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The Relationship between Nursing Excellence and Electronic Health Record Adoption

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THE RELATIONSHIP BETWEEN NURSING EXCELLENCE AND ELECTRONIC HEALTH RECORD ADOPTION

By

Christine Lippincott

A DISSERTATION

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Coral Gables, Florida

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Doctor of Philosophy

THE RELATIONSHIP BETWEEN NURSING EXCELLENCE AND
ELECTRONIC HEALTH RECORD ADOPTION

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The United States government has invested over a billion dollars to support the nationwide implementation, adoption, and “meaningful use” (MU) of electronic health record (EHR) technology. The American Reinvestment and Recovery Act of 2009 represents just one example of how the delivery of healthcare services is evolving from a fee-for-service to a pay-for-performance model that is data-driven. Under the Centers for Medicare and Medicaid Services (CMS) Meaningful Use (MU) Program, hospitals that fail to demonstrate how their use of electronic health record systems improves patient outcomes will not only lose EHR incentive payments, but could face financial penalties beginning as early as 2015. The transition from paper to electronic records is challenging and end-user resistance is a commonly cited reason for EHR implementation failures. Nurses are the largest group of hospital clinicians and the largest group of EHR end-users, yet there is minimal research on the relationship between the level of nursing care and the successful adoption of EHRs in U.S. hospitals.

The aims of this non-experimental quantitative study were to: (a) examine the relationship between nursing excellence and EHR adoption, and (b) examine the relationship between the tenure of nursing excellence and EHR adoption. The predictor variable of nursing excellence was operationalized by Magnet recognition by the
American Nurses Credentialing Center (ANCC) as of December 2013. The predictor variable of tenure of Magnet status was represented by two groups, Early-designation (initial designation occurring from 1994-2009) and Recent-designation (initial designation occurring from 2010-2013). The outcome variable of EHR adoption was operationalized by positive receipt of at least one payment from the CMS for the Medicare EHR Incentive Program or the achievement of Level 6 or 7 on the Health Information and Management Systems Society (HIMSS) Analytics Electronic Medical Record Adoption Model (EMRAM) as of December 2013. This study utilized two distinct target populations and two distinct samples. The MU analyses only included hospitals that were eligible for the Medicare EHR Incentive Program based on their CMS facility category. Out of a possible 393 United States (U.S.) Magnet hospitals, 330 represented the target population for the MU hypotheses. Out of a possible 6,582 U.S. hospitals, 4,929 were included in the study sample for the MU analyses. The HIMSS Analytics EMRAM analyses did not exclude hospitals that were ineligible for the Medicare EHR Incentive Program, and they also were independent of healthcare organizations’ CMS reporting structures. Out of a possible 393 U.S. Magnet hospitals, all 393 represented the target population for the HIMSS Analytics hypotheses. Out of a possible 6,582 U.S. hospitals, 6,419 were included in the study sample for the HIMSS Analytics analyses. Data were analyzed using binary logistic regression.

Magnet-designated hospitals had 3.58 times greater likelihood than non-Magnet hospitals of receiving Medicare EHR incentive payments for MU attestation ($p < .001$). Magnet hospitals also had 3.68 times greater likelihood than non-Magnet hospitals of achieving Level 6 on the HIMSS Analytics EMRAM ($p < .001$), and 4.02 times greater
likelihood than non-Magnet hospitals of achieving Level 6 or 7 ($p < .001$) when Levels 6 and 7 were combined together as one outcome variable. No significant relationships were found between Magnet status and the achievement of HIMSS Analytics EMRAM Level 7 when it was analyzed as an individual dependent variable ($p = .802$). No significant relationships were found between the tenure of Magnet status and any of the measures of EHR adoption.

Further study implications include the examination of multiple hospital characteristics that may contribute to EHR adoption and the qualitative exploration of nursing leaders’ perspectives at Magnet organizations that have successfully adopted EHR technology.
Dedication

This work is dedicated to my family who continually inspire me to achieve the highest standard possible and to face adversity with strength and perseverance. This dissertation is also dedicated to S.D., R.S., S.R., S.S., and B.C.J. for their unconditional love and support throughout the years.
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# TABLE OF CONTENTS

| LIST OF FIGURES | ix |
| LIST OF TABLES | x |
| LIST OF ABBREVIATIONS | xi |

## Chapter

1 INTRODUCTION

- Background of the Study .......................................................................................... 1
- The Healthcare Regulatory Landscape ....................................................................... 4
- Meaningful Use ........................................................................................................ 4
- MU Stage I .................................................................................................................. 7
- Nursing’s Role in Meeting Stage I Criteria ............................................................... 11
- MU Stage II .............................................................................................................. 12
- MU Stage III ........................................................................................................... 17
- HIMSS Analytics EMR Adoption Model .................................................................. 18
- Affordable Care Act and Value-Based Purchasing .................................................. 20
- Nursing Excellence and Magnet Recognition ........................................................... 21
- Journey to Magnet ..................................................................................................... 22
- 2008 Magnet Recognition Program Application Manual ....................................... 24
- Electronic Health Record Life Cycle ....................................................................... 25
- The Connection between Nursing Excellence and EHR Adoption ......................... 27
- Statement of the Problem ........................................................................................ 29
- Purpose of the Study ............................................................................................... 30
- Significance of the Study ........................................................................................ 30
- Research Questions ................................................................................................. 31
- Hypotheses ................................................................................................................ 31
- Theoretical Frameworks .......................................................................................... 32
- The Donabedian Quality Framework ....................................................................... 32
- Application of the Donabedian Quality Framework to this Study .......................... 33
- The Magnet Model ................................................................................................... 35
- Transformational Leadership ..................................................................................... 36
- Structural Empowerment ........................................................................................ 37
- Exemplary Professional Practice ............................................................................. 38
- New Knowledge, Innovations, and Improvements .................................................. 38
- Empirical Outcomes ............................................................................................... 39
- Application of the Magnet Model to this Study ...................................................... 40
- Assumptions ............................................................................................................. 41
- Summary .................................................................................................................. 42
4 RESULTS………………………………………………………………. 142
Magnet Data............................................................................. 142
CMS Meaningful Use................................................................ 142
H1....................................................................................... 143
H2a ................................................................................. 143
H2b..................................................................................... 143
H2c..................................................................................... 144
H3....................................................................................... 144
H4a..................................................................................... 144
H4b..................................................................................... 145
H4c..................................................................................... 145
Summary.............................................................................. 149

5 DISCUSSION............................................................................ 152
Findings and Interpretations.................................................... 152
Research Hypothesis 1............................................................... 153
Research Hypothesis 2............................................................... 154
Research Hypothesis 3............................................................... 157
Research Hypothesis 4............................................................... 159
Strengths and Limitations of the Study..................................... 160
Strengths................................................................................ 160
Limitations............................................................................. 161
Implications and Recommendations........................................ 164
Broader definitions of Nursing Excellence and EHR Adoption.... 165
Inclusion of multiple predictor variables..................................... 165
Incorporation of qualitative data from nursing leaders................ 167
Dissemination of Findings........................................................ 169
Summary.............................................................................. 169

REFERENCES............................................................................. 172

APPENDICES............................................................................. 189
A: HIMSS Analytics United States EMR Adoption Model.............. 189
B: Magnet Recognition Program® Magnet Model.......................... 190
C: Definition of Terms.................................................................. 191
D: Development of Magnet Data Set for Hypothesis 1..................... 196
E: Development of Study Sample for Hypothesis 1......................... 197
F: Magnet Hospitals by State......................................................... 198
G: States with HIMSS Analytics EMRAM Level 6 or 7 Magnet Hospitals......... 200
H: States with HIMSS Analytics EMRAM Level 7 Magnet Hospitals............. 201
I: States with HIMSS Analytics EMRAM Level 6 Magnet Hospitals............. 202
List of Figures

1. Application of the Donabedian Quality Framework to this Study .......... 35
2. Application of the Magnet Model to this Study .......................... 41
3. Study Samples ............................................................. 136
## List of Tables

1. Meaningful Use Stage I Core Objectives .................................................. 8
2. Meaningful Use Stage I Menu Objectives ............................................... 9
3. Meaningful Use Stage I Clinical Quality Measures ................................. 10
4. Meaningful Use Stage II Core Objectives ............................................. 12
5. Meaningful Use Stage II Menu Objectives ........................................... 14
6. Meaningful Use Stage II Clinical Quality Measures ............................... 15
7. HIMSS Analytics United States EMRAM ............................................... 19
8. Magnet Organizations and EHR Adoption (MU Attestation) .................... 146
9. Magnet Organizations, Tenure of Magnet Recognition and EHR Adoption... 147
10. Summary of Logistic Regression Results ................................................ 148
11. Summary of Hypotheses and Results .................................................... 150
List of Abbreviations

ANCC  American Nurses Credentialing Center
ARRA  American Recovery and Reinvestment Act of 2009
CMS   Centers for Medicare and Medicaid Services
CDSS  Clinical Decision Support System
CNO   Chief Nursing Officer
CPOE  Computerized Provider Order Entry
CQM   Clinical Quality Measure
DQF   Donabedian Quality Framework
EHR   Electronic Health Record
EMR   Electronic Medical Record
EMRAM Electronic Medical Record Adoption Model
HHS   Department of Health and Human Services
HIE   Health Information Exchange
HIMSS Health Information and Management Systems Society
HIT   Health Information Technology
HITECH Health Information Technology for Economic and Clinical Health Act
IT    Information Technology
NDNQI National Database of Quality Indicators
MU    Meaningful Use
PPACA Patient Protection and Affordable Care Act of 2010
SPSS  Statistical Package for the Social Sciences
VBP   Value-Based Purchasing
CHAPTER 1
INTRODUCTION

Recent healthcare reform initiatives mandate that health systems and providers electronically capture, share, and ultimately utilize data to improve patient outcomes. Two pieces of government legislation in particular, the American Recovery and Reinvestment Act (ARRA) of 2009 and the Patient Protection and Affordable Care Act (PPACA) of 2010 have significantly altered the delivery of healthcare services in the United States. As a result of the ARRA, PPACA, and other quality-of-care programs, the healthcare industry is experiencing a paradigm shift from a volume-based delivery model to a data-driven, value-based approach to healthcare services (AONE, 2012). This shift presents unprecedented opportunities for professional nursing practice to support EHR adoption and quality improvement efforts, while simultaneously quantifying its contributions to patient care through the use of EHR technology.

Background of the Study

The Centers for Medicare and Medicaid Services (CMS) established the Electronic Health Records Incentive Program, also referred to as “Meaningful Use” (MU), in accordance with the ARRA (CMS, 2010). Under MU, hospitals and providers eligible for Medicare and/or Medicaid reimbursement must demonstrate that their utilization of electronic health records (EHRs) positively impacts the quality of care they provide or risk significant financial losses (CMS, 2014b). Effective in 2015, Medicare and Medicaid reimbursement dollars will be awarded to those who meet the established MU objectives (CMS, 2014b), while failure to meet established criteria will result in financial penalties (Centers for Disease Control and Prevention, 2012; Jha et al., 2011).
Demonstration of EHR MU and the subsequent qualification for CMS reimbursement occurs in three stages, the first of which began in 2011, while the third stage is scheduled to begin in 2016 (HealthIT.gov, 2014b). Successful attestation to MU is one metric of EHR adoption within the United States’ healthcare system.

Another measure of EHR adoption is the Healthcare Information and Management Systems Society (HIMSS) Analytics Electronic Medical Record Adoption Model (EMRAM). The EMRAM is a model that ranks healthcare organizations on an eight-point scale, from zero to seven in ascending order, based on their level of electronic medical record (EMR) adoption (HIMSS Analytics, 2014c). The EMRAM is an independent, non-federal metric that is widely regarded as an industry standard for the evaluation of organizational EMR adoption. According to the HIMSS Analytics database, only 3% of the 5,458 hospitals evaluated as of December 2013 achieved Level 7 on the EMRAM (HIMSS Analytics, 2014d).

Many of the metrics by which MU is measured are related to the quality of nursing care. These metrics either represent nursing-sensitive indicators, or are dependent on nursing documentation. Despite the fact that nurses represent the largest group of EHR end-users (Choromanski, 2011; Harrington, 2012), the relationship between exemplary nursing care and the adoption of EHRs has not been widely researched. The American Nurses Credentialing Center’s (ANCC’s) Magnet Recognition Program distinguishes hospitals that demonstrate nursing excellence, quality patient care, and innovations in professional practice (ANCC, 2014b). The Magnet Recognition Program is guided by the Magnet Model, which offers a framework for both professional
nursing practice and nursing research (ANCC, 2014e). The model acknowledges Global Issues in Nursing and Health Care through five Core Models and their 14 respective Forces of Magnetism (ANCC, 2014e). To attain Magnet recognition, hospitals must embody all components of the Magnet Model using established, quantifiable measures. Among those criteria are: transformational nursing leadership, structural empowerment for all levels of nursing, and adoption of new innovations and demonstrated improvements to patient outcomes. To substantiate and support the attainment of Magnet Core Models, hospitals seeking Magnet status engage in an application process that involves extensive data capture of nursing-sensitive indicators (ANCC, 2014e).

The major goal of this study is to investigate whether there is a relationship between nursing excellence (operationally defined as Magnet designation) and EHR adoption (operationally defined by either Meaningful Use attestation or achievement of Level 6 or 7 on the HIMSS Analytics EMRAM). Successful EHR adoption is represented by two distinct measures to allow for the analysis of hospitals that are Magnet-designated but ineligible to participate in the CMS’ Medicare EHR Incentive Program due to their CMS classification. The HIMSS Analytics EMRAM does not exclude hospitals that specialize in long term, psychiatric, pediatric, rehabilitation, or cancer treatment. Therefore, by using a measure of EHR adoption that is independent of Medicare eligibility in addition to Medicare MU attestation, every U.S. Magnet-designated hospital can be analyzed in at least one of the study’s hypotheses.
The Healthcare Regulatory Landscape

A decade has passed since President George W. Bush allocated 100 million dollars to support the goal of nationwide EMR adoption by the year 2014 (Smolij & Dun, 2006). This objective has not been realized and many other developed nations have surpassed the U.S. in achieving widespread EHR adoption (Kumar & Aldrich, 2010). On February 13, 2009, the United States Congress passed the ARRA, commonly referred to as the “stimulus package”, which President Barack Obama signed into law on February 17, 2009 (Recovery.gov, 2014). As part of the ARRA, the Health Information Technology and Clinical Health (HITECH) Act was enacted under Title XIII “to promote the adoption and Meaningful Use of health information technology” (United States Department of Health and Human Services, 2014b. para. 1) by allocating $27 billion in incentives for hospitals and physicians to adopt the meaningful use of EMRs (Blumenthal, 2010). The HITECH Act formally tasked the Office of the National Coordinator (ONC) for Health Information Technology to oversee national efforts to implement and utilize the most advanced health information technology (HIT), and to coordinate nationwide electronic exchange of health information (HIE) (HealthIT.gov, 2014a).

Meaningful Use

The Centers for Medicare and Medicaid Services (CMS) formalized the concept of “meaningful use of health information technology” through the Medicare and Medicaid EHR Incentive Programs. These programs reward health systems and providers to first implement, adopt, and/or upgrade certified EHRs, and then to
subsequently utilize them to quantifiably improve the quality of their patient care (CMS, 2014b; United States Department of Health and Human Services, 2014b). Specifics on what actions are required to receive a payment are described in greater detail below. The United States Congress also authorized penalties for providers who cannot prove Meaningful Use of certified EHRs by the year 2015 (Jha et al., 2011).

There are multiple definitions of EHR adoption. The three main components of Meaningful Use that the ARRA specified are: 1) the use of certified EHR technology in a meaningful application such as electronic prescribing (e-prescribing), 2) the use of certified EHR technology for electronic health information exchange to enhance the quality of healthcare, and 3) the use of certified EHR technology for the submission of clinical quality measures (CQMs) and other like measures selected by the Secretary (CMS, 2010). Meaningful Use is defined by the CMS (2014a) as the demonstrated use of certified EHR technology to improve the quality, safety, and efficiency of patient care; decrease health disparities; engage patients and their families; improve the coordination of care; improve public and population health; and protect the security and privacy of patient data.

There are guidelines for certification of EHR technology. The CMS and the ONC established criteria and standards for the data that EHRs must utilize to qualify for the CMS EHR Incentive Programs. Certified EHRs store data in a structured format that facilitates the easy retrieval and transfer of patient information by providers, which enables them to use EHRs in ways that support optimal care. Entire EHR clinical suites and individual modules that meet the certification requirements are awarded a CMS EHR
Certification ID which identifies the technology being utilized to demonstrate Meaningful Use (CMS, 2013a). Certified EHR technology must also have the ability to calculate the numerators, denominators and exclusions for each of the clinical quality measures (Health Resources and Services Administration, 2014a). The Centers for Medicare and Medicaid Services released the first list of certified EHRs in the fall of 2010 (CMS, 2010). Hospitals and providers can access a list of certified EHRs on the ONC’s website (CMS, 2013a).

There are three stages of Meaningful Use that represent increasing levels of health information technology integration and sophistication. For each respective stage, eligible hospitals, critical access hospitals (CAHs), and healthcare providers attest for Medicare and/or Medicaid reimbursement by leveraging certified EHRs to achieve mandatory Core Objectives, selected Menu Objectives, and Clinical Quality Measures (CQMs) (CMS, 2014b). Stage I of Meaningful Use addresses data capture and sharing, Stage II incorporates the advancement of clinical processes, and Stage III focuses on improved outcomes (HealthIT.gov, 2014b). The three stages of Meaningful Use evolve over a period of five years, with Stage III scheduled to begin in 2016. The initial reporting period for Stage I is 90 days during the first year, followed by a second full year of reporting to attest for Meaningful Use (CMS, 2010). After successfully meeting Stage I criteria, hospitals and providers are then expected to meet Stage II requirements for a period of two full years. Successful attestation for Stage I Meaningful Use is a prerequisite for Stage II qualification (CMS, 2013d). Distribution of Medicare and Medicaid payments for Stage I began in 2011 as Stage II interim and final rules were
proposed and publicly commented on (CMS, 2014b). The final rule for Stage II requirements was published by CMS on September 4, 2012 (CMS, 2013d). The objectives of Stage I Meaningful Use were designed to provide the technical and clinical foundation upon which Stages II and III could build to achieve the overall goal of improved patient outcomes. Providers are permitted to claim exclusions for some of the core and menu objectives if those objectives are not applicable to their practice, specialty, or patient population (CMS, 2014b). As of December 2013, CMS’s EHR Incentive Program awarded over 5,000 Medicare payments to eligible hospitals in the United States (CMS, 2014b).

MU Stage I

In January 2010, the U.S. Department of Health and Human Services (HHS) published the initial Stage I Meaningful Use criteria requiring hospitals and providers to electronically capture data in a structured format in order to track clinical conditions, and to communicate patient health information for care coordination efforts (Brown, 2010). Implementation of clinical decision support (CDS) tools; disease management; medication management; and the initial reporting of CQMs and public health data are key components of Meaningful Use Stage I (Brown, 2010). Eligible hospitals must meet 18 out of a possible 23 Meaningful Use Core and Menu objectives, plus 15 Clinical Quality Measures to qualify for a Stage I incentive payment from the CMS (CMS, 2010). The Core and Menu objectives are the health information technology targets hospitals must reach to demonstrate their use of certified EHRs in ways that may enhance the delivery of
patient care. All 13 Core Objectives are mandatory. The Stage I Core Objectives are listed in Table 1 on the following page.

Table 1

*Meaningful Use Stage I Core Objectives (All 13 must be reported)*

<table>
<thead>
<tr>
<th>Number</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Implement computerized provider order entry (CPOE)</td>
</tr>
<tr>
<td>2</td>
<td>Implement drug-drug and drug-allergy interaction checks</td>
</tr>
<tr>
<td>3</td>
<td>Record demographics</td>
</tr>
<tr>
<td>4</td>
<td>Implement one clinical decision support rule</td>
</tr>
<tr>
<td>5</td>
<td>Maintain up-to-date problem list of current and active diagnoses</td>
</tr>
<tr>
<td>6</td>
<td>Maintain active medication list</td>
</tr>
<tr>
<td>7</td>
<td>Maintain active medication allergy list</td>
</tr>
<tr>
<td>8</td>
<td>Record and chart changes in vital signs</td>
</tr>
<tr>
<td>9</td>
<td>Record smoking status for patients 13 years or older</td>
</tr>
<tr>
<td>10</td>
<td>Report hospital clinical quality measures to CMS or States</td>
</tr>
<tr>
<td>11</td>
<td>Provide patients with an electronic copy of their health information, upon request</td>
</tr>
<tr>
<td>12</td>
<td>Provide patients with an electronic copy of their discharge instructions at time of discharge, upon request</td>
</tr>
<tr>
<td>13</td>
<td>Protect electronic health information</td>
</tr>
</tbody>
</table>

In addition to reporting all 13 of the Stage I Core Objectives, eligible hospitals must report five out of 10 of the Menu Objectives. The Stage I Menu Objectives are listed in Table 2 on the following page.

**Table 2**

*Meaningful Use Stage I Menu Objectives (Five out of 10 must be reported)*

<table>
<thead>
<tr>
<th>Number</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Capability to submit electronic data to immunization registries or immunization information systems and actual submission according to applicable law and practice</td>
</tr>
<tr>
<td>2</td>
<td>Capability to submit electronic data on reportable (as required by State or local law) lab results to public health agencies and actual submission according to applicable law and practice</td>
</tr>
<tr>
<td>3</td>
<td>Capability to submit electronic syndromic surveillance data to public health agencies and actual submission according to applicable law and practice</td>
</tr>
<tr>
<td>4</td>
<td>Implement drug formulary checks</td>
</tr>
<tr>
<td>5</td>
<td>Record advance directives for patient 65 years old or older</td>
</tr>
<tr>
<td>6</td>
<td>Incorporate clinical lab test results into certified EHR technology as structured data</td>
</tr>
<tr>
<td>7</td>
<td>Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, or outreach</td>
</tr>
<tr>
<td>8</td>
<td>Use certified EHR technology to identify patient-specific education resources and provide those resources to the patient if appropriate</td>
</tr>
<tr>
<td>9</td>
<td>The eligible hospital or critical access hospital (CAH) who receives a patient from another setting of care or provider of care or believes an encounter is relevant should perform medication reconciliation</td>
</tr>
<tr>
<td>10</td>
<td>The eligible hospital or CAH that transitions their patient to another setting of care or provider of care or refers their patient to another provider of care should provide summary care record for each transition of care or referral</td>
</tr>
</tbody>
</table>
Finally, all 15 of the Stage I Clinical Quality Measures must be reported to the CMS.

Table 3

*Meaningful Use Stage I Clinical Quality Measures (All 15 must be reported)*

<table>
<thead>
<tr>
<th>Number</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emergency Department Throughput – admitted patients - Median time from ED arrival to ED departure for admitted patients</td>
</tr>
<tr>
<td>2</td>
<td>Emergency Department Throughput – admitted patients – Admission decision time to ED departure time for admitted patients</td>
</tr>
<tr>
<td>3</td>
<td>Ischemic stroke – Discharge on antithrombotics</td>
</tr>
<tr>
<td>4</td>
<td>Ischemic stroke – Anticoagulation for A-fib/flutter</td>
</tr>
<tr>
<td>5</td>
<td>Ischemic stroke – Thrombolytic therapy for patients arriving within 2 hours of symptom onset</td>
</tr>
<tr>
<td>6</td>
<td>Ischemic or hemorrhagic stroke – Antithrombotic therapy by day 2</td>
</tr>
<tr>
<td>7</td>
<td>Ischemic stroke – Discharge on statins</td>
</tr>
<tr>
<td>8</td>
<td>Ischemic or hemorrhagic stroke – Stroke education</td>
</tr>
<tr>
<td>9</td>
<td>Ischemic or hemorrhagic stroke – Rehabilitation assessment</td>
</tr>
<tr>
<td>10</td>
<td>VTE prophylaxis within 24 hours of arrival</td>
</tr>
<tr>
<td>11</td>
<td>Intensive Care Unit VTE prophylaxis</td>
</tr>
<tr>
<td>12</td>
<td>Anticoagulation overlap therapy</td>
</tr>
<tr>
<td>13</td>
<td>Platelet monitoring on unfractionated heparin</td>
</tr>
<tr>
<td>14</td>
<td>VTE discharge instructions</td>
</tr>
<tr>
<td>15</td>
<td>Incidence of potentially preventable VTE</td>
</tr>
</tbody>
</table>

Nursing’s Role in Meeting Stage I Criteria

Nurses are directly involved in the attainment of 11 of the 13 MU Stage I Core Objectives through their responsibilities with medication administration, medication reconciliation, nursing admission assessments, shift assessments, patient education and discharge teaching. Of the 13 Stage I Core Objectives, there are only two that are not directly related to bedside nursing care. These are objective number five: Maintain up-to-date problem list of current and active diagnoses (CMS, 2010), and objective number 10: Report hospital clinical quality measures to CMS or States (CMS, 2010).

Direct patient care nurses also complete four of the 10 Stage I Menu Objectives as part of their nursing admission assessments, delivery of patient education, and completion of medication reconciliation. Nurses participate in communications between healthcare professionals at different settings of care when patients need to be referred or transferred, which pertains to the provision of a summary of care, or Menu Objective number 10 (CMS, 2013b). There are 15 Clinical Quality Measures requirements for Stage I Meaningful Use, and nine of the 15 are completed during the delivery of nursing care. These include medication administration, patient education and discharge teaching, and specific nursing interventions such as VTE assessment and non-pharmaceutical VTE prophylaxis.
MU Stage II

Stage II of Meaningful Use aims to utilize the data capture and sharing capacities achieved in Stage I to support advanced clinical processes (HealthIt.gov, 2014b). To qualify for Stage II Medicare and Medicaid incentive payments, eligible hospitals and CAHs must meet 16 Core Objectives and three out of a possible six Menu Objectives. They are also required to report on 16 out of 29 CQMs (CMS, 2013d). The 16 Core Objectives for Stage II are described in Table 4.

Table 4

*Meaningful Use Stage II Core Objectives (All 16 must be reported)*

<table>
<thead>
<tr>
<th>Number</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Use computerized provider order entry (CPOE) for medication, laboratory, and radiology orders directly entered by any licensed healthcare professional who can enter orders into the medical record per state, local, and professional guidelines</td>
</tr>
<tr>
<td>2</td>
<td>Record all of the following demographics: preferred language, sex, race, ethnicity, date of birth, date and preliminary cause of death in the event of mortality in the eligible hospital or CAH</td>
</tr>
<tr>
<td>3</td>
<td>Record and chart changes in the following vital signs: height/length and weight (no age limit); blood pressure (ages 3 and over); calculate and display body mass index (BMI); and plot and display growth charts for patients 0-20 years, including BMI</td>
</tr>
<tr>
<td>4</td>
<td>Record smoking status for patients 13 years old or older</td>
</tr>
<tr>
<td>5</td>
<td>Use clinical decision support to improve performance on high-priority health conditions</td>
</tr>
<tr>
<td>6</td>
<td>Provide patients the ability to view online, download, and transmit information about a hospital admission</td>
</tr>
<tr>
<td>7</td>
<td>Protect electronic health information created or maintained by the Certified EHR Technology through the implementation of appropriate technical capabilities</td>
</tr>
</tbody>
</table>
Table 4 continued from previous page

**Meaningful Use Stage II Core Objectives (All 16 must be reported)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Incorporate clinical lab test results into Certified EHR Technology as structured data</td>
</tr>
<tr>
<td>9</td>
<td>Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research, or outreach</td>
</tr>
<tr>
<td>10</td>
<td>Use clinically relevant information from Certified EHR Technology to identify patient-specific education resources and provide those resources to the patient</td>
</tr>
<tr>
<td>11</td>
<td>The eligible hospital or CAH who receives a patient from another setting of care or provider of care or believes an encounter is relevant should perform medication reconciliation</td>
</tr>
<tr>
<td>12</td>
<td>The eligible hospital or CAH who transitions their patient to another setting of care or provider of care or refers their patient to another provider of care provides a summary care record for each transition of care or referral</td>
</tr>
<tr>
<td>13</td>
<td>Capability to submit electronic data to immunization registries or immunization information systems except when prohibited, and in accordance with applicable law and practice</td>
</tr>
<tr>
<td>14</td>
<td>Capability to submit electronic reportable laboratory results to public health agencies, except where prohibited, and in accordance with applicable law and practice</td>
</tr>
<tr>
<td>15</td>
<td>Capability to submit electronic syndromic surveillance data to public health agencies, except where prohibited, and in accordance with applicable law and practice</td>
</tr>
<tr>
<td>16</td>
<td>Automatically track medications from order to administration using assistive technologies in conjunction with an electronic medication administration record (eMAR)</td>
</tr>
</tbody>
</table>

For Stage II, eligible hospitals and CAHs are required to meet three of six Menu Objectives listed in Table 5.

Table 5

**Meaningful Use Stage II Menu Objectives (Three out of six must be reported)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Record whether a patient 65 years old or older has an advance directive</td>
</tr>
<tr>
<td>2</td>
<td>Record electronic notes in patient records</td>
</tr>
<tr>
<td>3</td>
<td>Imaging results consisting of the image itself and any explanation or other accompanying information are accessible through CEHRT</td>
</tr>
<tr>
<td>4</td>
<td>Record patient family health history as structured data</td>
</tr>
<tr>
<td>5</td>
<td>Generate and transmit permissible discharge prescriptions electronically (eRx)</td>
</tr>
<tr>
<td>6</td>
<td>Provide structured electronic lab results to ambulatory providers</td>
</tr>
</tbody>
</table>

*Note. Adapted from “Stage 2 Eligible Hospital and Critical Access Hospital (CAH) Meaningful Use Core and Menu Objectives Table of Contents”, by the CMS, 2012b. Publicly available at http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Downloads/Stage2_MeaningfulUseSpecSheet_TableContents_EligibleHospitals_CAHs.pdf*

The third requirement of Meaningful Use Stage II is the completion of 16 out of 29 of the clinical quality measures. Table 6 describes the 29 CQMs on the following page.
Table 6

*Meaningful Use Stage II Clinical Quality Measures (16 out of 29 must be reported)*

<table>
<thead>
<tr>
<th>Number</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emergency Department (ED)-1 Emergency Department Throughput – Median time from ED arrival to ED departure for admitted ED patients</td>
</tr>
<tr>
<td>2</td>
<td>ED-2 Emergency Department Throughput – admitted patients – Admit decision time to ED departure time for admitted patients</td>
</tr>
<tr>
<td>3</td>
<td>Stroke-2 Ischemic stroke – Discharged on anti-thrombotic therapy</td>
</tr>
<tr>
<td>4</td>
<td>Stroke-3 Ischemic stroke – Anticoagulation Therapy for Atrial Fibrillation/Flutter</td>
</tr>
<tr>
<td>5</td>
<td>Stroke-4 Ischemic stroke – Thrombolytic Therapy</td>
</tr>
<tr>
<td>6</td>
<td>Stroke-5 Ischemic stroke – Antithrombotic therapy by end of hospital day two</td>
</tr>
<tr>
<td>7</td>
<td>Stroke-6 Ischemic stroke – Discharged on Statin Medication</td>
</tr>
<tr>
<td>8</td>
<td>Stroke-8 Ischemic or hemorrhagic stroke – Stroke education</td>
</tr>
<tr>
<td>9</td>
<td>Stroke-10 Ischemic or hemorrhagic stroke – Assessed for Rehabilitation</td>
</tr>
<tr>
<td>10</td>
<td>Venous Thromboembolism (VTE)-1 VTE prophylaxis</td>
</tr>
<tr>
<td>11</td>
<td>VTE-2 Intensive Care Unit (ICU) VTE prophylaxis</td>
</tr>
<tr>
<td>12</td>
<td>VTE-3 VTE Patients with Anticoagulation Overlap Therapy</td>
</tr>
<tr>
<td>13</td>
<td>VTE-4 VTE Patients Receiving Unfractionated Heparin (UFH) with Dosages/Platelet Count Monitoring by Protocol (or Nomogram)</td>
</tr>
<tr>
<td>14</td>
<td>VTE-5 VTE discharge instructions</td>
</tr>
<tr>
<td>15</td>
<td>VTE-6 Incidence of potentially preventable VTE</td>
</tr>
<tr>
<td>16</td>
<td>AMI-2-Aspirin Prescribed at Discharge for AMI</td>
</tr>
</tbody>
</table>
Table 6 continued from previous page

*Meaningful Use Stage II Clinical Quality Measures (16 out of 29 must be reported)*

<table>
<thead>
<tr>
<th>Number</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>PC-01 Elective Delivery Prior to 39 Completed Weeks Gestation</td>
</tr>
<tr>
<td>18</td>
<td>AMI-8a Primary PCI Received Within 90 Minutes of Hospital Arrival</td>
</tr>
<tr>
<td>19</td>
<td>AMI-10 Statin Prescribed at Discharge</td>
</tr>
<tr>
<td>20</td>
<td>PN-6 Initial Antibiotic Selection for Community-Acquired Pneumonia (CAP) in Immunocompetent Patients</td>
</tr>
<tr>
<td>21</td>
<td>SCIP-INF-1 Prophylactic Antibiotic Received within 1 Hour Prior to Surgical Incision</td>
</tr>
<tr>
<td>22</td>
<td>SCIP-INF-2 Prophylactic Antibiotic Selection for Surgical Patients</td>
</tr>
<tr>
<td>23</td>
<td>SCIP-INF-9 Urinary catheter removed on Postoperative Day 1 (POD1) or Postoperative Day 2 (POD2) with day of surgery being day zero</td>
</tr>
<tr>
<td>24</td>
<td>ED-3 Median time from ED arrival to ED departure for discharged ED patients</td>
</tr>
<tr>
<td>25</td>
<td>Home Management Plan of Care (HMPC) Document Given to Patient/Caregiver</td>
</tr>
<tr>
<td>26</td>
<td>Exclusive Breast Milk Feeding</td>
</tr>
<tr>
<td>27</td>
<td>Healthy Term Newborn</td>
</tr>
<tr>
<td>28</td>
<td>EHDI-1a Hearing screening before hospital discharge</td>
</tr>
<tr>
<td>29</td>
<td>AMI-7a Fibrinolytic Therapy Received Within 30 minutes of Hospital Arrival</td>
</tr>
</tbody>
</table>


There are 14 additional CQMs in Stage II as compared to Stage I, which reflects the increased specificity and depth of each measure. Providers who were early
demonstrators of Meaningful Use in 2011 are required to meet three consecutive years of Meaningful Use under the Stage I criteria before they can progress to the Stage II criteria in 2014. Providers who are not considered early demonstrators of Stage I must meet two years of Stage I criteria before advancing to the Stage II criteria in their third year (CMS, 2013d). Stage II criteria focus on more robust health information exchange; additional requirements for e-prescribing and the incorporation of laboratory results; electronic communication of patient care summaries across multiple settings; and increased patient-controlled data (HealthIT.gov, 2014b). Objectives in Stage II also include leveraging decision support for national high-priority conditions, increasing patient access to electronic self-management tools and improving population health (HealthIT.gov, 2014b).

In addition to completing and building upon Stage I MU Core and Menu Objectives, in Stage II there are three new CQMs in Stage II that are related to nursing care. They are CQM number 21: SCIP-INF-1 Prophylactic Antibiotic Received within 1 Hour Prior to Surgical Incision; CQM number 23: SCIP-INF-9 Urinary catheter removed on Postoperative Day 1 (POD1) or Postoperative Day 2 (POD2) with day of surgery being day zero; and CQM number 29: AMI-7a Fibrinolytic Therapy Received within 30 Minutes of Hospital Arrival, all of which fall within the scope of nursing practice.

**MU Stage III**

The overall goal of the third and final stage of MU is to improve patient outcomes. The previous goals from Stages I and II of data capture, data sharing, and advanced clinical processes were developed to support and facilitate Stage III’s
objectives. The focus of Stage III is to better the quality, safety, and efficiency of healthcare delivery in order to improve health outcomes. As of the third fiscal quarter of 2014, the criteria for Stage III were not published by CMS. Stage III criteria are scheduled to take effect in 2016 (HealthIT.gov, 2014b). Successful attestation to the MU objectives for the Medicare EHR Incentive Program represents a very important metric of EHR adoption in the U.S., but it is exclusive to hospitals that are Medicare-eligible. The HIMSS Analytics EMRAM is another way that healthcare organizations can measure their EMR progress, and this metric is independent of hospitals’ Medicare status.

**HIMSS Analytics EMR Adoption Model**

The Healthcare Information and Management Systems Society (HIMSS) was founded in 1961 and is an international not-for-profit organization dedicated to improving healthcare through the use of information technology (HIMSS Analytics, 2014a). The organization is comprised of over 52,000 individual members, 600 corporations, and 250 not-for-profit organizations, all of whom collaborate to generate health information technology education, industry events, research and thought leadership (HIMSS Analytics, 2014a). The HIMSS Analytics EMRAM consists of eight levels of EMR adoption, beginning at zero, which represents no EMR installation of ancillary applications (laboratory, pharmacy, and radiology), and evolves to Level 7 which reflects installation of a complete EMR (HIMSS Analytics, 2014c). There are three versions of the EMRAM: 1) The United States EMRAM, 2) the Canada EMRAM, and 3) the Ambulatory EMRAM (HIMSS Analytics, 2014c). The cumulative capabilities
of the HIMSS Analytics EMRAM for hospital facilities are listed in Table 7 and in Appendix A.

Table 7

**HIMSS Analytics United States EMRAM**

<table>
<thead>
<tr>
<th>Level</th>
<th>Cumulative Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Complete EMR, Continuity of Care Document (CCD) transactions to share data; Data warehousing; Data continuity with emergency department (ED), ambulatory, out patient</td>
</tr>
<tr>
<td>6</td>
<td>Complete EMR, Continuity of Care Document (CCD) transactions to share data; Data warehousing; Data continuity with emergency department (ED), ambulatory, out patient</td>
</tr>
<tr>
<td>5</td>
<td>Closed-loop medication administration</td>
</tr>
<tr>
<td>4</td>
<td>Computerized provider order entry (CPOE), clinical decision support (CDS) (clinical protocols)</td>
</tr>
<tr>
<td>3</td>
<td>Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology</td>
</tr>
<tr>
<td>2</td>
<td>Clinical data repository (CDR), controlled medical vocabulary, CDS, may have document imaging, HIE capable</td>
</tr>
<tr>
<td>1</td>
<td>Ancillaries are all installed - Laboratory, Radiology, and Pharmacy</td>
</tr>
<tr>
<td>0</td>
<td>All three ancillaries are not installed</td>
</tr>
</tbody>
</table>

(HIMSS Analytics, 2014c. Reproduced with permission)

Achievement of Level 7 reflects a complete EMR that utilizes data warehousing, data sharing, and continuity of data exchange between multiple healthcare settings (HIMSS Analytics, 2014c). In addition to supporting health data exchange, a complete EMR includes numerous clinical and interdisciplinary applications that directly impact, and are impacted by, nursing practice such as electronic nursing and clinical documentation (flow sheets), clinical decision support (error checking and clinical
protocols), and closed-loop medication administration. As of the end of the fourth quarter of 2013, only 3% of the 5,458 American hospitals in the HIMSS Analytics Database had achieved the top tier of Level 7 (HIMSS Analytics, 2014d), while 12.5% reached Level 6 (HIMSS Analytics, 2014d). Hospitals outside of the United States may obtain their EMRAM score; however, this study only includes U.S. hospitals because the CMS’ EHR Meaningful Use Incentive Programs are exclusive to the United States’ healthcare system. Just as Magnet designation represents excellence in professional nursing practice, attainment of either EMRAM Level 6 or 7 is regarded as the HIT industry standard for excellence in EHR adoption.

**Affordable Care Act and Value-Based Purchasing**

The Patient Protection and Affordable Care Act, also referred to as the Affordable Care Act (ACA) or “Obamacare”, was signed into law by President Obama on March 23, 2010, and upheld by the Supreme Court on June 28, 2012 (United States Department of Health and Human Services, 2014a). The ACA mandates health insurance reform (Fontenot, 2014) with a focus on improving quality and lowering healthcare costs, protecting consumers, and expanding access to healthcare (United States Department of Health and Human Services, 2014c). The ACA supports the expansion of health information technology use and the practice of electronic information exchange (United States Department of Health and Human Services, 2012). As part of the ACA and in an effort to improve state Medicare systems, the Centers for Medicare and Medicaid Services will facilitate the adoption of health information technology by augmenting the existing 50% federal match by 40 % (to a 90 % federal match) for any health information
technology investments made by states prior to 2016 (Berwick, 2010). The ACA also includes the Value-Based Purchasing (VBP) program which aligns financial incentives with a hospital’s ability to transform the quality of their patient care, thus placing emphasis on the quality of patient care instead of the quantity of patient care (CMS, 2013f). After discharge, the hospital VBP specifically evaluates patients’ perceptions of the quality of nursing care they received using the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey (Medicare.gov, 2014). The ACA reflects the U.S. government’s commitment to expanding the use of HIT, as well as its expectation that healthcare providers improve the quality of care that their patients receive.

**Nursing Excellence and Magnet Recognition**

The United States government and the healthcare industry are dedicated to the use of EHR systems to capture, measure, report, and improve patient outcomes. The American Nurses Credentialing Center’s (ANCC’s) Magnet Recognition Program emphasizes the quantifiable improvement of empirical outcomes through the delivery of superior nursing care, which includes the use of new innovations. Both the MU attestation and the Magnet application processes are data-driven, and they share numerous patient care objectives and metrics. The core components of the Magnet Model: Transformational Leadership; Structural Empowerment; New Knowledge, Innovations, and Improvement; and Exemplary Professional Practice are all aligned with the adoption of EHR systems. In this study, the Magnet Model components are hypothesized to support successful EHR adoption.
The Magnet Recognition Program was developed by the ANCC to recognize hospitals for nursing excellence, high quality patient care, and innovations in professional practice (ANCC, 2014a). The term “Magnet” dates back to the 1980s when it was used to refer to hospitals that were still able to attract nurses to work for them despite the severe nursing shortage at that time (Magnet Testimonials, 2012). In 1983, McClure, Poulin, Sovie, and Wandelt researched the characteristics of hospitals that successfully retained nursing professionals. This work was part of the 1981 initiative by the American Academy of Nursing to identify and study “Magnet” facilities, and it established the foundation for the Forces of Magnetism (Kirkley, Johnson, & Anderson, 2004). Both domestic and international hospitals may apply for Magnet status, however, as of December 2013, only 393 healthcare facilities in the United States were recognized as Magnet hospitals (ANCC, 2014a). Magnet status is one of the most distinguished healthcare designations an organization can achieve, and it is one of the only programs focused solely on nursing care and nursing-specific indicators at the organizational level. As with the HIMSS Analytics EMRAM variable, this study examines only Magnet hospitals located in the United States because Meaningful Use attestation is a phenomenon unique to the U.S.

**Journey to Magnet**

The application process for Magnet recognition is referred to as a journey (ANCC, 2014c). The initial eligibility criteria for Magnet applicants focuses on the healthcare organization’s nursing leadership, Chief Nursing Officer (CNO) education, nurse manager education, and facility-wide implementation of the American Nurses
Association’s Scope and Standards for Nurse Administrators (ANCC, 2008). During the first phase of the journey to Magnet, hospitals submit their CNO’s credentials and curriculum vitae, an organization chart, and a nationally benchmarked measurement instrument of nurse satisfaction to the ANCC (ANCC, 2008). In the remaining phases of the application process, hospitals submit written documentation that describes their organizational overview, demographic information, and nursing’s organizational relationship to the overall facility. Magnet applicant hospitals are required to provide documentation of staff certifications, patient satisfaction scores, employee nursing satisfaction, nursing-sensitive outcomes, and performance on quality improvement initiatives. They must also provide evidence that their facility is generating new knowledge, new innovations, and/or practice improvements through nursing research (ANCC, 2014a). Hospitals that are on the Magnet journey are required to collect and report nursing-sensitive data for the most recent four consecutive quarters. This data is benchmarked nationally and must include data on patient falls and pressure ulcers, as well as data from two additional nursing-sensitive indicators from the following categories: patient outcomes for blood stream infections, ventilator acquired pneumonia, use of restraints, pediatric intravenous infiltrations, or other specialty-specific indicators that are nationally benchmarked (ANCC, 2013b). Applicant hospitals must provide written narratives that articulate how all of the Magnet components are operationalized through their organizational programs or processes. These narrative descriptions are defined as the Sources of Evidence (SOE). SOEs represent the Magnet Program requirements in specific terms that clarify the expectations for all of the Core
Models/Magnet components, and these SOEs are evaluated and scored by the team of Magnet appraisers (ANCC, 2008).

Upon submission of the mandatory documents by the applicant healthcare organization, Magnet Program appraisers review and score all of the documentation prior to conducting a site visit of the hospital. The appraiser team then prepares a report for the Committee on Magnet Recognition (COM) based on their findings. After review of this report, the COM votes on whether or not the hospital has demonstrated Magnet excellence, and it informs the organization of its decision (ANCC, 2008). After initial Magnet designation is awarded, it is valid for a period of four years. During this time, Magnet organizations must submit a biennial report in the second year of recognition (ANCC, 2008). Re-designation involves an additional application, submission of documentation, and an appraisal process that includes an onsite visit by the ANCC (ANCC, 2014f). This study includes all U.S. first-time Magnet-designees and re-designated hospitals as of December 2013.


The Magnet Application Manual is the official reference for candidate organizations during their journey to Magnet. The manual describes the Magnet Model and specifies eligibility criteria, the application process, instructions for documentation, and provides information about site visits (ANCC, 2013a). The new 2014 Magnet Application Manual was released in July 2013 and took effect on August 1, 2014. Hospitals that submitted documentation between April 1 and June 1, 2014, had the option of using either the new 2014 manual or the previous version, the 2008 Application
Manual (ANCC, 2013a). To be consistent with the December 2013 Medicare reimbursement data for Meaningful Use and the HIMSS Analytics 2013 fourth quarter EMRAM levels, the 2008 Magnet Application Manual criteria are utilized in this study.

**Electronic Health Record Life Cycle**

Electronic health records have the potential to positively impact the delivery of healthcare in the United States (Naser, 2012). Reduced medical errors, improved quality, reduced costs, better population health, and increased ability to conduct research studies are some of the potential benefits of implementing EHR systems (Menachemi & Collum, 2011). Zlabek, Wickus, and Mathiason (2011) analyzed the effects of an acute care EHR with computerized provider order entry (CPOE) on several measures of patient safety and cost of care. Their results indicate that the implementation of an EHR with CPOE is consistent with decreased costs of care and increased levels of patient safety for their selected measures. Elnahal, Joynt, Bristol, and Jha (2011) propose that an EHR’s ability to support improvements in patient care delivery is contingent upon its proper design and implementation. The design and implementation of an EHR represent two of the phases that contribute to successful EHR adoption.

The process healthcare organizations use to plan, select, implement and evaluate information systems is referred to as the system development life cycle (SDLC) (Wagner, Lee, & Glaser, 2009). The term SDLC can refer to software development or the purchase of information systems from a vendor corporation. It can also describe the leasing of a system through an application service provider who is responsible to deploy, host, and manage the healthcare organization’s clinical and/or administrative information systems.
via centrally located servers (Wagner et al., 2009). There are four general phases of the SDLC: planning and analysis; design; implementation; and support and evaluation (Wagner & Lee, 2006).

Dimick (2009) described the EHR life cycle as having six phases: 1) initiation and planning, 2) requirements analysis, 3) design and development, 4) development and testing, 5) implementation, and 6) operations and maintenance. The first phase of the EHR life cycle, initiation and planning, involves the assessment of existing functionality; review and selection of EHR vendor(s); and resource planning. The core services include system review analysis, vendor analysis, identification of business needs, risk assessments, and impact analysis. The second phase, requirements analysis, describes the assessment and evaluation of the healthcare organization’s business needs. The core services are data flow analysis and workflow analysis (Dimick, 2009). The third EHR life cycle phase is the design and development phase, during which the development of the functional specifications to meet the organization’s needs are reconciled with the vendor products. This involves service for database support and development, business case analysis, reports analysis, and information technology design. The fourth phase, development and testing, describes the modification of the information systems to reconcile requirements and design, and the repeated testing of software and functions. Functional user testing and data flow analysis are the main services provided in this phase (Dimick, 2009). The fifth phase in the EHR life cycle is the implementation phase. The system is transitioned from testing into production as the end-users start to utilize the products in their daily workflow. The core services of training, system process support,
and information technology support are essential to this fifth phase of implementation. The sixth phase, operations and maintenance, is represented by the organization-wide release of the EHR system and the ongoing use in a live environment. Follow-up support and continuous engagement to support learning are the core services of the operations and maintenance phase (Dimick, 2009). The SDLC and the EHR life cycle are dynamic and non-linear in nature, and as with any information technology project life cycle, activities of one phase may overlap with one or more other phases (Schwalbe, 2013). The process of implementing EHR technology within the hospital setting is highly complex (Hoffmann, 2009) and benefits from team collaboration (Rimmerman, Heidenreich, & Appel, 2009). The disciplines of health informatics, clinical informatics, nursing informatics, and medical informatics must seamlessly intersect in order for EHRs to help, not hinder, patient care and the optimization of data analytics.

**The Connection between Nursing Excellence and EHR Adoption**

This study proposes that the connection between nursing excellence and electronic health record adoption lies in the successful embodiment of the Magnet Core Models and the data-driven Magnet application process. The demonstrated ability to accurately capture, collect, analyze, report, and apply data to improve patient outcomes is required to earn Magnet recognition, and it is also required for Meaningful Use attestation. Successful application of the Magnet Model at the organizational level may support the adoption of EHR systems. The Core Magnet Model of Transformational Leadership stipulates that an organization’s CNO be positioned to impact organizational change through strategic planning, advocacy, influence, visibility, accessibility, and
communication (ANCC, 2008). This Magnet component supports nursing leadership’s ability to engage in organizational executive decisions relating to all phases of the EHR system lifecycle. Some of the specific EHR implementation activities where nursing should be represented include: the needs assessment; vendor vetting; vendor selection; contract negotiations; system configuration; application testing; end-user training; clinical ownership; and system maintenance, support, reconfiguration, and optimization.

In the Magnet Model, Transformational Leadership is conceptualized to have reciprocal relationships with the Magnet components of Structural Empowerment and New Knowledge, Innovations, and Improvements. The former two components are also conceptualized to have bi-directional relationships with the Core Model of Exemplary Professional Practice (ANCC, 2008). In this study, transformational nursing leadership is applied as the fundamental component that supports the embodiment of the other four Magnet Core Models.

The Magnet Core Models of New Knowledge, Innovations, and Improvements; Exemplary Professional Practice; and Structural Empowerment and their respective Forces of Magnetism are applied to this study as antecedents and attributes of nursing engagement in the EHR life cycle. Active engagement by nurses in the EHR life cycle is related to all five of the Magnet Core Models, and it also is conceptualized to support the Magnet component of Empirical Outcomes by facilitating the data-driven journey to Magnet. This study proposes that the Magnet application process supports the Meaningful Use attestation process through the rigorous capture, collection, analysis, and utilization of nursing data to improve Empirical Outcomes. Meaningful Use’s Stage III
objectives emphasize improved patient outcomes, which are supported by the foundation established during the completion of Stages I and II’s data capture and sharing, and advanced clinical processes objectives. The intensive data collection period required of Magnet candidate hospitals and the subsequent utilization of their data to improve the quality of nursing care is congruent with the purpose and methodology of CMS’ EHR Incentive Programs. Hospitals with Magnet status are widely considered to have better nursing care environments than non-Magnet hospitals (Jayawardhana, Welton, & Lindrooth, 2014), and the ability to demonstrate nursing excellence for Magnet recognition may be an attribute of hospitals that are well-positioned to demonstrate MU.

**Statement of the Problem**

The United States government invested over a billion dollars to support the nationwide implementation, adoption, and meaningful use of EHRs (Smith, Bradley, Bichescu, & Tremblay, 2013), yet EHR system implementation in the United States lags behind that of other developed nations (Jha et al., 2011; Kumar & Aldrich, 2010). Failure to successfully implement and demonstrate meaningful use of EHR technology results in both the loss of financial incentives and the incurrence of financial penalties (Jha et al., 2011). Some of the most common reasons for information technology (IT) project failure include financial barriers, data and privacy concerns, and lack of acceptance by the users of the technology (Klosek, 2011). In the hospital, nursing delivers the greatest percentage of direct clinical care (Kirkley et al., 2004) and is the largest consumer of EHR technology (Choromanski, 2011; Harrington, 2012). As the largest group of EHR end-users, nurses and the quality of the nursing care they deliver
are central to understanding best practices in EHR adoption. Too often the needs of direct care nurses are underestimated or overlooked during the EHR life cycle, resulting in health information systems that are incompatible with clinical workflow. This in turn, can lead to end-user resistance to EHR systems and poor EHR adoption (Gillespie, 2002). The problem this research examines is the lack of knowledge surrounding the role of nursing excellence in the successful adoption of EHRs in U.S. hospital settings.

**Purpose of the Study**

The main objective of this observational quantitative study is to determine if Magnet hospitals are more likely to have higher EHR adoption than non-Magnet hospitals. This study also examines if the length of Magnet designation is positively related to the receipt of Medicare MU reimbursement, or the attainment of HIMSS Analytics EMRAM Level 6 or 7. By analyzing associations between facilities with excellent nursing care and facilities that successfully adopted EHRs, the current study is designed to answer key questions about the impact of exemplary nursing practice on hospital EHR initiatives. This research aims to establish a foundation for additional investigation of the role of nursing practice on EHR adoption, and vice-versa.

**Significance of the Study**

Despite the national attention electronic health record adoption has received, there is an identified gap in the current literature (2014) surrounding nursing’s impact on EHR adoption. The majority of the research studies published on EHR adoption, MU attestation, and HIT quality improvement initiatives were written from a business, medical, or policy perspective. There is also very limited research on Magnet
organizations within the context of healthcare technology and EHR adoption. The rationale for this study is the need to increase the body of knowledge on the relationship between nursing excellence and EHR adoption so that both practices may be advanced.

**Research Questions**

The primary research question for this study is: Is the presence of Magnet designation associated with successful EHR adoption? Four specific questions guided the research methods of this study: 1) Are Magnet hospitals more likely to attest to Meaningful Use than non-Magnet hospitals? 2) Are Magnet hospitals more likely to attest to have higher EHR adoption than non-Magnet hospitals? 3) Are Early-designation (1994-2009) Magnet hospitals more likely to attest to Meaningful Use than Recent-designation (2013-2014) Magnet hospitals? 4) Are Early-designation (1994-2009) Magnet hospitals more likely to have higher EHR adoption than Recent-designation (2010-2013) Magnet hospitals?

**Hypotheses**

The above research questions were analyzed using the following hypotheses:

*H1*: Magnet hospitals are more likely than non-Magnet hospitals to receive Medicare reimbursement for Meaningful Use.

*H2a*: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7.

*H2b*: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 7.

*H2c*: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6.

*H3*: Early-designation Magnet hospitals (1994-2009) are more likely to receive Medicare reimbursement for Meaningful Use Stage than Recent-designation Magnet hospitals (2010-2013).
H4a: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).

H4b: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).

H4c: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 than Recent-designation Magnet hospitals (2010-2013).

Theoretical Frameworks

The theoretical support for this study is based on two conceptual frameworks, the Donabedian Quality Framework (DQF) (1980) and the American Nurses Credentialing Center’s Magnet Model (ANCC, 2008). The DQF offers a framework for evaluating the quality of healthcare by examining the organizational conditions and characteristics that impact care delivery. It proposes that the organizational structures and processes involved in the delivery of healthcare influence the outcomes, or quality of the care, that is delivered (Donabedian, 1980). The Magnet Model describes the relationships that exist between the concepts of structure, process, and outcomes, by focusing on the nursing infrastructure that is created as a result of hospitals’ organizational structures and processes (ANCC, 2008).

The Donabedian Quality Framework

The Donabedian Quality Framework, or Donabedian Model, is widely recognized within health systems research as an established framework for assessing the quality of health services (McDonald, Sundaram, Bravata, et al., 2007). The constructs of structure, process, and outcomes were first introduced by Avedis Donabedian in 1966, and these components were incorporated into a formal model 14 years later. The DQF conceptualizes how the structures and processes of healthcare organizations influence
their outcomes, and it is flexible enough to be applied in a variety of clinical settings. The concept of structure represents the physical and organizational attributes that are generally stable such as physical buildings, medical equipment, personnel, access to care, financial processes, government regulation, and hospital policies. The concept of process represents the actions that are performed, and the interactions between patients and caregivers that transpire during the delivery of care. An organization’s processes are driven by its structures, and these processes occur in order to improve patient health. Outcomes are the third and ultimate concept in the Donabedian Model. Donabedian (1980) described an outcome as an alteration in a patient’s health status that can be attributed to the antecedents of the care received. Some examples of outcomes include patient survival, patient recovery, functional restoration, and satisfaction with care (McDonald et al., 2007). The Committee on Quality of Health Care in America (CQHCA) acknowledged Donabedian’s many contributions to the field of healthcare quality in the Foreword of the Institute of Medicine’s (IOM’s) 2001 report “Crossing the Quality Chasm: A New Health System for the 21st Century”. In this report, Donabedian was recognized for his work with the conceptualization and measurement of quality (CQHCA, IOM, 2001).

Application of the Donabedian Quality Framework to this Study. As the initial concept in the DQF, a healthcare organization’s structures provide the foundation for its subsequent processes. In this study, the organizational characteristics of structure are represented by the concepts of organizational structure, organizational culture, shared governance, and the Magnet components of Transformational Leadership and Structural
Empowerment. The physical characteristics of structure are manifested through organizations’ EHR systems and the embodiment of the Magnet core model of New Technologies, Innovations, and Improvements. As a regulatory initiative, the CMS MU EHR Incentive Programs also represent the concept of structure in this study.

In the DQF, the physical and organizational structures of healthcare settings support their processes. Therefore, the actions and interactions that transpire during the healthcare processes are dependent on the environment in which patient care is delivered (McDonald et al., 2007). In this study, the processes are represented by nursing engagement in the EHR life cycle, end-user adoption of EHR systems, the data collection of nursing-sensitive indicators for Magnet recognition, data capture and sharing as the MU Stage I overall goal, advanced clinical processes as the Stage II overall goal, and the Magnet component of Exemplary Professional Practice. These processes are performed to generate positive outcomes such as improved communication, continuity of care, patient safety, and overall patient and population health, all of which align with the objectives of Meaningful Use.

Outcomes demonstrate the impact of the processes that occur within a healthcare organization. They are the products of the infrastructure created by an organization’s structure and processes (Mitchell, Ferketich, & Jennings, 1998). In this research study, outcomes are represented by CMS Medicare reimbursement for Meaningful Use attestation, which is congruent with, and supported by, nursing-sensitive indicators, patient satisfaction, and the Magnet component of Empirical Outcomes. Although Stage III MU has not begun as of 2014, its overall goal is improved outcomes (HealthIt.gov,
In this study, receipt of CMS dollars for successful Meaningful Use attestation is conceptualized to represent EHR adoption. Figure 1 shows the application of the Donabedian Quality Framework to this study.

**The Magnet Model**

The 2008 Magnet Recognition Program Model is the second theoretical framework that guides the development of this study. The model is comprised of five Core Models, or components, which are divided into fourteen Forces of Magnetism.
Although it is not considered to be a model component, the concept of Global Issues in Nursing and Health Care is an overarching principle that surrounds the five Core Models (ANCC, 2014c). The five Core Models are 1) Transformational Leadership; 2) Structural Empowerment; 3) Exemplary Professional Practice; 4) New Knowledge, Innovations and Improvements; and 5) Empirical Outcomes (ANCC, 2014e) (see Appendix B).

**Transformational Leadership.** Healthcare organizations applying for Magnet designation are required to identify one nursing professional as their Chief Nursing Officer (CNO). He or she is responsible for maintaining the organization’s overall standards of nursing practice, and must also be actively involved in his or her organization’s “highest governing, decision-making, and strategic-planning body” (ANCC, 2008, p. 6). Within a Magnet hospital, the CNO represents a transformational leader who cultivates a powerful vision; clear nursing philosophy; professional practice model; and strategic and quality plans in his or her leadership of nursing services. One of the main responsibilities of a transformational CNO is to help his or her organization to evolve to address existing and anticipated needs and strategic priorities (ANCC, 2008). In addition to the CNO’s responsibilities, nurse leaders at every level of Magnet facilities are expected to demonstrate Transformational Leadership by supporting and advocating for their nursing staff and their patients. The transformational CNO must be strategically positioned to exert influence on executive stakeholders, particularly during times of change management. He or she must also be perceived as an executive leader himself or herself (ANCC, 2008). Contemporary transformational leadership in nursing has evolved from the practice of providing stability and growth to the delivery of leadership that
transforms organizational beliefs, values, and behaviors (ANCC, 2014e). This Core Model of the Magnet Model is represented by two Forces of Magnetism: Quality of Nursing Leadership and Management Style. The Sources of Evidence (SOEs) for the Transformational Leadership component are Strategic Planning; Advocacy and Influence; Visibility, Accessibility, and Communication (ANCC, 2008).

**Structural Empowerment.** The next Core Model is Structural Empowerment, which is comprised of five Forces of Magnetism: Organizational Structure, Personnel Policies and Programs, Community and the Healthcare Organization, Image of Nursing, and Professional Development. The ANCC posits that Structural Empowerment is facilitated by the structures and processes that influential nursing leadership develops (2014e). The flat organizational structure of Magnet hospitals supports nurses at all levels to engage in decision-making activities, and to practice shared governance. Nursing leaders are expected to serve on committees and task forces that guide the delivery of safe, efficient, and high-quality patient care. In turn, it is the responsibility of Magnet organizations to provide the necessary structures and processes to empower their nurses to pursue role development, career advancement, and lifelong learning (ANCC, 2008). An essential characteristic of Magnet organizations is the presence of lateral and bi-directional communication and decision-making between direct-care nurses, managers, and the CNO (ANCC, 2008). The five SOEs for Structural Empowerment are Professional Engagement; Commitment to Professional Development; Teaching and Role Development; Commitment to Community Involvement; and Recognition of Nursing (ANCC, 2008).
**Exemplary Professional Practice.** The next Core Model, or component, of the Magnet Model is Exemplary Professional Practice. There are five Forces of Magnetism that support this component: Professional Models of Care, Consultation and Resources, Autonomy, Nurses as Teachers, and Interdisciplinary Relationships (ANCC, 2008). This force emphasizes not only the attainment of Exemplary Professional Practice, but also the achievements that result from such practice. Magnet organizations proactively research, develop, and test professional nursing practice models to advance their quality of care. Autonomy, interdisciplinary collaboration, equity in care, and workplace advocacy are some of the other attributes of Exemplary Professional Practice (ANCC, 2008).

Providing a culture of safety is also fundamental to the component of Exemplary Professional Practice, and Magnet applicant organizations must analyze their own data against national benchmarks to evaluate how their level of care compares to that of other hospitals. This benchmarking process helps Magnet candidate hospitals identify appropriate systematic quality improvement initiatives. There are nine SOEs for this Magnet component: Professional Practice Model; Care Delivery System(s); Staffing, Scheduling, and Budgeting Processes; Interdisciplinary Care; Accountability, Competence, and Autonomy; Ethics, Privacy, Security, and Confidentiality; Diversity and Workplace Advocacy; Culture of Safety; and Quality Care Monitoring and Improvement (ANCC, 2008).

**New Knowledge, Innovations, and Improvements.** The fourth Core Model is New Knowledge, Innovations, and Improvements. This component addresses the application of current evidence, new models of care, new evidence, and identifiable
contributions to nursing science; it is represented by one Force of Magnetism, Quality Improvement. Magnet hospitals must have established programs that support evidence-based practice (EBP) and research programs. The integration of EBP and research into all clinical settings throughout the organization is mandatory, as is the systematic review and application of published research studies (ANCC, 2008). Magnet healthcare organizations are required to have research activity productivity targets and they must also demonstrate innovations in patient care. The three SOEs for the New Knowledge, Innovations, and Improvements component are Research, Evidence-Based Practice, and Innovation (ANCC, 2008). One of the Innovation SOE specifically refers to Innovation as “The structure(s) and process(es) by which nurses are involved with the evaluation and allocation of technology and information systems to support practice or nurses’ participation in architecture and space design to support practice” (ANCC, 2008, p. 32).

Empirical Outcomes. As a Core Model, Empirical Outcomes are positioned in the very center of the Magnet Model, surrounded by the other models of Transformational Leadership; Structural Empowerment; Exemplary Professional Practice; and New Knowledge, Innovations, and Improvements. Quality of Care is the component that represents the concept of Empirical Outcomes. The ANCC (2014e) stipulates that Empirical Outcomes should be categorized within the context of clinical outcomes that are related to nursing practice; workforce; patient and consumer; and organizational outcomes. In the preceding four Core Models, the Empirical Outcomes are requested as Sources of Evidence (ANCC, 2008).
Application of the Magnet Model to this Study

This study applies the ANCC’s Magnet Model within the context of the Donabedian Quality Framework. The Magnet Model leverages the concepts of structure, process, and outcomes; and the 2008 Magnet Application Manual represents a departure from previous versions that placed greater emphasis on structure and process. With the 2008 Application Manual, the focus was on the outcomes of the infrastructure created by the preceding structures and processes. These outcomes are described by the ANCC as “essential to a culture of excellence and innovation” (ANCC, 2008, p. 3). Structure is defined in the Magnet Model as the organizational and healthcare system characteristics that include nursing leadership, practice models, and access to resources. Process is defined as the actions that are included in the safe, ethical, evidence-based, and autonomous delivery of nursing and healthcare services. Practice also involves actions that focus on quality improvement efforts. Finally, outcomes are defined as evidence of the effect that structure and process have had at the patient, consumer, organizational, and nursing level. Evidence of the impact of outcomes may be qualitative or quantitative, and may be reported from multiple levels of a healthcare organization (ANCC, 2008). In the current study, the Donabedian Quality Framework is also applied to the Magnet Recognition Program with the Core Models of Transformational Leadership; Structural Empowerment; New Knowledge, Innovations, and Improvements; and Exemplary Professional Practice representing the concept of structure. The journey to Magnet represents the concept of process, and the Core Model of Empirical Outcomes represents
the Donabedian concept of outcomes. Figure 2 illustrates the application of the Magnet Model to this research study.

**Figure 2. Application of the Magnet Model to this Study**

Assumptions

Assumptions are basic principles that are believed to be true without verification or proof (Polit & Beck, 2012). In this study, there are components of the research that the researcher assumed to be true. These assumptions are articulated so that readers may understand the context of their development, and interpret the results within the context of these assumptions. It is assumed for the purposes of this study that all of the publicly-accessible data sets are complete and that they contain accurate information. It is also
assumed that any missing data would have been acknowledged by the publisher of the data.

Summary

Implementation and adoption of electronic health records is a national priority. With billions of dollar invested by the United States government, and millions of dollars at risk for healthcare organizations who do not demonstrate Meaningful Use of EHR systems, there is an immediate need for researchers to investigate best practices for successful EHR adoption. The impact of professional nursing practice on EHR adoption has not been thoroughly investigated. Using Magnet recognition to represent nursing excellence, this study examines the relationship between nursing excellence and EHR adoption in U.S. hospital settings. Electronic health record adoption is represented by receipt of Medicare EHR Incentive Program payments from the CMS for Meaningful Use attestation, or the achievement of Level 6 or 7 on the HIMSS Analytics EMRAM. The objectives of this study are to contribute to the current body of knowledge and to provide a foundation for future nursing informatics research.
CHAPTER 2

LITERATURE REVIEW

Previous research on the effects of the Health Information Technology for Economic and Clinical Health Act on electronic health record adoption in hospital settings has reflected generally positive results; however, it is unlikely that the goal of universal EHR adoption will be realized without additional work efforts (DesRoches et al., 2013). Nurses’ experiences with EHRs are not the same as physicians’ experiences (Robles, 2009), and the relationship between excellent nursing practice and EHR adoption is under-studied. Dykes and Collins (2013) specifically note that there is a lack of existing research focused on the relationship between nursing-specific indicators and the utilization of healthcare information technology. Chapter 2 presents a literature review of the current state of the science to substantiate the need for this study.

This literature review begins with publications written about the two theoretical frameworks that support the conceptual foundation for this study, the Donabedian Quality Framework and the Magnet Model. The DQF is reviewed within the context of nursing and EHR adoption, and literature on the American Nurses Credentialing Center’s Magnet Model is reviewed within the context of nursing and electronic health records. Next, there is a review of articles that examine the Magnet Recognition Program’s relationship with patient outcomes. The subsequent section of the literature review addresses the organizational characteristics of hospitals that have attested to Meaningful Use. Publications about the HIMSS Analytics Electronic Medical Record Adoption Model, and a review of the factors that influence EHR adoption in hospital settings are also included. The current study’s literature review concludes with a discussion of the
existing literature on nursing, leadership, EHRs, MU, and the HIMSS Analytics EMRAM as interrelated concepts.

**Search Strategy**

The review of the literature was conducted using multiple sources including online research databases, scholarly journals, government reports and legislation, government websites, organizations’ official websites, books, white papers, and industry publications. Online databases hosted by the University of Miami that were utilized included: CINAHL Plus; ERIC; Library, Information Science & Technology Abstracts, MEDLINE; PUBMED; ProQuest Dissertations and Theses; and ProQuest Health Management. Sage Journal Online and Wiley Online Library were also used in the literature search to access peer-reviewed articles. Keywords searched included: Donabedian Quality Framework; Donabedian Model; Donabedian Theory; Magnet Model; Magnet Hospitals and Patient Outcomes; Meaningful Use Attestation; Barriers to EHR Adoption; Nursing and Electronic Health Records; Nursing and Electronic Medical Records; Healthcare and Information Management Systems Society; and HIMSS Analytics.

The literature review incorporates both current and historical sources. The majority of the articles related to EHR systems and the EHR Incentive Programs were published between 2009 and 2014. This time period coincides with the passing of the American Recovery and Investment Act, which includes the HITECH Act and the CMS EHR MU Incentive Programs. Some of the references related to the Magnet Recognition Program that were reviewed preceded 2009 in order to provide an accurate background
of the program’s origins and evolution. The 2008 Magnet Application Manual was referenced as opposed to the 2014 manual so the timeframe of the application criteria for Magnet recognition was consistent with the attestation period for Meaningful Use. Some classic works written about the DQF that were published prior to 2009 were also reviewed.

**The Donabedian Quality Framework in Nursing and Electronic Health Records**

Avedis Donabedian’s Quality Framework is used in a limited number of publications to describe the relationships between organizational structures, processes, and outcomes as they relate to nursing and electronic health records. Donabedian (1980) proposed that structures in healthcare are the settings, or the context in which healthcare is delivered. Structures are relatively stable factors such as physical buildings or organizational characteristics. Examples of structure also include a hospital’s nursing staff and its technology resources such as an electronic health record system. Processes describe how care is delivered and include all of the acts of healthcare delivery (Donabedian, 1980). An example of a nursing process is a registered nurse completing an admission assessment on a new patient and documenting his or her findings electronically. Outcomes are the effects of healthcare, and they are supported by the infrastructure created by a healthcare organization’s structures and processes (Donabedian, 1980). An example of a nursing-specific outcome is the placement of a on fall precautions as a result of the appropriate structures and processes being in place. As a registered nurse (structure) electronically documents a fall assessment (process) in the EHR (structure), clinical decision support rules can trigger fall risk alerts based on the
inputted data that identify a patient’s level of fall risk (process), which have the capability to suggest the initiation of fall risk protocols (outcome). Ideally in this scenario, the patient would not experience a fall in the hospital setting, which would represent both a positive outcome (the absence of a patient fall) and a measurement of the quality of care (number of inpatient falls).

Dykes and Collins (2013) posit that the Donabedian framework is useful in conceptualizing how health information technology can be leveraged to establish connections between nursing care and improved patient outcomes. They reiterate that the structure-process-outcome model serves as the foundation for the evaluation of healthcare quality in many United States organizations. Dykes and Collins (2013) propose that Donabedian’s model is an appropriate framework to link nursing practice to improvements in patient outcomes because there are multiple aspects of nursing care, manifested as both structures and outcomes, that can impact patient outcomes. Structures are the elements that influence the context in which patient care is delivered (Donabedian, 1980). Dykes and Collins (2013) describe the number of nursing care hours and the presence or absence of advanced clinical information systems as two examples of structures in nursing care. Processes are the actions and interactions that occur during the delivery of healthcare (Donabedian, 1980). Two examples that Dykes and Collins (2013) give to represent the concept of process are: risk assessments completed by nurses and the subsequent nursing interventions that are implemented to address the identified risks. Dykes and Collins also specifically refer to the nursing actions as processes of care (2013). Finally, outcomes are the effects, or the products, of
healthcare (Donabedian, 1980). They are produced as a result of the infrastructure that is established by structures and processes. In Dykes and Collins’ (2013) article, the concept of outcomes is represented by nursing-sensitive outcomes such as pressure ulcers and patient falls. The authors reported that there are very few rigorous studies in the current literature that investigate the relationship between the utilization of health information technology and nursing outcomes. They recommend that additional research be conducted to determine which types of health information systems are associated with improved processes and outcome indicators (Dykes & Collins, 2013).

Kelley, Brandon, and Docherty (2011) applied Donabedian’s 1980 model to organize nursing studies in an integrative review of research focused on the relationship between electronic nursing documentation and the quality of patient care delivery. Kelley et al. (2011) selected the Donabedian Model because they believe most nurses are familiar with the framework. In their study, the concept of structure was represented by nurses’ use of electronic documentation. The associated structural aspects are the characteristics of the nurses using the electronic documentation and the characteristics of the actual electronic documentation system. Process was conceptualized as the daily interactions that took place between the nursing staff and the electronic documentation system. In the Donabedian Model (1980), high-quality outcomes are the result of high-quality structures and processes. In Kelley et al.’s (2011) integrative review, outcomes are represented as the health status of patients at the time of discharge or transfer from the hospital setting. Their search of the relevant literature resulted in a review of 24 studies published within the last 30 years.
Kelley et al.’s (2011) review of the construct of structure reveals that certain characteristics nurses possess affect their attitudes towards the electronic nursing documentation systems. While age was not found to have a statistically significant relationship with nurses’ attitudes; the level of education was positively associated with favorable opinions of electronic systems (Kelley et al., 2011). In reviewing the construct of process, they found that some nurses were concerned with the amount of time electronic documentation required as opposed to paper-based charting. Kelley et al. (2011) reported that in some of the studies, nurses were worried that increased time spent on electronic documentation would detract from the amount of time they could spend providing direct patient care. Additionally, there were nurses who articulated that electronic documentation systems failed to meet their day-to-day interaction needs (process needs) with respect to retrieval of previously charted data. There were also mixed reactions regarding the use of pre-set, discrete data element options for documentation. Some nurses felt restricted by pre-set options such as drop-down boxes, and reported that they preferred to use free-text narrative charting; others indicated that they appreciated pre-set choices and electronic care-planning because they believed that those functions helped to trigger their memory (Kelley et al., 2011).

The results of the Kelley et al. (2011) review indicate that nurses were not asked to describe how electronic documentation facilitated the delivery of safe patient care. Although nursing satisfaction with electronic systems is the focus of several studies, there is a lack of investigation about if and why nurses think electronic documentation supports safe nursing practices. Their integrative review concludes that the body of
knowledge surrounding the empirical evaluation of patient health outcomes as a product of electronic nursing documentation is highly limited (Kelley et al., 2011). The authors conclude there are research gaps across all three of the constructs of quality: structure, process, and outcomes and they were unable to quantify the result of electronic nursing documentation on the quality of patient care. Kelley et al. (2011) propose that additional research is needed to understand the impact of electronic nursing documentation.

Clark and Normile (2012) refer to the structure-process-outcome model as a characterization of organizational flow in a quantitative, exploratory, retrospective comparative analysis of patients admitted to critical care (CC) units from the emergency department (ED). Their study leveraged data obtained from electronic medical records to investigate the characteristics, factors, and occupancy rates that affect the outcomes of ED patients admitted to CC units. The researchers posit that in an ED care environment, the movement of patients through the healthcare system is measured as input-throughput-output. They equate input-throughput-output to organizational flow, and thus by default, compare it to Donabedian’s structure-process-outcome model (Clark & Normile, 2012). Clark and Normile (2012) assert that the structure-process-outcome model can be used to extrapolate the influence of the healthcare system on the flow and outcome of the patients (2012). They reference Donabedian’s position that processes are driven by structure (1980), and in their study they identify policies, procedures, and protocols as representations of structure. The researchers suggest that the outcomes produced by processes must be evaluated by the original structure(s) in order to stimulate quality improvement initiatives (Clark & Normile, 2012). For this study, data (including nursing
documentation) were retrieved from the hospital’s EMR, Microsoft Amalga®, which is a single database system (Clark & Normile, 2012). The results of Clark and Normile’s (2012) retrospective study indicate that the longer the time from a patient’s arrival to the ED to the time an order was placed for an ICU bed, the more likely patient mortality with an odds ratio (OR) of 1.288. The higher the patient occupancy or census in the ICU at the time the decision was made to admit the patient to ICU, the more likely patient mortality (OR = 1.09, p = .026, 95% CI [1.01, 1.77]). The results of the study did not find a significant relationship between patient occupancy in the ED at the time of the decision to admit to ICU and patient mortality. Uninsured patients who were admitted to the ICU from the ED had higher mortality (OR = 1.58, p = .036, 95% CI [1.03, 2.14]). Patients who were transported to the ED via ambulance, and then admitted directly from the ED to the ICU were also shown to have higher mortality (OR = 1.83, p < .001, 95% CI [1.33-2.52]) (Clark & Normile, 2012). The authors propose that their findings could generate further researchable questions that leverage additional nursing-specific variables extracted from a single comprehensive database that houses all EMR data on a unified platform (Clark & Normile, 2012).

The structure-process-outcome model of the Donabedian Quality Framework has been used in a small number of nursing research studies to illustrate the relationship between electronic health records and health information technology systems (structure), the utilization of such systems in nursing practice (processes), and the resulting outcomes. The consensus in the literature is that additional investigation is warranted to further examine the relationship between nursing practice and EHRs. The ANCC’s
The Magnet Recognition Program is guided by the Magnet Model and the Magnet Model incorporates constructs of Donabedian’s framework. The following section discusses the use of the Magnet Model in publications that investigate nursing care and electronic health records.

**The Magnet Model in Nursing and Electronic Health Records**

Only a limited number of articles were found that focus on the application of the Magnet Model within the context of use of electronic health records in nursing practice. The scholarly literature is mostly written from the perspective of nursing professionals who recognize and articulate how the Magnet Model is an appropriate framework for health information technology initiatives. Nursing authors articulate how they utilized components of the Magnet Model to guide their health IT projects, and they offer evidence to support their positions. Most of the publications on this subject are articles that describe the authors’ own experiences implementing technology, as opposed to empirical research studies.

Kirkley, Johnson, and Anderson describe the increase in clinical information technology supporting nursing excellence as a “significant development” (2004, p. 94) in professional practice, and they assert there are connections between many of the forces of Magnetism and the successful deployment of clinical information systems (CISs). They suggest that the development of technology to support nursing has had an impact on the delivery of nursing care within the United States (Kirkley et al., 2004). The authors argue that there are numerous parallels between the characteristics that differentiate Magnet-level care and the successful implementation of CISs to support nursing
interventions and outcomes. They based their research on the experience of North Carolina Baptist Hospital of Wake Forest University Baptist Medical Center, which received Magnet designation in 1999, and began installing the IDX LastWord® clinical enterprise system in 1998 (Kirkley et al., 2004). Considering that for many organizations the average journey to Magnet can last 4.25 years (Russell, 2010), and that implementing a CIS also takes several years, much of the work occurs in tandem for these two types of projects.

Kirkley et al. (2004) write that the leadership strategies, interdisciplinary collaboration, workflow analysis, and design processes essential to technology adoption are aligned with the Magnet Recognition Program’s Quality of Leadership Force of Magnetism. The Magnet emphasis on the Quality of Nursing Leadership, where nursing leaders must be willing to take risks and demonstrate innovative and dynamic leadership skills, was compared to the organizational leadership required to successfully implement a health information system. Additionally, the nurse leaders at the Wake Forest University Baptist Medical Center were reported to have leveraged data extracted from the CIS’s decision support software to analyze information pertaining to nurse staffing, patient satisfaction metrics, and patient accounting figures (Kirkley et al., 2004).

Another force of Magnetism, Management Style, is embodied by nursing leadership that is visible, accessible, and dedicated to effective communication with its nursing staff (ANCC, 2008). Magnet nursing leaders exemplify a participative management style, and they solicit and incorporate staff feedback into their decision. Kirkley et al. (2004) write that organizations implementing CISs would benefit by
incorporating this Magnet leadership style, as it supports the active engagement of bedside clinicians during system design, testing, and training phases. The collaboration of nursing with information services staff was reported to facilitate appropriate technical and clinical configuration of the LastWord® CIS at the medical center (Kirkley et al., 2004).

The Magnet Model supports a decentralized organizational design. Kirkley et al. (2004) state that the Organizational Structure Force of Magnetism is consistent with the organizational teamwork required throughout the life cycle of an enterprise-wide CIS. The authors believe that the flat and collaborative nature of Magnet facilities’ organizational structure is consistent with successful interdisciplinary efforts to select, design, and implement clinical information systems on a large scale. The ability for direct patient care nurses and administrators to access real-time patient data from CISs is described as a powerful nursing tool supported by technology (Kirkley et al., 2004). Specific examples of how LastWord® enhances patient safety include automated suggestions/alerts for protocol initiation such as a skin care protocol; and drug-drug and drug-allergy interaction checking (Kirkley et al., 2004). The ability of nurses to readily access these capabilities reflects the Magnet Core Model of Structural Empowerment.

The Quality of Care Force of Magnetism stipulates that nursing leadership supports its nurses by providing them with the proper environment to deliver high-quality care to their patients. Nurses must also perceive that they provide high-quality nursing care (ANCC, 2003). Kirkley et al. (2004) present the example of how a CIS application facilitated both requirements of the Quality of Care force through electronic pre-
screening of patients to identify risk for pneumonia. The computerized screening was incorporated into initial nursing assessments at the medical center, and it resulted in a 75% decrease in aspiration pneumonia (Kirkley et al., 2004). It also gave nurses at all levels the ability to extract outcomes data from the system, thus allowing them to recognize, and be recognized for, the quality of care they delivered. As a current Force of Magnetism, Quality of Care contributes to both the Exemplary Professional Practice and the New Knowledge, Innovations, and Improvements Core Models (ANCC, 2008).

The Quality Improvement Force of Magnetism also represents part of the New Knowledge, Innovations, and Improvements Core Model (ANCC, 2008). Kirkley et al. (2004) give an example of how the adoption of computerized provider order entry (CPOE) at Wake Forest assisted two cardiology units in achieving a 35% and a 39% decrease in adverse drug events respectively over the course of one year. The researchers describe how the implementation of new CIS technology actually affords nursing leaders the unique opportunity to make system and practice assessments, and to initiate changes that lead to improvements (Kirkley et al., 2004).

In a similar format to the Kirkley et al. (2004) article, Lindgren, Elie, Vidal, and Vasserman (2010) describe how the process of implementing the Siemens Patient Care Document System at South Miami Hospital exemplifies several of Magnet ideals. This implementation initiative was called the Clinical Transformation Project (CTP), and Lindgren et al. (2010) posit that multiple manifestations of Forces of Magnetism were present in the CTP. They propose that the CTP facilitated the standardization of clinical practice and the timely improvement of the quality of care delivery. The authors also
note that by measuring the components of the CTP against the ANCC’s Magnet Recognition Program, which is a benchmark for nursing care, the quality of the CTP was substantiated (Lindgren et al., 2010).

The goal of the CTP at South Miami Hospital was to achieve standardized, quality nursing care. Lindgren et al. (2010) state that to transform clinical nursing practice into a system that is both effective and efficient, it is imperative to incorporate electronic health records as well as the electronic communication and storage of patient data, organizational procedures, policies, forms, and evidence-based guidelines into practice. The aim of the CTP was to implement an interdisciplinary electronic documentation system across all seven locations, which included an EMR for each patient (Lindgren et al., 2010). A bar-coded medication administration system, MAK, and Zynx, an evidence-based protocol tool were also implemented during the CTP. The needs of the bedside clinicians were considered during the planning and analysis of the new systems. Registered nurses were trained to educate their peers on the new technologies, and nursing informatics specialists were hired for the team to provide their expertise throughout the project life cycle as well (Lindgren et al., 2010). Direct care nurses and mid-level managers were involved in “fast track” sessions that addressed the standardization of content with respect to nursing documentation, forms, flowsheets and assessments. These fast track sessions represented collaborative efforts between clinicians from across the health system and information sciences, as opposed to the traditional design approach that is led by software engineers (Lindgren et al., 2010).
The Clinical Transformation Project at Baptist Health South Florida represents an interdisciplinary effort that lasted two years. Lindgren et al. (2010) describe connections between several of the major structures and processes of the CTP with selected Forces of Magnetism. They articulate how organizational structure integrity is demonstrated by what they describe as “complete support for the CTP by the BHSF administration” (Lindgren et al., 2010, p. 77). The authors specifically reference how nurses at every level participated in the fast track sessions, and that the sentiment of empowerment for change resonated throughout the organization. They report how the Magnet principles of shared governance, shared decision making, and interdisciplinary patient care were highly evident during the development of the CTP (Lindgren et al., 2010). These manifestations of Forces of Magnetism are congruent with the 2008 Core Models of Structural Empowerment; Transformational Leadership; Exemplary Professional Practice; and New Knowledge, Innovations, and Improvements.

The application of the Magnet Model in clinical information technology is an evolving and emerging approach to EHR research. Initial publications describe connections between the Magnet Model and healthcare technology, but there have not been many empirical studies conducted in this area. There are many aspects of EHR systems that merit additional research, such as studying the associations between evidence-based practice, EHR technology (specifically clinical decision support tools), and the delivery of safe nursing care. Despite the fact that more empirical research needs to be conducted, the existing publications offer a basic foundation for future investigation of this phenomenon.
The Impact of Magnet Recognition on Patient Outcomes

The philosophies of the Magnet Model have been linked to multiple nursing practice scenarios in the literature; however, only recently have they begun to be applied to the adoption of clinical information systems. Over the past two decades the actual Magnet Recognition Program has been studied with greater frequency than its application to IT initiatives in nursing research. As of May 2014 the Magnet Research References list published on the American Nurses Credentialing Center’s website listed 52 studies that investigated relationships between Magnet environments and patient, nurse, and/or organizational outcomes (ANCC, 2014g). Two literature reviews were also cited, one published by the Agency for Healthcare Research and Quality (AHRQ) and the other by the ANCC, which were published in 2008 and 2011. As of May 2014 none of the 52 studies listed on the ANCC’s official online Magnet Research References list focused specifically on electronic health records.

In addition to the Magnet Research References link, the ANCC also offers a resource called the “Library of Magnet Journal Articles” on its website. To guide the accession of relevant and recent journal articles related to the Magnet experience, the ANCC suggests that either PubMed or CINAHL (Cumulative Index to Nursing and Allied Health Literature) be used as the online database, and that specific search criteria be entered (ANCC, 2014d). The ANCC’s website recommends, “When searching PubMed, enter the key concepts magnet AND hospital in the search box to obtain current listing. When searching CINAHL, use the advanced search option and enter 3 terms: Hospital [abstract]; AND magnet [abstract]; OR magnet [title]” (ANCC, 2014d, para. 5).
Initial review of the PubMed results revealed that more than half of the articles are not related to the ANCC’s Magnet Recognition Program, with many of the studies focused on magnetic resonance research or varying approaches to magnetic therapy. The literature search was revised using the same filters and entering the words “magnet” and “hospitals” and “nursing”. For the CINAHL database search, the words “hospital” with the optional field of “abstract”; “magnet” with the optional field of “abstract”; and “magnet” with the optional field of “title” were entered with “AND” applied as the operator to the relationship between “hospital” and “magnet” (as an “abstract”); and “OR” selected as the operator for “magnet” as a “title”. The research studies selected for the literature review were all published after 2008, and they examine the relationship between Magnet environments and patient outcomes within hospitals in the United States. Research focused on non-U.S. hospitals was excluded because Meaningful Use is only applicable to the American healthcare system.

This study uses Magnet recognition to represent the concept of nursing excellence. As the operational definition of nursing excellence in this study, research on nursing-specific patient outcomes was reviewed and organized by common patient outcome themes. The most common themes that emerged are: 1) patient falls, 2) pressure ulcers, 3) mortality, 4) failure to rescue, and 5) infections. Other patient outcomes that emerged, but to a lesser degree than the aforementioned themes are: 1) missed nursing care, 2) myocardial infarction, 3) length of stay, and 4) the National Quality Forum’s Safe Practices. These patient outcomes and nursing practice issues are discussed in the following section of this study as they were presented in the literature.
Patient Falls

The National Database of Nursing Quality Indicators (NDNQI) describes a patient fall as a descent to the floor that is unplanned, either with or without injury (Choi & Boyle, 2013; Lake, Shang, Klaus, & Dunton, 2010). Nearly one million patient falls occur in hospital settings annually in the United States (Oliver, Healey, & Haines, 2010), and the American Nurses Association (ANA) considers patient falls to be a nursing-sensitive indicator (He, Dunton, & Staggs, 2012). The estimated cost of treating fall-related injuries is between $16 billion and $19 billion to the healthcare system, and the CMS no longer reimburses hospitals for fall-related treatment(s) (CMS, 2008). The NDNQI is a repository for nursing-sensitive indicators, and is the only database containing data collected at the nursing unit level (ANA, 2014a). The NDNQI reports structure, process, and outcome indicators of nursing-sensitive care, and has been utilized repeatedly in nursing research. The majority of the current literature supports an inverse relationship between Magnet designation and patient falls on nursing units in hospital settings; however, not all studies support this association. This section presents a synthesis of recent patient fall research within the past five years.

In 2014, Everhart et al. published a 54-month longitudinal study of hospitals in the United States that were participating in the NDNQI. The purposes of the study were to determine if hospitals could be classified into fall trajectory groups over time, and to extrapolate nurse staffing and hospital characteristics that were associated with fall rate trajectory groups. Data were analyzed from a sample of 1,529 NDNQI hospitals from July 2006 to December 2010, with a mean fall rate of 3.65 falls per 1,000 patient days.
The three fall rate trajectory groups were: 1) consistently high with a mean fall rate of 4.96 per 1,000 patient days, 2) consistently medium with a mean fall rate of 3.63 per 1,000 patient days, and 3) consistently low with a mean fall rate of 2.50 per 1,000 patient days (Everhart et al., 2014). The two research hypotheses were: H1) greater total nursing hours per patient day and registered nurse skill mix (total nurse staffing) will be associated with lower fall rate trajectory groups, and H2) organizational characteristics of Magnet designation, hospital teaching status, larger bed size, and metropolitan location will be associated with lower fall trajectory groups (Everhart et al., 2014). The results of this study indicate that hospitals with higher total nurse staffing, Magnet status, and bed size greater than 300 are significantly less likely to be categorized as “consistently high” with respect to their fall rate group. The odds ratio (OR) for Magnet designation was reported as $OR = 0.49$ (95% CI [0.35, 0.70]). The researchers propose that even hospitals for whom the journey to Magnet is not financially feasible could benefit by implementing the principles of the Magnet program to facilitate the reduction of patient fall rates (Everhart et al., 2014).

Choi and Boyle (2013) investigated the relationship between registered nurse (RN) workgroup job satisfaction and patient falls in hospital units, using Magnet status as one of the control variables. Data collected from 2,763 nursing units of 576 hospitals in the 2009 NDNQI were analyzed. The total number of falls for a unit was divided by the total number of patient days on that unit, and this figure was multiplied by 1,000 to calculate the patient fall rate (Choi & Boyle, 2013). Job satisfaction was measured at the unit level using the seven item NDNQI-Adapted Job Enjoyment Scale. In the analysis of
RN job satisfaction and patient falls, the researchers controlled for both unit and hospital characteristics. Unit characteristics were nurse staffing, RN education, and RN unit tenure; and hospital characteristics were Magnet status, hospital size, teaching status. Of the 576 hospitals whose data were analyzed, 43% were Magnet and 57% were non-Magnet. Random-intercept binomial regression analyses were conducted, and when controlling for unit and hospital characteristics, RN workgroup satisfaction was found to be significantly inversely related with patient falls ($IRR = 0.94, p < .001, 95\% \text{ CI}[0.91, 0.97]$) (Choi & Boyle, 2013). There was not a significant association found between Magnet status and patient falls ($IRR = 0.98, p > .05, 95\% \text{ CI}[0.93, 1.02]$). Hospital status as either a teaching or a non-teaching facility was the only hospital characteristic that was found to be significantly related to patient falls ($IRR = 1.10, p < .001, 95\% \text{ CI}[1.05, 1.15]$) (Choi & Boyle, 2013). Choi and Boyle (2013) conclude that due to the significant and inverse relationship between RN workgroup satisfaction and patient falls that their study found, strategies to improve RN satisfaction should be customized at the nursing unit level.

Lake et al. (2010) found that the fall rate in Magnet hospitals was 5% lower than the fall rate in the non-Magnet facilities they studied. Five thousand, three hundred and eighty-eight nursing units from 108 Magnet and 528 non-Magnet hospitals participating in the 2004 NDNQI were included in this study that examined the relationships between nurse staffing, RN staff composition, Magnet status, and patient falls in hospital (Lake et al., 2010). The 2004 data were obtained by the researchers in 2006, and only falls that occurred while patients were physically present on their nursing unit were counted. Fall
rates were calculated as falls per 1,000 patient days, and patient days were defined as lasting 24 hours and beginning on the day of admission. The day of patient discharge was not included (Lake et al., 2010). Both nurse staffing and Magnet status showed a significant inverse correlation with patient fall rates. The results of the negative binomial regression analysis indicate that there was an incidence ratio rate of 0.95, which was statistically significant ($p < .001$) (Lake et al., 2010). In a unit-specific analysis of the estimated number of patient falls per year in Magnet and non-Magnet facilities, Magnet intensive care units (ICUs) were estimated to have 4.5 falls per year versus 5.2 estimated falls on non-Magnet ICUs. Magnet stepdown units were estimated to have 24 falls per year versus 25.1 estimated falls on non-Magnet stepdown nursing units. Magnet medical units were estimated to have 23.1 patient falls per year versus 24.2 estimated falls on non-Magnet medical units. Magnet surgical units were estimated to have 34.8 falls per year versus 36.3 estimated patient falls on non-Magnet surgical units. Magnet medical-surgical units were estimated to have 31.1 falls per year versus 32.5 estimated falls on non-Magnet medical-surgical nursing units. Finally, rehabilitation nursing units in Magnet hospitals were estimated to have 43.3 patient falls per year versus 45.3 estimated falls on non-Magnet rehabilitation units (Lake et al., 2010). The researchers of this study conclude that the establishment of care environments that are congruent with Magnet standards may improve patient safety (Lake et al., 2010).

Unlike other research studies, He et al. (2012) did not find a statistically significant difference between patient falls at Magnet and non-Magnet hospitals in the United States. They conducted a longitudinal study of unit-level data using data collected
during 2004 through 2009 for the NDNQI to examine trends in the rate of inpatient falls (He et al., 2012). The sample included 36,970 observations from 8,915 nursing units in 1,171 hospitals in the United States. The independent variables included hospital size, (greater than or less than 300 beds); Magnet status; unit-level total nursing hours per day; and RN skill mix as represented by the proportion of total nursing hours provided by RNs at baseline. The dependent variable was the annual count of unit-level inpatient falls. Descriptive analysis was utilized to calculate the rate of falls per 1,000 patient days. The researchers took the annual count of unit-level days as the exposure variable. The employed a hierarchical Poisson regression model to ascertain the time trend of the unit-level fall rate, and to estimate associations between baseline characteristics and patient fall rate (He et al., 2012). Fall rates were found to be the lowest in critical care units and highest in rehabilitation units. From a chronological perspective, when all of the other variables were controlled for, the 2004 cohort fall rate was not significantly different than the other years’ cohorts. The estimated time trends indicate that the mean fall rates of critical care, medical, medical-surgical, and rehabilitation units did decrease by 1% to 2% on average annually, but that fall rates increased by 1% on surgical units per year. There was no significant difference in time trends for the step-down units. Additionally, Magnet status was not found to be significantly associated with patient fall rates ($p = .07$) (He et al., 2012). The researchers acknowledge that their finding that Magnet status is not related to fall rates is not consistent with several previous studies using NDNQI data. He et al. (2012) posit that their research differed in methodology from other studies because they analyzed longitudinal data from several cohorts, unlike
other studies that only utilized 12-months worth of data in cross-sectional research design.

Some of the limitations of using National Database of Nursing Quality Indicators data cited in the literature relate the potential lack of generalizability of the NDNQI sample hospitals to other hospitals. NDNQI hospitals are a self-selected sample population (Everhart, Schumacher, Duncan, Hall, Neff, & Shorr, 2014) that represent more large and not-for-profit hospitals than there are in the national profile. Lake et al. (2010) reported that in 2004 there was a disproportionate percentage of Magnet facilities participating in the NDNQI. At that time, only 7% of U.S. hospitals had received Magnet recognition; however, 17% of NDNQI participants were Magnet facilities (Lake et al., 2010). The consensus of the current literature is that further investigation on the relationship between Magnet status and patient falls is greatly needed.

**Pressure Ulcers, Failure to Rescue, and Mortality**

Pressure ulcers are another patient care outcome that are considered nursing-sensitive indicators. In 2008 the Centers for Medicare and Medicaid Services implemented payment restrictions for conditions added as a secondary diagnosis during hospitalization that are high in cost or value, and that could have been avoided if established evidence-based guidelines had been adhered to (CMS, 2012a). These payment restrictions are in accordance with the Deficit Reduction Act of 2005 which mandates a quality adjustment in Medicare Severity Diagnosis Related Group (MS-DRG) payments for certain hospital-acquired patient conditions. The CMS (2012a) titled this provision “Hospital-Acquired Conditions and Present on Admission Indicator Reporting.”
(HAC and POA). Also, the Magnet Culture of Safety Force of Magnetism specifically requires Magnet applicant hospitals to provide the ANCC with analysis and evaluation of data on their patient falls, prevalence and/or incidence of nosocomial pressure ulcers, and two additional nursing-sensitive data sets (ANCC, 2008). The national attention on pressure ulcer prevalence and prevention has stimulated considerable interest among nursing researchers.

Rogers (2013) conducted a study that examined present on admission (POA) pressure ulcer reporting practices and hospital acquired condition (HAC) rates at a 333-bed hospital in the United States. The CMS considers pressure ulcers that are present on admission but not documented by the hospital staff to be a HAC, and will not reimburse healthcare facilities for treatment of HACs (Rogers, 2013). The objective of Rogers’ (2013) work was to determine if a process could be developed to capture POA pressure ulcers accurately by using electronic technology as part of the process to identify, document, and communicate POA pressure ulcer findings from nurses to physicians. The hospital’s existing electronic wound assessment screen was reconfigured with a new POA on-screen alert, or prompt, for POA charting and subsequent communication of the documentation findings to the patients’ admitting physician (Rogers, 2013). The hospital in this study was on the journey to Magnet at the time of this research, and as an applicant hospital, it had prioritized the Quality Improvement, Quality of Care, and Advancing the Culture of Safety Forces of Magnetism for its initial Magnet action (Rogers, 2013).
The research design was described as a “before and after study” (Rogers, 2013, p. 567) that compared data collected from November of 2012 to February of 2013 to the same periods during the previous two years; November of 2010 to February of 2011; and November of 2011 to February of 2012, respectively. Rogers’ (2013) study found that when compared to the 2010-2011 pre-intervention time period, there was a decrease in missed present on admission pressure ulcers. The post-intervention time period of 2012-2013 reflected a significant change for present on admission pressure ulcer reporting \( (z = 2.51, p < .01) \). Compared to the 2011-2012 pre-intervention time period, there was also a decrease in missed present on admission pressure ulcers, as the post-intervention time period of 2012-2013 demonstrated a statistically significant change for present on admission pressure ulcer reporting \( (z = 2.63, p < .01) \) (Rogers, 2013). Although the HAC (pressure ulcers that were present on admission but were not documented) rates for the post-intervention period were 0% for all four months of November 2012 through February 2013, this was not attributed to the intervention because the data analysis revealed that the most significant HAC reduction actually occurred before the implementation of the electronic prompt. Rogers (2013) describes the increased accuracy of documentation related to pressure ulcers that were present on admission as an evolving process that improved over time. Rogers also states that process changes consisting of “EMR upgrades, shared governance, Magnet journey, participation in the National Database of Nursing Quality Indicators, and unit-based nursing councils and skin care champions” (2013, p. 567) may have contributed to the enhanced communication.
between the clinical nurses who assessed and documented patients’ pressure ulcers and the admitting physicians.

Mills and Gillespie (2013) compared 12 hospital characteristics at 80 Magnet facilities to those at 80 non-Magnet hospitals to explore if they differed with respect to nursing-sensitive outcomes. They found no significant differences for the risk-adjusted rates for pressure ulcers or failure to rescue (Mills & Gillespie, 2013). They posit that the impact of Magnet designation on nursing-sensitive outcomes has been under-researched, and that pressure ulcers and failure to rescue rates are two nursing-sensitive outcomes that have been established as indicators of patient safety. “Failure to rescue” refers to patient deaths resulting from unsuccessful treatment of an unanticipated emergency or complication. In their research, the authors further clarify failure to rescue as deaths resulting from complications of care associated with sepsis, deep vein thrombosis/pulmonary embolism, pneumonia, shock/cardiac arrest, gastrointestinal hemorrhage/acute ulcer, or acute renal failure (Mills & Gillespie, 2013). Nursing staffing has been linked to failure to rescue and according to HealthGrades (2010), Medicare patients were reported as having the highest incidence rate of failure to rescue at 92.7 per 1,000 at-risk hospitalizations from 2006 to 2008 in the United States.

Mills and Gillespie (2013) analyzed data from 2001 to 2005 from five different United States Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) databases. They excluded children’s and federal hospitals from their study, and focused on adult inpatient populations in community healthcare facilities. Expected rates for pressure ulcers and failure to rescue were calculated, along with risk-adjusted
rates that followed the AHRQ’s recommended algorithm. In 2005 there were 201 Magnet-recognized hospitals in the U.S. out of 5,747 that met the American Hospital Association’s criteria for a hospital facility (AHA, 2005, as cited in Mills & Gillespie, 2013). This number reflects that approximately 4% of hospitals were Magnet at that time. The results of the analyses failed to demonstrate any statistically significant differences across the 12 hospital characteristics, including the two nursing-sensitive indicators of pressure ulcers and failure to rescue ($p > .05$). The researchers conclude that while they did not find significant differences between Magnet and non-Magnet facilities for the variables measured, additional studies should continue to examine the connection between Magnet recognition and patient outcomes. They suggest that more complex models may be needed to measure intermediate Magnet outcomes of nursing satisfaction and nurse retention as variables that may also affect patient outcomes (Mills & Gillespie, 2013).

McHugh et al. (2013) examined whether Magnet hospitals had lower risk-adjusted mortality and failure to rescue when compared to non-Magnet hospitals, and if so, why this may be. Logistic regression models were used to estimate differences for surgical patients related to the odds of mortality and failure to rescue in Magnet and non-Magnet hospitals. The study also attempted to determine the degree to which differences in patient outcomes could be explained by nursing care, after both patient and hospital differences were controlled for (McHugh et al., 2013). Data from 56 Magnet and 508 non-Magnet hospitals were analyzed, which represents a greater proportion of Magnet facilities than the previous studies. The results indicate that the surgical patients cared
for in Magnet hospitals had 14% lower odds of mortality ($OR = 0.86, p = .0, 95\% CI [0.76, 0.98])
and that these patients also had 12% lower odds of failure to rescue ($OR = 0.88, p = .07, 95\% CI [0.77, 1.01])
(McHugh et al., 2013). The surgical patients at the Magnet organizations had a 1.5% mortality rate within 30 days as
compared to a 1.8% mortality rate within 30 days for the patients treated at non-Magnet hospitals ($p < .001$).
In the Magnet facilities, 4% of surgical patients experienced failure to rescue and died of complications, compared to 5% at non-Magnet organizations ($p < .001$). The research team concludes that not only did the Magnet work environment and the greater percentages of bachelor’\’s prepared and specialty certified nurses have a positive effect on patient outcomes, but that surgical patients in Magnet facilities had lower odds of mortality and failure to rescue when controlling for nursing factors and differences in hospitals and patients. McHugh et al. (2013) propose that the achievement of Magnet recognition reflects better working conditions for nurses, and this, in turn, supports better patient outcomes.

**Other Outcomes**

Not all of the research surrounding Magnet organizations and desired patient outcomes supports a positive relationship between these variables. Goode, Blegen, Park, Vaughn, and Spetz (2011) compared outcomes across eight aspects of patient care and nurse staffing in 19 Magnet and 35 non-Magnet hospitals in the U.S. Data were extracted from operational and clinical databases of the 2005 University Health Systems Consortium (UHC), which represents a subset of data collected for a previous study on nurse staffing and patient outcomes. Goode et al. (2011) calculated outcomes obtained
from patient discharge data utilizing the Agency for Healthcare Research and Quality’s patient safety indicators and inpatient quality indicators software. This approach allowed the researchers to calculate a ratio of observed to expected rates, or risk adjusted rates, of adverse patient outcomes. Total nursing hours were derived from worked hours of care for RNs, licensed practical nurses, and certified nursing assistants on adult units. Nurse managers, nurse educators, and clinical nurse specialists hours were excluded from the analyses, as were vacation and sick time hours. Goode et al. (2011) used bivariate and multivariate analyses to examine patient outcomes that had been demonstrated in previous research to reflect the quality of nursing care. The outcomes they studied were: hospital acquired pressure ulcers, failure to rescue, hospital acquired infections, postoperative sepsis, congestive heart failure (CHF) mortality, myocardial infarction (MI) mortality, postoperative metabolic derangement, and length of stay (LOS) greater than expected.

The results indicate that hospital acquired pressure ulcers were the only outcome where patients at Magnet hospitals had better outcomes (Goode et al., 2011). Statistical significance was set at an alpha of .10, and the ratio of observed to expected pressure ulcers for the 19 Magnet facilities was 1.2 versus 1.32 for the 35 non-Magnet hospitals ($p < .10$). Seventy quarters of data were collected for the Magnet organizations, as compared to 138 quarters of data for the non-Magnet facilities. For the seven other patient outcomes, only three produced statistically significant results. Hospital acquired infections, postoperative sepsis, and postoperative metabolic derangement were all found to have significantly lower adverse event rates at the non-Magnet hospitals ($ps < .05$).
The findings for failure to rescue, CHF mortality, MI mortality, and LOS greater than expected all reflected non-significant results (Goode et al., 2011).

Multivariate analyses were also conducted for the outcomes that included covariates known to impact patient outcomes such as hospital case index and nurse staffing. When controlling for other variables, Magnet hospitals were found to have higher rates of postoperative sepsis for both intensive care units \((p < .05)\), and general care units \((p < .10)\). Patient rates of postoperative metabolic derangement were also higher in the intensive care units \((p < .10)\), of Magnet hospitals than in non-Magnet facilities (Goode et al., 2011). None of the other multivariate analyses yielded statistically significant findings. The results of this study also indicate that Magnet hospitals had a slightly lower average of total nursing care hours, and a lower staff mix than the non-Magnet organizations. Goode et al. (2011) conclude that patients treated in non-Magnet hospitals had better outcomes of nursing care than patients treated in Magnet facilities, and they suggest that the lower nursing staff total and lower nursing skill mix both contributed to their findings. The authors acknowledge that their research results were not what they had expected to find, and they articulate the importance of continued investigation of how to best deliver nursing care, emphasizing that “staffing matters” (Goode et al., 2011, p. 522). It is interesting to note that the Goode et al. (2011) study did not utilize data from the NDNQI as many previous studies did.

**Adoption of Safe Practices**

One study by Jayawardhana, Welton, and Lindrooth (2011) did not investigate empirical patient outcomes and Magnet status, but rather the adoption rates of safe
practices for Magnet and non-Magnet hospitals. Their study examined the adoption of National Quality Forum (NQF) Safe Practices during 2004 to 2006 in 34 regions of the U.S. The research team incorporated several quality data sets to complete a secondary data analysis approach. The data sets were from the American Hospital Association Annual Survey, the Healthcare Cost Reports Information System, and the Leapfrog Group Annual Hospital Survey. The NQF Safe Practices were part of an initiative by the Leapfrog Group to improve the quality of hospital care (Jayawardhana et al., 2011). The Leapfrog survey was used to create a composite safe practice score (CSPS), which ranged from 0 to 1,000. A score of zero reflected no adoption of NQF Safe Practices, while a score of 1,000 indicated that a hospital had demonstrated complete adoption. The study sample included 140 Magnet and 1,320 non-Magnet facilities, which reflects that 11% of the sample hospitals were Magnet. Data were collected over three years, and the results revealed that in 2004, the Magnet hospitals earned a mean CSPS of 865, as compared to a mean score of 774 for the non-Magnet hospitals \( p < .001 \). Two years later in 2006, the mean CSPS for the Magnet facilities had improved by 60 points to 925, whereas the mean CSPS for the non-Magnet organizations showed greater improvement, increasing by 98 points to a score of 872 \( p < .001 \). Jayawardhana et al. (2011) also reported that hospitals with fewer beds, larger proportions of Medicare patients, more average hours of nursing care delivered, and higher levels of competition from other regional facilities all were associated with greater composite safe practice scores. They posit that in the 34 Leapfrog regions studied, Magnet hospitals located in urban areas were more likely to earn higher adoption rates of the National Quality Forum Safe Practices than non-Magnet
hospitals in the same areas during the time of the study. Jayawardhana et al. (2011) note that other non-Magnet hospitals had lessened the gap by the end of the study in 2006. Overall, the authors conclude that Magnet hospitals may be able to adopt safe practices more readily than their non-Magnet counterparts due to their nursing characteristics (Jayawardhana et al., 2011).

Most research studies on the relationship between Magnet hospitals and patient outcomes for nursing-sensitive outcomes reported positive associations between Magnet facilities and patient outcomes. However, some studies either failed to find statistically significant positive relationships, or they reported negative associations between Magnet status and patient outcomes. Hickey, Gauvreau, Connor, Sporing, and Jenkins (2010) also failed to find any statistically significant associations between Magnet recognition status and patient mortality for pediatric congenital heart surgery. Hickey et al. (2010) compared the risk-adjusted mortality rates at 38 U.S. children’s hospitals, 16 of which were Magnet-designated using data the 2005-2006 Pediatric Health Information System Database. The in-hospital mortality rate following congenital heart surgery for the study’s sample was 4%. Univariate analyses and risk adjusted analyses did not support the presence of a significant relationship between Magnet recognition and in-hospital mortality ($OR = 0.90, p = .42, 95\% CI [0.68, 1.18]$) (Hickey et al., 2010). The results of the Goode et al. (2011) and Hickey et al. (2010) studies could indicate the need for researchers to continue to examine the relationship between Magnet status and patient outcomes using databases other than NDNQI. The Hickey study was conducted at a pediatric hospital; therefore, it was not included on the previous review that focused on
adult hospital studies. This research is referenced here to support the perspective that Magnet outcomes may differ when the data is not collected from the National Database of Nursing Quality Indicators.

**Hospital Characteristics Associated with Meaningful Use Attestation**

At present there is a lack of data regarding the characteristics of hospitals that have qualified for Meaningful Use financial incentives (Adler-Milstein, Furukawa, King, & Jha, 2013). A few studies have started to examine the organizational characteristics of hospitals that successfully attested to the Centers for Medicare and Medicaid Services’ EHR Incentive Program’s initial stages, and there is a need for ongoing evaluation.

Diana, Kazley, Ford, and Menachemi (2012) undertook a study at the beginning of the Meaningful Use EHR Incentive Program that investigated which hospital characteristics were related to healthcare organizations’ intentions to apply for MU incentive payments. The purpose of their research was to provide policy makers with data and information that could guide future program decisions and adjustments, if necessary. Diana et al. (2012) recommend that policy makers explore ways to reduce potential barriers to pursuing MU incentives to prevent the inadvertant creation of a digital divide among American hospitals. Diana et al. (2012) utilized a cross-sectional design to analyze data collected by the American Hospital Association (AHA) in their 2009 AHA Annual Survey Information Technology Supplement and the Centers for Medicare and Medicaid Services 2008 Hospital Cost Reports. The researchers hypothesized that independent variables such as a hospital’s current electronic health record usage, bed size, teaching status, system membership, for-profit versus not-for-
profit status, percent of Medicare and Medicaid discharges, and geographic location would influence organizations’ decision to attempt MU attestation. The dependent variable was operationalized with the question: “Do you intend to apply for Medicare or Medicaid incentive payments for meaningful use of health IT?” (Diana et al., 2012, p. 2), which was based on a question from the AHA’s 2009 survey. The sample consisted of 2,980 non-federal acute hospitals, 2,860 of which had responded to the question regarding intention to apply for incentives. To be consistent with the AHA survey, hospitals’ electronic health record use was classified as full use, partial use, or none. This study also used the Herfindahl-Hirschman Index (HHI) as a variable in a model that measured market-level competition. The HHI considers the number of organizations in a market and the market share that each one controls. In this study, the HHI was calculated as the sum of the squares of the market share, measured in terms of system-level bed size, with the hospitals’ county representing the market (Diana et al., 2012). The results revealed that 89% of the hospitals in Diana et al.’s study were not-for-profit, 60% were located in urban areas, and 93% did not identify themselves as teaching facilities (2012). The mean bed size was 181, \( SD = 201.5 \); the mean Herfindahl-Hirschman Index was 0.57, \( SD = 0.34 \); and the mean payer mix was 0.56 Medicare and Medicaid, \( SD = 0.15 \). With respect to self-reported hospital EHR use, 21% of the hospitals had reported fully adopted EHRs, 61% reported that they had partially adopted EHRs, and 18% had not adopted EHR systems at their organization (Diana et al., 2012).

Of the 2,680 hospitals that answered the question “Do you intend to apply for Medicare or Medicaid incentive payments for meaningful use of health IT?” (Diana et al.,
the majority indicated that they planned to pursue either Medicare alone, or a combination of Medicare and Medicaid incentives. Approximately 19% of hospitals responded that they were going to seek incentives through Medicare \((n = 452)\), while 67\% \((n = 1,598)\) stated that they intended to pursue financial incentives from both Medicare and Medicaid (Diana et al., 2012). The results of the logistic regression indicated that healthcare organizations that reported full EHR use \((OR = 3.61, p < .01, 95\% CI [2.13, 6.12])\), or partial EHR use \((OR = 1.85, p < .01, 95\% CI [1.33, 2.54])\) were significantly more likely to seek funding than organizations that did not report any existing EHR use. The hospital characteristics that were positively related to the intention to pursue financial incentives were: hospital bed size \((OR = 1.26, p < .10, 95\% CI [1.06, 1.50])\) and urban location \((OR = 1.88, p < .01, 95\% CI [1.21, 2.91])\). Conversely, the hospital characteristics that were negatively associated to the intention to pursue financial incentives were: for-profit tax status \((OR = 0.25, p < .01, 95\% CI [0.17, 0.36])\) and system members \((OR = 0.52, p < .01, 95\% CI [0.39, 0.71])\). There were not statistically significant relationships found between the variables of intent to pursue MU incentives and percentage of Medicare and Medicaid discharges, hospital teaching status, and market competition (Diana et al., 2012).

Diana et al. (2012) report that a high proportion of hospitals intend to pursue EHR incentives, and that there are specific organizational characteristics associated with a higher likelihood of this intention. The authors conclude that having EHR system(s) already in place greatly increased hospitals’ intentions to seek MU funding. For-profit, system member, and rural hospitals were less likely to express interest in pursuing
financial incentives. Diana et al. (2012) suggest that these findings may offer the CMS guidance moving forward to ensure that vulnerable facilities motivated to adopt EHRs, and that they are properly supported throughout this process. This study did not examine the characteristics of hospitals that actually qualified to receive financial incentives for their use of EHRs, but rather it focused on whether or not hospitals intended to pursue MU incentives, and the associations between organizational characteristics and the presence or lack of intent to apply for CMS funding.

While the 2012 Diana study investigated hospitals’ intent to attempt to attest to Meaningful Use, Jha et al. (2010) examined hospitals’ readiness to meet MU criteria. Jha et al. (2010) studied associations between hospital size, ownership, and geographic location with the ability to meet individual MU criteria, and MU Stage I objectives in general. Data were collected in 2009 to investigate four research questions: 1) How have EHR adoption rates changed since the American Recovery and Reinvestment Act was passed? 2) Which kinds of hospitals adopted EHRs? 3) How many facilities are capable of meeting Meaningful Use criteria in 2009? 4) In 2009, did the capability to meet Meaningful Use differ based on the type of hospital? (Jha et al., 2010). Data on hospitals’ information technology efforts were obtained from the AHA’s 2009 survey of hospital hospitals. The AHA sent a survey to the Chief Executive Officer (CEO) of every hospital in its association. He or she was requested to have the person with the greatest knowledge of their hospital’s IT initiatives complete the survey. Jha et al. (2010) utilized the following definitions to distinguish basic health records from comprehensive health records. A basic electronic health record refers to “A set of ten clinical functions
deployed in at least one hospital unit” (Jha et al., 2010, p. 1952). A comprehensive electronic record reflected “A set of 24 clinical functions deployed in all hospital units” (Jha et al., 2010, p. 1952). The AHA survey had 3,101 respondents, which represented a 69% response rate (Jha et al., 2010). Between 2008 and 2009, the percentage of facilities that reported having a comprehensive EHR nearly doubled, from 2% to 3%. The percentage of hospitals that reported having a basic EHR increased from 7% to 9%, making the total proportion of U.S. hospitals reporting either basic or comprehensive EHR capabilities 12% (Jha et al., 2010). This study found that large, urban, and private hospitals are more likely to have adopted electronic records in the twelve months prior to the AHA survey than their small, medium, non-teaching, public, and rural counterparts. The results of the analyses indicate that critical access hospitals had 80% lower odds of having adopted a minimum of a basic EHR in 2009 than large hospitals ($p < .05$). Jha et al. (2010) found that less than 12% of the hospitals surveyed reported that their systems met the definition for either a basic or a comprehensive EHR, and that only 2% were in a position to meet the government’s definition of “meaningful use” of an EHR. Jha et al.’s (2010) conclusions were consistent with Diana et al.’s (2012) in that both recommend that measures be taken to ensure that the Centers for Medicare and Medicaid Services EHR Incentive Programs do not inadvertently perpetuate the digital divide between hospitals in the United States.

Two years after the Jha et al. (2010) published the results of their study on hospitals’ Meaningful Use readiness, DesRoches, Worzala, Joshi, Kralovec, & Jha (2012) found that small, rural, and non-teaching hospitals were still slow to adopt electronic
health record systems. DesRoches et al. (2012) utilized similar research methods as Jha et al. (2010), but they analyzed data collected from an updated version of the AHA annual survey of health information technology adoption that reflected a survey that was fielded from October until December of 2011. As with previous AHA surveys, CEOs were asked to have the person with the greatest knowledge of their hospital’s IT initiatives complete the new survey. A basic EHR system was described as complete implementation of all of the following applications in at least one clinical unit: computerized systems for basic demographic information, physician notes, nursing assessments, laboratory and radiology reports, patient problem lists, computerized medication order entry, and diagnostic test results. Comprehensive EHR systems were distinguished by their ability to perform all of the previous functions, plus an additional 14 capabilities, and all 24 functions must be implemented on all of the major care units of the hospital. The authors reported that this version of the AHA survey included responses from 3,233 hospitals, reflecting a 58% response rate.

DesRoches et al. (2012) reported that there was a notable increase between 2010 and 2011 in the proportion of hospitals that had either a basic or a comprehensive EHR system. Comprehensive EHRs were reported by 9% percent of the hospitals surveyed, which was up from the 4% reported in 2010. The presence of basic EHRs increased from 12% in 2010 to 18% in 2011. Compared to hospitals that reported not having any EHR, facilities that had a minimum of a basic system were more likely to be classified as large, teaching hospitals located in the northeastern part of the country. Discrepancies in EHR adoption rates grew based on these very same characteristics: hospital size, teaching
status, and geographic location. Over 18% of the 2011 respondent hospitals met the researchers' proxy standard for MU criteria, i.e. 12 functions implemented on a minimum of one clinical unit. The most frequently implemented EHR capabilities were: an electronic system for recording patient demographics, medication allergy lists, vital signs, clinical decision support, and patient medication lists. The least frequently implemented capabilities reported were: drug-drug and drug-allergy checks, calculation of quality measures, and provision of electronic copies of medical records to patients. The least organizations likely to have implemented all of the MU functions were small and rural hospitals.

According to the CMS, as of February of 2012, slightly more than 800 out of approximately 5,000 American hospitals had received $1.4 billion in Medicare EHR incentive payments (2012, as cited in DesRoches et al., 2012). The 2012 DesRoches study offers evidence that U.S. hospitals are making strong progress towards EHR adoption; however, the authors express concerns that the technology gap is widening, and that small, non-teaching hospitals in rural areas are not as quick to adopt EHR systems. The authors emphasize the importance of establishing a stronger health information exchange infrastructure, and the value of developing specialized programming for healthcare organizations that have virtually no health IT in place (2012).

Adler-Milstein et al. (2013) investigated how hospitals fared during the first 18 months of the EHR Incentive Programs, and they identified characteristics of hospitals that qualified to incentive payment(s). The two main purposes of their study were to assess hospital participation level in the first 18 months of the EHR Incentive Programs,
and to determine if at-risk hospitals lagged behind in the attestation process. The researchers analyzed CMS data in an attempt to answer four research questions. The first question contained two components: 1) What is the proportion of United States hospitals that have qualified for incentive payments? and 2) How many of those hospitals were capable of qualifying before the EHR Incentive Program began? The second question was: Are there certain types of hospitals such as safety net or small critical access hospitals less likely to qualify for incentive payments than other facilities? The third question the researchers posed was: What is the extent to which safety net hospitals are choosing the Adopt-Implement-Upgrade (AIU) option to receive funding? The AIU approach is an alternative to the traditional Meaningful Use attestation method that permits eligible facilities to receive a payment before actually demonstrating meaningful use of EHRs. This option was developed as a result of data showing that safety net hospitals might not have the financial resources to purchase and implement full EHRs (Jha, DesRoches, & Shields et al., 2009, as cited in Alder-Milstein, 2013). The fourth and final research question in this study was: To what extent are the MU requirements acting as a minimum for actual EHR utilization, or are healthcare organizations exceeding the basic criteria to leverage EHR technology broadly for all of their patients? (Adler-Milstein et al. 2013).

The research team analyzed data from the CMS on Stage I of the MU Programs as of December 31, 2012. The CMS granted the researchers access to Medicaid and AUI data in addition to Medicare data, as only Medicare attestation is required to be publicly accessible by law (Adler-Milstein et al., 2013). Hospital characteristics were assigned
based on responses to the 2011 AHA survey, and hospital financial data were obtained from Medicare Cost Reports. The final analytic sample contained 4,663 hospitals, after hospitals with missing sources of data were removed. As outcome measures, the hospitals were placed into one of three mutually exclusive groups: 1) Meaningful Use Stage I attestors under either Medicare or Medicaid, 2) hospitals engaged in the Adopt-Implement-Upgrade alternative, and 3) Medicare-certified facilities that either did not qualify for incentives or that chose not to engage in the programs. The hospital characteristics that were examined included degree of sophistication of EHR use; safety net status; for-profit, not-for-profit, or publicly owned status; affiliation with a healthcare system; teaching status; geographic location; association with a system offering a health maintenance organization product; and hospital financial health.

Adler-Milstein et al. (2013) found that 76% of eligible hospitals in the United States had qualified for some form of an incentive payments through the end of the year 2012. Two thousand, five hundred and twelve hospitals (52%) of all hospitals qualified for a payment by attesting to Meaningful Use Stage I. One thousand, 141 (24%) of hospitals qualified for AUI incentives, and 1,185 (24%) of hospitals did not participate. The results of bivariate analyses supported the investigators’ hypotheses that small hospitals are less likely to have qualified for a payment than large hospitals, 69% versus 82% ($p < .001$). No significant relationship was found between qualification for an incentive payment and safety net status. Multivariate analysis showed that small hospitals had less than half the odds of meeting eligibility for payments when compared to larger facilities ($OR = 0.49, p < .001, 95\% CI [0.36, 0.68]$). The authors conclude that
the first 18 months of the CMS EHR Incentive Programs resulted in broad engagement across the U.S., and that safety net hospitals fared better than expected. They caution that safeguards are still needed to support smaller hospitals, especially critical access hospitals, as they attempt to meet the many challenges of MU attestation (Adler-Milstein et al., 2013).

As the Centers for Medicare and Medicaid Services EHR Incentive Programs evolve, researchers will continue to analyze and evaluate how and why certain hospitals are able to adopt EHR systems and qualify for MU incentive payments. In the literature reviewed for this study, no studies were identified that considered the organizational characteristic of Magnet status as either a predictor/independent variable, or a covariate in their analyses. Several hospital characteristics including facility size (number of patient beds), teaching status, and urban location appeared repeatedly in both the Magnet and MU research that was reviewed.

**Electronic Medical Record Adoption Model**

The original Electronic Medical Record Adoption Model (EMRAM) was developed in 2005 by the Healthcare Information and Management Systems Society (HIMSS) Analytics leaders as a method of tracking hospitals’ and health systems’ adoption of electronic medical records within the United States (Pettit, 2013). The hospital EMRAM categorizes healthcare organizations’ EMR capabilities on an eight-level continuum, under the basic premise that EMR adoption can be scored by using the information technology data that the HIMSS Analytics Database captures (Pettit, 2013). Multiple database searches did not return any empirical studies that incorporated HIMSS...
Analytics EMRAM level, Meaningful Use attestation, and Magnet recognition together as variables; however, a few articles were retrieved that explored associations between the EMRAM and CMS financial incentive programs. These articles are reviewed in the following section.

In 2009, the Executive Vice President of HIMSS Analytics published a document that he describes as a “mapping between the American Recovery and Reinvestment Act meaningful use measurements and the stages of the EMRAM” (Davis, 2009, p. 2). The purpose of this mapping was to offer insight into the American hospital market with relation to the potential EMR adoption metrics to meet Meaningful Use criteria. Davis (2009) clarified that this document was not intended to serve as an authoritative guide to attestation. Data from the HIMSS Analytics database were used to provide a context for the state of adoption rates for essential EMR applications. Based on the timing of the publication, the EMR Adoption Model Trends for 2007-2008 were utilized, and the ARRA measures that the EMRAM levels were mapped to reflected compliance expectations as of 2009. The findings of Davis’ report reveals that overall, the 2011 ARRA measures were primarily mapped to HIMSS Analytics Level 3, the 2013 measures to HIMSS Analytics Level 4, and the 2015 proposed measures to HIMSS Analytics Levels 6 and 7. Davis (2009) emphasizes the need for hospitals to implement their EMR systems in a way that delivers the data specified by each ARRA measure as a natural by-product of clinical documentation and care management.

Some of the reported of advancing hospital EMR systems include reduction in medication errors, decreased dictation expenses, and increased physician satisfaction with
their access to patient information (Pettit, 2013). Kaiser Permanente is an integrated healthcare delivery system comprised of 37 hospitals and 600 outpatient centers located in nine states and the District of Columbia (Weston & Roberts, 2013). It has the largest non-profit health plan, with 9 million members and it employs 49,000 nurses. Kaiser Permanente achieved Level 7 on the HIMSS Analytics EMRAM, and Weston and Roberts (2013) note that having advanced EHR implementation and optimization allowed the healthcare system to leverage real-time data, performance improvement, advanced analytics, and patient engagement to facilitate clinical transformation. Levels 6 and 7 are the two highest levels on the HIMSS Analytics continuum of EMR adoption, and both of these levels have been used in the literature to represent hospitals’ attainment of advanced EMR capabilities (Jarvis, Johnson, Butler, O’Shaughnessy, Fullam, Tran, & Gupta, 2013) or EMR sophistication (Smith et al., 2013). Sensmeier (2009) described some of the clinical achievements that the EMRAM Level 6 support as: 1) less than 10 minutes elapsed time from completion of electronic medication ordering to dispensing of medication for STAT orders; 2) less than 15 to 20 minutes elapsed time from completion of electronic medication ordering to dispensing of medication for routine orders; 3) diagnostic report turn-around times are recorded in minutes as opposed to hours; 4) reduction in use of agency nurses where one facility reported saving $2 million in agency staffing costs; and 5) reduction in medication errors related to handwriting, and reduction of wrong or omitted drug errors by as much as 70%.

Jarvis et al. (2013) conducted a cross-sectional analysis that examined the association between advanced EHR use, as represented by attainment of HIMSS
Analytics EMRAM Level 6 or 7, and estimated hospital process and experience of care scores for the Medicare Value-Based Purchasing (VBP) Program. The main purpose of their study was to investigate the influence of advanced EHR capabilities on patients’ satisfaction and hospital quality. Jarvis et al. (2013) also evaluated if the relationships between advanced EHR utilization with quality and patient satisfaction scores are comparable for teaching and non-teaching hospitals.

This study’s sample included all hospitals eligible to participate in the CMS VBP Program for fiscal year 2013 (Javis et al., 2013). Exclusion from the study was based on exclusion from the VBP Program, as these hospitals lacked estimated hospital scores. The researchers utilized estimated scores calculated by the American Hospital Association (AHA). According to Jarvis et al. (2013), the AHA estimated scores for both the clinical process of care and patient experience of care for the initial year of the CMS Hospital VBP Program were based on Hospital Compare data. The clinical process of care scores were calculated by summing the greater of the improvement or achievement scores for each of the eight Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) dimensions with a consistency score that was calculated from the difference between the lowest HCAHPS score and the achievement threshold for each respective HCAHPS dimension. The patient experience of care scores were composite scores that were derived from the eight mandatory experience of care dimensions from HCAHPS. There were 2,988 hospitals that had estimated VBP scores, and data from April 2008 to March 2010 were used in the analyses (Jarvis et al., 2013).
The HIMSS Analytics EMRAM scores were retrieved from the HIMSS Analytics web site. Jarvis et al. (2013) defined advanced electronic health record adoption as achievement of Level 6 or 7. This measure was first dichotomized into whether or not a hospital had reached Level 6 or 7, and then a second variable was established which was categorical and indicated the level of EHR use: non-advanced, Level 6, or Level 7. The hospital characteristics that were analyzed included type of organization (government, for-profit, or not-for-profit), health care system status (member or non-member of a system), total bed size, teaching status, total annual admissions, and geographic location. These characteristics were obtained from the AHA’s 2009 annual survey (Jarvis et al., 2013).

Of the 2,988 hospitals with estimated VBP scores, 248 hospitals met the criteria for advanced EHR users by having HIMSS Analytics EMRAM Level 6 or 7. This represents 8% of the study’s sample, with 2,740 (92%) of the hospitals classified as non-advanced EHR users (Jarvis et al., 2013). Hospitals with advanced EHRs were found to have more total beds and more annual admissions ($p < .001$). There was a greater percentage of hospitals with advanced EHR usage that belonged to a health care system ($p = .002$), and that were not-for-profit ($p < .001$) (Jarvis et al., 2013). Hospitals with advanced EHR systems had significantly higher mean estimated clinical process of care scores than facilities with non-advanced systems, 41.8 versus 38.3 ($p < .001$). Conversely, the results of Jarvis et al.’s (2013) analyses indicates that hospitals with advanced EHRs implemented had lower estimated mean experience of care scores (29.4) than facilities using non-advanced EHRs (35.1) ($p < .001$). The results of the generalized
linear regression models indicate that after controlling for hospital characteristics in the analyses, hospitals with advanced EHRs had 4.21 point higher estimated process of care scores than hospitals with non-advanced EHRs. Facilities that were members of healthcare systems were associated with 5.17 point higher process of care scores, and for-profit hospital status was associated with 9.72 point higher process of care scores. After controlling for hospital characteristics, advanced EHR utilization was not found to be associated with the estimated experience of care scores, (Jarvis et al., 2013).

The results of the descriptive analyses identified that although there was a larger proportion of Level 7 (93%) than Level 6 (68%) facilities that belonged to a hospital system, \( p < .001 \), no other hospital characteristics were found to be significantly different between these EMRAM levels. Without controlling for hospital characteristics, Level 7 hospitals were found to have higher process of care scores (49.4) than Level 6 hospitals (40.2) \( p = .005 \). Experience of care scores were lower for Level 7 hospitals (25.2) than for Level 6 hospitals (30.2) \( p = .035 \). After controlling for hospital characteristics, Level 7 status was still associated with higher process of care scores than Level 6. The authors found no difference in the experience of care scores based on level of advanced EHR use after controlling for hospital characteristics.

Jarvis et al. (2013) found that there was positive relationship between advanced EHR use and clinical process quality of care scores in hospitals in the United States. In their study, hospitals with more advanced EHR use generally had lower unadjusted patient experience of care scores. However, when hospital characteristics such as number of beds, teaching status, geographic location, for-profit versus not-for-profit, and
system member versus non-member status were controlled for, the differences in patient experience scores were not statistically significant. Jarvis et al. (2013) conclude that advanced EHRs offer the greatest advantage in improving clinical process of care scores, without compromising patients’ experience of care.

Smith et al. (2013) also used the HIMSS Analytics EMRAM to investigate the associations between information technology governance characteristics and the impact on hospital financial performance. Similar to the Jarvis study, Smith et al. (2013) identified EMRAM Levels 6 and 7 to represent “EMR sophistication”. Although Smith et al.’s research did not examine nursing practice or the products of nursing care specifically, it did utilize the HIMSS Analytics EMRAM in a similar manner. Smith et al.’s (2013) sample consisted of 86 hospitals in the United States that reached either Level 6 or Level 7 on the HIMSS Analytics EMRAM between 2006 and 2009 and that had complete financial and clinical data accessible from the American Hospital Directory. The authors presented multiple hypothesizes including H1: Information technology governance structure where the Chief Information Officer (CIO) reports directly to the Chief Executive Officer will be positively associated with a sophisticated EMR; H2: CIO turnover will be negatively associated with EMR sophistication; and H3: the act of disbanding an IT steering committee will be negatively associated with EMR sophistication (Smith et al., 2013).

The results of the logistic regression model indicate there was only support for Hypothesis 2, which asserts that CIO turnover will be negatively associated with EMR sophistication. There was a statistically significant negative association between CIO
turnover and the presence of EMR sophistication ($\beta = -1.18$, $OR = 0.31$, $p < .05$) (Smith et al., 2013). Hypothesis 3 was not supported by Smith et al.’s (2013) results. The researchers also hypothesized that EMR sophistication, as defined by Level 6 or 7, would lead to improved organizational economic performance. The linear regression models used to test the hypotheses supported this hypothesis that financial performance is strongly associated with EMR sophistication. Smith et al. (2013) reported that hospitals with sophisticated EMRs are more cost-efficient than other hospitals, as demonstrated by the decrease in total operating expenses ($\beta = -2,500$, $p < .10$) and payroll expenses ($\beta = -1,333$, $p < .10$). The research team suggests that healthcare organizations’ executives should consider the Chief Information Officer’s structural power when they are assessing current or future levels of IT capabilities (Smith et al., 2013).

**Factors Influencing Electronic Health Record Adoption**

Despite being an information-intense discipline, the healthcare industry has been criticized for its slow adoption of information technology (Wagner, Lee, & Glaser, 2009). There are a number of possible factors for this slow adoption. One common perception is that healthcare has fallen behind other professions in its application of IT because healthcare executives are not as technically savvy or advanced as leaders in other fields. Leidner, Preston, and Chen (2010) posit that healthcare organizations in general have not been highly effective in leveraging information technology. However, Wagner et al. (2009) propose that healthcare leaders face specific IT implementation challenges that other executives are less vulnerable to, such as the complexity and infrastructure of healthcare organizations. According to a recent McKinsey study, more than 40% of
information technology projects with budgets of $15 million or greater fail, and 17% of large IT projects fare so poorly that they threaten the company’s existence (Bloch, Blumberg, & Laartz, 2012). Healthcare organizations are distinct from other entities due to their unique clinical, operational, and financial needs as well as the diversity of their workforces. The next section analyzes both positive and negative factors that influence EHR implementation in hospital settings.

Gagnon et al. (2012) reviewed 101 studies examining factors that facilitate and hinder information and communication technologies (ICTs) in clinical environments. They defined ICT as “…all digital technologies that facilitate electronic capture, process, storage, and exchange of information” (Gagnon et al., 2012, p. 241). This study complements a previous Cochrane systematic review on the effectiveness of interventions for encouraging ICT adoption. Twenty-seven quantitative, 49 qualitative, and 25 mixed-method studies were reviewed; and the participants included physicians in 38 studies; nurses in 17 studies; a combination of clinical professional (physicians, nurses, pharmacists, and other clinicians) in 25 studies; and a combination of clinical plus clerical, administrative, and implementation team members in 21 of the studies.

The most prevalent limiting factors to ICT implementation that Gagnon et al. (2012) identified in their systematic review were issues pertaining to design, technical difficulties, level of familiarity with ICT systems, and time concerns. The researchers note how human and organizational factors were often recognized as contributing to system implementation failure in the literature (Gagnon et al., 2012). They found that the technological, human, and organizational factors that supported ICT adoption were
primarily associated with either perceptions of the characteristics of specific system applications, or with organizational considerations. Certain ICT characteristics at the individual, professional, and organizational level were also found to be barriers to adoption (Gagnon et al., 2012). These characteristics included unfamiliarity with new systems and increased workloads associated with ICT implementations. Although ICTs’ compatibility with clinical processes did present as a facilitating factor in a limited number of studies, ICT incompatibility with workflow was more often reported as a barrier to adoption (Gagnon et al., 2012). Such incompatibility was described as poor fit with work processes, tasks, or work practices. Interoperability, cost and legal concerns were also cited as incompatibility issues that affected ICT implementation. The human factors preventing successful adoption included concerns about interactions between patients and providers/health professionals, attitudes of coworkers towards technology, and the applicability of the systems to patients’ individual characteristics. The factor of patients’ attitudes about ICTs appeared in the literature as both an adoption barrier and facilitator. The organizational barriers included relationships between different professional groups that generated concerns regarding role boundaries and changing responsibilities. At the organizational level, issues related to access to material resources (the ICTs) were frequently noted as barriers in the studies reviewed by Gagnon et al. (2012).

The most common information and communication technology characteristic that facilitated system adoption was the perception of system usefulness. Successful adoptions were distinguished by a clear comprehension of the benefits of adopting
innovation by end-users. The second most common facilitating factor was ease of ICT system use. Two very important supportive factors that Gagnon et al. (2012) noticed repeatedly were comprehensive training strategies for end-users and strong IT support. The presence of specially-trained super-users or clinician champions, coupled with end-user participation in the design and implementation strategy also appeared as supportive factors to ICT adoption. An additional supportive factor of technology adoption was the early monitoring of system usage during implementation. Organizational and management support were identified as having positive influences on ICT implementations as well (Gagnon et al., 2012).

Silow-Carroll et al. (2012) examined the experiences of nine hospitals that had recently implemented comprehensive electronic health record systems. They found that strong leadership, active engagement of clinicians in the design and implementation phases, mandatory end-user training, and compliance with budgetary and timeline requirements were the keys to successful implementation projects. The authors defined a comprehensive EHR as one that enabled 24 functionalities throughout the hospital. They accessed data from surveys completed for the American Hospital Association’s Health Forum in 2007 and 2009. The analyses included data from hospitals that improved the breadth of EHR functionality from little or no EHR capabilities to meeting the criteria for comprehensive systems. These facilities were designated as “most improving” (Silow-Carroll et al., 2012, p. 2) and were the focus of this report so the researchers could investigate the process of improvement as evidenced successful implementation. Hospitals that already had comprehensive EHRs in place in 2007 were not included in
This study. Interviews were conducted with hospital staff familiar with their organizations’ EHR’s adoption processes to ascertain the following information: the most powerful drivers behind EHR adoption; key functions; challenges to implementation, and strategies used to address them; and plans and approaches to improve the utility of EHR systems (Silow-Carroll et al., 2012).

The majority of the nine hospitals examined in the Silow-Carroll article had included the adoption of a comprehensive EHR as part of a strategic plan to coordinate inpatient and outpatient services across their continuum of patient care. The hospitals all confirmed that their systems contained a minimum of 24 functions related to nursing and clinical documentation, diagnostic results, clinical decision support, and computerized provider order entry. They all likewise stated that they had met Meaningful Use criteria and anticipated receiving CMS EHR incentive payments for 2012. The majority of the nine hospitals also reported receiving payments in 2011 (Silow-Carroll et al., 2012).

Most of the hospitals described dedicating at least one full year to the design, building, and validation of their systems. Multiple interviewees cited the importance of EHRs to support new modules and advancing technologies such as voice-recognition for dictation, and barcoding tools. A predominance of commercial EHR products over homegrown systems was noted with eight out of the nine hospitals reported using a vendor’s EHR. This frequency was attributed to customization improvements in commercial EHRs and the potential to install one integrated platform for inpatient and ambulatory records (Silow-Carroll et al., 2012).
Silow-Carrol et al.’s (2012) report discussed six challenges to EHR adoption that were identified by the hospital representatives as being particularly critical to successful EHR conversions and system optimization. Several strategies to address these issues were also presented. The key challenges were: 1) achieving physician and staff buy-in, 2) training, 3) performance improvement, 4) using EHRs for performance reporting, 5) cost and training, and 6) encouraging appropriate use of EHRs (Silow-Carroll et al., 2012). All of the interviewees indicated that one of the most critical challenges to EHR implementation and optimization was gaining buy-in from physicians and other staff members. Personnel expressed concerns about their anticipated disruption to their daily workflows and practices. This perceived anticipated upheaval was exacerbated by persistent ambiguity about potential EHR system benefits (Silow-Carroll et al., 2012).

Some of the solutions recommended by the respondents focused on identifying strong departmental leaders who could drive change and hold physicians and staff accountable throughout the entire implementation process. The importance of setting realistic expectations from the beginning was also referenced. Additionally, there was a need for hospital leadership to enforce accountability, and occasionally discipline disruptive or resistant staff. All nine hospitals endorsed having clinical staff drive EHR design and implementation, and the utilization of clinical super-users and physician champions was a reoccurring theme. Silow-Carroll et al. (2012) report that some healthcare organizations suggested engaging EHR skeptics in the design and implementation of the systems, as many of those individuals eventually became strong advocates of the new technology.
Training presented another great challenge to the implementation of comprehensive EHR systems. Hospitals stated that they needed to increase their IT staff; incorporate IT-focused clinicians to bridge the gap between information systems and clinical practice; coordinate off-site training for integrated health systems; and continually update training efforts for new staff in response to system enhancements or modifications (Silow-Carroll et al., 2012). The strategies provided included making significant financial investments in staff training, creating training hubs for integrated systems, and leveraging super-users to facilitate training efforts. Similar to overcoming physician and staff buy-in, management was also advised to make all training mandatory, and to require clinicians to pass a proficiency exam before gaining access to the system. One hospital’s interviewee was quoted as saying “If you short-change training, you will bring productivity to a halt” (n.d., as cited in Silow-Carroll et al., 2012).

The third implementation challenge all of the hospitals faced was the optimization of their EHRs to support performance improvement. The initial barriers were related to streamlining processes through technology with minimal disruption to organizational and clinical processes. Electronic health records have the potential to promote standardization of practice, but this comes at the risk of alienating physicians (Silow-Carroll et al., 2012). As EHR adoption evolves within a hospital, the focus shifts to using the systems for measurement and reporting purposes to leveraging them to improve the quality of care. To mitigate adoption risks, the hospitals interviewed in the Silow-Carroll study suggested strategies such as applying Lean value mapping techniques and using Six Sigma teams; transitioning changes in policies and procedures that affect staff
performance gradually; and incorporating a hybrid implementation approach that incrementally replaces existing practices with new ones (i.e. replacing verbal orders with computerized order entry). Silow-Carroll et al. (2012) emphasize that while electronic health records are tools to support quality improvement initiatives, they are not intended to replace healthcare organizations’ current quality assurance and reporting programs. Multiple hospitals described implementing daily checks in the systems for compliance with CMS Core Measures. This study proposes several recommendations to optimize EHRs to support performance improvement. Those recommendations include embedding checklists in templates and the placement of data elements in discrete fields as opposed to narrative free-text options to expedite automatic data capture and extraction for quality monitoring programs (Silow-Carroll et al., 2012).

Using EHRs effectively for performance reporting was an additional challenge encountered by many of the hospitals described in this article. There were frustrations with systems that had limited ability to generate CMS reports for Hospital Compare and MU certification. Often there were incompatibilities between CMS reporting requirements and system data storage formats, which resulted in the need for manual data extraction. To address these issues, some of the hospitals engaged their quality improvement and accreditation personnel throughout the entire EHR life cycle, including vendor selection. They encouraged these professionals to collaborate with IT and clinicians to help establish priorities and to guide staff to focus on the right measures (Silow-Carroll et al., 2012).
Each of the nine hospitals considered the cost and timing of comprehensive EHR implementations to be interrelated challenges. To facilitate success, they developed strategies to manage, contain and recoup EHR costs; coordinate and time their system rollouts; staff the rollouts; and maintain their systems with the most current technologies (Silow-Carroll et al., 2012). One facility recommended hiring temporary workers instead of consultants or full time employees to augment staff when necessary, citing this approach as the more cost-efficient alternative. Strong organizational leadership was once again referenced as a critical element to keep IT projects on schedule and under or at the established budget. To measure return-on-investment, it was advised that healthcare organizations gather substantial baseline data prior to their EHR conversion.

The final challenge discussed by Silow-Carroll et al. (2012) addresses how to encourage the appropriate use of comprehensive EHRs (2012). The hospitals involved in the study revealed they had all encountered clinicians creating technological “shortcuts” with their electronic entries which resulted in missing or incomplete documentation. One of the organizations described how they modified their software to color code information that had been input via a copy-paste function to deter physicians from copying previous patient notes. On the vendor side, more sophisticated voice-recognition applications are being developed that can capture, standardize, and input patient problems and clinical data from dictated visit note to the EHR. Other recommendations from hospitals that were successful in meeting MU criteria include embedding clinical guidelines for staff to promote consistent use of evidence-based practices; generating performance reports that include trends and benchmarks; using integrated systems to
facilitate communications between inpatient and outpatient settings; and investing in predictive analytic programs (Silow-Carroll et al., 2012).

In a 2011 study, Lluch proposes that barriers to electronic health record adoption are generally attributed to either technical or socio-technical challenges at the organizational level. There is a lack of consensus in the literature on how to quantify the proportion of health information technology failures that can be blamed on the technology itself. Some researchers have suggested that inadequate socio-technical consideration is more detrimental to successful HIT adoption than technical problems actually are (Lluch, 2011). Lluch (2011) focused on the socio-technical factors affecting HIT adoption from an organizational management, and conducted a systematic review of 79 articles that addressed these barriers. Lluch (2011) used the term “health information technology” to reflect EHRs, electronic prescribing (eRX), computerized provider order entry (CPOE), picture archiving and communications systems (PACS), online access to medical journals and resources, videoconferencing, and telemedicine. Seven of the studies that Lluch (2011) evaluated were systematic reviews, 40 were qualitative studies, 12 were quantitative studies, and 20 were reported as mixed-method investigations.

The Galbraith model was used to organize the organizational management barriers into five primary categories: 1) structure of healthcare organizations, 2) tasks, 3) people policies, 4) incentives, and 5) information and decision processes. Lluch (2011) also identified 10 subcategories within three of the five main categories. The first category, structure of healthcare organizations, describes barriers within healthcare settings related to the way different team members or professionals at various levels are
organized and how effectively they collaborate together. The subcategories are hierarchy, team work and cooperation, and autonomy. Previous studies propose that the presence of traditional hierarchical structure limited the contributions of younger workers who are members of Generation Y (born after 1978), and who would likely represent change agents within their healthcare organizations. Lack of team work between members of different “tiers” of workers was also identified as a possible barrier to ICT adoption (Lluch, 2012).

The second category of organizational management barriers is tasks, which represents how work is organized. There are two subcategories of tasks: 1) changes in work processes and routines, 2) and face-to-face interaction versus new ways of working. An example of this type of barrier is the perception of clinicians that the use of technology will lead to the depersonalization of healthcare delivery (Shortliffe, 2005).

The third main category of organizational socio-technical barriers to HIT adoption is people policies. Inadequate formal policies defining how accountable people are expected to be in terms of their system knowledge, as well as lack of training and/or computer literacy were cited as potential barriers to HIT implementation (Lluch, 2011). Training; support; trust and liability; lack of legal framework; accountability to their employer; and center of gravity and autonomy were the subcategories of the “people policies” barrier. Center of gravity is described as a dominant determinant of organizational structure, systems, and processes. The allocation of resources and the policies that are created often reflect where the center of gravity is situated within an organization.
The fourth category of HIT adoption barriers is incentives, which Lluch (2011) refers to as reward programs that are broadly comprised of both monetary and non-monetary compensation. There were differing opinions reflected in the articles that Lluch reviewed. Some researchers such as Ford, Menachemi, and Phillips (2006) indicate that pay-for-performance programs would likely stimulate EHR utilization; however, others including Ross et al. (2010, as cited in Lluch, 2011) posit that incentivizing health professionals through policies would not be sufficient, and that the industry should focus on redesigning workflows and processes that can support EHR adoption. The fifth and final main category of organizational HIT barriers that Lluch found in the literature is information and decision processes. The introduction of new HIT, including EHRs, requires modifications to information and decision processes. Many of the research studies found that such changes initially resulted in heavier workloads for clinicians, which led to resistance to the technology. Lluch (2011) believes that many barriers to HIT adoption within the different categories and their respective subcategories are interrelated, and that additional research is needed to explore the development of optimal IT applications, along with the cost-effectiveness of health information technology. Lluch also asserts that there is a gap in the literature surrounding organizational change; incentives for adoption; liability concerns; end-user proficiency and competencies; organizational structure; and the workflow issues inherent to achieving benefits of HIT. Lluch (2011) anticipates that overcoming the barriers to acceptance will be a lengthy and challenging journey that may be facilitated by the
creation of a shared organizational vision and consistent support from administrators, policy makers, technical professionals, and clinical peers.

The Premier healthcare alliance is a national network of 2,300 not-for-profit hospitals and 63,000 other healthcare sites located in the United States (DeVore & Figlioli, 2010). This network surveyed its hospital members to establish a best practices library dedicated to electronic health records. The Premier library provides support for organizations interested in pursuing MU attestation in areas such as clinical documentation, computerized provider order entry, medication management, privacy, quality measure reporting, health information exchange, population health management, and personal health records (DeVore & Figlioli, 2010). The Premier best practices library offers “lessons learned” from the experiences of their member organizations with electronic health record implementation.

DeVore and Figlioli (2010) summarize the findings of the Premier EHR adoption survey and describe recurring best practice strategies for facilitating organizational culture change, executive leadership, effective communication, and clinician support. They found seven emerging themes and present them as the top seven lessons learned. DeVore and Figlioli’s (2010) article articulates the same position as Lluch’s (2011) work which asserts that cultural changes present a greater challenge to EHR adoption than technical issues do. In this first lesson learned, DeVore and Figlioli (2010) propose that given the magnitude of health information technology initiatives, they must be perceived and presented as exercises in change management, as opposed to solely IT projects. The authors believe that leaders should ensure that only a limited number of changes are
imposed on system users at the same time, and that end-users should be empowered with a forum to communicate feedback before full implementation occurs. Most importantly, the focus should be on system usability and designing applications that make it easy for users to practice safely and difficult to make a mistake (DeVore & Figlioli, 2010).

The second lesson emphasizes the importance of clinical champions to translate both the value of the new EHR and the benefits of engaging in change to their peers. The Premier hospitals surveyed recommended that medical, nursing, and other clinical providers be identified and leveraged throughout the entire EHR implementation journey (DeVore & Figlioli, 2010). They specifically referenced the value of involving senior medical leadership in design activities in order to obtain physician support. The third lesson also addresses physicians and the preference for hands-on EHR training over traditional classroom training. Hospitals reported that hands-on training (complemented with trainers shadowing physicians in actual work environments) was the more effective training approach (DeVore & Figlioli, 2010).

The fourth lesson learned from the Premier EHR survey is that there is great potential for alert integration and reporting of measures to maximize hospitals’ investments in health information technology (2010). Alerts that warn clinicians of potential drug-drug and drug allergy interactions are examples of patient safety alerts. Hospitals surveyed consistently claimed that linking EHR technology to organizational quality and safety goals is a compelling argument to earn staff buy-in and to justify return-on-investment. Recommendations were made for hospitals to identify the information they need for quality reporting, and then to ensure that it is incorporated into
order sets and clinical decision support tools. An example presented by DeVore and Figlioli (2010) was to capture the administration of an aspirin within an hour of admission for a patient diagnosed with a myocardial infarction in a structured format rather than to document it in a free-text note. Another consideration discussed was the need to balance the frequency of clinical prompts with the potential for alert fatigue. Some of the hospitals in the survey suggested reviewing alert reports to track and review which alerts were consistently closed by end-users within two seconds, which would indicate that they were not being read.

The next lesson summarized by DeVore and Figlioli (2010) addresses the Health Insurance Portability and Accountability Act (HIPAA) Security Rule. The recommendation was made to develop a robust security program that includes procedures for handling and reporting security incidents, as well as conducting post-incident analyses. This recommendation also proposes that policies be created that are specific to the security of handheld and mobile devices (DeVore and Figlioli, 2010). The sixth lesson learned from the Premier hospitals is to implement clear and precise policies on how formal and informal communications occur in the EHR. An example presented was the informal practice of using “sticky notes” to communicate between clinicians. These messages are not part of the official medical record, yet can be conveyed electronically, so DeVore and Figlioli (2010) emphasize the importance of discovering why staff use these methods to message one another, and if communication gaps exist that need to be reconciled.
The final lesson from the Premier library reflects the reality that financial budgets need to be designed with a certain degree of flexibility. The point was made that many healthcare organizations do not account for the numerous indirect costs of EHR system implementation such as compensating staff to attend training or to participate in design sessions, purchasing or developing upgrades needed to optimize workflow, expanding the infrastructure necessary to support additional electronic data, and additional customizations or reconfigurations post-implementation (DeVore and Figlioli, 2010). Direct costs that are frequently omitted from EHR implementation budgets were reported to be physician champion compensation; third party consulting fees for project management, training, or process redesign; additional help desk staff or hours; evidence-based practice or clinical documentation tools; and unexpected contingencies. The hospitals surveyed suggest that every IT budget should have the flexibility to accommodate any last-minute essentials that must be addressed.

Harle et al. (2013) compared hospitals that received MU incentive payments for the first year of the program from the CMS to those that did not qualify for payments based on the challenges they had anticipated one year earlier. This study utilized data from three sources, the American Hospital Association’s (AHA’s) annual survey of hospitals, the 2010 AHA EHR adoption survey, and the CMS data identifying hospitals that had received Medicare incentive payments in 2011 for meeting MU criteria (Harle et al., 2013). There were 2,475 hospitals examined in this study, with 13% of the hospitals (n = 313) having successfully attested in 2011. The research team used multivariate regression analyses to investigate differences in the anticipated challenges related to MU
between hospitals that received payments and hospitals that intended to participate in the EHR Incentive Program but were unable to qualify for any funding. The AHA EHR adoption survey asked that hospitals select two out of seven MU criteria that they felt “will or would be the most challenging to achieve” (AHA, 2010, as cited in Harle et al., 2013). The seven potential challenges were: 1) implementation of clinical decision support rules, 2) implementation of computerized provider order entry (CPOE) at a specified level of sophistication, 3) exchange of clinical information with other providers, 4) ability to perform medication reconciliation across the continuum of care, 5) provide patients with electronic access to their data, 6) generation of problem lists for codified data sets, and 7) generation of numerator and denominator for reporting of quality indicators directly from the EHR (Harle et al., 2013).

The results of the analyses, after controlling for standard hospital characteristics, indicate that there were significant differences between the challenges reported by the hospitals that achieved MU and those that did not, with regard to three out of the seven criteria. Only 32% of MU attesters anticipated that implementing CPOE at a specified level would be a challenge, versus 50% of non-attesting hospitals ($p < .001$). The hospitals that indicated that CPOE was the primary anticipated challenge were 18% less likely to attest to MU than hospitals that reported other criteria as their primary concern (Harle et al., 2013). The hospitals that did receive CMS Medicare incentive payments were more likely to anticipate challenges giving patients access to their data in electronic form than hospitals that did not receive payments (31% versus 23%) ($p = .004$). Hospitals that received payments were also significantly more likely to anticipate
challenges generating numerator and denominator data for quality reporting from the EHR (38% versus 27%, \( p < .001 \)). Harle et al. (2013) also note that certain hospital characteristics were associated with specific anticipated challenges. Hospitals located in urban settings were significantly more likely to anticipate challenges with performing medication reconciliation across settings of care (\( p < .001 \)) and generating problem lists (\( p = .04 \)) than rural hospitals. Teaching hospitals (\( p < .001 \)) and system hospitals (\( p = .04 \)) were both significantly less likely to report CPOE as a concern than for-profit hospitals (\( p = .004 \)) (Harle et al., 2013).

**Barriers to EHR Adoption Specific to Nursing**

Gillespie (2002) reported that many information technology projects fail as a direct result of lost nursing support. He explains that when nurses’ needs are prioritized under those of physicians in terms of IT planning and implementation, it can result in nurses’ resistance to a new information system. According to some Chief Information Officers, this resistance can prove to be just as strong, if not stronger, than physician resistance (Gillespie, 2002). Over a decade since Gillespie’s statement was made, end-user resistance still persists; however, there is the expectation that increasing nursing engagement throughout the EHR life cycle, may help to reduce many of these barriers. Gillespie (2002) writes that nurses often cite increased access to patient data as a primary advantage of EHRs, while the magnitude of transitioning from paper to electronic records presented too much of a change for some nurses practicing at the bedside. Albanese (2002, as cited in Gillespie, 2002) asserts that adopting EHRs is a much more intense experience for nurses than it is for physicians, because nurses complete more
documentation and process more information than doctors do. Sassen (2009) conducted a literature review of nurses’ perceptions of, and experiences with, EHRs and found several common themes in the literature: inattention to nursing workflow; inability of systems to capture the “invisible work of nurses” (p. 262); logistical EHR issues that resulted in additional workloads; inadequate training; lack of usable output from the systems; and perceptions of nurses that the EHR systems imposed upon them that did not meet their needs. Sassen (2009) posits that some healthcare institutions mistakenly did not solicit or support clinician participation in the selection, implementation, and maintenance of their new electronic health record.

In a systematic review of studies comparing different user groups’ perspectives of barriers and facilitators to EHR implementation, McGinn et al. (2011) found that non-physician clinical users of EHRs, including nurses, reported implementation barriers related to perceived system usefulness and design or technical issues. Some of the specific negative factors reported were concerned with: evidence surrounding the benefits of using an EHR; scientific rigor of the EHR’s resources; trialability; observability; ethical considerations; and coworkers’ attitudes about the EHR (McGinn et al., 2011). In contrast to physicians, nurses and other non-medical clinicians did not express concerns about fee for service remuneration. McGinn et al (2011) also wrote that compared to physicians, other healthcare professionals tend to consider poor organizational management as a challenge to EHR implementation. Some of the management practices that were described as barriers were: top-down leadership style, poor project timing, and lack of adequate resources to support implementation efforts. One study reviewed noted
that poor management techniques not only exacerbated implementation challenges, but also fostered passive resistance to the EHR’s implementation (McGinn et al., 2011).

As the CMS EHR Incentive Programs mature, new research will continue to contribute to the current body of knowledge. The most commonly reported challenges to EHR adoption are related to poor system designs that are incompatible with clinical processes; low level of end-user familiarity with EHR systems; perceptions that the EHR would increase workloads or decrease time available for patient interactions; difficulties meeting budgetary and timeline restrictions; legal issues; technical problems; and struggles to redesign workflows to leverage electronic systems as they replace paper-based records. Some of the main factors reported in the literature to positively affect EHR adoption are the end-users’ perceptions of system usefulness; end-user comprehension of potential system benefits; system ease of use; comprehensive end-user training; end-user engagement in design and implementation activities; IT support; and strong organizational leadership.

Multiple strategies to facilitate EHR implementation were described by healthcare organizations that have successfully adopted EHRs and received Meaningful Use incentive payments, however, there is still need for additional investigation. The next section of this literature review focuses on the state of the science dedicated to nursing practice and nursing leadership’s relationship with MU attestation and the HIMSS Analytics EMRAM.
Nursing, Nursing Leadership, Meaningful Use, and the HIMSS Analytics EMRAM

The paradigm shift in healthcare from a quantity to a quality-focused delivery model presents the nursing profession with an unique opportunity to transform the quality of patient care, while simultaneously quantifying nursing’s contribution to healthcare outcomes. Although research has been conducted relating to EHR implementation strategies, MU attestation, the HIMSS Analytics EMRAM, professional nursing, and Magnet hospitals all as individual constructs, little is known about the associations between those variables. The current study aims to address this identified gap in the literature. The final section of the literature review discusses recent publications that address the relationships between nursing practice, EHR adoption, Meaningful Use attestation, the HIMSS Analytics EMRAM, and/or the Magnet Recognition Program.

Nursing, Electronic Health Records, and Meaningful Use

Simpson (2011) articulates that “The data that nurses collect at the point of care will prove ‘meaningful use’ of technology, making our facilities eligible for an ARRA payday” (p. 82). He describes nursing’s critical role in proving MU as a collaboration between Chief Nursing Officers (CNOs), Nurse Informaticians (NIs), and clinically-focused nurses (Simpson, 2011). The CNOs and NIs are responsible for identifying which data and information to prioritize, while the direct patient care professionals are the nurses who demonstrate the “meaningful use” of technology through their daily interventions and interactions with patients. According to Simpson (2011), NIs strive to achieve four objectives which facilitate the demonstration of Meaningful Use: 1) documenting and improving the quality of patient care, 2) codifying administrative
processes, 3) supporting lifelong learning, and 4) providing data that helps to advance research. These goals are also consistent with the Magnet Model’s core components of Exemplary Professional Practice; New Knowledge, Innovations, and Improvements; and Empirical Outcomes. Simpson (2011) asserts that NI research supports the need for a universal nomenclature, taxonomy, and vocabulary for nursing practice as these standardizations support electronic data retrieval, analysis, and management. These processes, in turn, facilitate the demonstration of Meaningful Use and help to define and measure the work of nurses. Simpson (2011) describes nursing’s active participation in organizational informatics as instrumental to the integration of Meaningful Use metrics into existing quality improvement programs, as well as to the attainment of HIMSS Analytics Level 7.

Murphy, J. (2010) also notes that the impending transition from inefficient, disjointed, silos of paper-based records to an interoperable and interconnected nationwide electronic system would make it very difficult to overstate the importance of nurses and nursing informatics. She highlights the vital role of nurses to healthcare organizations who are on the journey to Meaningful Use. Murphy J. refers to the Alliance for Nursing Informatics’ 2009 recommendations to the Robert Wood Johnson Foundation on the future of nursing which claim that nurses will play an integral role in achieving nationwide adoption and implementation of EHR systems in a meaningful way (2010). Hodges and Wierz (2012) and Prestigiacomo (2012) note that many hospitals and systems have identified the importance of accurate nursing documentation and demonstrated delivery of high quality nursing to their organization’s Medicare
reimbursement. Several recent research projects investigated the use of EHR technology in distinct but complementary studies. One study initiated by Harrison and Lyerla (2012) and then completed by Harrison, Stalker, Henderson, and Lyerla (2013) focused on the CMS MU objectives to incorporate clinical decision support into EHR systems. Another study by Westra et al. (2010) addressed the re-utilization of EHR data to improve quality outcomes.

One of the MU Stage I Core Objectives is to implement one clinical decision support rule (CMS, 2010). This is an expectation that is expanded upon in Stage II where the requirement is to use clinical decision support to improve performance on high-priority health conditions (CMS, 2012b). A clinical decision support system (CDSS) is based on one or more rules that enable a computer to perform an action such as an alert, reminder, or the ability to present suggestions for action to the end-user (Harrison & Lyerla, 2012). The objective of CDSSs is to assist in clinical decision making processes in order to improve the quality of healthcare services by leveraging evidence-based research. Harrison and Lyerla (2012) analyzed the use of a CDSS to improve inpatient hypoglycemic management by the nursing staff at a small midwestern hospital. The quality improvement department at this healthcare organization had identified diabetes and hypoglycemia as high priorities for their patient population (Harrison & Lyerla, 2012), which is consistent with the criteria to meet the aforementioned MU Stage II Core Measure.

Harrison and Lyerla’s (2012) study utilized the Deming cycle, also referred to as the Plan-Do-Study-Act model, for its conceptual framework. The intervention consisted
of the development and implementation of an evidence-based CDSS that guided nurses through possible nursing interventions to address inpatient hypoglycemic episodes using a series of relevant questions. The research team developed an algorithm for the CDSS that incorporated the most updated hospital protocols, radio buttons in place of narrative text box for discrete data capture, and embedded best practices supported by current evidence-based research (Harrison & Lyerla, 2012). They described an initial question in the hypoglycemia management CDSS’s algorithm in the following way: “For example, an initial question asked if the patient can swallow. If the answer was ‘yes’, oral glucose would be included in the treatment recommendation. If the answer was ‘no’, intravenous glucose would be listed as a recommended intervention” (Harrison et al., 2013, p.251).

The electronic health records of discharged patients who had a primary or secondary diagnosis of diabetes from February 2010 to August 2011 were reviewed by the research team. The study design included the review of three different samples of 150 episodes of blood glucose levels that were less than 70mg/dL, and were collected at three different time points. The three sample collection periods occurred six months prior to the new CDSS; within six months after implementing the new CDSS; and seven to 12 months post implementation, respectively (Harrison & Lyerla, 2012). Hypoglycemic episodes that occurred in the critical care unit were excluded because those episodes were managed with a different protocol than the new CDSS. The goal of this study was to determine if rates of adherence to the hypoglycemic guidelines persisted over time. The results showed a 9% increase in guideline compliance between phase 1 (pre-implementation) and phase 2 (six months post-implementation), with compliance rates
improving from 4% to 13% (Harrison et al., 2013). The researchers reported a statistically significant increase in hypoglycemic guideline adherence between phase 2 (six months post-implementation) and phase 3 (even to 12 months post implementation), with rates improving from 13% to 25% ($\chi^2 = 42.16, p \leq .001$). The average blood glucose across the three time periods was between 56 to 57 mg/dL, which was not significant, (ANOVA, $f = 0.015, p = .864$). In phase 2 however, there was a significant difference between the blood glucose values for the patient episodes when the hypoglycemic protocol was adhered to (51mg/dL) and when the protocol was not followed (58mg/dL) (T test, $t = 4.85, p = .010$) (Harrison et al., 2013). The odds ratio indicated that the hypoglycemic protocol was almost twice as likely to be followed in phase 2 as in phase 1 ($OR = 1.84$), and almost three times as likely in phase 3, ($OR = 2.82$) (Harrison et al., 2013). Harrison et al. (2013) summarized that although their study yielded statistically significant improvements to hypoglycemic management protocols between the pre and post CDSS implementation periods, the improvement could not be considered significant from a compliance perspective, with only a 25% increase observed. They conclude that there is opportunity for continued improvement, and they state that hypoglycemia guideline compliance is now measured and reported on a monthly basis at the research hospital’s quality council meetings (Harrison et al., 2013).

Another one of the tenets of “meaningful use” of EHRs is the reuse of captured data for quality improvement purposes. The Nursing Management Minimum Data Set (NMMDS) is a research-based minimum set of standardized data elements for collecting either unit or service-level nursing management data (Westra et al., 2010). This essential
data set is utilized by nursing leaders to guide decisions related to quality improvement initiatives. The NMMDS was based on three theoretical frameworks, the Donabedian Model, the USA Nursing Minimum Data Set, and the Iowa Model of Nursing Administration (Westra et al., 2010). The NMMDS identifies administrative nursing variables that can be incorporated with billing and clinical data to illustrate the influence of nursing resources and the context of care on patient safety and patient outcomes. According to Westra et al. (2010), variables from the NMMDS have been integrated into the Magnet Recognition Program, the National Database of Nursing Quality Indicators (NDNQI), the Joint Commission quality indicators, and the National Quality Forum.

Westra et al. (2010) recently updated and normalized the NMMDS data elements, definitions, and measures to the current national standards, and then they proceeded to map them to the Logical Observation Identifier Names and Codes (LOINC). The LOINC terminology represents a federally recognized standardized data set, and Westra et al. (2010) stated that they elected to use this terminology because it contains similar data structures to the NMMDS, and due to the fact that it has been used in the past to incorporate survey tools. The authors reworded, redefined, and reorganized first three data elements of the 2005 NMMDS: Unit/Service Unique Identifier (NMMDS 02); Nursing Delivery Unit or Service (NMMDS 02); and Patient or Client Population (NMMDS 03). The objective was to correlate the NMMDS with the current nursing and government quality improvement standards and research. These three updated data elements were made publicly accessible, and Westra et al. (2010) state that they could be
applied to multilevel and multi-agency analyses of the context of nursing care on patient outcomes, safety, and nursing workforce data requirements.

Over two decades ago, Norma Lang explained that “If we cannot name it, we cannot control it, practice it, teach it, finance it, or put it into public policy” (Clark & Lang, 1992, p.109). By standardizing nursing management data, Westra et al. (2010) propose that nursing data can then be defined, captured, stored and linked in data warehouses, and new reports can be generated to provide insight on the relationship between nursing management data with nursing interventions and the outcomes of care. They reiterate how one of the criteria for EHR incentive payment is the reuse of EHR data for quality improvement. This study concludes that widespread use of the NMMDS has the potential to decrease administrative burden and increase the meaningful use of healthcare data by facilitating the availability of relevant nursing data for safety measurement and quality improvement across healthcare organizations (Westra et al., 2010).

Nursing Leadership and EHR Adoption

Edwards (2012) acknowledges that there is not a great body of research available to nursing administrators on the subject of EMR optimization, and that the existing knowledge is primarily qualitative in nature. However, she presents this lack of research as an opportunity for nurse executives to document their best practices during their EMR transitions to share with the nursing and healthcare communities. Edwards (2012) states that nursing leaders can and should act as a foundation for the electronic medical record because their knowledge of clinical workflow, decision-making abilities, and leadership
positions are aligned with the skills needed to transfer health care information to an electronic record. In a systematic review of the importance of developing nursing intellectual capital in use and oversight of EHRs, and associated best practices, Poe, Abbott, and Pronovost (2011) found that the majority of research studies on this topic were non-experimental and contained methodological issues inherent with their study design.

Despite the evolving nature of the nursing research in this area, there have been organizational efforts to advance the integration of nursing leadership and EHR adoption. In 2012, the American Organization of Nurse Executives (AONE) formally recognized the essential nature of nursing informatics leadership within the context of current healthcare reform. The AONE published a position paper encouraging the advancement of the executive nurse informaticist role within healthcare organizations (2012). The Technology Informatics Guiding Educational Reform (TIGER) initiative represents an ongoing effort to support nursing, nursing leadership, and health information technology collaborations. Formed in 2004, the goal of the TIGER initiative is to join stakeholders to create a vision, strategies and actions to improve nursing practice, education, and patient care through health information technology (HIMSS Analytics, 2014e). There are nine collaboratives that comprise the TIGER initiative: HIT agenda, standards, competencies, education, staff development, usability, virtual demonstration, personal health records, and leadership. Every collaborative offers resources and recommendations for nurses to empower their utilization of healthcare technology. The leadership collaborative specifically recommends alignment with the Magnet Recognition
Program as a way to demonstrate nursing excellence in using technology to improve the delivery of patient care. (Brusco, 2011). The TIGER Initiative also recommends that healthcare organizations “facilitate nursing leadership to understand, promote, own, and measure the success of IT projects” (2007, p. 12).

**HIMSS Analytics Level, EMR Adoption, and Nursing-Sensitive Indicators**

The effects of electronic medical record implementation on nursing-sensitive patient outcomes were analyzed by Furukawa, Raghu, and Shao in 2010. Furukawa et al. (2010) investigated if there was support for the theory that health information technology could decrease the burden of non-value-added activities on nursing staff and facilitate improvements in quality, safety, and satisfaction. They found partial support for the hypothesis that EMR implementation is positively related to improved nursing-sensitive patient outcomes. The authors referenced previous research by Hendrich et al. that suggests that 35% of nursing practice time is dedicated to documentation, while only 20% is spent on patient care activities (2008, as cited in Furukawa et al., 2010). There is the potential for health IT to reduce the cost of healthcare while simultaneously increasing efficiency, quality of care, and patient safety (Blumenthal et al., 2008), yet there has not been enough data collected on the relationships between EMRs and nursing practice. Furukawa et al.’s (2010) study examined the impacts of EMRs on several outcome variables that were previously under-studied. In addition to nurse-sensitive patient outcomes, their study addressed how hospital costs, length of stay (LOS), and nurse staffing were affected by the implementation of EMRs in 326 hospital hospitals in California from 1998 to 2007 (Furukawa et al., 2010).
Data from the 1998-2007 HIMSS Analytics Databases were used to represent the level of electronic medical record adoption. Data from the 1998-2007 Annual Financial Disclosure Reports and Patient Discharge Databases from the California Office of Statewide Health Planning and Development were used as the nurse staffing and patient outcomes variables (Furukawa et al., 2010). The research team created measures of EMR sophistication based on the HIMSS Analytics EMRAM, dividing the EMRAM into three categories for the purposes of their research. Electronic Medical Record stage 1 (EMR-S1), was used to describe hospitals that had begun implementing three of the core ancillary department information systems: laboratory, pharmacy, and radiology, as well as a clinical data repository. Technical functionality at the EMR-S1 level was defined by automation of the patient record, electronic facilitation of communication between and within departments, and improved access to clinical information. The next tier on Furukawa et al.’s (2010) EMR sophistication classification was Electronic Medical Record stage 2 (EMR-S2). EMR-S2 hospitals already had implemented all of the EMR-S1 applications, and had started implementing both electronic nursing documentation and electronic medication administration records. Functional characteristics of EMR-S2 were automation of nursing workflow processes, clinical documentation, and electronic recording of the administration of patient medications. The highest level that Furukawa et al. (2010) assigned to the hospitals in their study was Electronic Medical Record stage 3 (EMR-S3). Hospitals in this category already had implemented EMR-S1 and EMR-S2 functionality, and had begun to incorporate clinical decision support (CDS) and computerized physician order entry (CPOE). EMR-S3 functionality was distinguished by
automation of clinical decision processes, order entry management, and clinical decision making support.

Furukawa et al. (2010) utilized the patient safety indicators (PSIs) and inpatient quality indicators (IQIs) from the Agency for Healthcare Research and Quality to develop measures of patient indicators. A hospital risk-adjusted rate per 1,000 hospitalizations for each PSI and IQI indicator was calculated by applying PSI and IQI software to the patient discharge data; and the researchers also created variables for patient outcomes that Needleman, Kurtzman, and Kizer had associated with nursing care (2007, as cited in Furukawa et al., 2010). These variables included hospital rates of infections due to medical care; decubitis ulcers; failure to rescue; and mortality from acute myocardial infarction, congestive heart failure, and pneumonia.

Furukawa et al. (2010) reported that the longitudinal analysis specified fixed-effects regressions that were estimated using ordinary least squares. The within-hospital effects of EMR implementation related to changes in nurse staffing and patient outcomes at the same facility were estimated by the fixed-effects regressions. The study found that EMR-S1 hospital classification was associated with a 1.4% to 1.7% higher rate of in-hospital complications (decubitis ulcers, failure to rescue, and selected infections due to medical care) in the second and third years of EMR implementation. The only significant effect found for hospitals categorized as EMR-S2 was a 16.7% to 16.9% lower rate of acute myocardial infarction mortality in the second and third years of EMR implementation. Hospitals with the highest level of EMR implementation, EMR-S3, were associated with lower rates of mortality, but higher rates of complications. There
was a 2.3% to 3% increase in patient complications and a 3% to 4.2% decrease in mortality in the second and third years of EMR implementation for EMR-S3 facilities. Furukawa et al. (2010) concludes that there is partial support for the hypothesis that EMR implementation is associated with improvements in nursing-sensitive outcomes. They recommend that future research focus on the long-term effects of EMRs, as their study was limited to the first three years of implementation.

**Synthesis of Constructs Reviewed**

Chapter 2 described the components that affect electronic medical record adoption, Meaningful Use attestation, and the Health Information and Management Systems Society’s Electronic Medical Record Adoption Model in United States’ hospital settings, and their documented relationships with nursing practice and the American Nurses Credentialing Center’s Magnet Recognition Program. The Donabedian Quality Framework was referenced in the literature as an appropriate model to conceptualize associations between health information technology and nursing care that result in improved patient outcomes (Dykes & Collins, 2013); and it was also applied by Kelley et al. (2011) to organize an integrative review of research studies that investigated relationships between electronic nursing documentation and the quality of care delivery.

The Magnet Model, which leverages the Donabedian Model’s concepts of structure, process, and outcomes, was used by several authors as the theoretical framework to describe their hospitals’ health information technology initiatives (Kirkley et al., 2004; Lindgren et al., 2010). The actual Magnet Recognition Program itself was the focus of more than 50 research studies in the ANCC’s Magnet Research References
resource. Studies that focused on patient outcomes produced mixed results when comparing rates of nursing-sensitive indicators at Magnet versus non-Magnet hospitals, but the majority of the research indicated that Magnet facilities were associated with superior outcomes. Everhart et al. (2014), Lake et al. (2010), Rogers (2013), and McHugh et al. (2013) found that patient outcomes for nursing-sensitive patient care indicators were generally better at Magnet hospitals. Jayawardhana et al. (2011) concluded that the nursing characteristics of Magnet facilities may facilitate their adoption of safe practices more readily than their non-Magnet counterparts. Choi and Boyle (2013), He et al. (2012), Mills and Gillespie (2013), and Hickey et al. (2010) however, did not find nursing-sensitive patient outcomes at Magnet healthcare organizations to be statistically significantly different than those at non-Magnet facilities. Goode et al. (2011) also found that while patients at Magnet hospitals had better outcomes with respect to lower rates of hospital acquired pressure ulcers, patients treated at non-Magnet facilities fared better with regard to some of the other nursing-sensitive indicators they analyzed.

Several organizational characteristics of hospitals that successfully met Meaningful Use criteria emerged in the literature, as well as characteristics that appeared to limit a hospital’s abilities to receive the Centers for Medicare and Medicaid EHR incentive payments. Diana et al. (2012) reported that hospital bed size, urban location, and current partial or full use of an existing EHR were positively associated with hospitals’ reported intent to pursue incentive payments. Another study conducted in anticipation of CMS payment distribution found that large, urban, and privately-owned
hospitals were more likely to have already adopted EHRs than smaller, non-teaching, rural and public hospitals (Jha et al., 2010). Other researchers also noted that hospital size, teaching status, and geographic location were organizational characteristics associated with discrepancies in EHR adoption rates (DesRoches et al., 2013). Adler-Milstein et al. (2013) investigated the characteristics of hospitals that received CMS payments during the first 18 months of the EHR Incentive Programs, and reported that smaller hospitals had less than half the odds of meeting eligibility requirements than larger facilities. There were multiple researchers who expressed concern about the ability of smaller, non-teaching, and rural hospitals to attest to MU, and recommendations for legislators to consider this, and to implement safeguards for such facilities, were found throughout the literature.

There were no research studies that examined correlations between the HIMSS Analytics EMRAM and the Magnet Recognition Program as of May 2014. Some of the published literature was written from a health information technology industry perspective, with Davis (2009) mapping the 2011 Meaningful Use measures to HIMSS Analytics Level 3; 2013 Meaningful Use measures to HIMSS Analytics Level 4; and the proposed 2015 Meaningful Use measures to HIMSS Analytics Levels 6 and 7. Two empirical studies utilized HIMSS Analytics EMRAM Levels 6 and 7 as a representation of advanced EHR use (Jarvis et al., 2013) and EMR sophistication (Smith et al., 2013), respectively. In a cross-sectional analysis of associations between advanced EHR use and Hospital Consumer Assessment of Healthcare survey scores, Jarvis et al. (2013) used HIMSS Analytics EMRAM levels 6 and 7 to represent the construct of advanced EHRs.
They found that hospitals with advanced EHR systems (i.e. that had achieved Level 6 or 7 on the HIMSS Analytics EMRAM) were associated with significantly higher mean estimated clinical process of care scores than hospitals that did not have advanced EHRs in place. This study also revealed that healthcare organizations with advanced EHR use were more likely to have a higher number of beds, a greater number of annual admissions, belong to a health system, and be not-for-profit than hospitals with less advanced EHRs (Jarvis et al., 2013). Smith et al. (2013) used HIMSS Analytics EMRAM Levels 6 and 7 to reflect superior EMR capabilities. In this investigation, hospital attainment of HIMSS Analytics Level 6 or Level 7 was used to represent the variable of EMR sophistication (2013). This study reported a negative association between EMR sophistication and Chief Information Officer turnover, and positive associations between EMR sophistication and organizational financial performance (Smith et al., 2013).

With so much at stake clinically, operationally, and financially, factors that influence electronic health record adoption have been widely studied. Studies that included nursing documentation and EHR system utilization were common in the literature, but research that specifically focused on nursing’s relationship to EHR adoption and meeting MU criteria was not as prevalent. There were several systematic reviews, hospital system publications, and individual research projects that reported both the barriers to, and the facilitators of EHR adoption. Recurring challenges to health information technology implementation included: design issues related to poor EHR system fit with clinical workflow; technical difficulties; lack of formal organizational
policies to guide change management initiatives; low level of familiarity with the EHR systems; low clinician computer skills; and timeline, legal, and cost concerns (DeVore & Figlioli, 2010; Gagnon et al., 2012; Lluch, 2011; Silow-Carroll et al., 2012). Factors that were repeatedly found to support EHR adoption were: clinicians’ perceptions of system usefulness; clear comprehension of the benefits of adopting the EHR system; end-user engagement in design and implementation of the EHR; use of clinical champions and super-users; comprehensive end-user training; strong IT support for end-users; continuous feedback communication with end-users; and strong executive leadership (DeVore & Figlioli, 2010; Gagnon et al., 2012; Lluch, 2011; Silow-Carroll et al., 2012).

The barriers to EHR adoption specific to nursing were similar to the challenges to all clinicians; however, multiple sources in the literature propose that nurses are impacted more by implementation barriers for several reasons. First, nurses have historically been excluded from, or have had limited representation, in organizational IT project planning, with physicians serving as the primary decision-makers (Gillespie, 2002). Secondly, nurses are affected more by EHR implementations because they process more data than physicians (Albanese, 2002, as cited in Gillespie). Finally, Sassen noted in a literature review of nurses’ perceptions of, and experiences with ERHs, that nurses reported frustration with health IT systems that were unable to capture the “invisible work” that nurses complete on a daily basis (2009, p. 262). The publications reviewed suggested that consistent nursing engagement throughout all phases of the EHR life cycle would decrease nursing resistance, and consequently increase clinical adoption of electronic health records in the hospital setting.
Nursing scholars described how the data nurses document during the delivery of patient care have the potential to support MU attestation (Murphy, J., 2010; Simpson, 2011); however, additional efforts are needed to standardize a professional nomenclature that will support electronic data retrieval, analysis, and management. Westra et al. (2010) focused on standardizing a nomenclature by updating three data elements from the Nursing Minimum Data Set to current national standards, and then mapping them to the Logical Observation Identifier Names and Codes terminology. In the same empirical study, Harrison and Lyerla (2012) and Harrison et al. (2013) examined nursing utilization of an electronic clinical decision support system for diabetes and hypoglycemia management. Their results found a 25% increase in hypoglycemic protocol by nursing staff post CDSS implementation (Harrison et al., 2013). Although their research yielded results that were statistically significant, Harrison et al. (2013) articulated that a 25% compliance improvement could not be translated into clinical significance, and they noted the opportunity for further improvement. Furukawa et al. (2010) analyzed the effects of EMR implementation on nursing-sensitive patient outcomes for the first three years following implementation. They found partial support for a positive relationship between the variables with lower EMR capabilities associated with higher rates of in-hospital complications, and highest EMR capabilities associated with both higher rates of in-hospital complications and decreased mortality.

The need for nursing leadership to engage in EHR projects and for nurse researchers to expand the body of knowledge was evident throughout the literature. The AONE published a position paper supporting nursing informatics leadership in healthcare
organizations (2012), and the TIGER initiative was formed to advance nursing practice, nursing education, and the delivery of patient care through health information technology. The TIGER (2007) initiative recommended that hospitals support and facilitate nursing leaders’ involvement and ownership in health IT projects.

Summary

The majority of the research reviewed indicated that Magnet facilities were associated with better nursing-sensitive patient outcomes than non-Magnet hospitals. Two articles directly connected the Magnet Model to EHR adoption by describing its application to successful EHR implementations in U.S. hospitals. The role of clinicians, including nurses, on EHR adoption was reported as having both positive and negative impacts. The direction of clinical influence (positive or negative) varied depending on the level of clinical engagement throughout the EHR lifecycle. Nursing leaders were called upon to actively participate in organizational EHR initiatives to facilitate nursing representation, end-user support, and successful EHR adoption. Currently, there are limited scholarly resources specific to nursing’s relationship to EHR adoption, MU attestation, and scores on the HIMSS Analytics EMRAM. This lack of research presents an opportunity to augment the body of knowledge surrounding possible connections between the Magnet Recognition Program and nursing’s contributions to successful EHR adoption.
CHAPTER 3

METHODS

This study examined the relationship between nursing excellence (as represented by Magnet designation) and the adoption of electronic health records (as represented by MU attestation or achievement of Level 6 or 7 on the HIMSS Analytics EMRAM) in U.S. hospitals. A quantitative, non-experimental research approach was utilized to investigate these relationships. Previous studies explored associations between hospital characteristics and EHR adoption, as well as associations between Magnet organizations and nursing-sensitive patient outcomes. This study was distinct from other research in that it examined the successful adoption of hospital EHR systems specifically within the context of exemplary nursing practice.

Study Design and Research Approach

The current study used two large datasets. Administrative data sets were analyzed with descriptive and inferential statistics to generate knowledge about EHR adoption in the presence of nursing excellence. The unit of analysis was the individual hospital. The hospitals examined were limited to healthcare organizations in the United States because the CMS EHR Incentive Programs are unique to the American healthcare system. As part of the HITECH Act, the Meaningful Use programs exemplify how the ARRA of 2009 is intended to “…modernize our nation’s infrastructure” (Centers for Disease Control and Prevention, 2012, para. 1) through the meaningful utilization of certified EHR technology.
Operational Definitions

**Nursing excellence.** The operational definition of nursing excellence was current Magnet recognition by the American Nurses Credentialing Center as of December 2013. This definition aligned with the concepts of professionalism, holistic care, practice, and humanism, and was quantified by the receipt of Magnet designation or re-designation. Hospitals with current Magnet designation as of December 2013, hospitals awarded Magnet designation for the first time in 2013, and hospitals that were re-designated as Magnet organizations in 2013 were included in the analyses. Tenure of Magnet designation was based on the date of initial Magnet recognition. Hospitals that had earned Magnet status but failed to re-designate at any point, and therefore had to re-apply for recognition were categorized as Early-designation (1994 to 2009) or Recent-designation (2010 to 2013) based on their original year of Magnet recognition.

**Electronic health record adoption.** The study used two operational definitions of EHR adoption. The first was the receipt of Medicare reimbursement from the CMS for Meaningful Use attestation as of December 2013. The second was the achievement of Level 6 and/or 7 on the HIMSS Analytics EMRAM as of December 2013.

Data Management

**Nursing excellence.** Four separate Magnet hospital data sets were developed to represent the predictor variable of nursing excellence (see Table 8). The first data set was established to examine the relationship between Magnet recognition and MU attestation (H1). The inclusion and exclusion criteria for this data set focused on the Magnet hospitals’ eligibility to receive Medicare payments from the CMS for meeting MU
criteria. Healthcare organizations ineligible for EHR Incentive Program Medicare payments were excluded from both MU analyses (H1 and H3). Hospitals ineligible for Medicare EHR payments are those that are not considered Subsection (d) Hospitals paid under the Inpatient Prospective Payment System by the CMS Section 1886(d)(1)(B) of the Social Security Act. The Social Security Administration (2014) defines Subsection (d) Hospitals as hospitals located within one of the 50 United States or the District of Columbia that are not one of the following types of facilities: 1) a rehabilitation hospital, 2) a psychiatric hospital, 3) a hospital whose inpatient population is predominantly under the age of 18, or 4) a hospital with an average inpatient stay that is greater than 25 days. Additionally, cancer-specialty hospitals are not eligible for the Medicare EHR incentive program (Murphy, K., 2013). Many of the Medicare-ineligible hospitals could potentially qualify for Medicaid funding if they meet the established EHR adoption criteria, have a minimum of 10% Medicaid patient volume, and have an appropriate CMS Certification Number, also known as Medicare Provider Number or appropriate OSCAR number, (New York State Department of Health, 2011).

Hypothesis 1. The names, states, and year of initial Magnet designation of all of the Magnet-recognized hospitals as of December 2013 were electronically retrieved from the ANCC’s official web site. These data elements were manually entered into an Excel spreadsheet (Microsoft Office University Version 2010) by the researcher and verified by two research volunteers for accuracy. The final group of Magnet hospitals used to represent nursing excellence in H1 excluded 69 Magnet hospitals out of a possible 399. Six hospitals were excluded because they were not located in the United States. Sixty-
three hospitals were excluded because of their facility category: 33 children’s hospitals/healthcare systems; six cancer centers; two rehabilitation hospitals; two psychiatric hospitals; one long-term hospital; one clinic; and one home health/hospice organization. Seventeen individual hospitals were also removed from the data set because they were identified as belonging to healthcare systems, and their CMS reporting structure (individual versus consolidated) could not be verified through publicly-accessible data sets. The final sample consisted of 330 Magnet organizations out of a possible 399 ($n = 330$). Appendix D shows the process used to establish the Magnet hospital data set used to test H1.

**Hypothesis 2.** A second Magnet data set was developed to test H2a, H2b, and H2c that did not exclude Medicare EHR Incentive Program-ineligible hospitals and healthcare systems. The HIMSS Analytics EMRAM is not based on CMS eligibility; therefore, the facilities that were excluded from the data set utilized in the Meaningful Use analyses (H1 and H3) were included in the HIMSS Analytics analyses (H2a, H2b, H2c, H4a, H4b, and H4c). These facilities represented the Medicare-ineligible hospitals and the hospitals whose CMS reporting structure could not be verified using public data files. The six international Magnet hospitals were still excluded from the H2a, H2b, and H2c analyses because the study’s population of interest was United States hospitals. This resulted in a final group of 393 Magnet hospitals used to represent nursing excellence in H2a, H2b, and H2c ($n = 393$).

**Hypothesis 3.** The researcher developed a third Magnet data set to test hypothesis 3. As with the first data set used to test H1, this data set also excluded all hospitals that
were not eligible for Medicare EHR Incentive Program payments. Of the 330 Medicare-eligible hospitals, 251 were identified as “Early-designation” Magnet facilities because their year of initial Magnet recognition was between 1994 and 2009 (n = 251). Seventy-nine of the Medicare-eligible Magnet hospitals were identified as “Recent-designation” Magnet facilities because their year of initial Magnet recognition was between 2010 and 2013 (n = 79).

**Hypothesis 4.** A fourth Magnet data set was developed to test H4a, H4b, and H4c. This final data set, like the second data set that tested H2a, H2b, and H2c, included hospitals that were not eligible for Medicare EHR Incentive Program payments because the HIMSS Analytics EMRAM scores are independent of hospitals’ CMS status. Of the 393 U.S. Magnet hospitals, 297 were identified as “Early-designation” Magnet facilities because their year of initial of Magnet recognition was between 1994 and 2009 (n = 297). Ninety-six of the Medicare-eligible Magnet hospitals were identified as “Recent-designation” Magnet facilities because their year of initial Magnet recognition was between 2010 and 2013 (n = 96).

**EHR Adoption**

*Receipt of Medicare EHR Meaningful Use Incentive Program payment.* The first measure of EHR adoption was the receipt of at least one Medicare EHR Incentive Program payment from the CMS. The HITECH Act requires that the Centers for Medicare and Medicaid Services publicly disclose the names, business phone numbers, and business addresses of Medicare eligible professionals, eligible hospitals, and critical access hospitals that received payment(s) for successful demonstration of Meaningful
Use (CMS, 2014c). It does not mandate public disclosure of information related to recipients of Medicaid MU financial incentives (CMS, 2014c). The Medicaid EHR Incentive Programs are individually run by each state and as of September 2014, all 50 states had launched their respective programs (CMS, 2014d). Some states have posted the names of the eligible hospitals and providers that received Medicaid EHR Incentive Program payments on their respective websites, but not every state has elected to publish this data.

As a national program, the Medicare EHR Incentive Program payment data is posted on the CMS.gov web site in comma separated value (CSV) file format and updated on a quarterly basis (CMS, 2014c). For this study, the CSV file “EH Recipients of Medicare EHR Incentive Program Payments” (as of December 2013) was downloaded into an Excel spreadsheet by the researcher from CMS.gov. This data set originally contained 5,190 entries that represented individual distributions of Medicare payments from May 2011 through December 2013; however, many hospitals appeared multiple times in the data set because they received more than one MU incentive payment between 2011 and 2013. For the purposes of this study, receipt of more than one Medicare MU payment represented a duplicate value. One thousand, six hundred and three such duplicate entries were removed from the data set before the CSV file was transferred into International Business Machines (IBM) Statistical Package for the Social Sciences (SPSS) Version 21. The criterion for duplication was the presence of identical provider NPI and CCN numbers. The CMS uses the National Provider Identifier (NPI) for Medicare claims and the CMS Certification Number (CCN) is used to verify that a
provider is Medicare-certified, and for what specific services (CMS, 2007). This resulted in 3,587 hospitals that had received at least one Medicare payment for successful Meaningful Use attestation between May 2011 and December 2013 ($n = 3,587$).

Electronic health record adoption, as represented in this data set, was a dichotomous outcome variable.

**Achievement of Level 6 or 7 on the HIMSS Analytics EMRAM.** The second measure of EHR adoption in this study was the achievement of Level 6 or 7 on the HIMSS Analytics EMRAM. The HIMSS Analytics publishes the names and locations of the hospitals that attain EMRAM Levels 6 and 7 on its website and this data is updated on a quarterly basis. Hospitals that participate in the HIMSS Analytics Annual Study are eligible to receive their EMRAM score as a free service (HIMSS Analytics, 2014c). The HIMSS Analytics Annual Study collects data on hospital information systems related to products, software, and hardware inventory to answer questions pertaining to use of healthcare information technology by clinical practitioners (HIMSS Analytics, 2014b). The results of the study are de-identified and shared among the respondents to facilitate collaboration and to advance healthcare IT initiatives and participation in the HIMSS Analytics Annual Study is voluntary. HIMSS Analytics data were retrieved from the HIMSS Analytics’ www.himssanalytics.org website and manually entered into three Excel spreadsheets by the researcher. The first spreadsheet contained 161 HIMSS Analytics Level 7 hospitals as of December 2013 ($n = 161$). The second spreadsheet contained 708 HIMSS Analytics Level 6 hospitals as of December 2013 ($n = 708$). The third spreadsheet was comprised of both Level 7 and Level 6 hospitals as of December
2013. The combined set contained 869 hospitals ($n = 869$). The accuracy of the data sets was reviewed and verified by two research volunteers. Electronic health record adoption, as represented by the achievement of Level 6 or 7 on the HIMSS Analytics EMRAM was a dichotomous dependent variable.

**Study Samples**

There were 6,582 U.S. hospitals identified from the HRSA HHSSDR, CMS General Hospital Information data set, and CMS EHRMEHRIPP data set. To test H1, 1,653 of the initial 6,582 hospitals were excluded from the H1 analysis because they were ineligible for the Medicare EHR Incentive Program, resulting in a sample of 4,929 hospitals. Appendix D describes the development of the study’s sample for H1. To test H2a, H2b, and H2c, of the initial 6,582 hospitals, 239 Transplant hospitals with zero beds were excluded, but 76 hospitals that were evaluated as individual facilities by the HIMSS were included, resulting in a sample of 6,419 hospitals.

The Magnet hospitals examined in the H3 analysis represented a subset of the H1 Magnet hospitals. Of the 330 U.S. Magnet facilities that were eligible for the Medicare EHR Incentive Program, 251 were coded as Early-designation and 79 were coded as Recent-designation. The Magnet hospitals examined in the H4a, H4b, and H4c analyses represented a subset of the H3 Magnet hospitals. Of the 393 U.S. Magnet facilities, 297 were coded as Early-designation and 96 were coded as Recent-designation. Figure 3. On the following page describes the study samples.
Research Questions and Study Hypotheses

The purpose of this study was to investigate if there is a positive relationship between nursing excellence and electronic health record adoption in hospital settings in the United States. Four research questions guided the development of the study’s hypotheses.
Research question 1: Are Magnet hospitals more likely to attest to Meaningful Use than non-Magnet hospitals?

H1: Magnet hospitals are more likely than non-Magnet hospitals to receive Medicare reimbursement for Meaningful Use.

Research question 2: Are Magnet hospitals more likely to have high EHR adoption than non-Magnet hospitals?

H2a: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7.

H2b: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 7.

H2c: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6.

Research question 3: Are Early-designation Magnet hospitals more likely attest to Meaningful Use than Recent-designation Magnet hospitals?

H3: Early-designation Magnet hospitals (1994-2009) are more likely to receive Medicare reimbursement for Meaningful Use than Recent-designation Magnet hospitals (2010-2013).

Research question 4: Are Early-designation Magnet hospitals more likely to have high EHR adoption than Recent-designation Magnet hospitals?

H4a: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).

H4b: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).

H4c: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 than Recent-designation Magnet hospitals (2010-2013).

Data Analyses

Preliminary analyses. Summary statistics about the number of Magnet hospitals that received Medicare EHR incentive payments for Meaningful Use between 2011 and 2013, or that achieved HIMSS Analytics EMRAM Level 6 or 7 were examined.
**Hypothesis testing.** Binary logistic regression analyses were used to test all of the study’s hypotheses. Data analysis was conducted using IBM SPSS Version 21.0. Regression analysis examines relationships between independent and dependent variables by evaluating the ability of one variable to either predict or explain another variable (Lomax & Hahs-Vaughn, 2012). Regression is similar to analysis of variance (ANOVA) in that both are iterations of the same general linear model. With ANOVA, independent variables are categorical (measured on nominal or ordinal scales) and dependent variables are continuous (measured on interval or ratio scales). With regression, however, independent and dependent variables are usually continuous, although there are exceptions in certain analytical tests (Lomax & Hahs-Vaughn, 2012). A specific example is logistic regression analysis, which allows for the utilization of dichotomous dependent variables. Logistic regression is used to establish which variables affect the probability of a particular outcome occurring (Munro, 2005). Logistic regression uses the logistic equation to predict the log odds of a dependent event (Garson, 2011). In this study, the dependent events were Medicare reimbursement for Meaningful Use for H1 and H3, and high HIMSS Analytics EMRAM levels for H2a, H2b, H2c, H4a, H4b, and H4c. The general logistic regression equation is written as: $z = b_0 + b_1X_1 + b_2X_2 + \ldots + b_kX_k$ (Garson, 2011, p. 3).

With logistic regression, independent variables may be categorical or continuous, but nominal-level predictors require coding prior to entry into statistical software. The presence or absence of Magnet recognition among hospitals that received Medicare payments for Meaningful Use Stages I or II was dichotomized as either “Not Magnet”
(coded as 0) or “Magnet” (coded as 1) for H1. Hospitals that received Magnet recognition for the first time 2010 to 2013 were labeled as “Recent Magnet” (coded as 0), and hospitals that received initial Magnet designation from 1994 to 2009 were labeled as “Early Magnet” (coded as 1).

Logistic regression was an appropriate statistical approach for this study because its goal was to predict the probability of Magnet hospitals either receiving Medicare EHR incentive payments or achieving Level 6 or 7 on the HIMSS Analytics EMRAM. Hosmer and Lemeshow (1989) posited that the minimum number of cases per independent variable in logistic regression is ten.

Assumptions

In order for the analyses to be valid, the regression models must satisfy the assumptions of logistic regression, or appropriate actions must be taken to address any identified violations. The assumptions of logistic regression are distinct from the assumptions of linear regression. Lomax and Hahs-Vaughn (2012, p. 431) described the assumptions of logistic regression as “somewhat relaxed” as compared to ordinary least squares regression. For multiple regression analyses, the assumptions that must be met are normality, homoscedasticity, linearity, independence and collinearity (Fairchild & MacKinnon, 2010; Miles & Shevlin, 2001). Logistic regression does not assume that linear relationships exist between independent and dependent variables (Agresti, 2002), because there is an assumed linear relationship between the logit of the independent and dependent variables (Anderson, 2003). The term “logit” refers to the logistic probability unit, and it represents the natural logarithm of the odds. In logistic regression analysis,
the outcome variable is transformed into the logit (Polit, 1996). According to Agresti (2002), independent variables in logistic regression are not required to demonstrate a normal distribution, nor must they have equal variance with each group. Likewise, normal distribution of dependent variables is neither assumed nor required (Anderson, 2003).

Lomax and Hahs-Vaughn (2012) described the four primary assumptions of logistic regression as: 1) noncollinearity, 2) linearity, 3) independence of errors, and 4) values of the independent variable (X) are fixed. This study used binary or binomial logistic regression, which alters the assumptions that must be satisfied as compared to multivariate logistic regression. In this study, multicollinearity was not considered as a threat to the analyses because each hypothesis contained only one independent variable. The design of the study assumed a between-subjects design, thus satisfying the assumption of independence of errors. In this study, all of the values of the predictor variable were observed as they were obtained from the American Nurses Credentialing Center’s Magnet Recognition list. All of these values were used in the actual analyses for their respective hypotheses.

Ethical Considerations

This study did not involve human subjects research and no patient data were analyzed. The data were retrieved from the official and publically accessible web sites for the CMS; the American Nurses Credentialing Center (ANCC); and the Health Information and Management Systems Society (HIMSS). The data retrieved online from each of the three web sites were de-identified to the hospital level. Written permission
from the ANCC was obtained to reproduce the copyrighted Magnet Model graphic, and written permission from HIMSS Analytics was obtained to reproduce the copyrighted Electronic Medical Record Adoption Model graphic. A licensing agreement was signed by the researcher, a representative from the HIMSS, and the University of Miami which granted the researcher access to the 2013 HIMSS Analytics Database for the purpose of this academic study. In accordance with the licensing agreement, all data were treated as confidential and stored on a password-protected laptop that was only accessible by the researcher. The laptop was stored in secure and locked locations at all times. The University of Miami’s Institutional Review Board (IRB) reviewed the proposal for this study and granted a letter of Notification of Not Human Research Determination on September 3, 2014.
CHAPTER 4

RESULTS

The purpose of this study was to investigate if hospitals that demonstrate nursing excellence are more likely to successfully adopt EHR technology than hospitals that do not demonstrate nursing excellence. Nursing excellence was represented by Magnet recognition. EHR adoption was operationalized in two ways: 1) Medicare MU attestation, or 2) the achievement of Level 6 or 7 on the HIMSS Analytics EMRAM.

Magnet Data

There were 393 U.S. Magnet hospitals located in 48 states at the end of December 2013 (ANCC, 2103b). There were no Magnet-recognized facilities located in Mississippi, Nevada, New Mexico, Puerto Rico, Utah, Vermont, the U.S. Virgin Islands, or Wyoming. The states with the most Magnet facilities were: Illinois (n = 37), Texas (n = 32), Ohio (n = 26), California (n = 24), New Jersey (n = 24), Pennsylvania (n = 24), North Carolina (n = 23), and New York (n = 21). These eight states contained 54% of the Magnet facilities located in the U.S. Appendix D lists the number of Magnet hospitals by state.

CMS Meaningful Use

Four thousand, twenty-nine hospitals met the eligibility criteria for the CMS’ Medicare EHR Incentive Program and had verified CMS numbers. Three hundred and thirty out of 393 Magnet-designated U.S. hospitals were determined to be Medicare EHR-eligible. Two hundred and ninety-seven (90%) of the 330 Magnet Medicare EHR-eligible healthcare organizations received at least one Medicare payment from the CMS
for Meaningful Use attestation between May 2011 and December 2013. Magnet hospitals represented 8% of all of the recipients of Medicare EHR MU payments.

_H1:_ **Magnet hospitals are more likely than non-Magnet hospitals to receive Medicare reimbursement for Meaningful Use.**

The logistic regression model was statistically significant, $\chi^2(1, N = 330) = 63.61, p < .001$. Magnet-recognized hospitals (90% receiving payment) were more likely than non-Magnet hospitals (72% receiving payment) to receive Medicare EHR payments for MU attestation, ($B = 1.28, SE = 0.19, p < .001, 95\% \text{ CI} [2.49, 5.16], OR = 3.58$).

_H2a:_ **Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7.**

The logistic regression model was statistically significant, $\chi^2(1, N = 393) = 132.67, p < .001$. Magnet-recognized hospitals (36% achieving Level 6 or 7) were more likely than non-Magnet hospitals (12% achieving Level 6 or 7) to achieve Level 6 or 7 on the HIMSS Analytics EMRAM, ($B = 1.39, SE = 0.11, p < .001, 95\% \text{ CI} [3.23, 5.01], OR = 4.02$).

_H2b:_ **Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 7.**

The logistic regression model was not statistically significant, $\chi^2(1, N = 393) = .06, p = .802$. Magnet-recognized hospitals (19% achieving Level 7) were not more likely than non-Magnet hospitals (18% achieving Level 7) to achieve Level 7 on the HIMSS Analytics EMRAM.
H2c: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6.

The logistic regression model was statistically significant, \( \chi^2(1, N = 393) = 100.61, p < .001 \). Magnet-recognized hospitals (29% achieving Level 6) were more likely than non-Magnet hospitals (10% achieving Level 6) to achieve Level 6 on the HIMSS Analytics EMRAM, \( B = 1.30, SE = 0.12, p < .001, 95\% CI [2.91, 4.65], OR = 3.68 \).

H3: Early-designation Magnet hospitals (1994-2009) are more likely to receive Medicare reimbursement for Meaningful Use than Recent-designation Magnet hospitals (2010-2013).

The logistic regression model was not statistically significant, \( \chi^2(1, N = 330) = 1.70, p = .192 \). Early-designation Magnet hospitals (89% receiving payment) were not more likely than Recent-designation Magnet hospitals (94% receiving payment) to receive Medicare EHR payments for MU attestation.

H4a: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).

The logistic regression model was not statistically significant, \( \chi^2(1, N = 393) = .19, p = .660 \). Early-designation Magnet hospitals (35% achieving Level 6 or 7) were not more likely than Recent-designation Magnet hospitals (38% achieving Level 6 or 7) to achieve Level 6 or 7 on the HIMSS Analytics EMRAM.
**H4b: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).**

The logistic regression model was not statistically significant, \(\chi^2(1, N = 393) = .98, p = .324\). Early-designation Magnet hospitals (17% achieving Level 7) were not more likely than Recent-designation Magnet hospitals (25% achieving Level 7) to achieve Level 7 on the HIMSS Analytics EMRAM.

**H4c: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 than Recent-designation Magnet hospitals (2010-2013).**

The logistic regression model was not statistically significant, \(\chi^2(1, N = 393) = .03, p = .876\). Early-designation Magnet hospitals (29% achieving Level 6) were not more likely than Recent-designation Magnet hospitals (28% achieving Level 6) to achieve Level 6 on the HIMSS Analytics EMRAM.

Table 8 on the following page compares the percentages of MU attestation among Magnet versus non-Magnet organizations as well as the percentages of MU attestation among Early versus Recent-designation Magnet hospitals.
Table 8

*Magnet Organizations and EHR Adoption (MU Attestation)*

<table>
<thead>
<tr>
<th></th>
<th>Nursing Excellence</th>
<th>Received Medicare EHR Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnet Status ($n = 330$)</td>
<td>90% ($n = 297$)</td>
<td></td>
</tr>
<tr>
<td>Non-Magnet ($n = 4599$)</td>
<td>72% ($n = 3290$)</td>
<td></td>
</tr>
<tr>
<td>Tenure of Magnet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early-designation Magnet ($n = 251$)</td>
<td>89% ($n = 223$)</td>
<td></td>
</tr>
<tr>
<td>Recent-designation Magnet ($n = 79$)</td>
<td>94% ($n = 74$)</td>
<td></td>
</tr>
</tbody>
</table>

Table 9 on the following page compares the percentages of HIMSS Analytics EMRAM Level 6 or 7 achievement among Magnet versus non-Magnet and Early-designation versus Recent-designation organizations.
Table 9

*Magnet Organizations, Tenure of Magnet Recognition, and EHR Adoption (HIMSS Analytics Levels 6 and 7)*

<table>
<thead>
<tr>
<th>Nursing Excellence</th>
<th>Achieved HIMSS Level 6 or 7</th>
<th>Achieved HIMSS Level 7</th>
<th>Achieved HIMSS Level 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnet (n = 393)</td>
<td>36% (n = 140)</td>
<td>19% (n = 27)</td>
<td>29% (n = 113)</td>
</tr>
<tr>
<td>Non-Magnet (n = 6026)</td>
<td>12% (n = 729)</td>
<td>18% (n = 134)</td>
<td>10% (n = 595)</td>
</tr>
</tbody>
</table>

Tenure of Magnet HIMSS 6 or 7

| Early-designation (n = 297) | 35% (n = 104) |
| Recent-designation (n = 96) | 38% (n = 36) |

Tenure of Magnet HIMSS 7

| Early-designation (n = 104) | 17% (n = 18) |
| Recent-designation (n = 36) | 25% (n = 9) |

Tenure of Magnet HIMSS 6

| Early-designation (n = 297) | 29% (n = 86) |
| Recent-designation (n = 96) | 28% (n = 27) |
Table 10 summarizes the results of all of the study’s regression analyses.

Table 10

*Summary of Logistic Regression Results*

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>$B$</th>
<th>$SE$</th>
<th>Wald</th>
<th>$df$</th>
<th>$p$</th>
<th>Exp(B)</th>
<th>C.I. for Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 Magnet and MU</td>
<td>1.28</td>
<td>0.19</td>
<td>46.84</td>
<td>1</td>
<td>.000</td>
<td>3.58</td>
<td>2.49 – 5.16</td>
</tr>
<tr>
<td>H2a Magnet and HIMSS 6 or 7</td>
<td>1.39</td>
<td>0.11</td>
<td>152.99</td>
<td>1</td>
<td>.000</td>
<td>4.02</td>
<td>3.23 – 5.01</td>
</tr>
<tr>
<td>H2b Magnet and HIMSS 7</td>
<td>0.06</td>
<td>0.24</td>
<td>0.06</td>
<td>1</td>
<td>.801</td>
<td>1.06</td>
<td>0.67 – 1.68</td>
</tr>
<tr>
<td>H2c Magnet and HIMSS 6</td>
<td>1.30</td>
<td>0.12</td>
<td>119.01</td>
<td>1</td>
<td>.000</td>
<td>3.68</td>
<td>2.91 – 4.66</td>
</tr>
<tr>
<td>H4a Tenure of Magnet and HIMSS 6 or 7</td>
<td>-0.11</td>
<td>0.24</td>
<td>0.20</td>
<td>1</td>
<td>.659</td>
<td>0.90</td>
<td>0.56 – 1.45</td>
</tr>
<tr>
<td>H4b Tenure of Magnet and HIMSS 7</td>
<td>-0.47</td>
<td>0.46</td>
<td>1.01</td>
<td>1</td>
<td>.316</td>
<td>0.63</td>
<td>0.25 – 1.56</td>
</tr>
<tr>
<td>H4c Tenure of Magnet and HIMSS 6</td>
<td>0.04</td>
<td>0.26</td>
<td>0.02</td>
<td>1</td>
<td>.876</td>
<td>1.042</td>
<td>0.63 – 1.74</td>
</tr>
</tbody>
</table>

Note. $B$ = log odds; $SE$ = standard error; Wald = significance test; $df$ = degrees of freedom; $p$ = significance level; Exp(B) = odds ratio; C.I. = confidence interval; LL = lower limit; UL = upper limit.
Summary

This goal of this study was to examine if hospitals that are recognized for nursing excellence are more likely to successfully adopt electronic health records (EHRs) than hospitals that are not recognized for nursing excellence. A total of 330 U.S. Magnet hospitals were analyzed in the Meaningful Use (MU) hypotheses and 393 U.S. Magnet hospitals were analyzed in the HIMSS Analytics EMRAM hypotheses.

Magnet recognition by the ANCC represented nursing excellence as the predictor variable in all of the study’s hypotheses. Receipt of at least one Medicare payment from the CMS for the EHR Incentive Program between May 2011 and December 2013 represented the outcome variable of EHR adoption in H1 and H3. Achievement of Level 6 or 7 on the HIMSS Analytics EMRAM represented the outcome variable of EHR adoption in H2a, H2b, H2c, H4a, H4b, and H4c. Univariate binary logistic regression analyses were performed to examine the likelihood of EHR adoption based on U.S. hospitals’ Magnet status and their tenure of Magnet designation.

The models for H1, H2a, and H2c were statistically significant at the .05 level and their null hypotheses were rejected. H1 tested the relationship between Magnet recognition and MU attestation, H2a tested the relationship between Magnet recognition and achievement of Level 6 or 7 on the HIMSS Analytics EMRAM, and H2c tested the relationship between Magnet recognition and achievement of Level 6 on the HIMSS Analytics EMRAM. The model for H2b was not statistically significant at the .05 level and the null hypothesis was not rejected. Hypothesis 2b tested the relationship between Magnet recognition and achievement of Level 7 on the HIMSS Analytics EMRAM.
None of the models for H3, H4a, H4b, or H4c were statistically significant at the .05 level, and therefore their null hypotheses were not rejected. These hypotheses tested the respective relationships between the tenure of Magnet recognition and EHR adoption as represented by MU attestation, achievement of Level 6 or 7, achievement of Level 7, or achievement of Level 6 on the HIMSS Analytics EMRAM. Table 12 summarizes all of the study’s hypotheses and their respective results.

Table 11

*Summary of Hypotheses and Results*

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: Magnet hospitals are more likely than non-Magnet hospitals to receive Medicare reimbursement for Meaningful Use.</td>
<td>This relationship was statistically significant ($p &lt; .001$) and the research hypothesis was supported.</td>
</tr>
<tr>
<td>H2a: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7.</td>
<td>This relationship was statistically significant ($p &lt; .001$) and the research hypothesis was supported.</td>
</tr>
<tr>
<td>H2b: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 7.</td>
<td>This relationship was not statistically significant ($p = .801$). The research hypothesis was not supported.</td>
</tr>
<tr>
<td>H2c: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6.</td>
<td>This relationship was statistically significant ($p &lt; .001$) and the research hypothesis was supported.</td>
</tr>
<tr>
<td>H3: Early-designation Magnet hospitals (1994-2009) are more likely to receive Medicare reimbursement for Meaningful Use than Recent-designation Magnet hospitals (2010-2013).</td>
<td>This relationship was not statistically significant ($p = .219$). The research hypothesis was not supported.</td>
</tr>
<tr>
<td>H4a: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).</td>
<td>This relationship was not statistically significant ($p = .659$). The research hypothesis was not supported.</td>
</tr>
</tbody>
</table>
Table 11 continued from previous page

*Summary of Hypotheses and Results*

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4b: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).</td>
<td>This relationship was not statistically significant ($p = .316$). The research hypothesis was not supported.</td>
</tr>
</tbody>
</table>
CHAPTER 5
DISCUSSION

The objective of this study was to determine if nursing excellence increases the likelihood of hospital EHR adoption in the United States. The Donabedian Quality Framework and the Magnet Model were used to conceptualize how the construct of nursing excellence (operationalized as Magnet recognition) supports the adoption of EHRs (operationalized as Meaningful Use attestation or achievement of Level 6 or 7 on the HIMSS Analytics EMRAM). This quantitative study utilized a cross-sectional research design to examine secondary data. Logistic regression analyses were conducted to investigate the relationship between nursing excellence and EHR adoption as well as the relationship between the tenure of Magnet designation and EHR adoption. Chapter 5 summarizes the study’s findings and interpretations; strengths and limitations; implications for practice; and offers recommendations for future nursing informatics research.

Findings and Interpretations

Four research questions were examined in this study:

1. Are Magnet hospitals more likely to attest to Meaningful Use than non-Magnet hospitals?
2. Are Magnet hospitals more likely to have high EHR adoption (HIMSS Analytics EMRAM Level 6 or 7) than non-Magnet hospitals?
4. Are Early-designation (1994-2009) Magnet hospitals more likely to have high EHR adoption (HIMSS Analytics EMRAM Level 6 or 7) than Recent-designation (2010-2013) Magnet hospitals?

This section discusses the significance of the findings for each of the hypotheses along with interpretations of the results.

**Research Hypothesis 1**

*H1: Magnet hospitals are more likely than non-Magnet hospitals to receive Medicare reimbursement for Meaningful Use.*

The current study found that Magnet-designated hospitals have significantly greater likelihood than non-Magnet hospitals of receiving Medicare EHR incentive payments for MU attestation. This finding is consistent with the findings of Kirkley et al. (2004) and Lindgren et al. (2010) that describe how the application of the Magnet Model can be directly translated into successful EHR adoption practices in hospital settings. These works illustrate how the embodiment of the Magnet Core Models of Transformational Leadership; Structural Empowerment; New Knowledge, Innovations, and Improvements; and Exemplary Professional Practice (ANCC, 2008) support the implementation of EHR technology and how this also has the potential to improve Empirical Outcomes. While scholars have begun to investigate associations between nursing excellence, Magnet principles, MU, and EHR adoption (Harrison & Lyerla, 2012; Harrison et al., 2013; Simpson, 2011; Westra et al., 2010), the positive finding from the current study’s first hypothesis is important to nursing practice because the researcher was not able to identify any previous studies that specifically examined
Magnet hospitals’ outcomes compared to non-Magnet hospitals for the CMS’ Medicare EHR Incentive Program or the HIMSS Analytics EMRAM. The MU criteria for Stage II is more complex and challenging than the criteria for Stage I, and as of June 2014, only eight hospitals had successfully attested to Stage II (Pennic, 2014). Currently there is minimal data about the characteristics of hospitals that have received EHR incentive payments (Adler-Milstein et al., 2013), and the result of this analysis offers evidence that nursing excellence, as operationalized by Magnet recognition, is a hospital characteristic that is positively associated with MU attestation.

**Research Hypothesis 2**

*H2a: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7.*

*H2b: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 7.*

*H2c: Magnet hospitals are more likely than non-Magnet hospitals to achieve HIMSS Analytics Level 6.*

This hypothesis was designed to test the likelihood of Magnet hospitals achieving high levels of EHR adoption. The measure did not exclude healthcare organizations that were ineligible for the Medicare MU program. Hypothesis 2 also attempted to distinguish Magnet hospitals’ likelihood of EHR adoption on varying levels of an established adoption scale by examining Magnet hospitals’ likelihood of achieving HIMSS Level 6 or 7, HIMSS level 7, or HIMSS Level 6.

The results of this study indicate that Magnet-recognized facilities have significantly greater likelihood than non-Magnet hospitals of achieving Level 6 or 7 on the HIMSS Analytics EMRAM. The results also indicate that Magnet-recognized
facilities have significantly greater likelihood than non-Magnet hospitals of achieving Level 6 on the HIMSS Analytics EMRAM. Although the EMRAM is a different approach to measuring EHR adoption from MU attestation, the positive correlation between Magnet status and achievement of HIMSS Level 6, or 6 and 7, is consistent with the finding that Magnet hospitals are more likely than non-Magnet hospitals to receive Medicare EHR incentive payments. The consistency across the three hypotheses (H1, H2a, and H2c) which utilized two distinct measures of EHR adoption provides additional support to the position that nursing excellence is a hospital characteristic that is positively associated with EHR adoption in the United States.

There is growing interest in the impact of nursing excellence on healthcare technology initiatives. For the first time in 2014, the HIMSS Analytics Nursing Informatics Workforce Survey included a question about Magnet status, which was intended to “…explore the levels of quality patient care and nursing excellence at respondents’ organizations” (HIMSS Analytics, 2014d, p. 4). Forty-one percent of the respondents who reported that they were either employed in a hospital setting or in a healthcare system’s corporate offices indicated that they worked at a Magnet facility or that one of the hospitals within their healthcare system was Magnet recognized (HIMSS Analytics, 2014d). Considering that less than 10% of U.S. hospitals are Magnet, the fact that 41% of the HIMSS Analytics survey respondents were employed at Magnet organizations offers support for the continued investigation of the relationship between nursing and EHR adoption.
The hypothesis (H2b) which tested if Magnet hospitals have a greater likelihood than non-Magnet hospitals of achieving Level 7 on the HIMSS was not supported by the findings. The additional cumulative capabilities that Level 7 contributes to the EMRAM over Level 6 include: continuity of care document transactions for the sharing of data, data warehousing, and continuity of data with emergency, ambulatory, and outpatient settings (HIMSS Analytics, 2014e). Dullabh, Adler-Milstein, Hovey, and Jha (2014) define health information exchange (HIE) as the electronic sharing of clinical data across delivery settings. The primary distinction between Level 7 and Level 6 focuses mainly on an EMR’s ability to support HIE activities. HIE represents technical functionality, as opposed to a clinical process of care. While the delivery of nursing care does contribute to HIE and nurses do benefit from data exchange, the cumulative capabilities specific Level 7 of the HIMSS Analytics EMRAM are not directly related to nursing-sensitive outcomes. This offers a potential explanation for the failure to reject the null hypothesis for H2b. At the end of December 2013, there were only 161 hospitals in the U.S. that had reached Level 7 (HIMSS Analytics, 2014d). This figure represents less than 3% of the study’s sample, and this small sample size may have contributed to a statistical challenge encountered during data analysis that is described in the following section. An increasing number of hospitals are achieving Level 7 on the HIMSS Analytics EMRAM every year; however, until there are more hospitals at Level 7, researchers might consider consolidating Levels 6 and 7 together as one variable.
Research Hypothesis 3

H3: Early-designation Magnet hospitals (1994-2009) are more likely to receive Medicare reimbursement for Meaningful Use than Recent-designation Magnet hospitals (2010-2013).

The findings from the current study indicate that hospitals with longer tenure of Magnet status do not have greater odds than hospitals with shorter tenure of Magnet status of receiving Medicare EHR incentive payments for MU attestation. There are two possible explanations for this finding. First, there is very little difference between Early-designation and Recent-designation Magnet organizations with respect to their embodiment of the Magnet Model, or second, the manner in which the Magnet hospitals were categorized was not the most appropriate representation of the construct of tenure of Magnet recognition for the statistical analyses that were conducted.

The relationship between differences in the quality of nursing care at hospitals with longer tenure of Magnet designation compared to hospitals with less tenure of Magnet designation has not been widely investigated. Previous research that studied nursing-sensitive outcomes at Magnet versus non-Magnet hospitals did not examine healthcare organizations’ initial year of Magnet recognition. The works of Everhart et al. (2014), Goode et al. (2011), He et al. (2012), Hickey et al. (2010), Jayawardhana et al. (2011), Lake et al. (2010), and McHugh et al. (2013) either included Magnet status as an independent variable in inferential statistical analyses, or as an organizational characteristic presented in the descriptive statistics of their respective studies, but the tenure of Magnet recognition was not evaluated. A potential explanation for this could be the assertion that once a hospital has earned Magnet status, its level of nursing
excellence is comparable to that of hospitals that have been Magnet-designated for several years. In fact, 94% of the Recent-designation Magnet organizations attested to MU by December 2013, compared to only 89% of the Early-designation Magnet facilities. The HIMSS 2014 Nursing Informatics Workforce Survey (HIMSS Analytics, 2014d) reported that over one-third of the nurse informaticists (NIs) who worked at a Magnet organization stated that their hospital received Magnet recognition between 2006 and 2010, while 23% worked at hospitals that received Magnet recognition between 2001 and 2005. The fact that there were approximately 10% more NIs employed at Magnet hospitals with newer designation than those employed at Magnet hospitals with older Magnet designation is consistent with this study’s finding that longer tenure of magnet status does not impact an institution’s likelihood of receiving Medicare EHR incentive payments for MU attestation. One could therefore conclude that having longer tenure of Magnet designation does not increase the odds of a hospital attesting to MU.

Another possible explanation for the lack of association between tenure of Magnet status and the likelihood of receiving Medicare EHR incentive payments for MU is that classifying Magnet hospitals into two groups based on their tenure yields sample subsets of too small a size. In H3, the predictor variable of Tenure of Magnet Status represented a subsample of the sample of Magnet hospitals that were eligible to participate in the Medicare MU program. Two hundred and ninety-seven (90%) Magnet facilities received at least one incentive payment. Two hundred and twenty-three were Early-designation hospitals and 74 were Recent-designation. Twenty-eight Early-designation hospitals and five Recent-designation hospitals did not receive a Medicare
MU payment. By using a subsample of a sample, the range of an independent variable is restricted, which consequently affects accuracy of the statistical analysis (Rudner, 2013). The issue of the restricted range for H3 is also addressed in the limitations section of this chapter and represents one possible explanation for why H3 was not supported.

**Research Hypothesis 4**

*H4a: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 or HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).*

*H4b: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 7 than Recent-designation Magnet hospitals (2010-2013).*

*H4c: Early-designation Magnet hospitals (1994-2009) are more likely to achieve HIMSS Analytics Level 6 than Recent-designation Magnet hospitals (2010-2013).*

The findings of the current study do not support the hypotheses that hospitals with longer tenure of Magnet status designation will have a greater likelihood than hospitals with shorter tenure of Magnet status of achieving Levels 6 or 7 on the HIMSS Analytics EMRAM. The potential explanations for this finding may be the same as discussed above, namely, there is very little difference between Early-designation and Recent-designation Magnet organizations with respect to their ability to adopt of EHR technology, or the manner in which the Magnet hospitals were categorized was not the most appropriate for the statistical analyses that were conducted. Since the results of both the MU and the HIMSS Analytics EMRAM Tenure of Magnet Status hypotheses were not significant, we might conclude that longer tenure of Magnet designation does not increase the odds of successful EHR adoption in hospital settings.
Strengths and Limitations of the Study

**Strengths.** This study contributes original knowledge to the discipline of nursing informatics. Previous research primarily investigated topics such as acceptance of and/or resistance to EHR systems by nursing staff and changes in patient outcomes after the implementation of EHR technology (Choi & Boyle, 2013; Everhart et al., 2014; He et al., 2012; Hickey et al., 2010; Kelley et al., 2011; Lake et al., 2010; McHugh et al., 2013; Mills & Gillespie, 2013; Rogers, 2013), while narrative articles described hospitals’ journeys from paper to electronic systems (Kirkley et al., 2004; Lindgren et al., 2010). This study was unique in that it quantified the likelihood of Magnet hospitals adopting successfully EHRs compared to the likelihood of non-Magnet hospitals. Additionally, this study examined the relationship between the tenure of Magnet status and EHR adoption, which also has not been a consideration in previous research.

The study’s cross-sectional design utilized large quantities of data from three diverse sources. The use of data files from the CMS, the ANCC, and the HIMSS that reflected the same time period (December 2013) contributed to the consistency of the analyses. Secondary data analysis is a cost-effective research method (Hulley, Cummings, Browner, Grady, & Newman. 2007) and one that is well suited to HIT research. As a result, this study was able to examine one aspect of the phenomenon of nursing excellence without presenting any risks to patient privacy or safety. Analyzing secondary data also empowered the researcher to generate study results in a timely manner, which is of particular importance in the evaluation of technology initiatives and the MU research due to its time-sensitive nature.
The development of specific data sets (study samples) that were based on Medicare EHR Incentive Program eligibility represents both a strength and a limitation of this study. As a strength, developing customized data sets to test the study’s hypotheses allowed for the analysis of only those hospitals that were appropriate for each research question. The study’s sample for the Meaningful Use hypotheses (H1 and H3) included all hospitals identified as Medicare EHR-eligible, as opposed to only including hospitals that had registered with the CMS to participate in the Medicare MU program. The researcher aimed to study all hospitals that could potentially receive Medicare MU payments and not only those that elected to participate in the program.

The study’s sample for the HIMSS Analytics hypotheses (H2a, H2b, H2c, H4a, H4b, and H4c) included all of the hospitals analyzed in the MU hypotheses, plus the hospitals that did not meet the Medicare EHR Incentive Program eligibility criteria. The inclusion of these additional hospitals gave the current study a more comprehensive investigation of the relationship between Magnet recognition and successful EHR adoption because two different measures of EHR adoption were utilized. Also, every hospital designated as a Magnet facility in the United States in December 2013 was included in at least one of the study’s analyses.

**Limitations.** The development of customized data sets to test the study’s hypotheses was advantageous because this study had a very specific focus; however, this also limits the ability to compare this study’s findings to other research projects that utilized different data sets for their samples. The sample used in H1 and H3 was slightly larger than the number of hospitals registered for the MU programs because it included
all Medicare EHR-eligible hospitals. Thus, direct comparisons to other MU research studies whose sample included only registered, as opposed to eligible hospitals, cannot be made to the current study. The HIMSS Analytics hypotheses have a similar limitation because the sample used in this study is slightly larger than the number of hospitals in the HIMSS Analytics Database (that reflects data from 2013) because this study, by default of the larger sample, included some hospitals that were not in the 2013 HIMSS Analytics Database. Again, the researcher aimed to study all hospitals that could potentially receive a HIMSS Analytics EMRAM score and not only those that elected to participate in the survey.

Other limitations of this study were inherent to its research design. The use of data extracted from existing data sets limited the research questions that could be examined, and the researcher was not able to control the quality of the data collection (Hulley et al., 2007). Additionally, this study utilized administrative data sets that were not specifically designed for nursing research, which could further constrain how the relationships between the variables were analyzed (Waltz, Strickland, & Lenz, 2010).

The Magnet hospitals examined in H3 were divided into two subsamples, Early-designation (1994-2009) and Recent-designation (2010-2013). This hypothesis only examined a subset of Magnet-designated facilities, and consequently, a range restriction issue occurred. Cross-tabulations were conducted in SPSS between Tenure of Magnet Recognition and Medicare EHR Payment Status and there were only five (6%) Recent-designation Magnet hospitals that did not receive an EHR incentive payment. Restriction of range is the result of a study’s design or research circumstances that lessen the values
of one or both of the variables being analyzed (Weber, 2001). In this case, the use of a subset of a subset of a sample resulted in a reduction in the power of the statistical analysis (Recent-designation Magnet hospitals were a subset of Medicare EHR-eligible Magnet hospitals which were a subset of U.S. Magnet hospitals). Due to the fact that such a small number of hospitals are Magnet-recognized, their dichotomization as either Early or Recent-designation restricted the range of the independent variable, Tenure of Magnet, and therefore, this categorization was not the appropriate way to measure the length of Magnet designation.

Another limitation to this study was the use of only one measure, Magnet designation, to represent the variable of nursing excellence. Another potential measure of nursing excellence is the American Association of Critical Care Nurses’ Beacon Award for Excellence. North American hospital units can be awarded gold, silver, or bronze level Beacon awards for employing evidence-based practices to improve both patient and family outcomes (2014, American Association of Critical Care Nurses). Despite the emphasis on nursing excellence to achieve and sustain optimal outcomes, the Beacon Award was not utilized in this study due to its unit-level focus. The Magnet Recognition Program was determined to be a better metric for this study because Magnet status is awarded to entire hospitals, which is consistent with Meaningful Use attestation and HIMSS Analytics EMRAM scores.

The study’s univariate design presents another limitation. By only examining one predictor variable in each of the regression analyses (Magnet Status or Tenure of Magnet Status), this study did not consider any of the covariates such as hospital size (number of
licensed beds), annual revenue, nurse staffing, hospital state, hospital location (urban versus rural), delivery network status (member versus non-member of a multi-facility healthcare system), and EHR vendor that could potentially impact the adoption of hospital EHR technology in the U.S. Examination of the impact of these covariates presents the opportunity for additional research on this phenomenon.

**Implications and Recommendations**

Understanding the associations between the quality of nursing care and hospitals’ ability to adopt EHRs may help to identify best practices that guide both EHR adoption and the achievement of nursing excellence. The current study represents introductory research that is intended to justify and stimulate further investigation of this rapidly-evolving discipline. This study also sought to establish a foundation for continuing research that incorporates more complex analyses that could lead to specific conclusions about the hypothesized relationships.

While many healthcare organizations work to meet the short-term goal of attesting to MU in order to avoid missing CMS payments and incurring potential penalties, continuing research needs to address several critical questions: 1) What is the nature of the relationship between nursing practice and the adoption of EHRs? 2) What are the common characteristics of hospitals that successfully adopt EHRs? 3) What are the common characteristics of hospitals that demonstrate nursing excellence? 4) Are there organizational characteristics that are consistent among hospitals that demonstrate nursing excellence and successfully adopt EHRs? 5) Is the successful adoption of EHR technology associated with measureable improvements to nursing-specific patient care?
A recent study conducted by HIMSS Analytics and Healthgrades found that the performance of hospitals with high EMRAM levels was significantly better than hospitals that had low EMRAM levels for four patient outcomes, suggesting that there is a relationship between EMR use and patient outcomes. In this joint study, hospital performance was based on the number of patient mortalities (Beaudoin, 2014). Similar research that targets the outcomes of nursing care are warranted in light of the fact that nurses deliver majority of bedside care in the U.S. (AACN, 2011) and interact more with EHRs than any other group of healthcare professionals.

**Broader definitions of Nursing Excellence and EHR Adoption.** To examine the above questions, the constructs of nursing excellence and EHR adoption could be expanded to include metrics other than just Magnet recognition status and Medicare MU attestation or high scores on the HIMSS Analytics EMRAM. Measures such as hospitals’ Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores and the receipt of organizational honors such as the Malcolm Baldrige National Quality Award, the American Hospital Association-McKesson Quest for Quality Prize, the HIMSS Analytics Davies Award of Excellence, the Hospitals & Health Networks’ Most Wired designation, and the U.S. News and World Report’s Best Hospitals rankings are just some of the other criteria that could broaden the operational definitions of nursing excellence and EHR adoption beyond what this study examined.

**Inclusion of multiple predictor variables.** The positive findings for the hypotheses related to Magnet status and the likelihood of MU attestation or achievement of Level 6 or 7 or Level 7 on the HIMSS Analytics EMRAM justify additional
investigation that should incorporate the analysis of multiple potential covariates or predictors of successful EHR adoption. The organizational characteristics of high performing hospitals (those that earned Magnet status and either Medicare EHR Incentive payment(s) or Level 6 or 7 on the HIMSS Analytics EMRAM) should be cross-referenced to identify shared traits and characteristics. By adding organizational characteristics to linear regression analyses as predictor variables, factors such as hospital size (number of licensed beds), annual revenue, nurse staffing (ratios of skill mix, level of education, years of experience, and advanced certifications), ownership status, hospital state, hospital location (urban versus rural), teaching status, delivery network status (member versus non-member of a multi-facility healthcare system), and EHR vendor could help predict which types of hospitals will or will not successfully adopt EHR systems. Using a hierarchical linear regression model could provide even more knowledge as to the strength of each of the predictor’s effect on any of the statistically significant relationships.

One covariate that merits particular attention is the financial status of healthcare organizations that successfully adopted EHR technology. Hospitals with Magnet designation are regarded for their nursing excellence and quality patient outcomes for nursing-sensitive indicators (Stimpfel, Rosen, & McHugh, 2104); however, the journey to Magnet involves considerable financial and human resources that requires substantiation. According to Russell (2010), annual costs for healthcare organizations on the journey to Magnet ranged from $100,000 to $600,000. The high cost of completing the journey to Magnet, coupled with the results of this study, hold implications for healthcare policy.
One might conclude that only hospitals with extensive financial and human resources are capable of sustaining the journey to Magnet and successfully implementing robust EHR systems. Despite the U.S. government’s goal of increasing patient outcomes through the use of HIT, there is the concern that MU may be unintentionally widening the digital divide (Diana et al., 2012). Meeting MU attestation criteria may be cost-prohibitive for some facilities with lower revenues, and this could potentially create a situation where hospitals that are financially stable and/or profitable are rewarded, while the viability of hospitals that are already struggling financially becomes even more precarious. The results from this study indicate that hospitals having the resources to complete the journey to Magnet were more likely to receive MU incentive payments. This finding highlights the need for additional research on the characteristics of hospitals that do and do not successfully adopt EHRs so that interventions may be developed to guide existing and future healthcare reform.

**Incorporation of qualitative data from nursing leaders.** This study demonstrated that hospitals recognized for nursing excellence by the ANCC are more likely to attest to MU and to achieve Level 6 on the HIMSS Analytics EMRAM, regardless of how long they have been recognized as a Magnet facility. This information can be leveraged to stimulate further research as to why Magnet organizations are better positioned to have high levels of EHR adoption than their non-Magnet counterparts. Specifically, a follow-up qualitative study could focus on nursing leaders at Magnet hospitals that either attested to MU or achieved Level 6 or higher on the HIMSS Analytics EMRAM and their perspective on the relationship between nursing excellence
and EHR adoption at their healthcare facilities. Some potential research questions for CNOs and Directors of Nursing include: 1) Do you believe that embodying the Core Models of the Magnet Model supported the adoption of EHRs in your hospitals? 2) Do you believe that the adoption of EHRs in your hospital supported your journey to Magnet? 3) Which Core Model was most important to the adoption of EHRs in your hospital? 4) How do you compare the data-collection process for the Magnet journey to the attestation reporting procedures for MU?

The current study represents a starting point that has numerous implications and recommendations for nursing practice and health information technology research. Future research that leverages more inclusive measures of both nursing excellence and EHR adoption should be conducted to build upon the findings of this study. There were resource challenges accessing data that could enhance the comprehensiveness of the investigation of the relationship between nursing excellence and EHR adoption. Not all data on the CMS EHR Incentive Programs is publicly accessible such as a list of the hospitals that actually register for the Medicare and Medicaid MU programs. There are expansive data sets dedicated to hospital IT measures available for purchase; however, these are cost-prohibitive for an individual student researcher. With enhanced financial and human resources, additional research efforts should be initiated in this area to ensure that nurses are given the opportunity to fully engage in the EHR lifecycle so that patient outcomes may be improved through the use of EHR technology.
Dissemination of Findings

Findings from this study will be disseminated through written and verbal presentations in conjunction with the University of Miami School of Nursing and Health Studies. The study in its entirety will be shared with the American Nurses Credentialing Center and the Health Information and Management Systems Society. Nursing and healthcare technology conferences where the results of the study may be considered for presentation include the American Nurses Credentialing Center’s National Magnet Conference; the American Organization of Nurse Executives Annual Meeting and Exposition; the HIMSS Analytics Annual Conference and Exhibition; and the American Nursing Informatics Association Annual Conference. The findings from this study may also be submitted for consideration to *CIN: Computers, Informatics, Nursing*, a peer-reviewed journal that focuses on computers in nursing practice.

Summary

The United States’ healthcare system is evolving from a fixed, fee-for-service delivery approach to a pay-for-performance model (AONE, 2012), as mandated by recent legislation. U.S. hospitals must respond to the government’s imperatives to improve the quality of patient care through the use of HIT or they will face reductions in CMS reimbursement and the imposition of financial penalties (Jha et al., 2011). There is tremendous potential for EHRs to revolutionize the healthcare delivery process (Naser, 2012), but many challenges to EHR adoption persist. One of the most common barriers to the adoption of EHR technology is end-user resistance (Ajami & Bagheri-Tadi, 2013). Nurses are the greatest consumers of EHRs in the hospital setting (Choromanski, 2011;
Harrington, 2012), but there has been little investigation of the relationship between nursing excellence and EHR adoption.

This study proposed that hospitals recognized for nursing excellence with Magnet designation by the American Nurses Credentialing Center would be more likely to adopt EHRs. Using binary logistic regression to analyze secondary data, significant positive relationships were found between Magnet recognition and the likelihood of EHR adoption (as operationalized by Medicare MU attestation between May 2011 and December 2013). This study also found a significant relationship between Magnet recognition and the likelihood of EHR adoption (as operationalized by the achievement of Level 6 or 7 or the achievement of Level 6 on the HIMSS Analytics EMRAM). The relationship between Magnet recognition and the likelihood of EHR adoption (as operationalized by the achievement of Level 7 on the HIMSS Analytics EMRAM) was not statistically significant. The relationship between the tenure of Magnet designation and EHR adoption was not significant for either MU attestation or the achievement of Level 6 or 7 on the HIMSS Analytics EMRAM.

The variables of nursing excellence and EHR adoption and the nature of their relationship merit further investigation. Both of these variables represent components of the Donabedian Quality Framework. Nurses comprise the largest component of hospital staff in the U.S. (AACN, 2011), and clinical personnel are a structure of healthcare services. Physical EHR technology also represents a structure within Donabedian’s model. The actual delivery of nursing care is a healthcare process, as is the adoption and the utilization of EHR systems in the hospital setting. The outcomes that result from the
infrastructure created by these structures and processes are the empirical patient outcomes, or the quality of patient care that is delivered. By examining the shared characteristics of hospitals recognized for both nursing excellence and successful EHR adoption, insight may be gained as to the relationship between EHR utilization and improved patient outcomes, which is the objective of Meaningful Use Stage III and a core component of the Magnet Model. The current study provides baseline information about the relationship between nursing excellence and EHR adoption from which subsequent research questions that address the associations between the quality of nursing care, nurse staffing, health information technology, and patient outcomes may be generated.


He, J., Dunton, N., & Staggs, V. (2012). Unit-level time trends in inpatient fall rates of US hospitals. Medical Care, 50(9), 801-807. doi: 10.1097/MLR.0b013e31828a8b88


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Rogers. C. (2013). Improving processes to capture present-on-admission pressure ulcers. *Advances in Skin and Wound Care, 26*(12), 566-572. doi: 10.1097/01.ASW.0000437949.62301.6e


## United States EMR Adoption Model℠

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<thead>
<tr>
<th>Stage</th>
<th>Cumulative Capabilities</th>
<th>2013 Q3</th>
<th>2013 Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 7</td>
<td>Complete EMR, CCD transactions to share data, Data warehousing, Data continuity with ED, ambulatory, OP</td>
<td>2.2%</td>
<td>2.9%</td>
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<tr>
<td>Stage 6</td>
<td>Physician documentation (structured templates), full CDSS (variance &amp; compliance), full R-PACS</td>
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<td>Stage 5</td>
<td>Closed loop medication administration</td>
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<td>22.0%</td>
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<tr>
<td>Stage 4</td>
<td>CPOE, Clinical Decision Support (clinical protocols)</td>
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<td>15.5%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology</td>
<td>31.9%</td>
<td>30.3%</td>
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<tr>
<td>Stage 2</td>
<td>CDR, Controlled Medical Vocabulary, CDS, may have Document Imaging; HIE capable</td>
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<td>7.6%</td>
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<tr>
<td>Stage 1</td>
<td>Ancillaries - Lab, Rad, Pharmacy - All Installed</td>
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<td>3.3%</td>
</tr>
<tr>
<td>Stage 0</td>
<td>All Three Ancillaries Not Installed</td>
<td>6.9%</td>
<td>5.8%</td>
</tr>
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Data from HIMSS Analytics℠ Database ©2012

N = 5437  N = 5458
APPENDIX B

Magnet Recognition Program® Magnet Model

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APPENDIX C

Definition of Terms

Hospital: “A hospital that provides inpatient medical care and other related services for surgery, acute medical conditions or injuries (usually for a short-term illness or condition)” (Medicare.gov, 2014, para 2)

American Nurses Credentialing Center (ANCC): The American Nurses Credentialing Center is a subsidiary of the American Nurses Association (ANA), which offers credentialing and certification programs for individual nurses in specialty practice, and recognition programs for healthcare organizations. The mission of the ANCC is to globally promote excellence in nursing (ANCC, 2014a).

Biomedical Informatics: Biomedical informatics represents an interdisciplinary field which studies effective utilization of biomedical data, information, and knowledge for the purposes of improving health through scientific investigation, problem solving, and decision making (American Medical Informatics Association, 2014b).

Children’s Hospital: “A hospital with a majority of its inpatients under the age of 18, which participates and is paid in the Medicare program as a children's hospital” (Medicare.gov, 2014, para 17)

Clinical Informatics: Also known as applied clinical informatics or operational informatics, clinical informatics is the practice of applying informatics and information technology to the delivery of healthcare services. The focus of clinical informatics is information use by healthcare clinicians (American Medical Informatics Association, 2014a).
Critical Access Hospital: “A small facility that provides outpatient services, as well as inpatient services on a limited basis, to people in rural areas” (Medicare.gov, 2014, para 20).

Department of Health and Human Services (DHHS): “A federal agency that administers programs for protecting the health of all Americans, including Medicare, Medicaid, and the Children’s Health Insurance Program (CHIP)” (Medicare.gov, 2014, para 22).

Electronic Health Record (EHR): An electronic health record represents a comprehensive patient history containing medical and clinical data from multiple providers involved in a patient’s care. EHRs are designed to be shared across disciplines, and they have the ability to transition with a patient across health organizations, venues of care, and even state lines. Authorized members of the interdisciplinary team can create, share, and consult with each other using EHRs (HealthIT.gov, 2014c).

Electronic Medical Record (EMR): An electronic medical record is the digital version of a patient’s paper chart which contains his or her medical history from one healthcare practice. EMRs are commonly utilized for patient diagnosis and treatment, as they support the ability to track data over time, identify patients’ health maintenance needs, and monitor specific health parameters. EMRs are not always able to be shared across providers, thus the data they contain may need to be printed and subsequently delivered to other healthcare professionals (HealthIT.gov, 2014c). For the purposes of this study, the term electronic health record (EHR) was used primarily to refer to the dependent variable of EHR adoption. In limited cases however, the term electronic medical record (EMR) was utilized when the source of reference used the term EMR, as was the case
with the Healthcare Information and Management Systems Society Electronic Medical Record Adoption Model.

_EHR Adoption:_ For the purposes of this study, successful adoption of EMR or EHR technology were operationally defined as receipt of Medicare incentive payment for attestation of either Stage I or Stage II Meaningful Use objectives or the achievement of Level 6 or 7 on the HIMSS Analytics EMRAM.

_Eligible Hospital, Medicare:_ A hospital that is a subsection (d) hospital within the 50 United States or the District of Columbia which receives payment under the Inpatient Prospective Payment System (IPPS); a critical access hospital; or a Medicare Advantage-Affiliated hospital (CMS, 2013c).

_Health Information and Management Systems Society (HIMSS Analytics):_ The Health Information and Management Systems Society is a not-for-profit organization founded in 1961 that focuses on improved health outcomes through the use of information technology. HIMSS Analytics is an international organization that sponsors education, research, events, and media services; and promotes IT thought leadership (HIMSS Analytics, 2014a).

_Implementation of EHR Technology:_ Commencement of utilization of electronic health record systems (CMS, 2010)

_Inpatient Hospital Services:_ “Services you get when you're admitted to a hospital, including bed and board, nursing services, diagnostic or therapeutic services, and medical or surgical services” (Medicare.gov, 2014, para 31).
Nursing Informatics: The American Nurses Association (ANA) recognizes nursing informatics (NI) as a nursing specialty and defines it as the integration of nursing science, information science, and computer science for the purposes of managing and communicating data, information, knowledge, and wisdom into professional nursing practice. NI uses information structure, processes, and technology to support decision-making processes for patients, nurses, and other providers in a variety of settings across the continuum of care (2008).

Nursing-Sensitive Indicators: “Patient outcomes that are determined to be nursing sensitive are those that improve if there is a greater quantity or quality of nursing care (e.g., pressure ulcers, falls, and intravenous infiltrations). Some patient outcomes are more highly related to other aspects of institutional care, such as medical decisions and institutional policies (e.g., frequency of primary C-sections, cardiac failure) and are not considered ‘nursing-sensitive’” (ANA, 2014b, para 1).

Provider: “A doctor, hospital, health care professional or health care facility” (Medicare.gov, 2014, para 54).

Psychiatric Hospital: “A facility that provides inpatient psychiatric services for the diagnosis and treatment of mental illness on a 24-hour basis, by or under the supervision of a physician” (Medicare.gov, 2014, para 55).

Quality: “Quality health care is how well a doctor, hospital, health plan, or other provider of health care, keeps its patients healthy or treats them when they are sick. Good quality health care means doing the right thing at the right time, in the right way, for the right person and getting the best possible results” (Medicare.gov, 2014, para 56).
**Rehabilitation Hospital:** “A hospital that specializes in improving or restoring a patient's functional ability through therapies. Sometimes called a post-acute hospital” (Medicare.gov, 2014, para 62).

**Risk-Adjusted:** “Risk-adjusted” means that the measure calculations take into account how sick patients were when they went in for their initial hospital stay. When rates are risk-adjusted, it means that hospitals that usually take care of sicker patients won’t have a worse rate just because their patients were sicker when they arrived at the hospital. When rates are risk-adjusted, it helps make comparisons fair and meaningful” (Medicare.gov, 2014, para 64).

**Teaching Hospital:** “Hospitals that train residents in approved medical, osteopathic, dental or podiatry residency programs” (Medicare.gov, 2014, para 71).

**Upgrade of EHR Technology:** Expansion of technology, upgrade to certified EHR technology, or addition of new functionality to meet the established definition of certified technology (CMS, 2010).
APPENDIX D

Development of Magnet Data Set for Hypothesis 1

Magnet-recognized hospitals as of December, 2013 (n = 399)

- Exclusion of 6 non-U.S. hospitals (n = 393)
- Exclusion of 33 children's hospitals (n = 360)
- Exclusion of 6 cancer hospitals (n = 354)
- Exclusion of 2 rehabilitation hospitals (n = 352)
- Exclusion of 2 psychiatric hospitals (n = 350)
- Exclusion of 1 long-term hospital (n = 349)
  - Exclusion of 1 home health/hospice hospital organization (n = 348)
  - Exclusion of 1 clinic (n = 347)

Exclusion of 17 individual hospitals whose CMS reporting structures/CMS numbers could not be verified (n = 330)

Final sample of Magnet hospitals for H1 (n = 330)
APPENDIX E

Development of Study Sample for Hypothesis 1

U.S. hospitals identified from the HRSA Hospital Directory, CMS General Hospital data set, and CMS EHR MEHRIPP data set (n = 6,582)

- Exclusion of 534 Psychiatric hospitals (n = 6,048)
- Exclusion of 432 Long Term hospitals (n = 5,616)
- Exclusion of 245 Rehabilitation hospitals (n = 5,371)
- Exclusion of 103 Children’s hospitals (n = 5,268)
- Exclusion of 15 Religious Non-Medical Institutions (n = 5,253)
- Exclusion of 1 Medicaid-Only Children’s Psychiatric hospital (n = 5,252)
- Exclusion of 239 Transplant hospitals with 0 beds (n = 5,013)
- Exclusion of 11 Cancer hospitals coded as Short Term (n = 5,002)
- Exclusion of 51 hospitals located in Puerto Rico (n = 4,951)
- Exclusion of 5 hospitals located in U.S territories (n = 4,946)

- Exclusion of 17 individual hospitals whose CMS reporting structures/CMS numbers could not be verified (n = 4,929)

Final sample for H1 and H3 (n = 4,929)
# APPENDIX F

Magnet Hospitals by State

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## APPENDIX G

States with HIMSS Analytics EMRAM Level 6 or 7 Magnet Hospitals

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## APPENDIX H

States with HIMSS Analytics EMRAM Level 7 Magnet Hospitals

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## APPENDIX I

### States with HIMSS Analytics EMRAM Level 6 Magnet Hospitals

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