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Quality of Care: Impact of Nursing Home Characteristics

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Quality of Care : Impact of Nursing Home Characterisics

by

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DISSERTATION

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Dedication

This dissertation is dedicated to my parents, Sang Soon Lee and Soon Hee Kim, and to my academic parents, Charlene Harrington and Mary A. Blegen, for their unfailing love, care, support, and guidance.

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Abstract

Serious quality of care problems in nursing homes has been a persistent problem in the United States for over 40 years. Staffing shortages and inadequate staff expertise were major contributors to many chronic and recurring quality problems.

The purpose of this study was to examine multidimensional associations among organizational characteristics, nurse staffing levels, and comprehensive aspects of quality of care considering resources (payer mix), resident (case mix), and market characteristics. The quality of care was assessed by nurse staffing levels, processes and outcomes of care, and facility deficiencies.

From various theories: Donabedian's structure-process-outcome model, organizational theory, and economic theory, a conceptual framework and key factors of nursing home and market characteristics were formulated with the support of previous literature.

This study used secondary data from Online Survey Certification and Reporting (OSCAR) data, Minimum Data Set (MDS) 2.0, quarterly staffing data from state inspections, and Area Resource File (ARF). The population of 195 nursing homes out of 199 Colorado freestanding homes in 2000 was used for data analyses. Depending on outcomes, various types of multivariate regression models were used.

The major findings of this study were: (1) quality of care in Colorado nursing homes was highly dependent on resources from the external environment, (2) Medicaid reimbursement rates and proportion of Medicare residents were important resources for nurse staffing, and (3) deficiencies in nursing home care were significantly higher in for-profit and chain-affiliated nursing homes. A useful conceptual framework was confirmed with strong support of theoretical background, literature review, and empirical findings.

Considering different staffing decisions, regulatory systems need to be designed carefully and systematically to improve quality of care. Given the findings, this study suggests that higher nurse staffing levels can improve quality of care in nursing homes.

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CHAPTER 1

The Study Problem

Introduction

Nursing homes are the major health care organizations providing long-term care; they have a long history of caring for older adults and patients with disabilities in the United States. However, their services were not designed with the quality and safety of resident care as the highest priority. Accordingly, some aspects of nursing home services are derived from the business pursuit of profitability. Although market-driven strategies may attract potential nursing home residents, operating structures within nursing homes may find it difficult to compromise profits in order to provide high quality care for patients.

Many disciplines have studied this sector of health care. Sociologists regard nursing homes as organizational fields or institutions; economists think of nursing home services as an economic good in a market; and businessmen see nursing homes as one kind of industry. On the other hand, health services researchers designate nursing homes as a target for health care reform.

Beyond these lenses, nursing homes accommodate older adults and persons with disabilities. Their residents need enough good care during the most vulnerable state of health and life. This is important thing to keep in mind for decision-making on important matters. Medicare paid $12.9 billion and Medicaid paid $50.9 billion for nursing homes in 2002; public funds financed 63.5 percent of total nursing home expenditures (Levit et al., 2004). Therefore, quality of care problems in U.S. nursing homes deserves to be addressed by restructuring the system.

Background and Significance

Poor quality of care in nursing homes has been a persistent problem in the United States for over 40 years (Harrington, Mullan, & Carrillo, 2004; Institute of Medicine [IOM], 1986, 1996, 2001). More than 1.3 million people live in nursing homes, almost one third of which have quality and safety problems in care (Harrington, Carrillo, & LaCava, 2006). In 2000, 23.5 percent of facilities received at least one deficiency rating serious enough to cause harm or immediate jeopardy to residents (Harrington, Carrillo, & Blank, 2007).

Staffing shortages and inadequate staff expertise are major contributors to many chronic and recurring quality problems in U.S. nursing homes (Centers for Medicare and Medicaid Services [CMS], 2001; Harrington, 2004; Harrington 2005a, 2005b). Poor staffing levels and serious quality of care issues in nursing homes have long been a policy concern in the United States; only recently have comprehensive administrative systems been adopted to calibrate nursing home quality and to systemically compare facilities at the national level (Arling, Kane, Lewis, & Mueller, 2005). Despite government oversight within this sector, there are significant variations in quality of nursing home care not only across states, but also within states (Castle, Degenholtz, & Engberg, 2005; Harrington, Carrillo, Mullan, & Swan, 1998; Grabowski & Castle, 2004; U.S. General Accounting Office [US GAO], 1999).

Every year, approximately three million elderly and disabled Americans receive care in the 17,000 Medicare- and Medicaid-certified nursing homes in the United States (Nursing Home Quality Initiative, 2002). National health expenditures for nursing home care were $103.2 billion in 2002, as compared to $36.2 billion for

home health care (Levit et al., 2004). Although a recent trend in states is to shift more people from nursing homes and other institutions to home- and community-based settings, overall spending for freestanding nursing homes and the public share of payments continued to grow; in addition, there has been a deceleration in capacity, costs, and services used in the provision of nursing home care (Levit et al., 2004). Therefore, knowing the caliber of care and monitoring ongoing nursing home quality to assure appropriate quality and safety of the residents is crucial. To achieve desired levels of nursing home quality, this study will present evidence that assists in understanding the impact of nursing home characteristics on quality of care.

Purpose of the Study

The purpose of this study is to better understand the relationship between nursing home characteristics and quality of care. This study examines the multidimensional associations between organizational characteristics, nurse staffing levels, resident outcomes, and facility deficiencies. This study will use nursing homes in the state of Colorado in 2000 as a case study in determining the impact of nursing home characteristics. The quality of care is measured by (1) nurse staffing levels, (2) resident outcomes, and (3) deficiencies at the facility level. The findings in this study will provide further knowledge of the effectiveness of organizational structures and their environments with regard to quality of care.

The long-term objective of this research is to provide direction for sustainable improvements in nurse staffing levels by identifying the relationships among organizational characteristics, staffing levels, and nursing home outcomes that result in

better quality of resident care within different institutions and their contexts. Thus, this study will provide more concrete and comprehensive insight on the effectiveness of nursing home organization in general, as well as on internal and external regulatory systems for the quality of care within a state.

Specific Aims

The three specific aims of the study are:

1. To determine the effect of organizational characteristics (facility size, chain affiliation, and ownership) on nurse staffing levels controlling for resource (Medicaid reimbursement rates, proportions of Medicaid and Medicare residents), resident (ADL dependency and proportions of cognitively impaired residents), and market (competition, supply, demand) factors.
2. To determine the effect of organizational characteristics and nurse staffing levels on care processes (use of physical restraints, antipsychotic drugs, and indwelling catheters; bedfast patients, and incontinence) and outcomes of care (pressure ulcers, falls, urinary tract infections, and weight loss) controlling for resource, resident, and market factors.
3. To determine the effect of organizational characteristics and nurse staffing levels on facility deficiencies (total, substandard-care, quality-of-care, and quality-of-life) controlling for resource, resident, and market factors.

Hypotheses

This study will test the following major hypotheses while controlling for resource, resident, and market factors.

H_1: For-profit nursing homes (NHs) have lower nurse staffing levels, worse care processes, poorer resident outcomes, and more deficiencies than not-for-profit NHs.

H_2: Chain-affiliated NHs have lower nurse staffing levels, worse care processes, poorer resident outcomes, and more deficiencies than non-chain NHs.

H_3: Larger NHs have lower nurse staffing levels, worse care processes, poorer resident outcomes, and more deficiencies than smaller NHs.

H_4: NHs with higher RN staffing hours per resident day have better care processes, better resident outcomes, and fewer deficiencies than other NHs.

H_5: NHs with higher total staffing hours per resident day have better care processes, better resident outcomes, and fewer deficiencies than other NHs.

H_6: NHs with a higher RN skill mix have better care processes, better resident outcomes, and fewer deficiencies than other NHs.

Under Specific Aim 1, two additional research questions will be investigated: what factors are associated with noncompliance with the state minimum staffing standard of 2.48 total staffing hours per resident day, and what factors are associated with compliance with the CMS recommended nurse staffing standard of 4.1 total staffing hours per resident day?

Overview of the Study

This study is a secondary analysis using quantitative data and a cross-sectional study design to achieve three research aims. This non-experimental, descriptive correlational research design examines the relationships between organizational characteristics and quality of care highlighting the effect of nurse staffing levels within the relationships.

Data for the study was obtained from the Online Survey Certification and Reporting (OSCAR) data, Minimum Data Set 2.0 (MDS), and quarterly staffing data from the state inspections. The basic dataset includes staffing, resident and facility characteristics, and process and outcome indicators for 199 long-term care facilities in Colorado for the year 2000. This was supplemented with data from the Bureau of Health Professions Area Resources File (ARF) and case-mix adjusted Medicaid reimbursement rates for the state of Colorado.

Organizational characteristics, which are key measures of interest in this study, include facility size, chain affiliation, and for-profit status. Resource factors include payer mix, which is measured by Medicaid reimbursement rates, and the proportions of residents receiving Medicaid and Medicare. Resident characteristics include the average dependency score indicating resident care needs in the activities of daily living (ADL) such as assistance with eating, toileting, and transferring to and from the bed, chair, or a standing position, as well as percent of cognitively impaired patients from MDS quality indicators. Endogeneity between ADL dependency and staffing and between Medicaid reimbursement rates and staffing was taken into account in this study by using an instrumental-variable approach in a two-stage least squares

regression. Staffing, another key measure of interest, was treated as both an independent and dependent variable according to research aims.

Staffing variables consist of eight potential indicators: (1) registered nurse (RN) hours per resident day (hprd), (2) licensed practical nurse (LPN) hprd, (3) nurse assistant (NA) hprd, (6) nursing administrative hprd, (7) total staffing hprd (including all type of nursing staff and nursing administrative hprd). (8) RN skill mix (proportions of nursing hours provided by RN). These staffing indicators were selected and combined based on the purpose of the analytic models.

As another set of dependent variables, process-of-care variables, included: percentages of residents with physical restraints, antipsychotic drugs, indwelling catheters, residents who were bedfast, and incontinence. Outcome-of-care variables included: percentage of residents with pressure ulcers, falls, urinary tract infections, and weight loss.

Based on the characteristics of the dependent variables, different analytical approaches will be applied. For Specific Aims 1 and 2, two-stage least squares regression and ordinary least squares regression will be used to control for endogeneity problems. If dependent variables are not normally distributed, logged value will be used. For aim 3, negative binomial regression models will be used.

Significance of the Study

Improving nurse staffing levels has been addressed as a feasible way of improving quality of care for nursing home residents. Empirical results from previous studies consistently support the main hypothesis that quality of care can be predicted by facility-level nursing home characteristics, including facility size, ownership, chain affiliation, nurse staffing levels, and payer mix, as well as by market characteristics. However, few studies have considered these characteristics under the multidimensional aspects of quality of care with a well-controlled design for resident case mix. A comprehensive research project that examines the impact of these important factors would foster effective translation of nursing staffing levels to nursing home quality for future research and policy-making.

Further research is needed to explain the association between nurse staffing levels and quality of care under different contextual factors. Specifying the type of nursing staff who work in nursing homes is one approach to formulating policy for improving nursing worker capacity. A better understanding of the association of specific hour ratios of RNs, LPNs, NAs, and directors of nursing (DONs) with such outcomes would provide policymakers with empirical evidence upon which to make recommendations for nurse staffing levels. Although the role of DONs appears to be essential for directing care or managing workload in nursing home settings, working hours for this group were seldom investigated.

This research will extend current knowledge by using advanced quantitative study designs to examine the impact of nursing home characteristics on quality of care. It will provide informative insight on comprehensive aspects of quality of care that can

be used to enhance internal and external nursing home regulations. This will help facilitate a better understanding of the organizational and environmental factors that impact variations in quality of nursing home care. The information will strengthen the foundation of evidence for changing existing policies and regulations, as well as for restructuring the current system. This state-level research will help initiate state-level reform and change existing policy for enforcing nursing home regulations.

This comprehensive study is essential for a better understanding of the relationships between organizational characteristics and specific types of nurse staffing levels. It will provide a linkage to internal and external aspects of quality-of-care measures such as: processes, outcomes, and deficiencies of resident care. A greater understanding of the role of their contextual factors will provide additional insight regarding the supply and demand of nursing home care. It will inform future research about different needs for appropriate minimum standards for nurse staffing levels under different organizational structures and their context.

CHAPTER 2

Theoretical Background, Literature Review and Conceptual Framework

Introduction

Quality of care in nursing homes has been a matter of great concern to consumers, professionals, and policymakers in the United States since the 1960s (Harrington et al., 2004; Institute of Medicine [IOM], 1986, 2001, 2003; Mullan & Harrington, 2001). Nursing home quality has been so problematic that the U.S. government has become increasingly involved in regulating facilities. Although both state and federal governments have strengthened external regulations to assure nursing home quality, a market-driven environment places strong pressure on market competition pursuing profitability rather than high-quality care (O'Neill et al., 2003). This paradigm shift elucidates the point that U.S. nursing homes need long-term interventions that ensure sustainable improvements in quality of care.

This section introduces underlying theories related to this study, provides a comprehensive overview of the state of the science, and concludes with a conceptual framework. The conceptual framework incorporates different aspects of theoretical perspectives from: Donabedian's (1966) theoretical approach, resource dependency theory, institutional theory, and economic theory.

Theoretical Background

Several theoretical approaches have been used to examine quality of care in nursing homes in the United States. Most studies of quality rely on Donabedian's classic theoretical model, which highlights the relationships between structural

characteristics, processes of care, and outcomes of care (Harrington, 2005c). Organizational theories have grown in complexity and contribute to advancing empirical research on understanding how to improve quality of care in nursing homes (Harrington, 2005c). Economic theory, however, has been the predominant theory applied in health services research (Harrington, 2005c). Thus, this paper focuses on three major lenses that have frequently been used in nursing home studies.

The following section presents an overview of three theoretical models: Donabedian's theoretical framework, organizational theory, and economic theory. The section discusses these theoretical concepts and how they are related to quality of care in nursing homes based on a review of the literature. These theoretical frameworks propose a feasible structure for explaining relationships among the concepts and include symbolic depiction of aspects of reality for describing, explaining, predicting, or prescribing these relationships (Meleis, 2007).

Donabedian's Theoretical Framework

Donabedian (1966) offered a theoretical framework to assess and evaluate quality of care. The model provides minute information to assess quality about the causal linkages among the structural attributes of the settings in which care occurs, the processes of care, and the outcomes of care (Donabedian, 1988). Donabedian suggested inferences regarding the quality of care that could be drawn from the information using three grand categories: "structure," "process," and "outcome" (Donabedian, 1966, 1988, 1990).

Structure

Structure refers to the attributes of the settings in which care occurs (Donabedian, 1988). According to Donabedian's (1988) approach, structure indicates the organizational structure that influences the occurrence of quality problems. In particular, Donabedian (1988) included three types of attributes: (1) material resources (e.g., facilities, equipment, and money), (2) human resources (e.g., number and qualifications of personnel), and (3) organizational structure (e.g., medical staff organization, methods of peer review, and methods of reimbursement). This study examines facility characteristics and staffing levels as structural aspects of care to measure quality of nursing home care.

Process

Process refers to the actions taken in giving and receiving care (Donabedian, 1988). It includes patient activities in seeking care and carrying it out, as well as practitioner activities in making a diagnosis and recommending or implementing treatment (Donabedian, 1988). In this study, process of care is measured by the use of physical restraints, antipsychotic drug, and indwelling catheters, and the proportion of residents who were bedfast or incontinent.

Outcomes

Outcomes demonstrate the effects of care on the health status of patients and populations (Donabedian, 1988). Donabedian (1988) broadly defined health status as the degree of the patient's satisfaction with care including improvements in the patient's knowledge and tangible changes in the patient's behavior. Outcomes are, theoretically, a neutral concept that may include both positive and negative aspects of

care. Often, outcomes have been measured by adverse events rather than by improvements in resident populations. In this study, outcome of care is measured by the proportion of residents who had pressure ulcers, falls, urinary tract infections, weight loss.

Evaluation of Three Components

According to Donabedian (1988), a good structure creates favorable conditions for good processes of care, which in turn generates better outcomes. Thus, it is important to have established such causality prior to the assessment of quality with any particular component of structure, process, or outcome. By studying these three components, we can glean information from which to infer that conditions have an either salutary or adverse effect on patient outcomes (Donabedian, 1988).

Knowledge about the linkage between structure and processes, as well as between structure and outcomes, emerged from the organizational sciences (Donabedian, 1988). Donabedian (1988) noted that there is a weak relationship between structural attributes and the processes of care.

Donabedian's (1966) approach has been implemented to examine nursing home quality of care in many studies that conceptualized three dimensions of care: structure, process, and outcomes, as well as their relationships (Anderson, Hsieh, & Su, 1998; Bliesmer, Smayling, Kane, & Shannon, 1998; Dellefield, 2006; Rantz et al., 1998; Schirm, Albanese, & Garland, 1999; Unruh & Wan, 2004; Weech-Maldonado, Meret-Hanke, Neff, & Mor, 2004). However, this approach has an inherent limitation—this theory has been developed for the evaluation of the medical care process at the level of clinician-patient interactions rather than for the effective delivery of medical care at the

systems level. Thus, the theory excludes consideration of the administrative aspects of quality control and of economic efficiency problems as measurable dimensions of quality (Donabedian, 1966).

Most articles combined Donabedian's (1966) framework with organizational perspectives to investigate nursing homes as organizations and to specify the characteristics of individual nursing homes and their contextual/environmental factors (Bliesmer et al., 1998; Dellefield, 2006; Weech-Maldonado et al., 2004). As a further step, Unruh and Wan (2004) elaborated a systems framework to evaluate nursing home quality based on Donabedian's structure-process-outcome (SPO) approach combined with an organizational perspective. This advanced framework categorized contextual factors surrounding a nursing home under an open systems model, such as market environment and political environment, building upon classical variables like nurse staffing, quality of care, and residents' characteristics.

Key Variables

Operationalization of theoretical concepts is the key to measuring important factors that affect quality of care. Unruh and Wan (2004) determined four key concepts involved in the relationship between nursing home characteristics and quality of care: structure, process, outcome, and environments. Structure is generally operationalized by organizational characteristics—e.g., facility size, ownership, chain affiliation, payer mix, certification status, case mix or average activities of daily living (ADLs) of residents, and costs. Nurse staffing levels are generally used as structural variables defined as the number of staff providing care.

Organizational Theory

This section describes the dynamics in the U.S. nursing home field based on organizational theory.

Open Systems Theory

Open systems theory insists on the importance of the wider context or environment as it encompasses, shapes, penetrates, and renews the organization (Scott, 2001). Open systems theory explains that when changes in organizational form and the organizational field are understood over time, more attention should be given to changes in the environment, both the material-resource environment and the institutional environment (Scott, 1998, 2003).

The material-resource environment is that aspect of the environment most directly relevant to interpreting the organization as a production system that depends on and transforms scarce resources (Scott, 2003; Scott, Ruef, Mendel, & Caronna, 2000). This includes factors affecting supply and demand (for example, number of nursing homes in a given state and number of institutionalized patients in one nursing home); technologies, including both specialized medical equipment and information processing; and the structure of the industry as it affects the flow of resources among competitors and exchange partners, such as chains.

The institutional environment influences the structure and behavior of organizations. Changes in the number and type of institutional actors may transform the nature of an organizational field. Scott (2001) defined institutions as regulative, normative, and cultural-cognitive frameworks that, in combination, provide stability and meaning to social life. Individual organizations (nursing homes) can develop their

own distinctive norms and beliefs, co-called corporate cultures, which, in turn, provide organizational values, mission, and philosophy that affect their behaviors (Schein, 1992; Scott, 2003; Selznick, 1949). In examining changes in institutional environments, Scott et al. (2000) found that it is useful to distinguish three components: institutional actors, institutional logics, and governance systems.

Institutional actors include both individuals and collective actors, such as organizations or associations, as they function to both create and embody institutional logics, as defined below. A nursing home is an institutional actor, which is defined as an archetype (Kitchener & Harrington, 2004).

Institutional logics are sets of material practices and symbolic constructions which constitute a field's organizing principles and are available to organizations and individuals to elaborate upon (Friedland & Alford, 1991; Scott et al., 2000). Logics in a nursing home organization are related to profitability and the efficiency of patient care services. These logics (metrics) guide and give meaning to the nursing home's activities. Thus, changes in the prevailing logics, including rules and belief systems, represent significant changes in an organizational field (Scott et al., 2000). Ownership (for-profit or non-profit) can function as an institutional logic in the nursing home field (Kitchener & Harrington, 2004).

Governance systems are the actions that arrange one group of actors with another to support the regulatory system—whether by regimes created by mutual agreement, by legitimate hierarchical authority, or by non-legitimate coercive means (Scott et al., 2000). State and federal government have regulated nursing homes with regard to minimum staffing standards, bed supply, and adverse care outcomes. A

closer attention to the changing nature of power and authority structures between federal and state government and individual nursing homes would present the underlying processes of organizational fields regarding budget decisions and quality regulations.

Institutional actors function both as creators and carriers of institutional logics. As major financiers and regulators, federal and state governments can create new logics in the nursing home field. Strengthening governmental oversight with regulation is one way to reduce the negative effects of the isomorphism process in nursing homes. An example would be the inertia of poor quality of care due to understaffing for purposes of cost-saving. Changes in the nature of government regulation can have a powerful influence on how organizations compete for social legitimacy and financial advantage (Scott et al., 2000). According to Scott's (2000) view, significant changes over time in institutional actors, logics, and governance structures and their interrelations should be examined to understand organizational changes in the U.S nursing home fields.

Resource Dependency Theory

Resource dependency theory understands environments as political and economic systems, but it places emphasis on the benefits of adaptation to the environment (Scott, 2004). Based on its premise of rational adaptation to exogenous changes in the environment, organizational transformation is considered an intentional strategy arranged to increase the possibility of survival when economic or technological circumstances are changing (Ginsberg & Buchhoitz, 1990; Zinn, Weech, & Brannon, 1998).

Nursing homes, like other health care organizations, depend on resources derived from their environment and make themselves more suitable for the environment in order to survive (Banaszak-Holl, Zinn, & Mor, 1996; Harrington & Swan, 2003; Harrington, Swan, & Carrillo, 2007; Scott, 1998; Zinn et al., 1998; Zinn, Mor, Castle, Intrator, & Brannon, 1999). Nursing homes are strongly affected by financial resources from Medicaid and Medicare (Harrington, Swan, et al., 2007; Levit et al. 2004). Thus, organizational characteristics are mediating factors for organizational decisions and have an impact on the behavioral patterns of nursing homes for dealing with uncertainties (Banaszak-Holl et al., 1996; Zinn et al., 1999).

Organizational actions, such as increasing the number of RNs on staff, have been taken to ensure a stable flow of resources as a reasonable and adaptive response to changing conditions in the environment (Pfeffer & Salancik, 1978; Zinn et al., 1999). Changes in organizational structure or behavior precede adaptation to the demands of resource providers in order to maintain a steady stream of resources (Oliver, 1990; Zinn et al., 1998). Therefore, inappropriate nurse staffing and poor quality of care in U.S. nursing homes are attributed to ineffective adaptation to demands for better care with sufficient nursing staff. This theory provides a positive future direction for nursing home regulations in that more resources will make regulatory works effective to increase nursing staff.

Resource dependency theory assumes that the potential for obtaining vital resources (e.g., funding) is due to the power of an organization (Oliver, 1990; Pfeffer & Salancik, 1978). Nursing homes will, therefore, pursue close links with a sponsor to ensure stable access to critical resources and to increase their relative power.

Formation of a tie with a sponsor, like a not-for-profit or chain-affiliated nursing home, will cause material imbalance if it is more likely to diversify the facility's funding from the outside (Oliver, 1990).

According to Oliver (1990), nursing homes with diversified links to sources of funding and community support increase their power, influence, and the autonomy of their decision-making. More autonomous facilities are more likely to create a favorable environment for attracting trained nursing staff, as well as more residents. Several ties stemming from ownership, chain affiliation, payer mix, and more competitive environments may affect the autonomy of nursing homes in changing quality of care over time.

Pfeffer and Salancik (1978) noted that trade associations reduce competitive uncertainty by providing standard definitions and guidelines for product and product-quality to other organizations or by disclosing search results for available resources. This may apply to nursing homes, so that inter-organizational connections increase nursing homes' survival by creating favorable work environments with more reliable nursing staff for patient care, which helps them assure best practices.

According to Oliver (1990), intermediate size of chain or facility facilitates the formation of associations for the purpose of achieving stability within a nursing home. However, informal communication among organizations is enough to achieve inter-organizational coordination only if the number of nursing homes within the industry is small. Those nursing homes that have very large numbers of beds or associate with large or small chain nursing homes, by contrast, may render an association unstable because the diversity of interests is broader and more difficult to coordinate. Based on

these theoretical underpinnings, big or small chains and large facilities need to overcome poor coordination for quality of care.

Finally, according to Oliver (1990), trading relationships will occur in order to increase legitimacy if institutional pressures are apparent. Thus, most associations attempt to enhance nursing homes' legitimacy. Communicating with the public to improve the image of the trade is an important responsibility of such associations. However, these associations appear to strengthen legitimacy, in response to explicit institutional and public criticism. More constructive communications between nursing homes and their environments can give clear direction for each nursing home.

Both the organizational factors and environmental characteristics of a nursing home may affect willingness to improve quality of care (Zinn et al., 1999). In environments with abundant resources and alternative sources of supply, organizations are less likely to associate with other organizations and their adaptations also decrease (Zinn et al., 1999). In a more competitive environment, organizations share a bounded resource pool (Pfeffer & Salancik, 1978; Zinn et al., 1999). Their survival is more dependent on how resources are allocated among competitors than in less competitive environments. This suggests that the degree of competition in local markets may affect compliance with external constituencies (Zinn et al., 1999). In more competitive environments, organizations are more likely to enter into cooperative exchange relationships with other organizations in order to secure and stabilize resource flows (Oliver, 1990; Zinn et al., 1999).

Institutional Theory

Institutional theory values the cultural features of environments (Scott, 2004).

The perspective of institutional theory dictates that organizations consider not only their technical environment, but also their "institutional" environment: regulative, normative, and cultural-cognitive features that define social fitness (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Scott, 2004). Based on this theory, organizations such as nursing homes must establish organizational legitimacy and linked networks that constitute the institutional environment (Zinn et al., 1998).

Institutional theory provides an understanding of the persistence of poor quality nursing home care. In addition, it proposes solutions for adopting new norms and the institutional logics for the existing nursing home fields. Based on the theory, the U.S. nursing home field can be understood not only as a set of formal organizations, but also as a mechanism of coordination and regulation supported by complex networks of technical relationships and boundary-spanning exchanges (Kitchener & Harrington, 2004). The federal government has defined standards or requirements for nursing homes and retains the authority to enforce compliance within these institutions. The phenomenon of continuing poor quality and intensifying regulation for quality of care may be attributed to structural resistance to the expected outcome for quality care.

Legitimacy. According to institutional theory, organizations are driven to embrace the practices and procedures defined by prevailing concepts of functionality and institutional requirements of institutions (Meyer & Rowan, 1977). Individual nursing homes that are affiliated with large or small chains increase their legitimacy through branding and bolstering their own longevity with profit-seeking behaviors. Researchers, legislators, and policymakers have continuously attempted to institute laws and policies to ensure the legal rights of nursing home residents and the

accountability of public funds used for nursing home care (IOM, 1986, 2001, 2003). Nevertheless, persistent quality problems have exceeded nationwide governance systems, so that the field's profit-driven (or market-driven) environment generates insufficient staffing for direct nursing care, resulting in inadequate resident care and failure to meet the most fundamental needs of nursing home residents.

Institutionalization. Zucker (1987) noted that the concept of institutionalization provides some insight into organizational innovation. Institutionalized organizations will rapidly adopt innovations that positively influence a facility's reputation and/or legitimacy. In order to better understand the nursing home arena, it is helpful to understand the three pillars of institutionalization: cognitive (mimetic), normative, and coercive (regulative), as classified by institutional theorists (DiMaggio & Powell, 1983; Scott, 1987, 1995). The mimetic process of institutionalization involves adopting successful elements of other institutions when uncertainty is high (DiMaggio & Powell, 1983; Scott, 1987, 1995). The normative process transmits or accepts the norms of existing organizations as external sources (DiMaggio & Powell, 1983; Scott, 1987, 1995). The mimetic and normative pillars serve to standardize and institutionalize the practices and procedures of nursing home care and rationalize the legitimacy of their operations (DiMaggio & Powell, 1983; Scott, 1987, 1995). The coercive pillar of institutionalization centralizes the legitimacy of all nursing homes when the society values certain best practices or best care within institutions. The public facilitates institutionalization through governmental oversight by issuing deficiencies when the organization (nursing homes) fails to meet institutional requirements (DiMaggio & Powell, 1983; Scott, 1987, 1995). Understanding these

pillars of institutionalization may enable desired systemic changes to improve the quality of care within every cluster of homogeneous nursing home organizations (DiMaggio & Powell, 1983; Scott, 1987, 1995).

Financial regulation is the most sensitive and effective way to enhance nursing home quality based on the regulative pillar of institutionalization. Since the U.S. government is the primary funding for nursing home care in the country, nursing homes must adhere to government regulations in order to receive federally funded residents. Hence, the U.S. government is sufficiently powerful to impose structural reforms and standardized practices in all nursing homes. Furthermore, government-certified nursing homes are a form of the "coercive institutional pillar" model (Scott, 1995).

The majority of nursing homes are chain-affiliated and proprietary (Harrington et al., 2001). Their norms and values are more desirous of profit and cost-minimization than they are of compliance with legislation and with federal and state policies whose new standards may threaten profit margins. Changes in structural forms encouraged by the market may occur more rapidly than those imposed by force (Scott, 1987). Thus, the market enforces institutionalization of nursing homes more than governmental regulation.

Isomorphism. Adoption of externally imposed regulations prompts nursing homes to adapt isomorphism in order to increase the probability of organizational survival in the institutional environment (Zucker, 1987). Coercive isomorphism stemming from political influence and the problem of legitimacy (DiMaggio & Powell, 1983) results from both formal and informal pressures on organizations created by

their dependence on other organizations and societal norms. The existence of a common legal environment influences many aspects of an organization's behavior, therefore, legislation and governmental mandates have the ability to oversee and exact meaningful changes in nursing care organizations (DiMaggio & Powell, 1983).

Nursing homes facing environmental uncertainties may seek to use the economic and administrative power of large organizations to solve their problems and to satisfy their patients. This leads to conglomerated nursing home organizations (e.g. nursing home chains), which increase in size and scope. Similarly, these corporations adopt accounting practices, performance evaluations, and budgetary plans that are compatible with the policies of the parent corporation (DiMaggio & Powell, 1983). Not only can coercive isomorphism work to improve the relationship between the federal government and nursing home chains, but it could also work to achieve institutional isomorphic change toward better practices (Kitchener & Harrington, 2004).

DiMaggio and Powell (1983) explained that mimetic isomorphism results from the standardization of responses to uncertainty, which encourages imitation when goals are ambiguous or when the environment creates symbolic uncertainty. Strong governmental fines may generate symbolic uncertainty within nursing homes, resulting in the adoption of new standards of practice, since organizations tend to model themselves after similar organizations they perceive to be more legitimate or successful (DiMaggio & Powell, 1983). Mimetic transformation influenced the characteristics of corporations with profit-seeking cultures have dominated the institutional environment of the field, resulting in poor-quality of care, insufficient

staffing, and less attention to direct resident care (Kitchener & Harrington, 2004).

The third cause of isomorphic change in the organizational field is normative isomorphism, which is associated with professionalization according to DiMaggio and Powell (1983). Inter-organizational exchange of knowledge and resources for improving nursing home care and management helps contribute to the building of efficient and constructive hierarchies among nursing homes, which may promote the correction of quality problems. Recognition of best practices and proclamation of high quality nursing homes may give facilities legitimacy that results in financial benefits. According to the process of normative isomorphism (DiMaggio & Powell, 1983), acknowledgement of best practices and high quality nursing homes may help other nursing homes transform into similar structures or to implement operating procedures that improve their quality in the hope of obtaining similar rewards.

To facilitate these institutional isomorphic processes for improving internal organizational efficiency, organizations must be rewarded for being similar to other organizations in their fields (DiMaggio & Powell, 1983). If this similarity were to encourage nursing homes to attract career-minded nursing staff, the way magnet hospitals do, then that would facilitate a good public reputation.

*Institutional environment*s. Scott and his colleagues (2000) defined the institutional environment as one that encompasses the cultural belief systems, normative frameworks, and regulatory systems that provide meaning and stability to a sector. Although these institutions provide stability in societal life, they are also subject to change.

Institutional environments obtain their stipulating power from rationalization

(Zucker, 1987). Nursing homes have framed their institutional environments to benefit from economies of scale and cost-effectiveness with managerial strategies by specializing their practices (e.g., skilled nursing homes or assisted living facilities). By doing so, this specialization may increase their value through "rationalization" in their institutional environments (Scott, 1987). These rationalized norms and values make organizations more reluctant to implement changes to increase staffing because of the potential costs.

Further Steps in Nursing Home Research

The archetypal approach provides "templates for organizing" to help stabilize structural similarity within sectors (DiMaggio & Powell, 1983; Greenwood & Hinings, 1993; Kitchener & Harrington, 2004). Identifying and tracking movement between distinctive combinations of structures and systems is the key in this approach. A fundamental change in the nursing home archetype has taken place due to the rise of large-chain nursing home corporations (Kitchener & Harrington, 2004). Studies of nursing home chain organizations deserve more attention.

Unruh and Wan (2004) identify environmental factors that are important. In their model, these factors are explained as precursors to structural components. Contextual/institutional components include population characteristics (socioeconomic and demographic), relevant market, location, reimbursement mechanism and rates, and regulatory control—all important elements encountered by nursing homes. Considering environmental uncertainties from the organizational perspectives, further research is needed to test whether organizational characteristics moderate organizational decisions on nurse staffing levels and whether important resources

mediate organizational decisions on nurse staffing levels.

Economic Theory

Economic theory explains the economic problems of pursuing and maintaining access to health care. The theory assumes that individuals must give up some of one resource in order to get some of another based on rationality. Rationality is defined as making a decision to get best outcomes given one's limited resource (Folland, Goodman, & Stano, 2007). The resources related to health care are highly affected by the economy of the health industry. The basic principles that illustrate supply and demand in the market are major constructs that explain the relationships among nursing homes. The theory of demand suggests that the quantity demanded would be less at higher prices. As long as people buy less at higher prices, then the demand curve will be downward sloping. The responsiveness of demand to price is measured by elasticity. Many variables will affect the demand for nursing home care. Demand may be affected by the price of other substitutable goods. When any other variable affects demand, its effect will be shown as a shift in the curve. For-profit nursing homes use the strategies to maximize profit, reduce costs, and increase market power. This section addresses the economic underpinnings of nursing home characteristics and quality of care.

Supply and Demand

Excess demand was one of the explanations nursing homes have proposed for poor quality of care provided to public pay patients (Folland et al., 2007). Scanlon (1980) showed that the nursing home market was segmented, with residents supported

by public funds filling the number of beds that remain after private demand has been satisfied. This occurred because Medicaid reimbursement rates, established by state governments, were too low to attract a sufficient supply of beds. This was attributed to states' policies (i.e. the certificate of need and moratoria) limiting the supply of nursing home beds. Although states recognize excess demand, states must also balance the costs of reducing excess demand with demands from other services along with their total budget constraints. Limited beds and excess demand may result in market segmentation between for-profit and non-profit homes. Previous evidence has shown that this different ownership has a significant impact on the difference in quality of care (Harrington, Zimmerman, et al., 2000; Harrington et al., 2001; Spector, Selden, & Cohen, 1998). However, occupancy rates in nursing homes have declined and home- and community-based services have broadened so that there may not be excess demand at the current time (Grabowski, Ohsfeldt, & Morrissey, 2003; Kitchener & Harrington, 2004).

Supply by for-profit nursing homes. For-profit facilities are assumed to operate with the twin goals of cost-minimization and profit-maximization. Considering this objective, they are likely to discriminate between private-pay and Medicaid residents. Medicaid pays significantly less than the private-pay in most states. There is evidence that a higher proportion of Medicaid recipients within a facility is associated with lower quality of care (Nyman, 1988). A study by Mor and colleagues (2004) also revealed that only 15% of U.S. nursing homes (nonhospital- based) serve predominantly Medicaid residents and these homes have fewer nurses, lower occupancy rates, and more health-related deficiencies. These facilities serving

predominantly Medicaid patients tended to be located in poor communities. This study shows a differential gradient between the median per capita income and the proportion of facilities classified as a lower tier, serving predominantly Medicaid residents. The poorest urban counties are more likely to contain lower-tier facilities than are the wealthiest urban counties and the gradient is even steeper in rural counties. More than one-quarter of the nursing homes in the poorest rural counties are categorized as lower tier. Remarkably, compared with upper-tier facilities, lower-tier facilities have significantly fewer registered nurses (RNs) per resident in both for-profit and non-profit facilities.

Efficiency of nursing home chains. In the United States, two-thirds of the nation's nursing homes are chain-affiliated (Harrington, Carillo, Thollaug, & Summers, 1999). Economic models of the nursing home market address the behavioral differences between for-profit and non-profit (or government-owned) nursing homes (Scanlon, 1980). These models suggest that for-profit nursing homes are more efficient than non-profit nursing homes. Because owners of for-profit homes intend to maximize profits, they have a reason to minimize costs and are apt to strive for efficiency. Owners of non-profit homes are assumed to maximize size and emphasize quality, which may lead to inefficiency. However, these theories do not explain differences between for-profit chains and independent homes, both of which would be described as cost minimizers (Fizel & Nunnikhoven, 1993).

Fizel and Nunnikhoven (1993) apply the theory of multiplant firms to address possible efficiency differentials between for-profit chain and for-profit independent homes. Chains may be able to increase efficiency by sharing the services of nurses and

aides among their homes. These savings might come from economizing on consultant services, reducing labor force redundancies, or minimizing administrative staff. Chains may also increase efficiency by developing technical expertise at a rate much faster than independent homes. They can specialize in a narrow product array and increase the rate of output for each business unit. Chains may be able to attain further efficiency gains by circumventing the problems of indivisible capital. However, the effects of multiplant operations are negative when larger size slows the decision-making process. If chain-affiliated homes are slower to adapt to changes in economic and regulatory conditions, they may become less efficient than independent homes. Therefore, specialization and divisible capital may outweigh inefficiencies that are consequent to slow decision-making processes (Fizel & Nunnikhoven, 1993).

Profit and non-profit. For-profit nursing homes are assumed to be motivated by profit-maximizing goals, while non-profit homes are assumed to be committed to delivering higher levels of quality services (Hansmann, 1987; Weisbrod, 1988) or to maximizing size within existing environmental constraints (Scanlon, 1980). Different goal orientations may lead to different provider behaviors in nursing homes. Previous nursing home studies have reported significant cost differences among different ownership classes even after controlling for factors known to be associated with nursing home cost functions, such as payer mix, case mix, occupancy, and quality (Arling, Nordquist, & Capitman, 1987; Cohen & Dubay, 1990; McKay, 1991; Nyman, 1988).

An *externality* is an uncompensated, direct effect of the production or consumption of a good upon persons other than the providers or consumers (Folland et

al., 2007). The free market tends to underproduce goods for which significant external benefits exist. Because demand will represent only private benefits, it will understate society's benefits and provide a false or inadequate signal to the market. The market then produces less than the amount that will maximize net social benefits. This is economically inefficient and is called a case of market failure (Folland et al., 2007).

Generally, economists recognize both beneficial and detrimental externalities, but they argue about their relative importance and the appropriate remedy (Folland et al., 2007). An important responsibility of the federal government is to stabilize the economy through macroeconomic policies (Folland et al., 2007). The existence of a significantly large externality raises the possibility of a role for government. This is only a possibility because inefficiencies entailed in governmental activity might offset potential gains. If we recognize that markets may fail, we must also recognize that governments, too, may fail to act efficiently. The mainstream approach, however, usually takes into account that in some cases governmental activity will improve net benefits to society (Folland et al., 2007).

Economies of scale. Both chain and independent for-profit nursing homes seek to minimize cost. Therefore, economies of scale are key to assessing the effect of chain ownership on costs (McKay, 1991). If higher levels of production lead to improved abilities to take advantage of specialization, providing a better division of labor, then average costs may possibly be reduced. Decreasing average costs over the longrun generates economies of scale. If, on the other hand, increased level of output leads to difficulties in managing and coordinating, then this may result in diseconomies of scale. Such issues are relevant for determining the optimal size for nursing homes

(Folland et al., 2007). A study by McKay (1988) revealed that those nursing homes providing more patient days have a lower average cost, so that there are real economies of scale in the provision of nursing home care.

Arling, Nordquist, and Capitman (1987) indicated that chain facilities appear to provide a standard, relatively low-cost level of care that is concentrated on the Medicaid market and is insensitive to case-mix variation. Since Medicaid patients provide less income than private payers, this strategy would appear to contradict the hypothesized tendency toward profit maximization. On the other hand, chains may gain an advantage from stabilization of the revenue from Medicaid. Planning and control can be strengthened through uniform policies for nursing, housekeeping, dietary, and administrative functions. Economies of scale may be more easily achieved when individual nursing homes in the system have the same patient characteristics and operating conditions.

Market Competition

During the 1990s, market competition for long-term care services changed (Mukamel, Spector, & Bajorska, 2005). Nursing homes increasingly faced competition from home care and assisted living, which can be alternatives to nursing home care for less medically needy residents (Kitchener & Harrington, 2004; Mukamel et al., 2005). Because many states abolished moratoria on nursing home construction and loosened certificate-of-need regulations (Harrington, Swan, Nyman, & Carrillo, 1997), demand for nursing homes decreased and bed supply increased (Mukamel et al., 2005). In the excess demand market, in which residents, especially those covered by Medicaid, have to wait long periods for an available bed, competition matters only for private pay and

Medicare residents (Mukamel et al., 2005). Competition for the private-pay patient involves a degree of risk that nursing homes may seek to minimize. Competitive environments inevitably necessitate an investment in special programming and facility amenities, as well as the flexibility to tailor operations to local conditions (Arling et al., 1987).

Trade-off between profit and quality. Several studies suggest that for-profit nursing homes provide poorer care than non-profit and public nursing homes (Aronson, Zinn, & Risko, 1994; Davis, 1993; Harrington et al., 2001; Spector et al., 1998). If increasing quality raises costs more quickly than revenues, profits must fall as quality improves. That is, a trade-off between profit and quality would exist. Although it is unlikely that this relationship would pertain to all nursing homes or across all levels of quality, nursing homes can vary in their ability to efficiently produce quality as a result of differences in their scales of operations. Even more so, facilities can differ in terms of their ability to charge higher prices along with raising quality of care as a result of differences in demand elasticity in the markets they serve (O'Neill, Harrington, Kitchener, & Saliba, 2003).

O'Neill et al. (2003) posit that a relationship between quality and profit levels exists but that the nature of this depends on the circumstances in which a facility operates. If prices can be raised to match the additional costs associated with enhancing quality, there will be no trade-off between profit and quality. If prices cannot be raised, an inverse relationship between the two should be expected. The ability to raise prices (or reduce costs) while improving quality can differ across proprietary and nonproprietary sectors. This, in turn, may allow profit to contribute to

differences in quality between two sectors. These assumptions suggest that staffing decisions can intervene in any causal pathway between profits and quality. However, decreased investment in staff and staff retention is one mechanism by which funneling funds away from care may lower quality. Empirically, O'Neill et al. (2003) demonstrated that for-profit homes in California had significantly lower quality of care than nonproprietary homes. Furthermore, those homes with the highest levels of profit distribution were associated with significantly more serious deficiencies and total numbers of deficiencies than non-profit nursing homes.

Conclusion

These three different perspectives provide a relevant theoretical background in which to better understand potential relationships between nursing home characteristics and quality of care. Donabedian's conceptual framework provides a systematic structure to assess and measure quality of care. This theory provides a good construct and classifies essential variables for analyzing the relationship between nursing home characteristics and quality of care.

From the organizational perspective, open systems theory demonstrates that the institutional environment and material-resource environment are interdependent, each affecting the other (Scott, 2003). Theoretical arguments derived from open systems theory demonstrate that institutional and resource dependence perspectives have begun to address one another in productive ways (Scott, 2004). According to Zinn and colleagues (1998), organizational changes resulting from rational decisions in the association between nursing home characteristics and quality of care could be

predicted and interpreted utilizing resource dependency theory and the institutional approach. Resource dependency theory, however, emphasizes rational adaptation in the face of external dependence and is more explicit about managerial choice in the context of constraints.

The pattern of regulation and its impact on quality of care must be carefully scrutinized in further research. Despite efforts by the Centers for Medicare and Medicaid (CMS) to strengthen oversight of nursing home quality, many problems persist. Nursing homes should ensure high-quality care and safety for nursing home residents. Sanctions and monetary penalties at the facility level may encourage quality improvement. In any managerial decision, internal governance systems may help institutionalize quality-improving systems to ensure organizational correction of various deficiencies in the short term, as well as to enhance direct patient care in the long run. Rather than viewing these three theories as alternative approaches, it is better to consider these theories as complementary and enhancing our understanding of nursing homes as complex organizations.

The State of the Science

Introduction

Quality of care in nursing homes has been a matter of great concern to consumers, professionals, and policymakers in the United States for over 40 years (Harrington, Mullan, & Carrillo, 2004; Institute of Medicine [IOM], 1986, 2001, 2003; Mullan & Harrington, 2001). Nursing home quality has been so problematic that the U.S. government has become increasingly involved in regulating facilities. Although external regulations to ensure nursing home quality have been strengthened by both state and federal governments, a market-driven environment places strong pressure on showing profitability. This paradigm shift elucidates the point that U.S. nursing homes need long-term interventions that ensure sustainable improvements in quality of care.

The purpose of this section is to explore the body of research literature that examines the impact of nursing home characteristics and environmental factors on variations in quality of nursing home care. These measures can be classified using Donabedian's (1966) framework (See Table 2.1). Structural factors in nursing home quality are generally identified as nurse staffing levels and organizational characteristics. Process measures are those that examine actual care procedures such as the use of physical restraints. Outcome measures include deficiencies issued for violations of regulatory requirements of resident care and proportions of adverse resident outcomes. Staffing levels have been more likely to be examined as structural measures rather than as outcomes.

Table 2.1 *The Classification of Nursing Home (NH) Quality*

Measurement of Quality in NHs	Operational Definitions
Structure-specific indicators	Nurse staffing levels
Process-specific measures	Use of physical restraints, indwelling catheters, antipsychotic drugs; numbers of bedfast patients, patients with bowel or bladder incontinence, and deficiencies
Outcome-specific measures	Weight loss, development of pressure ulcers, frequency of falls, mortality rates, and deficiencies

To understand the predictors related to quality of care, this paper reviewed the literature of three outcome measures: (1) nurse staffing levels, (2) deficiencies, and (3) quality measures from the Minimum Data Set (MDS). The literature review is then used to identify future research needs.

Nursing home characteristics impact quality of care at the facility level. This section examines the research literature delineating the predictors of quality of care. It also examines studies of outcomes including nurse staffing levels, deficiencies, and quality measures, as well as studies of nursing home characteristics such as staffing, case mix, payer mix, and market factors that affect outcomes.

Outcomes: Quality of Care

Three outcome measures are discussed here: nurse staffing levels, deficiencies, and quality measures.

Nurse Staffing Levels

Staffing can be conceptualized as a quality measure itself, and, therefore, can be used as a dependent variable to describe nursing home quality. Nurse staffing is one of the most important structural characteristics of nursing homes and is related to the process and outcomes of nursing home care. Staffing includes size, composition, competency levels, administration, and organization of the nursing staff (IOM, 2003). It is typically reported only as hours per resident day (HPRD), calculated by dividing total nursing hours worked in the facility by total resident days of care (IOM, 2003).

Both nursing home resources (e.g. proportion of Medicaid patients, proportion of Medicare patients, and facility Medicaid reimbursement rates) and nursing home characteristics (e.g. for-profit, multi-facility system member, and facility occupancy rates) were important predictors of staffing levels (Harrington et al., 1998; Harrington & Swan, 2003). The strongest predictor of staffing levels for registered nurses (RNs), licensed practical nurses (LPNs), licensed nurses (RNs and LPNs), and total nursing staff (RNs, LPNs and nurse assistants [NAs]) was resident case mix. Resident case mix reflects residents' severity of disability and their care needs at the facility level, while there was no association with NA hours per resident day (Harrington et al., 1998). Staffing hours for direct care significantly differed by three different facility levels of care according to the residents' case mix: intermediate care only, intermediate and extended care, and multi-level but extended care only (McGregor et al., 2005). Other

studies also found that resident case mix was a positive predictor of RN hours and a negative predictor of total nursing hours (Harrington & Swan, 2003; Harrington, Swan, & Carrillo, 2007).

Investor-owned homes and chains have significantly lower nurse staffing levels and more quality problems, controlling for resident case mix and many other factors (Harrington, Woolhandler, Mullan, Carrillo, & Himmelstein, 2001; Spector et al., 1998). The mean number of staff hours per resident-day was higher for all occupations in the not-for-profit than in the for-profit facilities (McGregor et al., 2005). Non-profit homes have been found to be associated with 0.14 (3.8%) more nursing staff and a 0.005 (3.9%) higher staffing skill mix (Grabowski & Hirth, 2003). States with higher percentages of for-profit facilities had lower RN staff levels (Harrington et al., 1998).

Other studies have shown that a higher percentage of Medicaid residents, large facility size, and high occupancy rates are related to lower staffing levels (Harrington et al., 1998; Harrington & Swan, 2003; Harrington, Zimmerman, et al., 2000; Harrington et al., 2001; Spector et al., 1998). However, states with a higher percentage of Medicaid residents had higher LPN staff levels (Harrington et al., 1998).

Establishing appropriate nurse staffing levels has been one approach state regulators have taken to improve the quality of care in U.S. nursing homes (Harrington, 2005a, 2005b). Notably, a higher state minimum RN staffing standard was also a positive predictor of RN and total nursing hours (Harrington, Swan, et al., 2007). Despite strong and accumulating evidence that higher nurse staffing levels in nursing homes result in safer patient care, there is wide variations in these levels across nursing homes (IOM, 2003).

While examining the relationship between nurse staffing standards of the state and actual staffing levels in their facilities, the variance in facility staffing was much greater within than between states (Mueller et al., 2006). Facilities in states with high staffing standards had somewhat higher staffing than states with no or low standards, whereas facility staffing in states with low standards was not significantly different from states with no standards. They noted that a very large proportion of variance in staffing between states can be attributed to state Medicaid payment rates and facility-level covariates. Higher nurse staffing was associated with lower occupancy percentages, higher percentages of Medicare or private pay patients, being hospital-based, having a smaller number of beds, not-for-profit ownership, and not being part of a chain.

Further study conducted by Harrington, Swan et al. (2007) found that facilities in states with higher minimum standards for RN hours had substantially higher actual RN hours per resident day (16.6 RN hours for every 100 residents). Moreover, total nurse staffing hours were also significantly higher in states that had higher minimum RN staffing standards. Their findings contribute convincing evidence that state minimum staffing standards have a stronger positive impact on actual nurse staffing levels than do Medicaid reimbursement rates.

Much attention has been given to endogeneity between resident characteristics (case mix) and nurse staffing time (Harrington & Swan, 2003; Harrington, Swan, et al., 2007). Because residents with a higher case mix need more nursing hours to meet their needs, decisions should be made to increase facilities' staffing hours when residents need additional care. At the same time, facilities with higher staffing levels may be

more likely to admit residents with a higher need (Harrington & Swan, 2003; Harrington, Swan, et al., 2007).

Deficiencies

Deficiencies can be specified as a summary count of all violations received during a facility's inspection (Omnibus Budget Reconciliation Act, 1987). State licensing and certification surveyors issue deficiencies to facilities for various types of care problems across nursing homes (Carter & Porell, 2003; Harrington, Zimmerman et al., 2000). Residents of homes with fewer deficiencies will experience better quality of care. Deficiencies are categorized by a tag that has its own number and the number refers to a critical requirement (See Table 2.2).

Table 2.2 *Classification of Deficiencies in OSCAR data*

Classification	Description	Inclusion in substandard-care
• Resident behavior & facility practice	- Restraints; abuse; staff treatment of residents	Yes
• Quality of life	- Dignity; self-determination and participation; participation in resident and family groups; participation in other activities; accommodation of needs; activities; social services; environment	Yes
• Quality of care	- Activities of daily living; vision and hearing; pressure sores; urinary incontinence; range of motion; mental and psychosocial functioning; naso-gastric tubes; accidents; nutrition; hydration; special needs; unnecessary drugs; medication errors	Yes
• Resident rights	- Informing residents of rights and available services; protection of resident funds; free choice; privacy and confidentiality; grievance procedures; access and visitation rights; personal property; self-administration of drugs; refusal of certain transfers	No

Table 2.2 *Classification of Deficiencies in OSCAR data (continued)*

Classification	Description	Inclusion in substandard-care
• Admission, transfer, & discharge rights	- Transfer and discharge; notice of bed-hold policy and readmission; equal access to quality care; admission policy	No
• Nursing services	- Sufficient staff; registered nurses; Nursing homes (NHs) – waiver of requirement to provide licensed nurses on a 24-hour basis; skilled nursing facilities (SNFs) – waiver of the requirement to provide services of a registered nurse for more than 40 hours per week	No
• Dietary	- Menus and nutritional adequacy; food; therapeutic diets; frequency of meals; assistive devices; sanitary conditions	No
• Physician	- Physician supervision and visits; available physician for emergency care; delegation and performance of physicians in SNFs	No
• Specialized rehabilitation	- Provision of specialized rehabilitation services and their qualification	No
• Dental	- Dental services in SNFs and NHs	No
• Pharmacy	- Pharmaceutical procedures; service consultations; drug regimen reviews; labeling and storage of drugs and biologicals	No
• Infection control	- Infection control program; preventing spread of infection; linens	No
• Physical environment	- Life safety from fire; emergency power; space and equipment; resident rooms; toilet facilities; resident call system; dining and resident activities; other environmental conditions	No
• Administration	- Licensure; compliance with federal, state, and local laws and professional standards; relationship to other regulations; required training and proficiency of nursing aides; staff qualifications; use of outside resources; medical directors; laboratory services; radiology and other diagnostic services; clinical records; disaster and emergency preparedness; transfer agreement; quality assessment and assurance; disclosure of ownership	No

Several studies supported the hypothesis that deficiencies are strongly associated with nursing home characteristics (Castle, 2002; Harrington, Zimmerman, et al., 2000, 2001; O'Neill, Harrington, Kitchener, & Saliba, 2003). Furthermore, the organizational and aggregate resident characteristics of these nursing homes, especially RN staffing levels, Medicaid census, and average ADL levels, affect deficiencies on

quality of care over time. From 1996 to 2000, persistent poor quality in the use of physical restraints in nursing homes was negatively associated with higher staffing levels and was positively associated with higher Medicaid census and higher average activities of daily living (ADL) levels (Castle, 2002).

Different measures of nurse staffing levels in nursing homes were associated with different types of deficiencies (Harrington, Zimmerman, et al., 2000). Fewer RN hours and NA hours were associated with more total deficiencies and quality of care deficiencies, while fewer nursing assistant staff or other care staff hours were associated with different deficiencies, such as quality of life (Harrington, Zimmerman, et al., 2000). Facilities with more residents who had urinary incontinence and pressure sores and higher percentages of Medicaid residents had more deficiencies when staffing and resident characteristics were controlled; facilities that had more depressed and demented residents, that were smaller, and that were not-for-profit or government-owned had fewer deficiencies (Harrington, Zimmerman, et al., 2000; Harrington et al. 2001).

One study examined the relationship between deficiencies and a range of predictors, including profit, ownership, chain affiliation, payer mix, and ethnic mix (O'Neill et al., 2003). Proprietary homes had higher total and life-threatening deficiencies than non-proprietary ones, controlling for resident characteristics. Chain ownership was significantly associated with higher total deficiencies but not with those deficiencies causing harm or jeopardy to the residents. Ethnic mix of residents and facility size were also significantly related to deficiencies. Among proprietary homes, the highest profit group had significantly more deficiencies than the lower profit group.

Unlike other studies that used deficiencies as a negative outcome, they could be used as an independent predictor of the aggressiveness of nursing home care (Carter & Porell, 2003). More annual deficiencies related to care was associated with substantially lower hospitalization rates (OR=0.99). The number of deficiencies may reflect the ability to detect potential problems in resident status to prevent adverse events. The study suggested that resident heterogeneity alone did not account for the wide variation in hospitalization rates across nursing homes. Facility characteristics like profit status, nurse staffing patterns, nursing home size, chain affiliation, and percentage of Medicaid and Medicare reimbursed days significantly influenced the risk of hospitalization.

Although a report issued by the Institute of Medicine (2001) on improving quality of care in nursing home encourages stronger enforcement of nursing home regulations, the issues of variations in regulatory practices across states and a national trend toward downward reporting of deficiencies are growing (Harrington & Carrillo, 1999).

Quality Measures

Nursing home quality measures (QMs) were developed to support quality assurance and improvement activities and to ensure that cost savings are based on increased efficiency and not on decreased quality of care (Karon, Sainfort, & Zimmerman, 1999). Quality Indicators (QIs) were first developed by researchers at the University of Wisconsin's Center for Health Systems Research and Analysis (CHSRA) from the Minimum Data Set (MDS). The MDS is a clinical data set that includes over 400 items measuring a variety of functional, behavioral, social, and clinical aspects of

nursing home residents (Harris & Clauser, 2002; Morris et al., 1990; Zimmerman et al., 1995). The Centers for Medicare and Medicaid Services (CMS) renewed a previous set of MDS-based quality indicators (CHSRA QIs) and newly termed quality measures (QMs) in 2002 (Berg et al., 2002). In CHSRA QIs, risk factors were adjusted by dividing resident groups into low- and high-risk categories and calculating QI rates for each category (Arling, Karon, Sainfort, Zimmerman, & Ross, 1997). The CMS QMs adjust risk with a multiple logistic regression approach in which the observed QM rate is defined as a ratio to the expected rate based on the risk characteristics of resident groups (Arling et al., 2005; Berg et al., 2002).

Quality measures are derived from facility information routinely collected by MDS assessment data focusing on self-reported measures for evaluating processes and outcomes of care (Arling et al., 2005). The receipt or non-receipt of a service, presence or absence of a condition at a single point in time (prevalence), or development of or change in a condition over time (incidence) are defined at the resident level and aggregated at the facility, state, and national levels. Proportions based on the number of residents who meet certain conditions at the facility level are based on resident outcomes with a term of quality measures in MDS (Arling, Lewis, Kane, Mueller, & Flood, 2007). Originally, as shown in Table 2.3, all 24 CHSRA QIs were calculated for the nursing home population as a whole. Newly developed CMS QMs were defined by 11 measures for long-term care residents with quarterly MDS assessments and 3 measures for short-term residents with 14-day MDS assessment (Arling et al., 2005; Castle & Engberg, 2007; Morris et al., 2002).

Table 2.3 *Definitions of 24 Quality Measures in Minimum Data Set 2.0*

Classification	Definitions	Risk-adjustment
QI 1	Incidence of new fractures; residents who have a hip fracture or other fractures that are new since the last assessment	Not risk-adjusted
QI 2	Prevalence of falls	Not risk-adjusted
QI 3 (high & low risk)	Prevalence of behavioral symptoms affecting others; behavioral symptoms are defined as verbal abuse, physical restraint use, or socially inappropriate/disruptive behavior	Risk-adjusted
QI 4	Prevalence of symptom of depression	Not risk-adjusted
QI 5	Prevalence of depression with no antidepressant therapy	Not risk-adjusted
QI 6	Use of 9 or more medications	Not risk-adjusted
QI 7	Incidence of cognitive impairment	Not risk-adjusted
QI 8 (high & low risk)	Prevalence of bladder or bowel incontinence	Risk-adjusted
QI 9	Prevalence of occasional or frequent bladder or bowel incontinence without a toileting plan	Not risk-adjusted
QI 10	Prevalence of indwelling catheters	Not risk-adjusted
QI 11	Prevalence of fecal infection	Not risk-adjusted
QI 12	Prevalence of urinary tract infections	Not risk-adjusted
QI 13	Prevalence of weight loss	Not risk-adjusted
QI 14	Prevalence of tube feeding	Not risk-adjusted
QI 15	Prevalence of dehydration	Not risk-adjusted
QI 16	Prevalence of bedfast residents	Not risk-adjusted
QI 17	Incidence of decline in late-loss ADL	Not risk-adjusted
QI 18	Incidence of decline in ROM	Not risk-adjusted
QI 19 (high & low risk)	Prevalence of antipsychotic use in the absence of psychotic or related conditions	Risk-adjusted
QI 20	Prevalence of any antianxiety/hypnotic use	Not risk-adjusted
QI 21	Prevalence of hypnotic use more than two times in the last week	Not risk-adjusted
QI 22	Prevalence of daily physical restraints	Not risk-adjusted
QI 23	Prevalence of little or no activity	Not risk-adjusted
QI 24 (high & low risk)	Prevalence of stage 1-4 pressure ulcers	Risk-adjusted

The multidimensional resident-specific QMs from MDS items have reflected quality of care more directly related to patient safety than such proxy measures as facility survey citations, which are commonly used in nursing home research (Harrington, Zimmerman, et al., 2000; Harrington et al., 2001; Munroe, 1990; Spector & Takada, 1991). There are five QMs that are frequently used by providers (Arling et al., 2005). They are falls, pressure sores, weight loss, use of restraints, and use of antipsychotic medications. These measures are frequently used because they are deleterious outcomes or processes that can cause adverse outcomes. They are easily documented and are often associated with each other and they are indications for quality improvement (Arling et al., 2005). Risk-adjusted outcome measures of ADL decline, pressure ulcers, and use of physical restraints met all validity criteria: face, content, construct, and criterion (Mukamel, 1997).

A previous study supported the fact that use of antipsychotic drugs depends on nursing home characteristics (Hughes, Lapane, & Mor, 2000). In for-profit facilities, both the presence of special care units and mental health professionals were associated with increased antipsychotic use. Other facility factors, such as increasing size, being part of chain, and higher occupancy rates, were associated with decreased antipsychotic drug use. In the not-for-profit environment, facility characteristics (e.g., increasing occupancy rates, certified nurses' aides per 100 beds) were associated with decreasing rates of antipsychotic drug use. Higher percentages of Medicare residents and residents with dementia or mental retardation were associated with increased medication use. Facility and resident characteristics are associated with the use of antipsychotic medications, although the extent to which these factors explain

variability in the use of antipsychotic drugs may vary on the basis of the underlying financial incentives of institutions.

Predictors of Quality: Nursing Home Characteristics

Facility Attributes

Aspects of an organizational structure, such as the composition of the nursing staff and their training, are expected to influence the outcomes of resident care. Likewise, specific clinical actions taken and the way they are performed are expected to affect clinical outcomes (Bliesmer et al., 1998). Organizational structures may influence delivery of care in terms of their processes and outcomes of care. Although it is difficult for a nursing home to change its characteristics, a fact that stems from its structure, the type and amount of nursing staff can be easily changed and determined by a facility's decision-making process. Hence, unchangeable attributes (e.g., ownership, chain, etc.) and manageable attributes (e.g., nurse staffing levels) must be better understood at the facility level.

Ownership Type

Much interest has surrounded the question of whether facility ownership is related to quality of care differences (Aaronson, Zinn, & Rosko, 1994; Bliesmer et al., 1998; Carter & Porell, 2003; Davis, 1993; Grabowski & Castle, 2004; Grabowski & Hirth, 2003; Harrington & Swan, 2003; Harrington, Swan, et al., 2007; Harrington, Zimmerman, et al., 2000; Hughes et al., 2000; McGregor et al., 2005; Mueller et al., 2006; O'Neill et al., 2003; Spector et al., 1998; Steffen & Nystrom, 1997; Zinn, 1994). Recent studies have demonstrated that not-for-profit homes are associated with lower

hospitalization rates (Carter & Porell, 2003), better nurse staffing (Aaronson et al., 1994; Grabowski & Hirth, 2003; McGregor et al., 2005) and desirable resident outcomes (Aaronson et al., 1994; Grabowski & Hirth, 2003). Compared with staffing levels of homes with for-profit ownership, not-for-profit status was associated with an estimated 0.23 more hours per resident-day of care provided by support staff after controlling for facility size and level of care (McGregor et al., 2005). In Pennsylvania for-profit nursing homes, restraint use rates in Medicaid-dependent residents were higher and functional severity for high-risk residents was greater than in non-profit nursing homes (Aaronson et al., 1994).

Not-for-profit status was associated with 0.84 percent fewer bedsores, 1.1 percent fewer catheters, 1.7 percent lower use of physical restraints, and 1.6 percent fewer tube feedings (Grabowski & Hirth, 2003). Not-for-profit homes were associated with 0.14 more nursing staff and 0.005 higher staffing skill mix. Grabowski and Hirth (2003) pointed out that the majority of previous empirical studies on the relationship between ownership and quality measures used a dummy variable for type of ownership rather than a measure of the relative proportion of for-profit and not-for-profit firms. They also indicated that the coefficient on an ownership variable is biased to zero, because the performance of for-profits and not-for-profits tends to converge in areas with high not-for-profit shares. Conversely, if the provision of high quality care by not-for-profit nursing homes crowds out the provision by for-profits, the coefficient is likely biased away from zero.

Many studies have reported that for-profit nursing homes provided lower quality care or substandard nursing care compared to not-for-profit or public nursing

homes (Harrington et al., 2001; O'Neill et al., 2003; Steffen, & Nystrom, 1997). Investor-owned facilities averaged 5.89 deficiencies per home, 46.5% higher than not-for-profit and 43.0% higher than public facilities, and also evidenced more of each deficiency category (Harrington et al., 2001). In the multivariate analysis conducted by Harrington et al. (2001), investor-ownership not only predicted 0.679 additional deficiencies, but had markedly lower nurse staffing levels.

Even though higher staffing was significantly related to fewer deficiencies in all homes in both the for-profit and not-for-profit sector, there was a significant difference in nurse staffing between for-profit and not-for-profit homes (O'Neill et al., 2003). The average total nursing hours per resident day in proprietary homes was 3.11, compared to 3.91 ($p<0.05$) in nonproprietary homes in the study by O'Neill and colleagues (2003). Furthermore, among proprietary homes, the highest profit group had significantly more deficiencies than those in the lower profit group. For-profit facilities had significantly lower staffing in all homes (O'Neill et al., 2003).

Residents with health problems are more likely to be located in for-profit homes. The likelihood of residing in a not-for-profit nursing home is positively associated with higher socioeconomic status (Spector et al., 1998). Residents coming from hospitals are more likely to be placed in for-profit homes, reflecting the relative disadvantage such individuals face with respect to their ability to wait in what can be long queues for placement in not-for-profit nursing homes. At the same time, those moving from one nursing home to another are more likely to be moving from for-profit to not-for-profit homes. This finding was consistent with the hypothesis that individuals disproportionately view not-for-profit status as a signal of quality. These

behavioral tendencies suggest the need for further study of the time-varying effects of ownership on nursing home quality.

Chain Affiliation

Chain-owned nursing homes have become the dominant type of provider in the United States, but little is known about their management structures (Harrington et al., 2001; Kamimura et al., 2007). Facilities with poorer health performance among their residents are substantially more likely to be acquired by a chain, while deficiency citations and the prevalence of pressure ulcers increases in homes belonging to chains (Banaszak-Holl, Berta, Bowman, & Mitchell, 2002). However, there is interesting evidence that multi-facility systems (chains) were positively associated with RN staffing (Harrington & Swan, 2003).

Chain structure can manipulate a facility's decision to minimize costs and maximize profits with stringent staffing, even if this action may deteriorate quality of care. On the other hand, chain-affiliated homes can transfer resources and knowledge from one to the other to operate their services more efficiently within a similar organizational structure. This standardization can also create more efficiency in adopting effective strategies either to maximize profits or to provide better quality of care. Banaszak-Holl et al. (2002) explained that the combination of low unit inertia with high adaptation to corporate high quality care likely reflects the nature of multiunit organizations in which many competencies arise in administrative procedures and organizational routine rather than in physical assets and technical advantages. Chains deserve further evaluation relative to efficiencies.

A few studies have garnered attention to the chain's effect on staffing hours,

deficiencies (Harrington, Zimmerman, et al., 2000), and quality measures (Castle & Banaszak-Holl, 2003). These studies should focus more on the role of RN staff and the effect of administrative hours in chain-affiliated nursing homes. Therefore, more research is needed to quantify the unique effect of chains on staffing levels, deficiencies, and quality measures.

Nurse Staffing Levels

Nurse staffing levels have been described as the strongest predictor of quality of care in nursing homes (Bates-Jensen et al., 2004; Harrington, 2005c; Schnelle et al., 2004). This is not only because they are easy to measure, but also because there is ample evidence that higher staffing levels result in better processes of care. Because nursing home residents are characteristically vulnerable and are highly dependent upon nursing staff for their physical, mental, and social needs, many studies have documented the importance of nursing staff in both the process and the outcomes of nursing home care (Aaronson et al., 1994; Bates-Jensen et al., 2004; Bliesmer et al., 1998; Carter & Porell, 2003; Castle & Engberg, 2007; Harrington & Swan, 2003; Harrington, Swan, et al., 2007; Zhang & Grabowski, 2004).

Over the past 30 years, numerous research studies have documented the important relationship between nurse staffing levels, particularly RN staffing, and outcomes of care (CMS, 2001). Licensed nursing hours (but not unlicensed hours) have been found to be significantly related to improved functional ability, increased probability of discharge to home, and reduced mortality in the first year after admission (Bliesmer et al., 1998). Furthermore, higher total nurse staffing hours, particularly RN hours, were shown to be associated with fewer facility-level

deficiencies in a study of all U.S. nursing homes (Harrington, Zimmerman, et al., 2000).

In a study using multivariate analyses, staffing level remained the strongest predictor of time observed in bed after controlling for resident functional measures (Bates-Jensen et al., 2004). Residents of lower-staffed homes were nearly five times more likely to have more than 50% observed time in bed than residents in higher-staffed homes. This study revealed that in more than 50% of hourly observations, residents who were observed in bed during daytime hours had significantly increased daytime sleeping, decreased social engagement, and decreased food and fluid consumption during mealtimes, controlling for resident functional status. Based on the results, researchers highlighted the possibility of improving in-bed times through increasing total staffing hours.

Some studies have indicated that increasing the number of nonprofessional staff or substituting LPNs for RNs will not necessarily lead to improved resident outcomes (Bliesmer et al., 1998; Bostick, 2004). Only licensed nursing hours, including RN and LPN hours, were associated with a greater probability of discharge, less dependency of residents three years later, and lower death rates (Bliesmer et al., 1998). Prevalence of pressure ulcers was significantly affected by all RN, LPN, and NA staffing hours (odds ratios 0.97, 1.03, 0.99, respectively), whereas only RN and NA staffing hours decreased the rate (Bostick, 2004).

Since the early 1970s, the research literature had demonstrated that higher RN hours and total nursing hours per resident day improve resident outcomes, including resident survival, improved functional status, and increased discharges from nursing

homes (IOM, 1996, 2001, 2003). Higher staffing levels are also related to fewer occurrences of resident pressure ulcers, catheterizations, urinary tract infections, to less antibiotic use, malnutrition, and dehydration, and fewer facility deficiencies (IOM, 1996, 2001, 2003). Based on this evidence, the three IOM reports (1996, 2001, 2003) recommended improvement in nurse staffing levels to reduce quality of care problems.

One study by the Centers for Medicare and Medicaid Services (CMS) reported that 4.1 total (nurse assistants plus licensed nurses) direct care hours per resident day (hprd) and 1.3 licensed nurse hprd (.75 for registered nurses [RNs] and .55 for licensed practical nurse [LPNs]) were minimum staffing levels for preventing poor resident outcomes, such as weight loss and pressure ulcers (CMS, 2001). Although no significant quality improvements are observed for staffing levels above these thresholds, quality is improved with incremental increases in staffing up to and including these thresholds. This report pointed out that 97% of U.S. nursing homes did not meet one or more of the recommended minimum staffing thresholds, and 52% of nursing homes failed to meet all of these standards.

Although staffing differences do not necessarily imply differences in quality of care, studies have suggested that higher direct-care staffing levels are linked to better care (Harrington, Zimmerman, et al., 2000; Schnelle et al., 2004; Spector & Takada, 1991). Several studies found that higher staffing, particularly of RNs, is associated with higher overall quality, as demonstrated by fewer nursing home deficiencies and better resident outcomes (Bates-Jensen et al., 2004; Castle, 2002; Castle & Engberg, 2007; Harrington, Zimmerman, et al., 2000; Schnelle et al., 2004; Zhang, Unruh, Liu, & Wan, 2006).

A longitudinal study conducted from 1987 to 1993 (Zhang et al., 2006) showed that there was a positive relationship between RN staffing and quality of care, as measured by the proportion of residents with pressure ulcers, physical restraints, and urinary catheters, after controlling for other facility residents, market and state factors, while the increase in staffing was not directly related to improvement in quality.

Higher RN staffing has been found to be related to improved functional status for residents, lower mortality rates, increased discharge from the nursing home, fewer pressure ulcers, less restraint usage, fewer catheterizations and urinary tract infections, and less antibiotic use (Anderson et al., 1998). The highest-staffed homes reported significantly lower resident care loads during onsite interviews across day and evening shifts (7.6 residents per nurse assistant), compared with homes with 9 to 10 residents per NA. They performed significantly better on 13 of 16 care processes implemented by NAs, compared with lower-staffed homes (Schnelle et al., 2004). Conversely, negative outcomes have been associated with inadequate staffing and inadequately trained staff. These negative outcomes include malnutrition, dehydration, starvation, hospitalization, high urinary catheter use, low rates of skin care, and low participation of residents in activities (Schnelle et al., 2004; Spector & Takada, 1991).

Interestingly, lower levels of administrative staff were associated with higher deficiencies outside of the "other" category that included administrative deficiencies (Harrington, Zimmerman, et al., 2000). Further research is needed to refine the relationship between administrative nurse staffing hours and quality of care under different organizational structures.

Furthermore, recent studies have reported that the relationships between quality

of care and staffing characteristics are nonlinear. They found interactions among independent variables (Castle & Engberg, 2007; Schelle et al., 2004; Zhang et al., 2006). Building on this evidence, research methods should be carefully designed to clarify the effect of interactions among different types and levels of nurse staffing on quality of care.

Case Mix

Case mix refers to nursing home residents' needs for assistance with activities of daily living (ADLs). Resident case mix has been measured by the average ADL dependency score of residents who were totally dependent in three ADLs: eating, toileting, and transferring to and from the bed, chair, or a standing position (Harrington & Swan, 2003; Harrington et al., 1998; Harrington, Swan, et al., 2007). This information is reported by facilities on the On-line Survey Certification and Reporting (OSCAR) system data.

In U.S. nursing homes, staffing levels and resident case mix have been shown to be endogenous (Harrington, 2005c; Harrington & Swan, 2003; Harrington, Swan, et al., 2007). Resident case mix has been found to be a positive predictor of staffing levels for RNs, LPNs, licensed nurses, and for total nurse staff, but not for NA hours per resident day (Harrington et al., 1998). Facilities with higher staffing are more likely to accept residents with more care needs, but residents with higher care needs are also more likely to go to facilities with higher staffing levels (Harrington & Swan, 2003).

Unlike previous studies that examined the negative effect of ownership on desirable resident outcomes, Bliesmer et al. (1998) reported a reverse effect of for-profit status, in that the residents of for-profit homes had less functional dependency

than those in not-for-profit institutions. This difference could be attributed to some element of case mix not captured when measuring age and functional status on admission.

Functional severity is negatively associated with two risk factors: the percentage of residents aged 85 and older and the Medicaid use rate (Aaronson et al., 1994). Castle (2002) also determined that more quality problems (deficiencies) in the use of physical restraints in nursing homes were significantly associated with lower staffing levels of caregivers, higher Medicaid census, and higher average ADL levels.

To control the endogeneity among case mix and staffing, a two-stage least squares regression analysis of total and RN staffing hours has been conducted (Harrington & Swan, 2003). Harrington and Swan (2003) found that resident case mix was a positive predictor of these staffing hours when other factors were constant, showing that case mix is clearly endogenous to staffing hours. Thus, case mix must be taken into account in analytical models, otherwise quality problems would appear to be associated with higher nurse staffing levels (Harrington, 2005c).

Carter and Porell (2003) also raised the possibility of unmeasured aspects of the negative relationship between average case mix and the risk of hospitalization rates in their findings. Although they found that the type of facilities with a higher case mix can have specialized services, such as IV therapy or a wound healing clinic, this reverse association may be attributable to more complex interactions between funding resources and resident case mix.

Payer Mix

Several studies have indicated that the extent of Medicare and Medicaid

reimbursement affects outcomes for nursing home residents (Aaronson et al., 1994; Carter & Porell, 2003; Castle, 2002; Grabowski & Castle, 2004), as well as nurse staffing levels (Harrington & Swan, 2003; Harrington, Swan, et al., 2007). To investigate whether care styles associated with a facility payer mix influence quality of care, researchers suggested specifying facility-level measures. Steffen and Nystrom (1997) reported that inadequate payments might decrease both quality of care and access to nursing home care for Medicaid residents. Among for-profit homes, Medicaid utilization increases as the self-payment rate increases to a greater extent than among non-profit homes, while non-profit nursing homes had higher levels of care staffing than for-profit nursing homes (Aaronson et al., 1994). A higher Medicaid payment rate was associated with a lower likelihood of having persistent poor-quality surveys, while persistent high quality was strongly related to an increase in Medicaid payment in QMs (Grabowski & Castle, 2004). In another study, a higher percentage of Medicaid residents were associated with persistent poor quality in the use of physical restraints (Castle, 2002).

Payer sources affect staffing levels differently. The proportion of Medicare residents was positively associated, while the proportion of Medicaid residents was negatively associated with both total nursing staffing hours and RN staffing hours (Harrington & Swan, 2003; Harrington, Swan, et al., 2007). Facilities with higher proportions of Medicare residents and lower proportions of Medicaid residents had significantly higher staffing hours. A 1% increase in Medicare residents increased total nurse staffing by 0.0068 hours per resident day. A 1% increase in Medicaid residents decreased total nurse staffing by 0.0105 hours per resident day (Harrington & Swan,

2003). The proportion of Medicaid residents in a facility was a negative predictor of RN hours. A 10% decrease in Medicaid residents increased total RN staff by 3 hours for every 100 residents per day (Harrington, Swan, et al., 2007). Notably, the Medicaid reimbursement rate was a positive factor for RN staffing hours, unlike the results in the total staffing model (Harrington & Swan, 2003).

Payer mix had an impact on hospitalization of nursing home residents. In Carter and Porell's (2003) study, residents in facilities where a greater percentage of total annual nursing home days was paid by Medicaid exhibited increased hospitalization rates (OR=1.10). On the other hand, residents of facilities with a greater percentage of Medicare paid days appeared to have a lower risk of hospitalization (OR=0.89). Higher concentrations of Medicaid residents (vs. Medicare and/or private pay residents) in a nursing home appear to indicate poor quality-of-care practice in terms of increased risk for hospitalization.

Payer mix affects resident outcomes differently between for-profit and not-for-profit nursing homes (Spector et al., 1998). Private pay residents in not-for-profit homes have significantly better outcomes, lowering death rates by 6.2% and infection rates by 6.3% compared to private pay residents in for-profit homes. Among the residents of not-for-profit homes, those whose primary payment source was Medicaid were 6.1% more likely to have an infection than private pay residents. However, they were 7.4% less likely to spend an above average proportion of time in the hospital compared to private pay residents. Interestingly, among the residents of for-profit homes, Medicaid and private pay residents had very similar outcomes, with the exception that Medicaid residents were 7.6 % less likely to die than private pay

residents.

Facility Size

An explanatory study grouping 92 randomly sampled nursing homes by three different outcome levels (good, average, poor) found that the only facility characteristic that was significantly different was the number of licensed beds, with smaller facilities having better outcomes (Rantz et al., 2004). Facilities in the consistently good resident outcome group had a median size of 80 beds, whereas facilities in the poor resident outcome group were larger, with a median of 120 beds.

Chain size and facility size can have different effects on health performance. Chains operating more homes (i.e., large chains) tend to achieve greater improvements in health deficiencies, and larger facilities also have ongoing decreases in both pressure ulcer rates and deficiency citations (Banaszak-Holl et al., 2002). The researchers conducting this study placed the results in an organizational perspective, suggesting relatively low inertia regarding poor quality of care, as well as transfer of capability for standardization within chains. The former means that larger chains were less sensitive to external impacts on quality of care, because larger units were more likely to standardize their competence and resources within the unit.

Market Characteristics

Previous studies have taken county-level measures of market conditions and resource abundance from the Area Resource File (Castle & Banaszak-Holl, 2003), which is a publicly available data set summarizing a large array of census, health, and social resource information for all counties. These data are compiled at the county level from a number of sources commonly used in health services research, including

the American Hospital Association (AHA), the U.S. Census, the Centers for Disease Control (CDC), and the National Center for Health Statistics (NCHS) (Castle & Banaszak-Holl, 2003).

Markets with a greater not-for-profit market share had a lower likelihood of persistent poor quality. One study showed that this hypothesis was significantly supported across all QMs: the prevalence of pressure ulcer, feeding tube usage, and indwelling catheter use, except the physical restraints measure (Grabowski & Castle, 2004). This finding was consistent with Grabowski and Hirth's (2003) finding that an increase in not-for-profit market share improves overall nursing home quality. These findings supported their hypothesis that not-for-profits were a quality signal for uninformed nursing home consumers. Their coefficient on the not-for-profit dummy variable was also statistically significant at the 10% level for all six of the quality measures. However, it was noted that their evidence was not conclusive as to whether quality was higher in the government sector relative to the for-profit sector.

More empty beds per community-dwelling elders within the market (i.e., less restrictive market) were associated with a decrease in persistent low quality when measured by an increase in the use of physical restraints and catheters, but the rates of pressure ulcers and use of feeding tubes were not statistically significant (Grabowski & Castle, 2004). Areas where there was an excess of nursing home beds per county had more RN hours of care (Harrington, Swan, et al., 2007).

County characteristics also affect quality of care at the facility level. Personal income in a county had a negative effect on total nursing hours (Harrington & Swan, 2003). For every $1,000 increase of personal income in a county, total nursing staff

levels decreased by 0.02 hours (2 hours for every 100 residents) per day. Nursing home residents in urban counties had significantly increased risks of hospitalization in comparison with rural regions (Carter & Porell, 2003). One city experienced 111% greater odds of hospitalization than other counties, while residents of some rural counties appeared no more (less) likely to be hospitalized. This result affirms that more hospital beds and physician supply factors are more commonly associated with urban settings and with increased hospitalization rates of nursing home residents (Carter & Porell, 2003).

Regional factors, especially state characteristics, influence nurse staffing levels. States with higher percentages of large facilities had lower RN and LPN hours. States with higher percentages of for-profit facilities had lower RN staff levels (Harrington et al., 1998). States with a higher percentage of Medicaid residents had higher LPN staff levels (Harrington et al., 1998). Facilities in states with higher percentages of aged, females in the labor force, higher average incomes, and a party split in the state legislature had higher RN staffing hours. States with more metropolitan areas had fewer RN hours, controlling for other factors (Harrington, Swan, et al., 2007). Higher levels of resident case mix were also positively associated with licensed nurse staff levels in states (Harrington et al., 1998). These findings suggest that state characteristics are important predictors of nurse staffing levels.

The availability of alternatives to nursing home care may affect nursing home characteristics and quality of care. There might be interplay between residential care supply and nursing home use (Swan & Newcomer, 2000). In terms of service supply, a viable alternative to a nursing home, such as resident care or assisted living, may affect

the resident case mix and various other organizational attributes (Newcomer et al., 2001; Swan & Newcomer, 2000). Long-term care policy also can affect community-level market area conditions, including the bed supply in residential care facilities (Newcomer et al., 2001). However, little attention has been given to the association between market conditions of alternatives to nursing homes and to nursing home characteristics.

There are disparities among the regions. Only 15% of U.S. nursing homes (nonhospital- based) serve predominantly Medicaid residents and these homes have fewer nurses, lower occupancy rates, and more health-related deficiencies (Mor et al., 2004). Those facilities serving predominantly Medicaid patients tend to be located in poorer communities. One study showed a differential gradient between the median per capita income and the proportion of facilities classified as lower tier, serving predominantly Medicaid residents. The poorest urban counties are more likely to contain lower-tier facilities than are the wealthiest urban counties. The gradient is even steeper in rural counties, with more than one-quarter of nursing homes in the poorest rural counties categorized as lower tier. Remarkably, compared with upper-tier facilities, lower-tier facilities have significantly fewer RNs per resident in both for-profit and non-profit facilities. These findings bolster the observation that nursing home residents in poor counties are more likely to receive poor care due to limited access to care.

Conclusion

Based on the state of the science, this study attempts to examine the relationship between nursing home characteristics and quality of care.

Conceptual Frameworks

This section proposes an overall conceptual framework, drawn from the review of the literature and the theories discussed in Chapter 2. As shown in Figure 2.1, the framework was then divided into three diagrams for each research aim to make it feasible for empirical study.

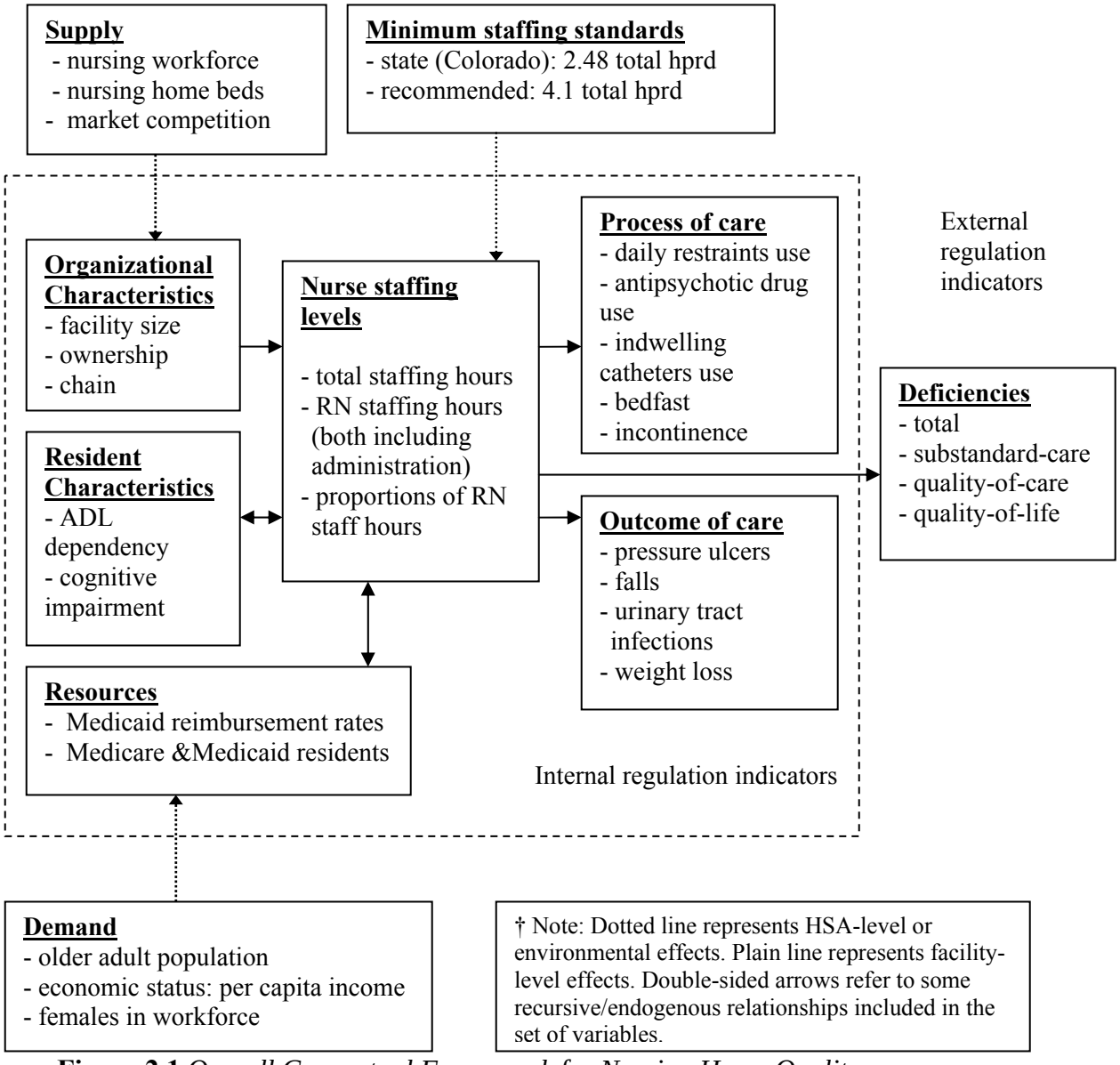

Figure 2.1 *Overall Conceptual Framework for Nursing Home Quality*

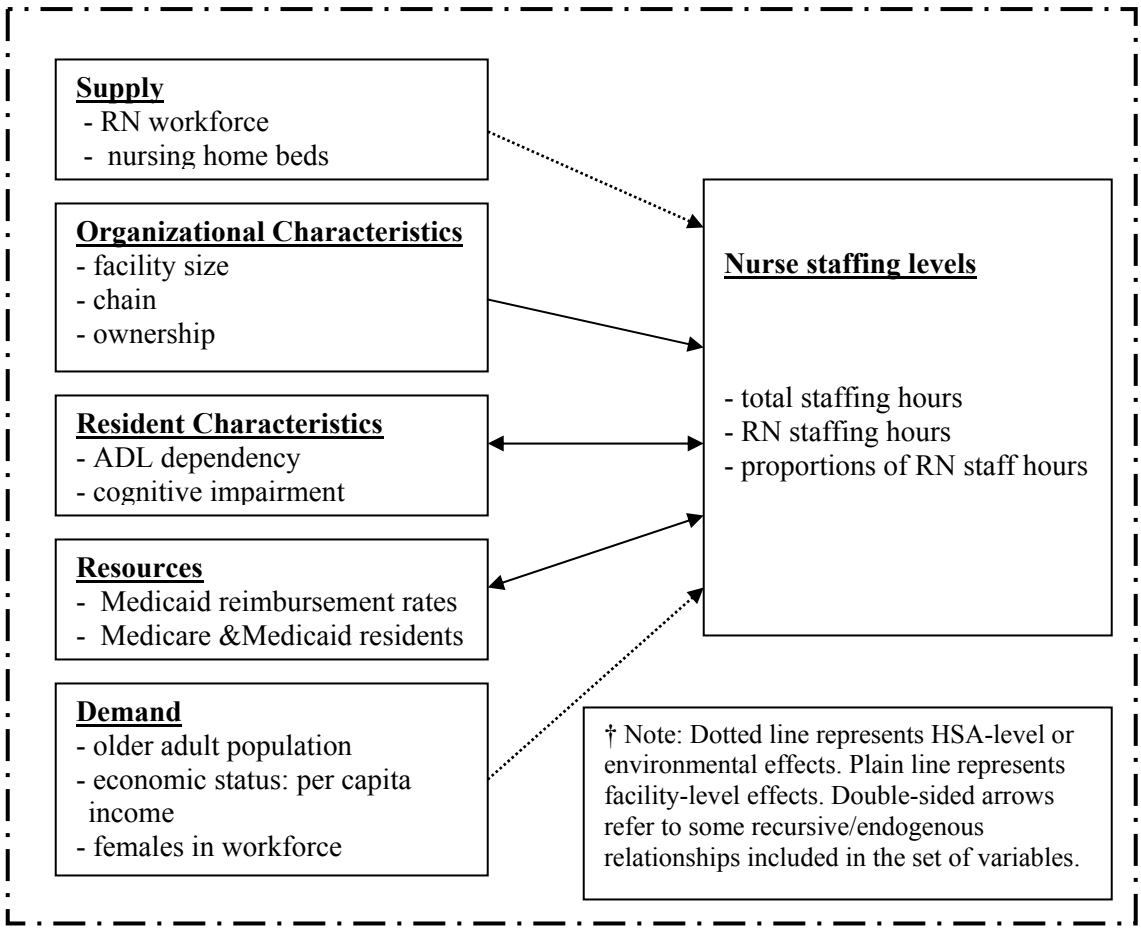

Figure 2.2 *Specific Aim 1: Conceptual Submodel for Nursing Home Staffing*

The first conceptual model, Figure 2.2 demonstrates the dynamics of nursing home characteristics and the environment while highlighting the endogenous relationships. Each arrow explains causal linkages among dependent and independent variables, and the intercorrelations indicating endogeneity between ADL dependency and nurse staffing levels, as well as between Medicaid reimbursement rates and nurse staffing levels.

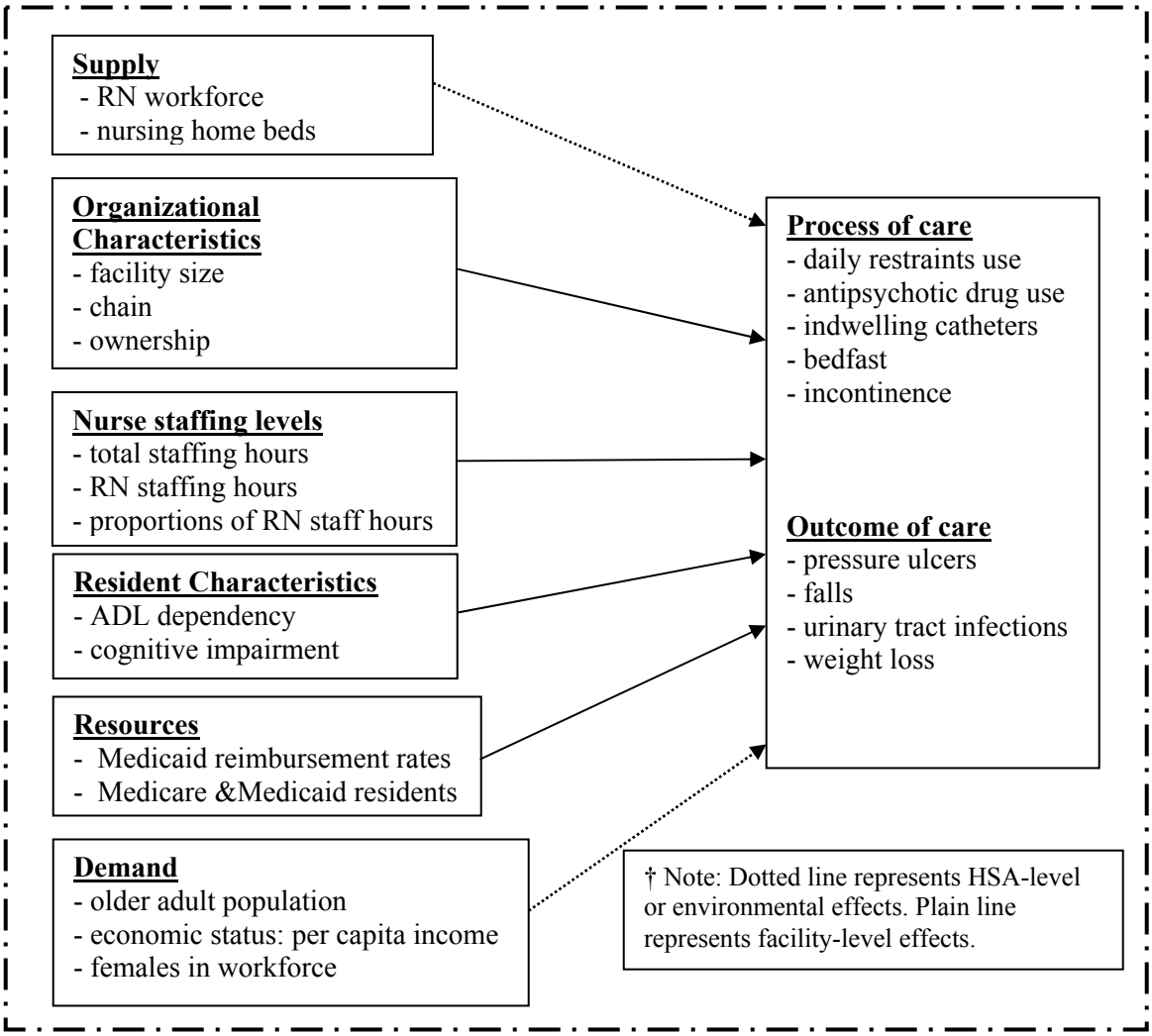

Figure 2.3 *Specific Aim 2: Conceptual Submodel for Nursing Home Quality Measures*

The second conceptual model addresses predictors related to each quality measure that is related to processes and outcomes of care. The effects of HSA-level market characteristics (i.e. supply and demand) take into account the nursing home environment that determines process-of-care and outcome-of-care indicators.

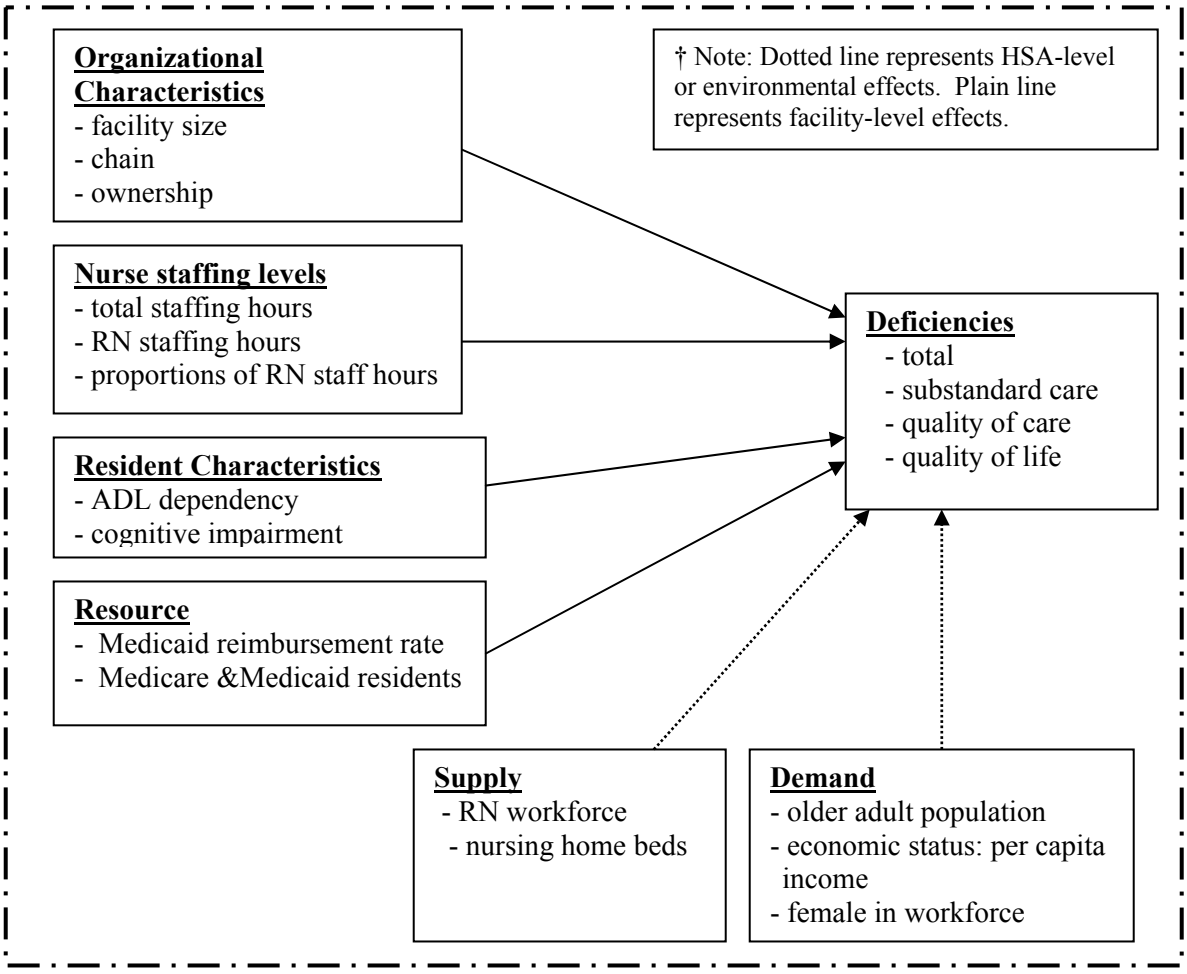

Figure 2.4 *Specific Aim 3: Conceptual Submodel for Nursing Home Deficiencies*

The third conceptual model illustrates how facility-level and HSA-level characteristics predict the number of deficiencies. The third aim will test what characteristics were significantly associated with the variations in deficiencies.

CHAPTER 3

Methodology

Introduction

This study attempted to quantify the effects of organizational characteristics and nurse staffing on quality of care when controlling for resources, resident, and market characteristics of nursing homes. This study used secondary data from four administrative databases: the Online Survey Certification and Reporting (OSCAR) data, Minimum Data Set (MDS) 2.0, quarterly staffing data from state inspections, and Area Resource File (ARF). This study had three research aims and used a variety of advanced quantitative analytic approaches, which will be called "multi-methods." The first aim was to identify the effects of organizational characteristics on nurse staffing levels. The second aim was to find the effects of organizational characteristics and nurse staffing on process and outcome quality measures of resident care. The third aim was to examine the effects of organizational characteristics and nurse staffing on facility deficiencies in nursing homes. This chapter describes study design, population and setting, data collection and procedures, variables, methodological challenges, data analysis and interpretation, as well as protection of human subjects.

Study Design

This study was performed with a non-experimental, descriptive, and correlational model testing design using the following methods: multivariate 2-stage least squares (2SLS) regression, multivariate ordinary least squares (OLS) regression, and multivariate negative binomial regression models. Depending on the methodological challenges and types of outcome variables, the appropriate method was

chosen. Because of the major concern of endogeneity, an instrumental variable approach was used along with the 2SLS regression models. The unit of analysis was a nursing home.

This study focused on determining cross-sectional and multivariate effects of predictors on outcomes and extensively analyzed multiple outcomes that can give full details of the major concepts. The primary advantage of this "multi-methods" design is that it gives not only simple, easy, concrete, but also comprehensive information that can be easily used for policy implications. The cross-sectional designs are economical and easy to manage (Polit & Beck, 2006). Multidimensionality of quality measurements requires simplifying the effects of nursing home characteristics in order to identify substantial relationships among nursing home organizations, their environments, and their outcomes with regard to quality of care. Thus, the cross-sectional design has been the most common type of research design for investigating quality of care in the nursing home research field. Using a cross-sectional design, however, poses difficulties in inferring causation. The weakness of the cross-sectional design was strengthened by a strong theoretical background and a two-stage least squares regression method.

Population and Setting

The study population was all nursing homes in Colorado in operation during the year of 2000. This included 199 nursing homes, excluding hospital-based nursing homes, veteran's homes, and specialized care facilities (e.g. hospice and rehabilitation care units). The final subjects for data analysis were 195 nursing homes, which is nearly the total population of 199 regular freestanding nursing homes in Colorado.

Because of missing values in market characteristics, three nursing homes were excluded for data analyses. After checking outliers with histograms and box-plots, one nursing home was excluded from analysis as an extreme outlier.

There was a regional imbalance in nursing home bed supply between counties, suggesting that market concentration and competition among nursing homes were different from county to county. Based on the population in this study, nursing homes were located in 46 out of 64 counties in 2000. As shown in Appendix A.1, 19 counties had only one nursing home; other 20 counties had 2 to 10 nursing homes. Six counties had more than 10 nursing homes.

Data Collection and Procedure

The basic dataset was created by Dr. Mary A. Blegen at University of California, San Francisco and the University of Colorado Health Science Center research team from 9/30/00 to 8/31/04. The original project, entitled *Quality Factors in Nursing Home Choice* was funded by the Agency for Healthcare Research and Quality (AHRQ) with grant number R18 HS 10926. From this previous study, Online Survey Certification and Reporting (OSCAR) data, Minimum Data Set 2.0 (MDS), and deficiency citations were combined with quarterly staffing data from the state inspection in 2000. The variables of Activities of Daily Living (ADL) dependency, ownership, chain affiliation, county name, and address for the year 2000 were obtained from other OSCAR data available from Dr. Charlene Harrington and her research team at the University of California, San Francisco.

As of the year 2000, Colorado state government proposed a new rule to institute a different reimbursement rate for each nursing home after controlling for

resident case mix. Through an Internet search, Medicaid reimbursement rates were added to the dataset. Thus, Medicaid reimbursement rates were included as a main predictor, and their endogenous relationships to RN and total staffing levels were considered.

For market variables, county-level data were retrieved from the Bureau of Health Profession's Area Resources File for the year 2000. To control regional differences with respect to market competition, supply, and demand of nursing home care, the calculation of market characteristics was clustered by 15 Health Services Areas.

Health Services Area (HSA) is a broader concept for geographical differentiation, which is more resource-driven than a county. As shown in Appendix A.2, 18 counties had no nursing home within the HSA. To consider the effects of those counties having no nursing homes on the adjacent nursing home market, all market characteristics in these counties were included into each HSA or adjacent HSA in the calculation of market variables. After these procedures, HSA-level characteristics were used in data analyses and standard errors in all regression analyses were clustered for the 15 HSAs.

Before the clustering in regression models, one-way analysis of variance (ANOVA) was conducted for every continuous predictor and outcome with an HSA categorical variable. Among HSAs, there were significant differences in nursing home size (F=2.49, p<.01), RN staffing hours per resident day (F=1.91; p<.01), total staffing hours per resident day (F=4.26; p<.01), RN skill mix (F=2.10, p<.05), weight loss rate (F=2.27, p<.01), and falls rate (F=1.73, p<.10).

Variable Descriptions

This study classified variables based on four different perspectives: Donabedian's structure-process-outcome approach, resource dependency theory, institutional theory, and the supply-and-demand approach from economic theory. These theoretical approaches framed the main structure, range, and composition of the study variables. Donabedian's theory provides the basic foundation for examining causality using the linkage between structure, process, and outcome in the relationships. Resource dependency theory determined the 'resource' factors, which consist of the variables in the concept of payer mix, including reimbursement rates, as well as 'market' or environmental factors. The supply-and-demand approach identified the 'demand' factors of nursing home care and the 'supply' factors of nursing homes that have an impact on the relationship between nursing home characteristics and quality of nursing home care including nurse staffing levels. Institutional theory comprised nursing home characteristics that were time-invariant organizational attributes as 'organizational' variables (i.e. facility size, chain, and ownership). Table 3.1 summarizes the independent and dependent variables that were included in the analytic models.

Dependent variables. Quality of care was measured by nurse staffing variables for Specific Aim 1, by quality measures (QMs) for Specific Aim 2, and by deficiencies for Specific Aim 3. Five process QMs included the prevalence of (1) physical restraint use, (2) antipsychotic drug use, (3) indwelling catheter use, (4) bedfast residents, and (5) incontinence. The outcome QMs included (1) pressure ulcers, (2) falls, (3) urinary tract infections, and (4) weight loss. Four deficiency variables were the (1) number of

total deficiencies that a nursing home was cited for annually, (2) number of substandard-care deficiencies that consisted of quality-of-care, quality-of-life, and other deficiencies, (3) number of quality-of-care deficiencies, and (4) number of quality-of-life deficiencies.

Staffing variables. Three staffing variables were used as dependent variables for Specific Aim 1. They were then included as independent variables for Specific Aims 2 and 3. Two staffing measures were selected from the original data, which were Registered Nurse (RN) staffing hours per resident day (including care and administrative hours provided by RNs) and total staffing hours per resident day (including all care and administrative hours provided by RNs, Licensed Practical Nurses [LPNs], Nurse Assistants [NAs]). RN skill mix was calculated as the percentage of RN staffing hours out of total staffing hours per resident day. Under Specific Aim 1, compliance with the state required minimum staffing standards of 2.48 total staffing hours per resident day was examined as a dependent variable. For long-stay residents, the desired level of 4.1 total staffing hprd that was recommended by the CMS report (2001) was also explored as a dependent variable.

Independent Variables. Three organizational characteristics (ownership, chain affiliation, and facility size) were used. Ownership was categorized into for-profit and not-for-profit. Chain affiliation was categorized by chain or non-chain. The number of total beds was used for measuring facility size. Resident case mix was controlled by two measures: ADL dependency score and the percentage of cognitively impaired patients. The ADL dependency score was calculated from OSCAR data using three ADLs: eating, toileting, and transferring. The average dependency score for each of

three ADLs was retrieved from OSCAR data using a three-point scale where a higher number indicates higher need for assistance. The percentage of cognitively impaired patients was retrieved from MDS 2.0 data. Payer mix contained Medicaid reimbursement rates and the proportions of Medicaid and Medicare residents for each nursing home.

For HSA-level market characteristics, the number of RNs per 100,000 population was used for measuring nursing workforce supply. To measure nursing home supply, the Herfindahl Index, total NH beds per 1000 population of persons aged over 65, and the percentage of excess nursing home beds in each HSA were included. To account for alternative supply of hospital beds per 1,000 population of persons aged 65 and older, this study included skilled nursing facility (SNF) beds per 1,000 population of aged over 65 and number of home health agencies per 1,000 population of aged over 65. Population per square mile was considered for the geographical environment. Two demand factors were considered: proportion of the population older than 65 years in the HSA and personal income per capita in the HSA. During the analyses, the percentage of employed females in the labor workforce was included because its importance had been shown in other study findings (Harrington, Swan, et al., 2007). To reduce the number of predictors in market variables, Pearson correlation coefficients were checked. Only a compact set of variables was selected from the initial analytical model. However, the other main predictors of interest (staffing, resource, organizational, and resident characteristics) were maintained based on the specific aims and study purpose.

Table 3.1 *Research Variables*

Variable Names	Definitions	Data Sources
Dependent Variables : **QUALITY MEASURES**		
<*Process Measures*>		
% of physical restraint use	(QI 22) Prevalence of residents using daily physical restraints; Residents who were restrained (trunk, limb, or chair) on a daily basis on the most recent assessment	MDS 2.0
% of antipsychotic drug use	(QI 19) Prevalence of all high and low risk residents using antipsychotic drugs without psychotic or related conditions; Denominator for this QM excludes residents with psychotic disorders, Tourette's syndrome, Huntington's disease or those with hallucinations on the most recent assessment	MDS 2.0
% of indwelling catheter use	(QI 10) Prevalence of residents with indwelling catheters on the most recent assessment.	MDS 2.0
% of bedfast	(QI 16) Prevalence of residents determined to be bedfast on the most recent assessment	MDS 2.0
% of bladder/bowel incontinence	(QI 8) Prevalence of residents who were determined to be incontinent or frequently incontinent on the most recent assessment; The denominator doesn't count those people who were comatose, had indwelling catheters, or ostomies on the most recent assessment	MDS 2.0
<*Outcome Measures*>		
% of pressure ulcers	(QI 24) Prevalence of low-risk residents who have been assessed with a pressure ulcer(s) stage 1- 4 on the most recent assessment; denominator is all residents on the most recent assessment	MDS 2.0
% of falls	(QI 2) Prevalence of residents who have been coded with a fall within the time frame of the most recent assessment (past 30 days)	MDS 2.0
% of urinary tract infections	(QI 12) Prevalence of residents who were identified as having had a urinary tract infection on the most recent assessment.	MDS 2.0
% of weight loss	(QI 13) Prevalence of residents noted with weight loss (5% or more in the last 30 days or 10% or more in the last 6 months) on the most recent assessment	MDS 2.0

†Note: **MDS**: Minimum Data Set 2.0 version.

Table 3.1 *Research Variables (continued)*

Variable Names	Definitions	Data Sources
Both Dependent and Independent Variables		
STAFFING LEVELS		
RN staffing hprd	RN care and administrative hours per resident day	State (2000)
Total staffing hprd	Total care hours per resident day and administrative hours per resident day	State (2000)
RN skill mix	RN staffing hours divided by total staffing hours	Calculated from existing data
Dependent Variable		
DEFICIENCIES		
Quality-of-care deficiencies	The number of deficiencies that are related to activities of daily living, vision and hearing, pressure sores, urinary incontinence, range of motion, mental and psychosocial functioning, naso-gastric tubes, accidents, nutrition, hydration, special needs, unnecessary drugs, and medication errors	OSCAR
Quality-of-life deficiencies	The number of deficiencies that are related to dignity, self-determination and participation, participation in resident and family groups, participation in other activities, accommodation of needs, activities, social services, and environment	OSCAR
Other deficiencies	The number of deficiencies that related to resident behavior and facility practice including restraints, abuse, and staff treatment of resident	OSCAR
Substandard-care deficiencies	Summing up deficiencies of three categories: quality-of-care, quality-of-life, and other substandard deficiencies	OSCAR
Total deficiencies	The number of all deficiencies including substandard and not-substandard categories	OSCAR
Independent Variables		
NURSING HOME CHARACTERISTICS		
Organizational Characteristics		
Facility size	The number of total beds	OSCAR
Chain affiliation	Chain=1; Non-chain NHs = 0	OSCAR
Ownership	For-profit=1; Not-for-profit and government-owned = 0	OSCAR
Resident Characteristics (Case Mix)		
ADL dependency	Average percentage of residents totally dependent on three ADL indices (eating, toileting, and transferring to and from bed, chair, and wheelchair, or a standing position) in Harrington, Swan et al. (2007)	OSCAR
% of cognitively impaired	(QI 7) the incidence of the cognitive impairment	MDS 2.0

†Note: **OSCAR**: Online Survey Certification and Reporting System from the Centers for Medicare and Medicaid; **MDS**: Minimum Data Set 2.0 version; **State**: state inspection data.

Table 3.1 *Research Variables (continued)*

Variable Names	Definitions	Data Sources
Resources (Payer Mix)		
Medicaid reimbursement rates	Amount of dollars that were received for each Medicaid resident; the state government sets a rate for each nursing homes based on the case-mix index.	Web
% of Medicaid residents	Proportion of residents who are funded by Medicaid	State (2000)
% of Medicare residents	Proportion of residents who are funded by Medicare	State (2000)
MARKET CHARACTERISTICS		
Supply Factors		
Workforce Supply		
RNs per 100,000 pop.	Total RNs numbers per 100,000 population in the HSA	State board of nursing (2005)
Nursing Home Supply		
Herfindahl Index	Nursing facility beds for each facility are divided by the total nursing home beds in each HSA, and then the proportions for each facility are squared and summed to create an index for each HSA. The index ranges from 0 to 1 with the higher values indicating more concentration (more competition)	Calculation from ARF (2000) and OSCAR (2000)
Total NH beds per 1,000 pop. of aged 65+	Total number of NH beds number which is divided by regional population of 65 and older and multiplied 1000 in each HSA	Calculation from ARF (2000)
% excess beds	Calculated by subtracting number of residents from total number of beds identifying the vacant beds from each facility in each HSA	Calculation from OSCAR (2000)
Hospital beds per 1,000 pop. of aged 65+	Total hospital beds divided by the number of persons of age 65+ and multiplied by 1000 in each HSA	ARF (2000)
Number of skilled nursing facilities (SNFs) per 1,000 of pop. aged 65+	Total number of SNFs divided by number of persons of aged 65+ multiplied by 1000 in each HSA	ARF (2000)
Number of home health agencies per 1,000 of pop. aged 65+	Total number of home health agencies divided by the number of persons of age 65+ and multiplied by 1000 in each HSA	ARF (2000)
Demand Factors		
Population aged 65+	Proportion of aged 65 and older in each HSA	ARF (2000)
Personal income per capita	Average income per capita in each HSA (in $1)	ARF (2000)
% females in the labor workforce	Proportion of employed females in the labor workforce in each HSA	ARF (2000)

†Note: **State**: state inspection data**; OSCAR**: Online Survey Certification and Reporting System from the Centers for Medicare and Medicaid; **Web**: Internet website search; **ARF**: U.S. Bureau of Health Professions Area Resource File.

Methodological Challenges

Nesting Problems

There is a knowledge gap in regard to interactions between environmental factors at the market level and quality of care at the facility level. The "grouped" nature of certain explanatory variables, such as non-profit market share, state-level payment rates, and market-level wage rates, has been a concern (Grabowski & Castle, 2004). This issue includes the problem of heteroskedasticity and biased estimates of the parameter standard errors. When the true residual variance-covariance matrix follows a grouped structure, estimates of standard errors are biased downwards. To reduce this problem, the Huber-White robust estimator has been used to adjust the standard errors when accounting for intra-county correlation (Grabowski & Castle, 2004; Harrington, Swan et al., 2007). For this study, intra-HSA correlations were taken into account by correcting standard errors with the Huber-White robust estimator.

Endogeneity Problems

Endogeneity originally refers to simultaneity assuming significant correlation between an independent variable, a so-called endogenous variable, and the error term of the dependent variable (Blundell & Powell, 2003). Econometric estimation has commonly been used to examine theory-based systems of relationships including endogeneity like a model of supply and demand (Greene, 2008). Previous studies observed considerable endogeneity among case mix and nurse staffing, and payment variables and nurse staffing (Cohen & Dubay, 1990; Harrington & Swan, 2003; Harrington, Swan et al., 2007). Moreover, studies examining processes and outcomes

of nursing home care should take into account their endogenous relationship in analytical models. Endogeneity may produce a reverse relationship, indicating that adverse outcomes are more likely to be associated with higher staffing levels (Harrington, 2005c). One major problem with studies of nursing home staffing, processes, and outcomes of care is difficulty in controlling for resident acuity or case mix (Harrington, 2005c). Therefore, these recursive relationships are fully considered in this study.

Solution for endogeneity: The use of instrumental variables. Previous studies used a two-stage least squares (2SLS) regression method with instrumental variables to assess the effects of endogenous predictors, such as resident case mix and Medicaid reimbursement rates, on total and RN staffing levels (Harrington & Swan, 2003; Harrington, Swan et al., 2007). Each endogenous factor was regressed on all exogenous factors in the first stage by using an ordinary least squares (OLS) regression analysis, and the predicted values for each endogenous factor were retained for the second stage. In the second stage, an outcome was regressed on all exogenous factors and predicted values of endogenous factors retained from the first stage.

For example, resident characteristics are expected to be endogenous with nurse staffing levels because nursing homes with higher staffing levels may choose to or may be more likely to admit residents with a higher case mix (Harrington & Swan, 2003). To correct the biased estimators, instrumental variables were employed in the two-stage least squares regression analysis under Specific Aim 1. Potential variables that were highly correlated with an endogenous variable but not with the outcome became

instruments for the endogenous variable. To identify whether there is significant endogeneity between the endogenous predictor and the outcome, the Durbin-Wu-Hausman test for endogeneity was used.

Possible instrumental variables were tested for use in the two-stage least square regression models. Weak instrument tests, using F statistics, partial R-square, and eigenvalue, were used to determine the appropriateness of the instruments. Good instruments are not correlated with the equation's disturbance (error) term, and they are highly correlated with the included endogenous variables (Baum, 2006). The p-values of the *F* test and comparison of R-square between excluded instruments and included instrument models state that instruments are not weak if they are statistically significant (less than .05). The eigenvalue provided for every first-stage regression was evaluated based on the Wald test reported in the Stata 10.0 output. A set of overidentification tests was used in Stata 10.0 to check a set of instruments for redundancy. When all p-values of the tests are more than 0.05, it means that we accept the hypotheses that the instruments are valid.

Risk-Adjustment Problem for Quality Measures

Current quality measure rates are likely to be inaccurate and misleading because they fail to take into account estimation errors and involve only limited risk adjustment (Arling et al., 2007). According to Mukamel & Brower (1998), one cannot assume that the relative quality rank of a nursing home is the same for all resident outcomes. There is divergence in risk adjustment methods used to evaluate quality of care in nursing homes; even when risk adjustment was taken into account, the quality

measures that were based on different outcomes were not correlated to one another. Therefore, this study included a wide array of outcomes under the three research aims.

Data Cleaning and Checking

Data were cleaned with regard to (1) the nursing homes that were included, (2) accuracy of the variables for this study, as well as (3) extreme outliers. Missing values were checked for all study variables. For a few missing values of the main research variables, such as Medicaid reimbursement rates and the percentages of cognitively impaired patients, a mean substitution within the HSA was performed. This was done because the rates were dependent upon regional differences. Variable distributions were checked using ranges, frequencies, and a histogram. This research treated outliers with restraint to maximize analytic power by including as many nursing homes as possible. Thus, only one extreme outlier reporting 100 percent of restraint use and more than 7 hours per resident day for RN staffing hours was removed, while other outliers were kept. Quarterly collected data: staffing hours, percentage of Medicaid residents, number of total beds, and QMs were aggregated by taking the mean of four time points in the 2000 data.

Data Analysis

All variables were described using frequencies, ranges, percentages, measures of central tendency (means), standard deviations, and standard errors. Variables were compared across the HSAs. To check the normal distribution of outcomes and residuals for each variable, histogram, box-plot, and normal q-q plot (residual vs. fitted plot in Stata) were employed. The distributions of three QMs— catheter use, physical restraint use, and bedfast were questioned for violating the assumption of normality.

However, log transformed regression models did not improve the overall model statistics. Thus, ordinary least squares regressions were used as other QMs.

Bivariate analysis was performed to guide the selection of key predictors of market characteristics, as well as to check the correlations among the dependent variables: three staffing variables, five process quality measures, four outcome quality measures, and four deficiency measures. Pearson correlations among the independent variables were examined for variable selection before the regression analyses. Variance Inflation Factors (VIF) was checked for multicolinearity problems in every regression model. All sets of predictors that were included in the analytic models provided overall VIF means that were less than 4, which suggests that there was no multicolinearity problem.

Specific Aim 1 : To determine the effects of organizational characteristics on nurse staffing levels controlling for other factors.

Analytical Hypotheses for Aim 1

(1) For-profit nursing homes (NHs), chain-affiliated NHs, and larger NHs have lower RN staffing hours, lower total staffing hours, and lower RN skill mix, controlling for resources, resident, and market characteristics.

(2) NHs which are for-profit, are part of a chain, and have larger numbers of beds are less likely to be compliant with the state minimum staffing standard of 2.48 hours per resident day or the recommended total nursing staffing standards of 4.1 total staffing hours per resident day.

To test these hypotheses for Specific Aim 1, this study conducted two-stage least squares (2SLS) regression, ordinary least squares (OLS) regression depending on distribution and type of staffing variables. To control the potential bias of clustered features of HSA-level market factors within the regressions, the cluster procedures were employed in all regression models for the 15 HSAs. First, 2SLS regression models were employed because Medicaid reimbursement rates and ADL dependency were assumed to be endogenous with three staffing models: (1) RN staffing, (2) total staffing, and (3) RN skill mix. To find instruments for the endogenous variables, a simple ordinary least squares regression was conducted in the first stage regressing Medicaid reimbursement rates, ADL dependency, and RN staffing, independently on exogenous variables including all potential instrumental variables. Finally, for Medicaid reimbursement rates, the final chosen instruments were the percentage of Medicaid residents and the percentage of populations aged over 65 years. For ADL dependency, instruments were the percentage of Medicare residents and per capita income.

In the first stage, each endogenous variable was regressed by using ordinary least square (OLS) analysis on all exogenous factors. The predicted value for each endogenous variable was retained within the dataset for the second stage. In the second stage, an outcome was regressed on the predicted values of endogenous variables and exogenous factors from the first stage. If there was no endogeneity problem, OLS regressions were used for data analysis. The following equations were examined for the first aim.

$$STAFFING\_LEVEL = \beta_0 + \beta_{1i}\, ORGANIZATIONAL\_CHARACTERISTICS_i + \beta_{2j}\, RESOURCE_j + \beta_{3k}\, RESIDENT\_CHARACTERISTICS_k + \beta_{4m}\, MARKET\_CHARACTERISTICS_m + \varepsilon_{ij}$$

In this equation, ε_{ij} indicates the error term for the staffing variable that was regressed. In the 2SLS models, two predicted values for Medicaid reimbursement rates and ADL dependency estimated in the first stage replaced the existing variables in the second-stage regression equation.

Specific Aim 2 : To determine the effects of organizational characteristics and nurse staffing levels on process and outcome of care controlling for other factors.

Analytical Hypotheses for Aim 2

For process measures: (1) For-profit nursing homes (NHs), chain-affiliated NHs, and larger NHs have a higher prevalence of residents with physical restraint use, psychotic drug use, and/or indwelling catheter use. These nursing homes have more bedfast and/or incontinent residents controlling for resources, resident, and market characteristics. (2) NHs with higher RN staffing hours, higher total staffing hours, and/or higher RN skill mix have a lower prevalence of residents using physical restraints, antipsychotic drugs, indwelling catheters, were bedfast and/or incontinent controlling for resources, resident, and market characteristics.

For outcome measures: (1) For-profit nursing homes (NHs), chain-affiliated NHs, larger NHs have a higher prevalence of residents with pressure ulcers, falls, urinary tract infections, and weight loss controlling for resources, resident, and market characteristics. (2) NHs with higher RN staffing hours, higher total staffing hours, and/or higher RN skill mix have a lower prevalence of residents with pressure ulcers, falls, urinary tract infections, or weight loss controlling for resources, resident, and market characteristics.

For Specific Aim 2, endogeneity was tested between staffing and each outcome QM. The purpose was to examine whether one of the staffing variables is endogenous

with one of the outcome QMs or not. Then multivariate OLS regression analysis methods were used for the five process QMs, as well as for the outcome QMs that were not endogenous with the staffing variables. The following equation was conducted for each dependent variable.

$$\text{Process } QM = \beta_0 + \beta_{1i} ORGANIZATIONAL\_CHARACTERISTICS_i + \beta_{2j} RESOURCE_j + \beta_{3k} RESIDENT\_CHARACTERISTICS_k + \beta_{4m} MARKET\_CHARACTERISTICS_m + \beta_{5n} STAFFING_n + \varepsilon_{ij}$$

$$\text{Outcome } QM = \beta_0 + \beta_{1i} ORGANIZATIONAL\_CHARACTERISTICS_i + \beta_{2j} RESOURCE_j + \beta_{3k} RESIDENT\_CHARACTERISTICS_k + \beta_{4m} MARKET\_CHARACTERISTICS_m + \beta_{5n} STAFFING_n + \varepsilon_{ij}$$

In this equation, ε_{ij} is the error term for each dependent variable. Staffing variables in the equations were either (1) RN staffing (care + administrative) hprd, (2) total staffing (care by RNs, LPNs, NAs + administrative) hprd, or (3) total staffing hours with RN skill mix.

Specific Aim 3 : To determine the effects of organizational characteristics and nurse staffing levels on deficiencies in nursing homes controlling for other factors.

Analytical Hypotheses for Aim 3

(1) For-profit NHs, NHs affiliated with a large chain, and larger NHs have more total deficiencies, more substandard deficiencies, more quality-of-care, and quality-of-life deficiencies than other NHs controlling for resources, resident, and market characteristics.

(2) NHs with higher RN staffing hours, NHs with higher total staffing hours, and NHs with higher RN skill mix have fewer total deficiencies, fewer substandard deficiencies, fewer quality-of-care, and fewer quality-of-life deficiencies than other NHs controlling for resources, resident, and market characteristics.

This research aim was investigated using negative binomial regression models because the number of deficiencies has been shown to have a distribution term that is a zero-truncated count data with over-dispersion. The third aim is grounded on the following equation.

$$\begin{aligned} DEFICIENCIES = \beta_0 &+ \beta_{1i}\, ORGANIZATIONAL\_CHARACTERISTICS_i \\ &+ \beta_{2j}\, RESOURCES_j \\ &+ \beta_{3k}\, RESIDENT\_CHARACTERISTICS_k \\ &+ \beta_{4m}\, MARKET\_CHARACTERISTICS_m \\ &+ \beta_{5n}\, STAFFING_n + \varepsilon_{ij} \end{aligned}$$

In this equation, ε_{ij} is the error term for each outcome.

Protection of Human Subjects

This study was primarily developed from a larger dataset that was built upon existing data from a previous federally funded project conducted from the University of Colorado Health Sciences Center. The previous study had been approved for use of the Colorado nursing home data by the institutional review board at the University of Colorado Health Sciences Center, the Colorado Multiple Institutional Review Board (CMIRB). This dissertation research project expanded the existing Colorado data independently and obtained approval for use from the Committee on Human Research (CHR) at the University of California, San Francisco (UCSF). Since there is no personal information within the data, a request for Category 4 exemption was accepted for CHR approval at UCSF on April 11th, 2008.

CHAPTER 4

Results

Introduction

This project examined statewide patterns of nurse staffing and systematic variations in quality of care and patient safety in Colorado nursing homes as of the year 2000. Three specific aims were investigated (1) effects of organizational characteristics on nurse staffing levels, (2) effects of nurse staffing and organizational characteristics on process and outcome measures, and (3) effects of nurse staffing and organizational characteristics on facility deficiencies. For all research aims resource, resident, and market characteristics were included in the analyses. Data analyses focused on two major topics of interest: (a) impact of ownership, chain affiliation, and facility size on three major sets of outcomes in Specific Aims 1, 2 and 3; and (b) impact of registered nurse (RN) staffing (including care and administrative hours per resident day provided by RNs), total staffing (including care and administrative hours by RNs, licensed practical nurses [LPNs], and nurse assistants [NAs]), and RN skill mix (proportions of nursing hours provided by RNs) on two major sets of outcomes in Specific Aims 2 and 3. In this chapter, findings were incorporated into these two main pillars. Statistical significance for the findings was set at the .05 level but when the p-value was less than .10, it was noted in the tables.

Descriptive Findings

For the year 2000, 195 of 199 freestanding nursing homes in Colorado were analyzed for this research. There was a significant disparity in the supply of nursing home beds among counties. The geographical regions were clustered into 15 Health

Services Areas.

Tables 4.1- 4.4 show means and standard deviations for all study variables. The average number of beds in the nursing homes was 96.3 and ranged from 28 to 264. Sixty-eight percent, 133 of 195 nursing homes were affiliated with chains. Of 195 nursing homes, 139 (71.2%) were for-profit and 56 (28.7%) were not-for-profit. The average Medicaid reimbursement rate was $115.10 per day and ranged from $71 to $149.

To fairly reflect residents' potential risk for poor outcomes in nursing home care, the percentage of cognitively impaired patients was included as a control variable along with the average score in Activities of Daily Living (ADL) dependency. The average percentage of cognitively impaired patients was 14% and average ADL dependency was 1.99 on a scale from 1 to 3. The average percentage of Medicaid patients was 63.7, while the average percentage of Medicare patients was 6.51.

Table 4.1 Nurse Staffing Levels : *Descriptive Statistics* (N=195)

Nurse Staffing Variables	Mean	S.D.	Range
Registered Nurse staffing hours per resident day (hprd) (including administrative hours)	0.6	.2	0-1.6
RN care hours per resident day	0.4	.2	0-1.3
LPN care hours per resident day	0.6	.2	.2-1.5
Licensed care hours per resident day	1.1	.2	.6-2.0
NA care hours per resident day	1.9	.3	1.1- 3.4
Nursing administrative hours per resident day	.16	.09	0-.48
Total staffing hprd (including administrative hours)	3.2	0.5	2.0-5.4
% RN hours per total staffing hour (RN skill mix)	19.1	5.9	6.2-43.1
% LPN hours per total staffing hour	20.9	6.4	6.6-40.8
% NA hours per total staffing hour	64.4	5.9	43.9-77.5

Table 4.2 Nursing Home Characteristics : *Descriptive Statistics* (N=195)

Variables	Mean/Percent	S.D.	Range
Nursing Home Characteristics			
Organizational Characteristics			
Facility size: No. of total beds	96.3	46.3	28-264
Chain-affiliated	68.2% (133/195)		
Non-chain	31.8% (62/195)		
For-profit	71.2% (139/195)		
Not-for-profit	28.7% (56/195)		
Resident Characteristics			
Average ADL dependency score	1.99	0.4	1-2.9
Cognitively impaired patients (%)	14.1	11.0	0-80.6
Resources (Payer mix)			
Medicaid Reimbursement rates	$115.1	14.8	$71-149
Medicaid patients (%)	63.7	22.5	0-98.7
Medicare patients (%)	6.5	6.3	0-34.8

Table 4.3 Market Characteristics : *Descriptive Statistics* (No. of HSAs = 15)

Clustered by 15 Health Services Area (HSA)	Mean	S.D.	Range
Workforce Supply of the Market			
Number of RNs per 100,000 population (year 2005)	985.2	175	674-1308
Market Competition			
Herfindahl index	0.22	0.25	.02-1.00
Bed Supply of the Market			
Percent of excess nursing home beds (year 2000)	17.4	2.0	14.5-21.7
Market Demand			
Proportion of populations aged 65 + (year 2000)	12.4	3.60	8-22
Per capita income in $s (year 2000)	25,412	6,211	18,337-39,347
Percent females in employed workforce (year 2000)	45.6	1.2	42.9-47.9

Table 4.4 Deficiencies and Quality Measures: *Descriptive Statistics* (N=195)

Outcomes	Mean	S.D.	Range
Deficiencies			
Total deficiencies	5.1	6.8	0-47
Substandard-care deficiencies	2.9	3.7	0-18
Quality-of-care deficiencies	1.8	2.5	0-14
Quality-of-life deficiencies	0.7	1.1	0-5
Quality Measures : Process of care			
Indwelling catheter use (%)	7.0	4.5	0-30
Antipsychotic drug use (%)	15.4	10.1	.3-77.1
Physical restraint use (%)	9.8	6.7	0-32.5
Bedfast (%)	2.9	2.3	0-12.5
Bladder or bowel incontinence (%)	51.0	12.1	17.2-95.8
Quality Measures : Outcome of care			
Urinary tract infections (%)	8.1	4.3	.6-33.0
Weight loss (%)	12.4	4.5	2.4-28.1
Falls (%)	17.5	5.6	4.7-34.0
Pressure ulcers (%)	7.8	3.8	0-27.8

Bivariate Correlations

Bivariate correlations are presented in Tables 4.5, 4.6, and 4.7. Table 4.5 illustrates correlations among organizational characteristics, resources, supply, demand, and staffing variables. Interestingly, larger nursing home size, for-profit status, and chain affiliation were significantly correlated with more Medicare residents and fewer nursing home beds supply per 1,000 population aged over 65. Larger nursing homes and for-profit status were also significantly correlated with more home health agencies, larger populations per square mile, and higher per capita income in the HSA. More RNs in the HSA were significantly associated with larger nursing home size and higher

Medicaid reimbursement rates. Medicaid reimbursement rates were significantly correlated with demand variables: population per square mile, population aged over 65, per capita income, and the percentage of females in the labor workforce.

There were strong negative correlations between (1) number of hospital beds per 1,000 population aged over 65 and number of skilled nursing facility beds per 1,000 population aged over 65; (2) Herfindahl index and number of home health agencies; (3) percentage of population aged over 65 and per capita income; (4) population per square mile and percentage of population aged over 65; (5) percentage of population aged over 65 and number of home health agencies. These relationships ranged from -.72 to -.60. On the other hand, there were strong positive correlations between (1) Herfindahl index and percentage of the population aged over 65; (2) number of the total nursing home beds per 1,000 populations aged over 65 and percentage of the population aged over 65; (3) number of home health agencies and per capita income; (4) population per square mile and per capita income. These relationships ranged from .64 to .87.

As presented in Table 4.5, nursing home size, for-profit status, nursing home chain, and more Medicaid residents were correlated with lower staffing levels ranging from -.40 to -.21. Higher Medicaid reimbursement rates were correlated with higher staffing levels ranging from .26 to .41. Interestingly, a higher proportion of the population aged over 65 in the HSA was significantly related to more total staffing hours per resident day, but was also significantly related to fewer RN staffing hours per resident day and lower RN skill mix.

As shown in Table 4.5, there was a moderate correlation between total staffing

hours per resident day (hprd) and RN staffing hprd (r=.50). The RN skill mix was not correlated with total staffing hprd, but was highly correlated with RN staffing hprd (r=.91).

As shown in Table 4.6, there were significant correlations between process QMs and outcome QMs. Catheter use and bedfast status were positively correlated with UTIs, weight loss, and pressure ulcers ($.18 \leq r \geq .32$). Restraint use was positively correlated with pressure ulcers. Incontinence was positively correlated with falls, UTIs, and weight loss ($.15 \leq r \geq .34$). Interestingly, antipsychotic drug use was negatively correlated with all outcome QMs ($-.28 \leq r \geq -.14$). There were significant positive correlations among outcome QMs ($.21 \leq r \geq .44$). There were strong correlations among four types of deficiencies ($.57 \leq r \geq .96$). However, there were very low correlations between deficiencies and process QMs; and no correlations between deficiencies and outcome QMs.

Table 4.5 *Correlation Matrix: Organizational Characteristics, Market Characteristics and Nurse Staffing*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. NH Size	1.00																			
2. For-profit	.27*	1.00																		
3. Chain	.19*	.30*	1.00																	
4. Medicaid reimb. rates	.05	-.21*	-.09	1.00																
5. Medicaid residents	-.01	.00	-.10	-.22*	1.00															
6. Medicare residents	.19*	.31*	.31*	.11	-.45*	1.00														
7. Herfindahl index	-.18*	-.09	-.10	-.13	.07	-.05	1.00													
8. Excess beds	.12	.10	-.03	-.00	-.07	.03	.11	1.00												
9. RNs/100,000 pop.	.17*	.10	.14	.15*	-.00	.05	-.22*	-.25*	1.00											
10. Total NH beds/1,000 pop. 65+	-.19*	-.19*	-.21*	-.24*	.08	-.13	.46*	.08	-.45*	1.00										
11. Hospital beds/1,000 pop. 65+	-.09	-.11	-.10	-.07	.10	-.17*	.18*	.03	.08	.09	1.00									
12. SNF beds/1,000 pop. 65+	-.01	.02	.04	-.13	-.03	.10	-.03	.10	-.31*	.28*	-.70*	1.00								
13. No. of home health agencies	.26*	.15*	.09	.11	-.02	.03	-.64*	.23*	.00	-.51*	-.02	-.18*	1.00							
14. Pop. per square mile	.29*	.15*	.08	.28*	-.16*	.06	-.41*	.15*	-.00	-.42*	-.21*	-.09	.57*	1.00						
15. Pop. aged 65+	-.24*	-.19*	-.13	-.28*	.15*	-.15*	.64*	-.04	-.20*	.68*	.51*	.05	-.60*	-.64*	1.00					
16. Per capita income	.28*	.15*	.07	.27*	-.14	.05	-.57*	.14	.08	-.61*	-.03	-.31*	.81*	.87*	-.72*	1.00				
17. Females in workforce	.10	.09	.20*	-.25*	.08	-.04	-.09	-.31*	.28*	-.12	.04	.04	.13	-.03	.18*	-.06	1.00			
18. Total staffing hours per resident day	-.25*	-.40*	-.26*	.41*	-.21*	-.00	.15*	-.06	-.12	.12	.19*	-.12	-.17*	-.18*	.20*	-.15*	-.26*	1.00		
19. RN staffing hours per resident day	-.29*	-.26*	-.12	.36*	-.27*	.12	-.11	-.15*	.08	-.12	-.11	-.01	-.03	.02	-.18*	.05	-.19*	.50*	1.00	
20. RN skill mix	-.23*	-.12	-.03	.26*	-.21*	.14*	-.16*	-.11	.13	-.16*	-.19*	.02	.02	.11	-.27*	.12	-.13	.13	.91*	1.00

**P-value* <.05

Table 4.6 *Correlation Matrix: Processes, Outcomes, and Deficiencies of Care*

	1	2	3	4	5	6	7	8	9	10	11	12	13
Process QMs													
1. Catheter use	1.00												
2. Restraint use	.19*	1.00											
3. Bedfast status	.23*	-.01	1.00										
4. Incontinence	-.12	.15*	.06	1.00									
5. Antipsychotic drug use	-.20*	.07	-.12	-.08	1.00								
Outcome QMs													
6. Falls	-.13	-.13	-.01	.34*	-.14*	1.00							
7. Urinary tract infections	.28*	.08	.25*	.15*	-.28*	.21*	1.00						
8. Weight loss	.18*	.07	.19*	.24*	-.23*	.31*	.24*	1.00					
9. Pressure ulcers	.32*	.25*	.24*	.14	-.23*	.12	.44*	.28*	1.00				
Deficiencies													
10. Total deficiencies	.14*	-.07	-.07	.02	-.00	-.01	-.07	-.02	.02	1.00			
11. Substandard-care deficiencies	.16*	-.04	-.07	.06	-.03	-.04	-.09	-.04	.02	.93*	1.00		
12. Quality-of-care deficiencies	.14	.00	-.06	.07	-.04	-.04	-.08	-.01	.01	.89*	.96*	1.00	
13. Quality-of-life deficiencies	.12	-.05	-.07	.01	.01	-.04	-.11	-.06	.03	.70*	.74*	.57*	1.00

**P-value* <.05

Table 4.7 *Correlation Matrix: Between Predictors and Outcomes* (**P-value* <.05)

	Total hprd	RN hprd	RN skill mix	NH size	For-profit	NH Chain	Medicaid reimb. rates	Medicaid residents	Medicare residents	Herfindahl index	Excess beds	RNs/10 0,000 pop.	Pop. Aged 65+	Per capita income	Females in workforce
Process QMs	Nurse Staffing Levels			Org. Characteristics			Resources (Payer mix)			Supply Factors			Demand Factors		
Catheter use	.28*	.07	-.05	.02	-.03	-.07	.23*	.03	.12	-.07	-.12	.10	-.07	.00	-.02
Restraint use	.18*	-.04	-.12	.07	.03	-.04	-.01	-.04	.08	.04	-.17*	-.02	.07	-.10	.08
Bedfast status	.22*	.13	.06	.02	-.06	-.07	.18*	-.09	.03	-.00	.03	.12	.03	-.13	.00
Incontinence	.10	.05	.02	.04	-.06	.06	.15*	-.39*	.06	-.08	-.02	.13	-.08	.10	-.00
Antipsy. drug use	-.23*	-.12	-.04	-.05	.16*	.03	-.17*	.33*	-.24*	-.07	-.02	.08	.02	-.02	.11
Outcome QMs															
Falls	-.03	.15*	.17*	.02	-.07	.04	.06	-.35*	.09	-.09	-.09	.10	-.10	-.01	-.03
UTI	.45*	.35*	.18*	-.13	-.17*	-.08	.23*	-.16*	.14	.00	-.09	-.02	-.03	-.00	-.10
Weight loss	.11	.12	.08	.10	.15*	.04	.08	-.29*	.35*	-.02	-.04	.16*	-.06	-.05	-.04
Pressure ulcers	.26*	.11	.03	-.06	.02	.02	.17*	-.16*	.29*	.00	-.04	.04	.01	-.03	.05
Deficiencies															
Total deficiencies	-.05	-.10	-.09	.24*	.19*	.16*	-.02	-.01	-.01	-.14	.05	.03	-.19*	.26*	-.02
Substandard-care deficiencies	-.05	-.11	-.11	.29*	.19*	.17*	.04	.01	.01	-.11	.04	.00	-.21*	.28*	-.02
Quality-of-care deficiencies	-.03	-.09	-.10	.28*	.18*	.15*	.04	-.01	.02	-.12	.02	.02	-.20*	.27*	-.01
Quality-of- life deficiencies	-.08	-.13	-.11	.31*	.16*	.19*	.05	.05	-.01	-.10	.07	-.03	-.20*	.23*	-.03

Variable selection for market variables. The best subset of market factors was configured based on the theoretical background and correlations among variables. High correlations (above *r*= .70) were identified between per capita income and other variables including number of home health agencies (*r*=.81), population per square mile (*r*=.87), and population of persons aged over 65 (*r*=-.72). Higher correlations were also found between skilled nursing facility beds and hospital beds (*r*=-.70). The population of aged over 65 also had moderate to high correlation with total nursing home beds (*r*=.68), population per square mile (*r*=-.64), and the Herfindahl index (*r*=.64). To reduce multiple colinearity among the market factors, the Herfindahl index, percentage of excess beds, number of RNs, percentage of population aged over 65, and per capita income were selected from the initial set of market variables. Two highly inter-related variables, percentage of population aged over 65 and per capita income, were not included together within the model for Specific Aim 1. Based on theoretical reasoning, RN supply, percentage of population aged over 65, per capita income, and percentage of females in the labor workforce were excluded from the set of market variables for the process QM models in Specific Aim 2.

Table 4.7 presents the correlations between selected predictors (columns) and outcomes (rows). Total staffing hours per resident day were significantly correlated with a higher percentage of catheter use, restraint use, bedfast status, urinary tract infections (UTIs), and pressure ulcers but a lower percentage of antipsychotic drug use. RN staffing hours per resident day and RN skill mix were significantly correlated with higher percentages of falls and UTIs. For-profit status was correlated with antipsychotic drug use and UTIs. There were no correlations between staffing levels

and four types of deficiencies. However, there were significant positive correlations between organizational characteristics and four types of deficiencies. The correlation coefficients ranged from .15 to .31.

Of three organizational characteristics, only for-profit status was weakly correlated with higher percentages of antipsychotic drug use and weight loss, and lower percentages of UTIs. Higher numbers of Medicaid residents were correlated with lower percentages of incontinence, falls, UTIs, weight loss, and pressure ulcers. The correlation coefficients ranged from -.39 to -.16. Higher Medicaid reimbursement rates were correlated with higher percentages of bedfast status, incontinence, UTIs, and pressure ulcers ($.15 \leq r \geq .18$). Higher numbers of Medicare residents were correlated with higher percentages of weight loss and pressure ulcers ($.29 \leq r \geq .35$). Interestingly, antipsychotic drug use was inversely correlated with three resource variables in the direction of other QMs. Higher Medicaid reimbursement rates and more Medicare residents were correlated with less antipsychotic drug use. More Medicaid residents were correlated with more use. Few market variables were correlated with process and outcome QMs, or deficiencies. Higher percentages of excess beds in the HSA were correlated with less use of physical restraints. More RNs per 100,000 population were correlated with a higher percentage of residents with weight loss. A higher percentage of population aged 65+ was correlated with fewer deficiencies of all types ($-.21 \leq r \geq -.19$). Higher per capita income was correlated with more deficiencies of all types ($.23 \leq r \geq .28$).

Relationships of For-profit Status, Chain Affiliation, and Size to Nursing Home Characteristics

Table 4.8 shows that for-profit nursing homes were significantly larger (F=15.5, p<.01) and had more Medicare residents (*F*= 20.8, p<.01) than nonprofit homes. They had significantly lower (6%) Medicaid reimbursement rates (*F*=8.9, p<.01). There were no differences in proportions of Medicaid residents, persons cognitively impaired, or ADL dependency scores.

Table 4.8 For-profit Status: *Comparing Means (Standard Deviations in Parenthesis)*

	Not-for-profit	For-profit	*F*
N	56	139	
Number of total beds	76.5 (46.7)	104.3 (43.8)	15.5***
Medicaid reimbursement rates ($)	120.0 (14.9)	113.2 (14.4)	8.9***
Medicare patients (%)‡	3.5 (3.4)	7.8 (6.8)	20.8***
Medicaid patients (%)	63.7 (18.8)	63.7 (23.8)	.0
Cognitively impaired (%)	13.3 (11.6)	14.3 (10.7)	.3
ADL dependency	2.0 (.4)	2.0 (.3)	.0

†Note: one-way ANOVA was conducted; F statistics were reported from ANOVA tables; ***p-value<.01; ‡Levene's test of homogeneity variance showed that there is a significant difference in variance between groups.

Table 4.9 demonstrates that chain-affiliated nursing homes were larger (*F*=7.4, p<.01) and had more Medicare residents (*F*=19.9, p<.01) than non-chain homes. Unlike for-profit status, there was no difference in Medicaid reimbursement rates between chain-affiliated and non-chain groups.

Table 4.9 Chain Affiliation: *Comparing Means (Standard Deviations in Parenthesis)*

	Non-chain	Chain-affiliated	*F*
N	62	133	
Number of total beds	83.3 (42.7)	102.4 (46.8)	7.4***
Medicaid reimbursement rates ($)	117.1 (15.4)	114.2 (14.6)	1.7
Medicare patients (%)‡	3.7 (3.7)	7.8 (6.8)	19.9***
Medicaid patients (%)	67.0 (18.7)	62.1 (23.9)	2.0
Cognitively impaired (%)	13.6 (13.4)	14.2 (9.7)	.1
Average ADL dependency‡ (eating, toileting, transferring)	1.9 (.4)	2.00 (.3)	1.0

†Note: one-way ANOVA was conducted in SPSS 16.0; F statistics were reported from ANOVA tables; ***p-value<.01; ‡Levene's test of homogeneity variance showed that there is a significant difference in variance between groups.

Although facility size was measured by the number of nursing home beds and included as a continuous variable in every regression model, large nursing homes (≥100 beds) had more Medicare residents than small homes (<100 beds) (F=10.7, p<.01) and higher ADL dependency scores (F=46.3, p<.01), but there was no difference in other characteristics.

Table 4.10 Nursing Home Size (≥100 beds): *Comparing Means (Standard Deviations in Parenthesis)*

	< 100 beds	≥100 beds	*F*
N	105	90	
Number of total beds‡	62.4 (20.3)	135.8 (35.5)	324.9***
Medicaid reimbursement rates ($)	115.0 (15.5)	115.3 (14.2)	.0
Medicare patients (%)	5.2 (5.7)	8.1 (6.6)	10.7***
Medicaid patients (%)	64.6 (22.4)	62.6 (22.6)	.4
Cognitively impaired (%)	13.9 (12.5)	14.2 (8.8)	.0
Average ADL dependency‡ (eating, toileting, transferring)	1.8 (.3)	2.2 (.3)	46.3***

†Note: one-way ANOVA was conducted in SPSS 16.0; F statistics were reported from ANOVA tables; ***p-value<.01; ‡Levene's test of homogeneity variance showed that there is a significant difference in variance between groups.

Specific Aim 1: Impact of Organizational Characteristics on Nurse Staffing Levels

Overall analytic models for Specific Aim 1. Data analyses incorporated three main outcomes: registered nurse (RN) staffing hours (including administration) per resident day, total staffing hours per resident day, and RN skill mix. First, a two-stage least squares (2SLS) regression model was applied for each staffing outcome. Robust clustering for 15 HSAs was used to control commonalities within each geographical area. In these 2SLS models, Medicaid reimbursement rates and average ADL dependency scores were assumed to be endogenous with each staffing outcome. These endogenous variables were predicted within two instrumental variables in stage one; then the predicted values were included as independent variables in stage two.

Based on theoretical reasoning and first-stage regression for two endogenous variables, the two best possible instruments were selected for each endogenous variable. As shown in the first two columns of Table 4.11, percentage of Medicaid patients and percentage of population aged over 65 were the instruments for Medicaid reimbursement rates. Percentage of Medicare patients and per capita income were the instruments used for average ADL dependency. The same sets of instruments were used to test endogenous relationships with either Medicaid reimbursement rates or ADL dependency for the three staffing variables. For each staffing variable, endogeneity tests with each endogenous variable were conducted, so that each set of instruments was separately tested. The results for weak instrument tests were identical over three staffing outcomes because first-stage regression findings were the same (See Table 4.11). However, test results of overidentifying restrictions were different over three staffing outcomes.

Appendix A.4 highlights the first-stage regression summary for testing hypothesis of endogeneity, weak instruments, and overidentifying restrictions. First, two instruments (percentage of Medicaid residents and population aged 65 and over) were chosen for Medicaid reimbursement rates. When it is assumed that Medicaid reimbursement rates were endogenous with one of three staffing variables, the instruments were strong enough to predict staffing outcome (partial R-squared=.06; Robust F [2, 14]=10.94; p<.01; eigenvalue=5.84). Overidentifying restrictions test results also showed that the instruments were valid only for RN staffing hours and RN skill mix. There was significant endogeneity between Medicaid reimbursement rates and RN staffing hours (Durbin Chi^2 = 15.95, p<.01; Wu-Hausman F [1,184] = 16.39, p<.01; robust regression F [1, 14] = 15.28, p<.01); and between Medicaid reimbursement rates and RN skill mix (Durbin Chi^2 = 18.54, p<.01; Wu-Hausman F [1,184] = 19.33, p<.01; robust regression F [1, 14] = 39.83, p<.01).

Second, two instruments (percentage of Medicare residents and per capita income) were chosen for ADL dependency. When it is assumed that ADL dependency was endogenous with one of three staffing variables, the instruments were weak for predicting the staffing outcome (partial R-squared=.01; Robust F [2, 14]=4.27; p<.05; eigenvalue=.83). Although weak instruments were used for ADL dependency, the chi-square test and F statistics confirmed that 2-stage least squares (2SLS) regression coefficients were significantly different from ordinary least squares (OLS) regression coefficients. Moreover, overidentifying restrictions test results showed that the instruments were valid only for RN staffing hours and RN skill mix.

Finally, there was significant endogeneity between ADL dependency and RN

staffing hours (Durbin $Chi^2 = 8.44$, $p<.01$; Wu-Hausman F [1,184] = 8.33, $p<.01$; robust regression F [1, 14] = 11.29, $p<.01$); and between ADL dependency and RN skill mix (Durbin $Chi^2 = 10.55$, $p<.01$; Wu-Hausman F [1,184] = 10.53, $p<.01$; robust regression F [1, 14] = 9.99, $p<.01$). However, total staffing hours per resident day had no endogeneity problem with either Medicaid reimbursement rates or ADL dependency. Moreover, the overidentifying restriction tests showed that the instruments used for total hours were not valid. Thus, a simple ordinary least squares regression model was chosen as the best fit for total hours over a 2SLS regression model. As shown in Table 4.11, existing endogenous relationships were appropriately controlled to correct for biased OLS coefficients.

Table 4.11 *2-Stage Least Squares Regression for RN Staffing Hours and RN Skill Mix and Ordinary Least Squares Regression for Total Staffing Hours*

Two endogenous variables and three outcomes	1st Stage Regression		2nd Stage Regression		OLS Regression
	Endogenous Variables		*Outcome Variables*		*Outcome With No Endogeneity*
	Medicaid reimbursement rates ($)	ADL dependency (1-3)	RN staffing hprd	RN skill mix (%)	Total staffing hprd
	Unstandardized (B) Coefficients (Robust Standard Errors in Parenthesis)				
Nursing Home Characteristics					
Medicaid reimbursement rates §			**.020***** (.005)	**.519***** (.117)	**.011***** (.002)
ADL dependency §			.311 (.280)	13.22 (13.54)	.142 (.083)
Number of beds (facility size)	.025 (.018)	**.004***** (.000)	**-.003**** (.001)	-.100* (.055)	**-.002***** (.000)
For-profit status	**-8.148***** (2.468)	-.114 (.071)	.095* (.074)	**4.480***** (2.202)	**-.218***** (.054)
Chain	-1.813 (1.305)	.000 (.035)	.010 (.033)	.830 (.835)	**-.100**** (.037)
Cognitively Impaired (%)	**.123**** (.044)	**.006**** (.003)	**-.007***** (.002)	-.233 (.067)	.000 (.003)
Market Characteristics					
Herfindahl Index	5.654 (12.949)	**.169**** (.068)	-.028 (.092)	-2.024 (2.244)	.549 (.464)
Excess beds (%)	-.416 (1.160)	**-.040***** (.006)	-.002 (.011)	.389 (.576)	-.025 (.024)
RNs per 100,000 population	**.023***** (.008)	**.0002***** (.0001)	**-.0003**** (.0001)	**-.009***** (.002)	-.000 (.000)
Females in labor workforce (%)	**-3.204**** (1.625)	**-.031**** (.011)	.057* (.030)	**1.993**** (.700)	-.059 (.040)
Instruments					
Medicaid residents (%)	**-.097***** (.021)				
Medicare residents (%)		.003 (.004)			
Population aged 65^{+} (%)	-3.54* (.687)				
Per capita income ($)		**.000005**** (.000002)			
Intercept	**313.835***** (67.682)	**3.353***** (.570)	**-4.220**** (1.844)	**-146.763***** (40.222)	**5.402**** (1.996)
R-squared	.2530	.2988	.3015	.2567	.3652
F statistics	**42.47*****	**68.24*****	**35.55*****	**23.00*****	**14.80*****

†Note: N=195, 2stage-least square regression and simple ordinary least square regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; Robust standard errors adjusted for 15 clusters were reported in parenthesis; § The Predicted values of Medicaid reimbursement rate and ADL dependency score from the first stage regression were included in the second stage regression for each staffing outcome**;** *p-value <.10; **p-value<.05; ***P<.01; Statistically significant coefficients at .05 of significance level were bolded.

Hypotheses Testing for Specific Aim 1

To test the three following hypotheses, Table 4.11 presents the best-fit regression models for each staffing outcome. Unstandardized (*B*) regression coefficients and robust standard errors were reported. For RN staffing hours per resident day and RN staffing mix, second-stage regression findings were reported from two-stage least squares (2SLS) regression models. For total staffing hours per resident day, simple ordinary least squares (OLS) regression models without instruments were presented.

H_1: For-profit nursing homes (NHs) have lower nurse staffing levels than not-for-profit NHs.

As shown in Table 4.11, holding other factors constant, for-profit nursing homes reported 5.4 minutes more RN staffing hours per resident day (B= .095, p<.10) and a 4.5 % higher RN skill mix (B= 4.480, p<.01) than not-for-profit homes. For-profit homes had lower (13 minutes) total staffing hours per resident day (B= -.218, p <.01) compared to not-for-profit nursing homes. This illustrates that for-profit nursing homes provided relatively more RN care and administrative hours with less total staffing hours. Thus, H_1 was partially supported for total staffing hours, but the reverse effects were shown for RN staffing hours and RN skill mix.

H_2: Chain-affiliated NHs have lower nurse staffing levels than non-chain NHs.

As shown in Table 4.11, OLS regression models showed that chain-affiliated nursing homes had 6 minutes less total staffing (B= -.100, p<.01) than nursing homes

not affiliated with chains, keeping other factors constant. On the other hand, effects of chain affiliation on RN staffing and RN skill mix were not statistically significant. Thus, H_2 was partially supported for total staffing hours per resident day.

H_3: Larger NHs have lower nurse staffing levels than smaller NHs.

As shown in Table 4.11, if a nursing home has 10 additional nursing home beds, RN staffing hours were decreased by 1.8 minutes (B= -.003, p<.01). The proportion of RN staffing decreased by 1% (B= -.100, p<.10) as total staffing hours were decreased by 1.2 minutes (B= -.002, p<.01), holding other variables constant. In sum, this hypothesis was clearly supported by three staffing outcomes.

Specific Aim 2: Impact of Organizational Characteristics and Nurse Staffing Levels on Resident Outcomes

Overall analytic models for Specific Aim 2. This aim comprehensively examined the impact of organizational characteristics and nurse staffing on nine quality measures (QMs) from the Minimum Data Set. Four of these QMs (percentages of residents with pressure ulcers, falls, urinary tract infections, and weight loss) measured the outcomes of resident care. The other five QMs (percentages of residents with catheter use, restraint use, bedfast status, incontinence, and antipsychotic drug use) measured care processes. Separate regression analyses were conducted for each process and outcome measure to determine the effects of ownership, chain, size and nurse staffing. Of the nine QMs, four outcome QMs were assumed theoretically to be endogenous with one of three staffing variables because homes with residents needing

more intense nursing care would have higher staffing levels. Hence, 2SLS regression models with an instrumental variable approach were applied for four QMs. Although only pressure ulcers showed endogeneity statistically for RN staffing hours, especially when HSA cluster was considered, this study applied a more conservative approach reporting the 2SLS regression models for all four outcomes.

Two instruments (percentage of population aged over 65 and percentage of females in the labor workforce) were chosen for the RN staffing hours model. When it is assumed that RN staffing hours per resident day were endogenous for the percentage of pressure ulcers, the instruments were strong enough to predict pressure ulcers (partial R-squared =.04; Robust F [2, 14]=6.75, p<.01; minimum eigenvalue = 3.45). The endogeneity test results showed that there is endogeneity at the significance level of .05 when clustering was considered (Durbin Chi^2 = 2.59, p=.1075; Wu-Hausman F [1,182] = 2.45, p=.1192; robust regression F [1, 14]= 4.95, p=.0430). The tests of overidentifying restrictions showed that the instruments were valid (p>.05)

The same instruments (percentage of population aged over 65 and percentage of females in the labor workforce) were used for the RN skill mix model. When it is assumed that RN skill mix was endogenous for the percentage of pressure ulcers, the instruments were strong enough to predict pressure ulcers (partial R-squared =.07; Robust F [2, 14]=10.52, p<.05; minimum eigenvalue = 6.69). The endogeneity test results showed that there was no endogeneity (Durbin Chi^2 = .73, p=.3921; Wu-Hausman F [1,182] = .69, p=.4085; robust regression F [1, 14]= .78, p=.3933). The tests of overidentifying restrictions showed that the instruments were valid (p>.05).

The same instruments (percentage of population aged over 65 and percentage

of females in the labor workforce) were used for the total staffing hours model. When it is assumed that total staffing hours were endogenous for the percentage of pressure ulcers, the instruments were strong enough to predict pressure ulcers (partial R-squared =.09; Robust *F* [2, 14]=9.86, p<.05; minimum eigenvalue = 9.98). The endogeneity test results showed that there was no endogeneity (Durbin Chi^2 = 1.71, p=.1905; Wu-Hausman *F* [1,182] = 1.61, p=.2056; robust regression *F* [1, 14]= 1.62, p=.2241). The tests of overidentifying restrictions showed that the instruments were valid (p>.05).

All outcome QMs followed these three steps testing endogeneity and weak instruments for three staffing variables. To be consistent with the approach across the outcomes, 2SLS regression models were presented for all outcome QMs in Table 4.12-4.15. Thus, existing endogeneity between staffing variables and four outcome QMs were controlled consistently using 2-stage least squares models.

Table 4.12 *Two-stage Least Squares Models for Pressure Ulcers*

Regression Coefficients *(Robust Standard Errors in Parenthesis)*	1st Stage RN staffing hprd	2nd Stage Pressure ulcers (%)	1st Stage RN skill mix	2nd Stage Pressure ulcers (%)	1st Stage Total staffing hprd	2nd Stage Pressure ulcers (%)
RN staffing hprd §		**-11.272****				
		(5.026)				
RN skill mix§				-.210		
				(.175)		
Total staffing hprd§						-.607
						(1.959)
Number of beds	**-.001****	**-.029*****	-.035*	**-.020****	**-.001*****	-.014*
(facility size)	(.001)	(.009)	(.018)	(.008)	(.000)	(.007)
For-profit status	**-.081*****	-.718	**-1.140****	-.061	**-.192*****	-.098
	(.020)	(.740)	(.522)	(.609)	(.049)	(.875)
Chain	-.032	-.744	-.255	-.384	**-.110****	-.441
	(.033)	(.759)	(.835)	(.690)	(.039)	(.714)
Medicaid reimbursement	**.003*****	**.081*****	.059*	**.050****	**.011*****	.038
rates	(.001)	(.023)	(.029)	(.020)	(.002)	(.031)
Medicaid residents (%)	**-.002*****	-.016	**-.038*****	-.002	**-.003*****	.005
	(.001)	(.020)	(.012)	(.018)	(.001)	(.015)
Medicare residents (%)	.005*	**.250*****	.126*	**.220*****	.003	**.195*****
	(.003)	(.066)	(.071)	(.063)	(.003)	(.061)
ADL dependency	-.018	.924	-.837	.914	.093	1.090*
	(.029)	(.570)	(.915)	(.564)	(.069)	(.570)
Cognitively Impaired	**-.003*****	-.019	**-.092*****	-.005	-.000	.013
(%)	(.001)	(.023)	(.022)	(.025)	(.003)	(.015)
Herfindahl Index	-.032	-2.460	1.650	-1.433	-.299	.892
	(.146)	(2.676)	(3.470)	(2.755)	(.237)	(2.041)
Excess beds (%)	**-.022*****	-.247	-.387*	-.121	-.024	-.074
	(.006)	(.171)	(.189)	(.172)	(.027)	(.130)
Population aged 65+ (%)	**-.017****		**-.774*****		**.064*****	
	(.007)		(.183)		(.016)	
Female in labor workforce	-.019		-.096		**-.108*****	
(%)	(.016)		(.558)		(.034)	
Intercept	**2.000****	11.429*	40.158	7.397	**6.928*****	4.320
	(.016)	(6.417)	(25.989)	(6.712)	(1.728)	(4.557)
R-squared	.3550	.1417	.2741	.1361	.4319	.1306
F statistics	**82.01*****	**96.97*****	**100.04*****	**103.62*****	**92.54*****	**68.68*****

†Note: The Same with Table 4.11

Table 4.13 *Two-stage Least Squares Models for Falls*

Regression Coefficients *(Robust Standard Errors in Parenthesis)*	1st Stage RN staffing hprd	2nd Stage Falls (%)	1st Stage RN skill mix	2nd Stage Falls (%)	1st Stage Total staffing hprd	2nd Stage Falls (%)
RN staffing hprd §		7.781				
		(10.588)				
RN skill mix§				.153		
				(.292)		
Total staffing hprd§						.168
						(3.342)
Number of beds	**-.001****	.009	-.035*	.003	**-.001*****	-.002
(facility size)	(.001)	(.017)	(.018)	(.012)	(.000)	(.009)
For-profit status	**-.081*****	-.142	**-1.140****	-.591	**-.192*****	-.631
	(.020)	(1.322)	(.522)	(.980)	(.049)	(.900)
Chain	-.032	.505	-.255	.257	**-.110****	.258
	(.033)	(.744)	(.835)	(.764)	(.039)	(.971)
Medicaid reimbursement rates	**.003*****	-.052	.059*	-.032	**.011*****	-.020
	(.001)	(.052)	(.029)	(.033)	(.002)	(.041)
Medicaid residents (%)	**-.002*****	**-.073*****	**-.038*****	**-.083*****	**-.003*****	**-.088*****
	(.001)	(.020)	(.012)	(.013)	(.001)	(.016)
Medicare residents (%)	.005*	-.095	.126*	-.076	.003	-.057
	(.003)	(.077)	(.071)	(.074)	(.003)	(.062)
ADL dependency	-.018	2.382	-.837	2.394	.093	2.290
	(.029)	(1.592)	(.915)	(1.592)	(.069)	(1.574)
Cognitively Impaired (%)	**-.003*****	.006	**-.092*****	-.003	-.000	-.016
	(.001)	(.038)	(.022)	(.040)	(.003)	(.037)
Herfindahl Index	-.032	-.911	1.650	-1.547	-.299	-3.065
	(.146)	(5.015)	(3.470)	(4.960)	(.237)	(3.883)
Excess beds (%)	**-.022*****	-.191	-.387*	-.276	-.024	-.313
	(.006)	(.268)	(.189)	(.296)	(.027)	(.355)
Population aged 65^{+} (%)	**-.017****		**-.774*****		**.064*****	
	(.007)		(.183)		(.016)	
Female in labor workforce	-.019		-.096		**-.108*****	
(%)	(.016)		(.558)		(.034)	
Intercept	**2.000****	**21.517****	40.158	**24.126*****	**6.928*****	**27.067****
	(.016)	(7.919)	(25.989)	(7.440)	(1.728)	(12.224)
R-squared	.3550	.1651	.2741	.1640	.4319	.1626
F statistics	**82.01*****	**27.92*****	**100.04*****	**19.99*****	**92.54*****	**17.66*****

Table 4.14 *Two-stage Least Squares Models for Urinary Tract Infections*

Regression Coefficients *(Robust Standard Errors in Parenthesis)*	1st Stage RN staffing hprd	2nd Stage UTIs (%)	1st Stage RN skill mix (%)	2nd Stage UTIs (%)	1st Stage Total staffing hprd	2nd Stage UTIs (%)
RN staffing hprd §		3.09				
		(4.017)				
RN skill mix§				.069		
				(.098)		
Total staffing hprd§						-.189
						(1.893)
Number of beds	**-.001****	**-.014****	-.035*	**-.016*****	**-.001*****	**-.019*****
(facility size)	(.001)	(.006)	(.018)	(.005)	(.000)	(.005)
For-profit status	**-.081*****	-.948	**-1.140****	-1.122	**-.192*****	-1.204
	(.020)	(.819)	(.522)	(.730)	(.049)	(1.113)
Chain	-.032	-.456	-.255	-.553	**-.110****	-.593
	(.033)	(.674)	(.835)	(.645)	(.039)	(.814)
Medicaid reimbursement	**.003*****	.034	.059*	.041*	**.011*****	.049
rates	(.001)	(.028)	(.029)	(.021)	(.002)	(.036)
Medicaid residents (%)	**-.002*****	.004	**-.038*****	.000	**-.003*****	-.003
	(.001)	(.013)	(.012)	(.014)	(.001)	(.011)
Medicare residents (%)	.005*	.117*	.126*	**.124****	.003	**.133****
	(.003)	(.059)	(.071)	(.052)	(.003)	(.060)
ADL dependency	-.018	1.873	-.837	1.883	.093	1.860
	(.029)	(1.229)	(.915)	(1.215)	(.069)	(1.152)
Cognitively Impaired (%)	**-.003*****	.005	**-.092*****	.003	-.000	-.004
	(.001)	(.012)	(.022)	(.013)	(.003)	(.013)
Herfindahl Index	-.032	1.025	1.650	.847	-.299	.333
	(.146)	(1.907)	(3.470)	(2.129)	(.237)	(2.727)
Excess beds (%)	**-.022*****	-.100	-.387*	-.131	-.024	-.152
	(.006)	(.182)	(.189)	(.155)	(.027)	(.157)
Population aged 65^{+} (%)	**-.017****		**-.774*****		**.064*****	
	(.007)		(.183)		(.016)	
Female in labor workforce (%)	-.019		-.096		**-.108*****	
	(.016)		(.558)		(.034)	
Intercept	**2.000****	1.489	40.158	2.347	**6.928*****	4.348
	(.016)	(6.305)	(25.989)	(5.638)	(1.728)	(7.110)
R-squared	.3550	.1389	.2741	.1387	.4319	.1383
F statistics	**82.01*****	**19.30*****	**100.04*****	**20.88*****	**92.54*****	**21.89*****

Table 4.15 *Two-stage Least Squares Models for Weight Loss*

Regression Coefficients *(Robust Standard Errors in Parenthesis)*	1st Stage RN staffing hprd	2nd Stage Weight loss (%)	1st Stage RN skill mix	2nd Stage Weight loss (%)	1st Stage Total staffing hprd	2nd Stage Weight loss (%)
RN staffing hprd §		-2.488				
		(9.105)				
RN skill mix§				-.112		
				(.236)		
Total staffing hprd§						1.966
						(3.071)
Number of beds	**-.001****	-.005	-.035*	-.006	**-.001*****	.002
(facility size)	(.001)	(.015)	(.018)	(.010)	(.000)	(.007)
For-profit status	**-.081*****	.922	**-1.140****	1.032	**-.192*****	1.569*
	(.020)	(1.043)	(.522)	(.641)	(.049)	(.799)
Chain	-.032	-.953	-.255	-.884	**-.110****	-.569
	(.033)	(.821)	(.835)	(.700)	(.039)	(.869)
Medicaid reimbursement rates	**.003*****	.014	.059*	.013	**.011*****	-.018
	(.001)	(.037)	(.029)	(.022)	(.002)	(.047)
Medicaid residents (%)	**-.002*****	-.033	**-.038*****	-.033*	**-.003*****	-.023
	(.001)	(.020)	(.012)	(.017)	(.001)	(.024)
Medicare residents (%)	.005*	**.200****	.126*	**.202****	.003	**.179****
	(.003)	(.090)	(.071)	(.081)	(.003)	(.070)
ADL dependency	-.018	1.693*	-.837	1.652*	.093	1.540
	(.029)	(.897)	(.915)	(.901)	(.069)	(.895)
Cognitively Impaired (%)	**-.003*****	.005	**-.092*****	.002	-.000	.014
	(.001)	(.029)	(.022)	(.021)	(.003)	(.025)
Herfindahl Index	-.032	.113	1.650	-.270	-.299	-.486
	(.146)	(4.137)	(3.470)	(3.765)	(.237)	(2.986)
Excess beds (%)	**-.022*****	-.238	-.387*	-.227	-.024	-.173
	(.006)	(.278)	(.189)	(.318)	(.027)	(.345)
Population aged 65+ (%)	**-.017****		**-.774*****		**.064*****	
	(.007)		(.183)		(.016)	
Female in labor workforce (%)	-.019		-.096		**-.108*****	
	(.016)		(.558)		(.034)	
Intercept	**2.000****	14.357*	40.158	14.926*	**6.928*****	7.404
	(.016)	(7.873)	(25.989)	(7.655)	(1.728)	(10.069)
R-squared	.3550	.1774	.2741	.1782	.4319	.1797
F statistics	**82.01*****	**29.37*****	**100.04*****	**36.82*****	**92.54*****	**92.37*****

Table 4.16-4.18 summarizes the OLS regression models for five process QMs including three different sets of staffing variables. Table 4.16 summarizes OLS regression models including RN staffing hours per resident day as a predictor. Table 4.17 summarizes OLS regression models including total staffing hours per resident day as a predictor to compare the effect of nursing home care by total staff with that of RNs. Table 4.18 summarizes OLS regression models including total staffing hours per resident day and RN skill mix as predictors to differentiate the impact of nursing care by RNs from that of total staff.

Table 4.16 *Effects of RN Staffing and Organizational Characteristics on 5 Process Measures*

Outcomes	Catheter use	Restraint use	Bedfast	Incontinence	Antipsychotic drug use
Predictors	*Unstandardized (B) Coefficients (Robust Standard Errors in Parenthesis)*				
RN staffing hprd	-.684	-2.297	.688	-3.773	.176
	(1.883)	(2.550)	(.876)	(4.324)	(4.496)
Organizational Characteristics					
Number of beds	-.006	.007	.001	**-.043****	-.000
(facility size)	(.008)	(.010)	(.003)	(.011)	(.019)
For-profit status	-.072	.345	-.027	-.101	4.421*
	(.946)	(1.512)	(.502)	(1.763)	(2.46)
Chain	-1.006*	-1.468	-.244	1.674*	1.264
	(.569)	(1.342)	(.344)	(.886)	(2.045)
Resources and Resident Characteristics					
Medicaid	**.067****	-.002	.023*	.048	-.030
reimbursement rates	(.026)	(.024)	(.013)	(.071)	(.045)
Medicaid residents	**.036*****	-.012	-.005	**-.174*****	.082*
	(.011)	(.022)	(.009)	(.024)	(.041)
Medicare residents	**.150*****	.102	.001	-.261*	**-.351****
	(.042)	(.093)	(.031)	(.128)	(.144)
ADL dependency	1.383*	1.216	.233	**13.603*****	-4.921
	(.659)	(.899)	(.350)	(1.836)	(3.181)
Cognitively impaired	.003	-.022	-.014	.091	-.007
	(.061)	(.024)	(.008)	(.052)	(.033)
Market Characteristics					
Herfindahl index	-2.128	4.340	.517	-5.056	-8.845*
	(2.618)	(4.370)	(1.848)	(5.609)	(4.518)
Excess beds	**-.319****	**-.906*****	.056	.038	-.135
	(.146)	(.233)	(.162)	(.467)	(.508)
Intercept	.591	**24.645*****	-1.023	35.167	24.890
	(3.606)	(4.576)	(2.073)	(13.030)	(16.238)
R-squared	.1131	.0641	.0497	.3138	.2025
F statistics	**15.89*****	**15.52*****	**14.51*****	**1221.72*****	**38.45*****

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata SE10.0; Robust standard errors were reported in parenthesis; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Table 4.17 *Effects of Total Staffing and Organizational Characteristics on 5 Process Measures*

Outcomes	Catheter use	Restraint use	Bedfast	Incontinence	Antipsychotic drug use
Predictors	*Unstandardized (B) Coefficients (Robust Standard Errors in Parenthesis)*				
Total staffing hprd	**2.762*** **	**3.728*** **	.914*	-.617	-2.077
	(.879)	(1.054)	(.446)	(2.170)	(1.446)
Organizational Characteristics					
Number of beds	.000	.017*	.002	**-.039*** **	-.005
(facility size)	(.008)	(.009)	(.003)	(.010)	(.019)
For-profit status	.645	1.406	.148	.006	3.905
	(.818)	(1.329)	(.377)	(1.736)	(2.214)
Chain	-.565	-.824	-.129	1.713	.944
	(.514)	(1.352)	(.308)	(.982)	(2.082)
Resources and Resident Characteristics					
Medicaid	.035*	**-.051** **	.017	.038	-.008
reimbursement rates	(.020)	(.023)	(.015)	(.075)	(.042)
Medicaid	**.045*** **	.003	-.004	**-.168*** **	.076
residents	(.010)	(.019)	(.009)	(.021)	(.034)
Medicare	**.135*** **	.074	.000	**-.277** **	-.341
residents	(.042)	(.092)	(.026)	(.122)	(.130)
ADL dependency	1.140*	.902	.144	**13.696*** **	-4.735
	(.538)	(.954)	(.320)	(1.837)	(3.152)
Cognitively	.008	-.013	-.016*	.101*	-.010
impaired	(.057)	(.028)	(.007)	(.051)	(.030)
Market Characteristics					
Herfindahl index	-3.711	2.566	-.248	-3.670	-7.567
	(3.560)	(3.843)	(1.645)	(6.031)	(5.343)
Excess Beds	-.273	**-.822*** **	.057	.090	-.164
	(.166)	(.233)	(.176)	(.475)	(.505)
Intercept	-7.018	**13.32** **	-2.840	**33.848** **	30.350*
	(5.027)	(5.081)	(2.478)	(13.139)	(16.101)
R-squared	.1654	.1033	.0688	.3107	.2084
F statistics	**17.32*** **	**46.53*** **	**7.05*** **	**1545.3*** **	**71.52*** **

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata SE10.0; Robust standard errors were reported in parenthesis; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Table 4.18 *Effects of Total Staffing, RN Skill Mix, and Organizational Characteristics on 5 Process Measures*

Outcomes	Catheter use	Restraint use	Bedfast	Incontinence	Antipsychotic drug use
Predictors	*Unstandardized (B) Coefficients (Robust Standard Errors in Parenthesis)*				
Total staffing hprd	**2.669****	**3.580*****	**.919****	-.696	-2.010
	(.902)	(1.058)	(.426)	(2.195)	(1.36)
RN skill mix	-.100	-.159*	.005	-.084	.072
	(.057)	(.087)	(.036)	(.121)	(.217)
Organizational Characteristics					
Number of beds	-.003	.012	.002	**-.042*****	-.002
(facility size)	(.010)	(.010)	(.003)	(.011)	(.019)
For-profit status	.569	1.286	.152	-.058	3.960
	(.816)	(1.331)	(.398)	(1.736)	(2.257)
Chain	-.595	-.873	-.128	1.688	.966
	(.513)	(1.322)	(.314)	(.997)	(2.100)
Resources and Resident Characteristics					
Medicaid	**.045****	-.035	.016	.046	-.015
reimbursement rates	(.020)	(.027)	(.013)	(.079)	(.043)
Medicaid residents	**.041*****	-.004	-.003	**-.172*****	.079*
	(.009)	(.020)	(.009)	(.024)	(.041)
Medicare residents	**.148*****	.096	-.000	-.266*	**-.351****
	(.039)	(.098)	(.029)	(.124)	(.149)
ADL dependency	1.09*	.823	.146	**13.654*****	-4.700
	(.577)	(.930)	(.316)	(1.861)	(3.229)
Cognitively	-.001	-.027	-.015*	.094*	-.003
impaired	(.057)	(.031)	(.007)	(.052)	(.034)
Market Characteristics					
Herfindahl index	-4.574	1.192	-.207	-4.396	-6.944
	(4.228)	(3.499)	(1.825)	(5.630)	(5.853)
Excess beds	-.300	**-.865*****	.058	.068	-.145
	(.181)	(.245)	(.174)	(.475)	(.508)
Intercept	-4.570	**17.212*****	-2.954	**35.907****	28.586
	(5.387)	(5.684)	(2.294)	(13.432)	(18.179)
R-squared	.1790	.1186	.0690	.3121	.2098
F statistics	**15.98*****	**73.08*****	**44.66*****	**1232.34*****	**304.72*****

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata SE10.0; Robust standard errors were reported in parenthesis; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Hypotheses Testing for Specific Aim 2

For specific aim 2, six hypotheses were investigated with the overall analytical models. Each hypothesis was questioned using three different analytical models. To better understand the effect of interest on nine resident outcomes, summary tables are presented below. According to each hypothesis, unstandardized coefficients and their robust standard errors were retrieved from Table 4.12-18. In each summary table for H_1, H_2 and H_3 hypothesizing whether the three organizational factors affect care processes or outcomes of care, the three rows represent three different analytical models. The unstandardized coefficients in the first row were retrieved from the 2SLS or OLS models including RN staffing hours per resident day as a staffing measure in Tables 4.12-4.16. The second row values were from the 2SLS or OLS models including total staffing hours per resident day in Tables 4.12-4.15 and 4.17. The values in the third row were from 2SLS or OLS models including total staffing hours per resident day and RN skill mix in Table 4.15-16. For H_4, H_5 and H_6 hypothesizing that higher RN staffing, total staffing, and RN skill mix were associated with lower percentages of adverse resident outcomes indicated by nine QMs, unstandardized coefficients were retrieved from the relevant models in Tables 4.12-4.15 and 4.18.

H_1: For-profit nursing homes (NHs) have higher percentages of poor care processes and adverse resident outcomes than not-for-profit NHs.

As shown in Table 4.19-4.20, there were no significant effects of for-profit status on process and outcomes QMs. Therefore, H_1 was not supported.

Table 4.19 *Unstandardized Coefficients for For-profit on 4 Outcome QMs from 3 Models*

For-profit	Pressure ulcers	Falls	UTIs	Weight loss
Model $_{\text{RN staffing}}$	-.718 (.740)	-.142 (1.322)	-.948 (.819)	.922 (1.043)
Model $_{\text{RN skill mix}}$	-.061 (.609)	-.591 (.980)	-1.122 (.730)	1.032 (.641)
Model $_{\text{Total staffing}}$	-.098 (.875)	-.631 (.900)	-1.204 (1.113)	1.569* (.799)

†Note: N=195, 2SLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata SE 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01.

Table 4.20 *Unstandardized Coefficients for For-profit on 5 Process QMs from 3 Models*

For-profit	Catheter use	Physical Restraint use	Bedfast	Incontinence	Antipsychotic Drug use
Model $_{\text{RN staffing}}$	-.072 (.946)	.345 (1.512)	-.027 (.502)	-.101 (1.763)	4.421* (2.46)
Model $_{\text{Total staffing}}$	.645 (.818)	1.406 (1.329)	.148 (.377)	.006 (1.736)	3.905 (2.214)
Model $_{\text{Total \& RN skill mix}}$	.569 (.816)	1.286 (1.331)	.152 (.398)	-.058 (1.736)	3.960 (2.257)

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata SE 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01.

H_2: Chain-affiliated NHs have higher percentages of poor care processes and adverse resident outcomes than non-chain NHs.

As shown in Table 4.21-4.22, there were no significant effects of chain affiliation on process and outcomes QMs. Therefore, *H_2* was not supported.

Table 4.21 *Unstandardized Coefficients for Chain on 4 Outcome QMs from 3 Models*

Chain	Pressure ulcers	Falls	UTIs	Weight loss
Model $_{\text{RN staffing}}$	-.744 (.759)	.505 (.744)	-.456 (.674)	-.953 (.821)
Model $_{\text{RN skill mix}}$	-.384 (.690)	.257 (.764)	-.553 (.645)	-.884 (.700)
Model $_{\text{Total staffing}}$	-.441 (.714)	.258 (.971)	-.593 (.814)	-.569 (.869)

†Note: N=195, 2SLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata SE 10.0; *p-value ≤.10; *p-value <.05; **p-value<.01.

Table 4.22 *Unstandardized Coefficients for Chain on 5 Process QMs from 3 Models*

Chain	Catheter use	Physical Restraint use	Bedfast	Incontinence	Antipsychotic Drug use
Model $_{\text{RN staffing}}$	-1.006*	-1.468	-.244	1.674*	1.264
	(.569)	(1.342)	(.344)	(.886)	(2.045)
Model $_{\text{Total staffing}}$	-.565	-.824	-.129	1.713	.944
	(.514)	(1.352)	(.308)	(.982)	(2.082)
Model $_{\text{Total \& RN skill mix}}$	-.595	-.873	-.128	1.688	.966
	(.513)	(1.322)	(.314)	(.997)	(2.100)

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata SE 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01.

H_3: Larger NHs have higher percentages of poor care processes and adverse resident outcomes than smaller NHs.

As shown in Table 4.23-24, three analytical models demonstrated that larger nursing homes have significantly lower rates of pressure ulcers, urinary tract infections, and incontinence. With each additional bed increase in a nursing home, the nursing home had a 0.02~0.03% lower percentage of pressure ulcers, 0.01~0.02% lower percentage of urinary tract infections, and a 0.04% lower percentage of incontinence. Therefore, H_3 was not supported, while the reverse effects were found for two outcome measures and one process measure.

Table 4.23 *Unstandardized Coefficients for Facility Size on 4 Outcome QMs from 3 Models*

Number of beds (Facility size)	Pressure ulcers	Falls	UTIs	Weight loss
Model $_{\text{RN staffing}}$	**-.029*****	.009	**-.014****	-.005
	(.009)	(.017)	(.006)	(.015)
Model $_{\text{RN skill mix}}$	**-.020****	.003	**-.016*****	-.006
	(.008)	(.012)	(.005)	(.010)
Model $_{\text{Total staffing}}$	-.014*	-.002	**-.019*****	.002
	(.007)	(.009)	(.005)	(.007)

†Note: N=195, 2SLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Table 4.24 *Unstandardized Coefficients for Facility Size on 5 Process QMs from 3 Models*

Number of beds (Facility size)	Catheter use	Physical Restraint use	Bedfast	Incontinence	Antipsychotic Drug use
Model $_{\text{RN staffing}}$	-.006 (.008)	.007 (.010)	.001 (.003)	**-.043*** ** (.011)	-.000 (.019)
Model $_{\text{Total staffing}}$	.000 (.008)	.017* (.009)	.002 (.003)	**-.039*** ** (.010)	-.005 (.019)
Model $_{\text{Total \& RN skill mix}}$	-.003 (.010)	.012 (.010)	.002 (.003)	**-.042*** ** (.011)	-.002 (.019)

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

H_4: NHs with higher RN staffing hours have lower percentages of poor care processes and adverse resident outcomes than other NHs.

Table 4.25-26 illustrates effects of RN hours per resident day were not statistically significant for outcome and process QMs, except for pressure ulcers. Higher RN staffing hours per resident day were associated with lower (11%) percentage of pressure ulcers, while RN hours did not have a significant effect on other process and outcome QMs. Therefore, H_4 was partially supported for pressure ulcers.

Table 4.25 *Unstandardized Coefficients for RN Staffing on 4 Outcome QMs*

	Pressure ulcers	Falls	UTIs	Weight loss
2SLS Model $_{\text{RN staffing}}$				
RN staffing hprd	**-11.272**** (5.026)	7.781 (10.588)	3.09 (4.017)	-2.488 (9.105)

†Note: N=195, 2SLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Table 4.26 *Unstandardized Coefficients for RN Staffing on 5 Process QMs*

	Catheter use	Physical Restraint use	Bedfast	Incontinence	Antipsychotic Drug use
OLS Model $_{\text{RN staffing}}$					
RN staffing hprd	-.684 (1.883)	-2.297 (2.550)	.688 (.876)	-3.773 (4.324)	.176 (4.496)

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

H_5: NHs with higher total staffing hours have lower percentages of poor care processes and adverse resident outcomes than other NHs.

Table 4.27-28 illustrates that higher total staffing hours per resident day were significantly related to higher percentages of three process QMs (catheter and restraint use, and bedfast status). The total hours had no significant effects on other two process QMs and outcome QMs. Therefore, H_5 was not supported, while reverse effects were identified for catheter and restraint use, and bedfast status.

Table 4.27 *Unstandardized Coefficients for Total Staffing on 4 Outcome QMs*

	Pressure ulcers	Falls	UTIs	Weight loss
OLS Model $_{Total\ staffing}$				
Total staffing hprd	-.607	.168	-.189	1.966
	(1.959)	(3.342)	(1.893)	(3.071)

†Note: N=195, 2SLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Table 4.28 *Unstandardized Coefficients for Total Staffing on 5 Process QMs*

	Catheter use	Physical Restraint use	Bedfast	Incontinence	Antipsychotic Drug use
OLS Model $_{Total\ staffing}$					
Total staffing hprd	**2.762*** **	**3.728*** **	.914*	-.617	-2.077
	(.879)	(1.054)	(.446)	(2.170)	(1.446)
OLS Model $_{Total\ staffing\ \&\ RN\ skill\ mix}$					
Total staffing hprd	**2.669** **	**3.580*** **	**.919** **	-.696	-2.010
	(.902)	(1.058)	(.426)	(2.195)	(1.36)

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

H_6: NHs with higher RN skill mix have lower percentages of poor care processes and adverse resident outcomes than other NHs.

As shown in Table 4.27-28, no significant effects of RN skill mix on nine QMs were found at the .05 confidence level. Therefore, H_6 was not supported.

Table 4.29 *Unstandardized Coefficients for RN Skill Mix on 4 Outcome QMs*

	Pressure ulcers	Falls	UTIs	Weight loss
2SLS Model *Total staffing & RN skill mix*				
RN skill mix	-.210	.153	.069	-.112
	(.175)	(.292)	(.098)	(.236)

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Table 4.30 *Unstandardized Coefficients for RN Skill Mix on 5 Process QMs*

	Catheter use	Physical Restraint use	Bedfast	Incontinence	Antipsychotic Drug use
OLS Model *Total staffing & RN skill mix*					
RN skill mix	-.100	-.159*	.005	-.084	.072
	(.057)	(.087)	(.036)	(.121)	(.217)

†Note: N=195, simple OLS regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Specific Aim 3: Impact of Organizational Characteristics and Nurse Staffing Levels on Facility Deficiencies

Overall Analytic Models for Specific Aim 3

Negative binomial regression models using three different sets of staffing variables were conducted for each outcome (See Table 4.31-33). Four types of deficiencies were used as outcomes: total citations, substandard-care citations, quality-of-care citations, and quality-of-life citations. For Specific Aim 3, fifteen negative binomial regression models were conducted and confirmed that negative binomial regression analysis was the appropriate method to use for the outcomes rather than the Poisson regression model. Like other aims, robust clustering for 15 HSAs was applied to the negative binomial regression models using Stata. Since clustering restricts the number of predictors for getting chi-square test statistics for an overall model, less attention has been paid to whether an overall model was statistically significant or not.

Table 4.31 *Negative Binomial Regression for RN Staffing Hours on Four Types of Deficiencies*

Outcomes	Total Citations	Substandard-care Citations	Quality-of-care Citations	Quality-of-life Citations
Predictors	*Unstandardized (B) Coefficients (Robust Standard Errors in Parenthesis)*			
RN staffing hprd	-.402	-.326	-.268	-.180
	(.497)	(.647)	(.602)	(.698)
Organizational Characteristics				
Number of beds	.005*	**.006****	**.006****	**.007****
(facility size)	(.002)	(.003)	(.002)	(.003)
For-profit status	.345	.325	.312	**.388****
	(.199)	(.278)	(.285)	(.184)
Chain	**.346****	**.314****	**.328****	.600*
	(.137)	(.136)	(.132)	(.312)
Resource and Resident Characteristics				
Medicaid reimbursement rate	**-.008****	-.001	-.002	.003
	(.004)	(.004)	(.004)	(.006)
Medicaid residents (%)	.001	.003	.001	.006
	(.004)	(.003)	(.003)	(.005)
Medicare residents (%)	-.023*	-.017	-.016	**-.033*****
	(.013)	(.011)	(.015)	(.012)
ADL dependency	-.012	-.005	.027	.271*
	(.318)	(.319)	(.306)	(.148)
Cognitively impaired (%)	.011	.012	.007	.010
	(.009)	(.010)	(.008)	(.008)
Market Characteristics				
Herfindahl index	.401	1.063*	.998	1.02
	(.616)	(.553)	(.648)	(.684)
Excess beds (%)	-.059	**-.115****	**-.111*****	-.034
	(.046)	(.048)	(.041)	(.064)
RNs per 100,000 populations	.001	-.000	.000	-.001
	(.001)	(.001)	(.001)	(.001)
Females in labor workforce (%)	-.223	-.186	-.177	-.144
	(.122)	(.146)	(.139)	(.193)
Population aged 65^{+} (%)	-.016	-.035	-.007	-.125
	(.056)	(.085)	(.077)	(.078)
Per capita income ($)	**.00005****	**.00005****	**.00005****	.000
	(.00001)	(.00002)	(.00002)	(.000)
Intercept	10.644	9.393	7.674	6.252
	(5.686)	(6.086)	(5.520)	(8.845)

†Note: N=195, negative binomial regression models were conducted with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Table 4.32 *Negative Binomial Regression for Total Staffing Hours on Four Types of Deficiencies*

Outcomes	Total Citations	Substandard-care Citations	Quality-of-care Citations	Quality-of-life Citations
Predictors	*Unstandardized (B) Coefficients (Robust Standard Errors in Parenthesis)*			
Total staffing hprd	.251*	.233	.304	.191
	(.150)	(.178)	(.206)	(.116)
Organizational Characteristics				
Number of beds (facility size)	**.005*** **	**.007*** **	**.006*** **	**.008*** **
	(.002)	(.002)	(.002)	(.002)
For-profit status	.392	.357	.338	.424*
	(.225)	(.302)	(.284)	(.216)
Chain	**.348** **	**.317** **	**.334** **	.623*
	(.148)	(.140)	(.140)	(.338)
Resource and Resident Characteristics				
Medicaid reimbursement rate	**-.012*** **	-.005	-.007	.000
	(.004)	(.005)	(.004)	(.006)
Medicaid residents (%)	.002	.004	.002	.007
	(.004)	(.003)	(.002)	(.004)
Medicare residents (%)	**-.022** **	-.017*	-.015	**-.033*** **
	(.012)	(.009)	(.012)	(.011)
ADL dependency	-.031	-.029	-.001	**.251** **
	(.299)	(.294)	(.288)	(.123)
Cognitively impaired (%)	.011	.012	.007	.011
	(.008)	(.009)	(.007)	(.007)
Market Characteristics				
Herfindahl index	.451	**1.129** **	1.105*	1.08
	(.591)	(.533)	(.610)	(.662)
Excess beds (%)	-.048	**-.105** **	**-.101** **	-.025
	(.043)	(.045)	(.042)	(.063)
RNs per 100,000 populations	.001	-.000	.000	-.001
	(.001)	(.001)	(.001)	(.001)
Females in labor workforce (%)	-.185	-.160	-.141	-.129
	(.121)	(.137)	(.128)	(.191)
Population aged 65^{+} (%)	-.012	-.031	-.009	-.130*
	(.056)	(.084)	(.077)	(.077)
Per capita income ($)	**.00005*** **	**.00005** **	**.00006*** **	.000
	(.00002)	(.00002)	(.00002)	(.000)
Intercept	7.790	7.297	5.041	4.916
	(5.291)	(5.066)	(4.643)	(8.944)

†Note: N=195, negative binomial regression models were conducted with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Table 4.33 *Negative Binomial Regression for Total Staffing Hours and RN Skill Mix on Four Types of Deficiencies*

Outcomes	Total Citations	Substandard-care Citations	Quality-of-care Citations	Quality-of-life Citations
Predictors	*Unstandardized (B) Coefficients (Robust Standard Errors in Parenthesis)*			
Total staffing hprd	.256*	.234	.314	.191
	(.142)	(.170)	(.199)	(.215)
RN skill mix	-.022	-.019	-.021	-.010
	(.016)	(.023)	(.021)	(.030)
Organizational Characteristics				
Number of beds	.005*	**.006****	**.006****	**.007*****
(facility size)	(.002)	(.003)	(.003)	(.003)
For-profit status	.379*	.346	.337	**.415****
	(.218)	(.300)	(.297)	(.201)
Chain	**.364****	**.334****	**.358*****	.624*
	(.143)	(.141)	(.123)	(.341)
Resource and Resident Characteristics				
Medicaid	**-.012*****	-.004	-.006	.001
reimbursement rate	(.004)	(.004)	(.004)	(.006)
Medicaid residents	.002	.003	.002	.007
(%)	(.004)	(.003)	(.002)	(.005)
Medicare residents	-.021*	-.015	-.013	**-.032****
(%)	(.012)	(.010)	(.014)	(.013)
ADL dependency	-.031	-.031	-.005	.257*
	(.313)	(.311)	(.310)	(.127)
Cognitively	.009	.011	.005	.010
impaired (%)	(.009)	(.010)	(.007)	(.009)
Market Characteristics				
Herfindahl index	.548	**1.216****	**1.199****	1.127*
	(.585)	(.529)	(.602)	(.654)
Excess beds (%)	-.049	**-.110****	**-.104****	-.026
	(.042)	(.047)	(.043)	(.063)
RNs per 100,000	.001	-.000	.000	-.001
populations	(.001)	(.001)	(.001)	(.001)
Females in labor	-.195	-.169	-.147	-.139
workforce (%)	(.123)	(.143)	(.133)	(.191)
Population aged	-.038	-.052	-.032	-.136
65^{+} (%)	(.061)	(.089)	(.080)	(.077)
Per capita income	**.00004*****	**.00005****	**.00006*****	.000
($)	(.00002)	(.00002)	(.00002)	(.000)
Intercept	9.998	8.346	5.986	5.572
	(5.567)	(5.754)	(5.153)	(8.800)

†Note: N=195, negative binomial regression models were conducted with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Hypotheses Testing for Specific Aim 3

Six hypotheses were examined by comparing negative binomial regression coefficients. Unstandardized coefficients (*B*) from each negative binomial regression model were retrieved from Table 4.31-4.33. The coefficients were exponentiated as incident rate ratios to assess relationship between response and predictors (Hilbe, 2007). An incident rate ratio indicates the ratio by which the number of incidents multiplies, which is attributable to the predictor. The ratios with 95% confidence intervals are reported in Tables 4.34-4.39.

H_1: For-profit nursing homes (NHs) have more deficiencies than not-for-profit NHs.

As shown in Table 4.34, there were significant effects of for-profit status on quality-of-life citations in two analytical models. The quality-of-life citations were significantly increased by approximately 50% ($p<.05$) when the nursing homes were for-profit. For other types of citations, the effects were insignificant. Therefore, H_1 was partially supported for quality-of-life deficiencies.

Table 4.34 *Negative Binomial Coefficients for For-profit on Deficiencies*

For-profit	Total citations	Substandard-care citations	Quality-of-care citations	Quality-of-life citations
Model $_{\text{RN staffing}}$	.345	.325	.312	**.388****
	(.199)	(.278)	(.285)	(.184)
IRR (95% CI)	1.46	1.38	1.36	**1.47****
	(.95 to 2.10)	(.80 to 2.39)	(.78 to 2.39)	(1.03 to 2.11)
Model $_{\text{Total staffing}}$	.392	.357	.338	.424*
	(.225)	(.302)	(.284)	(.216)
IRR (95% CI)	1.48	1.43	1.42	1.53*
	(.95 to 2.30)	(.79 to 2.58)	(.79 to 2.54)	(1.00 to 2.33)
Model $_{\text{Total \& RN skill mix}}$	.379*	.346	.337	**.415****
	(.218)	(.300)	(.297)	(.201)
IRR (95% CI)	1.461*	1.41	1.40	**1.51****
	(.95 to 2.24)	(.79 to 2.54)	(.78 to 2.51)	(1.02 to 2.25)

†Note: IRR means *Incident Rate Ratios*; N=195, negative binomial regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

H_2: Chain-affiliated NHs have more deficiencies than non-chain NHs.

Table 4.35 highlights consistent evidence that chain-affiliated nursing homes have more deficiencies of three types: total citations, substandard-care citations, and quality-of-care citations. The number of citations was significantly increased by approximately 40% for these outcomes in three analytical models ($p<.05$). Therefore, H_5 was partially supported for three types of deficiencies, but quality-of-life citations did not support the hypothesis.

Table 4.35 *Negative Binomial Coefficients for Chain Affiliation on Deficiencies*

Chain	Total citations	Substandard-care citations	Quality-of-care citations	Quality-of-life citations
Model $_{\text{RN staffing}}$	**.346****	**.314****	**.328****	.600*
	(.137)	(.136)	(.132)	(.312)
IRR (95% CI)	**1.41****	**1.37****	**1.39****	1.82*
	(1.07 to 1.86)	(1.05 to 1.79)	(1.08 to 1.79)	(.99 to 3.36)
Model $_{\text{Total staffing}}$	**.348****	**.317****	**.334****	.623*
	(.148)	(.140)	(.140)	(.338)
IRR (95% CI)	**1.42****	**1.37****	**1.40****	1.86*
	(1.06 to1.89)	(1.04 to 1.81)	(1.06 to 1.84)	(.96 to 3.62)
Model $_{\text{Total \& RN skill mix}}$	**.364****	**.334****	**.358*****	.624*
	(.143)	(.141)	(.123)	(.341)
IRR (95% CI)	**1.44****	**1.40****	**1.43*****	1.87*
	(1.09 to 1.91)	(1.06 to 1.84)	(1.12 to 1.82)	(.96 to 3.64)

†Note: IRR means *Incident Rate Ratios*; N=195, negative binomial regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

H_3: Larger NHs have more deficiencies than smaller NHs.

Table 4.36 illustrates that the effects of facility size were statistically significant for all outcomes, holding other variables constant. For total citations, magnitude of the effect was smaller than for other outcome models. Its coefficients were insignificant in the model with RN staffing hours and the model including total staffing hours and RN skill mix. On the other hand, the model not including RN staffing hours or RN skill mix and including total staffing hours had significant effects on total citations. There

was a 5% increase in number of total citations per 10 more beds (*B*=.005; $IRR_{size=10}$= $e^{.05}$=1.05, p<.01). In three analytical models, there were significantly increasing effects of facility size on number of quality-of-care citations by 6% (*B*=.006, p<.05), number of quality-of-life citations by 7~8% (*B*=.007/.008, p<.05), and number of substandard-care citations by 6~7% (*B*=.006/.007, p<.05) for each increase of 10 nursing home beds. Therefore, H_3 was supported.

Table 4.36 *Negative Binomial Coefficients for Facility Size on Deficiencies*

Number of beds (Facility size)	Total citations	Substandard-care citations	Quality-of-care citations	Quality-of-life citations
Model $_{\text{RN staffing}}$	.005*	**.006****	**.006****	**.007****
	(.002)	(.003)	(.002)	(.003)
IRR (95% CI)	1.005*	**1.006****	**1.006****	**1.007****
	(1.9995 to 1.0091)	(1.0003 to 1.0114)	(1.0007 to 1.0105)	(1.0023 to 1.0127)
Model $_{\text{Total staffing}}$	**.005*****	**.007*****	**.006*****	**.008*****
	(.002)	(.002)	(.002)	(.002)
IRR (95% CI)	**1.005*****	**1.007*****	**1.006*****	**1.008*****
	(1.0018 to 1.0090)	(1.0024 to 1.0109)	(1.0026 to 1.0100)	(1.0044 to 1.0113)
Model $_{\text{Total \& RN skill mix}}$	.005*	**.006****	**.006****	**.007*****
	(.002)	(.003)	(.003)	(.003)
IRR (95% CI)	1.005*	**1.006****	**1.006****	**1.007*****
	(1.9999 to 1.0094)	(1.0002 to 1.0117)	(1.0004 to 1.0106)	(1.002 to 1.0130)

†Note: IRR means *Incident Rate Ratios*; N=195, negative binomial regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

H_4: NHs with higher RN staffing hours have fewer deficiencies than other NHs.

As shown in Table 4.37, there were no significant effects of RN staffing hours per resident day on all types of deficiencies when holding other predictors constant. Therefore, H_4 was not supported.

Table 4.37 *Negative Binomial Coefficients for RN Staffing on Deficiencies*

	Total citations	Substandard-care citations	Quality-of-care citations	Quality-of-life citations
NBR Model $_{RN\ staffing}$				
RN staffing hprd	-.402	-.326	-.268	-.180
	(.497)	(.647)	(.602)	(.698)
IRR (95% CI)	.668	.722	.765	.836
	(.25 to 1.78)	(.20 to 2.57)	(.24 to 2.49)	(.21 to 3.28)

†Note: IRR means *Incident Rate Ratios*; N=195, negative binomial regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

H_5: NHs with higher total staffing hours have fewer deficiencies than other NHs.

As shown in Table 4.36, there were no significant effects of total staffing hours on four kinds of citations when holding other factors constant. Hence, H_5 was not supported.

Table 4.38 *Regression Negative Binomial Coefficients for Total Staffing on Deficiencies*

	Total citations	Substandard-care citations	Quality-of-care citations	Quality-of-life citations
NBR Model $_{Total\ staffing}$				
Total staffing hprd	.251*	.233	.304	.191
	(.150)	(.178)	(.206)	(.116)
IRR (95% CI)	1.286*	1.262	1.356	1.211
	(.98 to 1.73)	(.89 to 1.79)	(.91 to 2.03)	(.79 to 1.86)
NBR Model $_{Total\ \&\ RN\ skill\ mix}$				
Total staffing hprd	.256*	.234	.314	.191
	(.142)	(.170)	(.199)	(.215)
IRR (95% CI)	1.291*	1.263	1.368	1.210
	(.98 to 1.71)	(.91 to 1.76)	(.93 to 2.02)	(.79 to 1.85)

†Note: IRR means *Incident Rate Ratios*; N=195, negative binomial regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

H_6: NHs with a higher proportion of RN staffing hours have fewer deficiencies than other NHs.

As shown in Table 4.39, there were no significant effects of RN skill mix on deficiencies while holding other variables constant. Therefore, H_6 was not supported.

Table 4.39 *Negative Binomial Coefficients for RN Skill mix on Deficiencies*

	Total citations	Substandard-care citations	Quality-of-care citations	Quality-of-life citations
NBR Model *Total & RN skill mix*				
RN skill mix	-.022	-.019	-.021	-.010
	(.016)	(.023)	(.021)	(.030)
IRR (95% CI)	.979	.981	.979	.990
	(.95 to 1.01)	(.94 to 1.03)	(.94 to 1.02)	(.93 to 1.05)

†Note: IRR means *Incident Rate Ratios*; N=195, negative binomial regression models were used with robust clustering (by 15 HSAs) procedure in Stata 10.0; *p-value ≤.10; **p-value ≤.05; ***p-value≤.01; Statistically significant coefficients were bolded.

Other Findings

After the main analyses, this research explored two additional research questions: (1) What factors are related to noncompliance with the state minimum staffing standard of 2.48 total staffing hours per resident day? (2) What factors are related to compliance with the CMS recommended staffing standard of 4.1 total staffing hours per resident day? For the first question, only seven nursing homes were below the state minimum staffing standard of 2.48 total staffing hours. The number of total beds varied ranging from 56 to 242, all seven nursing homes were for-profit, and five were chain-affiliated. These seven nursing homes were located in the HSAs with high competition (Herfindahl index <.10, except for one nursing home with .19). For the second question, only eight nursing homes were above the recommended staffing standard of 4.1 total staffing hours. Six homes were not-for-profit and non-chain. Even

though one of these highly staffed nursing homes had 131 total beds, the other seven were small nursing homes with fewer total beds ranging from 30 to 56. Half of these nursing homes were located in the HSA with high competition in bed supply, while the other half were located in less competitive areas. Because subjects were so few (less than 5% of the sample), this research questions could not be completed with statistical analyses.

Summary of Findings

For Specific Aim 1, H_1 (for-profit status is related to lower staffing) and H_2 (chain affiliation is related to lower staffing) were partially supported for total staffing hours holding other factors constant. However, the reverse effect of for-profit status was found for both RN staffing hours and RN skill mix. Higher RN staffing levels were reported in for-profit nursing homes when endogeneity and other exogenous predictors were controlled. H_3 (Larger nursing home size is related to lower staffing) was clearly supported. Larger nursing homes had lower staffing levels than smaller ones.

For Specific Aim 2, H_1 (for-profit status is related to more residents with adverse outcomes) was partially supported for weight loss. For-profit homes reported higher percentages of residents with weight loss than not-for-profit homes. H_2 (chain affiliation is related to more residents with adverse outcomes), H_3 (larger nursing home size is related to more residents with adverse outcomes) were not supported. H_4 (RN staffing hours are related to fewer residents with adverse outcomes) was partially supported for pressure ulcers, holding other factors constant. H_5 (total staffing hours are related to fewer residents with adverse outcomes) was not supported, but the

reverse effects of total staffing were identified for percentages of catheter and restraint use, and bedfast status. H_6 (RN skill mix is related to fewer residents with adverse outcomes) was not supported.

For Specific Aim 3, H_1 (for-profit status is related to more deficiencies) was partially supported for quality-of-life citations, while H_2 (chain affiliation is related to more deficiencies) was supported except for quality-of-life citations. There was a significant effect of for-profit status only on quality-of-life citations. Nursing homes affiliated with chains had more total, substandard-care, and quality-of-care citations. H_3 (facility size is related to more deficiencies) was clearly supported. Large nursing homes had more number of deficiencies of all types. Three hypotheses that RN staffing hours (H_4), total staffing hours (H_5), and RN skill mix (H_6) are related to fewer deficiencies were not supported. There was no association between nurse staffing levels and facility deficiencies when holding other factors constant.

In additional analyses, only seven nursing homes were below the state minimum staffing standard of 2.48 total staffing hours. Although number of total beds varies, all seven nursing homes were for-profit homes. Six homes were located in HSAs with high competition. Five were chain-affiliated. On the other hand, only eight nursing homes were above the recommended staffing standard of 4.1 total staffing hours. Of the eight homes, six were not-for-profit and non-chain; seven were small nursing homes (less than 60 beds).

CHAPTER 5

Discussion

Introduction

The purpose of this research was to better understand the relationship between nursing home characteristics and quality of care. This study examined the multidimensional relationships among organizational characteristics, nurse staffing levels, resident outcomes, and facility deficiencies with three research aims. The three specific aims were to determine the effect of organizational characteristics: (1) on nurse staffing levels, (2) nurse staffing levels on care processes and outcomes of care, and (3) nurse staffing levels on facility deficiencies. Resources, resident, and market characteristics were controlled for all three aims.

To achieve the three specific aims, six directional hypotheses posited the negative effects of for-profit status (H_1), chain affiliation (H_2), facility size (H_3), and the positive effects of RN staffing hours per resident day (hprd) (H_4), total staffing hprd (H_5), and RN skill mix (H_6) on the quality of care. Two research questions addressed features related to (1) noncompliance with existing current minimum state staffing standard of 2.48 total staffing hprd and (2) compliance with the federally recommended minimum staffing standard of 4.1 total staffing hprd.

Overall, the study designs using multi-methods were able to achieve the three research aims and to test the six hypotheses. Additional research questions were answered with further descriptive analysis.

Meaning of Findings

Specific Aim 1: Impact of Organizational Characteristics on Nurse Staffing Levels

Three organizational characteristics (for-profit status, chain affiliation, and facility size) were significantly associated with nurse staffing levels. For-profit homes and chain-affiliated nursing homes provided less total staffing hours per resident day (hprd). Larger nursing homes also provided less RN and total staffing hprd, as well as lower RN skill mix. A plausible explanation for the relationship between size and staffing is that small homes are "required" to have more RN care under federal mandates than larger homes, while large homes are not required to have as much RN staffing as smaller homes. Under the Omnibus Budget Reconciliation Act of 1987 (OBRA 1987), each home must have one RN on duty seven days a week on the day shift, and one licensed vocational nurse (LVN) on evening and night shifts but there is no adjustment for nursing home size. Thus, a 30-bed home and a 200-bed home can have the same licensed nurse staffing levels. Accordingly, large homes are apt to make economical staffing decisions expecting economies of scale. Overall, these findings were consistent with previous studies which found for-profit and larger homes had lower RN and total staffing levels (Grabowski & Hirth, 2003; Harrington & Swan, 2003; Harrington, Swan, et al, 2007; Harrington et al., 2001).

However, the finding that for-profit nursing homes provided higher (4.5%) proportions of RN staffing hours when endogeneity and other factors were controlled was inconsistent with previous studies. A possible explanation from an economic perspective (Scanlon, 1980) is that for-profit nursing homes may be more efficient than not-for-profit homes. For-profit nursing homes may prefer to hire registered nurses

who can work more efficiently providing and managing resident care rather than other types of direct care staff. Another possible explanation is that fewer total hours per resident day (hprd) may result in relatively higher proportions of RN hours because the denominator gets smaller. Thus, the finding of higher RN skill mix in for-profit homes may reflect relatively lower levels of total staffing hprd than not-for-profit homes.

Of 195 nursing homes, seven were below the state minimum staffing standards of 2.48 total staffing hprd. Of the seven noncompliant homes, all were for-profit and five were chain-affiliated. Six homes were located in HSAs with high competition. These relevant characteristics demonstrated failure to meet state minimum standards may reflect decisions compromising quality for profitability. Another explanation from resource dependency theory is nursing homes can survive even when they cannot make adaptations to the state staffing mandates, which illustrate the functional failure of the state regulatory systems. A previous study revealed that Colorado was the lowest ranked (50^{th}) state of all states comparing average scores of five nursing home enforcement indicators: average number of deficiencies in 1999, percentage of facilities with deficiencies in 1999, percentage of facilities cited for harm and jeopardy in 1999, percentage cited for sub-standard care in 1999, and average civil money penalties issued per facility surveyed in 1999 (Harrington et al., 2004). Given the evidence, noncompliance with state minimum staffing standard represents the outcome of weak state regulatory systems that failed to provide a fundamental level of quality care in seven nursing homes. The level of 2.48 hprd is a low state staffing standard as compared to other states (i.e. CA, DE, NV, and AR) that had higher staffing standards of over 3.0 total staffing hprd (Harrington, 2005a). Furthermore, the fact that Colorado

has one of the lowest staffing standards in the U.S. can explain why Colorado nursing homes have low staffing (Harrington, Swan et al., 2007).

The minimum staffing threshold set by the Center for Medicare and Medicaid Services (CMS), which noted incremental benefits for increased staffing up to a point, was 4.1 total staffing hprd (2.8 hprd for NAs and 1.3 hprd for licensed staff – including .75 hprd for RNs) (CMS, 2001). Of 195 nursing homes, only eight were above the CMS recommended minimum staffing standards of 4.1 total staffing hprd in Colorado. Of the eight compliant homes, six were not-for-profit and non-chain nursing homes; seven were small nursing homes. These organizational characteristics (not-for-profit, non-chain, small size) apparently affect institutional logic on decision-making systems for nurse staffing. From resource dependency theory, a nursing home organization adapts a new form as an intentional strategy to increase the possibility of survival considering their economic or technological circumstances. This means that the seven homes, which do not comply with the state minimum mandate, decided to decrease staffing levels to survive. Then it can be concluded that the profit-driven strategy on staffing decisions threatens each nursing home's internal regulatory systems for high quality care provided by qualified nursing staff. Given this insight, it is clear that customized regulatory systems should be used to enforce different decision-making strategies. From institutional theory, external governing systems, such as public policies, create new institutional logics that can change staffing patterns within organizations through regulative institutionalization. This finding implies that state minimum staffing standards, to be a more effective public policy, must force nursing homes to increase nurse staffing levels to the desired point, providing them

either financial incentives or monetary penalties (i.e. civil money penalties).

In sum, Specific Aim 1 found systematic variations in nurse staffing decisions depending on different operating structures of nursing home organizations. Noncompliance with minimum or recommended staffing standards illustrated partial failure of current internal and external regulatory systems with regard to quality of care. This provides evidence for future directions to empower the regulatory and enforcement systems.

Specific Aim 2 & 3: Impact of Organizational Characteristics and Nurse Staffing Levels on Resident Outcomes and Facility Deficiencies

Hypothesis (H_1) that for-profit nursing homes have worse care processes, poorer resident outcomes, and more deficiencies than not-for-profit homes was supported, only for quality-of-life deficiencies. Other deficiencies were higher in for-profit homes but the difference was not statistically significant. For-profit status had no significant effect on most resident outcomes and other three types of deficiencies, holding other factors constant. This weak finding was inconsistent with previous studies that found not-for-profit homes had better resident outcomes (Aaronson et al., 1994; Grabowski & Hirth, 2003) and fewer deficiencies (Harrington, Zimmerman, et al., 2000).

Hypothesis (H_2) that chain-affiliated nursing homes have worse care processes, poorer resident outcomes, and more deficiencies than non-chain homes, was supported only for deficiencies. Chain affiliation had no effect on process and outcomes of care, while having significantly more deficiencies of three types: total, substandard-care, and

quality-of-care. Building on evidence of Harrington, Zimmerman, et al. (2000), this finding shows that nursing homes affiliated with chains had higher numbers of citations than non-chain homes, holding other factors constant.

Hypothesis (H_3) that larger nursing homes have worse care processes, poorer resident outcomes, and more deficiencies than smaller homes was also supported only for deficiencies. Larger nursing homes had higher numbers of citations in all categories (total, substandard-care, quality-of-care, and quality-of-life), holding other factors constant. These findings were consistent with one study which found that number of total beds was positively associated with total, quality-of-care, quality-of-life, and other deficiencies (Harrington, Zimmerman, et al., 2000). However, the insignificant relationships between facility size and process and outcome QMs were inconsistent with previous studies which concluded that larger homes had poorer resident outcomes (Rantz et al., 2004).

Hypothesis (H_4) that nursing homes with higher RN staffing hours have lower percentages of poor care processes and adverse resident outcomes, as well as fewer deficiencies than other nursing homes was supported only for pressure ulcers. Coefficients for RN staffing hours on deficiencies were all negative but none was significant. Hypothesis (H_5) that nursing homes with higher total staffing hours have lower percentages of poor care processes and adverse resident outcomes, as well as fewer deficiencies than other nursing homes was not supported. Nursing homes with higher total staffing hours had higher percentages of catheter use, physical restraint use, and bedfast residents. Hypothesis (H_6) that nursing homes with higher RN skill mix have lower percentages of poor care processes and adverse resident outcomes, as

well as fewer deficiencies was not supported. There were no significant effects of RN skill mix on outcomes. These findings are not consistent with a large body of literature that demonstrated that: (1) higher RN staffing levels resulted in better quality of care addressing with fewer pressure ulcers, catheterized residents, urinary tract infections, and deficiencies, and (2) higher total staffing levels contributed to improved resident functional outcomes (IOM, 2001). Although RN staffing hours per resident day had no significant effect on eight QMs (except pressure ulcers), unstandardized regression coefficients of RN staffing hours and RN skill mix were negative for pressure ulcers, weight loss, catheter and restraint use, and incontinence. These findings may be a matter of study design or a problem of the state enforcement system. First, these weak findings may be explained by the case mix measures – ADL dependency and percentage of cognitively impaired residents. Perhaps they were not enough to control for differences in existing risk of admitted residents among nursing homes. The ADL dependency score was a very crude measure ranging from 1 to 3, which would not accurately reflect the overall dynamics of the residents. A more sophisticated measure that incorporates large variations in admitted residents reflecting the (1) functional, (2) medical, and (3) nursing care needs might help control the resident case mix. Secondly, a small sample of 195 nursing homes might be the reason for many insignificant findings. Thirdly, as mentioned earlier under Specific Aim 1, a weak enforcement system may affect the relationship between nurse staffing levels and nursing home outcomes. A probable reason that staffing levels are not related to deficiencies is that the degree of enforcement in Colorado is extremely low (Harrington et al., 2004). Thus, this finding suggests that the effectiveness of nursing home organization quality of care

must be strengthened by a state quality assurance system with effective enforcement strategies.

The most important and powerful finding is that there is a threshold for nurse staffing, which can provide care good enough to ensure patient safety in terms of care processes and resident outcomes. The CMS study (2001) and a study by Schnelle et al. (2004) confirmed nursing home staffing need to exceed a threshold of 4.1 and 4.5 total nursing hours per resident day, respectively. Moreover, Schnelle et al. (2004) showed that there was a significant improvement in multiple care processes provided by NAs for the homes reporting total staffing levels above 4.5 hours per resident day. However, no differences were found in process measures for low-staffed homes in the study. Since Colorado nursing homes were on average lower than the threshold, effects of nurse staffing on process measures and on deficiencies could not be strong enough to be statistically significant. Another explanation is that the overall Medicaid reimbursement rates in Colorado are too low to maintain appropriate staffing levels. This may result in the ineffectiveness of nursing home organizations in maintaining better staffing for better processes and outcomes of care. Swan et al. (2001) showed that Colorado was a middle ranked (19^{th}) state of the 50 states with $101.50 as the average actual daily rate of Medicaid reimbursement in 1998. Although this study found higher average Medicaid reimbursement rates in 2000 ($115.10), the case-mix adjusted reimbursement rates in Colorado would not be enough to improve nurse staffing up to the desired threshold. Thus, this study suggests that the cascade relationship of Medicaid reimbursement rates, nurse staffing, and quality of nursing home care should be critically considered for policy-making.

In sum, for Specific Aim 2, only the significant relationship between RN hours per resident day and pressure ulcers supported the directional hypothesis (H_4) that more RN staffing hprd was associated with better processes and outcomes. The effects of for-profit status (H_1), chain affiliation (H_2), facility size (H_3), total staffing hprd (H_5), and RN skill mix (H_6) on resident outcomes were not significant, so the directional hypotheses were not supported. For Specific Aim 3, the effects of for-profit status (H_1), chain affiliation (H_2), and facility size (H_3) on deficiencies were partially supported. The effects of RN staffing hprd, total staffing hprd, and RN skill mix on deficiencies were not supported. The noted pattern of decreasing deficiencies with higher RN staffing was not statistically significant.

The Impact of Resources on Nurse Staffing Levels, Processes and Outcomes of Care, and Deficiencies

Higher Medicaid reimbursement rates were associated with higher RN staffing hours, RN skill mix, and total staffing hours when other factors were controlled. This finding is consistent with previous studies which found higher Medicaid reimbursement rates were related to higher staffing levels (Aaronson et al., 1994; Cohen & Spector, 1996; Grabowski, 2001a, 2001b; Harrington, Swan, et al., 2007; Zinn, 1993a, 1993b). However, higher Medicaid reimbursement rates were associated with higher percentages of pressure ulcers and catheter use, and lower percentages of restraint use. Recent studies have found that higher Medicaid reimbursement rates are associated with better quality of care (Cohen & Spector, 1996; Grabowski, 2001a, 2001b; Grabowski & Angelelli, 2004). However, early state-level studies found that

higher Medicaid reimbursement rates resulted in poorer quality of care (Gertler, 1989; Nyman, 1985). A possible explanation regarding the inconsistent and mixed findings regarding Medicaid reimbursement rates and quality of care is that payment cannot directly change resident care but would change organizational resource flow, which may affect the organization and management of nursing staff.

Homes with higher percentages of Medicaid residents had fewer falls and incontinence, but more catheter use. Homes with higher percentages of Medicare residents had more pressure ulcers, weight loss, urinary tract infections, and catheter use, but less antipsychotic drug use. This finding suggests that the relationships between the resources from Medicaid or Medicare and QMs may only reflect the different resident characteristics, which result in the effects on different resident outcomes. Resources significantly affected staffing levels, but did not affect outcome QMs. Importantly, the 2SLS regression models suggested that nurse staffing levels were mediators between resources and four outcome QMs.

Homes with higher Medicaid reimbursement rates had fewer total deficiencies. Higher percentages of Medicare residents were also significantly related to fewer total and quality-of-life deficiencies. This suggests that nursing homes with more resources do provide better quality care.

The Impact of Resident Characteristics on Nurse Staffing Levels, Processes and Outcomes of Care, and Deficiencies

Of two case mix measures, only cognitive impaired residents had significant impact on RN staffing patterns. Nursing homes with higher percentages of cognitively

impaired residents had significantly lower RN staffing hours per resident day and lower RN skill mix. The percentage of cognitively impaired residents did not affect total staffing hours per resident day, or any of the process or outcome QMs. However, the ADL dependency score was not significantly related to nurse staffing levels. Nursing homes with residents with higher ADL dependency scores were associated with higher percentages of incontinence and higher numbers of quality-of-life deficiencies, holding other factors constant. These findings are partially consistent with previous studies finding that resident case mix was a strong positive predictor of nurse staffing levels (Harrington & Swan, 2003; Harrington et al., 1998; Harrington, Swan, et al., 2007), poor resident outcomes (Carter & Porell, 2003), and deficiencies (Castle, 2002; Harrington, Zimmerman, et al., 2000).

The Impact of Market Characteristics on Nurse Staffing Levels, Processes and Outcomes of Care, and Deficiencies

Overall, this study clearly supported the observation that market characteristics were significantly associated with a wide array of quality of care indicators. The number of RNs in the HSA was negatively associated with RN staffing hours and RN skill mix in nursing homes when endogeneity and other factors were controlled. A negative relationship between RN supply and RN staffing may be a result of unequal competition between hospitals and nursing homes. An area with more RNs would have more hospitals, which attract RNs with higher wages and a more professional work environment than nursing homes. The relative numbers of registered nurses in the geographic areas surrounding hospitals were positively associated with RN staffing

levels in hospitals (Blegen, Vaughn, & Vojir, 2008). The study also found that overtime hours and LPN hours increased in the regions with a lower RN supply. Nursing homes compete with hospitals for RN recruitment, which could result in fewer RN nursing hours, as well as a lower percentage of RN hours in nursing homes.

The proportion of employed females in the labor workforce was positively associated with RN skill mix and negatively associated with total staffing hours per resident day. However, no significant effects were found for RN staffing hours per resident day, holding other factors constant. This is not consistent with one study that found that the percentage of employed females in the labor workforce was positively associated with RN staffing hours but negatively associated with total staffing hours (Harrington, Swan, et al., 2007).

Excess nursing home beds in the HSA were significantly associated with fewer RN staffing hours per resident day, lower percentages of catheter and restraint use, fewer substandard-care and fewer quality-of-care deficiencies. A higher Herfindahl index (less competitive and more concentrated market) was significantly associated with more substandard-care deficiencies. This finding is consistent with a previous study that reported a higher Herfindahl index was significantly associated with lower RN and total staffing hours (Harrington, Swan, et al., 2007). From a resource dependency perspective, organizations in more competitive environments are more likely to enter into cooperative exchange relationships with other organizations in order to secure and stabilize resource flows (Oliver, 1990; Zinn et al., 1999). Thus, nursing homes in a more competitive environment are more likely to have higher quality standards.

Interestingly, nursing homes in HSAs with higher per capita incomes had more deficiencies of three types: total, substandard-care, and quality-of-care. The HSAs with higher average per capita income are more likely to be in urban areas with large populations and more resources available to homes in the region. Thus, these areas may face more competitive market environments among nursing homes and against alternative services (e.g. hospitals or residential care facilities). Families in higher income areas may be more likely to complain about poor quality, which can result in higher deficiencies than those families in low income areas. Thus, the finding illustrates the competitive disadvantage stemming from an aggressive market environment. This consumer-sensitive feature of deficiency citations appears to generate strong associations between market environment and quality of care. Overall, these findings suggest that bed supply, market competition, and economic status of the community affect staffing patterns, processes of care, and level of compliance with state requirements for quality of care. From an institutional perspective, cognitive and normative institutionalization processes can explain relationships between market environment and quality of care. Dynamics of the market environments may influence staffing decisions within institutions.

Significance

This study investigated the multidimensional associations between organizational characteristics, nurse staffing levels, processes and outcomes of care, and facility deficiencies controlling for resources, resident and market characteristics. This study attempted to strengthen theoretical applications and to resolve

methodological challenges addressed in the field. Several leading theories were incorporated into the conceptual framework. Using multi-methods, this study thoroughly examined how different types of quality of care in nursing home organizations correlated with, or could be predicted by, organizational characteristics, nurse staffing levels, resources, resident, and market characteristics. Providing a strong theoretical background and using a robust study design, this study makes a unique contribution to the greater understanding of the effectiveness of nursing home organizations in improving quality of care, considering their resources, residents, and market environment.

Based on state of the science, quality of care was comprehensively defined to embrace three very distinctive portions of care quality: (1) nurse staffing levels are manageable, changeable, and time-varying components; (2) process and outcome QMs capture resident-sensitive quality of care; (3) deficiencies indicate compliance with mandatory, minimum aspects of care quality. Nurse staffing levels are manageable or changeable part of aspects of quality of care, so these measures should be the target for health care reform to improve the overall quality of care at the state and national level. Processes and outcomes of care are a very critical but versatile part focusing on resident-centered aspects of quality and safety, which should be able to reflect the consequences caused by structure-induced care problems. Deficiencies are the minimum or baseline standard of the quality of care that must be met. These three different aspects of quality of care provide advanced knowledge that can be utilized for a greater understanding of nursing home organization for future research and for policy-making.

This study advances understanding of the relationship between nursing home characteristics and quality of care using multiple methods. The multi-method approach is one way to increase validity and reliability of measuring a concept by capturing it in multiple ways. For process of care, resident outcomes, and deficiency citations, three analytical models were presented for each outcome. Each analytical model included a different staffing variable, but an identical set of resources, market, facility, and resident characteristics.

Building on the findings of Harrington, Swan, et al. (2007), this single state study also found endogenous relationships between ADL dependency and RN staffing levels (hprd and skill mix), as well as between Medicaid reimbursement rates and RN staffing levels (hprd and skill mix). Endogeneity was controlled with two-stage least squares models, so that biased coefficients were corrected. Although a previous study found endogeneity problems for total staffing hours, this study did not replicate those findings. This evidence contributes to the ability to find appropriate analytical methods for use in future studies. It also contributes to a better understanding of the relationship between nursing home characteristics and nurse staffing levels by using more accurate coefficients. This methodological advance will help researchers consider endogeneity in these relationships in the future.

This study confirmed the impact of market characteristics was crucial for predicting quality of care problems. This study uniquely found a significant negative relationship between RN supply in the area and RN staffing levels in nursing homes when endogeneity and other factors were controlled. This evidence will contribute to future nursing home studies considering nurse shortages in the area as an important

context. Moreover, an interesting pattern was found in that the Herfindahl index, the proportion of excess beds, and per capita income were significantly associated with some processes (catheter and restraint use) and deficiencies (total, substandard-care, and quality-of-care). This evidence contributes to the understanding of the significant impact of market competition, bed supply, and wealth in the area on providing quality care.

This study resolved nesting problems between market-level and facility-level characteristics. In particular, all market characteristics were clustered for 15 Health Services Areas. The "clustering" procedure was used for all regression models to correct standard errors based on this clustering. Accordingly, robust standard errors were reported in this study. After this procedure, there was no change in the unstandardized regression coefficients, however, the standard errors are affected making it more difficult to reject the null hypotheses.

Limitations

The accuracy and reliability of secondary data is a threat that can influence the findings. This study merged four administrative datasets, all of which may have included intrinsic problems regarding validity and reliability of the measures when they were initially designed, as well as when the data was collected. Therefore, measurement errors and ascertainment bias would be a limitation that could bias the findings of this study.

As a cross-sectional study, significant associations were examined in this study. However, these associations may differ from current associations because they can vary over time. Therefore, identifying the patterns of relationships was more useful

than focusing on the actual magnitude of the relationship. In addition, time difference and context need to be considered when applying the findings to other studies, or to policy-making.

Another limitation is that the measures of nurse staffing available in this study did not capture education, experience, or proficiency of care and management (Harrington, Zimmerman, et al., 2000). Many studies have recognized that high staff turnover rates were one of the important contributors to poor quality of care (Harrington & Swan, 2003; IOM, 2001). These unmeasured characteristics are also important aspects of nurse staffing that can affect quality of care along with the number of nursing hours and RN skill mix.

The small sample, 195 nursing homes, could be a limitation which may weaken significance of the findings. With a larger sample, effects of nurse staffing on processes and outcomes of care, and deficiencies might become statistically significant.

Implications for Quality-of-Care Theory

This study designed a conceptual framework with strong theoretical support from the literature incorporating Donabedian's structure-process-outcome approach, institutional theory, resource dependency theory, and economic theory. The framework posited three types of outcomes from the structure, process, and outcome schemes. Three research aims emerged when each outcome type was posited. From institutional theory, this study examined effects of organizational values on high quality care and organizational norms on nurse staffing levels. Therefore, the main study purposed to examine the impact of nursing home characteristics on quality of care was explored by (1) the effects of organizational characteristics on nurse staffing levels and (2) the

effects of organizational characteristics and nurse staffing on processes, outcomes, and deficiencies of resident care, controlling for resource, resident, and market factors. Research questions exploring factors related to noncompliance with state minimum staffing standard and compliance with federally recommended staffing standard brought out institutional characteristics of relevant homes and their institutional logic for staffing decisions.

From resource dependency and economic theoretical perspectives, nursing home organizations are adapting their staffing decisions to the surrounding market environment, market competition, and supply and demand factors. Consequences of their decisions may result in the systematic variations among different institutions within a state. Thus, this study concurrently examined impact of resource (payer mix), resident (case mix), and market factors on care quality of three types – nurse staffing levels, processes and outcomes of care, and deficiencies, as control variables. Two economic concepts: (1) trade-off between profit and quality, and (2) economies of scale were utilized theoretically to interpret the associations between for-profit status and quality of care, and between facility size and quality of care.

Finally, four theories merged in the conceptual/theoretical framework. The conceptual/theoretical framework supported the study design and empirical findings as different aspects affecting different functions and different abstract levels of knowledge. Although each theory provided an appropriate theoretical foundation for designing and conducting this study, resource dependency and economic theories were dominant for interpretation of the overall findings.

Implications for Nursing and Health Policy

This study found that nursing home organizations have different norms for staffing decisions depending on their characteristics and market environment. This knowledge will help policymakers design more effective regulatory systems. Considering their behavior patterns, different staffing mandates need to be specified to assure the quality and safety of resident care.

This study demonstrated that financial resources were significantly associated with quality of care. Medicaid reimbursement rates contributed to higher nurse staffing levels and fewer facility deficiencies. More Medicare residents were significantly associated with fewer deficiencies. Accordingly, a nursing home's staffing decisions seem to be dependant upon more stable resources that support the nursing home financially. Thus, financial incentives for high staffing levels would be an effective strategy that motivates nursing homes to improve quality of care with higher nurse staffing levels.

Implications for Future Research

This study used a state population to examine the multidimensional relationships among organizational characteristics, nurse staffing levels, processes and outcomes of care, and deficiencies. A larger study using a multi-state or national sample can increase the power to detect some significant relationships that this study could not capture. A longitudinal study design would help determine the short-term, mid-term, and long-term effects of nurse staffing on quality of care controlling for the staffing differences of different institutions and their resources.

This study showed that desired effects of nurse staffing on processes and outcomes of care were very few and most of them were not statistically significant. Pressure ulcers were the only outcome that was highly correlated with RN staffing hours per resident day, which predicted better outcomes. Catheter use, physical restraint use, and bedfast status were significantly associated with total staffing hours per resident day, while the staffing measure predicted poorer processes of care. These mixed findings may be attributable to endogeneity between nurse staffing levels and resident case mix, which was not controlled well enough in Specific Aims 2 and 3. Thus, this study recommends that future studies control for endogeneity between nurse staffing and resident case mix. Future studies should also include more unmeasured aspects of nurse staffing that can fully capture the differences in quality of care.

Conclusion

This study achieved its purpose of better understanding the relationship between nursing home characteristics and quality of care using advanced analytic strategies. The major findings of this study were: (1) quality of care in Colorado nursing homes was highly dependent on resources from the external environment, (2) Medicaid reimbursement rates and proportion of Medicare residents were important resources for nurse staffing, and (3) deficiencies in nursing home care were significantly higher in for-profit and chain-affiliated nursing homes.

A useful conceptual framework was confirmed with strong support of the theoretical background, literature review, and empirical findings. This framework elucidated complex multi-dimensional relationships in concrete and simple ways to

help understand the impact of nursing home characteristics and their environments on quality of care. In the end, this study will contribute to a greater understanding of the complex realities in the U.S. nursing home field providing a robust research design and an evidence-based framework.

To improve overall quality of care within a state, nurse staffing levels need to be targeted by instituting higher state staffing standards and health policies that enable nursing homes to increase nurse staffing levels. Possible sets of public policies are: (1) increasing Medicaid reimbursement rates with higher minimum nurse staffing standards, (2) increasing Medicaid reimbursement rates adjusting for nurse staffing levels, (3) requiring a minimum RN skill mix level and higher minimum total staffing hours per resident day for larger homes with 100 and more total beds, or (4) instituting higher staffing standards for homes in less competitive areas and paying them higher Medicaid reimbursement rates. These options would help to develop an exemplary community health system for Colorado. It is hoped that all Colorado nursing homes become an example of higher standards in regard to quality and safety of care.

Appendix A.1 *The Number of Nursing Homes within Counties in Colorado (Year 2000)*

Number of Nursing Homes	Number of Counties	Name of County
0 NHs	19 counties	Clear Creek, Costilla, Custer, Dolores, Eagle, Gilpin, Grand, Hinsdale, Jackson, Lake, Mineral, Ouray, Park, Pitkin, Saguache. San Juan, San Miguel, Summit, Teller
1 NHs	19 counties	Archuleta, Bent, Broomfield, Chaffee, Cheyenne, Conejos, Crowley, Elbert, Gunnison, Huerfano, Kiowa, Kit Carson, La Plata, Las Animas, Moffat, Rio Blanco, Routt, Sedgwick, Washington
2 NHs	9 counties	Alamosa, Baca, Douglas, Lincoln, Logan, Montezuma, Phillips, Prowers, Rio Grande
3 NHs	5 counties	Garfield, Montrose, Morgan, Otero, Yuma
4 NHs	1 county	Delta
6 NHs	2 counties	Fremont, Weld
9 NHs	3 counties	Boulder, Mesa, Pueblo
12 NHs	2 counties	Adams, Larimer
13 NHs	1 county	Arapahoe
19 NHs	1 county	El Paso
22 NHs	1 county	Jefferson
26 NHs	1 county	Denver
Total	64 counties	

Appendix A.2 *Counties and HSAs: Distribution of Colorado Nursing Homes (Year 2000)*

Health Services Area (HSA) code	Number of NHs	Number of Counties	County Names
562	2	1 county	Baca
688	76	12 counties, including six counties with no NHs	Adams, Arapahoe, Clear Creek*, Denver, Douglas, Elbert, Gilpin*, Grand*, Jefferson, Park*, Summit*; Jackson*[+]
704	11	3 counties	Huerfano, Las Animas, Pueblo
711	13	5 counties including two counties with no NHs	Eagle*, Garfield, Mesa, Pitkin*, Rio Blanco
731	5	6 counties including three counties with no NHs	Alamosa, Conejos, Costilla*, Mineral*, Rio Grande, Saguache*
735	1	2 counties	Moffat, Routt
740	4	5 counties including two counties with no NHs	Archuleta, Dolores*, La Plata, Montezuma, San Juan*
745	8	5 counties	Bent, Crowley, Kiowa, Otero, Prowers
754	23	5 counties including one county with no NHs	Cheyenne, El Paso, Kit Carson, Lincoln, Teller*
760	13	4 counties	Morgan, Washington, Weld, Yuma
761	8	6 counties including three counties with no NHs	Delta, Gunnison, Hinsdale*, Montrose, Ouray*, San Miguel*,
763	5	3 counties	Logan, Phillips, Sedgwick
786	1	2 counties including one county with no NHs	Chaffee, Lake*
795	9	1 county	Boulder
796	12	1 county	Larimer
812	6	2 counties	Fremont, Custer
0	1	1 county	Broomfield
Total	198	64 counties	

†Note: Asterisks (*) after the name presents the county with no NHs. [+] Jackson county (HSA code 771) was added in HSA code 688 based on the geographical location.

Appendix A.3 *Number of Chain-owned Nursing Homes within the Chain*

Chain Name in Colorado	Chain Size : Numbers of NHs in Colorado
Mariner Post Acute Network	30
Life Care Centers of America	16
Integrated Health Services Inc	11
Beneficial Living Systems	6
Vencor, Inc	6
Evangelical Lutheran Good Sam Society	5
Bayside Colorado Healthcare Assoc Inc	4
Volunteers of America American Housing Foundation Inc Colorado Medical Investors Catholic Health Initiatives	3
Sunbridge Healthcare Peak Medical Corporation Pinon Management Corporation Manorcare Health Services Columbine Health Systems Baptist Home Assoc of the RKY MTNS Inc Continuum Health Partnership Inc Mariott Senior Living Services Juniper Partners Consulting Management and Education Inc	2
Sisters of Charity Health Care Systems RHA, Inc Pitman Place LLC Sage Health Services of Indiana Inc Glen Valley Care CTR The Waverley Group, Inc Parkman Enterprises, Inc Eden Foundation Long Term Health Care Servi Senior Living of Denver LLC Convenant Retirement Communities Inc Tutera Health Care Education/Healthcare Dev Found/Beloit Chancellor Health Care LLC Living Center Rocky Mountain Inc St Paul Management	1
Total	135 NHs

Appendix A.4 *Specific Aim 1: Endogeneity and Instrument Test Statistics*

Outcomes	Tests of Endogeneity for Medicaid Reimbursement Rates (MRRs)		
	Durbin (score) chi^2	Wu-Hausman F(1, 184)	Robust Regression F(1,14) ¶
RN Staffing hprd	15.95***	16.39***	15.28***
Total Staffing hprd	.71	.67	.14
RN skill mix	18.54***	19.33***	39.83***

Two Instruments for MRRs	Weak Instrument Tests			Tests of Overidentifying Restrictions H_0= Instruments are valid
	Partial R-squared	Minimum Eigenvalue	Robust F(2,14) ¶	
1. Medicaid Residents 2. Population aged 65^+	.06	5.84	10.94***	RN staffing hours (p>.05) Total staffing hours*** RN skill mix (p>.05)

Outcomes	Tests of Endogeneity for ADL dependency		
	Durbin (score) chi^2	Wu-Hausman F(1, 184)	Robust Regression F(1,14)¶
RN Staffing hprd	8.44***	8.33***	11.29***
Total Staffing hprd	.25	.24	.21
RN skill mix	10.55***	10.53***	9.99***

Two Instruments for ADL dependency	Weak Instrument Tests			Tests of Overidentifying Restrictions H_0= Instruments are valid
	Partial R-squared	Minimum Eigenvalue	Robust F(2,14)¶	
1. Medicare Residents 2. Per capita income	.01	.83	4.27**	RN staffing hours (p>.05) Total staffing hours*** RN skill mix (p>.05)

†Note: N=195**;** Stata SE 10.0 was used for endogeneity and instrument tests; ¶F statistics were adjusted for 15 clusters; *p-value <.10; **p-value<.05; ***p-value<.01.

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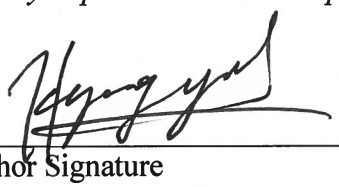

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