USE OF CLINICAL HEALTH INFORMATION TECHNOLOGY IN NURSING HOMES: NURSING HOME CHARACTERISTICS AND QUALITY MEASURES

by

Carla Spinelli-Moraski
A Dissertation
Submitted to the
Graduate Faculty
of
George Mason University
in Partial Fulfillment of
The Requirements for the Degree
of
Doctor of Philosophy
Nursing

Committee:

__________________________  Dr. Kathy Richards, Chair

__________________________  Dr. Carol Urban, 1st Reader

__________________________  Dr. Thomas Prohaska, 2nd Reader

__________________________  Dr. Kathy C. Richards, Assistant Dean,
Doctoral Division and Research
Development

__________________________  Dr. Thomas R. Prohaska, Dean, College of
Health and Human Services

Date: ______________________  Spring Semester 2014
George Mason University
Fairfax, VA
Use of Clinical Health Information Technology in Nursing Homes: Nursing Home Characteristics and Quality Measures

A Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at George Mason University

by

Carla Spinelli-Moraski
Masters of Science
George Mason University, 2008
Bachelors of Science
George Mason University, 2004
Bachelors of Arts
Hofstra University, 1994

Chair: Kathy Richards, Assistant Dean, Doctoral Division and Research Development
Department of Nursing

Spring Semester 2014
George Mason University
Fairfax, VA
DEDICATION

This is dedicated to my incredible husband Rich for his patience, understanding, editing, and emotional guidance throughout this process. To my parents for teaching me I could achieve anything I set my mind to. Lastly, this is dedicated to my three office mates: Wallace and Barky who taught me statistics made more sense after taking a walk and Kevin who dictated when the laptop was hers and when it was mine.
ACKNOWLEDGEMENTS

I would like to express my heartfelt gratitude to Dr. Kathy Richards for her dedication, support, and guidance over the past two years. Her continued leadership provided me strength and the determination to complete this journey. I would also like to thank Dr. Carol Urban who kept me positive and provided much needed therapy during my struggles. A special thank you to Dr. Thomas Prohaska who provided valuable insight and mentorship. Thank you to Dr. Meiners who assisted me in finding my initial stride. Finally, I would like to offer my sincerest appreciation to Dr. Robin Remsburg. She saw something special in me and offered me countless opportunities to grow as a person.

I would also like to thank my devoted husband Rich. Without his emotional support, editing services, and ability to keep me focused I might not have completed this process. You are my better half.

Additionally, I would like to send a very special thank you to Karen Doyle. Thank you for believing in me, giving me numerous opportunities, and for your networking. You will always be the admiral, and a good friend.

This research would not have been possible without the National Gerontological Nurses Association, and the National Association Directors of Nursing Administrators. Thank you for opening your membership to me.

Lastly, I wanted to recognize Sandy Rogers. I will miss our study sessions and our statistical conversations. You were always available to make me laugh, even during the darkest hours.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Tables</td>
<td>viii</td>
</tr>
<tr>
<td>List of Figures</td>
<td>ix</td>
</tr>
<tr>
<td>List of Abbreviations</td>
<td>x</td>
</tr>
<tr>
<td>Abstract</td>
<td>xi</td>
</tr>
<tr>
<td>Chapter One: Introduction to Study</td>
<td>1</td>
</tr>
<tr>
<td>Purpose Statement</td>
<td>3</td>
</tr>
<tr>
<td>Research Questions</td>
<td>3</td>
</tr>
<tr>
<td>Significance</td>
<td>4</td>
</tr>
<tr>
<td>Conceptual Framework</td>
<td>7</td>
</tr>
<tr>
<td>Conceptual Model</td>
<td>10</td>
</tr>
<tr>
<td>Tools</td>
<td>13</td>
</tr>
<tr>
<td>Clinical HIT sophistication</td>
<td>13</td>
</tr>
<tr>
<td>Electronic Health Record</td>
<td>14</td>
</tr>
<tr>
<td>Computerized Provider Order Entry</td>
<td>14</td>
</tr>
<tr>
<td>Clinical Decision Support</td>
<td>15</td>
</tr>
<tr>
<td>Organization</td>
<td>15</td>
</tr>
<tr>
<td>Provider status</td>
<td>16</td>
</tr>
<tr>
<td>Ownership</td>
<td>16</td>
</tr>
<tr>
<td>Bed size</td>
<td>16</td>
</tr>
<tr>
<td>Perceived barriers. Perceived</td>
<td>17</td>
</tr>
<tr>
<td>Perceived benefits</td>
<td>17</td>
</tr>
<tr>
<td>Resident Outcomes</td>
<td>17</td>
</tr>
<tr>
<td>Antipsychotic Medications</td>
<td>18</td>
</tr>
<tr>
<td>Pressure Ulcers</td>
<td>18</td>
</tr>
<tr>
<td>Falls with injuries</td>
<td>19</td>
</tr>
<tr>
<td>Summary</td>
<td>19</td>
</tr>
<tr>
<td>Chapter Two: Literature Review</td>
<td>21</td>
</tr>
<tr>
<td>Clinical Health Information Technology</td>
<td>22</td>
</tr>
<tr>
<td>Electronic Health Records</td>
<td>23</td>
</tr>
</tbody>
</table>
Electronic health records in nursing homes ................................................................. 23
Electronic health records and quality of care in nursing homes ............................. 26
Computerized Provider Order Entry and Clinical Decision Support ..................... 28
Benefits and Barriers ..................................................................................................... 35
Barriers. ....................................................................................................................... 35
Benefits....................................................................................................................... 36
Nursing Home Characteristics .................................................................................... 38
Provider status ........................................................................................................... 38
Ownership................................................................................................................ 39
Number of beds ........................................................................................................ 40
Staffing levels ......................................................................................................... 41
Resident Outcomes .................................................................................................... 42
Antipsychotics. .......................................................................................................... 42
Pressure ulcers ....................................................................................................... 43
Falls with injuries .................................................................................................... 44
Summary of the Literature ......................................................................................... 45
Chapter Three: Methods ............................................................................................ 47
Research Design and Overview ............................................................................... 47
Setting and Sample .................................................................................................. 48
Setting ...................................................................................................................... 48
Sample ..................................................................................................................... 48
Sample size ............................................................................................................. 48
Inclusion criteria .................................................................................................. 50
Exclusion criteria ................................................................................................. 50
Measures .................................................................................................................. 50
Questionnaire .......................................................................................................... 50
Expert panel ........................................................................................................... 51
Peer review ............................................................................................................ 52
Nursing Home Compare ......................................................................................... 52
Data Analysis ............................................................................................................ 57
Normality and missing data ...................................................................................... 57
Descriptive statistics ............................................................................................... 57
Bivariate analyses ................................................................................................. 57
Research questions and multivariate analysis. ........................................................ 57
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1 State Surveys of Electronic Health Record Implementation</td>
<td>25</td>
</tr>
<tr>
<td>Table 2 Calculation of Effect Size</td>
<td>49</td>
</tr>
<tr>
<td>Table 3 Variable Definitions</td>
<td>54</td>
</tr>
</tbody>
</table>
**LIST OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1 The Systems Engineering Initiate for Patient Safety</td>
<td>8</td>
</tr>
<tr>
<td>Figure 2 Conceptual Model for Use of Clinical Health Information Technology System</td>
<td>10</td>
</tr>
</tbody>
</table>
LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>CMS</td>
<td>Centers for Medicare and Medicaid</td>
</tr>
<tr>
<td>CA</td>
<td>Clinical Assistant</td>
</tr>
<tr>
<td>CDS</td>
<td>Clinical Decision Support</td>
</tr>
<tr>
<td>CPOE</td>
<td>Computerized Provider Order Entry</td>
</tr>
<tr>
<td>CVI</td>
<td>Content Validity Index</td>
</tr>
<tr>
<td>CINAHL</td>
<td>Cumulative Index to Nursing and Allied Health Literature</td>
</tr>
<tr>
<td>EHR</td>
<td>Electronic Health Records</td>
</tr>
<tr>
<td>HIT</td>
<td>Health Information Technology</td>
</tr>
<tr>
<td>LPN</td>
<td>Licensed Practical Nurse</td>
</tr>
<tr>
<td>MDS</td>
<td>Minimum Data Set</td>
</tr>
<tr>
<td>NADONA</td>
<td>National Association of the Directors of Nursing Administrators</td>
</tr>
<tr>
<td>NGNA</td>
<td>National Gerontological Nursing Associations</td>
</tr>
<tr>
<td>OSCAR</td>
<td>On-Line Survey and Certification of Automated Records</td>
</tr>
<tr>
<td>RN</td>
<td>Registered Nurse</td>
</tr>
<tr>
<td>SEIPS</td>
<td>Systems Engineering Initiative for Patient Safety</td>
</tr>
</tbody>
</table>
This study compares quality measures among nursing homes that have adopted different levels of clinical health information technology (HIT) and examines the perceived barriers and benefits of the adoption of electronic health records as reported by Nursing Home Administrators and Directors of Nursing. A cross-sectional survey distributed online to a convenience sample of Nursing Home Administrators and Directors of Nursing (n=163) requested information on the adoption of electronic health records, computerized provider order entry, and clinical decision support within their nursing home. These responses were linked to nursing home characteristics and the quality measures for antipsychotic use, pressure ulcers, and falls with injuries reported by the Centers for Medicare and Medicaid Nursing Home Compare secondary data set.

Analysis of data found 29% fewer long-stay residents on antipsychotic medications when a computerized provider order entry system was in place compared to
nursing homes with just an electronic health record system. Results also indicated 27% fewer residents taking antipsychotics when a clinical decision support system was used compared to just an electronic health record. Nursing homes using computerized provider order entry had 45% fewer long-stay residents with pressure ulcers compared to nursing homes using paper charting.

Results examining nursing home leaders’ perceptions of barriers to the adoption of technology found compatibility with other existing systems to be an important concern to all nursing home leaders. Nursing home leaders with existing EHR systems considered costs the most important barrier. One of the most important benefits reported by nursing home leaders was the ability to monitor quality of care. Nursing home leaders with an EHR system reported access to clinical data and staff oversight as other significant benefits.

These findings suggest nursing homes can benefit from the adoption of clinical health information technology through improvements in quality of care, especially when advanced technology such as computerized provider order entry and clinical decision support systems are in place.
CHAPTER ONE: INTRODUCTION TO STUDY

The application and sophistication of clinical health information technology (HIT), specifically electronic health records (EHR), computerized provider order entry (CPOE), and clinical decision support, in nursing homes is low despite the consensus that the use of these technologies could lead to more efficient, safer, and improved quality of care (Brandeis, Hogan, Murphy, & Murray, 2007). Furthermore, it is unclear how clinical information system sophistication, defined as the level of integration for EHR, CPOE, and clinical decision support affects the quality of care in nursing homes.

The use of EHRs in nursing homes as recently as 2006 was reported to be 1% (Poon et al., 2006), while recent surveys reported a 20 - 40% adoption rate in the use of EHR (Richard, Kaehny, May, & Kramer, 2009; Wang & Biedermann, 2012). The reasons for this increase in adoption are unknown. The benefits of clinical HIT have been reported throughout the literature in various healthcare settings, but little data supports similar findings in nursing homes. Systematic reviews in the past 10 years on clinical HIT in nursing homes found insufficient evidence to support that adoption of this technology had improved the quality of care for residents (Buntin, Burke, Hoaglin, & Blumenthal, 2011; Chaudhry et al., 2006). Mixed results have been reported and only one study examined multiple quality of care issues (Pillemer et al., 2012).
Quality of care is a significant issue in nursing homes, because poor quality is associated with resident pain and suffering, increased costs, and poor nursing home ratings. The Centers for Medicare and Medicaid (CMS) publically report many quality measures for certified nursing homes. Of the many quality indicators that are measured three contribute to significant pain and suffering and increased costs, they are high rates of inappropriate use of antipsychotic medications, increased rates of acquired pressure ulcers, and falls with injuries.

Studies on the use of clinical HIT in hospital settings have been associated with significant improvements in quality of care through reductions in medication errors, enhanced surveillance and monitoring, communication, and improved adherence to evidence based guidelines (Chaudhry et al., 2006). For example, recent studies have found considerable reductions in medicine-related issues, including a 17 - 23% decrease in adverse drug events with the use of CPOE and clinical decision support systems (Bates et al., 1998; Colpaert et al., 2006). CPOE and clinical decision support offer more sophisticated features within an EHR. Other studies report a 14 - 18% decrease in inappropriate medication prescribing (Agostini, Zhang, & Inouye, 2007; Mattison, Afonso, Ngo, & Mukamal, 2010). Improvements in quality of care have also been seen in non-medication related care issues. Peterson et al. (2005) reported a 64% reduction in fall related injuries and a 13% decrease in pressure ulcers in hospitals using an EHR (Dowding, Turley, & Garrido, 2012). To date, the data suggests that the use of clinical HIT can improve quality of care through reductions in inappropriate medication prescribing and undesirable health outcomes, such as pressure ulcers and falls, through
adherence to protocols and streamlining processes (Chaudhry et al., 2006). Studies also suggest integrated information technology systems have greater success of reducing medication errors and avoidable health outcomes because they offer improved communication tools, increased availability of information and the ability to alert physicians of potential problems, such as drug interactions or improper dosing.

Due to the limited available research, there is a need to determine if quality measures differ between homes with various levels of clinical HIT sophistication. This information can potential lead to finding new ways to reduce use of inappropriate antipsychotic use, reduce acquired rates of pressure ulcers, and fewer falls with injuries, in turn reducing resident pain and suffering and reducing costs nursing homes pay for the treatment of these issues. It is also important to examine the perceived barriers and benefits of the adoption of HER. This will allow those who have not implemented these systems to learn from those that have, as well as provide additional insight as to what the challenges to adoption are.

**Purpose Statement**

The primary purpose of this study was to examine the differences in quality of care measures among nursing homes with different levels of clinical HIT sophistication. Secondary purposes were to 1) describe characteristics of nursing homes at different levels of clinical HIT sophistication; and 2) identify the perceived benefits and barriers for the adoption of clinical HIT systems.

**Research Questions**
1. What nursing home characteristics (provider status, ownership, bed size, and staffing levels among Licensed Practical Nurse (LPN), Registered Nurse (RN), and Clinical Assistants (CA)) are associated with levels of clinical HIT use: a) EHR; b) EHR with CPOE; and c) EHR with CPOE and clinical decision support, and those that do not use any clinical HIT in Medicare and Medicaid certified nursing homes?

2. What are Nursing Home Administrators and Directors of Nursing perceived benefits and barriers of clinical HIT among certified Medicare and Medicaid nursing homes with and without EHRs?

3. Are there differences in antipsychotic medication use, pressure ulcers, and falls with injuries among nursing homes that have different levels of sophistication of clinical HIT: 1) no EHR technology, 2) non-integrated EHR; 3) EHR with CPOE; and 4) EHR with CPOE and clinical decision support in Medicare and Medicaid certified nursing homes?

Significance

Over 200 billion dollars is spent annually on long term care costs, with 69% of that being paid by Medicare and Medicaid (Alexander, Steege, Pasupathy, & Wise, 2013). Improvements in quality of care can reduce costs through reduced hospitalizations, treatments, and injuries. Three meaningful quality of care issues associated with high costs in nursing homes are inappropriate use of antipsychotic medication, acquired pressure ulcers, and falls with injuries. These three quality care indicators contribute to increased rates of death, decreased quality of life, severe pain and
suffering (Degenholtz, Rosen, Castle, Mittal, & Liu, 2008), and substantial costs to the Centers for Medicare and Medicaid (CMS) (Rantz et al., 2004). In older adults, antipsychotic medications have been associated with a 60 - 70% increase in the rate of death, as well as an increase in falls, cerebral vascular events, movement disorders, and sedation (Dahl, Wright, Xiao, Keeven, & Carr, 2008; Wooltorton, 2002, 2004). Usage of antipsychotic medications in older adults living in nursing homes has been reported to be as high as 32%, highlighting this as a serious quality of care issue (Chen et al., 2010; Kamble, Chen, Sherer, & Aparasu, 2008; Rochon et al., 2007). These medications are also costly. In 2008, CMS reported spending over $5.6 billion for antipsychotic medications alone (Congressional Budget Office, 2011). Evidence from studies conducted in the hospital setting have found reductions in the use of psychotropic medications when clinical decision support systems are in place (Peterson et al., 2005), and have also reported reductions in the prescribing of inappropriate medications (Mattison et al., 2010). Reductions in the use of psychotropic medications and inappropriate prescribing of medications might improve health outcomes and reduced costs for CMS.

Pressure ulcers and falls are also significant quality of care issues in nursing homes. The rates of pressure ulcer-associated deaths are high, approaching 80% in persons at least 75 years old, with estimated costs between $9.1 billion and $11.6 billion per year (Berlowitz et al., 2011). The National Nursing Home Survey found almost 34% of residents reported falls (Jones, Dwyer, Bercovitz, & Strahan, 2009). These falls can have serious consequences leading to death, fractures, a decrease in mobility, and a
decrease in the activities of daily living. According to Medicare, direct costs for fall related injuries were over $8 billion in 1999 (Bishop, 2002).

Preventing pressure ulcers and falls requires nursing staff to processing patient data, but too often nursing staff do not have the time to consistently analyze and detect the multitude of conditions, including diagnosis, medications, diet, activity level, specified by the growing body of protocols and standards of care (Teigland, Gardiner, Li, & Byrne, 2005). Studies have found that nursing staff may be unaware of or do not consistently follow standards of care for preventing pressure ulcers and preventing falls (Tsilimingras, Rosen, & Berlowitz, 2003; Wipke-Tevis et al., 2004). A standardized care process available through an electronic standardized care plan has the potential to provide nurses with the information and ability to consistently provide the most appropriate care. A study in nursing homes reported technology can support evidence-based clinical decision making, promote data standards, and enabling more efficient communication (Alexander et al., 2013), in turn, reducing pressure ulcers and falls.

Reductions in inappropriate antipsychotic medication use, pressure ulcers, and falls can significantly improve quality of life for the millions of older adults residing in nursing homes, as well as reduce direct medical costs associated with these events. Improvements in these quality of care issues through the use evidence-based clinical decision support, more efficient communication, and standardization of protocols might be found with the use of clinical HIT. This study examines the impact of various levels of clinical technology sophistication on antipsychotic medication use, pressure ulcers, and falls with injuries.
Conceptual Framework

The concept of improving patient and resident quality of care by changing the design of the healthcare system is often associated with the Open System Theory (Katz & Kahn, 1978). This theory has been adapted to fit the healthcare setting and is called the Systems Engineering Initiative for Patient Safety (SEIPS) model (Carayon et al., 2006). It has been applied in the healthcare setting on multiple occasions, usually for the purpose of reducing healthcare provider errors and reducing patient injury (Gurses, Carayon, & Wall, 2009; Karsh, Holden, Alper, & Or, 2006; Koppel, Wetterneck, Telles, & Karsh, 2008).

The Systems Engineering Initiative for Patient Safety focuses on how the work system design impacts processes and outcomes, as illustrated in Figure 1 (Carayon et al., 2006). The components of the work system interact with one another and are made up of the organization, persons, environment, tasks and technology. The second category, process, involves care process, process improvement, and information flow. The final category, outcomes, focuses on patient safety and quality of care.
Within the work system category, a person, in this case a healthcare provider, performs a range of tasks, using different tools and/or technologies (Carayon et al., 2006). These tasks occur within certain environments under organization conditions. The work system component of tools and technologies can include various technologies, medical devices, and human factors associated with technology, such as usability (Carayon et al., 2006). These tools and technologies impact management of the different clinical and administrative care processes, such as medication prescribing, and provide guidelines for standards of care. These tools might also be affected by organizational factors, such as culture, structural space, and leadership.
Organizational factors affect the quality of care in the healthcare environment. Some of the organizational factors can be considered organizational characteristics, such as the how different groups interact with one another, and the methods leadership uses to make decision that can affect patient care. Organizational culture can be affected by such organizational characteristics as structure and physical space (Leavitt, Pondy, & Boje, 1989, p. 288). Other organizational characteristics can include number of beds within a nursing home, size and location and staffing.

In the Systems Engineering Initiative for Patient Safety model, the process category includes care processes and information flow. These care processes could be any number of procedures the healthcare provider must complete to provide care, or to communicate care needs, such as medication doses and proper care procedures. Carayon (2010) reports the majority of patient safety issues occur in the process category through a failure to follow established checking procedures and in confusion with written miscommunication. These issues can have an effect on patient outcomes.

In this model, the outcomes could be measured at the organizational level. For example reducing the number of residents receiving unnecessary antipsychotics can reduce costs and increase revenue that could be used to provide additional staffing. Organizational outcomes can also be measured at the patient level, such as the overall reduction in residents who have acquired pressure ulcers or had a fall. These organizational and patient outcomes can affect one another. For example, if outcomes improve profitability or employee morale, then these might affect patient safety through additional factors, such as increased staffing, or extra training for nursing staff. In turn,
additional staffing and training could continue to improve patient outcomes. The conceptual model for this study is based on the Systems Engineering Initiative for Patient Safety model.

**Conceptual Model**

This research study explored how the sophistication of the technology and organizational factors of the work system interact with the patient care process and thus affect patient quality of care. The basic model (Figure 2) assumes that the level of sophistication and guidance of the clinical HIT system the greater the probability of adherence to best practices by the nurses and other health care providers. This contributes to better health outcomes for residents residing in these homes. This model also assumes that specific organizational characteristics of each nursing home are associated with the adoption of the clinical HIT including the level of sophistication itself.

![Figure 2 Conceptual Model for Use of Clinical Health Information Technology System](image)

**Figure 2 Conceptual Model for Use of Clinical Health Information Technology System**

EHR = electronic health record; CPOE= computer provider order entry; CDS= clinical decision support; CA=clinical assistant; LPN=licensed practical nurse; RN=registered nurse
There are various levels of sophistication in clinical HIT that might be available in a nursing home, ranging from no EHR technology to the most sophisticated technology with an integration of EHR, computer provider order entry and clinical decision support systems. It is also the case that certain organizational influences including perceived benefits and barriers on the part of the nursing home leaders of these systems might influence the choice of these tools.

The organizational factors for the conceptual model for this study were selected based on past evidence that supports their effect on quality of care in nursing homes (Banaszak-Holl, Zinn, & Mor, 1996; Castle, 2005). The organizational factors are provider status, ownership (profit/non-profit), bed size, and staffing levels because they are considered significant organizational factors that affect healthcare information systems (Hikmet, Bhattacherjee, Menachemi, Kayhan, & Brooks, 2008). Additional organizational factors are the perceived barriers and benefits in the use of HIT. These factors are meaningful because they might affect the decision to purchase an information system or continue relying on a paper system.

The tools and organization affect the health care process. Care processes might be different based on the information provided by the tools and technology. For example, a physician might alter their choice of antipsychotic medications when the clinical decision support system alerts them to a contraindication for this patient. If the clinical decision support system had not been available the care processes might have resulted in the initial (inappropriate) medication order. Clinical decision support systems work in conjunction with a computerized provider order entry system. These two technologies
are only available if an integrated EHR system is in place. Based on the different levels of technology there may be the availability to provide different types of clinical assistance. In this example, had the provider not been alerted to the contraindication the patient would have received an order for an antipsychotic medication, in turn the facility would have to pay the cost for this medication, the nurse would have to take the time to safely administer the medication, and the resident would be receiving a medication, that has negative side effects, for no reason.

The specific outcomes measures for this study are antipsychotic medication use, pressure ulcers, and falls with injuries. As discussed earlier, these measures were selected based on their overall significance for improving quality of care in nursing homes. High rates of antipsychotic use, acquired pressure ulcers and falls all signify poor quality of care in a nursing home. A lower rate for these measures signifies a high quality of care. Examining the rates of these outcome measures in different nursing homes offers a method for feedback about how the current work system and care process are functioning.

This feedback is then used to determine if the desired outcomes were met; for example, if the patient safety goal is to reduce the use of antipsychotic medications, pressure ulcers, and falls, did the work system and process system provide the support to accomplish this? If it did not, the feedback will then prompt changes in the work system or in the process system of the model, such as changing staffing levels or incorporating more advanced technology.
**Tools.** Clinical HIT is a subsection of the broader term, Health Information Technology, that encompasses technology used for various clinical operations management, and direct clinical functions in healthcare organizations (Richard, Kaehny, May, & Kramer, 2009). The combination of different technology systems can be constructed as a measure of levels of information system sophistication, and defined as the level of integration of multiple clinical, administrative, and support systems used in resident care (Alexander & Madsen, 2009). The elements for the independent variables in this study include: no technology, EHR use, the combination of EHR and CPOE, and the combination of EHR, CPOE and clinical decision support. These systems, either stand-alone or in combination, are considered the most significant clinical health information systems available today because of their potential to provide quick and easy access to healthcare providers (U.S. Congress, 111 Session, 2009).

**Clinical HIT sophistication.** Clinical HIT sophistication can be broken down into three main categories, functional, technical, and integration (Alexander & Madsen, 2009). The functional category includes processes and activities supported by technology, such as ordering a medication and then administering the medication. The technical sophistication is the extent of use of hardware and software devices, such as, use of a handheld documentation device. The integration category represents the combination of systems that work together to provide and support patient care. Clinical HIT sophistication is a measurement of the combination of these three categories. In this study sophistication was defined as the integration of EHR, CPOE and clinical decision support.
**Electronic Health Record.** An EHR is a collection of health-related information for an individual that is created, gathered, managed, and consulted by authorized health care clinicians and staff (U.S. Congress, 111 Session, 2009). This is a broad term that can be interpreted in many ways. A literature review of existing surveys on health information systems in nursing homes found inconsistent definitions of EHR; in many of the existing surveys, no definition was present at all (Richard et al., 2009). In this study the definition of an EHR is the electronic capture of patient demographics and diagnoses, nurses’ notes, medication and treatment orders, medication administration, and physicians’ notes.

There might be additional components of an EHR such as financial records, laboratory tests, and radiology results; however, these other attributes have not been chosen as part of the definition for this study because they might involve software from other companies that is not able to communicate with the medical record technology the nursing home has selected. For example, laboratory and radiology results would most likely be completed by a third party company, but this third party might not be permitted to integrate into a nursing home’s EHR. In the nursing home setting, the most frequently used areas of a resident chart include patient demographics, nurses’ notes, medication and treatment records, medication administration, and physicians’ notes.

**Computerized Provider Order Entry.** CPOE is a process for physicians or other care providers to enter medication and treatment orders into a patient’s record electronically instead of using paper charts (Kaushal & Bates, 2012). CPOE is a broad term referring to a variety of computer-based medication and treatment ordering systems
that communicate standardized and legible orders over a computer network in real time (Kaushal & Bates, 2012). This level of communication might be associated with reductions in errors, as discussed in Chapter 2. In these systems, physicians or prescribing providers directly enter treatment plans, medications and notes into a patient’s EHR. This study will categorize a nursing home as a user of CPOE when providers enter medication and treatment orders more than 50% of the time.

Clinical Decision Support. Clinical decision support software enhances computer provider order entry systems by integrating clinical and patient information and providing support to the physician (Schedlbauer et al., 2009). These systems range from basic to complex, and have the ability to remind and alert physicians of potential conflicts when ordering medication (Schedlbauer et al., 2009). It is important to note clinical decision support software is not unified, with each vendor providing different levels of complexity and the ability to analyze information in a different manner. These systems offer many features such as, providing preprogramed alerts on medication information, the ability to analyze patient data to determine if there is a contraindication in a medication order, and the inclusion of standardized treatment alerts. Therefore, information received by providers could vary from system to system. This study will categorize a nursing home as having clinical decision support when any level of the system is in use.

Organization. In this study’s model the organization was the nursing home. Study variables within the organization describe the characteristics of the nursing homes, and the perceived organizational benefits and barriers for the adoption of clinical HIT. The data for organization variables comes from the CMS’s public dataset called Nursing
Home Compare. The data is submitted to CMS by each certified nursing home for every resident through the required forms called Minimum Data Set.

**Provider status.** Provider status is a description of how the nursing home is reimbursed for the care it provides. Reimbursement is most frequently received from Medicare and/or Medicaid, but it could also be paid by a private payer, an insurance payer, or a government fund (DeLellis & Ozcan, 2012). Provider status is counted as the number of residents who are funded by Medicare, usually for short-term stays, and Medicaid, that normally covers long-term stays. A third payer-source is identified as “Other”. A nursing home is considered to accept either Medicare and/or Medicaid as listed on the Nursing Home Compare dataset maintained by the Center for Medicare and Medicaid Services.

**Ownership.** Ownership is defined as for profit, non-profit or government owned nursing home. Qualification as a non-profit corporation is based on tax status as listed on the Long Term Care Nursing home Certification Application for Medicare and Medicaid (CMS, 2012a). A nursing home is considered to be for profit or non-profit as is reported on their annual nursing home application form CMS-671. This information is listed on the Nursing Home Compare dataset maintained by the Center for Medicare and Medicaid Services.

**Bed size.** Bed size is the number of available beds a nursing home offers for either short or permanent stay residents as reported on the nursing home license (Center for Medicare and Medicaid Services, 2012). The official number of beds is reported on their
annual nursing home application form CMS-671, and is listed on the Nursing Home Compare dataset.

Clinical assistant, licensed practical nurse, registered nurse staffing levels.

Staffing levels are defined by the Department of Health and Human Services as the number of hours per resident per day. The number of hours per resident day for clinical assistants, licensed practical nurses and registered nurses is reported on a nursing home’s annual nursing home application form CMS-671. These figures are then reported on the Nursing Home Compare dataset.

Perceived barriers. Perceived barriers to the adoption of technology by nursing home directors and administrators are economic, sociological, organizational, and psychological factors that impede the implementation of clinical HIT (Butler & Sellbom, 2002). These barriers can affect how the organizational structure and hence can influence why clinical technology has or has not been implemented. This study categorizes perceived barriers to be those items selected from question 11 in the Use of Technology in Nursing Homes Survey.

Perceived benefits. Perceived benefits of technology are those factors which contribute to a person’s beliefs about the safety and security of a system, the satisfaction found when using the system, and the contributions to basic human needs (Gardner & Gould, 1989). This study categorizes perceived benefits as those items selected from question 12 in the Use of Technology in Nursing Homes Survey.

Resident Outcomes. The primary dependent outcome measures include the quality of cares measures specifically antipsychotic medication use, acquired pressure
ulcers, and falls with injuries. Quality measures are indicators of performance of adherence to best practices provided to nursing home residents. It is widely held that deviations in quality care influence a resident’s health outcome (Donabedian, 1988). The use of clinical HIT might play a role in reducing deviations in quality of care, by providing infrastructure for improved communication and standardization of care.

**Antipsychotic Medications.** Antipsychotic medications are classified as a chemically diverse group of medications that affect the central nervous system for the purpose of treatment of broad psychotic disorders (Lehne, 2004). They are frequently inappropriately prescribed to residents in nursing homes, usually for behavioral reasons (Stevenson, Decker, Dwyer, Huskamp, Grabowski, Metzger & Mitchell, 2010). The Center for Medicare and Medicaid Services (CMS) reports 39.4% of older adults living in nursing homes, who have cognitive impairment and behavior problems but no diagnosis of psychosis, receive at least one psychotropic medication (Center for Medicare & Medicaid Services, 2010). Clinical decision support technology has the ability to provide clinical alerts to remind providers what the appropriate indications for antipsychotic medications are, therefore potentially reducing inappropriate use.

**Pressure Ulcers.** A pressure ulcer is localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction (Black et al., 2007). In nursing homes, they are often the result of multiple factors including lack of nutrition, dehydration, lack of mobility, medical conditions, and moisture build-up. Pressure ulcers occur in 2 - 28% of the nursing home population (Park-Lee & Caffrey, 2009) with high percentages of acquired pressure ulcers.
being associated with poor quality of care (Comondore et al., 2009; Mukamel, 1997).
Pressure ulcers are reported as a quality measure for nursing homes in each resident’s Minimum Data Set records.

**Falls with injuries.** A fall is considered an unintentional change in position where any portion of the body is unintentionally placed on the ground, floor, or next lower surface. An intercepted fall, where a resident is caught and lowered to the ground, is still considered a fall (CMS, 2012b). Residents living in nursing homes are three times more likely to experience a fall than those living in the community, with an average of 1.7 falls per nursing home bed annually (Rapp, Becker, Cameron, König, & Büchele, 2012). Falls with injuries are reported as a quality measure for nursing homes in each resident’s Minimum Data Set records.

**Summary**

There is little known regarding the application and sophistication of clinical HIT in nursing homes, specifically EHR, CPOE, and clinical decision support. The same technologies used in hospitals have been shown to improve the quality of care by providing support in clinical decision-making, improving communication and promoting standardization of data. However, there is little evidence of the outcomes of clinical HIT in the nursing home setting.

This study used the Systems Engineering Initiative for Patient Safety model as a framework to determine how clinical HIT influences care processes and resident outcomes. An improvement in resident outcomes, through streamlined work flow processes and communication, can translate into less pain and suffering for residents and
reduced costs for the Medicare and Medicaid. Examining the perceived benefits of and barriers to the adoption of clinical HIT systems provides policy makers, nursing home leaders and technology vendors, with significant information on how these systems affect care, work processes, and what components of a clinical HIT are important to the users of the system.

The results from this study will lead to a better understanding of the current state of adoption of EHRs, CPOE, and clinical decision support in nursing homes. It will also provide insight on the effects of clinical HIT sophistication on three quality of care measures that can be directly affected by improved communication and streamlined work processes, potentially encouraging the adoption of clinical HIT applications and their use as best practices. In addition the study offers an increased awareness of the barriers and benefits to the adoption of EHR systems, which can offer insight on best practice to nursing homes leaders who are looking to adopt these systems.
CHAPTER TWO: LITERATURE REVIEW

The purpose of this review of the literature from 2004 – February 2013 was to assimilate and evaluate evidence on the: 1) the adoption of clinical HIT in nursing homes; 2) the effects of clinical HIT on quality of care; and 3) and information system sophistication in nursing homes. Databases such as Cumulative Index to Nursing and Allied Health Literature (CINAHL) plus with Full Text, Medline, PsycINFO, Cochrane Library, and Google Scholar were searched using a combination of key words and term associated with health information technology, electronic health record, electronic medical record, computerized provider order entry, clinical decision support, information technology sophistication, quality measures, quality indicators, quality of care, antipsychotic, nursing home, falls, and pressure ulcer. This was not an exhausted literature review; there was an effort to include key articles from prior to 2004, articles that were frequently cited as significant in this field, and information from government agencies. This search yielded 3,617 publications. The highest yielding terms were clinical decision support (1,323) quality of care (1,264), and health information technology (820).

Inclusion criteria for relevant articles were: 1) addressing aspects of HIT including EHRs, computerized provide order entry, clinical decision support, and sophistication; 2) examining the use of HIT in clinical practice; 3) measuring patient
outcomes or safety with the use of HIT; 4) reporting on quality measures in nursing homes; 5) reviewing nursing home characteristics in relation to quality of care; 6) discussion of the implementation of HIT; 7) discussion of benefits and barriers to adoption of technology; and 8) discussion of the adoption of HIT in nursing homes.

Initially 3,243 publications were rejected by a review of the title, which indicated there was no association to the study topics. An additional 176 were rejected after a review of the abstract. Of the 198 articles that met the inclusion criteria: 129 were excluded for: 1) 68 were not original work; 2) 23 were not done in the United States; 3) 23 were duplicates; 4) 10 were articles regarding individual vendor software; and 5) 5 were excluded because their use of information system sophistication was not clear.

Of the 69 remaining articles: 1) 14 pertained to clinical decision support and computerized provider order; 2) 10 to EHRs; 3) 5 to information technology sophistication; 4) 15 to quality of care with nursing home characteristics; 5) 14 to quality of care in nursing homes; and 6) 11 to the benefits and/or barriers of technology adoption in nursing homes. Of these articles there were: 1) 3 systematic reviews; 2) a randomized study using cluster randomization; 3) 6 surveys sent to individual states; 4) 6 pre-post studies; 5) 4 qualitative studies; and 6) 3 comparative intervention studies using convenience samples. Individual studies identified in the systematic reviews, that met criteria, were included in the review. The remainders of studies were secondary analysis of a large data set collected by CMS and reports submitted to a Federal agency.

**Clinical Health Information Technology**

Clinical HIT is a subsection of a broader term, health information technology, that
encompasses technology used for various clinical operations management, and direct clinical functions in healthcare organizations (Richard et al., 2009). The number of healthcare technologies is considerable, but the most significant for clinical management include EHRs, CPOE, and clinical decision support. These systems can be independent; however, the more advanced systems are integrated and work in conjunction with one another. The sections to follow describe what is known about the adoption of clinical HIT in nursing homes and the effect of clinical HIT on resident outcomes in nursing homes.

**Electronic Health Records.** In 2009 Congress passed the American Recovery and Reinvestment Act, that outlined incentive programs for hospital centers and physicians’ offices to adopt EHRs by the year 2015 for the purpose of improving the quality of patient care (U.S. Congress, 111 Session, 2009). The act outlines the belief that quality of care can be improved through the meaningful use of EHRs. The term “meaningful use” is defined by The Centers for Medicare and Medicaid Services as the electronic capture of healthcare information for: tracking clinical conditions in order to more effectively communicate information to other care providers; implementing clinical decision support for medication and care management; engaging patients and families; and reporting clinical quality measures and public health information (Heubusch, 2010). The belief that use of electronic clinical management systems can improve quality of care is growing, but the evidence is needed.

**Electronic health records in nursing homes.** There is limited data on the actual number of nursing homes that have adopted EHRs. In 2006 data from the National
Nursing Home Survey (n=1,174) reported only 1% of nursing homes had implemented an EHR system (Poon et al., 2006). However, the data were from 2004 and the technology is now less costly and more readily available. Since 2006 six states have published results of surveys conducted on EHR adoption in nursing homes (Table 1).

These studies report between a 20-68% rates of adoption of EHRs. In three of these studies (Maryland, Minnesota and Texas) at least 75% of the homes within the state were surveyed. Interestingly, states conducting online surveys had higher response rates and slightly lower levels of EHR adoption than the states that mailed surveys. Only the study conducted in New York reported the adoption rate (8%) for CPOE. The study conducted in California selected a small sample for their survey, only 12%, of nursing homes that were associated with the state health care association. These results make it difficult to generalize across the state, let alone nationally. The study conducted in New York sampled only members of their Long Term Care Coalition. The nursing homes that belong to this Coalition are reported to be 10% of the nursing homes in the state and might not be representative of the other nursing homes within the state. Also, nursing homes belonging to this coalition are part of an advocacy group and membership is limited.
Table 1 State Surveys of Electronic Health Record Implementation

<table>
<thead>
<tr>
<th>Survey and Year</th>
<th>State</th>
<th>Design</th>
<th>NH* in the state</th>
<th>NH* sent survey (%)</th>
<th>Sample size (response rate)</th>
<th>Clinica l EHR use (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 (Wang &amp; Biedermann, 2012)</td>
<td>Texas</td>
<td>Mailed survey. Items based on HHS** survey.</td>
<td>1,200</td>
<td>n=913 (76%)</td>
<td>n=137 (15%)</td>
<td>39%</td>
</tr>
<tr>
<td>2010 (Cowdry, 2010)</td>
<td>Maryland</td>
<td>Electronic survey via Survey Monkey. Items not available.</td>
<td>235</td>
<td>n=235 (100%)</td>
<td>n=53 (23%)</td>
<td>30%</td>
</tr>
<tr>
<td>2008 (Reierson &amp; Soderlund, 2008)</td>
<td>Minnesota</td>
<td>Online survey. Items not available.</td>
<td>380</td>
<td>n=380 (100%)</td>
<td>n=297 (78%)</td>
<td>32%</td>
</tr>
<tr>
<td>2007 (Hudak &amp; Sharkey, 2007)</td>
<td>California</td>
<td>Mixed-methods. Survey items not available. Focus group discussed barriers and perception of value.</td>
<td>1,231</td>
<td>n=150 (12%)</td>
<td>n=80 (53%)</td>
<td>20%</td>
</tr>
<tr>
<td>2006 (Continue Leadership Coalition, 2006)</td>
<td>New York</td>
<td>Paper questionnaire. Items listed</td>
<td>632</td>
<td>n=62 (10%)</td>
<td>n=34 (55%)</td>
<td>68%</td>
</tr>
</tbody>
</table>

* NH = Nursing Home, **HHS = Health and Human Services (Kramer, Kaehny, Richard, & May, 2010), EHR=electronic health record
These studies suggest that adoption rates vary between states, but the majority of states reported a 20-39% rate of adoption for EHR. Only one state has reported the adoption rate of computerized provider order, and no states have reported on the use of clinical decision support systems.

**Electronic health records and quality of care in nursing homes.** The comprehensive literature search revealed one study reporting resident outcomes when an EHR was in place. The purpose of this quasi-experimental comparative post-test study was to determine differences in the resident outcomes for activities of daily living, range of motion, urinary tract infections, and pressure ulcers after the implementation of EHRs. A convenience sample of 18 separate nursing homes, divided into four groups (two intervention groups, one nursing support only group, and a control) was used. The researchers selected eight nursing homes that were willing to implement a bedside electronic medical record and ten nursing homes that did not have the technology. They purposely matched the nursing homes on bed size, staffing hours, and ownership status. One intervention group used a bedside electronic medical record and the second intervention group used a bedside electronic medical record and a nursing support group; the first control group used nursing support only, while the second control group did not use nursing support. Outcome data were collected from the Medicare Minimum Data Set (MDS) at 12 months and at 24 months. The MDS is the federally mandated electronic reporting process for all clinical assessments on residents of certified CMS nursing homes. It includes over sixteen sections regarding resident care including psychological assessments, nutritional care, clinical treatments, and activities of daily living. These
assessments are the basis for reimbursement rates and quality measures. This intervention study reported short term reductions of up to 53% in pressure ulcers for the intervention group with a bedside electronic medical record (p<.05). Reductions of up to 23% in urinary tract infections and 12% reductions in activities of daily living decline and a 1% improvement in range of motion were also noted in the electronic bedside medical record group, but these results were not significant (p>.05) (Rantz et al., 2010). These short-term reductions in pressure ulcers, urinary tract infections, and help with activities of daily living for the intervention group were not sustained over the 24 months. There were several limitations of this study. The first is the use of the convenience sample. The researchers had to find nursing homes that could support the costs of implementing this software and were willing to provide administrative support. Nursing homes willing to accept the costs might be considered proactive in their quality improvement and might have implemented a variety of quality improvement initiatives during the 24-month data collect. The cost associated with implementing a bedside electronic medical record also limits the number of participants within each group. Other factors, such as baseline data and nursing home characteristics, were taken into consideration for sample matching; however, due to the difficulty of finding participating nursing homes, the nursing homes were not matched on geography. Geography is important for nursing home studies because each state has different requirements for nursing homes, which might affect the quality outcome in those nursing homes. Geography is also significant because nursing homes located in low socio-economic areas might tend to have more Medicaid patients that tend to have a lower level of quality of care.
**Computerized Provider Order Entry and Clinical Decision Support.** The American Recovery and Reimbursement Act describes CPOE and clinical decision support as core measures for improving quality of care through technology (CMS, 2010). These core measures are part of the criteria, which allow hospitals and physician offices to meet the requirements of meaningful use. Except for one survey study, no other research studies on the adoption rates for CPOE or clinical decision support in the nursing home setting were. The one study, which was conducted in New York, reported an 8% adoption rate. This study was completed in 2006 and no updates have been found. The few studies that examine CPOE and clinical decision support offer insufficient evidence on the effects of CPOE and clinical decision support on quality outcomes in the nursing home setting.

**Computerized Provider Order Entry and Clinical Decision Support in nursing homes.** Only one study on the use of EHRs and CPOE system without clinical decision support in the nursing home was found. The literature search revealed five articles, four from the same study, reporting on the use of an EHR system that integrated both a CPOE system and a clinical decision support in the nursing home setting.

The first study, that included only EHRs and CPOE without clinical decision support, was a pre-post quasi-experimental, comparative study. This study examined how implementation a clinical HIT system affected resident outcomes for activities of daily living, falls, mortality, resident satisfaction, behavioral systems, and resident mood. (Pillemer et al., 2012). Activities of daily living were measured through the Performance Activities of Daily Living Scale, a 27-item scale that measures a persons’ abilities to
perform certain functions (Kuriansky & Gurland, 1976). The investigators assisted with the implementation of an EHR system with CPOE into five unionized, for-profit nursing homes located in New York City. The five nursing homes were matched on bed size, profit status, LPN/RN staffing ratios, and geography with 15 comparison nursing homes that did not have any clinical HIT. Data for the outcomes of activities of daily living, falls, and mortality were collected from the Minimum Data Set over a nine-month period. Data for resident satisfaction with resident mood were collected pre-post the implementation via a questionnaire completed by the residents. Data for behavioral changes were collected through observation of residents over the nine-month pre-post implementation timeframe. The study reported no significant difference on resident activities of daily living function, falls, mortality, and resident mood with the implementation of electronic medical records and CPOE. The study did not allow staff to become accustomed to the new system before starting data collection: the data were collected over a 9-month period, starting immediately following the implementation. The collection of data immediately following a change in a system (implementation of a new documentation system) might affect results due to the time it could take staff to learn the technology and become comfortable with the system.

One study examined the effects of implementing an EHR with CPOE and clinical decision support on resident outcomes was designed to determine if the use of EHRs with CPOE and clinical decision support had an effect on medication ordering (Gurwitz, Field, Rochon, Judge, Harrold, Bell, et al., 2008). The randomized control study involved two-large hospital associated nursing homes, one located in the United States and one in
Canada. These nursing homes were selected because they had already implemented an EHR system with CPOE. Each nursing home had been using the system for over one year and each was considered efficient in their use of the systems by the investigators. Due to the size of each home, with a combined total bed size of 1,229, the study was able to select different units in each nursing home as intervention groups providing for cluster randomization. It is not possible to completely randomize because it would be unethical to move residents to different rooms to accommodate the study design. An effort was made to match the intervention and control groups based on bed size and general characteristics of each unit, such as staffing ratio and type of unit (skilled care, dementia care, long-term). There were multiple outcomes measured in this study including types and doses of medication orders, adverse events associated with certain medications and prescribing habits. Intervention units received clinical decision support through alert messages when providers entered inappropriate drug orders. Control groups did not receive alert messages regarding their inappropriate drug orders. Data were collected for one year through reports generated by the technology system that allowed for tracking of each medication order and if an alert was given or not given and if changes were made to the order after the alert was given.

The results showed no significant difference in adverse drug events for units using the clinical decision support alert message system (Gurwitz et al., 2008), but it did find an improvement in medication prescribing for older adults with renal insufficiency (Field et al., 2009). This study also reported prescribers were significantly more likely to take
appropriate action after receiving alerts regarding medication orders, especially if the medication ordered was an opioid (8-10%) (Donovan et al., 2010; Judge et al., 2006).

This was the first study to examine the use of clinical decision support in nursing homes. Strengths of this study included the large sample size with the ability to randomize at a unit level. The study also collected data over a one-year period allowing for the minimizing of external factors, such as new physicians, to affect the results, and provides stabilization of outcome measures. This study was limited in terms of generalization of the findings due to its focus on hospital-based nursing homes rather than the larger majority of community based nursing homes in the United States. It is important to note that the clinical decision support alerts provided when ordering inappropriate medications were informational only, and did not suggest alternative courses of action. These alerts still provided the physician the opportunity to decide if the medication order was appropriate, but this limited use of a clinical decision support system might have influenced results. It is important to note data were collected around 2005-2006, and many improvements in the technology have been made since this time, such as the standardization of medication orders through the use of the Health Level 7 International standards coding now found in EHRs (Dolin et al., 2006).

The purpose of the third study reporting on resident outcomes after implementation of an EHR with CPOE and clinical decision support was to evaluate the effects of clinical decision support system on the risk for and prevalence of pressure ulcers and malnutrition. This pre-post, quasi-experimental design study used a convenience sample of residents (n=600) living in 15 nursing homes (Fossum,
Alexander, Ehnfors, & Ehrenberg, 2011). The study had two intervention groups and a reference group. One intervention group had four nursing homes implemented a clinical decision support system; the second intervention group consisted of seven nursing homes assigned to use a research-based risk assessment instrument. The control group was comprised of the remaining four nursing homes in which no EHR system was in place. Baseline data for pressure ulcers and malnutrition were collected prior to the implementation of the clinical decision support system and training to use the risk assessment form. Blood albumin levels were used as the measure for malnutrition. Data were collected after an eight-month period from both chart reviews and reports generated by the technology system. This study reported a significant decrease in malnourished residents in the group using the clinical decision support system compared to the risk assessment group and the control group. There were no reported differences in acquired pressure ulcers for either intervention group or the control group. A strength of this study was the researchers’ use of nursing homes that were already familiar with, and using an EHR that had a CPOE system. This removed the effect of the external factor of learning a new system. One consideration of this study is the researchers point out that their sample size was not large enough to provide sufficient power.

The level of evidence is insufficient to make recommendations about the effects of clinical HIT on resident outcomes in nursing homes. Some of the studies report improvements in medication prescribing and a reduction in pressure ulcers; however, other evidence reports that there are no effects on pressure ulcers, falls, or adverse drug events with the use of clinical HIT. None of the studies reported on the resident outcome
Computerized Provider Order Entry and Clinical Decision Support in ACUTE care. There is research on the relationship between EHRs and quality of care in hospital settings. Early literature in this field often reported no significant improvements in care for hospitals using EHRs (Overhage, Tierney, & McDonald, 1996; Pierpont & Thilgen, 1995; Wilson, McDonald, & McCabe Jr, 1982), though these studies were conducted in the 1980s and 1990s when the technology was significantly different than it is today. A systematic review of the current literature involving the effect of clinical HIT in hospitals between (2007 - 2010) revealed that 92% of the 154 articles identified reported improvements in work process efficiency, effectiveness of care, and patient safety (Buntin et al., 2011). This meta-analysis reported studies using more sophisticated clinical health information technology were more likely to find reductions in medication errors, adverse drug events, and inappropriate prescribing of medications.

Studies of hospitalized older adult patients often report improvements in care and medication prescribing when using clinical decision support systems. A prospective pre-post study (n=8655) examined whether there was a difference in the number of potentially inappropriate medication orders, in hospitalized patients over 65 years of age, when a clinical decision support system was in place (Mattison et al., 2010). This study collected ordering data, such as drug name and dosage, on 22 potentially inappropriately
prescribed medications, mostly from the BEERS list. The data for the 6-months prior to the implementation of the CPOE system with clinical decision support system and then collected data for 12-months after the implementation of these systems. The data for the 6-months immediately following implementation was not used in the analysis. The clinical decision support system alerted providers when inappropriate medication doses were ordered and suggested alternatives. This study found a highly significant decrease from 11.6 inappropriate medication orders per day to 10. Usage of these more advanced clinical decision support systems can produce significant improvements in patient quality of care.

A time series intervention study (n=7,456) examined if the use of clinical decision support targeted to psychotropic medications affected the incidence of inappropriate dosage (Peterson et al., 2005). This study used one hospital that had previously implemented a CPOE system. The investigators created medication dosage warning messages that included alternative orders, to be displayed to any provider when a psychotropic medication was ordered for any patient over the age of 65. These warning messages and alternatives were available for two weeks; after two weeks they were turned off, and no message appeared during the ordering phase. The messages and alternatives were then turned on again for two weeks for providers when ordering psychotropic medications. Data were collected from the reports generated by the EHRs. This study reported a significant decrease in the incidence of inappropriate high doses of psychotropic medications during the intervention period.
The third study examined the effects of a clinical decision support system on the prescribing of sedative-hypnotic drugs in patients over 65 years of age (Agostini et al., 2007). This retrospective study (n=12,153) used one hospital that had previously implemented an EHR with CPOE system. The investigators examined orders for sedative-hypnotic medications for one year both pre and post the implementation of the clinical decision support system. The clinical decision support system offered alternative therapeutic regimens, such as different medications or non-pharmacological suggestions when these medications were ordered. This study reported more appropriate prescribing of sedative-hypnotic drugs in 95% of patients after a clinical decision support system was implemented. Two strengths of this study were the large sample size and a two-year data collection period. Lack of control group is a weakness of this study.

Together these studies suggest that there can be a reduction in medication errors and inappropriate medication prescribing with implementation of a CPOE system that integrates with clinical decision support software.

**Benefits and Barriers**

The literature search found four studies on the perceived barriers of clinical HIT in nursing homes and benefits for nursing home administrators with regard to the adoption of clinical HIT. Many of these are qualitative studies, report similar results, even over the span of several years.

**Barriers.** There is little evidence on barriers to the adoption of clinical HIT in nursing homes. The majority of this research is on the costs associated with implementation of clinical HIT in nursing homes. The literature search identified three
qualitative and one quantitative study on barriers to adoption of clinical HIT in nursing homes.

One qualitative study was based on interviews with 36 nursing home administrators and directors, 28 of whom were not using EHRs and eight that were. The most common perceived barriers to the adoption of EHRs were cost and human factors, such as resistance to change, unfamiliarity with or fear of computers, and education level of nurse aides (Cherry et al., 2008). The quantitative study reported similar results in Texas nursing homes (Wang & Biedermann, 2012).

A recent dissertation study further explored cost as a barrier to the implementation of clinical HIT in nursing homes. This study examined the effects of using advanced technology features of the MDS software on quality of care measures. This study compared the quality measures of nursing homes that reported the use of the advanced features of their MDS software and those that had the software but did not use the advanced features (n=2,397). The study reported that only 30% of nursing homes were using advanced technology that they actually possess, and hence would be free to use (Liu, Castle, & Diesel, 2010). This implies that it is important to understand that access to HIT is not the only major barrier, underutilization is also a reality. Other factors that might be significant include staff training, fear of technology, difficulty understanding HIT, privacy concerns, and lack of infrastructure (Richard et al., 2009).

Benefits. The systematic review mentioned earlier on the adoption of EHRs, CPOE, and clinical decision support in hospitals between July 2007 and February 2010, reported improved communication between staff and between health care departments, as
well as, work process efficiency and increased access to information leading to increased patient safety as benefits of the adoption of clinical HIT in both nursing homes and acute care settings (Buntin et al., 2011). Qualitative studies in nursing home settings support these findings.

In one study, investigators interviewed 36 nursing home administrators and directors, 28 who were not using EHRs and eight who were. In an analysis between those who were and were not using EHR the most common perceived benefit was improved documentation and access to information (Cherry, Carter, Owen, & Lockhart, 2008). In another study researchers visited four separate nursing homes and talked with all levels of staff, including nursing home administrators and the directors of nursing. All four sites had implemented EHRs and reported benefits of the clinical HIT were improved workflow and communication (Bennett, Tuttle, May, Harvel, & Coleman, 2007). Finally, a third study using focus groups (n=22) conducted with nursing home administrators, directors, and nursing staff after implementation of an EHRs system, reported communication and quicker access to clinical information as the main benefits of the systems (Rantz et al., 2010).

Only one quantitative study was found on the benefits of clinical HIT in nursing homes. In this case, pre-post evaluations reporting on the effectiveness of communication after implementation of an EHRs system, was conducted in a total of 224 Veteran Affairs nursing homes (Lindner, Ben Davoren, Vollmer, Williams, & Landefeld, 2007). The number of discussions providers had with patients about advanced directives significantly increased between physicians and patients after an EHR system was
implemented. Given the number and diversity of nursing homes participating and the use of Veteran Affairs nursing homes where standard across nursing homes are the norm, these findings are impressive. Of course, the lack of a reference group overtime makes it difficult to rule out if other organization wide initiatives might have been an influence in the improvements in advance directive communication.

**Nursing Home Characteristics**

A 2013 systematic review (n=11) of nursing home characteristics for ownership, affiliations, chain status, location, percentage of private rooms, facility size and staffing found inconsistent associations with these characteristics and quality of care (Xu, Kane, & Shamliyan, 2013), suggesting general characteristics might not play a role in the level of care. However, earlier studies found associations with improvements in quality of care based on the nursing home characteristics, such as ownership, provider status, number of beds, and staffing. This section describes these nursing home characteristics in more detail and how these factors can influence quality of care.

**Provider status.** Nursing home quality of care is often associated with the level of reimbursement for payment of services. Medicare, Medicaid, and private pay are the most common types of payment. Nursing home whose residents are mainly Medicaid generally have limited resources and have lower nurse to patient ratio, lower occupancy rates, and more health-related deficiencies (Mor, Zinn, Angelelli, Teno, & Miller, 2004). They are more likely to be terminated from the Medicaid/Medicare program, and are located in the poorest counties. More often homes where the majority of residents are Medicaid are closed due to poor quality of care (Castle et al., 2009). Nursing homes are
reimbursed at a flat rate for their Medicaid residents, regardless of how much care is needed.

The poor quality of care is often reflected in the numbers reported as quality measures for the nursing homes, specifically antipsychotic use, and incidence of pressure ulcers and falls. Secondary analysis of Medicare data suggested that nursing homes that have high levels of Medicaid residents prescribe more medications (Castle, Hanlon, & Handler, 2009; Dwyer, Han, Woodwell, & Rechtsteiner, 2010), have higher rates of pressure ulcers (Grabowski & Castle, 2004), and an increase of between 17% and 34% of hospitalizations (Cai, Mukamel, Veazie, Katz, & Temkin-Greener, 2011). However, other studies suggested high level of Medicaid and Medicare reimbursement are associated with a decrease in the use of antipsychotic medication (Hughes et al., 2000; Huybrechts et al., 2012; Lapane & Hughes, 2004).

Ownership. Arguments have been made for different levels of quality in non-profit vs. for-profit nursing homes. Many studies using secondary data from Medicare and Medicaid find non-profit homes are associated with increased quality of care (Castle, Wagner, Ferguson, & Handler, 2010; Castle et al., 2009; Dwyer et al., 2010; Grabowski & Castle, 2004; Harrington, Zimmerman, Karon, Robinson, & Beutel, 2000; Lau, Kasper, Potter, & Lyles, 2004). Other studies have found for-profit homes improve in quality when they are in competition with non-profit homes (Castle, 2005). A meta-analysis completed in 2009 reported not-for-profit nursing home delivered higher quality in staffing and lower pressure ulcer prevalence, but no difference in state survey deficiency levels and restraints (Comondore et al., 2009).
There are inconsistent findings in the area of psychotropic antipsychotic prescribing. In a survey of respondents in nursing homes (n=107), Kim and Whall (2006) reported no significant difference between non-profit vs. profit nursing homes in relationship to psychotropic medication prescribing. Similarly, Hughes and colleagues (2000) examined data from the 1997 On-Line Survey and Certification of Automated Records (OSCAR) for Medicare/Medicaid-certified nursing homes and found a significant difference in antipsychotic prescribing in relationship to profit status. While this study included all certified nursing homes, the data is from 1997, which is dated in terms of this topic. In the past two years the CMS has launched an initiative to decrease the use of antipsychotics in nursing homes.

**Number of beds.** The number of nursing home beds has been a common covariate in many studies, usually in secondary data analysis of Medicare and Medicaid data. The number of beds is often associated with quality of care (Castle et al., 2009; Harrington et al., 2000; Teno et al., 2010). Analyses data of existing nursing homes has shown that home with fewer beds are positively associated with polypharmacy (Dwyer et al., 2010), while other studies have found more inappropriate drug prescribing in nursing homes with more than 100 beds (Lau et al., 2004). However a retrospective study using the nationally representative data set of the Medicare Current Beneficiary Survey merged to MDS assessments, medication administration records, and Medicare claims found no significant association between the number of beds and antipsychotic use (Briesacher et al., 2005).
The findings on psychotropic medications among older adults in nursing homes are more consistent. Based on the OSCAR data noted earlier large number of beds (> 100) was significantly associated with increased rates of antipsychotic use (Hughes et al., 2000). A more recent analysis of Medicare data found nursing homes that ranged between 100-250 beds had the highest percentage of antipsychotic prescribing rates (Chen et al., 2010).

**Staffing levels.** Several studies have reported associations in quality of care in nursing homes to staffing levels, specifically the number of registered nurses compared to licensed practical nurses (Castle, Wagner, Ferguson, & Handler, 2010; Castle & Anderson, 2011; Kim, Kovner, Harrington, Greene, & Mezey, 2009; O’Neill, Harrington, Kitchener, & Saliba, 2003; Reed, Blegen, & Goode, 1998). These studies of secondary data report lower rates of pressure ulcers, falls, and medication errors when there were higher levels of registered nurses compared to licensed practical nurses.

Specific studies have shown relationships between staffing and the use of psychotropic medications and quality. A recent multisite, cross-sectional descriptive study (n=107) found that low levels of RN staffing was significantly associated with increased levels of prescribing psychotropic medication (Kim & Whall, 2006). This is supported by a study, previously discussed, using a secondary analysis of OSCAR data from 1997. This study reported a significant difference in nursing homes with higher staffing ratios of registered nurses were less likely to have high use of antipsychotic medications (Hughes et al., 2000).
Registered nurse staffing ratios have shown to also be associated with the rate of pressure ulcers in nursing homes. A systematic review reported significant findings regarding increased registered nurse staffing and reductions in pressure ulcers (Bostick, Rantz, Flesner, & Riggs, 2006). An analysis of data from the 2004 National Nursing Home Survey (n=1,376) supports this finding in that significantly lower rates of pressure ulcers were associated with increased ratios of registered nurses (Horn, Buerhaus, Bergstrom, & Smout, 2005). These studies suggest the ratio of registered nurses to licensed practical nurses can be identified as a likely influence on the quality of care received in nursing homes.

**Resident Outcomes**

Quality of care in nursing home is reported via the Medicare website. This information compares rates of 21 different quality measures for all the Centers for Medicare and Medicaid Services certified nursing homes and is often used in research. Three measures of quality of care often used in nursing homes research are antipsychotics, pressure ulcers, and falls. These measures were selected for this study because they are potentially preventable.

**Antipsychotics.** The prevalence of antipsychotic medications in in nursing home residents has been reported to be between 24% and 32% (Chen et al., 2010; Kamble et al., 2008; Rochon et al., 2007). The use of antipsychotics in this population is also associated with a 60 - 70% increase in the rate of death (Schneeweiss, Setoguchi, Brookhart, Dormuth, & Wang, 2007), as well as an increase in falls, cerebral vascular events, movement disorders, and sedation (Dahl et al., 2008; Wooltorton, 2002, 2004).
Several studies have found associations between increased use of antipsychotic medications in nursing homes with poor ratings and increased survey deficiencies (Bronskill et al., 2009; Castle, Engberg, Lave, & Fisher, 2009).

Data analysis from the National Nursing Home Survey found a strong association between antipsychotic use and disruptive behavioral characteristics common among residents with a diagnosis of dementia, depression, anxiety or Parkinson’s (Kamble et al., 2008; Stevenson et al., 2010). Prescribing antipsychotic medications to modify behaviors, in some cases, can be considered inappropriate prescribing. Inappropriate prescribing of medications is associated with adverse drug events (ADE) (Gallagher, Barry, & O’Mahony, 2007). ADEs often lead to extra physician and hospitalizations, injury, and deterioration of body functioning (Chan, Nicklason, & Vial, 2001) resulting in high costs and resident pain and suffering.

**Pressure ulcers.** Pressure ulcers have been associated with increased pain, a decrease in activity, increased risk of sepsis, degradation of self-image, and an increase in costs and challenges of caregiving for elderly residents in nursing homes (Lynn et al., 2007). The Agency for Healthcare Research and Quality (2008) has developed standardized guidelines for the prevention of pressure ulcers. These guidelines state that a standardized assessment is the most significant factor in the prevention of pressure ulcers.

Findings from Medicare data for patients (1990 and 2001) found pressure ulcers were the cause of death in 114,380 persons (Redelings, Lee, & Sorvillo, 2005). Nearly 80% of pressure ulcer-associated deaths occurred in persons at least 75 years old. Costs
for pressure ulcers vary depending on the stage of the ulcer. These costs have been reported to be as high as $129,248 for a Stage IV pressure ulcer (Brem et al., 2010).

Since 2008, hospitals are no longer being reimbursed for acquired pressure ulcers, though, as of 2013, nursing homes are being reimbursed for the treatment of acquired pressure ulcers.

The recommendation for a standardize assessment of pressure ulcers is not being followed in the nursing home setting. A retrospective study of Veteran Affairs nursing homes (n=834) found only 61% of clinicians were conducting these standardized assessments upon admission (Saliba et al., 2003). Similarly a retrospective national study on pressure ulcers in nursing homes (n=882) found that standard protocols for prevention and care were not in place, allowing for a greater variation in pressure ulcer management (Bergstrom et al., 2005).

Falls with injuries. The prevalence of falls among persons living in nursing homes is reported to be an average of 1.7 falls per bed annually, with 10–25% of these falls resulting in fractures or lacerations (Rubenstein, 2006). The cost associated with injuries sustained from falls is high. The average hospitalization cost, in 2004, was $17,483, with femur fracture being the most expensive type of injury at $18,638 (Roudsari, Ebel, Corso, Molinari, & Koepsell, 2005). A systematic review reported falls related costs were between 0.85% and 1.5% of the total health care expenditures (Heinrich, Rapp, Rissmann, Becker, & König, 2010), with estimated costs around $40 billion by 2020 (Heinrich, Rapp, Rissmann, Becker, & König, 2011). Mortality for older adults is significantly increased after fractures occur. A review of the literature reports
mortality rates associated with fractures from falls ranges from 1.3% to 22.3% (Bluc et al., 2009).

**Summary of the Literature**

There are a limited number of studies on clinical HIT in the nursing home setting. Some of the studies report improvements in medication prescribing and a reduction in pressure ulcers; however, others report no effects on pressure ulcers, falls, or adverse drug events with the use of clinical HIT. Within the past eight years, only six states have conducted studies to describe the current state of clinical HIT in nursing homes. In addition, the majority of published research related to the effects of EHRs, CPOE, and clinical decision support on quality measures in nursing homes has been conducted in only a few states, mostly in hospital-based nursing home. These studies do not examine the specific quality measures of antipsychotic medication use, and only two examine pressure ulcers and falls. In contrast, a systematic review done of literature in the hospital setting, reported that the use of clinical HIT can affect patient outcomes through increased adherence to guideline-based care, standardization of work processes, and decreased medication errors (Chaudhry et al., 2006).

Multiple factors can affect the quality of care found in nursing homes. Some of the most noted factors associated with variance in the quality of care in nursing homes are provider status, ownership, number of beds in a nursing home, and staffing levels. Including these variables as covariates allows for a clearer understanding of the relationship between technology and quality measures in nursing homes.
Key quality measures that have a significant impact on resident pain and suffering and high costs are antipsychotic use, pressure ulcers, and falls with injuries. This study incorporates these as the main outcome variables when examining how clinical HIT sophistication could impact quality of care.
CHAPTER THREE: METHODS

This chapter describes the research design, setting, sample, setting, instruments, data collection procedures, data analysis, ethical considerations, and limitations of this study. The primary purpose was to examine the differences in quality of care between nursing homes with different clinical HIT sophistication. The primary research question was: Is there a difference in the quality measures for antipsychotic medication use, pressure ulcers, and falls with injuries among nursing homes that have different levels of sophistication of clinical HIT: 1) no EHR technology, 2) EHR; 3) EHR with CPOE; and 4) EHR with CPOE and clinical decision support in Medicare and Medicaid certified nursing homes?

Research Design and Overview

This study used a cross-sectional, descriptive, comparative design, in which the use of clinical technology was measures and compared with the quality measures for antipsychotic medication use, pressure ulcers, and falls with injuries. An investigator-developed questionnaire collected information on nursing homes use of different clinical technology. This information was then linked with selected measures from the CMS Nursing Home Compare public data set.
Setting and Sample

**Setting.** The setting for this study was certified Medicare and Medicaid Nursing Homes in the United States.

**Sample.** The sample consisted of nursing home directors and administrators who belonged to the National Gerontological Nursing Associations (NGNA) and the National Association of the Directors of Nursing Administrators (NADONA) and had registered their email addresses to the association listserv account.

**Sample size.** To answer the primary research question an estimated effect size for clinical HIT on antipsychotic medication use, pressure ulcers, and falls was needed. Six local nursing homes: three that had been using an electronic health record for at least the last six months of 2012, and three that matched in size, profit status, geography, and staffing levels, but did not have EHR, were selected. The most recent quality indicator data for these nursing homes was downloaded using Medicare’s Nursing Home Compare public dataset, [www.data.medicare.gov](http://www.data.medicare.gov). The investigator used the means and standard deviations for each group to calculate an effect size for the quality measures (Table 2) using the Explore feature of SPSS®, version 18. The Cohen’s d was then calculated using the online effect size calculator [http://www.uccs.edu/~lbecker/](http://www.uccs.edu/~lbecker/) developed by the University of Colorado (Becker, 2013).
Table 2 Calculation of Effect Size

<table>
<thead>
<tr>
<th>Group</th>
<th>Antipsychotic use</th>
<th>Falls with Injury</th>
<th>Pressure Ulcers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>ES</td>
</tr>
<tr>
<td>Clinical HIT</td>
<td>.086</td>
<td>.1036</td>
<td>.42</td>
</tr>
<tr>
<td>No Clinical HIT</td>
<td>.130</td>
<td>.0756</td>
<td>.0467</td>
</tr>
</tbody>
</table>

Clinical HIT = Nursing homes that were using electronic health records
No Clinical HIT = Nursing homes that were not using electronic health records
SD = Standard Deviation
ES = Effect Size

In order to calculate the sample size, an online statistical calculator (http://www.danielsoper.com/statcalc3/) by Daniel Soper was used (Soper, 2012). The calculated effect sizes ranged from .41 - .48. Based on this information, the smallest of the effect sizes (.41) was selected. The acceptable method for calculating a sample size for use in an ANCOVA research question is to use the same method as if calculating for an ANOVA power analysis (Polit & Beck, 2008, p. 271). The following data were used: an effect size of .41, a power of .80, and a probability level of .05. The calculated sample size to answer the primary research question for research question is 150 total.

Previous online surveys conducted for nursing homes have yielded between a 15% and 78% response rate (Richard et al., 2009; Wang & Biedermann, 2012). This study had estimated a 10% response rate based on previous response rates and studies on web surveys. A systematic review of online surveys found response rates increased when surveys are sponsored by Universities or the government (Fan & Yan, 2010) and when the topic is salient. There were 1,300 emails address contained in the NGNA listserv, and
2,800 in the NADONA listserv for a total of 4,100. Initial estimates were that 15% of the email addresses on the listservs would be incorrect email addresses or the emails would be blocked due to spam filtering, leaving the potential number of respondents as 3,485 (Fan & Yan, 2010). Using the 10% response rate, we anticipate 348 responses, which was twice the number needed for the sample.

**Inclusion criteria.** All certified Medicare and/or Medicaid nursing homes within the United States whose nursing home administrators or directors of nursing were members of the NGNA or the NADONA.

**Exclusion criteria.** Any nursing home that is in the process of closing or was missing all nursing home data on the Nursing Home Compare website were excluded.

**Measures**

Two tools were used to collect data. The first is an online survey developed specifically for this research project on the use of clinical HIT within a nursing home. The survey was sent to the nursing home administrators and directors of nursing. The second is a publicly available data set collected by CMS, via the MDS, and provided on the website Medicare Nursing Home Compare. The following sections outline the development of the survey and information regarding the secondary data set from CMS.

**Questionnaire.** The survey questionnaire collected data on nursing homes that were using 1) no EHR technology, 2) non-integrated EHR; 3) EHR with CPOE; and 4) EHR with CPOE and clinical decision support. Data was also collected data from the nursing home administrators and the directors of nursing on their perceived barriers and benefits of clinical HIT systems. Questions on the survey asked specific questions
related to nursing home use of various clinical HIT systems and how long systems had been in place. The survey (Appendix A) was developed using the instrument development concepts outlined by Polit & Beck (2008).

**Expert panel.** Five experts were selected to evaluate the face and content validity of the developed survey. These experts were selected based on their working knowledge of the long-term care environment, expertise in survey research, and expertise in health information technology. The survey was sent via Survey Monkey to five individuals who agreed to review the survey. The expert panel consisted of researchers representing academic, Veteran Affairs offices, and CMS.

Each expert was sent a packet of materials including information about the construct, reviewer instructions, and a link to the online survey. The experts responded with feedback on the developed survey and assessed each item and rated them based on the following guidelines (Polit & Beck, 2008).

- Does the item measure the use of clinical HIT?
- Is the item appropriate for the population (nursing homes)?
- Is the item clear?
- Should the item be worded differently?

The content validity index (CVI) was calculated to be .85, which is considered acceptable for a new instrument. The minimal changes made to the survey after the review from the expert panel included: 1) removing the word “chart” and using “medical health record” in questions 1-12; 2) questions 5 and 10 was rearranged to place the words
“verbal orders” earlier in the sentence; 3) question 8 added the option of “unsure”; and 4) questions 11 and 12 were changed to a Likert-type scale.

**Peer review.** Following suggestions for a peer review made by Pett, Lackey, & Sullivan (2003, p. 46) on developing questions for a survey, the updated version of the survey was emailed via Survey Monkey to 59 long-term care nurses who were asked to complete the survey as if they were a participant. They were also asked to comment on any portion of the question or answers they believed to be confusing or should be reworded. This was done to provide clarity for questions that were confusing or ambiguous. Minimal changes were made to the survey and included: a change in the skip logic for question 8, and the options for “staff empowerment” and “staff satisfaction” were separated into two choices instead of one in question 12, see Appendix I.

The pilot survey was then sent via Survey Monkey to 79 randomly selected potential participants. The participants were selected from a list of certified Medicare and Medicaid nursing homes from CMS’s Nursing Home Compare website. Directors of nursing were contacted explaining the study and asking if they would participate. The pilot study verified that the survey was functioning properly including the skip logic. The results from the pilot study were included in the final results.

**Nursing Home Compare.** Certified nursing homes are required to submit resident information to CMS, via the MDS, within specifically outlined time frames. They are also required to submit an application for recertification annually that includes updated information on nursing home characteristics. This data is collected through the Certification and Survey Provider Enhanced Reporting system. CMS then formats this
information into several different exportable database file and uses their website, https://data.medicare.gov, to publically report 18 quality measures and specific nursing home data.

Specific data variables from the July 1, 2013 dataset were exported into an excel spreadsheet to be used for analysis. Nursing homes characteristics for provider status (Medicare and/or Medicaid certified), ownership, hospital based, if they are continue care retirement communities, number of beds, and staffing levels for clinical assistants, registered nurses, and licensed practical nurses were exported. Bed size was recoded into three group, those of 0-99 beds, 100-199, and >200. The specific quality measures for long stay use of antipsychotic medications, pressure ulcers, and falls with injuries cover the Minimum Data Set reporting period of January 1, 2013 – March 31, 2013 were matched to the corresponding nursing home characteristics and exported into the excel spreadsheet. The variables that were used in this study are defined in Table 3.
### Table 3 Variable Definitions

<table>
<thead>
<tr>
<th>Variables</th>
<th>Conceptual</th>
<th>Operational</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic Health Record</td>
<td>Electronic Health Record is an electronic record of health-related information on an individual that is created, gathered, managed, and consulted by authorized health care clinicians and staff (U.S. Congress, 111 Session, 2009).</td>
<td>Answer to Question 1 as fully electronic, or combination on the Use of HIT in Nursing Homes.</td>
</tr>
<tr>
<td>Computer Provider Order Entry</td>
<td>Computerized provider order entry is a process for providers and/or physician to enter medication and treatment orders into patient’s record electronically instead of using paper charts (Kaushal &amp; Bates, 2012).</td>
<td>Answer to Question 10 as “electronically 100% of the time, or electronically 75% of the time, 25% of the time provide verbal orders, or electronically 50% of the time, 50% of the time provide verbal orders” on the Use of HIT in Nursing Homes.</td>
</tr>
<tr>
<td>Clinical Decision Support</td>
<td>Clinical Decision Support is software combined with Computerized provider order entry, offering the ability to analyze various data points of information and providing a notification of concerns based on provided data (Schedlbauer et al., 2009)</td>
<td>Answers to Question 9 as “yes” on the Use of HIT in Nursing Homes.</td>
</tr>
<tr>
<td><strong>Descriptive and Covariates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provider status</td>
<td>Provider status is a description of how the nursing home is reimbursed for the care provided. Two of the three payer-source outputs are measured by the number of residents who are funded by Medicare, usually for short-term stays, and the second is Medicaid, which normally covers long-term stays. The third payer-source is identified as “Other”, which is usually a private payer, or an insurance payer (DeLellis &amp; Ozcan, 2012).</td>
<td>Answers from question F9 on the Long Term Care Nursing home Certification Application for Medicare and Medicaid (Form CMS-671), reported on the nursing home compare dataset.</td>
</tr>
<tr>
<td>Ownership</td>
<td>Qualification as a non-profit corporation based on tax status as listed on the Long Term Care Nursing home Certification Application for Medicare and Medicaid (CMS, 2012a).</td>
<td>Answers from question F12 on the Long Term Care Nursing home Certification Application for Medicare and Medicaid (Form CMS-671), reported on the nursing home compare dataset.</td>
</tr>
<tr>
<td>Number of beds in a nursing home</td>
<td>The number of available beds a nursing home offers, where a resident may stay for a short or permanent period of time as reported on the nursing home license (Center for Medicare and Medicaid Services, 2012)</td>
<td>Answers from state annual applications for long term care nursing home, as reported on the nursing home compare dataset.</td>
</tr>
<tr>
<td>Staffing levels</td>
<td>Registered nurses are those persons licensed to practice as registered nurses in the State where the nursing home is located. Licensed Practical/Vocational Nurses are those persons licensed to practice as licensed practical/vocational nurses in the State where the nursing home is located. Do not include those hours of LPN/LVNs reported elsewhere (CMS, 2012a).</td>
<td>Reported on the nursing home compare dataset as the reported hours of staffing for clinical assistants, licensed practical nurses, and registered nurses.</td>
</tr>
<tr>
<td>Barriers</td>
<td>Factors affecting the rate of HIT adoption, including various economic, sociological, organizational,</td>
<td>Answer to Question 11 on the Use of HIT in Nursing Homes, rating the barriers on a scale</td>
</tr>
</tbody>
</table>
and psychological variables (Butler & Sellbom, 2002).

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Technology benefits being perceived as factors that contribute to a persons’: (1) safety and security, (2) pleasure and satisfaction, and (3) contribution to basic human needs (Gardner &amp; Gould, 1989).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>from 1-5, with one indicating a significant barrier and 5 representing a minor barrier. Answer to Question 12 on the Use of HIT in Nursing Homes, rating the benefits on a scale from 1-5, with one indicating a significant benefit and 5 representing a minor benefit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent</th>
<th>Antipsychotic Use</th>
<th>Antipsychotic medications are classified as a chemically diverse group of medications that affect the central nervous system for the purpose of treatment of broad psychotic disorders (Lehne, 2004).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Based on answers to section N, question 2a on Minimum Data Set 3.0 and is reported on nursing home compare as the percentage of long stay residents who received an antipsychotic medication (CMS, 2012a).</td>
</tr>
<tr>
<td></td>
<td>Pressure Ulcers</td>
<td>A pressure ulcer is localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction (Black et al., 2007)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Based on answers to section M questions 1-6 on the Minimum Data Set 3.0 and is reported on nursing home compare as a percent of long-stay residents with pressure ulcers that are new or worsened. (CMS, 2012a).</td>
</tr>
<tr>
<td></td>
<td>Falls with injuries</td>
<td>Unintentional change in position where any portion of the body is not purposely placed on the ground, floor or onto the next lower surface. An intercepted fall, where a resident is caught and lowered to the ground, is still considered a fall (CMS, 2012b).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Based on answers to section J, question 16-18 on Minimum Data Set 3.0 and is reported on nursing home compare as a percentage of falls with injuries (CMS, 2012a).</td>
</tr>
</tbody>
</table>
**MDS data.** MDS and nursing home data has been used extensively in past research on nursing homes. Multiple studies have concluded validity and reliability on the Minimum Data Set data’s, with findings of moderate to moderate/high validity (Shin & Scherer, 2009). It is important to note that the psychometric properties of the Minimum Data Set have been called into question due to the subjective nature of the data collection (vonKoss Krowchuk, Vince, Moore, & Richardson, 1995), as well as the potential for date errors and lack of training and standards for the data entry persons (Pabst, 2001). Criterion validity for Minimum Data Set has been found to be high, ranging from .041 to .092 for cognitive function (Shin & Scherer, 2009). Moderate to high construct validity ranging from 0.45 to 0.70 for cognitive function has also been reported (Lawton et al., 1998). Specific items of the Minimum Data Set related to skin (pressure ulcers) has been found to have an inter-rater reliability of .62 -.70 (Hawes et al., 1995; Lawton et al., 1998; Mor, Intrator, Unruh, & Cai, 2011; Shin & Scherer, 2009; Snowden et al., 1999). No specific reliability items for falls or antipsychotic use have been completed, though one study reported actual falls was under reported in the Minimum Data Set (Hill-Westmoreland & Gruber-Baldini, 2005). The majority of studies on the psychometric properties were conducted on the Minimum Data Set 2.0 version. There has been one study that examined the psychometric properties of the Minimum Data Set 3.0, and it reported an overall moderate to excellent reliability rating (Saliba & Buchanan, 2012).
Data Analysis

The primary outcome variables are the quality measures for antipsychotic use, pressure ulcers and falls with injuries among nursing homes with various levels of clinical HIT. Bivariate and multivariate models were run in order to examine the relationship with each quality measure on the levels of clinical HIT. Significance is based on a p-value of <.05. All analyses were done using SPSS version 19.0.

Normality and missing data. Continuous variables were inspected for missing data and normality using the Explore feature in SPSS®, allowing for the evaluation of skewness, kurtosis, and Kolmogorov-Smirnov statistics. Linearity was assessed through examination of residual plots and homoscedasticity was evaluated by conducting Box’s M test.

Descriptive statistics. Descriptive statistics were provided for all independent, dependent and covariate measures.

Bivariate analyses. All independent and dependent variables were examined through a series of bivariate analyses for the independent, dependent and covariate variables. Non-parametric tests were used to examine relationships between nominal independent and covariate variables, with parametric tests used to test relationships between the independent nominal variables and the continuous dependent variables.

Research questions and multivariate analysis. Research question 1. “What nursing home characteristics (provider status, ownership, bed size, and staffing levels among Licensed Practical Nurse (LPN),
Registered Nurse (RN), and Clinical Assistants (CA)) are associated with levels of clinical HIT use: a) non-integrated EHR; b) EHR with CPOE; and c) EHR with computer provider order entry and clinical decision support, and those that do not use any clinical HIT in Medicare and Medicaid certified nursing homes.” This question is answered through descriptive statistics and the nonparametric Chi-square test for the nominal independent variables of levels of clinical HIT and the nominal nursing home characteristics for ownership, provider status, and bed size. A t-test was used to examine the associations between the independent variables and the continuous nursing home characteristics of CA, LPN and RN staffing levels.

Research question 2. “What are differences in the perceived benefits and barriers of clinical HIT among certified Medicare and Medicaid nursing homes with and without EHRs?” This question was answered using the comparing means of a bivariate one-way ANOVA. Two groups were created; the first group had no EHR technology and the second group contained those nursing homes that had any level of EHR technology.

Research question 3. “Are there differences in the quality measures for antipsychotic medication use, pressure ulcers, and falls with injuries among nursing homes that have different levels of sophistication of clinical HIT: 1) no technology, 2) EHR; 3) EHR with CPOE; and 4) EHR with computer provider order entry and clinical decision support in Medicare and Medicaid certified nursing homes.” This question was answered by first using an analysis of variance with the independent variable for levels of clinical HIT and each quality measures for antipsychotic use, pressure ulcers, and falls with injury, providing five analyses. Interactions terms significant at the level of p<.05
remained for further evaluation of pairwise comparisons. Finally, covariates were added to see whether the strength of the associations found in the models remained after controlling for ownership, provider status, bed size, and staffing levels.

**Ethical Considerations**

**Human subjects.** Approval for this study was obtained from the George Mason University Office of Research Subject Protection (Human Subjects Review Board). Participating nursing homes were provided with the Human Subjects Review Board approval letter upon request. Due to the minimal potential for harm, an expedited request through the Human Subjects Review Board was requested. A copy of the approval can be seen in Appendix II. All survey data is password protected and only identifiable via a unique user identifier only the researcher has access. This information is kept in a secure, locked cabinet in a secure, locked room. All data regarding unique identifiers will be destroyed three years after completion of the study.

**Informed consent.** This study contains no personal identifiable patient information, but does contain nursing home nursing home wide public information. No nursing home resident or nursing home was identified. The portion of this study requesting information from nursing home administrators and directors regarding their use of various types of clinical HIT included an informed consent. For nursing home administrators and directors willing to complete the survey, informed consent will be assumed, based on their decision to complete the survey.

**Recruitment.** A monetary incentive was used for participants upon completion of the electronic questionnaire. VISA gift cards were awarded to four participants.
selected randomly by a computer program (http://andrew.hedges.name/experiments/random/). All email addresses were kept confidential and made available to only the primary researcher.

**Study Limitations**

As discussed earlier, the use of the Minimum Data Set is the standard for nursing home research. It is important to note that the Minimum Data Set was not initially designed for capturing research data, but for the use of nursing home to improve their quality of care. The inherent nature of such a large data set means there are no inclusion or exclusion criteria, so the sample might not be a true representation of the population (Shin & Scherer, 2009). Other considerations regarding the validity of the Minimum Data Set include the clinical competency, training, and education of the data entry persons (Lum, Lin, & Kane, 2005).

Due to the non-experimental design with no randomization causal inferences cannot be made. It is important to note that this study uses data collected by Medicare and Medicaid certified nursing homes. This does not reflect the numerous non-certified nursing homes, or government run nursing home such as the Community Living Centers operated by the Veteran Affairs Department.
CHAPTER FOUR: RESULTS

A total of 154 surveys responses were received from the 4,100 surveys sent; combining the nine pilot study surveys provided a final sample of 163 respondents, constituting a 4% response rate.

Nursing home characteristics were as follows: 90% accepted both Medicare and Medicaid, with 53% reporting themselves as for profit homes, 44% as non-profit, and the remaining 3% were owned by the government. The majority (91%) of the homes had 200 or fewer beds, with 46% having fewer than 100 beds. The mean staffing ratio per resident day for CAs was 2.58, for LPNs .90, and for RNs .91. The sample was representative of the national average.

The multivariate comparison in quality measures between nursing homes using no clinical HIT (n=39), EHR only (n=62), EHR with CPOE (n=32), and EHR with CPOE and clinical decision support (n=30) found significantly fewer long-stay residents on antipsychotic medications (M= .143, SD= .089, p=.004) when a CPOE system was in place compared to those long-stay residents living in nursing homes with just an EHR (M = .202, SD = .108). Significant difference for long-stay residents on antipsychotics were also found between nursing homes using a clinical decision support system (M = .147, SD = .090, p=.009) compared to those using just an EHR. There were fewer acquired pressure ulcers in nursing homes that use CPOE (M = .035, SD = .036) than those that
used paper (M = .064, SD = .044, p=.009) or clinical decision support (M = .063, SD = .046, p=.017).

Nursing home administrators and directors of nursing without an EHR system reported the most important barriers to the adoption of EHR were compatibility with other systems (M=2.97, SD=0.94), wireless access (M=2.87, SD=0.62), and concern that the system would become obsolete (M=2.71, SD=0.80), and listed the top benefits as improved regulatory compliance (M=4.57, SD=0.73), ability to exchange data electronically (M=4.46, SD=0.99), and monitoring clinical data (M=4.24, SD=0.64). For those with an existing EHR system, costs for hardware (M=3.22, SD=1.33) and software (M=3.16, SD=1.39) were the most important barriers, followed by compatibility with other systems (M=2.88, SD=1.33), while monitoring quality (M=4.60, SD=0.75), access to clinical data (M=4.60, SD=0.76), and staff oversight (M=4.52, SD=0.78) were listed as the top three benefits.
CHAPTER FIVE: DISCUSSION

Our results indicate higher quality of care is associated with the use of advanced clinical HIT systems. Nursing homes using CPOE and clinical decision support systems have significantly fewer long-stay residents on antipsychotic medication than nursing homes with only an EHR system. CPOE and clinical decision support systems are advanced integrated systems that provide immediate access to all patient information as well as extensive medication information, which can assist in making prescribing decisions. These systems have the capability to alert providers to medication interactions, proper dosing, and alternative medications. EHR systems do not provide this level of sophistication.

Nursing home leaders indicate that they believe the use of technology can improve quality of care and report an important benefit to the adoption of technology is their ability to monitor this data. These findings suggest best practices for the adoption of technology into nursing homes is to consider the long-term benefits of integrated clinical HIT systems, which in turn can improve quality of care and reduce nursing home costs for the associated care.

This analysis led to several recommendations for future research. Intervention studies should consider not only the effects of the different levels of clinical HIT on a larger set of quality indicators, but also how friendly the systems are for users. For
example, friendlier systems might reduce documentation time, improve staff satisfaction, or lead to better documentation in medical records, in turn improving quality of care.

Future studies should also explore the relationship between nursing homes costs among those with and without advanced clinical HIT, specifically on medication errors and administration costs. A greater understanding of cost savings realized through the use of advanced clinical HIT will increase the likelihood that these systems will be adopted.
APPENDIX I
Use of Clinical HIT in NH

Informed Consent

Informed Consent

Please read before completing the survey.

Research Purpose:
This survey is being conducted to assess use of various health information technologies (HIT) in nursing homes and their relationship to quality measures. The study is being conducted as part of a dissertation research study through George Mason University. If you choose to participate, you will be asked to complete the following survey. The survey should take less than 5 minutes to complete.

Risks:
There are no anticipated risks for participating in this study.

Benefits:
Direct benefits to you as a participant include a summary of data collected, including a list of the three most popular electronic health record vendors in your state, and a percentage of how many nursing homes in your state are using different types of clinical management.

Compensation:
All participants will be added to a raffle to win one of four $50 VISA or Target gift cards.

Confidentiality:
The information is confidential. You may refuse to answer any of the questions and you may stop at any time. No resident identifying information is being collected, though facility information will be identifiable. Information collected in the survey will be stored in a password-protected database that can only be accessed by the researcher. While it is understood that no computer transmission can be perfectly secure, reasonable efforts have been made to protect the confidentiality of your transmission. All records will be destroyed after the study.

Participation:
Your participation in this survey is voluntary, and you may withdraw from the survey at any time for any reason. If you decide not to participate or if you wish to withdraw from the survey, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party.

Contact:
This research is being conducted by Carla Spinelli-Moraski, PhD(c), MSN, RN-BC at George Mason University. Ms. Spinelli-Moraski may be contacted at 703-517-2207, or cs@gm.edu, for questions or to report a study-related problem. You may contact the George Mason University Office of Research Subject Protections at 703-993-4121 if you have any questions or comments regarding your rights as a participant in the study. This survey project has been reviewed according to George Mason University procedures governing your participation in research. Completing the survey will indicate that you have read this form and are agreeing to participate in this study.
### Use of Clinical HIT in NH

#### Health Records

1. Which of the following best describes your facility's methods for maintaining and updating a resident's medical health record including resident demographic information, nurse's notes, medication and treatment orders, medication administration record (MAR), and physician's notes, but NOT including MDS.

   - Paper only
   - Combination of paper and electronic
   - Fully electronic
2. Is your facility considering implementing an electronic health record system (EHR), to maintain resident demographics, nurse's notes, medication and treatment orders, MARs, and physician notes?

- [ ] Yes
- [ ] No
### Use of Clinical HIT in NH

3. When does your facility expect a resident’s medical health record, specifically patient demographics, nurse’s notes, medication and treatment orders, MARs, and physician notes, to be completely maintained electronically?

- [ ] Within the next 3 months
- [ ] Within the next 6 months
- [ ] Within the next year
- [ ] Within the next 2 years
- [ ] Within the next 3 years
- [ ] Greater than 3 years
- [ ] Not sure

4. Please select the electronic health record companies/vendors your facility is considering purchasing from? (Click all that apply).

- [ ] A4scripts
- [ ] American Data
- [ ] American Health Tech
- [ ] Answers on Demand (AOD)
- [ ] CCRx
- [ ] Galaxy Hosted Software
- [ ] Healthland
- [ ] HealthMEDIX
- [ ] Health Systems Corporation
- [ ] MDI Achieve
- [ ] Optimus
- [ ] Point Click Care
- [ ] VistA CPM

Other (please specify):
### Use of Clinical HIT in NH

5. Which of the following best describes how medication and treatment orders are entered into a resident’s medical health record by the physicians/providers.

- [ ] Hand written orders 100% of the time.
- [ ] Hand written orders 75% of the time, verbal orders 25% of the time.
- [ ] Hand written orders 50% of the time, verbal orders 50% of the time.
- [ ] Hand written orders 25% of the time, verbal orders 75% of the time.
- [ ] Verbal orders 100% of the time

Other (please specify)
Use of Clinical HIT in NH

Electronic Health Records

6. How long has your nursing home been electronically maintaining resident medical health records, specifically patient demographics, nurses’ notes, medication and treatment orders, MARs, and physician notes?

- Less than 3 months
- Between 3 months to 9 months
- Between 10 months to 12 months
- Greater than 12 months

7. Does your electronic medical health record contain a Clinical Decision Support system (CDS)? For example, if a provider orders a medication with an inappropriate dosage, is there an alert that warns the provider of the problem?

- Yes
- No
- Don’t know
Use of Clinical HIT in NH

<table>
<thead>
<tr>
<th>Use of CDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. If your electronic medical health record does have a CDS system do you</td>
</tr>
<tr>
<td>use it to assist physicians in making appropriate medication decisions,</td>
</tr>
<tr>
<td>by providing alerts or additional information for certain medications and/</td>
</tr>
<tr>
<td>or dosages?</td>
</tr>
<tr>
<td>☐ Yes</td>
</tr>
<tr>
<td>☐ No</td>
</tr>
</tbody>
</table>


## Use of Clinical HIT in NH

### Software

9. Which of the following best describes how medication and treatment orders are entered into a resident’s medical health record by the physicians/providers:

- [ ] Electronically enters orders 100% of the time.
- [ ] Electronically enter orders 75% of the time, verbal orders 25% of the time.
- [ ] Electronically enter orders 50% of the time, verbal orders 50% of the time.
- [ ] Electronically enter orders 25% of the time, verbal orders 75% of the time.
- [ ] Provide verbal orders 100% of the time.

**Other (please specify):**

10. Please select the electronic health record company/vendor your facility currently has installed? (Click all that apply).

- [ ] AllScripts
- [ ] American Data
- [ ] American Health Tech
- [ ] Answers on Demand (AOK)
- [ ] Cerner
- [ ] Galaxy Hosted Software
- [ ] Healthland
- [ ] Heathware
- [ ] Health Systems Connection
- [ ] MDI Achieve
- [ ] Optimus
- [ ] Point Click Care
- [ ] VISTA OPNS

**Other (please specify):**

___
### Use of Clinical HIT in NH

#### Charting

11. **How do the registered nurses or licensed practical nurses in your facility document daily resident care? (Choose all that apply).**
   - [ ] Paper charting
   - [ ] Handheld devices
   - [ ] Wall mounted units
   - [ ] Computers on wheels
   - [ ] Computers in a stationary/permanent area

12. **How do the certified nursing assistants in your facility document daily resident care? (Choose all that apply).**
   - [ ] Paper charting
   - [ ] Handheld devices
   - [ ] Wall mounted units
   - [ ] Computers on wheels
   - [ ] Computers in a stationary/permanent area
### Use of Clinical HIT in NH

#### Barriers & Benefits

13. On a scale of 1-5 please rate how significant each barrier listed below is/was to the adoption of an electronic health record at your nursing home. A 1 indicates an extremely significant barrier and 5 indicates not a barrier.

<table>
<thead>
<tr>
<th></th>
<th>Extremely Significant Barrier (1)</th>
<th>Highly Significant Barrier (2)</th>
<th>Significant Barrier (3)</th>
<th>Minor Barrier (4)</th>
<th>Not a Barrier (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of hardware (i.e.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>computers, handheld</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>devices, data lines)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of software (i.e.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>electronic health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>record, point of care</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of training staff</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Cost of hiring new</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>staff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown return or</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>investment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff resistance</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Lack of knowledgeable</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>information technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moving above to</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>transition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Historical data</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Concerns about</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>confidentiality/privacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerns about</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>electronic signatures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finding a system that</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>meets your needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerns the system</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>will become obsolete</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatibility with</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>current systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerns with wireless</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (please specify)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


### Use of Clinical HIT in NH

14. On a scale of 1-5 please rate how significant each benefit listed below is/was to the adoption of an electronic health record at your nursing home. A 1 indicates an extremely significant benefit and 5 indicates not a benefit.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Extremely Significant Benefit (1)</th>
<th>Highly Significant Benefit (2)</th>
<th>Significant Benefit (3)</th>
<th>Minor Benefit (4)</th>
<th>Not a Benefit (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to clinical data</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Oversight/control for management</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Monitoring quality</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Improved efficiency</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Staff empowerment</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Staff satisfaction</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Attractive job feature when recruiting new staff</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Integration between systems</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Improved regulatory compliance</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Ability to electronically exchange data with other providers or organizations (e.g., hospital, ID offices, labs, pharmacy)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Cost savings</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Resident safety (e.g., reduced medication errors)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Improved care planning</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Improved communication within facility (e.g., among staff between shifts)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Use of Clinical HIT in NH

14. On a scale of 1-5 please rate how significant each benefit listed below is/was to the adoption of an electronic health record at your nursing home. A 1 indicates an extremely significant benefit and 5 indicates not a benefit.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Extremely Significant Benefit (1)</th>
<th>Highly Significant Benefit (2)</th>
<th>Significant Benefit (3)</th>
<th>Minor Benefit (4)</th>
<th>Not a Benefit (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to clinical data</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Oversight/consult for management</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Monitoring quality</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Improved efficiency</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Staff empowerment</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Staff satisfaction</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Attractive job feature when recruiting new staff</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Integration between systems</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Improved regulatory compliance</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Ability to electronically exchange data with other providers or organizations (e.g., hospital, ND offices, labs, pharmacy)</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Cost savings</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Resident safety (e.g., reduced medication errors)</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Improved care planning</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Improved communication within facility (e.g., among staff between shifts)</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Use of Clinical HIT in NH

15. If you would like to be included in the raffle for one of 4 $50 Gift Cards please enter your email address or phone number so I may contact you if you are a winner.

*16. What is the name of your facility?

*17. In what city and state is your facility?
APPENDIX II
TO: Kathy Richards, College of Health and Human Services
FROM: Aurali Dude
        Assistant Vice President, Research Compliance
DATE: May 3, 2013
TITLE: Use of Clinical HIT in Nursing Homes: Facility Characteristics and Quality Measures

PROTOCOL NO: 8725
PROPOSAL NO.: N/A
Cc: Carla Spinelli-Moraski

The Office of Research Integrity & Assurance has reviewed your human subjects research application and found that there is no need for the Institutional Review Board (IRB) to review the work, as the work does not meet the federal definition of human subjects research requiring IRB review. As such, no further action is required of you at this time to comply with the GMU human subjects policy. However, if you modify your project to include human subjects research activities, you are required to request and receive approval from the IRB prior to conducting the research activities.

You may contact me at 703-993-5381 if you have any questions or need clarification. Thank you for your patience while the Office of Integrity & Assurance reviewed your paperwork to make this determination.
REFERENCES


Horn, S. D., Buerhaus, P., Bergstrom, N., & Smout, R. J. (2005). RN staffing time and outcomes of long-stay nursing home residents: pressure ulcers and other adverse outcomes are less likely as RNs spend more time on direct patient care. *AJN The American Journal of Nursing, 105*(11), 58.


Carla Spinelli-Moraski graduated from Hofstra University in 1994 with a Bachelor of the Arts in Political Science. After nine years in a successful sales career she returned to school and in 2004 completed the Second Degree Nursing Program, and received her Bachelor of Science in Nursing from George Mason University. She began her nursing career at INOVA Fairfax Hospital where she worked on the Pediatric Medical Surgical Unit. She became interested in gerontology and was hired as the Assistant Director of Nursing at Goodwin House Bailey’s Crossroad. In 2008 she received her Masters of Science in Nursing from George Mason University, and became board certified as a gerontology nurse. She is currently employed at Kaiser Permanente as the Quality and Sustainability Consultant.