospitals compared to non-designated hospitals, controlling for known covariates.

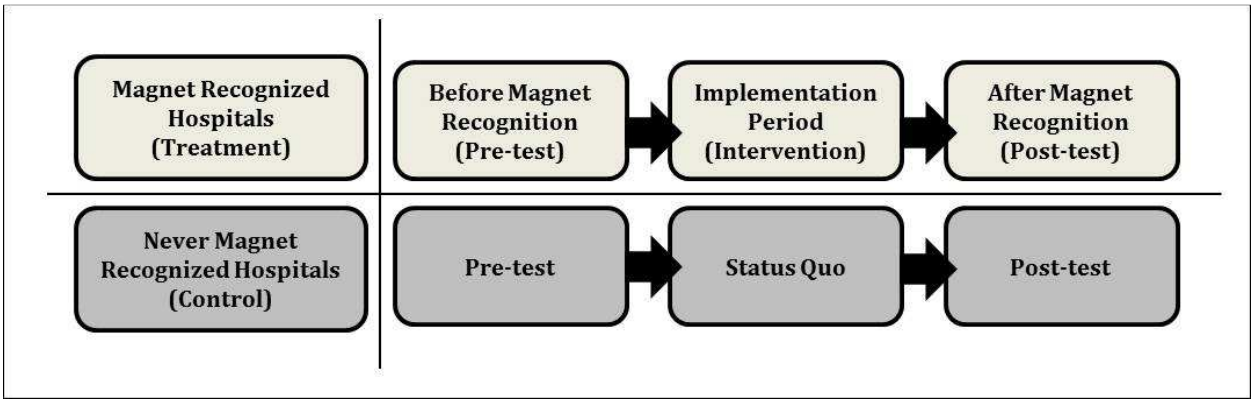
Reimbursement and market share (Research Question 1) and inefficiency (Research Question 2) are conceptualized as pathways through which the MR signal will benefit designated hospitals. Increasing reimbursement and market share may increase revenue generation and decreasing hospital cost inefficiency may reduce expenditures; therefore, if the MR signal is effective, a final outcome is expected to be an overall improvement in hospital financial performance. This leads to hypothesis 3:

Hypothesis 3: The MR signal will improve the financial performance of designated hospitals. This hypothesis represents the combined effects of hospital reimbursement, market share and inefficiency. These outcomes are interrelated and have also been theorized to affect hospital financial performance.[38, 136, 137]

Research Design

This dissertation applies a pre-post research design, using MR and never MR hospitals, to measure the effect of the MR signal on hospital reimbursement, market share, cost inefficiency and financial performance (Figure 3). This research design attempts to control for observable and unobservable factors that will potentially contribute to the difference between pre-test and post-test results and between the MR and never MR hospitals.

Figure 3. A pre-post research design using MR and never MR hospitals and three time periods (Pre-test, Intervention, and Post-test).



There are two study groups:

1. Treatment. "Magnet Recognized Hospitals" are hospitals that achieved MR anytime during the study period.
2. Control. "Never Magnet Recognized Hospitals" are hospitals that never achieved MR prior to, during or after the study period. This sub-sample excludes hospitals that have received MR prior to 2000 and after 2010. The remaining never MR hospitals are used in the matching process, described below.

There are three study periods:

1. Pre-test: Two years prior to the implementation period, when the hospital is not pursuing MR.
2. Implementation: Two years prior to the initial MR designation, when the hospital is preparing for MR. According to research literature, hospitals require approximately two years to transform into a MR hospital.[138]
3. Post-test: The year of initial MR designation and subsequent years of designation. Two years are required.

Data

This research study uses secondary data from four sources:

1. Healthcare Cost Reports Information System (HCRIS), which includes data for hospitals that filed Medicare and Medicaid cost reports and includes hospital characteristics, utilization, cost and charge by cost center, and other financial variables and operational characteristics.
2. Area Resource File (ARF) and other census data provide estimates of market population, area demographics, household income and socioeconomic characteristics to describe hospital demand and market characteristics.
3. American Hospital Association (AHA) Annual Survey, completed by most U.S. hospitals, includes information on hospital organization structure, service lines, staffing, expenses, physician organization structures, beds, utilization and facilities and services.[139]
4. American Nurses Credentialing Center (ANCC) website provides information on MR hospitals. A current listing of MR hospitals and the years of designation are listed on the Center's website. The information for each MR hospital has been collected manually and entered into an Excel® spreadsheet. This data is included in the final merged data set.

The four data sets are merged using both a year and a hospital identifier; however the definition of the year variable differs in the various data sets. The HCRIS data set includes hospital year observations organized by fiscal year and the ARF, ANCC and AHA data sets include hospital-year observations organized by calendar year. In order to merge HCRIS data set, a year-end variable is created using the following rule: the fiscal year end date for each hospital-year observation (i.e. 6/30/2000) is designated as the year-end variable (i.e. 2000) and is matched with the calendar year variable.

Study Sample

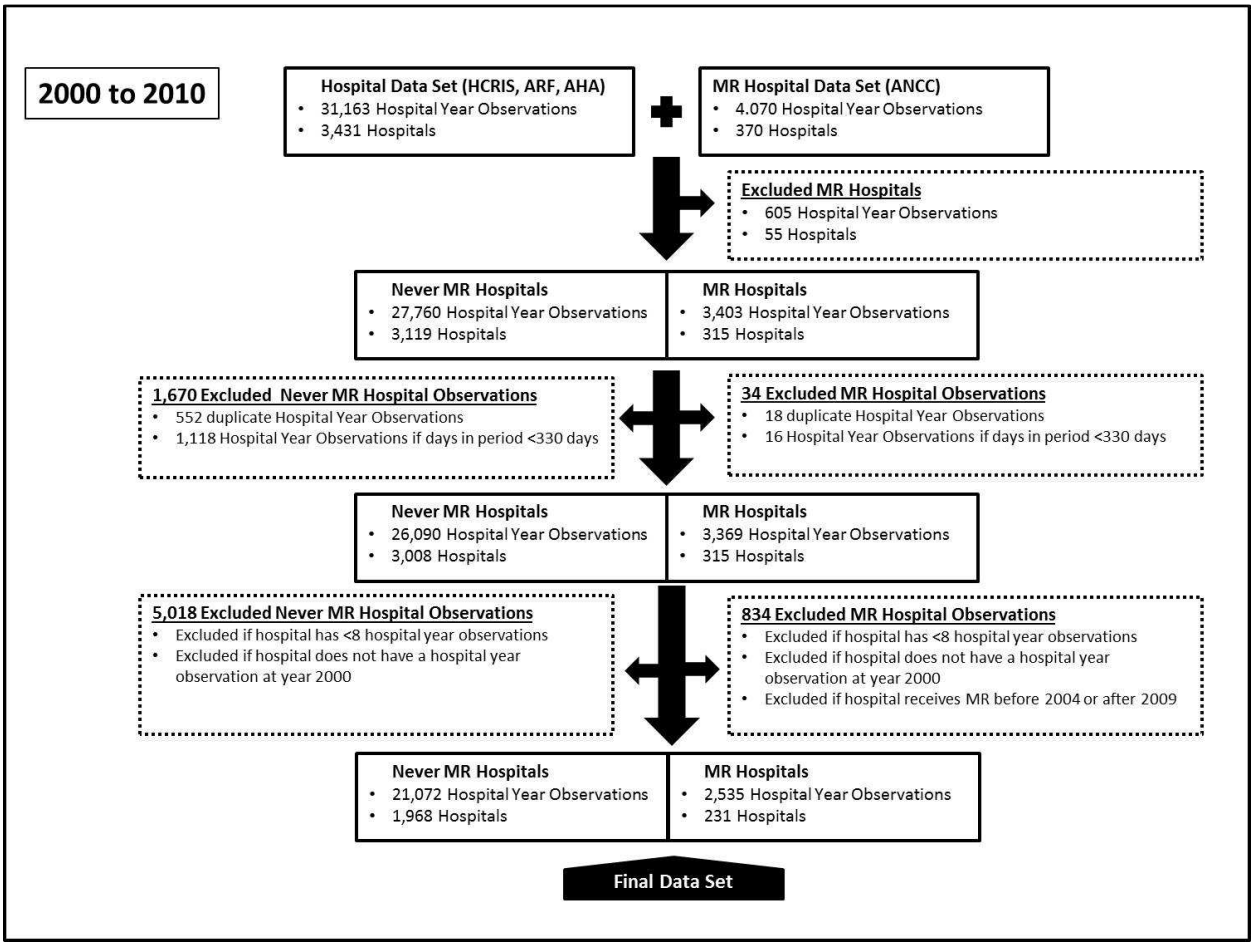
Figure 4 provides a detailed breakdown of the hospital sample and the exclusion criteria used to obtain the final data set. The study sample is a longitudinal, unbalanced panel of MR and never MR hospitals located in urban areas in the US from 2000 to 2010 (eleven years). The hospital data set consists of 3,431 hospitals (31,163 hospital year observations). Of the 370 Magnet hospitals (4,070 hospital year observations) collected from the ANCC website, 315 Magnet hospitals (3,403 hospital year observations) are identified in the hospital data set. The remaining 55 Magnet hospitals, which are not found in the hospital data set, include 27 children's hospitals, 19 rural hospitals, five Veteran Affairs (VA) hospitals, three rehabilitation hospitals, and one psychiatric hospital.

The study sample excludes duplicate hospital year observations (570) and hospital year observations if days in period are less than 330 days (1,134). Also hospitals with less than eight hospital year observations, hospitals that do not have a hospital year observation at year 2000, and hospitals that receive MR before 2004 and after 2009 are excluded from the study sample (1,124 hospitals). Each MR hospital must also have four consecutive years of data prior to MR

designation, and a maximum of two consecutive years of data following MR designation, for a maximum of six hospital-year observations. MR hospitals with limited or missing financial data potentially introduce noise and bias the results; therefore, only MR hospitals that have complete data over of the required six consecutive years are included. Although this requirement reduces the sample size, the reduction in the eligible hospital-year observations is trivial.

The final study sample consists of 23,607 hospital year observations (2,199 hospitals) from 2000 to 2010. There are 21,072 never MR hospital year observations (1,968 hospitals) and 2,535 MR hospital year observations (231 hospitals).

Figure 4. Consort diagram presenting the exclusion criteria used in determining the final hospital study sample.



Variables and Measurements

Table 1 is a comprehensive list of variables, measures, definitions and data sources that are utilized in the dissertation. The variables are grouped into four categories.

Magnet Recognition

The *Magnet Recognition Designation* variable identifies hospitals as either MR or never MR. The *Hospital Magnet Recognition Status* variable identifies the hospital's status during the 2000 to 2010 time period. A hospital status can be defined as either pre-test period,

implementation / status quo period or post-test period. Both MR and never MR hospital year observations are categorized as either pre-period, implementation / status-quo, or post period using a binary variable.

Financial Performance Measures

Net patient revenue per adjusted patient day is used to measure hospital *reimbursement.* To account for inflation, reimbursement has been adjusted to 2010 US dollars using the Medical Care Services Consumer Price Index.[140] The *total expenses*, *price of capital*, and *price of labour* are included in the cost function model to estimate hospital inefficiency.

Financial performance is measured using *operating profitability*, *total profitability* and *return on equity*. Operating margin is a measure of profitability[141] and frequently used to assess the financial health of an organization[142] since it is directly affected by changes in either operating revenue or costs. This ratio focuses on core business operations and therefore excludes investment income and other types of revenue and expenses unrelated to operating activities.[143]

Total margin is a measure of total profitability and includes income from both operating and non-operating activities.[144] Positive operating margin and positive total margin reflect positive financial performance. Return on equity is a measure of organizational performance and it measures the rate of return for each dollar in equity (net assets).[145]

Hospital Characteristics

Hospital characteristics include *hospital size* (measured by total number of beds) which is associated with reputation, higher economies of scale and financial expertise, lower per unit costs, and more successful strategic activity.[146, 147] *System affiliation* (determined using the Medicare Cost Report) indicates whether a hospital is owned by a larger system. Such

affiliations have been found to result in increased efficiency, lower risk, better financial outcomes, seamless care, greater control over referrals, and greater economies of scale.[146, 147]

Medicare payer mix and *Medicaid payer mix* are calculated as the percentage of total inpatient days attributed to Medicare and Medicaid, respectively. These measures provide an indication of the hospital's patient-mix [146] and the payer-mix.[148] An increased dependence on government payers, such as Medicare and Medicaid, is likely to be associated with a higher probability of financial distress and operating losses, because these payers typically do not pay the full average cost of care.[146]

Outpatient volume and *inpatient volume* are both common measures of hospital productivity. *Inpatient volume* is measured using total inpatient days, a widely accepted measure of inpatient workload. *Outpatient volume* is measured using total outpatient visits and is a widely accepted measure of outpatient workload, when combined with total inpatient days.[149] Both of these variables are included as outputs in the stochastic frontier analysis (SFA) cost function.[150]

Since resource consumption varies dramatically between patients classified in different Diagnosis Related Groups (DRGs), discharges have been adjusted by the *Medicare Case Mix Index* (MCMI), which reflects the costliness of DRGs into which the hospital's patients have been classified. [150, 151] Since a measure of outpatient MCMI is not available, *Percent Emergency Room Visits* (emergency room visits as a percent of total outpatient visits) and *Percent Outpatient Surgery* (outpatient surgery as a percent of total outpatient visits) are added to control for the outpatient case mix.[152] Research indicates that patients admitted through the emergency department and patients who require surgery tend to be more resource intensive groups of outpatients.[151]

Teaching affiliation indicates if a hospital is a teaching hospital and is used to control for differences in input quality.[150] Teaching hospitals produce different outputs than non-teaching hospitals (i.e. medical education)[153] and are more costly than non-teaching hospitals.[154] Teaching hospitals focus on training medical students and consume more inputs such as instructors, classroom space, diagnostic tests and state of the art technology.[154] Teaching hospitals also attract sicker patients who require more resources because of the education value this provides to the students [152, 154, 155] and there is consensus that quality of patient care tends to be higher in teaching than in nonteaching hospitals.[153] Teaching hospital status is included in the model as a binary variable.

Ownership indicates for-profit, not-for-profit ownership or government ownership. Due to their responsibilities to shareholders, for-profit firms are expected to more aggressively pursue cost reduction strategies than not-for-profit firms. For-profit firms are also unlikely to be interested in the adoption of innovations that are unproven or may raise costs[39], and as a result, may have higher operating margins than their not-for-profit counterparts.[156]

Market Characteristics

A hospital's operating environment and the market demand for health care services can also influence hospital financial performance and market share.[157] The hospital's market area is defined as the county in which the hospital is located.

The total *population* in the market, the market *population density* and the *percent of the population age 65 and over* describe the demand for hospital services in the market area. The average per capita *income*, *unemployment rate* and *poverty rate* (percentage of families or persons in poverty) measures a community's financial ability to purchase health care services.[158]

The likelihood of a resident to bypass a hospital and seek services at another facility is proxied by the average *distance from residence to hospital,* calculated as the (discharge-weighted) average straight-line distance from the residence ZIP centroid to the local hospital.[159]

The *hospital market share,* a measure of the amount of hospital competition in the market area, is measured as the hospital's discharges as a percentage of the total discharges in a hospital's market area.[159] The level of competition within a market may also influence the likelihood of MR and a hospital's performance. The *Herfindahl-Hirschman index* is a measure of market competition and it is calculated as the sum of the squared market shares (based on hospital discharges) of hospitals within the market area. The *Herfindahl-Hirschman index* represents perfect competition when it registers a score of 0, while a score of 1 represents a monopolistic market.[156] *Hospital competition* measures the number of hospitals physically located in the market area and is a measure of suppliers of health care services.

There is a large variation in the location of MR hospitals. *Region*, captured using U.S. census regions, is included to control for the effect of hospital location.[160] Unmeasured factors affecting hospital financial performance and market share over time are accounted for using *year* dummies.

Table 1. Listing of variables, measures, definitions and data sources.

Variable	Measure	Type	Aim	Data Source
Magnet Recognition				
Magnet Recognition Designation	1, Magnet Recognition Hospital 0, Never Magnet Recognition Hospital	Binary	Aim 1, 2, 3	ANCC
Hospital Magnet Recognition Status	0, Pre-Test 1, Implementation 1, Post-Test	Binary	Aim 1, 2, 3	ANCC
Financial Characteristics				
Reimbursement*	Net Patient Revenue per Adjusted Patient Day = Hospital Net Operating Revenue/Adjusted Patient Day	Continuous	Aim 1	HCRIS
Total Expenses*	Expenditures/Wage Rate, where wage rate is (payroll expenses+employee benefits)/FTE Personnel	Continuous	Aim 2	HCRIS
Price of Capital	(Depreciation+Interest Expense) / Number of Beds	Continuous	Aim 2	HCRIS
Price of Labour	(Payroll Expenses+Employee benefits) / FTE Personnel	Continuous	Aim 2	HCRIS
Operating Profitability*	Operating Margin (%) = [(Operating Revenues-Operating Costs)/(Operating Revenues)]*100	Continuous	Aim 3	HCRIS
Total Profitability*	Total Margin (%) = [(Total Revenues-Total Costs)/(Total Revenues)]*100	Continuous	Aim 3	HCRIS
Return on Equity*	Return on Equity (%) = [(Operating Revenues-Operating Costs)/(Equity)]*100	Continuous	Aim 3	HCRIS
Hospital Characteristics				

Variable	Measure	Type	Aim	Data Source
Hospital size	Number of Staffed Beds	Continuous	Aim 1, 3	HCRIS
System Affiliation	1, System Affiliation; 0, Free Standing	Binary	Aim 1, 2, 3	HCRIS
Medicare Payer Mix	Medicare Inpatient Days/Total Hospital Inpatient Days	Continuous	Aim 1, 2, 3	HCRIS
Medicaid Payer Mix	Medicaid Inpatient Days/Total Hospital Inpatient Days	Continuous	Aim 1, 2, 3	HCRIS
Outpatient Volume	Total Outpatient Visits	Continuous	Aim 2	HCRIS
Inpatient Volume	Total Inpatient Days	Continuous	Aim 2	HCRIS
Medicare Case Mix Index	Relative Resource Intensity of the Distribution of Diagnoses Related Groups	Continuous	Aim 2	AHA
Percent Emergency Room Visits	(Emergency Department Visits/Outpatient Visits)*100	Continuous	Aim 2	HCRIS
Percent Outpatient Surgery	(Outpatient Surgeries/Outpatient Visits)*100	Continuous	Aim 2	HCRIS
Teaching Affiliation	1, Teaching Affiliation 0, No Teaching Affiliation	Binary	Aim 1, 2, 3	AHA
Ownership	1, Not-for-Profit 1, For-Profit 0, Government	Binary	Aim 1, 2, 3	AHA
Market Characteristics				
Population	Total Population in the Market Area (1,000s)	Continuous	Aim 1, 3	ARF
Population Density	Market Population Density (1,000 population per square miles)	Continuous	Aim 1, 3	ARF
Percent of the Population 65 and Over	[Total Population Age 65 and Older in Market Area/Total Population in Market Area[*100]	Continuous	Aim 1, 3	ARF

Variable	Measure	Type	Aim	Data Source
Income	Average per Capital Income in Market Area (1,000s)	Continuous	Aim 1, 3	ARF
Unemployment Rate	Average Unemployment Rate in Market Area	Continuous	Aim 1, 3	ARF
Poverty Rate	Average Rate of Families or Person in Poverty in Market Area	Continuous	Aim 1, 3	ARF
Distance from Residence to Hospital	Average Distance from Place of Residence to Hospital (miles)	Continuous	Aim 1, 3	ARF
Hospital Market Share*	Hospital Discharges/Total Discharges in Market Area	Continuous	Aim 1, 3	ARF
Herfindahl-Hirschman Index	The sum of squares of the market shares, expressed as a percentage, held by each firm in an industry. HHI=$\sum_{i=1}^{n} S_i^2$	Continuous	Aim 2	ARF
Hospital competition	The total number of hospitals in the hospital's geographical market.	Continuous	Aim 1, 3	HCRIS
Region	1, Midwest; 1, Northwest; 1, South; 0, West	Binary	Aim 1, 2, 3	ARF
Year	2000=0 2001=1 … 2010=1	Continuous	Aim 1, 2, 3	ARF

*Measures of Hospital Outcomes used as dependent variables.
ANCC (American Nurses Credentialing Center), HCRIS (Healthcare Cost Report Information System), AHA (American Hospital Association), ARF (Area Resource File)

Statistical Analysis

The analysis is completed in two phases. In Phase 1, the never MR hospitals are matched with the MR hospitals and a longitudinal data set is created. In Phase 2, the matched never MR and MR hospital data set is used to conduct the empirical analysis and test each research hypothesis.

Phase 1a – Matching the MR and never MR Hospitals

In a pre-post research design, both control and treatment groups are required. The current study sample of hospitals contains MR hospitals and never MR hospitals. Since the counterfactual of the MR hospital is not observed in the data (i.e. it is a missing value), the objective is to use information from the never MR hospitals to impute a missing value for a hypothetical and not observed outcome.

Since hospitals may have specific characteristics that make them more likely to become MR, corrective methods, such as propensity score analysis, are recommended to control for selection bias when analyzing data collected from an observational study design.[161] Propensity score analysis is used to create ideal matched hospitals. The propensity score analysis predicts the probability that a hospital will achieve MR based on both hospital and market characteristics for all hospitals during the year 2000 (i.e. the pre-test period). A logit model is used to generate propensity scores:

$$Prob(Magnet\ Recognition = 1|X) = \frac{1}{1+e^{-X\beta}} = \frac{e^{X\beta}}{1+e^{X\beta}}$$

$$X\beta = \beta_0 + \beta_1 Hospital\ Characteristics + \beta_2 Market\ Characteristics + \beta_3 Region + \varepsilon \qquad Eq\ (1)$$

The variables employed in the propensity score analysis include hospital characteristics: *Hospital size, System affiliation, Medicare payer mix, Medicaid payer mix, Ownership, Teaching Affiliation* and market characteristics: *Population, Percent of the population 65 and over, Income, Unemployment rate, Hospital competition* and *Region*. The log of the predicted probability is used as the propensity score, since it approximates a normal distribution, where *p* is the predicted probability of becoming a MR hospital.

$$Propensity\ Score = \log\left(\frac{1-p}{p}\right) \qquad Eq\ (2)$$

A greedy matching algorithm is used to match MR hospitals to never MR hospitals in the year 2000. A maximum of 1 to 4 nearest neighbour matching within a caliper with replacement is used. The recommended caliper size is set at $0.25\sigma_p$, (where $0.25\sigma_p$ denotes the standard deviation for the estimated propensity scores in the sample).[162] Greedy matching requires a sizable common support region to work. Hospitals that fall outside of the common support region are excluded since they have no matches. If the common support region is small, the recommended procedure is to use different specifications (i.e. explanatory variables and/or functional forms) in the logit model to predict propensity scores and re-check the size of the common support region.[163, 164]

In order to create the sample for analysis, MR hospitals are matched with never MR hospitals in the year 2000. These matched hospitals remained matched throughout the study period. The never MR hospitals identified in the year 2000 through matching, continue as control hospitals in the remaining years of the sample (i.e. 2001, 2002, … , 2010). The resulting sample consist of matched MR (treatment) and never MR (control) hospitals, where $N_{match,MR}$

$_{Hospitals} = n(N_{match,never\ MR\ Hospitals})$. The $N_{match,MR\ Hospitals}$ is the number of MR hospitals after matching, $N_{match,never\ MR\ Hospitals}$ is the number of never MR hospitals after matching and *n* is the number of never MR hospital matches per MR hospital. It has been suggested in the literature that *n*=4 is an ideal number of never MR hospitals for each MR hospital.[163] Therefore, each matched MR hospital (1 hospital) and never MR hospitals (maximum of 4 hospitals) are combined to form a new unit, the hospital pentad. The hospital pentad will aim to simulate the MR hospital and its counterfactual for all three phases.

It is important to acknowledge the limitations of propensity score in matching MR hospitals to never MR hospitals. Specifically, no two hospitals are similar in all respects despite controlling for most characteristics. Even though the analysis plan aims to control for the selection bias by using propensity scores and matching, it should be noted that propensity scores only control for observed variables and do not consider the effect of unobserved variables[163] in the selection of MR. This in turn can also result in biased parameter estimates of the likelihood of becoming MR. One of the drawbacks of using observational data to determine causal inference is that despite controlling for potential endogeneity attributed to selection bias, there is a possibility that the parameter estimates will be biased.[163]

Standardized differences are used to measure covariate balances between the MR hospitals and never MR hospitals. The standardized difference is the absolute difference in sample means divided by an estimate of the pooled standard deviation of the variable, expressed as a percentage.[165] The following equations are used to calculate standardized differences.

$$\%\ Difference = \frac{100\times|\bar{x}_{Treatment}-\bar{x}_{Control}|}{\sqrt{\frac{s^2_{Treatment}-s^2_{Control}}{2}}} \quad for\ continuous\ variables \qquad Eq\ (3)$$

$$\%\ Difference = \frac{100\times|\hat{p}_{Treatment}-\hat{p}_{Control}|}{\sqrt{\frac{\hat{p}_{Treatment}(1-\hat{p}_{Treatment})+\hat{p}_{Control}(1-\hat{p}_{Control})}{2}}} \quad for\ binary\ variables \qquad Eq\ (4)$$

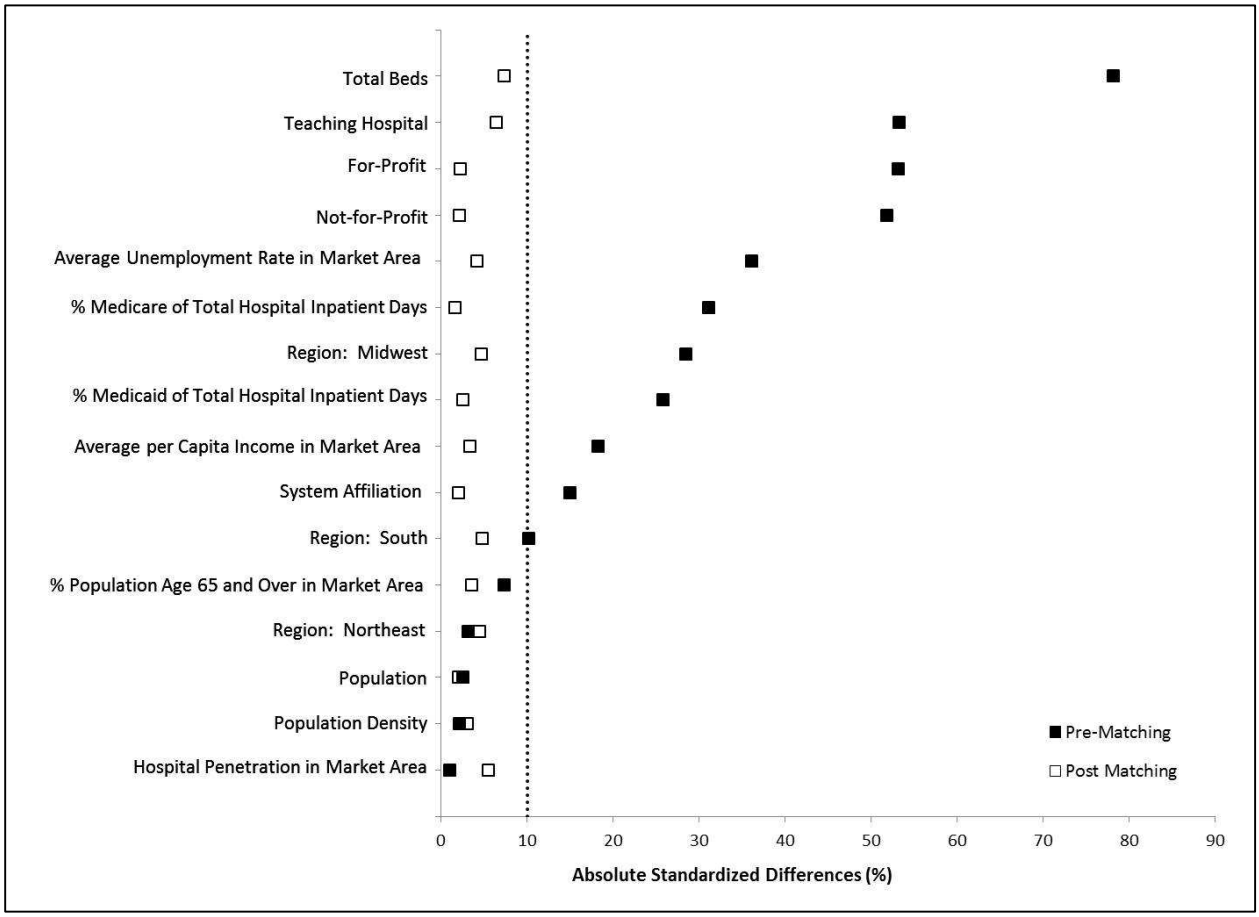
Balancing is considered successful if the standardized differences are less than 10%. Standardized differences greater than 10% in absolute value indicate serious imbalance.[164] In this situation, the model predicting propensity scores is re-configured and re-run until the matching successfully removes all significant imbalances. It is recommended using high-order polynomial terms and/or cross-product interaction terms in the logistic regression and rerunning the model may help to reduce imbalance between the two groups. For instance, including a squared term of the covariate that shows significance after matching or a product of two covariates if the correlation between the two covariates is likely to differ between the two groups.[162]

The sample used for the propensity score analysis consisted of 2,199 hospitals (231 MR hospitals and 1,968 never MR hospitals). The 231 MR hospitals are matched with 584 never MR hospitals (some never MR hospitals were re-matched with MR hospitals). A weakness in using the greedy matching model is the reduction in sample size attributed to a small region of common support, where specific MR hospitals and never MR hospitals cannot be matched (i.e. the observations fall outside the region of common support). Since each MR is matched with a maximum of four never MR hospitals, in the year 2000 the sample consists of 231 hospital pentads for a total of 1,152 hospitals (231 MR hospitals and 921 never MR hospitals).

Using the hospital year observations from the year 2000, standardized differences are estimated for pre and post matching to assess pre-match imbalance and post-match balance. The post-match standardized differences are <10% for all the covariates. This confirms that balance between the MR and the never MR hospitals have been successfully achieved. Figure 5 displays

the absolute standardized differences in covariates between the MR and never MR hospitals before and after propensity score matching.

Figure 5. Absolute standardized differences in baseline covariates between MR hospitals and never MR hospitals, before and after propensity score matching (post-match standardized difference <10% indicates excellent covariate balance).



Phase 1b – Creating the Final Data Set with Matched MR and Never MR Hospitals

The never MR hospitals generated from the propensity score analysis are then identified in the remaining hospital year observations (from 2001 to 2010). These never MR hospital year observations are designated as either pre-test, implementation or post-test for the years that correspond to the pre-test, implementation and post-test of the corresponding matching MR

hospitals. This results in an unbalance panel data set of 12,480 hospital year observations (from 2000 to 2010), consisting of 921 never MR hospitals and 231 MR hospitals. Since each hospital should have a maximum of 6 hospital year observations (2 hospital year observations for pre-test, 2 hospital year observations for implementation and 2 hospital year observations for post-test), hospital year observations that are not designated in one of these time periods are excluded from the final data set. The final data consists of 6,581 hospital year observations consisting of 921 never MR hospitals and 231 MR hospitals. This data set is used for the multivariate regression analysis described in Phase 2.

Phase 2 – Empirical Analysis

Descriptive Statistics

Descriptive statistics are used to summarize the data. In order to mitigate the effect of outliers, dependent variables are censored at the 1st and 99th percentile. Bivariate analysis is used to test for significant differences between the subgroup means for MR hospitals versus never MR hospitals. The differences between the group means on each measure are analyzed for direction and statistical significance using t-tests for continuous variables and chi-square test for categorical variables. Statistical significance is set at α=0.05 for all analyses. Correlation analysis is completed to identify potential multicollinearity among the independent variables. The analysis is conducted using Stata 11.1 (College Station, Texas).[166]

Multivariate Regression Analysis

Two different multivariate regression analyses are utilized to test the hypotheses described in this dissertation. For Research Questions 1 and 3, a difference-in-difference model

using hospital fixed effects is used, and for Research Question 2, a stochastic frontier analysis is used.

Difference-in-Difference Model Using Hospital Fixed Effects

A difference-in-difference model with hospital fixed effects is used for Aims 1 and 3 of the analysis. The following standard regression model is used for the analysis of each aim:

$$\begin{aligned} &Hospital\ Outcome_{ht} \\ &\quad = \beta_0 + \beta_1 Treatment_{ht} + \beta_2 ImplementationPeriod_{ht} + \beta_3 PostTestPeriod_{ht} \\ &\quad + \beta_4 Treatment_{ht} * ImplementationPeriod_{ht} + \beta_5 Treatment_{ht} * PostTestPeriod_{ht} \\ &\quad + \beta_6 Time_{ht} + \beta_7 Hospital\ Characteristics_{ht} + \beta_8 Market\ Characteristics_{ht} \\ &\quad + \varepsilon_{ht} \end{aligned} \qquad Eq\ (5)$$

$$where\ \varepsilon_{ht} = \mu_h + v_{ht}$$

where *h* indicates variables that vary by hospital and *t* indicates variables that vary by time. The μ_h refers to the unobserved time-invariant variables, and the v_{ht} refers to the unobserved time-variant variables. Fixed effect component, μ_h, captures unobserved heterogeneity across hospitals that are fixed over time.[167] This is a limitation of the study design and methodology.

Table 2 lists the *Hospital outcome* variables and associated measures for each aim. *Treatment* is a binary indicator of MR for each hospital. The never MR hospital is the referent variable. The *ImplementationPeriod* and *PostTestPeriod* are both binary indicators of hospital MR status during the study period. The referent variable is the pre-test period. *Time (=2000, 2001, 2002, …..,2010)* control for the year effects over the study period. The regression analysis also controls for both *Hospital Characteristics* and *Market Characteristics.* Standard errors are clustered at the hospital level to allow for correlation within hospitals over time.

Table 2. Hospital outcomes and measures.

Aim	Hospital Outcome Variable	Measure
Aim 1	Reimbursement	▪ Net Patient Revenue per Adjusted Patient Day
	Hospital Market Share	▪ Hospital Discharges as a Percent of Total Discharges in Hospital's Market Area
Aim 3	Profitability	▪ Operating Margin ▪ Total Margin ▪ Return on Equity

Table 3 decomposes the difference-in-difference equation (Equation 5) into individual components. Each cell corresponds to the marginal effect of the MR signal on hospital outcomes for each phase of the study time period. The coefficient β_1 is a measure of the difference in outcomes (i.e. reimbursement, market share and financial performance) between MR and never MR hospitals during the pre-test phase of the study. This parameter estimate will determine if the MR and never MR hospitals are similar or different at the initiation of the study. The coefficients $\beta_1 + \beta_4$ are a measure of the difference in outcomes (i.e. reimbursement, market share and financial performance) between MR hospitals and never MR hospitals during the implementation phase of the study. This parameter estimate will determine the effects of the MR signal prior to the commencement of the MR program. The coefficients $\beta_1 + \beta_5$ are a measure of the difference in outcomes (i.e. reimbursement, market share and financial performance) between MR and never MR hospitals during the post-test phase of the study. This parameter estimate will determine the effect of the MR signal after the commencement of the MR program. The coefficient β_5 is a measure of the overall effect of the MR signal on hospital outcomes (i.e. reimbursement, market share and financial performance). This estimate is a measure of the difference in hospital outcomes between MR and never MR hospitals and between post-test and pre-test attributed to the MR signal. For Aims 1 and 3, β_5 is the main parameter of interest since

it is the measure of the effectiveness of the MR signal on hospital outcomes. The null hypothesis for these analyses is that MR does not have a causal effect on hospital outcomes, $\beta_5 = 0$. If β_5 is determined to be significant, than the hypotheses for Aims 1 and 3 cannot be rejected.

Table 3. Difference-in-difference estimators for the effect of Magnet Recognition

	Pre-Test	Implementation	Post-Test	Post-Test – Pre-Test
Never MR Hospitals	β_0	$\beta_0 + \beta_2$	$\beta_0 + \beta_3$	β_3
MR Hospitals	$\beta_0 + \beta_1$	$\beta_0 + \beta_1 + \beta_2 + \beta_4$	$\beta_0 + \beta_1 + \beta_3 + \beta_5$	$\beta_3 + \beta_5$
MR Hospitals – Never MR Hospitals	β_1	$\beta_1 + \beta_4$	$\beta_1 + \beta_5$	$\boldsymbol{\beta_5}$

Stochastic Frontier Analysis

Stochastic Frontier Analysis (SFA) is used in Aim 2 to estimate the effect of the MR signal on hospital inefficiency. This method focuses specifically on cost inefficiency, which arises when a firm does not maximize output given a set of inputs consumed and/or when the firm does not select the optimal input mix, given the prices of inputs and the technology available.[150, 153] Estimated hospital level cost inefficiency is the percentage by which observed costs exceed minimum costs predicted for the best-practice frontier.[168]

SFA is an econometric technique, which uses regression analysis to estimate a cost function, except the difference being that inefficiency of a hospital is measured using the residuals from the estimated equation.[169] Maximum Likelihood estimation is used to estimate the parameters of the model.[170] Once the parameters in the model are estimated, the inefficiency term is extracted from the composed error term.[171]

SFA is based on the assumption that departures from the cost frontier can be decomposed into stochastic and deterministic factors.[172] The former represents random error and the latter represents inefficiency. The estimation of hospital cost inefficiency requires technical assumptions about the structure of costs and about the statistical distribution of the error term representing inefficiency.[173, 174] The application of SFA to panel data has been suggested to less likely yield biased estimates of the βs due to omitted variables and because panel models require fewer distributional assumptions about deterministic error.[152, 175]

A single-stage stochastic frontier panel model with random effects is used to analyze the determinants of cost inefficiency in MR hospitals. In this model, all of the independent variables are included in one equation.[154] This approach has the advantage of producing more efficient parameter estimates.[176] The following empirical model is used for this analysis:

$$TC_{ht} = f(Y_{ht}, W_{ht}) + \sum_i \gamma_i CM_{iht} + e_{ht} \qquad Eq\ (6)$$

$$where\ e_{ht} = v_{ht} + u_{ht}$$

Where *TC* is hospital *h*'s total costs at time *t*; *Y* is a vector of outputs (i.e. outpatient visits and number of inpatient days); *W* is a vector of input prices (i.e. price of capital and labour); *CM* is a vector of variables influencing quality of care and accounts for variation across a hospital's outputs, such as teaching status, case mix complexity, etc., and e_{ht} is the error term. The error term, e_{ht}, is composed of v_{ht}, which is the statistical noise (i.e. assumed to be distributed as $N(0,\sigma^2)$) and independent of u_h.[177] The u_h consists of positive departures from the cost frontier and represents cost inefficiency[178] and is often assumed to be iid $N|(0,\sigma^2)|$.[169] The half normal assumption is based on the idea that larger values of cost inefficiency are less likely than smaller

values of cost inefficiency.[177] The observations are indexed by a hospital index $h = 1, 2, \ldots, n$ and a time index $t = 1, 2, \ldots, T$.[152]

SFA requires the specification of functional form for the cost equation. Common functional forms used in the empirical research have been translog and Cobb-Douglas cost functions. The translog form is preferred because of the increased flexibility; however this requires the inclusion of an increased number of parameters to estimate and may result in multicollinearity problems.[179]

The general form of the translog cost model is used to estimate the stochastic frontier for hospitals, which is stated as the following:

$$\ln TC_{ht} = \alpha_0 + \sum_{j=1}^{J} \alpha_j \ln Y_{jht} + \sum_{k=1}^{K} \beta_k \ln W_{kht} + \frac{1}{2}\sum_{j=1}^{J}\sum_{l=1}^{J} \delta_{jl} \ln Y_{jht} \ln Y_{lht} + \frac{1}{2}\sum_{k=1}^{K}\sum_{m=1}^{K} \gamma_{km} \ln W_{kht} \ln W_{mht} + \sum_{j=1}^{J}\sum_{k=1}^{K} \rho_{jk} \ln Y_{jht} W_{kht} + \sum_{n=1}^{N} \theta_n CM_{nht} + \varphi Year_{ht} + v_{ht} + u_{ht} \qquad Eq\ (7)$$

Where *TC* is total expenses, *Y* is outputs, *W* is input prices, *CM* is variables influencing quality of care, *Year* is time-trend variable, v_{ht} is a two-sided randomly distributed error term, and u_{ht} is a non-negative term, indicating the proportion by which hospital *h's* costs exceed their feasible minimum due to inefficiency.

A time-varying model proposed by Battese and Coelli is used to estimate hospital specific cost inefficiency.[180] In this model the inefficiency-effects are defined by:

$$u_{ht} = \delta Z_{ht} + w_{ht}, \quad u_{ht} \geq 0. \qquad Eq\ (8)$$

where Z_{ht} is a vector of explanatory variables associated with the inefficiency-effects; δ is a vector of unknown parameters to be estimated; and w_{ht} are unobservable random variables, assumed to be independently distributed, obtained by truncation of the normal distribution with mean zero and unknown variance, σ^2.[150]

In addition to providing estimates of cost inefficiency, this model permits an estimation of the impact of both firm specific and environmental factors on cost inefficiency.[181] By including time in the *Z* vector with other firm-specific variables, inefficiency can differ by firm and by time.

The parameters of the cost frontier are simultaneously estimated by a maximum likelihood method using the FRONTIER 4.1 program, which uses a random effects regression technique.[182] A limitation the random effects model is that the effects must be assumed to be uncorrelated with the regressors.[174] Fixed effects is an alternative to this model; however this model cannot be used in a data set that has variables that are invariant over time.[183]

This model estimates inefficiency and the parameters of the inefficiency-effects variables simultaneously (one-stage method). Inefficiency-estimates can also be obtained using a two-stage estimation procedure, where the inefficiency-estimates from the first stage are regressed against inefficiency-effects variables in a second stage. The two-stage estimation procedure has been found to provide parameter estimates of the inefficiency-effect variables that are inefficient or more likely biased than those from the one-stage method.[176, 182]

The cost inefficiency of the *h*th hospital in the *t*th year (where t ranges from 1 in 2000 to 11 in 2010) is defined as the ratio of the stochastic frontier total costs to observed total costs. The stochastic total cost frontier is defined by the value total costs would be if u_{ht} (i.e., the cost inefficiency effect) was zero (i.e., full efficiency). Therefore

$$CE_{ht} = exp(-u_{ht}) \qquad Eq\ (9)$$

where CE_{ht} = cost efficiency and u_{ht} was defined previously.

This indicates that cost efficiency is no greater than 1 and the reciprocal of this quantity, exp(u_{ht}) is no less than one. The amount by which exp(u_{ht}) exceeds one is a measure of cost inefficiency.[152, 155]

CHAPTER 4: THE EFFECT OF THE MAGNET RECOGNITION SIGNAL ON HOSPITAL REIMBURSEMENT AND MARKET SHARE

Overview

In this Chapter, the focus is on examining the effect of the Magnet Recognition (MR) signal on both hospital patient reimbursement and market share. If consumers and purchasers interpret the MR designation as a signal of high quality care, then demand for MR hospitals should increase and lead to an increase in market share and revenue. Data from the American Hospital Association Annual Survey, Medicare Hospital Cost Reports, Area Resource File and American Nurses Credential Center is used for the analysis. Propensity score matching is used to select comparable hospital matches from the panel data set. The matched hospitals are used to construct the final study sample. Then a difference-in-difference model with hospital fixed effects is applied to the matched hospital sample to test the effect of the MR signal, while controlling for both hospital and market characteristics. Results indicate that the MR signal does not affect either patient reimbursement or market share of designated hospitals compared to non-designated hospitals.

Introduction

Hospitals in the U.S. face ongoing financial challenges as they strive to achieve their missions. These facilities are struggling to operate in a turbulent healthcare environment, consisting of a large population of uninsured and underinsured patients[79], changing

reimbursement policies, broadening regulatory requirements, increasing emphasis on quality care outcomes, and declining economic conditions.[11] In addition to these circumstances, hospitals are also coping with an aging workforce, a high percentage of elderly patients, high acuity patients and patients with multiple co-morbidities.[79, 184] Despite rising costs and limited opportunities to increase revenue, hospitals are trying to survive and maintain the delivery of high quality healthcare services. In order to mitigate these effects and ensure continued financial viability, many hospitals are employing strategies that will provide a distinct advantage and differentiate them from other hospital competitors, potentially providing opportunities to increase revenue through either market share and/or reimbursement. One way a hospital can distinguish itself is by signaling the underlying quality of its products and services.

Signals are used to reduce information asymmetry, which is defined as an imbalance of information between two parties, where one party has more information than another party. Signals are often used in healthcare to communicate the underlying quality of a hospital's products and services. The information contained in the signal permits consumers to make informed decisions and to distinguish between high quality and low quality products. Healthcare providers attempt to communicate the quality of their services to prospective patients and/or employees in a variety of ways.[9] Some communicate directly using public reporting of quality of care information.[10] Others communicate indirectly, or signal, unobservable information to consumers by attaining a costly, coveted quality designation, which the consumer can interpret as the firm's commitment of resources to quality management.[58] The quality information conveyed by the signal then leads consumers to update their perceptions[2, 43] about product and service quality within the context of market conditions.[44]

MR designation is an example of a signal employed by hospitals to communicate to patients, providers and payers, the hospital's dedication and commitment to health care quality and quality management.[9] MR is a quality designation given by the American Nurses Credentialing Center to hospitals and long term care facilities[18, 19] to recognize organizations as centers of nursing excellence.[86] Pursuing and sustaining MR requires the commitment of time and the investment of substantial human and financial resources by the hospital,[21, 22] and the designation has gained widespread attention in both research[24, 25] and practice[26] over the past two decades. MR is considered to be a symbol of distinction[11] and has been theorized to signal to patients and to health care providers, the hospital's dedication and commitment to quality patient care.[13-15]

There is growing evidence (empirical and anecdotal) that MR hospitals are associated with positive nursing, patient and organizational outcomes.[24, 25] These outcomes are interrelated and have also been theorized to affect both hospital reimbursement and market share through signaling delivery of quality care to payers, patients, and providers. Under this theory, payers (i.e. government and insurers) interpret and respond to the MR signal by either 1) steering patients to designated hospitals to receive quality patient care[18] and/or 2) increasing reimbursement for health services in high quality hospitals.[32] Likewise, patients interpret the MR signal and respond by seeking care at or referring family and friends to the designated hospital, or by remaining loyal to the designated facility through repeated visits. Lastly, providers interpret the MR signal by referring patients to designated hospitals where they will receive quality patient care. Despite these theories, there have been no research studies that have empirically evaluated the effect of the MR signal on either hospital patient reimbursement or market share.

The purpose of this research study is twofold:

(1) To investigate the effect of the MR signal on hospital reimbursement. It is hypothesized that the MR signal will increase reimbursement of designated hospitals, and

(2) To investigate the effect of the MR signal on hospital market share. It is hypothesized that the MR signal will increase market share of designated hospitals.

This study contributes to the evidence of signaling unobserved quality by hospitals in two ways. First, although the more general effect of signaling on firm performance using various outcomes has been studied previously, there is minimal research investigating the effect of signaling in the hospital industry. Second, although there is a large volume of studies conducted on MR hospitals, these research studies have been dominated by case studies, single-site evaluations[33] and cross sectional survey studies with convenience samples of organizations and staff respondents.[185] With the increased number of MR hospitals, it is now possible to design longitudinal research studies that address issues of modest sample size and omitted variable bias. This study uses externally reported administrative and financial information and employs a robust methodological approach and innovative analytical techniques to evaluating the effect of MR on hospital reimbursement and market share.

The outcomes of this research will inform managers and policy makers about the effectiveness of the MR signal at changing hospital reimbursement and market share, and thus its utility as a potential strategy to improve the hospital's marketability and financial health, especially in a highly competitive market area.

Research Design and Methods

Research Design

This study applies a pre-post research design to measure the effect of the MR signal on hospital reimbursement and market share. This research design attempts to control for observable and unobservable factors that will potentially contribute to the difference between the pre-test and post-test results. The observations are divided into two groups. The treatment group, hereafter referred to as "MR hospitals", includes hospitals that have achieved MR anytime during the study period. The control group includes hospitals that have never achieved MR prior to, during, or after the study period. This sub-sample excludes hospitals that have received MR prior to 2000 and after 2010. The control hospitals are referred to as "Never-MR hospitals".

Three study periods are used. The *pre-test period* is defined as a minimum of two years when the hospital is not pursuing MR. The *pre-test period* is a baseline measure, before the hospital is actively pursuing MR. The *implementation period* is defined as two years prior to the initial MR designation, when the hospital is preparing for MR. According to the research literature, hospitals pursuing the MR designation require approximately two years to transform and become a MR hospital.[138] The *implementation period* aims to control for any changes in hospital characteristics and outcomes that may occur during the transition to becoming a MR hospital. The *post-test period* is defined as the year of initial MR designation and one subsequent years of designation.

Data Sources

The hospital data for this analysis are obtained from Medicare's Hospital Cost Report Information System (HCRIS), the American Hospital Association's (AHA) Annual Survey of

Hospitals, the Area Resource File (ARF) and the American Nurses Credentialing Center (ANCC) website.

The four data sets are merged using both a year and a hospital identifier; however the definition of the year variable differs in the various data sets. The HCRIS data set includes hospital year observations organized by fiscal year and the ARF, ANCC and AHA data sets include hospital-year observations organized by calendar year. In order to merge HCRIS data set, a year-end variable is created using the following rule: the fiscal year end date for each hospital-year observation (i.e. 6/30/2000) will be designated as the year-end variable (i.e. 2000) and is matched with the calendar year variable.

Study Sample

The study sample is a longitudinal, unbalanced panel of MR and never MR hospitals located in urban areas in the US from 2000 to 2010 (eleven years). The initial data set consists of 3,431 hospitals (31,163 hospital year observations). Duplicate hospital year observations, hospital year observations with fewer than 330 days in the Medicare cost report period, hospitals with fewer than 8 hospital year observations, hospitals that do not have a hospital year observation at year 2000, and hospitals that received MR before 2004 and after 2009 are excluded from the data set.

In addition, to remain in the final study sample, each MR hospital must have four consecutive years of data prior to MR designation, and two consecutive years of data following MR designation, for a total of six hospital-year observations. MR hospitals with limited or missing financial data potentially introduce noise and bias the results; therefore, only MR hospitals that have complete data over the required six consecutive years are included. Although

this requirement reduces the sample size, the reduction in the eligible hospital-year observations is trivial.

The final sample consists of 23,607 hospital year observations (2,199 hospitals) from 2000 to 2010. This includes 21,072 never MR hospital year observations (1,968 hospitals) and 2,535 MR hospital year observations (231 hospitals).

Propensity score analysis is used to create a study sample of matched MR hospitals and never MR hospitals. Using data from the year 2000, the propensity score analysis predicts the probability that a hospital will ever achieve MR as a function of hospital and market characteristics in 2000. A greedy matching algorithm is used to match MR hospitals to never MR hospitals in the year 2000. Following the recommendation by Guo, a 1 to 4 nearest neighbour matching within a caliper without replacement is used.[163] As suggested by Rosenbaum, the caliper size is set at $0.25\sigma_p$, (where $0.25\sigma_p$ denotes the standard deviation for the estimated propensity scores in the hospital sample).[162] The matches from 2000 serve as the matches for the remainder of the study period.

This results in an unbalanced panel data set of 12,480 hospital year observations (from 2000 to 2010), consisting of 921 never MR hospitals and 231 MR hospitals. Since each hospital should have a maximum of 6 hospital year observations (2 hospital year observations for pre-test, 2 hospital year observations for implementation and 2 hospital year observations for post-test), hospital year observations that are not designated in one of these time periods are excluded from the final data set. The final study sample consists of 6,581 hospital year observations consisting of 921 never MR hospitals and 231 MR hospitals. Standardized differences are used to measure covariate balances between the MR hospitals and the matched never MR hospitals.

The post-match standardized differences are <10% for all the covariates. This confirms that balance between the MR and the never MR hospitals has been successfully achieved.

Variables and Measurements

Table 4 is a comprehensive list of variables, measures, definitions and data sources that are utilized in this analysis. The variables are discussed in detail below.

Dependent Variables

Net patient revenue per adjusted patient day is used to measure hospital *reimbursement*. The adjusted patient day is defined as the sum of inpatient days and equivalent patient days attributed to outpatient services. The MR signal is believed to affect the hospital's ability to negotiate better reimbursement rates with managed care organizations or result in a shift towards a more profitable payer mix.[32] To account for inflation, reimbursement has been adjusted to 2010 US dollars using the Medical Care Services Consumer Price Index.[140]

Hospital market share, a measure of the amount of hospital competition in the market area, is measured as the hospital's discharges as a percentage of the total discharges in a hospital's market area.[159] The hospital's market area is defined as the county in which the hospital is located. MR provides an opportunity for hospitals to market themselves[105, 127] and is theorized to signal to patients and clinicians that the hospital is a center for nursing excellence and a provider of quality patient care.[12] The MR signal is hypothesized to increase market share through increases in either payers steering patients towards a MR hospital, physician referrals or patient preferences for quality patient care.[110]

Independent Variables – Main Explanatory Variable

The *Magnet Recognition Designation* variable identifies hospitals as either MR or never MR. The *Hospital Magnet Recognition Status* variable identifies the time period as either *pre-test*, *implementation*, or *post-test* during the six year period over which each hospital is observed.

Independent Variables – Control Variables

Hospital Characteristics

Hospital characteristics are noted to be associated with a hospital's financial health.[157] These characteristics include a hospital's structural factors and processes, which influence hospital operations, marketability and ability to earn revenue.

Hospital characteristics include *hospital size* (measured by total number of beds) which is associated with higher economies of scale and financial expertise, lower per unit costs, and more successful strategic activity.[146, 147] *System affiliation* (determined using the Medicare Cost Report) indicates whether a hospital is owned by a larger system. Such affiliations have been found to result in increased efficiency, lower risk, better financial outcomes, seamless care, greater control over referrals, and greater economies of scale.[146, 147]

Medicare payer mix and *Medicaid payer mix* are calculated as the percentage of total inpatient days attributed to Medicare and Medicaid, respectively. These measures provide an indication of the hospital's patient-mix [146] and the payer-mix.[148] An increased dependence on government payers, such as Medicare and Medicaid, is likely to be associated with lower patient revenue, because these payers typically do not pay the full average cost of care.[146]

Teaching affiliation indicates if a hospital is a teaching hospital or a non-teaching hospital. Teaching hospitals are known to have higher costs than non-teaching hospitals.[155]

Teaching affiliation is included as a binary variable in this analysis. *Ownership* indicates for-profit, not-for-profit or government ownership. These variables are included to control for internal pressure for cost reduction associated with ownership.[186] Due to their responsibilities to shareholders, for-profit firms are expected to more aggressively pursue cost reduction strategies than not-for-profit firms. For-profit firms are also unlikely to be interested in the adoption of innovations that are unproven or may raise costs[39], and as a result, may have higher operating margins than their not-for-profit counterparts.[156]

Market Characteristics

A hospital's operating environment and the market demand for health care services can also influence hospital financial performance and market share.[157] The hospital's market area is defined as the county in which the hospital is located.

The total *population* in the market, the market *population density* and the *percent of the population age 65 and over* describe the demand for hospital services in the market area. The average per capita *income, unemployment rate* and *poverty rate* (percentage of families or persons in poverty) measures a community's financial ability to purchase health care services.[158] The likelihood of a resident to bypass a hospital and seek services at another facility is proxied by the average *distance from patient residence to hospital*, calculated as the average distance between the residence ZIP centroid of each Medicare discharge and the hospital.[159] *Hospital competition* measures the number of hospitals physically located in the market area and is a measure of suppliers of health care services.

There is a large variation in the location of MR hospitals. *Region*, captured using U.S. census regions, is included to control for the effect of hospital location.[160] Annual unmeasured

factors affecting hospital financial performance and market share over time are accounted for using *year* dummies.

Table 4. Listing of variables, measures, definitions and data sources.

Variable	Measure	Type	Data Source
Dependent Variable			
Reimbursement	Net Patient Revenue per Adjusted Patient Day = Hospital Net Operating Revenue/Adjusted Patient Day	Continuous	HCRIS
Hospital Market Share	Hospital Discharges/Total Discharges in Market Area	Continuous	ARF
Magnet Recognition			
Magnet Recognition Designation	1, Magnet Recognition Hospital; Never Magnet Recognition Hospital (referent)	Binary	ANCC
Hospital Magnet Recognition Status	Pre-Test (referent); Implementation; Post-Test	Binary	ANCC
Hospital Characteristics			
Hospital size	Number of Staffed Beds	Continuous	HCRIS
System Affiliation	System Affiliation; Free Standing (referent)	Binary	HCRIS
Medicare Payer Mix	Medicare Inpatient Days/Total Hospital Inpatient Days	Continuous	HCRIS
Medicaid Payer Mix	Medicaid Inpatient Days/Total Hospital Inpatient Days	Continuous	HCRIS
Teaching Affiliation	Teaching Affiliation; No Teaching Affiliation (referent)	Binary	AHA
Ownership	Not-for-Profit; For-Profit; Government (referent)	Binary	AHA
Market Characteristics			
Population	Total Population in the County (1,000s)	Continuous	ARF
Population Density	County Population Density (population per square miles)	Continuous	ARF

Variable	Measure	Type	Data Source
Percent of the Population 65 and Over	[Total Population Age 65 and Older in Market Area/Total Population in County]*100	Continuous	ARF
Income	Per Capita Income in Market Area (1,000s)	Continuous	ARF
Unemployment Rate	Unemployment Rate in Market Area	Continuous	ARF
Poverty Rate	Percent/proportion of Families or Person in Poverty in Market Area	Continuous	ARF
Distance from Residence to Hospital	Average Distance from Place of Residence to Hospital (miles)	Continuous	ARF
Hospital Competition	The total number of hospitals in the hospital's geographical market.	Continuous	HCRIS
Region	Midwest; Northwest; South; West (referent)	Binary	ARF
Year	2000 (referent); 2001…2010	Binary	ARF

ANCC: American Nurses Credentialing Center, HCRIS: Healthcare Cost Reports Information System, ARF: Area Resource File, AHA: American Hospital Association

Statistical Analysis

Descriptive statistics are used to summarize the data. In order to mitigate the effect of outliers, dependent variables are winsorized at the 1st and 99th percentile. Bivariate analysis is used to test for differences between the subgroup means for MR hospitals versus never MR hospitals. The differences between the group means on each measure are analyzed for direction and statistical significance using t-tests for continuous variables and chi-square test for categorical variables. Statistical significance is set at α=0.05 for all analyses. Correlation analysis is completed to identify potential multicollinearity among the independent variables. The analysis is conducted using Stata 11.1 (College Station, Texas).[166]

Empirical Analysis - Difference-in-Difference Estimation

A difference-in-difference model with hospital fixed effects is used to estimate the effects of MR on both reimbursement and hospital market share. The following standard regression models are used:

$$
\begin{aligned}
&Ln(Reimbursement_{ht}) \\
&\quad = \beta_0 + \beta_1 Treatment_{ht} + \beta_2 ImplementationPeriod_{ht} + \beta_3 PostTestPeriod_{ht} \\
&\quad + \beta_4 Treatment_{ht} * ImplementationPeriod_{ht} + \beta_5 Treatment_{ht} * PostTestPeriod_{ht} \\
&\quad + \beta_6 Time_{ht} + \beta_7 Hospital\ Characteristics_{pt} + \beta_8 Market\ Characteristics_{pt} \\
&\quad + \varepsilon_{ht} \\
&where\ \varepsilon_{ht} = \mu_h + v_{ht}
\end{aligned}
$$

$$
\begin{aligned}
&Hospital\ Marketshare_{ht} \\
&\quad = \beta_0 + \beta_1 Treatment_{ht} + \beta_2 ImplementationPeriod_{ht} + \beta_3 PostTestPeriod_{ht} \\
&\quad + \beta_4 Treatment_{ht} * ImplementationPeriod_{ht} + \beta_5 Treatment_{ht} * PostTestPeriod_{ht} \\
&\quad + \beta_6 Time_{ht} + \beta_7 Hospital\ Characteristics_{pt} + \beta_8 Market\ Characteristics_{pt} \\
&\quad + \varepsilon_{ht} \\
&where\ \varepsilon_{ht} = \mu_h + v_{ht}
\end{aligned}
$$

where *h* indicates variables that vary by hospital and *t* indicates variables that vary by time. The μ_h refers to the unobserved time-invariant variables, and the v_{ht} refers to the unobserved time-variant variables.

The coefficient β_1 is a measure of the difference in reimbursement and hospital market share between MR and never MR hospitals during the pre-test phase of the study. This estimate determines if the MR and never MR hospitals are similar or different at the initiation of the study. However, since this variable is invariant over time, β_1 cannot be estimated using hospital fixed effects regression. Fixed Effects Vector Decomposition (FEVD) is an econometric tool that has been recommended to estimate the coefficient of time-invariant variables.[187] Unfortunately, while the parameter estimates for the time-invariant variables are correct, the standard errors produced from the FEVD are biased downward, resulting in false conclusions about statistical significance.[188]

The coefficient β_3 is a measure of the difference in reimbursement and hospital market share from the pre-test period to the post-test period for never MR hospitals. This estimate measures the change in the reimbursement and hospital market share that are attributed to market and hospital factors. The summation $\beta_3 + \beta_5$ is the difference in reimbursement and hospital market share from the pre-test period to the post-test period for the MR hospitals. Thus, the difference, β_5, is the net effect of the MR signal on reimbursement and hospital market share. This estimate is a measure of the difference in reimbursement and hospital market share between MR and never MR hospitals and between post-test and pre-test attributed to the MR signal. In this study, β_5 is the main parameter of interest since it is a measure of the effectiveness of the MR signal on both reimbursement and hospital market share.

Results

Table 5 presents the descriptive statistics of the study sample. A comparison between MR hospitals and never MR hospitals reveals that MR hospitals receive higher reimbursement and have higher market share than never MR hospitals. The net patient revenue per adjusted patient day for MR hospitals is $3,518 versus $3,118 for never MR hospitals (p=0.000) and the hospital market share for MR is 19.5% versus 18.0% for never MR hospitals (p=0.045).

Table 6 presents the difference-in-difference estimates of the effect of the MR signal on hospital reimbursement and market share, controlling for hospital and market characteristics and including hospital fixed effects. Since the Magnet Recognition Hospitals (MR hospitals and never MR hospitals), Hospital size (Total beds), and Regions (Northeast, Midwest, and South) variables are time-invariant, these variables do not remain in the regression model.

The results of the difference-in-difference regression model indicate that the relationship between the MR signal and both reimbursement and hospital market share is modest – a 1.7 percent increase in revenue and 0.31 percentage point increase in market share – but both are statistically non-significant. The results also indicate that for-profit hospitals have an 11% greater reimbursement compared to government hospitals and hospitals affiliated with a teaching institution have 3.3% lower reimbursement compared to non-teaching affiliated hospitals.

Table 6 also shows that Medicare payer mix, population density, percent of population 65 and over, hospital competition and year variables are significantly associated with hospital market share. A one percentage point increase in Medicare payer mix is associated with a 0.058 percentage point increase in hospital market share. Population density and percent of population 65 and over are associated with 0.018 and 0.70 percentage point decreases in hospital market share, respectively. An increase of one additional hospital in a hospital's market area is

associated with a 0.13 percentage point decrease in hospital market share. All the year variables (from 2001 to 2010) are associated with a significant increase in hospital market share compared to the year 2000, suggesting increasing market share over the eleven year time period. This can be attributed to an increase in the number of total discharges per hospital per year potentially due to population growth in the hospital's market area.

Table 5. Summary statistics of dependent and independent variables (N=6,581 hospital year observations) from 2000 to 2010

	All Hospitals (N=6,581 hospital year observations & 1,152 hospitals)		Never Magnet Recognition Hospitals (N=5,246 hospital year observations & 921 hospitals)		Magnet Recognition Hospitals (N=1,335 hospital year observations & 231 hospitals)		P Value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Dependent variable							
Reimbursement*	3,203.72	1,051.92	3,117.64	1,006.67	3,518.54	1,149.75	0.000
Hospital market share (%)	18.30	24.30	18.00	24.40	19.50	23.90	0.045
Magnet Hospital Recognition Status							
Pre-test (%)	33.10	-	33.10	-	33.00	-	0.895
Implementation (%)	34.50	-	34.50	-	34.40	-	0.924
Post-test (%)	32.40	-	32.30	-	32.70	-	0.818
Hospital Characteristics							
Hospital size (Total beds)	445.00	333.00	439.00	340.00	466.00	302.00	0.080
System affiliation (%)	29.70	-	29.70	-	29.60	-	0.948
Medicare Payer Mix (%)	38.50	14.30	38.30	15.00	39.00	11.30	0.094
Medicaid Payer Mix (%)	11.90	9.70	12.00	10.10	11.50	7.83	0.090
Not-for-profit hospital (%)	86.10	-	86.00	-	86.20	-	0.844
For-profit hospital (%)	4.30	-	4.40	-	4.00	-	0.505
Government hospital (%)	9.60	-	9.60	-	9.80	-	0.820
Teaching Affiliation (%)	66.60	-	66.50	-	67.20	-	0.662
Market Characteristics							
Population (1,000s)	3,588.04	4,782.68	3,571.45	4,800.64	3,653.22	4,712.57	0.577
Population density	726.00	737.00	722.00	742.00	742.00	718	0.376
Percent of Population 65 and over (%)	12.00	2.45	12.00	2.48	12.10	2.35	0.422
Income	37,192.05	7,137.81	37,139.18	7,104.58	37,399.79	7,265.89	0.234
Unemployment Rate (%)	5.29	1.79	5.30	1.79	5.25	1.79	0.327

	All Hospitals (N=6,581 hospital year observations & 1,152 hospitals)		Never Magnet Recognition Hospitals (N=5,246 hospital year observations & 921 hospitals)		Magnet Recognition Hospitals (N=1,335 hospital year observations & 231 hospitals)		P Value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Poverty Rate	11.50	2.52	11.50	2.55	11.60	2.43	0.075
Distance from Residence to Hospital	16.60	8.56	16.70	8.61	16.20	8.35	0.046
Hospital competition	10.30	14.50	10.20	14.60	10.90	14.1	0.135
Region							
West	14.70	-	15.10	-	13.30	-	0.105
Midwest	31.50	-	31.10	-	33.40	-	0.098
Northeast	19.40	-	19.00	-	21.00	-	0.089
South	34.30	-	34.90	-	32.2	-	0.068
Year							
2000 (%)	3.90	-	3.90	-	3.90	-	0.958
2001 (%)	6.60	-	6.60	-	6.60	-	0.996
2002 (%)	9.00	-	9.00	-	9.00	-	0.975
2003 (%)	10.80	-	10.80	-	10.90	-	0.924
2004 (%)	12.70	-	12.70	-	12.60	-	0.913
2005 (%)	13.90	-	14.00	-	13.90	-	0.984
2006 (%)	13.40	-	13.40	-	13.30	-	0.949
2007 (%)	10.70	-	10.70	-	10.70	-	0.983
2008 (%)	8.20	-	8.20	-	8.30	-	0.853
2009 (%)	6.40	-	6.40	-	6.30	-	0.920
2010 (%)	4.40	-	4.40	-	4.50	-	0.861

*Adjusted for 2010 dollars according to the Consumer Price Index.

Table 6. Difference-in-difference regression with hospital fixed effects

Dependent Variable	ln(Reimbursement)		Hospital Market Share (%)	
	Coefficient	Robust SEs	Coefficient	Robust SEs
Hospital Intervention				
Magnet Recognition Hospital[a, f]	-	-	-	-
Magnet Recognition Hospital Status				
Implementation[b]	–0.011	0.0059	–0.18*	0.083
Post-test[b]	–0.010	0.0088	–0.24	0.14
Magnet Recognition*Implementation	0.0037	0.010	0.31	0.17
Magnet Recognition*Post-test	0.017	0.011	0.21	0.22
Hospital Characteristics				
Hospital Size[f]	-	-	-	-
System affiliation	–0.0084	0.0074	–0.031	0.099
Medicare Payer Mix	0.0020	0.0012	0.058**	0.016
Medicaid Payer Mix	–0.00018	0.00084	–0.0051	0.011
Not-for-profit hospital[e]	0.046	0.038	–0.0042	0.22
For-profit hospital[e]	0.11*	0.052	0.36	0.50
Teaching Affiliation	–0.033*	0.013	0.48	0.40
Market Characteristics				
Population (1,000s)	0.000021	0.000075	0.00053	0.00079
Population Density	0.00023	0.00044	–0.018**	0.0061
Percent of Population 65 and over	0.0295	0.0168	–0.70*	0.29
Income	0.0000012	0.0000023	–0.000053	0.000052
Unemployment Rate	0.00020	0.0037	–0.11	0.077
Poverty Rate	0.00017	0.0024	0.025	0.073
Distance from Residence to hospital	–0.0025	0.0026	–0.099	0.056
Hospital competition	0.0027	0.0025	–0.13**	0.032
Region				

Dependent Variable	ln(Reimbursement)		Hospital Market Share (%)	
	Coefficient	Robust SEs	Coefficient	Robust SEs
Northeast[d, f]	-	-	-	-
Midwest[d, f]	-	-	-	-
South[d, f]	-	-	-	-
Time				
Year 2001[c]	–0.0091	0.012	0.27*	0.13
Year 2002[c]	0.0039	0.015	0.55*	0.25
Year 2003[c]	0.021	0.017	0.71*	0.32
Year 2004[c]	0.026	0.020	1.03*	0.41
Year 2005[c]	0.025	0.022	1.13*	0.51
Year 2006[c]	0.028	0.027	1.41*	0.64
Year 2007[c]	0.027	0.031	1.84*	0.73
Year 2008[c]	0.0015	0.037	2.65**	0.87
Year 2009[c]	0.020	0.044	3.31**	0.97
Year 2010[c]	0.038	0.049	3.81**	1.08
Constant	7.30**	0.34	39.48**	6.37
Number of Hospital Year Observations	6,154		6,428	
Number of Hospitals	1,098		1,136	
F Statistic	(28, 1,097) = 3.72 p = 0.000		(28, 1,135)=2.38 p = 0.000	

[a]Reference is control hospitals; [b]Reference is the pre-test period; [c]Reference is year 2000; [d]Reference is west; [e]Reference is government hospitals; [f]Time invariant variables.
*Statistically significant at the 5% level. **Statistically significant at the 1% level.
Fixed effects are at the hospital level.

Discussion

Hospitals are motivated to pursue MR for a variety of reasons. These reasons include, but are not limited to, distinguishing themselves in the market place[81], increasing market share[15, 18, 31] and negotiating better reimbursement rates with payers[32], such as managed care organizations[32], all reasons which may result in potential increases in revenues.[136] This relationship is rationalized through the reputation effect of MR, which is proposed to be a marker of distinction. The designation provides an opportunity to promote the institution's success and it signals to the public that it is recognized as a place to receive high quality care.[16, 61, 62] In addition, the designation acknowledges that nursing services make a positive contribution to patient outcomes[91] thus attracting patients and increasing reimbursement rates, correspondingly increasing hospital market share and hospital reimbursement.

This study measured the effect of the MR signal on both hospital reimbursement and hospital market share. In contrast to findings from previous descriptive studies, the empirical results from this analysis indicate that the MR signal does not have an effect on either hospital reimbursement or hospital market share.[32] Increases in patient volume, which increases hospital market share, is influenced by various intermediate factors, such as employers, insurers, managed care organizations, and referring physicians.[189] All of these factors may override the overall effect of the MR signal on hospital market share. In terms of hospital reimbursement, the major payers include both the government and private health insurers. Government payers reimburse hospitals using prospective payment systems and may be less responsive to adjusting reimbursement rates for MR hospitals; whereas private health insurers and managed care organizations may be more agreeable to negotiating reimbursement rates with these hospitals. Positive adjustments in reimbursement rates may encourage and reward the focus on quality

service delivery and reduction in redundancies of service provision. Any potential increases in reimbursement rates by private health insurers may be diminished by limited increases or reductions in reimbursement by government payers.

In terms of hospital ownership, for-profit hospitals appear to receive higher reimbursement rates compared to government hospitals. This may reflect a greater focus by for-profit hospitals on well-insured patients or relatively profitable medical services.[190] On the contrary, teaching affiliation was found to be negatively associated with reimbursement rates. This result is consistent with previous studies that showed teaching hospitals have patients with more complex health problems requiring both more intensive care and longer inpatient stays that results in a lower reimbursement per patient day compared to non-teaching hospitals.[191]

Medicare payer mix was determined to be positively associated with hospital market share. An increase in Medicare inpatient days is likely attributed to an increase in the volume of Medicare patients, which may be attributed to population served by the hospital. Population density, hospital market penetration and the percent of population 65 and over are all negatively associated with hospital market share. The negative relationship with population density and hospital competition can be explained by the fact that an increase in the population of an area increases the number of firms (hospitals) in the area, leading to a reduction in the hospital market share.[192] The negative relationship between the percent of the population 65 and over on market share is unexpected. The negative effect of the percent of population 65 and over on market share may be attributed either to a reduction in accessing care from the hospital and accessing care from other sources such as home care.[193]

Implications

Hospital Market Share

Market share is an indicator used by firms to measure their ability to attract customers and their success in the market area. Hospitals publicize their MR designation to raise awareness and to market themselves to patients, nurses and the community.[60] Hospitals promote their MR using full page newspaper advertisements, billboards, websites and television spots.[99] The various forms of advertisement provide an opportunity to promote MR and communicate to the public that the hospital is recognized as a place to receive high quality care[16, 61, 62] and that nursing services make positive contributions to patient outcomes.[91] Hospitals incur enormous costs in the promotion of the MR. One organization estimated spending $100,000 on educational and celebratory events, promotional items, and graphic design supports for their communications campaign.[32]

Despite the use of costly advertisements and promotional materials, the study results indicate that the MR signal does not appear to have an effect on hospital market share. This may have numerous implications for both the MR program and hospitals. From the perspective of the MR program, both the validity and interpretability of the MR signal by may be debateable; specifically in-terms of the signal's ability to attract patients and improve reimbursement. The MR signal may either not be signalling "nursing excellence and the provider of quality patient care[12]" as previously considered or the MR signal may not be interpreted as "superior hospital performance and the delivery of quality health care services[18]" by payers, patients and providers. The ambiguity of the MR signal may have undesirable consequences for the MR program in-terms of promoting the designation as a mechanism to increase hospital market share.

These results may also prompt hospital CFOs and CEOs to re-evaluate the resources allocated to the promotion and advertising of MR. Furthermore, the marketing strategy used

when promoting the MR signal may need to be reviewed and perhaps revised. While MR has been associated with various positive benefits for patients, nurses and the organization, these benefits may not be carried in the MR signal. There may be weaknesses in the MR signal that may explain the study results. For instance, these benefits may not be in the message carried by the MR signal. Although MR hospitals are acknowledged as centers of nursing excellence and the gold standard for nursing care, these accolades and honours may not be communicated by the MR signal. The MR signal may also not be interpreted by the stakeholders. Patients and providers may either not associate quality care or nursing excellence with the MR designation or understand the importance of nursing services to the delivery of quality patient care. Lastly, the MR signal may not be eliciting the expected response to the signal. While the MR signal may be recognized and interpreted, patients, payers and providers may not be responding for various reasons. These reasons may include a lack of urgency to respond and limited control in decision making for a hospital visit. Despite recognizing the MR signal, the individual may not respond immediately due to the lack of urgency, i.e. he or she does not need to go to the hospital at that moment. However, in the case of an emergency, when a patient does need to visit a hospital, the patient will have limited decision making control; the decision will be determined either by the physician, the paramedics or the location of the nearest facility that meets the needs of the patient and the provider.

Hospital Reimbursement

Hospitals and payers try to negotiate reimbursement rates that are fair to both parties. In order to gain leverage when negotiating reimbursement rates, hospitals often use quality metrics that demonstrate that the hospital is achieving high quality standards. Quality metrics emphasize

the hospital's commitment to quality management and may even give hospitals an added advantage in negotiations.[194] MR hospitals are recognized for their commitment to nursing excellence and quality patient care [17] and a growing body of evidence confirms the positive organizational, nursing and patient benefits associated with Magnet Recognition.[83, 84]

Regardless of the many positive outcomes for nurses, patients and organizations associated with MR[28] and the emphasis on quality and safety in patient care[38], this study indicates that the MR signal does not have an effect on hospital reimbursement. From the perspective of hospitals, the CFOs and CEOS may not be leveraging the MR signal as a means to highlight their quality accomplishments to negotiate better reimbursement rates from the payers.

However, from the payers' perspective, payers may be unaware that MR signals hospitals that are classified as the gold standard because of their emphasis on quality and excellence in nursing care[195 90, 196] and may not respond to the signal as predicted. With an increase in the number of hospitals with MR or an increase in other signals used by hospitals, the MR signal may lose its distinctiveness and become weakened in the presence of other signals. In this case hospitals are no longer able to differentiate themselves as centers of excellence in nursing care. On the contrary, payers may recognize and correctly interpret the MR signal, but may not consider the information communicated by the signal as important or as valued as other quality signals utilized by hospitals.

Limitations

There are a few limitations associated with this study. Primarily, there are a number of variables of interest that were not included in the analysis due to inaccessibility of the data or inability to measure specific variables, potentially resulting in biased parameter estimates in the proposed empirical analysis. For example, the scope of services provided has been found to be

strongly associated with likelihood of pursuing Magnet designation [197], but is not available in the existing data set. In addition, the existence of other process management techniques, hospital's management style, and measures of organizational culture are unobservable but could affect how a hospital is managed both financially and operationally. However, the use of fixed effects regression was intended to control for variables such as these and all other unmeasured fixed hospital characteristics, which may be time invariant.

Although the analysis attempted to match MR hospitals to never MR hospitals, no two hospitals are similar in all respects. Propensity scores only control for observed variables and do not consider the effect of unobserved variables[163] in the decision of hospitals to seek MR. For example, a hospital may seek MR if other quality measures are decreasing. This non-random decision to seek MR can thus result in biased parameter estimates of the likelihood of MR.

Although the ANCC website lists the current MR designated hospitals, it does not provide information on hospitals that applied for MR but were unsuccessful, hospitals that are currently undergoing the transformation to become MR recognized, or hospitals that had their MR status rescinded due to non-compliance with the program's requirements.

Conclusion

MR is not intended to improve hospital reimbursement or hospital market share. However, the MR signal is promoted as a means to inform payers, patients and providers about the hospital's commitment to quality and patient care, consequently leading to increases in market share and increases in reimbursement. However, the results from this study indicate that the MR signal has no effect on either of these outcomes. Possible explanations may include the strength of the MR signal, the message carried by the MR signal, the interpretation of the

message in the MR signal, and the response or action after receiving the MR signal. All of these intermediate components that determine a signal's effectiveness may have contributed to the results found in this study.

The pursuit of MR is an important organizational decision resulting in substantial modifications to the structure of organizations and requires considerable investment of time and resources, initially and ongoing as the process continues. Knowledge of the limited benefit of the MR signal on hospital reimbursement and hospital market share may cause CEOs and CFOs of MR hospitals to re-evaluate the advertising and marketing resources dedicated to promoting and signaling the designation to patients, providers and payers. Resources may be re-allocated to other pathways that are positively impacted by the MR signal.

CHAPTER 5: COST EFFICIENCY OF MAGNET RECOGNIZED HOSPITALS: A STOCHASTIC FRONTIER APPROACH

Overview

This study examines the impact of the Magnet Recognition (MR) signal on hospital cost inefficiency during the period 2000 to 2010. The panel design includes 1,020 hospitals. The primary sources of data are the American Hospital Association's Annual Survey of Hospitals, Medicare Cost Reports, the Area Resource File, and the American Nurses Credentialing Center. Hospital cost inefficiency is estimated using a regression technique called stochastic frontier analysis. The results indicate that overall mean estimated cost inefficiency is lower for MR hospitals (12.12%) when compared to never MR (15.46%) and cost inefficiency decreased over the study period. A decrease in cost inefficiency is associated with system affiliation and an increase in cost inefficiency is associated with for-profit ownership and unemployment rate.

Introduction

Efficiency can be defined as the relationship between inputs and outputs.[150] In a perfectly competitive environment, firms operating inefficiently should go out of business in the long run, however this is not the case for hospitals. Market imperfections permit inefficient hospitals to survive and continue operations.[198] When resources are combined inefficiently, the firm incurs increased costs.[199] However, applying the concept of efficiency to hospital care is not straightforward, because neither the outputs produced nor the quality of care is uniform

across hospitals.[200] In other words, hospitals in the U.S. are described as inefficient because of the high costs and less-than average outcomes.[152]

It is assumed that hospitals select a set of inputs that will minimize costs of production given a certain level of output. The production process, described by the production function, converts inputs, such as medical and non-medical personnel, buildings, and equipment, into a given level of output, such as the number of discharges and outpatient visits. However, previous research has indicated that, on average, hospitals do not achieve minimum costs, which implies the presence of inefficiency in the production process. Due to the highly decentralized nature of hospitals, with multiple specialized departments within each hospital, the presence of inefficiencies is not unexpected.[198]

Hospitals are being exposed to various approaches to increase the focus on improving efficiency. Health plans are using provider efficiency ratings in network selection, pay-for-performance programs, or steering patients toward efficient providers through lower copayments and/or public reporting.[201] One of the major goals of Medicare's Prospective Payment System (PPS), which pays hospitals a fixed rate per case, is to promote efficiency by rewarding hospitals that are able to keep their costs below the PPS rates, and penalizing those that are not.[200] The Medicare Payment Advisory Commission has advocated using efficiency measurements to improve value in the Medicare program.[202] In a time when resources are limited, improving efficiency is important as this allows more services to be produced from a constant level of resources without compromising quality.

The MR Program is an option proposed to improve efficiency in hospitals. MR is a quality designation awarded to hospitals by the ANCC for demonstrating commitment to high standards in the delivery of nursing care and support for nursing practice throughout the

organization.[18, 19] MR is proposed to be a marker of distinction and a signal of superior performance.[18] Signals, such as MR, have been utilized by both healthcare and non-healthcare corporations to communicate unobservable information to stakeholders. Hospitals use signals to distinguish themselves from other facilities and to attract patients and providers.[56]

The MR signal has been associated with the promotion of excellence in nursing care[86] and professional nursing practice[131], a philosophy of evidence-based practice[114], emphasis on collaboration and team work[34, 35], and creation of a positive culture and work environment.[33] Designated hospitals are recognized as centers of nursing excellence[86], which signals to consumers and to health care providers about the quality of care which they can expect to receive or provide in a MR hospital.[13-15] Providers, such as nurses and physicians, are expected to interpret the MR signal and respond by seeking or maintaining employment in designated hospitals resulting in reduced nursing turnover, reduced recruitment[118, 132] and orientation costs[38], reduced usage of agency nurses[38] and increased provider satisfaction.[33, 60] These positive labour outcomes have been associated with cost savings and efficiency.[15, 133]

A large amount of literature has been published on MR hospitals. Research has identified that MR is related to positive outcomes, not only for nursing staff, but also for health care organizations and patients.[24, 25] MR has also been postulated to improve efficiency by creating a hospital work environment that is professionally stimulating and rewarding for nurses[131], which promotes nurse autonomy and gives nurses greater control over their work[15], thereby also improving retention and decreasing turnover of nurses.[118, 132] Improvements in hospital efficiency may be due to increasing productivity[38] and reducing costs through nurse autonomy[33], promotion of innovation[131] and discovery of quality improvements[13], and the delivery of evidence based care.[127, 129] The combination of all these outcomes will result in an increase in

efficiency. Despite these claims, there is no research literature on the influence of the MR signal on hospital cost inefficiency.

The popularity of the designation has motivated research on the effects of the MR signal on hospital financial performance and efficiency. With respect to efficiency, a number of researchers have suggested that the MR signal reduces inefficiency in hospitals by promoting a culture of collaboration, innovation and evidence based practice[114] resulting in the delivery of both cost effective care[15, 133] and quality patient care.[12]

This study uses stochastic frontier analysis (SFA) to investigate the effect of the MR signal on hospital inefficiency, controlling for various hospital and market factors. Since the availability of financial resources is limited, there is an increased focus on reducing inefficiency.[176] The results from this study will determine the relationship between the MR signal and hospital cost inefficiency, along with identifying the impact of internal factors and external pressures on cost inefficiency.

The effect of the MR signal on hospital cost inefficiency is important from a managerial, nursing profession and policy perspective. Hospital managers are worried about reducing inefficiency and improving overall financial performance. The results of this study can be used to decide whether or not pursuing MR is a potential option in light of the current fiscally constrained environment. Hospital managers are also dealing with a nursing shortage, which affects both hospital operations and the quality of services provided.[72] MR may be a potential solution to deal with the nursing shortage. MR has been hypothesized to give hospitals an advantage in terms of recruiting and retaining nurses[83] by signalling their dedication to a professional practice environment where nursing is valued and considered indispensable to the overall success of an organization.[115] In turn, nurses may view the MR signal as an indicator of a

hospital that is dedicated to nursing excellence and values the contribution of the nursing profession to hospital operations and the delivery of patient care. Nurses may consider MR a condition of future or continued employment with a hospital.

Policy makers and payers are interested in controlling the costs of health care without reducing access and compromising quality. The current focus is on restructuring reimbursement methods to incentivize providers to focus on reducing costs and enhancing quality patient care. The results from this study may provide another opportunity by which cost inefficiency may be reduced. MR may be considered as a potential solution for healthcare organizations to consider as they restructure and transition to a value based health care delivery system.

Using Stochastic Frontier Analysis to Measure Hospital Cost Inefficiency

Earlier studies that focused on determining hospital inefficiency focused on costs as an indirect measure of cost inefficiency. The assumption in these studies was efficiency must be increasing if costs are decreasing (or being contained). Unfortunately this assumption may not hold true. Cost containment can occur as a result from either decreases in inefficiency or decreases in the number of services and/or the quality of services or even perhaps from changing the product mix from more expensive to less expensive outputs.[153] Due to this limitation, various other methods were employed to obtain a direct measure of hospital inefficiency, such as ratio analysis or ordinary lease squares regression. These methods were also found to have a number of weaknesses. For instance, ratio analysis relies on arbitrary inefficiency criteria and ordinary least squares regression results in biased parameter estimates.[203] Frontier techniques were developed to overcome these weaknesses. Frontier methods, which include both SFA and Data Envelop Analysis, determine the best practice frontier and measure inefficiency as the distance between actual firm performance and a best practice frontier.[150, 153]

SFA is a common method used to estimate cost inefficiency in hospitals. In previous research, SFA has been applied to estimate cost inefficiency of Critical Access Hospitals[173], teaching hospitals[155], hospitals that are part of a network or members in a system[151, 176] and hospitals that are associated with health maintenance organizations.[152] SFA has also been applied to study cost inefficiency in non-healthcare industries such as the container port industry[204], airport industry[205], and banking industry.[206]

This is the first SFA-based study to examine the impact of the MR signal on hospital cost inefficiency. SFA is parametric technique which can be used to estimate the cost inefficiency of an organization by comparing actual performance with an estimated or theoretical best practice frontier. Intuitively, SFA creates a theoretical best practice frontier using actual hospital data and measures a hospital's inefficiency as the distance from the hospital's actual performance to the frontier.[150] The cost inefficiency of a hospital is defined as the ratio of observed total costs to the best practice, stochastic frontier total costs. The best practice frontier is defined by the value that total costs would be if full efficiency were attained.[169, 203]

SFA is based on the assumption that departures from the cost frontier can be decomposed into stochastic and deterministic factors.[172] The former represents random error and the latter represents inefficiency. The estimation of hospital cost inefficiency requires technical assumptions about the structure of costs and about the statistical distribution of the error term representing inefficiency.[173, 174] The application of SFA to panel data has been suggested to less likely yield biased estimates of the coefficients due to omitted variables and because panel models require fewer distributional assumptions about deterministic error.[152, 175]

Methods

Data Sources

This study is based on panel data for urban hospitals for the period 2000 to 2010 (T = 11). The random effects frontier model used in this study can incorporate an unbalanced panel design.[182] The individual hospital constitutes the level of analysis. The market area is defined as the county, which is frequently used in hospital studies.[152]

The hospital data for this analysis is obtained from Medicare's Hospital Cost Report Information System (HCRIS), the American Hospital Association's (AHA) Annual Survey of Hospitals, the Area Resource File (ARF) and the American Nurses Credentialing Center (ANCC) website. The four data sets are merged using both a year and hospital identifier.

Propensity score analysis was used on a larger sample of hospitals to match MR hospitals to never MR hospitals as a correction procedure for selection bias. Matched hospitals in the base year (2000) remained matched during the remaining study period (2001 to 2010). The resulting hospital sample contained MR hospitals (the treatment group) and never MR hospitals as the comparison group. After eliminating hospitals with incomplete data and implausible values, the final sample contained 1,020 hospitals (5,491 hospital year observations) for the period 2000 to 2010.

Research Design

The analysis utilized in this research study assumes that costs are determined as follows:

$$TC_{it} = f(Y_{it}, W_{it}) + e_{it} \qquad Eq\ (1)$$

where *TC* represents total costs; *Y* is a vector of outputs; *W* is a vector of input prices; and *e* is the error term, which can be decomposed as follows:

$$e_{it} = v_{it} + u_{it} \qquad Eq\ (2)$$

where *v* is statistical noise (i.e. assumed to be distributed as N(0, σ^2)) and *u* consists of positive departures from the cost frontier and represents cost inefficiency (i.e. the percentage by which observed costs exceed minimum costs predicted for a given level of output and input prices) for which a distribution must also be assumed.[186] Frequently, *u* is assumed to follow a half-normal distribution and is always nonnegative (i.e. assumed to be distributed as $N^{+}(0, \sigma^2)$)[207]; however there is no theoretical reason for the selection of this or other distributional forms.[177] The use of a general distribution, such as a truncated normal distribution is recommended as an alternative.[180] According to the literature, the various assumptions about the distribution of *u* appear to have little impact on estimated inefficiencies.[152] The observations are indexed by a hospital index *i*=1,2,…*n* and a time index *t*=1, 2,…,*T*.

Model Specifications

SFA requires the specification of functional form for the cost equation. Common functional forms used in the empirical research have been translog and Cobb-Douglas cost functions. The translog form is preferred because of the increased flexibility; however this requires the inclusion of an increased number of parameters to estimate and may result in multicollinearity problems.[179]

The general form of the translog cost model is used to estimate the stochastic frontier, which is stated as the following:

$$\ln TC_{it} = \alpha_0 + \sum_{j=1}^{J} \alpha_j \ln Y_{jit} + \sum_{k=1}^{K} \beta_k \ln W_{kit} + \frac{1}{2}\sum_{j=1}^{J}\sum_{l=1}^{J} \delta_{jl} \ln Y_{jit} \ln Y_{lit} + \frac{1}{2}\sum_{k=1}^{K}\sum_{m=1}^{K} \gamma_{km} \ln W_{kit} \ln W_{mit} + \sum_{j=1}^{J}\sum_{k=1}^{K} \rho_{ij} \ln Y_{jit} W_{kit} + \sum_{n=1}^{N} \theta_n CM_{nit} + \varphi Year_{it} + v_{it} + u_{it} \qquad Eq\ (3)$$

Where TC = Total expenses; *Y* = outputs; *W* = input prices; *CM* = outpatient case-mix adjusters influencing quality of care; *Year* is a time-trend variable; and v_{it} and u_{it} are variables previously described.

A time-varying model proposed by Battese and Coelli is used to estimate hospital specific inefficiency.[180] In this model the inefficiency-effects are defined by:

$$u_{it} = \delta Z_{it} + w_{it}, \quad u_{it} \geq 0. \qquad Eq\ (4)$$

where Z_{it} is a vector of explanatory variables associated with the inefficiency-effects; δ is a vector of unknown parameters to be estimated; and W_{it} are unobservable random variables, assumed to be independently distributed, obtained by truncation of the normal distribution with mean zero and unknown variance, σ^2.[150]

In addition to providing estimates of cost inefficiency, this model permits an estimation of the impact of both firm specific and environmental factors on cost inefficiency.[181] By

including time in the *Z* vector with other firm-specific variables, inefficiency can differ by firm and by time.

The parameters of the cost frontier are simultaneously estimated by a maximum likelihood method using the FRONTIER 4.1 program, which uses a random effects regression technique.[182] A limitation the random effects model is that the effects must be assumed to be uncorrelated with the regressors.[174] Fixed effects is an alternative to this model; however this model cannot be used in a data set that has variables that are invariant over time.[183] This model estimates inefficiency and the parameters of the inefficiency-effects variables simultaneously (one-stage method). Inefficiency-estimates can also be obtained using a two-stage estimation procedure, where the inefficiency-estimates from the first stage are regressed against inefficiency-effects variables in a second stage. The two-stage estimation procedure has been found to provide parameter estimates of the inefficiency-effect variables that are more inefficient or biased than those from the one-stage method.[176, 182]

The cost inefficiency of the *i*th hospital in the *t*th year (where t ranges from 1 in 2000 to 11 in 2010) is defined as the ratio of the stochastic frontier total costs to observed total costs. The stochastic total cost frontier is defined by the value total costs would be if u_{it} (i.e., the cost inefficiency effect) was zero (i.e., full efficiency). Therefore

$$CE_{it} = exp(-u_{it}) \qquad Eq\ (5)$$

where CE_{it} = cost efficiency and u_{it} was defined previously.

This indicates that cost efficiency is no greater than 1 and the reciprocal of this quantity, $\exp(u_{it})$ is no less than one. The amount by which $\exp(u_{it})$ exceeds one is a measure of cost inefficiency.[152, 155]

Cost Function Variables

For the specification of the stochastic frontier cost function, the approach by Rosko (2011) is followed.[150] First, the assumption of linear homogeneity in input prices is imposed by normalizing the cost equation by the price of labour. Therefore the dependent variable is the logarithm of (total expenses/the price of labour.) The continuous output and input price variables are also in natural log form. The output and input price variables are all entered directly and as squared and cross-product terms. These variables are assumed to influence the cost of transforming resources into services.[177] Descriptive statistics of the variables used in the study are presented in Table 7.

Two inputs, capital and labour, are included in the cost function model. The use of financial inputs determine whether the total cost of labour, supplies and capital can be reduced through more efficient production or substitution of less costly inputs.[201] The price of labour is calculated by the average annual salary per full-time-equivalent employee and the price of capital is calculated by the depreciation and interest expense per bed.

Hospital outputs are considered to be exogenous, an assumption that is common to hospital cost studies.[154] Outpatient visits and inpatient days are included as outputs in the cost function. [152]

Teaching hospital is a structural measure of quality. These hospitals produce different outputs than non-teaching hospitals (i.e. medical education)[153] and are more costly than non-teaching hospitals.[154] Teaching hospitals focus on training medical students and consume more inputs such as instructors, classroom space, diagnostic tests and state of the art technology.[154] Teaching hospitals also attract sicker patients who require more resources because of the education value this provides to the students. [152, 154, 155] According to Rosko (2007), the quality

of patient care tends to be higher in teaching than in nonteaching hospitals.[153] Teaching hospital status is included in the model as a binary variable.

Since hospital outputs are heterogeneous, it is important to control for variations in case mix. Consequently the ratio of outpatient surgeries to total outpatient visits and the ratio of Emergency Department Visits/Outpatient Visits are used to control for variations in outpatient case mix. Research indicates that patients who require surgery and patients seen in the emergency department tend to be a more resource intensive group of outpatients.[155] In order to control for heterogeneity in inpatient output, Medicare Case Mix Index is included in the analysis since patients with different diagnoses have different resource requirements.[173] Time trend is also included, which is recommended as a proxy for improvements in medical and organizational technology.[177] Therefore, this variable measures whether hospitals have been adopting a more expensive technology over time.

Inefficiency Effects Variables

Variables that are proposed to influence inefficiency are also included in the SFA model. These variables influence the cost inefficiency with which resources are transformed into services.[177] The estimated coefficients provide an indication of the association between the internal hospital environment and the external pressures on cost inefficiency.

To assess the impact of the MR signal on hospital efficiency, a vector of binary variables representing MR, the three phases of the study and interaction effects are included in the regression. The *Magnet Recognition Designation* variable is a binary variable, which identifies hospitals as either MR or never MR. The *Hospital Magnet Recognition Status* variable, also a binary variable, identifies the hospital status during the 2000 to 2010 time period. A hospital's status can be categorized as either *pre-test period*, *implementation period* or *post-test period*.

The primary variable of interest is the interaction between MR and Post-test (Magnet Recognition*Post-test). This variable measures the change in cost inefficiency for MR hospitals compared to the never-MR hospitals.

Hospital reimbursement impacts profits and creates incentives for hospitals to become more efficient. Two variables, *Medicare share* and *Medicaid share* of total inpatient days are used to represent a hospital's payer mix and the regulatory pressures of public payers. Medicare and Medicaid are federal and state payers, and both contribute to a large proportion of hospital revenues. Hospitals face the prospect of providing predominantly unprofitable medical care to patients covered by Medicare or Medicaid.[208] According to Cleverly and Harvey (1992) (as cited in Trussel, 2010), it is unlikely that Medicare reimbursements cover the full costs of treating patients.[146] It is postulated that Medicare's prospective payment system impairs the financial health of hospitals because the reimbursements fail to cover the hospital's actual costs of patient care.[146] Both Medicare and Medicaid increase the financial risk of the hospitals, leading hospitals to become more financially prudent and cost conscience; therefore both Medicare and Medicaid shares should be inversely related to cost inefficiency. Since Medicaid reimbursement rates are lower than Medicare rates, it is expected that *Medicaid share* will have a larger effect on inefficiency than *Medicare share*.[152]

The *Herfindahl-Hirschman Index* (HHI) is a measure of industry concentration in a market area. For hospitals, it is a measure of the distribution of discharges in a hospital's market area. The HHI is calculated by summing the squares of the market shares of discharges for all of the hospitals in the county. A value of 1 is indicative of a monopolistic market and measures close to 0 is indicative of a highly competitive environment. As the number of hospitals increase in a market area, the competition among hospitals also increases.[155] As a result, hospitals have

an incentive to increase efficiency. Therefore it is expected that as HHI decreases, hospital efficiency should increase.[152]

System affiliation indicates whether a hospital is owned by a larger system. Such affiliations have been found to result in increased efficiency, lower risk, better financial outcomes, seamless care, greater control over referrals, greater economies of scale[146, 147], and the elimination of duplicative administrative functions.[176] A hospital's *Ownership* status influences the emphasis placed on earning profits. Compared to not-for-profit hospitals, for-profit hospitals focus on earning profits, increasing shareholder wealth and reducing inefficiency.[154, 209] To represent ownership form, a binary variable is used, 1 for for-profit hospitals and 0 otherwise.[152]

Uncompensated care increases the financial risk of hospitals and leads hospitals to focus efforts to recoup costs and reduce inefficiency. Since a measure of the amount of uncompensated care provided by hospitals is not available, unemployment rate is used as a proxy measure in the regression. *Unemployment rate* has been found to be correlated with the percentage of population without insurance since most health insurance coverage is obtained from the place of employment.[210] Shifts in the cost frontier are measured using a time trend variable equal to 1 in 2000, 2 in 2001 up to 11 in 2011, which measures the impact of the cost changes in technology over time.[177] Table 7 presents the definitions and descriptive statistics of variables used in the stochastic frontier regression equation.

Model Selection and Specification

In order to estimate a stochastic frontier cost model, a number of null hypotheses are tested to select the specification that best fits the model. The final model is not directed by theory, but based on the results of various restriction tests. Table 8 presents the results of hypotheses tests that examine a number of restrictions.

Hypothesis tests are performed using the likelihood-ratio test: $\lambda=-2[\ln[L(H_0)] - \ln[L(H_1)]]$. Where $\ln[L(H_0)]$ and $\ln[L(H_1)]$ are obtained from the log-likelihood function under the null hypothesis (the restrictive model) and the alternative hypothesis (the unrestricted model) respectively and λ is the generalized likelihood statistic. If the null hypothesis is true, λ has a Chi-square distribution with degrees of freedom equal to the difference between the number of parameters estimated under null and alternative hypothesis.[151] If the restriction has minimal impact on the parameter estimates, the value of the log likelihood function will not change much and the null hypothesis will not be rejected. Chi square statistics (or mixed Chi-square) [211]with critical values at the $p < 0.05$ level are used to test the hypotheses.

When attempting to select the preferred model for this analysis the following decisions need to be made: (1) Should an Ordinary Least Squares (OLS) or SFA be used in the estimation? (2) Should a Cobb-Douglas or translog function be used? (3) Should inefficiency-effects variables be included in the model? and (4) What theoretical distribution should the composed error follow, a truncated normal distribution or a half-normal distribution?

First, in order to determine if SFA is a more appropriate estimation technique than OLS regression, the hypothesis, $\gamma = 0$, is tested. Where $\gamma = \sigma_u^2/(\sigma_v^2 + \sigma_u^2)$, σ_u^2 is the measure of inefficiency (i.e. one sided error) and σ_v^2 is statistical noise (i.e. classical random error term). Larger values of γ imply that the variance of the inefficiency effects represents larger proportions of the total variance of the error terms *u* and *v*.[152] Accepting the null hypothesis (H_0: $\gamma = 0$) implies that σ_u^2 is zero; therefore the parameters can be estimated using an OLS regression. The results of the likelihood-ratio tests indicate that the OLS regression is rejected and the SFA is used.

Second, likelihood-ratio tests are applied to determine whether the Cobb-Douglas or the translog function should be used for the analysis. While the translog function is used frequently because of the flexibility it provides, this function requires many independent variables which is a concern for studies with small sample sizes. Therefore, the Cobb-Douglas function may be considered as an alternative option. In the Cobb-Douglas function the parameters of the higher order output and input price variables are restricted to zero. The results of the likelihood-ratio tests indicate that the Cobb-Douglas frontier model is rejected and the translog model is used.[176]

Third, the inclusion of inefficiency effects variables to the model is tested. The null hypothesis that $\delta_1 = \delta_{12} = 0$ is tested.[153, 176] The results support the rejection of the null hypothesis, which implies that the inefficiency variables have a significant impact on cost inefficiency and are therefore included in the model.[176]

Fourth, the theoretical probability distribution of the inefficiency-effects, u_i, must be made. The half-normal distribution has been used frequently; however there is no a priori justification for the use of any specific distribution for the cost inefficiency-effects, u_i. The appropriateness of using the half-normal distribution is tested against the truncated-normal distribution.[176] The results of the likelihood-ratio test indicated that the truncated normal distribution should be used in the analysis. While the mean estimated inefficiency may vary under the different distributions, the relative inefficiency is minimally affected.

The results of the restriction tests support the use of SFA using a translog function, with a composed error that assumes a truncated normal distribution, and the inclusion of inefficiency effects related to internal and external environmental factors.

Table 7. Variable definitions and descriptive statistics

Variable	Description	Mean	Standard Deviation
Total Expenses*	Total expenses / Price of Labour	11.67	0.90
Outpatient Visits*	Outpatient visits	12.09	0.97
Inpatient Days*	Inpatient days	11.01	1.09
Price of Capital*	Depreciation and interest expense per bed	10.59	1.03
Price of Labour*	Annual salary per full-time equivalent employee	7.44	0.31
Emergency Room Visits (%)	(Emergency department visits/outpatient visits)*100	25.94	16.97
Outpatient Surgery (%)	(Outpatient surgery/outpatient visits)*100	5.45	16.97
Medicare Case Mix Index	Medicare Case Mix Index	1.50	0.25
Teaching Affiliation (%)	Binary variable (1,0) for hospitals that are teaching hospitals	61.91	48.56
Efficiency Effects Variables			
Magnet Recognition Hospital (%)	Binary variable (1,0) for Magnet Recognition hospital	19.85	39.89
Pre-test (%)	Binary variable (1,0) for Magnet Recognition status during pre-test period	33.29	47.13
Implementation (%)	Binary variable (1,0) for Magnet Recognition status during implementation period	34.27	47.47
Post-test (%)	Binary variable (1,0) for Magnet Recognition status during post-test period	32..43	46.82
Unemployment Rate	Average unemployment rate in hospital's market area	5.27	1.79
For Profit (%)	Binary variable (1,0) for investor-owned hospitals	4.50	20.73
System Affiliation (%)	Binary variable (1,0) for system affiliation	28.72	45.25
Medicare Share (%)	(Medicare inpatient days/total inpatient days)*100	39.01	14.39
Medicaid Share (%)	(Medicaid inpatient days/total inpatient days)*100	11.02	8.98
Herfindahl-Hirschman Index	Index for concentration of hospital discharges	0.17	0.24

*Indicates transformed by natural logarithm

Table 8. Generalized likelihood-ratio tests of null hypotheses for parameters of the translog stochastic cost frontier model.

Null hypothesis	Test statistic λ	x^2_{95} value	Decision	Implication
H_0: $\gamma = 0$[1]	2,509.07	17.67[2]	Reject	Use SFA instead of OLS.
H_0: $\beta_{ij} = 0$	2,862.24	18.31	Reject	Use the translog model instead of the Cobb-Douglas model.
H_0: $\delta_1 = \delta_{12} = 0$[3]	1,699.27	22.36	Reject	Include inefficiency variables in the model.
H_0: $u = 0$[4]	209.59	3.81	Reject	Use truncated-normal distribution rather than half-normal distribution for residuals.

[1] $\gamma = \sigma_u^2/(\sigma_v^2 + \sigma_u^2)$, where v represents the classical random error and u the inefficiency residual, so larger values of γ indicate that a greater proportion of the regression residuals is due to inefficiency.

[2] The critical value is taken from table 1 of Kodde and Palm[211] because a mixed Chi-square distribution must be used.

[3] $\delta_1 = \delta_{12} = 0$ represents the coefficients estimated for the inefficiency effects variables.

[4] The truncated-normal distribution has a placement parameter, u (estimated as δ_0 in Table 9). The half-normal distribution is a special case in which δ_0 is restricted to 0.

Table 9. Parameter estimates for the frontier cost function.

Variable	Coefficient	t-ratio
Constant	4.944	8.874**
Outpatient Visits	0.775	10.191**
Outpatient Visits Squared	0.032	4.551**
Inpatient Days	–0.649	–11.076**
Inpatient Days Squared	0.160	36.634**
Outpatient Visits x Inpatient Days	–0.130	–12.431**
Price of Capital	1.300	3.347**
Price of Capital Squared	1.197	18.164**
Price of Capital x Outpatient Visits	–0.184	–5.068**
Price of Capital x Inpatient Days	0.255	7.321**
Emergency Room Visits (%)	0.000	0.801
Outpatient Surgery (%)	0.004	17.562**
Medicare Case Mix Index	0.411	22.424**
Teaching Affiliation	0.078	9.708**
Year	0.019	15.434**
Inefficiency effects		
δ_0	–7.576	–50.392**
$\delta_{\text{Magnet Recognition}}$	0.097	1.534
$\delta_{\text{Implementation}}$	0.389	4.324**
$\delta_{\text{Post-test}}$	0.466	4.359**
$\delta_{\text{Magnet Recognition x Implementation}}$	–1.838	–16.144**
$\delta_{\text{Magnet Recognition x Post-test}}$	–1.841	–15.071**
$\delta_{\text{Unemployment Rate (%)}}$	0.034	2.000*
$\delta_{\text{For Profit}}$	0.049	4.755**
$\delta_{\text{System Affiliation}}$	–0.078	–2.408*
$\delta_{\text{Medicare Share (%)}}$	–0.002	–1.053
$\delta_{\text{Medicaid Share (%)}}$	0.014	7.052**
δ_{HHI}	0.492	5.910**
δ_{Year}	–0.009	–3.965**
σ^2	0.893	45.771**
$\gamma = \sigma_u^2/(\sigma_v^2 + \sigma_u^2)$	0.952	618.056**
Log-likelihood	49.36	

*$p < 0.05$
**$p < 0.01$

Table 10. Mean inefficiency estimates for all, MR and never-MR hospitals by time-period.

	All Hospitals			MR Hospitals			Never MR Hospitals		
Time-period	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**
Pre-period	1,828	0.1341	0.0861	358	0.1248	0.0712	1,470	0.1708	0.1225
Implementation	1,882	0.1325	0.1050	372	0.1235	0.0997	1,510	0.1688	0.1173
Post-period	1,781	0.1170	0.0878	360	0.1154	0.0923	1,421	0.1236	0.0653
Total time-period	5,491	0.1278	0.0938	1,090	0.1212	0.0890	4,401	0.1546	0.1073

Results

The parameters of the cost frontier were estimated using the simultaneous maximum likelihood method in the FRONTERI 4.1 program.[182] Table 9 presents the results for parameters estimated by the frontier cost function.

Cost Function Variables

The estimated coefficients for Price of Capital and some of the output variables (or their square or interaction terms) have parameter estimates that were either insignificant or counterintuitive. According to Rosko and Mutter (2010), this should not be unexpected due to the high correlations between the variables.[173] While multicollinearity impacts the reliability of the parameter estimates for the output variables and the Price of Capital[167], it does not introduce a bias in the inefficiency estimates.[180] Since the purpose of this study is not to investigate the cost function parameters, the trans-log cost function is retained.

Both Outpatient Surgery (%) and Medicare Case Mix Index have coefficients that are positive and significant, which is expected. Increases in the proportion of outpatient surgery or increases in Medicare Case Mix Index increase resource utilization and therefore increase costs. As expected, hospitals that are affiliated with teaching institutions are 7.8% more expensive than non-teaching hospitals.

Inefficiency Effects Variables

The primary variable of interest is the interaction between Magnet Recognition and Post-test, which indicates whether MR hospitals are more or less cost efficient than the comparison group of never MR hospitals. The results in Table 9 indicate that the cost-inefficiency estimates are negatively associated with MR in the post-test period. This suggests that compared to never

MR hospitals, MR hospitals are more efficient ($p<0.01$). These results confirm the statements made in the research literature that MR hospitals are more efficient.[15, 131]

The estimated results show a positive and significant coefficient of for-profit ownership, which indicates that for-profit hospitals in the sample are more cost inefficient than not-for profit hospitals ($p<0.01$). The positive coefficient for the Herfindahl-Hirschman Index ($p<0.01$) indicates that there is more cost inefficiency in markets where output is concentrated in fewer hospitals. This result has also been found in a number of other studies.[152, 176] According to Rosko (2001), profit maximizing firms with monopoly power are likely to increase profits by producing less output at higher prices or by changing the product mix to less expensive outputs thereby reducing costs.[152]

A higher unemployment rate is associated with more cost inefficiency which is anticipated ($p<0.05$). The coefficient on Medicaid Share is positive and significant. This finding suggests that Medicaid payment is associated with increased cost inefficiency, which is an unexpected result. System affiliation was associated with reduced cost inefficiency ($p<0.05$), which is consistent with results that this structural feature has operational benefits. Hospitals that are part of a multihospital system may have the ability to provide services at lower costs and greater efficiency by collaborating on service delivery.[151]

The positive coefficient of the time-trend variable in the cost function suggests that all hospitals (i.e. both MR and never MR hospitals) have been adopting more expensive technology. However, the time trend variable in the inefficiency effects variables is negative. This means that inefficiency decreased during the study period.

Estimated Inefficiency

Table 10 presents the mean estimated cost inefficiency by year for all hospitals, MR and never-MR hospitals. The mean estimated cost inefficiency score for the entire sample was 0.1278 or 12.78%, which lies in the ranges of inefficiency estimates found in other studies.[151, 152, 154, 155, 172, 173, 176] The MR hospitals had lower overall cost inefficiency (12.12%) than the never MR hospitals (15.46%). Over the three time periods, the mean cost inefficiency for both groups is declining. The largest decrease in mean inefficiency score occurred from the implementation period to the post-period for both MR and never MR hospitals.

Discussion

This study has provided some interesting results about the relationship between the MR signal and hospital cost inefficiency. While the MR signal has been promoted to increase productivity and reduce hospital costs, this is the first national panel study to investigate the relationship between the MR signal and inefficiency using SFA. The estimated results indicate that MR hospitals have lower cost inefficiency than the comparison group of never-MR hospitals. These findings support the hypothesis of this study and confirm the claims stated in the literature that the MR designation increases efficiency and contributes to cost-effective care.[127, 129]

The purpose of this study is to determine the effect of the MR signal on hospital cost inefficiency. As discussed previously, MR is theorized to signal the promotion of excellence in nursing care[86] and professional nursing practice[131], emphasis on collaboration and team work[34, 35], and creation of a positive culture and work environment.[33] Research has confirmed that a professional practice environment supports nurses to function at the highest scope of clinical practice, to work effectively in an interdisciplinary team of caregivers, and to mobilize resources

quickly.[75] In fact, the evidence suggests that hospitals with a poor working environment are associated with higher costs.[116]

Providers are expected to interpret the MR signal and respond by seeking or maintaining employment in designated hospitals resulting in reduced nursing turnover, reduced recruitment[118, 132] and orientation costs[38], reduced usage of agency nurses[38] and increased provider satisfaction.[33, 60] According to research evidence, MR hospitals result in high levels of nursing work satisfaction, which in turn leads to lower vacancy and turnover rates. One MR facility reported a reduction in nursing turnover from 30% in 2000 to 12% in 2008.[124] Another MR facility reported a decrease in nursing vacancy rates from 19% in 2000 to 5% in the first quarter of 2007.[125] Nurses who work at MR hospital are also more likely to stay than those who work in non-MR hospitals. According to the ANCC, the average length of employment of RNs on staff in a MR hospital is 8.35 years.[126]

This reduction in nursing turnover in MR hospitals is postulated to be linked to an associated savings of $64,000 per nurse.[38] One MR hospital reported a reduction in labour costs of $4 million each year since 2007.[124] These cost savings have been attributed to a reduction in recruitment costs, reduction in orientation costs, and productivity gains.[38] MR has been hypothesized to give hospitals an advantage in terms of recruiting and retaining nurses[83] by creating professional practice environments where nursing is valued. The designation is used as a recruiting tool to attract nurses seeking employment in the best clinical practice settings.[87] MR hospitals are acknowledged as good places to work for all employees, not just nurses.[87]

MR is now also used to recruit other health professionals, such as physicians, pharmacists, and laboratory technicians.[88] New hires have noted that MR is associated with

highly competent and coordinated staff.[81] Furthermore, physician satisfaction scores are higher at MR hospitals compared to non-MR hospitals, which also influences physician recruitment.[110]

It is important to note that in addition to the MR signal, this reduction in cost inefficiency may also be attributed to the operational changes that result due to the implementation of MR program. For instance, cost savings associated with MR have also been rationalized through the delivery of cost effective patient care, such as lower average lengths of stay, use of fewer pharmaceuticals, and fewer tests resulting in a reduction in average patient costs.[15, 133] A research study found that length of stay declined from 4.86 days to 4.73 days in a Magnet Recognized hospital.[128] It has been postulated the improvement in the nurses' work environment, attributed to MR, has been linked to reduction in medical errors and adverse patient outcomes.[23, 116] A study by Lake et al. found that patients in MR hospitals had a 5% lower fall rate after controlling for multiple factors that influence fall risk.[212] Another study in 2007, using National Database on Nursing Quality Indicators data reports fall rates in MR hospitals to be 10.3% lower than the non-MR hospitals. Pressure ulcer rates have also been reported to be lower in MR organizations. A 2008 study reported that patients who had received care for a hip fracture were less likely to develop decubitus ulcer in MR versus non-MR hospitals.[38] These fewer adverse events could lead to reduced use of high-cost intensive care units, which are supposed to increase efficiency and contribute towards cost effective care.[127, 129]

Prior research evidence appears to support the contribution of both the MR signal and operational changes on hospital cost inefficiency. Unfortunately, the results from this study cannot be used to determine between the reductions in cost inefficiency attributed to the MR signal and/or the operational changes from the MR program. However, a recent study by Jayawardhana et al. (2014) found evidence that MR hospitals result in a significant increase in

inpatient costs, a 2.46% increase in inpatient costs on average.[41] These findings indicate that there may be limited costs savings resulting from the delivery of inpatient health care services in MR hospitals. Therefore, perhaps the operational and structural changes due to the implementation of MR and the provision of cost-effective patient care may not be fully responsible for the reduction in hospital cost inefficiency. Instead, a plausible reason for the reduction in hospital cost inefficiency found in this study may be attributed to and associated with the MR signal.

Policy Implications

The results from this study suggest that MR hospitals are more efficient than never-MR hospitals. The reduction in inefficiency may be attributed to either or both the signaling effect of MR or the operational changes in hospitals due to MR. While the MR program is not intended to improve efficiency of hospitals, the study results support the claims of additional benefits related to the designation. This may have numerous implications.

For instance, this may result in an increase in demand for MR by hospitals interested in recruiting and retaining providers, especially nurses. Hospitals are now starting to realize that nursing shortages lead to increasing costs[88], which is attributed to the increased use of agency nurses (who are reimbursed at higher rates), increased overtime of nurses, and many other factors.[85] The financial health of a hospital is in jeopardy if they do not have a strong nursing department and cannot survive as a good health care facility.[99] MR has been hypothesized to give hospitals an advantage in terms of recruiting and retaining nurses[83] by creating professional practice environments where nursing is valued. With the nursing shortage, hospitals may use MR as a potential recruiting strategy to attract highly qualified nurses and other health care providers seeking employment to their organization.[17]

The MR signal may communicate standards and expectations established by hospitals. Such that, when seeking employment, nurses may also be more discriminating when making their selections and may require or only consider MR hospitals as places of employment. This may hinder the ability of non-MR hospitals to attract and retain nurses and other providers to their respective facilities.

There may also be an increase in the demand and appeal for MR by hospitals due to the potential cost savings that may result because of the restructuring and operational changes that take place during the transition to becoming a MR hospital.[213] With the reductions in provider payments that are occurring, government and advocacy agencies may consider promoting MR or components of MR as pathways to not only improve quality, but also to reduce costs and improve efficiency. Thus potentially ensuring the financial viability of the hospital and maintaining access to services by the community.

MR is a costly endeavour for hospitals. In light of these results, CEOs and CFOs will need to carefully contemplate their decisions to pursue MR in terms of the costs and the future cost savings that will result. Hospital managers of MR hospitals should be attentive to the specific changes and restructuring of health care delivery in their hospitals, since certain features may positively influence cost inefficiency.

The analysis of cost inefficiency in hospitals can make a major contribution to improving health services. The current health care system in the U.S. is undergoing major changes to ensure the sustainability of the system. The Patient Protection and Affordable Care Act focuses on increasing access, improving quality and reducing costs. The current payment systems are being restructured to incentivize providers to reduce costs, focus on the delivery of evidence based care, and encourage the delivery high quality care in an efficient manner. Opportunities to

increase revenue generation through reimbursement for hospitals may be limited. In order to continue operations and to be financially viable, hospitals will need to emphasize the delivery of cost effective care, while maintaining high quality.

Limitations

It is important to note that the results presented in this study are estimates of relative cost inefficiency and may differ from true cost inefficiency. SFA measures differences in inefficiency between hospitals in relation to a theoretical best practice frontier.

Despite the inclusion of a number of cost variables, the results may be affected by omitted variable bias or measurement error. While the distribution of the error term may have minimal impact on the estimates of relative cost inefficiency of the hospital sample, it may impact the magnitude of the point estimates.[176] In other words, while the relative inefficiency estimates will remain true, the mean values may change if a different theoretical probability distribution is selected to represent the residual.[177]

A number of efficiency analysis studies using SFA with longitudinal panel data have been conducted using the random effects regression technique.[182] This technique is known to have a few limitations. First, in this model the cost inefficiency error components must be assumed to be uncorrelated with the regressors. A violation of this assumption may lead to inconsistent inefficiency estimates.[152]

An alternative method is the application of a fixed effect regression approach.[183] The fixed effects regression does not require making the assumption that inefficiency is uncorrelated with the regressors and does not require a distribution assumption about the error components.[152] However, this approach will capture the effects of all unobservable variables that vary across hospitals, but are time invariant for each hospital. Furthermore, consistent estimation of

inefficiency requires a large number of observations per hospital. This study used a panel of 6 or fewer observations per hospital which may result in inconsistent estimates. In addition, the fixed effects approach assumes that hospital inefficiency is time invariant, i.e. the change in inefficiency is the same over time for each hospital. This assumption may not hold true if a hospital responds to environmental pressures by increasing efficiency in different amounts.[152, 176] With the availability of a long panel, this assumption may be relaxed by using an approach that allows time-varying inefficiency.[153]

The inclusion of quality variables to the SFA, such as mortality or readmission rate, may be appropriate if quality requires additional resources. For instance, reductions in quality might be falsely attributed to increases in cost inefficiency. In fact, changes in quality might be affected by improvements in processes, as well as, by increases in the number and quality of inputs. Rosko and Mutter (2007) recommend the inclusion of multiple quality outcome measures that capture the multifaceted nature of hospital quality[153] such as patient outcomes and severity of illness.[152] The inclusion of quality variables is constrained by the availability of valid quality measures for a national sample of hospitals. However, several researchers have included quality measures in frontier analysis of health care organizations and have found that these variables had minimal impact on results.[152, 209]

CHAPTER 6: THE EFFECT OF THE MAGNET RECOGNITION SIGNAL ON HOSPITAL FINANCIAL PERFORMANCE.

Overview

This study examines the effect of the MR signal on hospital financial performance. Data from the American Hospital Association Annual Survey, Medicare Hospital Cost Reports, Area Resource File and American Nurses Credential Center are used for the analysis. To control for selection bias, propensity score analysis is applied to match MR hospitals to never MR hospitals. The final study sample includes the matched hospitals. A difference-in-difference model with hospital fixed effects is applied to the matched hospital sample to test the effect of MR signal, while controlling for both hospital and market characteristics. Results indicate that the MR signal improves the financial performance of designated hospitals compared to non-designated hospitals.

Introduction

Signals have an important role in reducing the existence of information asymmetry. Information asymmetry is defined as an imbalance of information between two parties, where one party has more information than another party. This imbalance can result in misinformation and an imbalance of power in transactions. In health care, information asymmetry impairs the ability of hospitals to compete effectively in health care markets[10] because stakeholders are unable to evaluate the quality of health care. This incomplete information influences selection of

hospitals by payers, patients and providers[8], which may negatively influence a hospital's financial viability.

Signals are often used in healthcare to communicate the underlying quality of a hospital's products and services. The information contained in the signal permits stakeholders to make informed decisions and to distinguish between high quality and low quality products. Healthcare providers attempt to communicate the quality of their services to prospective patients and/or employees in a variety of ways.[9] Some communicate directly using public reporting of quality of care information to enable patients to make informed choices about their health care providers.[10] Others communicate indirectly, or signal, unobservable information to consumers by attaining a costly, coveted quality designation, which the consumer can interpret as the firm's commitment of resources to quality management.[58] The quality information conveyed by the signal then leads consumers to update their perceptions[2, 43] about product and service quality.[44]

MR designation is an example of a signal employed by hospitals to communicate their commitment towards health care quality and quality management to patients, providers and payers.[9] MR is a quality designation given by the ANCC to hospitals and long term care facilities[18, 19] to recognize organizations as centers of nursing excellence.[86] Pursuing and sustaining MR requires the commitment of time and the investment of substantial human and financial resources[21, 22] and the designation has gained widespread attention in both research[24, 25] and practice[26] over the past two decades. MR is considered to be a symbol of distinction[11] and has been theorized to signal that the hospital is a center for nursing excellence and the provider of quality patient care[12], which is an important attribute in today's competitive market place.[16, 17] MR signals to patients and to health care providers about the hospital's dedication and commitment to quality patient care.[13-15]

There is growing evidence (empirical and anecdotal) that MR hospitals are associated with positive nursing, patient and organizational outcomes.[24, 25] These outcomes are interrelated and have also been theorized to affect hospital financial performance through signaling the delivery of quality care to consumers, thereby increasing cost savings, revenue, and market share. Despite these claims, there have been no research studies that have empirically evaluated the effect of the MR signal on the financial performance of hospitals. The purpose of this research study is to investigate the effect of the MR signal on hospital financial performance.

This study builds on existing evidence on the effects of signaling unobserved quality in two ways. First, although the effect of signaling on firm financial performance has been widely studied in the corporate setting, there is minimal research focusing on the effect of signaling in hospitals, many of which are not-for-profit.

Second, although there are a large number of studies conducted on MR hospitals that have considered financial performance as an outcome, none has specifically examined the signaling effect of MR. Existing studies are predominantly case studies, single-site evaluations[33] or cross sectional surveys using convenience samples of organizations and staff respondents.[185]

With the increased number of MR hospitals in existence over an extended period of time, it is now possible to design longitudinal research studies that address issues of sample size and omitted variable bias, allowing robust evaluation of the effectiveness of the MR signal. This study uses externally reported administrative and financial information, and employs a robust methodological approach and innovative analytical techniques to evaluate the effect of MR on hospital financial performance.

Research Design and Methods

Research Design

This study applies a pre-post research design to measure the effect of the MR signal on hospital financial performance. The design attempts to control for observable and unobservable factors that will potentially contribute to any difference between the pre-test and post test results by dividing hospitals into two groups. The treatment group includes hospitals that have achieved MR anytime during the study period, and is referred to as MR hospitals. The control hospitals are referred to as "Never-MR hospitals."

Three study periods are used. The *pre-test period* is defined as a minimum of two years when the hospital is not pursuing MR. The *pre-test period* is a baseline before the hospital is considering pursuing MR. The *implementation period* is defined as two years prior to the initial MR designation, when the hospital is preparing for MR. According to the research literature, hospitals pursuing the MR designation require approximately two years to transform and become a MR hospital.[138] The *implementation period* aims to control for any changes in hospital characteristics and outcomes that may occur during the transition to becoming a MR hospital. The *post-test period* is defined as the year of initial MR designation and subsequent years of designation. A minimum of two years post-recognition are required.

Data Sources

The hospital data for this analysis are obtained from Medicare's Hospital Cost Report Information System (HCRIS), the American Hospital Association's (AHA) Annual Survey of Hospitals, the Area Resource File (ARF) and the American Nurses Credentialing Center (ANCC) website.

The four data sets are merged using both a year and a hospital identifier; however the definition of the year variable differs in the various data sets. The HCRIS data set includes hospital year observations organized by fiscal year and the ARF, ANCC and AHA data sets include hospital-year observations organized by calendar year. In order to merge HCRIS data set, a year-end variable is created using the following rule: the fiscal year end date for each hospital-year observation (i.e. 6/30/2000) will be designated as the year-end variable (i.e. 2000) and is matched with the calendar year variable. This will permit the four data sets to be merged. The final merged data set will be used in this analysis.

Study Sample

The study sample is a longitudinal, unbalanced panel of MR and never MR hospitals located in urban areas in the US from 2000 to 2010 (eleven years). The initial data set consists of 3,431 hospitals (31,163 hospitals year observations). Duplicate hospital year observations, hospital year observations with fewer than 330 days in the Medicare cost report period, hospitals with fewer than 8 hospital year observations, hospitals that do not have a hospital year observation at year 2000, and hospitals that received MR before 2004 and after 2009 are excluded from the data set.

In addition, to remain in the final study sample, each MR hospital must have four consecutive years of data prior to MR designation, and a minimum of two consecutive years of data following MR designation, for a maximum of six hospital-year observations. MR hospitals with limited or missing financial data potentially introduce noise and bias the results; therefore, only MR hospitals that have complete data over a minimum of six consecutive years are included. Although this requirement reduces the sample size, the reduction in the eligible hospital-year observations is trivial.

The final sample consists of 23,607 hospital year observations (2,199 hospitals) from 2000 to 2010. This includes 21,072 never MR hospital year observations (1,968 hospitals) and 2,535 MR hospital year observations (231 hospitals).

Propensity score analysis is used to create a study sample of matched MR hospitals and never MR hospitals. Using data from the year 2000, the propensity score analysis predicts the probability that a hospital will ever achieve MR as a function of hospital and market characteristics in 2000. A greedy matching algorithm is used to match MR hospitals to never MR hospitals in the year 2000. Following the recommendation by Guo, a 1 to 4 nearest neighbour matching within a caliper without replacement is used.[163] As suggested by Rosenbaum, the caliper size is set at $0.25\sigma_p$, (where $0.25\sigma_p$ denotes the standard deviation for the estimated propensity scores in the hospital sample).[162] The matches from 2000 serve as the matches for the remainder of the study period.

This results in an unbalanced panel data set of 12,480 hospital year observations (from 2000 to 2010), consisting of 921 never MR hospitals and 231 MR hospitals. Since each hospital should have a maximum of 6 hospital year observations (2 hospital year observations for pre-test, 2 hospital year observations for implementation and 2 hospital year observations for post-test), hospital year observations that are not designated in one of these time periods are excluded from the final data set. The final study sample consists of 6,581 hospital year observations consisting of 921 never MR hospitals and 231 MR hospitals. Standardized differences are used to measure covariate balances between the MR hospitals and the matched never MR hospitals. The post-match standardized differences are <10% for all the covariates. This confirms that balance between the MR and the never MR hospitals has been successfully achieved.

Variables and Measurements

Table 11 is a comprehensive list of variables, measures, definitions and data sources that are utilized in this paper.

Dependent Variables

MR is proposed to improve a hospital's financial performance either through increasing revenue[38] or decreasing expenses.[30] Together or individually, these changes may result in an increase in profitability and therefore have an impact on hospital financial performance. Financial performance is measured using *operating profitability*, *total profitability* and *return on equity*. Operating margin is a measure of profitability[141] and frequently used to assess the financial health of an organization[142] since it is directly affected by changes in either operating revenue or costs. This ratio focuses on core business operations and therefore excludes investment income and other types of revenue and expenses unrelated to operating activities.[143] Total margin is a measure of total profitability and includes income from both operating and non-operating activities.[144] Operating margin and total margin greater than zero indicate profitability (revenues are greater than expenses) and margins less than zero indicate losses (revenues are less than expenses.). Return on equity is another measure of financial performance and it measures the rate of return for each dollar in equity (net assets).[145]

Independent Variables – Main Explanatory Variable

The *Magnet Recognition Designation* variable identifies hospitals as either MR or never MR. The *Hospital Magnet Recognition Status* variable identifies the time period as either *pre-test*, *implementation*, or *post-test* during the six year period over which each hospital is observed.

Independent Variables – Control Variables

Hospital Characteristics

Hospital characteristics are noted to be associated with a hospital's financial health.[157] These characteristics include a hospital's structural factors and processes, which influence hospital operations, marketability and ability to earn revenue.

Hospital characteristics include *hospital size* (measured by total number of beds) which is associated with higher economies of scale and financial expertise, lower per unit costs, and more successful strategic activity.[146, 147] *System affiliation* (determined using the Medicare Cost Report) indicates whether a hospital is owned by a larger system. Such affiliations have been found to result in increased efficiency, lower risk, better financial outcomes, seamless care, greater control over referrals, and greater economies of scale.[146, 147]

Medicare payer mix and *Medicaid payer mix* are calculated as the percentage of total inpatient days attributed to Medicare and Medicaid, respectively. These measures provide an indication of the hospital's patient-mix [146] and the payer-mix.[148] An increased dependence on government payers, such as Medicare and Medicaid, is likely to be associated with lower patient revenue, because these payers typically do not pay the full average cost of care.[146]

Teaching affiliation indicates if a hospital is a teaching hospital or a non-teaching hospital. Teaching hospitals are known to have higher costs than non-teaching hospitals.[155] Teaching affiliation is included as a binary variable in this analysis. *Ownership* indicates for-profit, not-for-profit ownership or government ownership. These variables are included to control for internal pressure for cost reduction associated with ownership.[186] Due to their responsibilities to shareholders, for-profit firms are expected to more aggressively pursue cost reduction strategies than not-for-profit firms. For-profit firms are also unlikely to be interested

in the adoption of innovations that are unproven or may raise costs[39], and as a result, may have higher operating margins than their not-for-profit counterparts.[156]

Market Characteristics

A hospital's operating environment and the market demand for health care services can also influence hospital financial performance.[157] The hospital's market area is defined as the county in which the hospital is located.

The total *population* in the market, the market *population density* and the *percent of the population age 65 and over* describe the demand for hospital services in the market area. The average per capita *income*, *unemployment rate* and *poverty rate* (percentage of families or persons in poverty) measures a community's financial ability to purchase health care services.[158] The likelihood of a resident to bypass a hospital and seek services at another facility is proxied by the average *distance from patient residence to hospital*, calculated as the average distance between the residence ZIP centroid of each Medicare discharge and the hospital.[159] The *hospital market share*, a measure of the amount of hospital competition in the market area, is measured as the hospital's discharges as a percentage of the total discharges in a hospital's market area.[159] *Hospital competition* is measures the number of hospitals physically located in the market area and is a measure of suppliers of health care services.

There is a large variation in the location of MR hospitals. *Region*, captured using U.S. census regions, is included to control for the effect of hospital location on both the likelihood of becoming a MR hospital and the existence of regional differences.[160] Annual unmeasured factors affecting hospital financial performance and market share over time are accounted for using *year* dummies.

Table 11. Listing of variables, measures, definitions and data sources.

Variable	Measure	Type	Data Source
Dependent Variable			
Operating Profitability	Operating Margin (%) = [(Operating Revenues-Operating Costs)/(Operating Revenues)]*100	Continuous	HCRIS
Total Profitability	Total Margin (%) = [(Total Revenues-Total Costs)/(Total Revenues)]*100	Continuous	HCRIS
Reinvestment	Return on Equity (%) = [(Operating Revenues-Operating Costs)/(Equity)]*100	Continuous	HCRIS
Magnet Recognition			
Magnet Recognition Designation	1, Magnet Recognition Hospital; Never Magnet Recognition Hospital (referent)	Binary	ANCC
Hospital Magnet Recognition Status	Pre-Test (referent); Implementation; Post-Test	Binary	ANCC
Hospital Characteristics			
Hospital size	Number of Staffed Beds	Continuous	HCRIS
System Affiliation	System Affiliation; Free Standing (referent)	Binary	HCRIS
Medicare Payer Mix	Medicare Inpatient Days/Total Hospital Inpatient Days	Continuous	HCRIS
Medicaid Payer Mix	Medicaid Inpatient Days/Total Hospital Inpatient Days	Continuous	HCRIS
Teaching Affiliation	Teaching Affiliation; No Teaching Affiliation (referent)	Binary	AHA
Ownership	Not-for-Profit; For-Profit; Government (referent)	Binary	AHA
Market Characteristics			
Population	Total Population in the County (1,000s)	Continuous	ARF

Variable	Measure	Type	Data Source
Population Density	County Population Density (population per square miles)	Continuous	ARF
Percent of the Population 65 and Over	[Total Population Age 65 and Older in Market Area/Total Population in Market Area]*100	Continuous	ARF
Income	Per Capita Income in Market Area (1,000s)	Continuous	ARF
Unemployment Rate	Unemployment Rate in Market Area	Continuous	ARF
Poverty Rate	Percent/proportion of Families or Person in Poverty in Market Area	Continuous	ARF
Distance from Residence to Hospital	Average Distance from Place of Residence to Hospital (miles)	Continuous	ARF
Hospital Market Share	Hospital Discharges/Total Discharges in Market Area	Continuous	ARF
Hospital Competition	The total number of hospitals in the hospital's geographical market.	Continuous	HCRIS
Region	Midwest; Northwest; South; West (referent)	Binary	ARF
Year	2000 (referent); 2001…2010	Binary	ARF

ANCC: American Nurses Credentialing Center, HCRIS: Healthcare Cost Reports Information System, ARF: Area Resource File, AHA: American Hospital Association

Statistical Analysis

Descriptive statistics are used to summarize the data. In order to mitigate the effect of outliers, dependent variables are winsorized at the 1st and 99th percentile. Bivariate analysis is used to test for differences between the subgroup means for MR hospitals versus never MR hospitals. The differences between the group means on each measure are analyzed for direction and statistical significance using t-tests for continuous variables and chi-square test for categorical variables. Statistical significance is set at α=0.05 for all analyses. Correlation analysis is completed to identify potential multicollinearity among the independent variables. The analysis is conducted using Stata 11.1 (College Station, Texas).[166]

Empirical Analysis - Difference-in-Difference Estimation

A difference-in-difference model with hospital fixed effects is used to estimate the effects of MR on hospital performance:

$$
\begin{aligned}
&Financial\ Performance_{ht} \\
&\quad = \beta_0 + \beta_1 Treatment_{ht} + \beta_2 ImplementationPeriod_{ht} + \beta_3 PostTestPeriod_{ht} \\
&\quad + \beta_4 Treatment_{ht} * ImplementationPeriod_{ht} + \beta_5 Treatment_{ht} * PostTestPeriod_{ht} \\
&\quad + \beta_6 Time_{ht} + \beta_7 Hospital\ Characteristics_{pt} + \beta_8 Market\ Characteristics_{pt} \\
&\quad + \varepsilon_{ht}
\end{aligned}
$$

$$where\ \varepsilon_{ht} = \mu_h + v_{ht}$$

where *h* indicates variables that vary by hospital and *t* indicates variables that vary by time. The μ_h refers to the unobserved time-invariant variables, and the v_{ht} refers to the unobserved time-variant variables.

The coefficient β_1 is a measure of the difference in financial performance between MR and never MR hospitals during the pre-test phase of the study. This estimate determines if the

MR and never MR hospitals are similar or different at the initiation of the study. However, since this variable is invariant over time, β_1 cannot be estimated using hospital fixed effects regression. Therefore this parameter will not be estimated in the regression. Fixed Effects Vector Decomposition (FEVD) is an econometric tool that has been recommended to estimate the coefficient of time-invariant variables.[187] Unfortunately, while the parameter estimates for the time-invariant variables are correct the standard errors produced from the FEVD are biased downward, resulting in false conclusions about statistical significance.[188]

The coefficient β_3 is a measure of the difference in financial performance from the pre-test period to the post-test period for never MR hospitals. This estimate measures the change in the financial performance share that is attributed to market and hospital factors. The summation $\beta_3 + \beta_5$ is the difference in financial performance from the pre-test period to the post-test period for the MR hospitals. Thus, the difference, β_5, is the net effect of the MR signal on financial performance. This estimate is a measure of the difference in financial performance between MR and never MR hospitals and between post-test and pre-test attributed to the MR signal. In this study, β_5 is the main parameter of interest since it is a measure of the effectiveness of the MR signal on financial performance.

Results

Table 12 presents the descriptive statistics of the study sample. A comparison between MR hospitals and never-MR hospitals reveals that MR hospitals are better financial performers. The operating profitability (5.6% versus 3.65%), total profitability (5.71% versus 2.89%) and return on equity (6.75% versus 4.49%) are significantly higher for MR hospitals than non-MR

hospitals. Another notable difference between the MR and never-MR hospitals include that MR hospitals have a significantly higher market share (19.4% versus 17.9%).

Table 13 presents the results of the difference-in-difference regression model. Since *Magnet Recognition*, *Hospital size*, and *Region* are time-invariant, these variables do not remain in the regression model.

Results indicate that there is an overall positive and statistically significant relationship between the MR signal and both operating profitability and total profitability ($p<0.05$) between the pre-test and the post-test periods. The MR signal is associated with a 1.21 percentage point increase in operating profitability and a 0.86 percentage point increase in total profitability.

Table 12 also shows that Medicaid payer mix, not-for-profit and for-profit ownership, and poverty rate are significantly associated with operating profitability. Medicaid payer mix is associated with a 0.069 percentage point decrease in operating profitability. In comparison to government hospitals, both not-for-profit and for-profit ownership are associated with a 4.41 and 5.52 percentage point decrease in operating margin. Lastly, a one percentage point increase in poverty rate is associated with a 0.30 percentage point increase in operating margin.

Table 12. Summary statistics of dependent and independent variables (N=6,581 hospital year observations) from 2000 to 2010

	All Hospitals (N=6,581 hospital year observations & 1,192 hospitals)		Never Magnet Recognition Hospitals (N=5,246 hospital year observations & 921 hospitals)		Magnet Recognition Hospitals (N=1,335 hospital year observations & 231 hospitals)		P Value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Dependent variable							
Operating Profitability	4.06	8.46	3.65	8.81	5.60	6.78	0.000
Total Profitability	3.48	11.70	2.89	12.60	5.71	7.04	0.000
Reinvestment	4.98	9.60	4.49	10.00	6.75	7.94	0.000
Magnet Hospital Recognition Status							
Pre-test (%)	33.10	-	33.10	-	33.00	-	0.895
Implementation (%)	34.50	-	34.50	-	34.40	-	0.924
Post-test (%)	32.40	-	32.30	-	32.70	-	0.818
Hospital Characteristics							
Hospital size (Total beds)	445.00	333.00	439.00	340.00	466.00	302.00	0.080
System affiliation (%)	29.70	-	29.70	-	29.60	-	0.948
Medicare Payer Mix (%)	38.50	14.30	38.30	15.00	39.00	11.30	0.094
Medicaid Payer Mix (%)	11.90	9.70	12.00	10.10	11.50	7.83	0.090
Not-for-profit hospital (%)	86.10	-	86.00	-	86.20	-	0.844
For-profit hospital (%)	4.30	-	4.40	-	4.00	-	0.505
Government hospital (%)	9.60	-	9.60	-	9.80	-	0.820
Teaching Affiliation (%)	66.60	-	66.50	-	67.20	-	0.662
Market Characteristics							
Population (1,000s)	3,588.04	4,782.68	3,571.45	4,800.64	3,653.22	4,712.57	0.577
Population density	726.00	737.00	722.00	742.00	742.00	718.00	0.376
Percent of Population 65 and over (%)	12.00	2.45	12.00	2.48	12.10	2.35	0.422

	All Hospitals (N=6,581 hospital year observations & 1,192 hospitals)		Never Magnet Recognition Hospitals (N=5,246 hospital year observations & 921 hospitals)		Magnet Recognition Hospitals (N=1,335 hospital year observations & 231 hospitals)		P Value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Income	37,192.05	7,137.81	37,139.18	7,104.58	37,399.79	7,265.89	0.234
Unemployment Rate (%)	5.29	1.79	5.30	1.79	5.25	1.79	0.327
Poverty Rate	11.50	2.52	11.50	2.55	11.60	2.43	0.075
Distance from Residence to Hospital	16.60	8.56	16.70	8.61	16.20	8.35	0.046
Hospital competition	10.30	14.5	10.20	14.60	10.90	14.10	0.135
Hospital market share (%)	18.20	24.3	17.90	24.40	19.40	23.90	0.045
Region							
West	0.147	-	0.151	-	0.133	-	0.105
Midwest	0.315	-	0.311	-	0.334	-	0.098
Northeast	0.194	-	0.190	-	0.210	-	0.089
South	0.343	-	0.349	-	0.322	-	0.068
Year							
2000 (%)	0.039	-	0.039	-	0.039	-	0.958
2001 (%)	0.066	-	0.066	-	0.066	-	0.996
2002 (%)	0.090	-	0.090	-	0.090	-	0.975
2003 (%)	0.108	-	0.108	-	0.109	-	0.924
2004 (%)	0.127	-	0.127	-	0.126	-	0.913
2005 (%)	0.139	-	0.139	-	0.139	-	0.984
2006 (%)	0.134	-	0.134	-	0.133	-	0.949
2007 (%)	0.107	-	0.107	-	0.107	-	0.983
2008 (%)	0.082	-	0.082	-	0.083	-	0.853
2009 (%)	0.064	-	0.064	-	0.063	-	0.861
2010 (%)	0.044	-	0.044	-	0.045	-	0.920

Table 13. Difference-in-difference regression with hospital fixed effects

Dependent Variable	Operating Profitability		Total Profitability		Return on Equity	
	Coefficient	Robust SEs	Coefficient	Robust SEs	Coefficient	Robust SEs
Hospital Intervention						
Magnet Recognition Hospital[a, f]	-	-	-	-	-	-
Magnet Recognition Hospital Status						
Implementation[b]	0.12	0.28	–0.28	0.28	0.15	0.45
Post-test[b]	–0.030	0.46	–0.51	0.47	0.20	0.77
Magnet Recognition*Implementation	0.36	0.38	0.36	0.35	–0.47	0.60
Magnet Recognition*Post-test	1.21*	0.49	0.86*	0.43	0.088	0.71
Hospital Characteristics						
Hospital Size[f]	-	-	-	-	-	-
System affiliation	0.065	0.39	0.044	0.360	0.423	0.640
Medicare Payer Mix	0.034	0.048	0.029	0.040	0.110	0.070
Medicaid Payer Mix	–0.069*	0.030	–0.048	0.030	–0.120*	0.050
Not-for-profit hospital[e]	–4.41*	2.13	–1.46	1.33	4.55**	1.75
For-profit hospital[e]	–5.52*	2.62	–2.76	2.02	2.31	3.10
Teaching Affiliation	–1.19	0.75	0.12	0.65	–2.93	1.63
Market Characteristics						
Population (1,000s)	–0.0039	0.0032	–0.0024	0.0027	–0.0038	0.0048
Population Density	0.013	0.019	0.008	0.017	0.014	0.028
Percent of Population 65 and over	–1.18	0.84	–1.31	0.73	–0.16	1.08
Income	0.000050	0.00011	0.00	0.00	0.00	0.00
Unemployment Rate	0.043	0.18	0.00	0.17	0.010	0.26
Poverty Rate	0.30*	0.13	0.16	0.13	0.097	0.18
Distance from Residence to hospital	–0.0026	0.13	–0.016	0.09	0.086	0.19
Hospital Competition	–0.043	0.15	–0.25	0.13	0.19	0.26
Hospital Market Share (%)	8.31	5.19	7.21	5.13	2.91	5.05
Region						
Northeast[d, f]	-	-	-	-	-	-

Dependent Variable	Operating Profitability		Total Profitability		Return on Equity	
	Coefficient	Robust SEs	Coefficient	Robust SEs	Coefficient	Robust SEs
Midwest[d, f]	-	-	-	-	-	-
South[d, f]	-	-	-	-	-	-
Time						
Year 2001[c]	0.14	0.70	–0.59	0.55	–0.96	0.99
Year 2002[c]	0.73	0.84	–0.69	0.72	–1.13	1.15
Year 2003[c]	0.66	0.94	–0.058	0.85	–0.51	1.30
Year 2004[c]	0.92	1.07	0.69	0.96	0.37	1.53
Year 2005[c]	1.32	1.19	1.21	1.09	0.086	1.72
Year 2006[c]	0.93	1.38	1.36	1.30	–0.31	2.02
Year 2007[c]	1.77	1.56	2.31	1.48	–0.20	2.32
Year 2008[c]	0.29	1.91	–0.84	1.78	–3.97	2.79
Year 2009[c]	1.25	2.20	0.74	2.05	–1.89	3.22
Year 2010[c]	3.09	2.39	3.49	2.23	0.11	3.62
Constant	18.96	14.64	21.26	12.68	–4.60	23.01
Number of Hospital Year Observations	6,122		6,065		5,929	
Number of Hospitals	1,100		1,103		1,097	
F Statistic	(29, 1099)=4.42 p=0.000		(29, 1102)=12.18 p=0.000		(29,1096)=8.15 p=0.000	

[a]Reference is control hospitals; [b]Reference is the pre-test period; [c]Reference is year 2000; [d]Reference is west; [e]Reference is government hospitals; [f]Time invariant variables.
*Statistically significant at the 5% level. **Statistically significant at the 1% level.
Fixed effects are at the hospital level.

Discussion

The primary finding of this study is that the MR signal results in an increase in hospital profitability. Specifically, the MR signal is associated with a 1.21 percentage point increase in operating margin and a 0.86 percentage point increase in total margin. This translates to a $1.21 million increase in operating margin and $0.86 million increase in total operating margin for every $100 million in revenue. Based on the regression estimates, an average MR hospital has an operating margin of 5.61% and a total margin of 4.96% compared to an operating margin of 3.71% and a total margin of 3.72% for an average never-MR hospital.

These findings support the claims made in the various sources of literature that the non-financial benefits resulting from MR will result in improved financial performance. These non-financial benefits, which include improved retention and decreased turnover of nurses[118, 132], improved satisfaction for all clinical staff[15, 86], improved patient quality and safety[120, 214], and increased customer attraction for hospital selection[96], all correspond to potential for cost savings and increased revenue opportunities[38] that can improve financial performance.

A recent study by Jayawardhana et al. (2014) found evidence that MR hospitals result in a significant increase in both inpatient costs and inpatient revenues.[41] However, in order to achieve higher profitability (both operating and total profitability), the increase in inpatient costs would need to be offset by higher net inpatient revenue. In a previous research study, the author investigated the effect of MR signal on market share and reimbursement. In contrast to findings from previous descriptive studies, the empirical results from this analysis indicate that the MR signal does not have an effect on either hospital reimbursement or hospital market share.[32] These findings imply that the MR signal does not result in an increase a hospital's revenue.

The author also investigated the effect of the MR signal on hospital cost inefficiency applying a SFA, using total hospital expenses in the analysis. The results from this study indicate that the MR signal is associated with a significant ($p<0.01$) reduction in hospital cost inefficiency, which may be attributed to either the signaling effect of MR and/or operational and process changes that occur due to the transition to becoming a MR hospital. Decreases in hospital cost inefficiency are related to a reduction in hospital expenditures and increased productivity.[131] In the study by Jayawardhana et al. (2014) MR was found to increase inpatient costs by 2.46%[41], which suggests that any potential cost savings due to the delivery of cost effective patient care may be trivial, since on average inpatient costs appear to increase instead of decrease. This increase in inpatient costs in MR hospitals[41] supports the hypothesis that the reduction in cost inefficiency may be due to the MR signal. The increases in hospital profitability observed in this study may be attributed to a reduction in expenditures instead of increases in either market share or reimbursement.

Medicaid payer mix was found to have a negative effect on operating margin which is consistent with the findings in the literature. It has been shown that hospitals that are dependent on Medicaid have a higher probability of closing, a higher probability of bond rating downgrades and a lower profitability.[146] In terms of hospital ownership, both not-for-profit and for-profit hospitals have lower operating margins than government hospitals, which was unexpected. Property rights theory suggests that for-profit hospitals will be more focused on earning profits than not-for-profit hospitals. These results can be explained by the internal pressures to reduce costs and increase efficiency that are associated with ownership. Government hospitals likely have more pressure to reduce costs because of their accountability to the public, when compared to not-for-profit and for-profit hospitals.

Also of interest is that poverty rate is associated with an increase in operating margin. This was an unexpected finding. Poverty rate is considered to be an indicator of a community's financial ability to purchase health care services. Hospitals located in areas with higher poverty rates may respond by reducing inefficiencies and focusing on cost saving strategies, which may lead to improvements in operating margin.

Implications

The results of this study suggest that MR hospitals are more profitable than non-MR. This finding has implications for providers, policy makers, and the ANCC itself. First and foremost, hospital CNOs may now be more encouraged to pursue MR designation. In an era of scarce resources, some CNOs may have been reluctant to approach senior management and Boards with what could be considered costly proposals.. Removal or at least reduction of this barrier may empower nurse executives and lead to a new focus on nursing excellence in some hospitals.

Fewer CEOs and CFOs may perceive MR as a costly endeavour and may consider the pursuit of the designation due to the potential positive financial benefits. CEOs and CFOs have a fiduciary responsibility to invest scarce capital resources in ways that maximize benefit to the organization. Senior managers now have evidence that pursuing MR recognition will not necessarily adversely affect the financial health of the organization and indeed may improve it. This study strengthens the argument for MR, which has been perceived as a costly pursuit with negligible returns on the requisite investment.

Government, accreditation and industry organizations may support or require hospitals to attain MR. With the emphasis on reduction in reimbursement and linking reimbursement to the delivery of quality care, hospitals are facing challenges that impact their future sustainability and

ability to continue operations. MR may be a potential solution to help hospitals to continue to be financially viable while still improving quality of care by focusing on quality management, efficiency and cost containment. Although MR is a costly endeavour, hospitals may be encouraged to pursue MR through either the provision of financial support, financial incentives, or changes in reimbursement.

From the perspective of the ANCC itself, the study results may enhance the reputation and the perceived value of MR, may lead to more applications for MR, and increase the visibility and popularity of MR. The ANCC now has evidence of the financial benefits of the Magnet designation. However, as the demand for MR increases and more hospitals seek to become MR, the distinction and exclusivity attached to the MR signal may become weakened or diluted. To prevent this from happening, the ANCC may become more selective in bestowing hospitals with the MR designation by utilizing more rigor in review criteria.

Limitations

There are a few limitations associated with this study. Primarily, there are a number of variables of interest that were not included in the analysis due to inaccessibility of the data or inability to measure specific variables, potentially resulting in biased parameter estimates in the proposed empirical analysis. For example, the scope of services provided has been found to be strongly associated with likelihood of pursuing Magnet designation [197], but is not available in the existing data set. In addition, the existence of other process management techniques, hospital's management style, and measures of organizational culture are unobservable but could affect how a hospital is managed both financially and operationally. However, the use of fixed effects regression was intended to control for variables such as these and all other unmeasured fixed hospital characteristics, which may be time invariant.

Although the analysis attempted to match MR hospitals to never MR hospitals, no two hospitals are similar in all respects. Propensity scores only control for observed variables and do not consider the effect of unobserved variables[163] in the decision of hospitals to seek MR. For example, a hospital may seek MR if other quality measures are decreasing. This non-random decision to seek MR can thus result in biased parameter estimates of the likelihood of MR.

Although the ANCC website lists the current MR designated hospitals, it does not provide information on hospitals that applied for MR but were unsuccessful, hospitals that are currently undergoing the transformation to become MR recognized, or hospitals that had their MR status rescinded due to non-compliance with the program's requirements.

Conclusion

Although the primary purpose of the MR is not to improve financial performance of hospitals, with the current economic climate, fiscal constraints, healthcare workforce shortages, and reduced reimbursements, hospitals might be contemplating pursuing this strategy to increase competitiveness in the health care market and to improve financial performance. The pursuit of the MR is an important organizational decision resulting in substantial modifications to the structure and culture of organizations and requires considerable investment of time and resources, initially and ongoing as the process continues. Knowledge of the pathway by which the MR signal effects hospital financial performance can be the deciding factor for hospital managers and decision-makers interested in undertaking this endeavour.

CHAPTER 7: CONCLUSION

What did the three studies investigate?

This dissertation research aims to address the existence of information asymmetry in health care organizations by applying signaling theory to investigate the effect of MR on the various dimensions of financial performance. The three research studies in Chapters 3 to 6 investigated whether the MR signal has an impact on a hospital's financial performance. MR is proposed to be a signal of unobserved quality utilized by hospitals. According to signaling theory, hospitals signal their commitment to nursing excellence and quality care through the MR designation. The signal is received by payers, patients, and providers. Their responses and actions to the signal will influence three different intermediate outcomes: increasing reimbursement, increasing market share, and/or reducing cost inefficiency. An increase in reimbursement and/or market share will increase revenue and decreasing hospital cost inefficiency will reduce hospital expenditures. The combined effect will be an increase in hospital profitability.

What did the three studies find?

Although MR signal has been hypothesized to improve reimbursement through negotiations with payers[32] and increase market share by increasing patient volume through signaling to patients and providers the hospital's commitment to patient quality[15, 18, 31], the results in Chapter 4 do not support these hypotheses. The effect of the MR signal on hospital market

share and hospital reimbursement, while controlling for hospital and market characteristics, indicate that the MR signal has no influence on either of these intermediate outcomes.

MR has also been associated with the promotion of excellence in nursing care[86] and professional nursing practice[131], emphasis on collaboration and team work[34, 35], and creation of a positive culture and work environment.[33] Providers are expected to interpret the MR signal and respond by seeking or maintaining employment in designated hospitals resulting in reduced nursing turnover, reduced recruitment[118, 132] and orientation costs[38], reduced usage of agency nurses[38] and increased provider satisfaction.[33, 60] The combination of these outcomes is hypothesized to improve hospital efficiency by increasing productivity and reducing costs. The results in Chapter 5 indicate that MR decreases hospital cost inefficiency of designated hospitals compared to control hospitals. This finding supports the hypothesis of this study, and confirms the claims stated in the literature that MR increases hospital efficiency.[127, 129] However, in addition to the MR signal, the improvement in efficiency may also be attributed to operational and structural changes in the hospital. The requirements of attaining MR may result in changes in the hospital's policies and procedures, leading to the delivery of cost effective patient care and therefore a reduction in cost inefficiency. Unfortunately, the distinction between these two pathways cannot be determined.

Finally, there is growing evidence (empirical and anecdotal) that MR hospitals are associated with positive nursing, patient and organizational outcomes.[24, 25] These outcomes are interrelated and have been theorized to affect hospital financial performance through three pathways: (1) cost savings, (2) increased revenue, and (3) market share, all through signaling delivery of quality care to payers, patients and providers. The results in Chapter 6 show that the MR signal results in an increase in hospital profitability. The results from Chapter 4 indicate that

the increases in profitability are not attributed to either hospital reimbursement or hospital market share, since the MR signal did not have a significant effect on either of these outcomes. However, the increases in profitability may be due to a reduction in costs, occurring though improvements in hospital efficiency, which is confirmed in Chapter 5. The results in Chapter 5 show that MR is associated with a decrease in hospital cost inefficiency. However, this decrease may be due to either the signaling of MR to providers or the changes in the hospital's structure, process and delivery methods[93] that are required to become a MR. Unfortunately, the contribution of each pathway to the reduction in cost inefficiency is unknown. However, a recent study found an increase in average inpatient costs for MR hospitals[41], which may question the ability of a MR hospital to reduce costs in the provision of cost effective care.

Is Magnet Recognition an effective signal of unobserved quality?

The premise of this study was to determine the effectiveness of MR as a signal of unobserved quality. MR is considered to be a signal used by hospitals to communicate to consumers and health care providers about the care which they can expect to receive in a MR hospital.[13-15] MR is proposed to reduce the information asymmetry by signaling to various stakeholders, the hospitals' commitment to nursing excellence and quality management strategies. It is considered to be an effective signal of quality because it meets the two conditions previously described. First, MR is directly observable by consumers because hospitals have been shown to strongly promote receipt of the designation through marketing, public display of banners, and other advertising.[16, 60-62] Second, MR is costly[63] and therefore difficult to imitate for providers that do not have meaningful quality information to convey.[64]

The effectiveness of the MR signal is determined by its impact on the various dimensions of hospital financial performance: reimbursement, market share, cost inefficiency and profitability. Previous research suggests that the MR designation may signal quality information to multiple stakeholders including patients, payers and providers. It is hypothesized that if the MR signal is effective, these stakeholders will respond accordingly and the signaling hospital will experience an increase in hospital reimbursement[32], market share[15, 18, 31], efficiency[15, 133] and profitability.[38, 136, 137]

However, from the results of this study, it can be concluded that the effectiveness of the MR signal is limited. The MR signal did not appear to elicit the expected outcome from the hospital. In other words, it had no effect on either hospital reimbursement or market share. This result may be explained by a number of factors. The signaling environment may hamper or strengthen the signaling effect. A noisy environment, such as the existence of multiple different signals may diminish the observability of the signal. According to Connelly et al. (2011), signal effectiveness is also dependent upon the characteristics of the signal, such as signal strength, signal visibility, signal clarity, and signal frequency which are used to describe the detectability of a signal. Even if the signal is strong, the effectiveness may be determined by the characteristics of the receiver of the signal. The signal will not be recognized if the receiver is not looking for the signal or if the receiver is unable to interpret the signal.[43]

On the contrary to the findings listed above, MR was found to result in a decrease in hospital inefficiency, which supports the stated hypothesis. The MR signal has been hypothesized to reduce hospital inefficiency through reduced nursing turnover, reduced recruitment[118, 132] and orientation costs[38], reduced usage of agency nurses[38] and increased provider satisfaction.[33, 60] However, structural and operational changes attributed to the MR

program may also be responsible for these findings.[93] Unfortunately, the results of this study cannot determine the pathway by which hospital cost inefficiency is reduced. A recent study found that inpatient costs increased in MR hospitals[41], instead of decreased costs as proposed by Mason (2003).[127, 129] The increased inpatient costs in MR hospitals may weaken the argument that cost efficiency is due to the delivery of cost-effective care, but instead may be due to the MR signal and its reduction in nursing personnel costs, as stated previously. The effectiveness of the MR signal in this pathway may be due to the characteristics of the receiver, in this case the provider. Since MR is a designation given to hospitals for their dedication and commitment to nursing excellence and quality patient care, providers such as nurses may seek out and interpret this signal when selecting future employment.

The combined effect of the MR signal was found to result in a significant increase in hospital profitability. This increase in hospital profitability may be explained by the reduction in hospital inefficiency, which is associated with a decrease in hospital expenses. Given the findings of these three studies, the effectiveness of the MR signal appears to vary depending on the receiver. Overall, the MR signal can be described as weak and unrecognizable. First, the signal does not appear to be readily detected by receivers. Second, the signaling frequency is hindered due to the small number of MR hospitals currently in existence, thereby limiting the number of MR signals that are produced. Third, the signal fit, which is the correlation between the MR signal and hospital's unobservable quality (the focus on nursing excellence and quality patient care) is diminished. The signal effectiveness is also determined by the characteristics of the receivers. In order for a signal to be effective, the receiver needs to be actively scanning the environment for the signal. In this study, specifically the payers and patients may not be actively seeking out the MR signal, so these parties may be unaware of the existence of the MR signal

and do not respond as expected. Different receivers also interpret signals differently than others do. Providers like nurses and physicians, may be more aware of the MR signal, since it is a hospital designation, and may have a different interpretation of this signal when compared to patients and payers, who may have a completely different interpretation.[43]

What are the management and policy implications of the three studies?

First, for a signal to be effective, it needs to valid, recognizable, interpretable and elicit the appropriate response. No impact between MR and hospital reimbursement suggests that hospital CEOs and CFOs may not be leveraging MR as a means to highlight their quality accomplishments to negotiate better reimbursement rates from payers. In turn, the payers may not recognize, not interpret, and/or not respond to the MR signal. Payers may either be unaware or not value that MR hospitals are acknowledged as providers of excellence in nursing care.[213] Although previous research suggests that quality metrics emphasize the hospital's commitment to quality management and may even give hospitals an added advantage in negotiations[194], the MR signal does not appear to provide this benefit.

Second, no impact between MR signal and hospital market share indicates that hospital executives and policy makers should carefully consider the financial resources dedicated to publicizing MR. Hospitals incur enormous costs in the promotion of MR. Full page newspaper advertisements, billboards, websites and television spots are used to promote MR in an attempt to raise awareness and to market themselves to patients, nurses and the community.[60] While MR has been associated with various positive benefits for patients, nurses and the organization, these benefits may not be communicated by the MR signal to these various stakeholders, perhaps due to weaknesses in the signal.

Third, In light of the reduction in reimbursements payment methods and an increased focus on cost reduction and quality improvement, there may be an increased in demand by hospitals interested in pursuing the designation as a means to remain financially viable. Policy makers may consider promoting MR or components of MR as pathways to not only improve quality, but also to reduce costs and improve efficiency.

Fourth, from the perspective of the MR program, the study results may enhance the reputation and the perceived value of MR and may lead to more applications for MR and increase the visibility and popularity of MR. For hospitals, fewer CEOs and CFOs may perceive MR as a costly endeavour and may consider the pursuit of the designation due to the potential positive financial benefits. For government, accreditation and industry organizations may support or require hospitals attain MR as a means to improve quality and sustainability.

Finally, these results present hospital managers and policy makers with the pathway by which the MR signal has an impact on hospital profitability and the need to review and comprehend the structure and processes that lead to the improvement in hospital profitability. The primary purpose of the MR is not to improve reimbursement, increase market share, or reduce cost inefficiency. However, with the current economic climate, fiscal constraints, healthcare workforce shortages, and reduced reimbursements, hospitals might be contemplating pursuing this strategy to increase competitiveness in the health care market and to improve financial performance. The pursuit of the MR is an important organizational decision resulting in substantial modifications to the structure and culture of organizations and requires considerable investment of time and resources, initially and ongoing as the process continues.

REFERENCES

1. Rao AR, Qu L, Ruekert RW. Signaling Unobservable Product Quality through a Brand Ally. J Market Res 1999;36:pp. 258-268.

2. Erdem TT. Brand Equity as a Signaling Phenomenon. Journal of consumer psychology 1998;7:131-157.

3. Kirmani AA. No Pain, No Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality. J Market 2000;64:66-79.

4. Roberts PPW. Corporate reputation and sustained superior financial performance. Strategic Manage J 2002;23:1077-1093.

5. Gelb DS, Siegel P. Intangible assets and corporate signaling. Rev Quant Finance Account 2000;15:307-323.

6. Malani AA. Does Nonprofit Status Signal Quality? The Journal of legal studies 2008;37:551-576.

7. Terlaak AA. The effect of certification with the ISO 9000 Quality Management Standard: A signaling approach. Journal of economic behavior & organization 2006;60:579-602.

8. Werner RRM. Do consumers respond to publicly reported quality information? Evidence from nursing homes. J Health Econ 2012;31:50-61.

9. O'Neill C, Largey A. The role of quality standards-accreditation in redressing asymmetry of information in health care markets. Health Policy 1998;45:33-45.

10. Faber M, Bosch M, Wollersheim H, et al. Public Reporting in Health Care: How Do Consumers Use Quality-of-Care Information?: A Systematic Review. Med Care 2009;47:1.

11. Parsons ML, Cornett PA. Sustaining the pivotal organizational outcome: magnet recognition. J Nurs Manag 2011;19:277-286.

12. Karkos B, Peters K. A Magnet community hospital: Fewer barriers to nursing research utilization. J Nurs Adm 2006;36:377-382.

13. Jenkins M, Fields B. Pursuing Magnet(R) designation as a system or as individual entities: what is the right decision? J Nurs Adm 2011;41:172-178.

14. Hancock B. Magnet recognition: the Rush experience. J Christ Nurs 2006;23:22-25.

15. Buchan J. Magnet hospitals: what's the attraction? Nurs Stand 1997;12:22-25.

16. Bumgarner SD, Beard EL,Jr. The magnet application: pitfalls to avoid. J Nurs Adm 2003;33:603-606.

17. Smith EL. Making the magnet commitment. J Nurses Staff Dev 2003;19:272-6; quiz 277-8.

18. Lash AA, Munroe DJ. Magnet designation: A communique to the profession and the public about nursing excellence. Medsurg Nurs 2005;Suppl:7-12; quiz 13.

19. Gerhardt WE, VanKuiken D. Assessing magnet readiness using the nursing work index-revised survey. J Nurs Adm 2008;38:429-434.

20. Goode CJ, Krugman ME, Smith K, et al. The pull of magnetism: a look at the standards and the experience of a western academic medical center hospital in achieving and sustaining Magnet status. Nurs Adm Q 2005;29:202-213.

21. Rich VL, Barnsteiner JH. Achieving Magnet designation. Pa Nurse 2007;62:25-26.

22. Caskey L. Magnet hospitals: another look at a challenge for nurses. Okla Nurse 2002;47:26.

23. Gokenbach V, Drenkard K. The outcomes of Magnet environments and nursing staff engagement: a case study. Nurs Clin North Am 2011;46:89-105.

24. Hill KS. Magnet hospitals: recruiting and retaining nurses. Nurs Clin North Am 2011;46:xiii-xiv.

25. Westendorf JJ. Magnet recognition program. Plast Surg Nurs 2007;27:102-104.

26. Lewis C. Magnet status application. J Vasc Nurs 2008;26:65-66.

27. Patient satisfaction planner. Magnet facility credits communication for success. Hosp Peer Rev 2008;33:35-37.

28. Ulrich BT, Buerhaus PI, Donelan K, et al. Magnet status and registered nurse views of the work environment and nursing as a career. J Nurs Adm 2009;39:S54-62.

29. Morgan SH. Magnet learning communities. J Nurs Care Qual 2011;26:197-198.

30. ANCC. ANCC Magnet Recognition Program, 2011. 2011. Available at: http://nursecredentialing.org/Magnet.aspx. Accessed 9/26/2011.

31. Gaguski M. Magnet status--what's the attraction? ONS News 2006;21:1, 4-6.

32. Smith AP. Paving and resurfacing the road to Magnet: devil in the details--part II. Medsurg Nurs 2007;16:32-34.

33. Havens DS, Aiken LH. Shaping systems to promote desired outcomes. The magnet hospital model. J Nurs Adm 1999;29:14-20.

34. Kelly LA, McHugh MD, Aiken LH. Nurse outcomes in magnet(R) and non-magnet hospitals. J Nurs Adm 2011;41:428-433.

35. Ridley J, Wilson B, Harwood L, et al. Work environment, health outcomes and magnet hospital traits in the Canadian nephrology nursing scene. CANNT J 2009;19:28-35.

36. Tuazon N. Is Magnet a money-maker? Nurs Manage 2007;38:24, 26, 28-31.

37. Upenieks VV. What constitutes effective leadership? Perceptions of magnet and nonmagnet nurse leaders. J Nurs Adm 2003;33:456-467.

38. Drenkard K. The business case for Magnet. J Nurs Adm 2010;40:263-271.

39. Abraham J, Jerome-D'Emilia B, Begun JW. The diffusion of Magnet hospital recognition. Health Care Manage Rev 2011;36:306-314.

40. Russell J. Journey to Magnet: cost vs. benefits. Nurs Econ 2010;28:340-342.

41. Jayawardhana J, Welton JM, Lindrooth RC. Is There a Business Case for Magnet Hospitals? Estimates of the Cost and Revenue Implications of Becoming a Magnet. Med Care 2014.

42. Signaling Theory – An Introduction | Kiran Dhanwada Available at: http://kirandhanwada.com/2009/08/24/signaling-theory-–-an-introduction/. Accessed 7/11/2012.

43. Connelly BBL. Signaling Theory: A Review and Assessment. Journal of management 2011;37:39-67.

44. Dawar NN. The signaling impact of low introductory price on perceived quality and trial. Mark Lett 1997;8:251-259.

45. Talmor E. Asymmetric information, signaling, and optimal corporate financial decisions. Journal of Financial and Quantitative analysis 1981;16:413-435.

46. Koku PPS. Corporate name change signaling in the services industry. The Journal of services marketing 1997;11:392-408.

47. McGuire JB, Schneeweis T, Branch B. Perceptions of firm quality: A cause or result of firm performance. Journal of Management 1990;16:167-180.

48. Chemmanur TJ, Paeglis I, Simonyan K. Management quality, financial and investment policies, and asymmetric information. Journal of Financial and Quantitative Analysis 2009;44:1045.

49. Heil OO. Toward a theory of competitive market signaling: A research agenda. Strategic Manage J 1991;12:403-418.

50. Benner MJ. ISO 9000 practices and financial performance: A technology coherence perspective. J Oper Manage 2008;26:611.

51. Archibald RB, Haulman CA, Moody Jr CE. Quality, price, advertising, and published quality ratings. Journal of Consumer Research 1983:347-356.

52. Abe M. Price and advertising strategy of a national brand against its private-label clone: A signaling game approach. Journal of Business Research 1995;33:241-250.

53. Caves RE, Greene DP. Brands' quality levels, prices, and advertising outlays: empirical evidence on signals and information costs. International Journal of Industrial Organization 1996;14:29-52.

54. Erdem T, Swait J, Valenzuela A. Brands as signals: A cross-country validation study. J Market 2006:34-49.

55. Erdem T, Swait J. Brand credibility, brand consideration, and choice. Journal of Consumer Research 2004;31:191-198.

56. Herbig P, Milewicz J. Market Signaling in Hospitals. J Hosp Mark 1993;7:135-145.

57. Malani A, David G. Does nonprofit status signal quality? The Journal of Legal Studies 2008;37:551-576.

58. Boulding W, Kirmani A. A consumer-side experimental examination of signaling theory: do consumers perceive warranties as signals of quality? Journal of Consumer Research 1993:111-123.

59. Nelson EC, Rust RT, Zahorik A, et al. Do patient perceptions of quality relate to hospital financial performance? J Health Care Mark 1992;12:6-13.

60. Lewis CK, Matthews JH. Magnet program designates exceptional nursing services. Am J Nurs 1998;98:51-52.

61. Aiken LH, Havens DS, Sloane DM. The Magnet Nursing Services Recognition Program. Am J Nurs 2000;100:26-35; quiz 35-6.

62. Schlag MK, Sengin KK, Shendell-Falik N. Achieving magnet status. Nurs Adm Q 1998;22:1-10.

63. Pinkerton SE. The financial return on Magnet recognition. J Contin Educ Nurs 2005;36:51-52.

64. Vekony A, Halford M, Fowler T, et al. Hutt Valley DHB achieves Magnet recognition. Nurs N Z 2007;13:16-18.

65. Riehl M. Why you should consider working at a magnet hospital. Nursing 2007;37 Suppl Career:39.

66. Morgan SH, Lahman E, Hagstrom C. The Magnet Recognition Program: transforming healthcare through excellence in nursing services. J Nurs Care Qual 2006;21:119-120.

67. Wolf G, Triolo P, Ponte PR. Magnet recognition program: the next generation. J Nurs Adm 2008;38:200-204.

68. Duchene PM. Magnet recognition: one hospital's journey. Health Prog 2010;91:29-33.

69. Brahm N, Kelly-Rehm M, Farmer KC. Collaboration: what can health-care organizations learn about pharmacist retention from Magnet status hospitals? Res Social Adm Pharm 2009;5:382-389.

70. Roberts D. The Magnet philosophy: a prescription for nursing excellence. Medsurg Nurs 2007;16:6.

71. Brady-Schwartz DC. Further evidence on the Magnet Recognition program: implications for nursing leaders. J Nurs Adm 2005;35:397-403.

72. Ma CC, Hwang PW, Alexander JW. Taiwanese nurses' cognition and attitudes towards the Magnet Hospitals Recognition Programme. Int Nurs Rev 2010;57:78-84.

73. Delaney KR, Lynch P. Magnet forces: a structure for a transformation in inpatient psychiatric nursing. J Am Psychiatr Nurses Assoc 2008;14:346-352.

74. Ingle LL. Is obtaining magnet status valuable? J Nurses Staff Dev 2004;20:187-8; author reply 188.

75. Walker K, Middleton S, Rolley J, et al. Nurses report a healthy culture: results of the Practice Environment Scale (Australia) in an Australian hospital seeking Magnet recognition. Int J Nurs Pract 2010;16:616-623.

76. Weeks SK, Smith BC, Hubbartt E. Magnet recognition for nursing excellence--is your organization there yet? Rehabil Nurs 2006;31:48-51.

77. Dean-Baar S. Magnet Recognition Program illuminates nursing roles. Rehabil Nurs 2003;28:38.

78. Mueller C. Demonstrating excellence, attaining Magnet status. Creat Nurs 2002;8:7-8.

79. Grant B, Colello S, Riehle M, et al. An evaluation of the nursing practice environment and successful change management using the new generation Magnet Model. J Nurs Manag 2010;18:326-331.

80. Lindgren CL, Elie LG, Vidal EC, et al. Transforming to a computerized system for nursing care: organizational success within Magnet idealism. Comput Inform Nurs 2010;28:74-78.

81. Smith A. Paving and resurfacing the road to Magnet: the perspective and wisdom of Magnet-designated coordinators--part I. Medsurg Nurs 2007;16:29-31, 37.

82. Bliss-Holtz J, Winter N, Scherer EM. An invitation to Magnet accreditation. Nurs Manage 2004;35:36-42; quiz 43.

83. Houser B, Milton D. The Magnet pregnancy: phases of the journey to excellence. J Nurs Adm 2006;36:513-517.

84. Conerly C, Thornhill L. The Magnet site visit: your time to shine. Nursing 2010;40 Suppl:36-37.

85. Coile RC,Jr. Magnet hospitals use culture, not wages, to solve nursing shortage. J Healthc Manag 2001;46:224-227.

86. Trinkoff AM, Johantgen M, Storr CL, et al. A comparison of working conditions among nurses in Magnet and non-Magnet hospitals. J Nurs Adm 2010;40:309-315.

87. Jurkovich P, Karpiuk K, King CA. Magnet recognition: examples of perioperative excellence. AORN J 2010;91:292-299.

88. Greene J. Attracting nurses. Why magnet hospitals succeed. Trustee 2003;56:20-3, 1.

89. Day C. Engaging organizational support for the Magnet journey. Nurs Manage 2008;39:44-48.

90. Anderson HJ. Magnet hospitals rely on I.T. Health Data Manag 2008;16:70, 72, 74.

91. Grindel C, Roman M. The medical-surgical nurse: being a Magnet for excellence. Medsurg Nurs 2005;Suppl:4, 34.

92. Kassulke S. Becoming a Magnet hospital: the role of the perianesthesia nurse. J Perianesth Nurs 2004;19:71-77.

93. Jasovsky DA, Dornan LM, Geisler L, et al. Magnet demographic data: creating a system to streamline the process. J Nurs Adm 2005;35:490-496.

94. Cox KS, Carroll C, Sexton K. Achieving Magnet status: demonstrating nursing excellence. Kans Nurse 2005;80:1-2.

95. Steinbinder A. Bumps on the road to Magnet designation: achieving organizational excellence. Nurs Adm Q 2009;33:99-104.

96. Aiken LH, Havens DS, Sloane DM. Magnet nursing services recognition programme. Nurs Stand 2000;14:41-47.

97. Smith AP. Paving and resurfacing the road to Magnet: part III--unique organizational characteristics. Medsurg Nurs 2007;16:35-37.

98. Cox K, Drenkard K. Magnet innovations and outcomes in children's healthcare. J Pediatr Nurs 2011;26:105-106.

99. Havens DS, Johnston MA. Achieving magnet hospital recognition: chief nurse executives and magnet coordinators tell their stories. J Nurs Adm 2004;34:579-588.

100. Broom C, Tilbury MS. Magnet status: a journey, not a destination. J Nurs Care Qual 2007;22:113-118.

101. Middleton S, Griffiths R, Fernandez R, et al. Nursing practice environment: how does one Australian hospital compare with magnet hospitals? Int J Nurs Pract 2008;14:366-372.

102. Wallace B. The Magnet(R) journey of a community hospital. Am J Nurs 2011;111:30-31.

103. Luzinski C. Introducing the official leadership journal of the magnet recognition program(R). J Nurs Adm 2011;41:389-390.

104. Magnet makes an attractive marketing tool. Health Care Strateg Manage 2006;24:1, 13-6.

105. Frazier SC. Magnet home care agencies: a professional way to impact quality and retention. Home Healthc Nurse 2003;21:603-610.

106. Upenieks VV, Sitterding M. Achieving magnet redesignation: a framework for cultural change. J Nurs Adm 2008;38:419-428.

107. Rourke DR. The hospital library as a "magnet force" for a research and evidence-based nursing culture: A case study of two magnet hospitals in one health system. Med Ref Serv Q 2007;26:47-54.

108. Wise NJ. Maintaining magnet status: establishing an evidence-based practice committee. AORN J 2009;90:205-213.

109. Halfer D. Supporting nursing professional development: a magnet hospital's story. J Nurses Staff Dev 2009;25:135-140.

110. Poduska DD. Magnet designation in a community hospital. Nurs Adm Q 2005;29:223-227.

111. Atkinson M, Turkel M, Cashy J. Overcoming barriers to research in a Magnet community hospital. J Nurs Care Qual 2008;23:362-368.

112. Ingersoll GL, Witzel PA, Berry C, et al. Meeting Magnet research evidence-based practice expectations through hospital-based research centers. Nurs Econ 2010;28:226-35; quiz 236.

113. Pieper SK. Retaining staff the magnet way: fostering a culture of professional excellence. Healthc Exec 2003;18:12-17.

114. Inglis T. Seeking magnet hospital status. A TNA member's account of the arduous application process. Tex Nurs 2000;74:7, 10-2.

115. Robinson CA. Magnet nursing services recognition: transforming the critical care environment. AACN Clin Issues 2001;12:411-423.

116. Armstrong F. Magnet hospitals: what's the attraction? Aust Nurs J 2005;12:14-5, 17.

117. Reigle BS, Stevens KR, Belcher JV, et al. Evidence-based practice and the road to Magnet status. J Nurs Adm 2008;38:97-102.

118. Raso R. Talk among staff: unions, magnet status. Nurs Manage 2007;38:72.

119. Buchan J. Still attractive after all these years? Magnet hospitals in a changing health care environment. J Adv Nurs 1999;30:100-108.

120. Stubenrauch JM. Working conditions at magnet hospitals. Am J Nurs 2010;110:16-17.

121. Jayawardhana J, Welton JM, Lindrooth R. Adoption of national quality forum safe practices by Magnet(R) hospitals. J Nurs Adm 2011;41:350-356.

122. Gillispie V. Be a magnet, or just look like one. Colo Nurse 2005;105:12.

123. Cleary PD, McNeil BJ. Patient satisfaction as an indicator of quality care. Inquiry 1988;25:25-36.

124. Speagle A. Building a magnet culture. Colo Nurse 2009;109:3-4.

125. Saver C. Magnet status helps ORs attract and hold on to their nursing staff. OR Manager 2007;23:1, 13-4.

126. The attraction of magnet nursing services. Tex Nurs 2001;75:8-9.

127. Mason DJ. Nursing's best kept secret. Magnet hospitals can save health care. Am J Nurs 2000;100:7.

128. Mondino K. The road to excellence: Magnet designation, the Beacon Award, and primary nursing. Crit Care Nurs Clin North Am 2005;17:163-7, x.

129. Romano M. A strong attraction. As hospitals seek 'magnet' status to retain nurses and improve care, some see the program as little more than a pricey marketing gimmick. Mod Healthc 2002;32:28-32, 34.

130. McCue M. Nurse staffing, quality, and financial performance. J Health Care Finance 2003;29:54.

131. Clark ML. The Magnet Recognition Program and evidence-based practice. J Perianesth Nurs 2006;21:186-189.

132. Upenieks VV. The interrelationship of organizational characteristics of magnet hospitals, nursing leadership, and nursing job satisfaction. Health Care Manag (Frederick) 2003;22:83-98.

133. Kramer M, Schmalenberg C. Magnet hospitals: Part I. Institutions of excellence. J Nurs Adm 1988;18:13-24.

134. Buchan J. Magnet hospitals. Attraction of opposites. Health Serv J 2002;112:22-24.

135. Upenieks VV. What's the attraction to Magnet hospitals? Unlimited opportunity, resources, and autonomy draw nurses to these empowering facilities. Nurs Manage 2003;34:43-44.

136. Shetty YK. The quest for quality excellence: lessons from the Malcolm Baldrige Quality Award. S.A.M.advanced management journal 1993;58:34.

137. Hendricks KB. Firm characteristics, total quality management, and financial performance. J Oper Manage 2001;19:269.

138. Guanci G. Destination magnet: charting a course to excellence. J Nurses Staff Dev 2005;21:227-235.

139. Healthcare Market Research Reports: AHA Data Available at: http://www.ahadata.com/ahadata/html/AHASurvey.html. Accessed 11/24/2011.

140. Bureau of Labor Statistics Data Available at: http://data.bls.gov/pdq/SurveyOutputServlet. Accessed 2/14/2014.

141. Resnick AS, Corrigan D, Mullen JL, et al. Surgeon contribution to hospital bottom line: not all are created equal Ann Surg 2005;242:530-7; discussion 537-9.

142. Langabeer J. Predicting financial distress in teaching hospitals J Health Care Finance 2006;33:84-92.

143. Pink GH, Howard HA, Holmes GM, et al. Differences in Measurement of Operating Margin. 2008;17.

144. Zelman WN. Financial management of health care organizations : an introduction to fundamental tools, concepts, and applications. San Francisco, CA: Jossey-Bass; 2009.

145. Gapenski LC. Healthcare finance : an introduction to accounting and financial management. Chicago: AUPHA/HAP; 2005.

146. Trussel JM, Patrick PA. Evaluating Financial Distress in Rural Pennsylvania Hospitals. 2010.

147. Kim TH. Factors associated with financial distress of nonprofit hospitals Health Care Manag (Frederick) 2010;29:52-62.

148. Bazzoli G, Andes S. Consequences of hospital financial distress Hosp Health Serv Adm 1995;40:472-495.

149. Harrison JP, Coppola MN, Wakefield M. Efficiency of federal hospitals in the United States. J Med Syst 2004;28:411-422.

150. Rosko MMD. What Have We Learned From the Application of Stochastic Frontier Analysis to U.S. Hospitals? Medical care research and review 2011;68:75S-100S.

151. Rosko MD, PROENCA EJ. Impact of network and system use on hospital X-inefficiency. 2002;2002:C1-C6.

152. Rosko MD. Cost efficiency of US hospitals: a stochastic frontier approach. Health Econ 2001;10:539.

153. Rosko MMD. Stochastic Frontier Analysis of Hospital Inefficiency: A Review of Empirical Issues and an Assessment of Robustness. Medical care research and review 2007;65:131-166.

154. Rosko MD. Impact of internal and external environmental pressures on hospital inefficiency. Health Care Manag Sci 1999;2:63-74.

155. Rosko MD. Performance of US teaching hospitals: a panel analysis of cost inefficiency. Health Care Manag Sci 2004;7:7-16.

156. Weech-Maldonado R. Does quality of care lead to better financial performance?: the case of the nursing home industry. Health Care Manage Rev 2003;28:201.

157. Whiteis DG. Hospital and community characteristics in closures of urban hospitals, 1980-87 Public Health Rep 1992;107:409-416.

158. NORC Walsh Center for Rural Health Analysis. Financially Distress Rural Hospitals in Four States - Policy Analysis Brief. 2004;2.

159. McCue MJ, McCall N, Hurley RE, et al. Financial Performance and Participation in Medicaid and Medi-Cal Managed Care. Available at: http://www4.cms.gov/HealthCareFinancingReview/downloads/01Winterpg69.pdf. Accessed 6/16/2011.

160. Census Bureau Home Page Available at: http://www.census.gov/. Accessed 7/22/2011.

161. Rubin DB. Estimating causal effects of treatments in randomized and nonrandomized studies. J Educ Psychol 1974;66:688-701.

162. Rosenbaum PR. Optimal Matching for Observational Studies. Journal of the American Statistical Association 1989;84:pp. 1024-1032.

163. Guo S, Fraser MW. Propensity Score Analysis Statistical Methods and Applications. ; 2010.

164. D'Agostino RB. Tutorial in biostatistics: Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. Stat Med 1998;17:2265-2281.

165. Austin PC. A critical appraisal of propensity-score matching in the medical literature between 1996 and 2003. Stat Med 2008;27:2037-2049.

166. *Stata Statistical Software: Release 11*. College Station, TX: StataCorp LP.[computer program].

167. Wooldridge J. Introductory econometrics: A modern approach. : Cengage Learning; 2012.

168. Mutter RL, Greene WH, Spector W, et al. Investigating the impact of endogeneity on inefficiency estimates in the application of stochastic frontier analysis to nursing homes. Journal of Productivity Analysis 2013:1-10.

169. Jacobs R. Alternative methods to examine hospital efficiency: data envelopment analysis and stochastic frontier analysis. Health Care Manag Sci 2001;4:103-115.

170. Herr A. Cost and technical efficiency of German hospitals: does ownership matter? Health Econ 2008;17:1057-1071.

171. Assaf A, Matawie K. Estimation and decomposition of cost efficiency in the health care food service sector: an extended stochastic frontier approach. IMA Journal of Management Mathematics 2008;19:75-86.

172. Rosko MD. Impact of HMO penetration and other environmental factors on hospital X-inefficiency. Med Care Res Rev 2001;58:430-454.

173. Rosko MD, Mutter RL. Inefficiency differences between critical access hospitals and prospectively paid rural hospitals. J Health Polit Policy Law 2010;35:95-126.

174. Newhouse JP. Frontier estimation: How useful a tool for health economics? J Health Econ 1994;13:317-322.

175. Gannon B. Testing for variation in technical efficiency of hospitals in Ireland. Economic and Social Review 2005;36:273.

176. Rosko MD, Proenca J, Zinn JS, et al. Hospital inefficiency: What is the impact of membership in different types of systems? Inquiry 2007;44:335-349.

177. Lovell CK. Frontier analysis in healthcare. Int J Healthcare Technol Manage 2006;7:5-14.

178. McKay NL, Deily ME, Dorner FH. Ownership and changes in hospital inefficiency, 1986-1991. Inquiry 2002;39:388-399.

179. Coelli TJ, Rao DSP, O'Donnell CJ, et al. An introduction to efficiency and productivity analysis. : Springer; 2005.

180. Battese GE, Coelli TJ. A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empirical economics 1995;20:325-332.

181. Hjalmarsson L, Kumbhakar SC, Heshmati A. DEA, DFA and SFA: a comparison. Journal of Productivity Analysis 1996;7:303-327.

182. Coelli TJ. A guide to FRONTIER version 4.1: A computer program for stochastic frontier production and cost function estimation 1996.

183. Schmidt P, Sickles RC. Production frontiers and panel data. Journal of Business & Economic Statistics 1984;2:367-374.

184. Upenieks VV. Assessing differences in job satisfaction of nurses in magnet and nonmagnet hospitals. J Nurs Adm 2002;32:564-576.

185. Lundmark VA. Magnet Environments for Professional Nursing Practice. In: R. G. Hughes, ed. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville (MD); 2008.

186. Nedelea IC, Fannin JM. Efficiency Analysis of Rural Hospitals: Parametric and Semi-parametric Approaches. 2012.

187. Plumper T, Troeger VE. The estimation of time-invariant variables in panel analyses with unit fixed effects. Social Science Research Network, Working Paper 2004.

188. Greene W. Fixed effects vector decomposition: a magical solution to the problem of time-invariant variables in fixed effects models? Political Analysis 2011;19:135-146.

189. Goldstein SM. Empirical support for the Baldrige Award framework in US hospitals. Health Care Manage Rev 2002;27:62.

190. Horwitz JR. Making profits and providing care: comparing nonprofit, for-profit, and government hospitals. Health Aff (Millwood) 2005;24:790-801.

191. Frick AP, Martin SG, Shwartz M. Case-mix and cost differences between teaching and nonteaching hospitals. Med Care 1985;23:283-295.

192. Bradford DF. The economics of property-casualty insurance. : University of Chicago Press; 2007.

193. Radomski L. What happens when Medicare cuts hospital prices? Assessing the impact on inpatient discharges among the elderly. Find Brief 2013;16:1-3.

194. 4 Ways to Gain Leverage in Payor Contract Negotiations Available at: http://www.beckershospitalreview.com/hospital-management-administration/4-ways-to-gain-leverage-in-payor-contract-negotiations.html. Accessed 2/22/2014.

195. Pappas S. Porter Hospital achieves Magnet designation-nursing reflects on meaning. Colo Nurse 2009;109:9.

196. Doreen F, Robinson C. "Magnet" status as markers of healthy work environments. Interview by Joanne Disch. Creat Nurs 2002;8:4-6.

197. Mayer JD, Kohlenberg ER, Sieferman GE, et al. Patterns of rural hospital closure in the United States Soc Sci Med 1987;24:327-334.

198. Zhivan NNA. U.S. hospital efficiency and adoption of health information technology. Health Care Manag Sci 2012;15:37-47.

199. Pratt WR. What does free cash flow tell us about hospital efficiency? A stochastic frontier analysis of cost inefficiency in California hospitals. J Health Care Finance 2010;37:35-44.

200. Zuckerman S. Measuring hospital efficiency with frontier cost functions. J Health Econ 1994;13:255.

201. Hussey PS, De Vries H, Romley J, et al. A systematic review of health care efficiency measures. Health Serv Res 2009;44:784-805.

202. Medicare Payment Advisory Commission. Report to the Congress: Increasing the value of Medicare. : Medicare Payment Advisory Commission; 2006.

203. Jacobs R, Smith PC, Street A. Measuring efficiency in health care: analytic techniques and health policy. : Cambridge University Press; 2006.

204. Cullinane K, Wang T, Song D, et al. The technical efficiency of container ports: comparing data envelopment analysis and stochastic frontier analysis. Transportation Research Part A: Policy and Practice 2006;40:354-374.

205. Oum TH, Yan J, Yu C. Ownership forms matter for airport efficiency: A stochastic frontier investigation of worldwide airports. J Urban Econ 2008;64:422-435.

206. Lang G, Welzel P. Mergers among German cooperative banks: a panel-based stochastic frontier analysis. Small business economics 1999;13:273-286.

207. Skinner J. What do stochastic frontier cost functions tell us about inefficiency? J Health Econ 1994;13:323.

208. Grube ME. The big squeeze in search of a sustainable future for suburban community hospitals Healthc Financ Manage 2006;60:56-65.

209. Zuckerman S, Hadley J, Iezzoni L. Measuring hospital efficiency with frontier cost functions. J Health Econ 1994;13:255-280.

210. Diehr P. Estimating county percentages of people without health insurance. Inquiry 1991;28:413-419.

211. Kodde DA, Palm FC. NOTES AND COMMENTS WALD CRITERIA FOR JOINTLY TESTING EQUALITY AND INEQUALITY. Econometrica 1986;54:1243-1248.

212. Lake ET, Shang J, Klaus S, et al. Patient falls: Association with hospital Magnet status and nursing unit staffing. Res Nurs Health 2010;33:413-425.

213. Morgan SH. The Magnet Model as a framework for excellence. J Nurs Care Qual 2009;24:105-108.

214. Chen YM, Johantgen ME. Magnet Hospital attributes in European hospitals: a multilevel model of job satisfaction. Int J Nurs Stud 2010;47:1001-1012.