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Determinants of Nursing Home Performance:Examining the Relationship Between Quality and Efficiency

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Determinants of Nursing Home Performance:
Examining the Relationship Between Quality and Efficiency

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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ABSTRACT

Determinants of nursing home performance: examining the relationship between quality and efficiency

By Nailya O. DeLellis, MPH, Ph.D.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

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To assess the relationship between quality of care and efficiency of nursing homes this study used 10% random sample of non-hospital based nursing homes of size 20-360 beds and occupancy rate of 5-100% in OSCAR database 2008 (n=1430). Data Envelopment Analysis was used to calculate efficiency score and Structural Equations Modeling was used to assess the effect of environmental factors on efficiency score and quality measures as well as relationship between efficiency and quality of care. Logistic regression was performed to find the factors that affect high performance, defined as high efficiency and high quality.

In the study's sample, 149 facilities (10.4%) had an efficiency score of 1, which indicates perfect efficiency. The average efficiency score of nursing homes in the sample was 0.854 (0.079 min; 0.145 std). Competition positively affects efficiency, with a path coefficient 0.09 (*t*-value = 2.65). Although the path coefficients relating competition with

process and with outcome quality were positive (0.08 and 0.04, respectively), the results were not statistically significant. Stronger position of payers in the market positively affects process quality of care (path coefficient = 0.15, (*t*-value = 2.48). Higher efficiency of nursing homes is associated with higher outcome quality (path coefficient of 0.06, *t*-value = 1.99), but lower process quality (path coefficient of –0.20 , *t*-value = –2.95).

Only 7.4% of nursing homes in the sample could efficiently provide high quality services, which was defined as high performance in the study.

Among the factors that demonstrated statistically significant coefficients in the regression were the size of a facility, the availability of registered nurses, excess demand, and for-profit status.

The study provides evidence of the trade-off between efficiency and process quality, in which higher efficiency of a nursing home is associated with lower process quality of care. Findings in the study also suggested that higher efficiency is associated with higher outcome quality.

Key words: Nursing homes, efficiency, quality

CHAPTER 1: INTRODUCTION

As the population of the United States inevitably ages and the baby-boomer generation turns 65 years and older, the need for long-term care will increase (Chen & Shea, 2002). Many options for long-term care are available for the elderly, such as care provided by family members at home, home health agencies, community-based services, assisted living facilities, continuing care retirement communities, and nursing home facilities. In 2004, as many as 1.3 million people in the United States depended on nursing homes for long-term care (National Center for Health Statistics, 2007). The combination of an increasing aging population and steadily rising healthcare costs creates a need to find ways to improve the efficient use of nursing home resources (Anderson, Weeks, Hobbs, & Webb, 2003).

The quality of nursing home care has been a longstanding concern for healthcare (Nyman, 1989). In 2001, the Institute of Medicine published *Improving the Quality of Long-Term Care*, which highlights the need to improve the quality of healthcare services in the United States. Among common problems associated with quality of care in nursing homes, the publication lists quality indicators such as pressure sores, malnutrition and dehydration, the use of physical and chemical restraints, continence care, pain management, and the quality of life.

Cost is another important issue for long-term care. As healthcare costs in the United States steadily increased during recent decades, many attempts were made to contain these costs. Currently, the nation spends 15.3% of its gross domestic product on healthcare; out of this amount, 6.2% is spent on freestanding nursing homes (National Center for Health Statistics, 2007).

Increasing healthcare expenditures with the need for cost containment and an aging population with the potentially increased demand for long-term care are two important factors that highlight the need to provide high quality services with maximum efficiency. The purpose of this study is to determine the characteristics of nursing homes that achieve both high quality services and high efficiency.

Literature Background

The quality of healthcare has been a longstanding and an important issue in healthcare. However, researchers note that the quality of care is difficult to capture directly, and common measures of quality are a proxy of resident or facility outcomes (Bostick, Rantz, Flesner, & Riggs, 2006). A continuing discussion in the literature focuses on quality indicators used in nursing homes (Berg et al., 2002; Mor, Berg, et al., 2003). According to a review of the use of measures of performance in U.S. nursing homes, multidimensionality of quality may explain the relatively low correlation between different quality measures, and no single measure is suitable for all people (Mor, Angelelli, Gifford, Morris, & Moore, 2003).

Healthcare research includes numerous studies focusing on nursing home quality. A wide range of studies examines nursing home staffing and its effect on the quality of care (Bostick et al., 2006; Burgio, Fisher, Fairchild, Scilley, & Hardin, 2004; Decker, 2006; Harrington, Zimmerman, Karon, Robinson, & Beutel, 2000; Hickey et al., 2005; Schnelle et al., 2004; Weech-Maldonado, Meret-Hanke, Neff, & Mor, 2004; Zhang & Grabowski, 2004). Other studies examine the effect of reimbursement rates and policy on the quality of care (Cohen & Spector, 1996; Grabowski, 2001, 2004; Konetzka, Yi, Norton, & Kilpatrick, 2004; Lapane & Hughes, 2004; White, 2005/2006); state variability in quality indicators (Castle, Degenholtz, & Engberg, 2005); the effect of ownership on the quality of nursing home services (Aaronson, Zinn, & Rosko, 1994; Grabowski & Hirth, 2003; Harrington, Woolhandler, Mullan, Carrillo, & Himmelstein, 2001; Hillmer, Wodchis, Gill, Anderson, & Rochon, 2005; O'Neill, Harrington, Kitchener, & Saliba, 2003); factors affecting quality improvement (Berlowitz et al., 2003; Rantz et al., 2004); the cost of quality care (Hicks, Rantz, Petroski, & Mukamel, 2004; Phillips, Hawes, & Fries, 1993; Rantz et al., 2004; Weech-Maldonado, Shea, & Mor, 2006); and financial performance of nursing homes (Castle, 2005a; O'Neill et al., 2003; Weech-Maldonado, Neff, & Mor, 2003a, 2003b).

Due to financial challenges that nursing homes recently experienced (Weech-Maldonado et al., 2003a), the efficient use of resources became an important topic in research. A large number of studies investigate efficiency of nursing homes. Data Envelopment Analysis was used for studies of technical efficiency of nursing facilities in the United States (Ozcan, Wogen, & Mau, 1998) in relation to nursing home size

(Chattopadhyay & Ray, 1998; Hicks et al., 1997), for-profit status (Gertler & Waldman, 1994; Rosko, Chilingerian, Zinn, & Aaronson, 1995), and chain affiliation (Fizel & Nunnikhoven, 1993; Kleinsorge & Karney, 1992).

The literature also provides evidence of a relationship between efficiency of nursing homes and quality of care. Studies of nursing home performance in the United States analyze different aspects of the organization and environment, such as strategic groups, and nursing home performance reflected in efficiency and quality of care (Zinn, Aaronson, & Rosko, 1994), quality of care, chain affiliation, profit, and performance (Anderson et al., 2003; Fizel & Nunnikhoven, 1993; Rosko et al., 1995). Using pressure sores as the measure of quality in a sample of 69 nursing homes, Duffy, Fitzsimmons, and Jain (2006) demonstrated the usefulness of a Data Envelopment Analysis efficiency score as a benchmarking method for the long-term care industry. The research on nursing homes using a Data Envelopment Analysis efficiency score as a measure of performance reveals that for-profit facilities are generally more efficient than not-for-profit facilities (Anderson, Lewis, & Webb, 1999; Anderson et al., 2003; Duffy et al., 2006; Rosko et al., 1995; Zinn et al., 1994), and occupancy rate is positively associated with nursing home efficiency (Ozcan et al., 1998; Rosko et al., 1995).

Studies of nursing home quality and performance present contradictory results. For example, Zinn et al. (1994) noted that not-for-profit facilities provide better quality care, while Rosko et al. (1995) did not find a relationship between ownership and quality or efficiency. This difference may be partly due to different quality measures used in the two studies. Most of the studies restricted quality measures to pressure sores or ulcers,

catheters, and use of restraints (Duffy et al., 2006; Rosko et al., 1995; Zinn et al., 1994) and to deficiencies or inspection scores (Anderson et al., 2003; Fizel & Nunnikhoven, 1993).

Another potential problem is that all the studies involving nursing home efficiency calculated with Data Envelopment Analysis were based on data from a single state, such as Pennsylvania (Rosko et al., 1995; Zinn et al., 1994), Florida (Anderson et al., 2003), and Michigan (Fizel & Nunnikhoven, 1993), or on a relatively small sample, such as 69 facilities (Duffy et al., 2006). A literature search described in Chapter 2 did not reveal any study of the relationship between efficiency and quality of nursing homes, that used a wide range of process and outcome measures of quality on a national sample. Although numerous studies in the literature have analyzed technical efficiency of nursing homes with regard to quality of care, no attempt has been made to incorporate efficiency into a broader model of quality in terms of its structure, process, and outcome components.

Purpose of the Study and Research Questions

The purpose of this study is to examine the relationship between quality of care and efficiency of nursing homes to determine the characteristics of facilities that achieve high quality and high efficiency. Based on data from two secondary national databases and a variety of other sources, the study aims to answer the following research questions:

1. What is the relationship between the quality of care and the efficiency of nursing homes?

2. What are the characteristics of efficient nursing homes that provide high quality services?

Conceptual Framework

To answer the research questions, this study uses a general framework that combines Donabedian's Structure-Process-Outcome quality model with the resource dependence theory. These principles are described in detail in Chapter 3; however, a brief overview is provided in the following paragraphs.

According to Donabedian's (1980) Structure-Process-Outcome framework, healthcare quality is viewed as a three-part model that consists of structure, process, and outcome components. Structure includes "human, physical, and financial resources that are needed to provide medical care" (p.81). Structure is a necessary, although not sufficient, condition for process and outcome. Process is defined as a "set of activities that go on within and between practitioners and patients" (Donabedian, 1980, p. 79). Outcome is defined as "a change in the patient's current and future health status that can be attributed to antecedent health care" (Donabedian, 1980, p. 83).

Although the Structure-Process-Outcome model is widely used in the research of healthcare quality (Sainfort, Ramsey, & Monato, 1995; Weech-Maldonado, Meret-Hanke, et al., 2004), Unruh and Wan (2004) noted that researchers frequently use the model's components separately as indicators of quality, or they only look for causal links between the structural component and the process and outcome components. The full model, including the relationship or the interrelationship between all three components, is rarely used (Unruh & Wan, 2004), which may weaken the significance of study results or

present a limited view. The current study uses all three components of the Structure-Process-Outcome model in order to provide a more comprehensive analysis of nursing home quality indicators and their relationships.

This study also incorporates the resource dependence theory in its theoretical framework. Based on the work of Pfeffer and Salancik (1978), the resource dependence theory states that no organization is able to create all of its necessary resources, such as customers, payers, or suppliers. These resources are controlled by others in the environment, which creates a dependence on those organizations or groups of organizations. To decrease dependencies and actively try to increase its chances for survival, an organization may employ specific strategies in response to environmental pressures. Possessing the best access to resources and, therefore, the most power in the market improves the organization's chances of survival. An important feature of the resource dependence theory is that managers are viewed as proactive players in complex environments, seeking ways to lessen dependencies. Managers scan the environment to detect risks, look for business opportunities, and reduce uncertainty.

The resource dependence theory is widely used in general healthcare research, as well as in long-term care research (Banaszak-Holl, Zinn, & Mor, 1996; Dansky, Milliron, & Gamm, 1996; Starkey, Weech-Maldonado, & Mor, 2005; Zinn, Mor, Castle, Intrator, & Brannon, 1999). In the current study, the resource dependence theory is combined with Donabedian's Structure-Process-Outcome model in order to examine the environmental and organizational factors that affect performance in nursing home care.

As viewed in the conceptual model for this study, structure depends on the environmental and organizational characteristics of a nursing home and, in turn, affects the process and outcome quality components as well as the efficiency of a nursing home. Figure 1 illustrates the conceptual framework of the study.

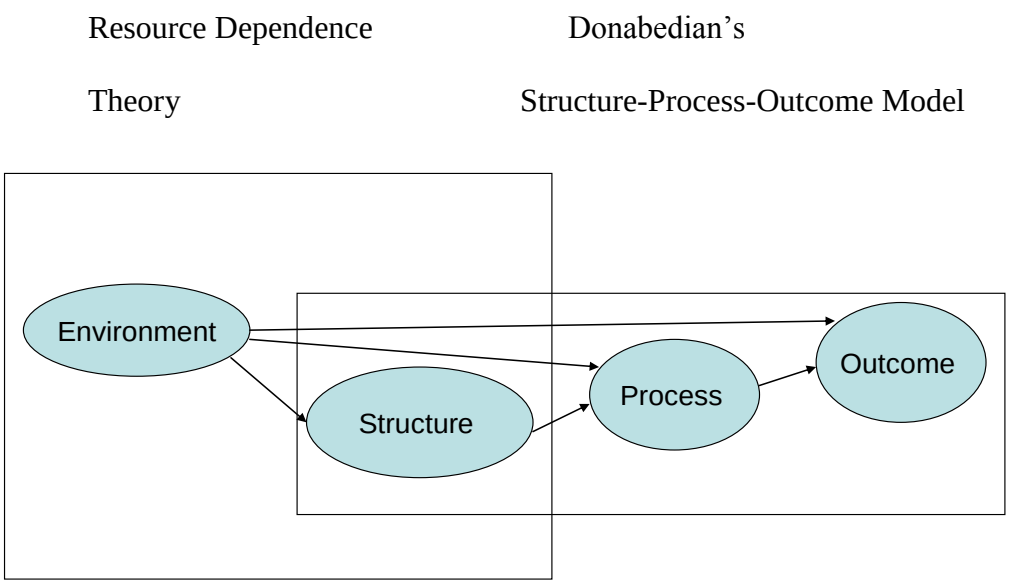


Figure 1. Conceptual Framework of the Study, Combining the Resource Dependence Theory with Donabedian's Structure-Process-Outcome Model.

In this study, the efficiency of nursing homes is measured as a Data Envelopment Analysis efficiency score and is viewed as a proxy for the process component of quality. High efficiency for a nursing home may be defined as providing services to a population with the best possible ratio of inputs and outputs.

Analytical Approach

This nonexperimental, cross-sectional study uses data from two secondary national databases and from several federal agencies. The information on quality of care

indicators and the data for Data Envelopment Analysis were obtained from the Online Survey, Certification and Reporting system, which is maintained by the Centers for Medicare and Medicaid Services. The quality indicators are defined as process or outcome quality components described by the National Quality Measures Clearinghouse, which is sponsored by the U.S. Department of Health and Human Services. Additional information on nursing home markets was obtained from the Area Resource File database, which is also sponsored by the U.S. Department of Health and Human Services, and from federal agencies such as the U.S. Bureau of Labor Statistics and the Bureau of Economic Analysis.

In the present study, the unit of analysis is a nursing home, and the market for a nursing home is defined as a county located in the United States. The population of the study includes U.S. nursing homes certified by the Centers for Medicare and Medicaid Services. The study's population excludes hospital-based facilities, nursing homes with fewer than 20 beds or more than 360 beds, and facilities with occupancy rates lower than 5% and higher than 100%. The study uses a 10% random sample.

After data assessment and description, the study includes Data Envelopment Analysis on data from the Online Survey, Certification and Reporting system to obtain an efficiency score for the nursing homes in the study's sample. Data Envelopment Analysis is a nonparametric statistical technique that transforms combinations of inputs and outputs into a single score to identify organizations that perform efficiently, relative to other organizations. In this study, the inputs for analysis are labor inputs and the number of beds. To assess difference in functions as well as in wages of personnel, the study

separates full-time equivalents of registered nurses, licensed practical nurses, and nurse aides from other nursing home personnel.

The analysis deliberately avoids any financial inputs to exclude the effect of difference in price on efficiency scores. The outputs of the study are the number of residents by payer source to reflect a possible difference in the required amount of care. For example, Medicare-paid patients typically use nursing home services after hospitalization, while Medicaid-paid patients tend to use nursing home services for long-term care; thus, these two types of patients may require different types and amounts of care (Decker, 2006) and often are served in different areas of the nursing home. Outputs that include resident census by payer source provide a better base for efficiency comparison. In addition, regarding payer-source outputs, the difference in reimbursement rates between Medicare and Medicaid payments are taken into account in the calculation of the efficiency score. The study uses an input-oriented model because, in healthcare, an organization usually has more control over its inputs than its outputs (Ozcan, 2008). Based on the efficiency score, the study defines efficient nursing homes.

To assess the relationship between variables, the study uses structural equation modeling, which serves purposes similar to multiple regression but allows one to take into account the interaction of variables and possibly a more complicated relationship. The approach views path models as causal, with path coefficients representing direct causal influence. The process of structural equation modeling combines validating the measurement model with path analysis for latent variables.

The current study includes eight latent variables. Three variables represent factors of the environment, or independent latent variables:

- competition (measured with three indicators: market concentration, number of substitutes in the market (number of Home Health Agencies in the county), and location);
- munificence (measured with four indicators: population over 65 years old, excess demand for nursing home services, number of registered nurses, and unemployment rate); and
- payers' position (measured with three indicators: percentage of Medicaid-paid residents, presence of a Pay-for-Performance program, and average annual personal income of potential private payers).

Four variables represent dependent latent variables:

- structure (measured with six indicators: number of beds (size of nursing home), system membership, ownership status, number of registered nurses, number of licensed practical nurses, and number of nurse aides);
- efficiency (measured with one indicator: an efficiency score calculated by Data Envelopment Analysis);
- process quality (measured with six indicators: use of catheters, use of physical restraints, residents who received a Pneumococcal vaccination, residents who received an influenza vaccination, residents on a pain management program, and residents with pressure sores or ulcers); and

- outcome quality (measured with five indicators: percentages of residents who are bedfast, show signs and symptoms of depression, have bladder incontinence, have bowel incontinence, and experience unexpected weight loss or gain).

The study's eighth latent variable represents a control variable, which is measured by an acuity index. Path coefficients and their significance are assessed to test the study's hypotheses.

To assess high performance, all nursing homes in the study's sample are defined as high quality or low quality facilities, based on a comparison of facility quality indicators with the national average of performance. Nursing homes are defined as high performers if they achieve high scores in both efficiency and quality. The final part of the study includes an analysis of factors that affect high performance in nursing homes, using logistic regression analysis to assess factors that affect the likelihood of high performance in a nursing home.

Research Contribution

The issue of nursing home performance is an important area of healthcare research. Numerous studies have focused on specific quality indicators as well as on groups of indicators and their relationship with certain characteristics of nursing homes and their environment. Several studies have also examined nursing home efficiency and the factors that affect the level of efficiency. Some researchers have analyzed the relationship between efficiency and certain quality indicators, such as rates of pressure ulcers and the use of physical restraints and catheterization in nursing homes.

The most popular framework for exploring quality of nursing home care is Donabedian's (1980) Structure-Process-Outcome model. However, the literature search conducted for the present study did not reveal any attempts to incorporate efficiency into the Structure-Process-Outcome model. The current study suggests that an efficiency score, which is the ratio of inputs to outputs, reflects the model's process component. Although nursing home managers cannot directly observe efficiency, they still have control over their organization's inputs and, sometimes, their organization's outputs; therefore, managers can affect the efficiency of nursing homes. This study also combines Donabedian's Structure-Process-Outcome framework with the resource dependence theory in order to embrace both environmental and organizational factors that affect performance in nursing home care.

Another important issue is the relationship between efficiency and quality of care in nursing homes. The current study analyzes nursing home characteristics that allow a facility to provide high quality services in the most efficient way. This concern is especially important in the light of recent trends involving a growing population of elderly individuals and efforts to contain rising healthcare costs. As Knickman and Snell (2002) noted, the "2030 problem," or the expected potential burden of aging baby boomers on the healthcare and public finance systems by the year 2030, is a major public policy concern. In order to effectively respond to the financial and social challenges related to a growing population of elderly individuals who need long-term care, including services provided by nursing homes, society must take actions now. By assessing nursing home characteristics that efficiently provide high quality services, the current study

provides important information that may enhance future research and assist in the nation's efforts to improve quality and efficiency in nursing home care.

Overview of Remaining Chapters

As a follow up to this chapter's introduction and brief overview of the literature background, research purpose and questions, theoretical framework, and analytical approach to the present study, the remaining five chapters provide a more in-depth explanation of the study's literature review, conceptual model, methodology, results, and implications.

Chapter 2 introduces definitions of terms used in the study and presents a literature review of issues concerning nursing home quality and efficiency and the factors that affect these two features. In accordance with the study's analytical approach, in which an efficiency score is obtained through Data Envelopment Analysis as a measure of efficiency, Chapter 2 also describes previous studies that have used Data Envelopment Analysis to examine healthcare in general and the nursing home industry in particular.

Chapter 3 describes the theoretical frameworks used to create a conceptual model for the present study. Donabedian's (1980) Structure-Process-Outcome model and the resource dependence theory are applied to formulate the study's hypotheses.

Chapter 4 describes the methodology and statistical approaches used to examine the relationship between nursing home efficiency and quality of care. Specific statistical techniques include Data Envelopment Analysis, structural equation modeling for testing the study's hypotheses, and logistic regression for analyzing high performance nursing homes in the study's sample.

Chapter 5 presents the results of the study's analysis, including a description of the study variables, of the efficiency and quality analysis, and of the hypotheses testing. The chapter also includes a description of high performers among nursing homes and factors that affect the likelihood of high performance.

Finally, Chapter 6 discusses the potential implications and significance of the study. The chapter also describes the study's limitations and identifies opportunities for future research related to nursing home quality of care and efficiency.

CHAPTER 2: LITERATURE REVIEW

Due to the growing population of elderly individuals in the United States, the demand for long-term care has increased and will likely affect the nation's nursing home industry. However, a declining number of nursing homes and escalating healthcare costs present additional challenges, creating the need for nursing homes to reduce expenditures while, at the same time, improve the quality of care for the nation's increasing elderly population. Understanding factors that contribute to optimal care and cost containment in U.S. nursing homes may help guide policy and procedures and lead to the development of measures that address the industry's dual challenge in providing improved quality of care and enhanced efficiency.

This chapter reviews the literature that examines the current characteristics of the nursing home industry in the United States and the various factors that affect nursing home quality of care and efficiency. However, as the review indicates, the variety and inconsistent nature of numerous findings reveal a lack of consensus concerning nursing home quality of care and productivity.

Definition of Terms

The following terms are used in this study, in accordance with their definitions supplied by various government agencies that are directed by the U.S. Department of Health and Human Services:

• Skilled nursing care: According to the online glossary provided by *Medicare: The Official U.S. Government Site for People with Medicare,* skilled nursing care is "a level of care that includes services that can only be performed safely and correctly by a licensed nurse (either a registered nurse or a licensed practical nurse)" (Medicare, 2008a, Skilled Nursing Care term).

• Nursing facility*:* According to the Centers for Medicare and Medicaid Services (CMS), a nursing facility "primarily provides to residents skilled nursing care and related services for the rehabilitation of injured, disabled, or sick persons, or on a regular basis, health related care services above the level of custodial care to other than mentally retarded individuals" (CMS, 2006a, Nursing Facility term).

• Skilled nursing facility*:* Skilled nursing facilities have the staff and equipment to provide skilled nursing care and/or skilled rehabilitation services and other related health services, such as intravenous injections and physical therapy (Medicare, 2008b). According to the Centers for Disease Control and Prevention (CDC), prior to 1985, skilled nursing facilities provided the most intensive nursing care available outside of a hospital (CDC, 2008). Medicare certifies skilled nursing facilities. In addition, Medicare pays for skilled nursing facility care when it is required after an injury or a hospital stay.

• Intermediate care facility*:* Intermediate care facilities provide health-related services on a regular basis for individuals "who do not require hospital or skilled nursing facility care but do require institutional care above the level of room and board" (CDC, 2008, para. 3). Medicaid, not Medicare, certifies intermediate care facilities.

• Long-term care*:* Long-term care is "a variety of services that includes medical and non-medical care to people who have a chronic illness or disability. …Long-term care can be provided at home, in the community, in assisted living [facilities] or in nursing homes" (Medicare, 2009a, para. 1). Medicaid is the major purchaser of long-term care services, paying for approximately 50% of all nursing home expenditures and 70% of all bed days (Grabowski, 2001).

• Nursing home*:* A nursing home provides a room, meals, and help with the activities of daily living and recreation for residents whose physical or mental problems prevent them from living on their own (CMS, 2006b). Nursing homes "provide care to people who can't be cared for at home or in the community. …For most people, this care generally is to assist people with support services such as dressing, bathing, and using the bathroom, for people who can't take care of themselves due to physical, emotional, or mental problems" (Medicare, 2009b, para. 1). Medicare does not pay for this type of care or for most nursing home care.

The Online Survey, Certification and Reporting database defines a nursing home as a facility that is certified and meets the Health Care Financing Administration's long-term care requirements for Medicare and Medicaid eligibility (CDC, 2008). According to information provided by the CDC, "nursing care homes must employ one or more full-time registered or licensed practical nurses and must provide nursing care to at least one-half the residents" (CDC, 2008, para. 2). The CDC also notes, "Beginning with the 1995 through 1999 National Nursing Home Surveys, nursing homes are defined as facilities that routinely provide nursing care services and have three or more beds set up for

residents. Facilities may be certified by Medicare or Medicaid…and may be freestanding or a unit of a larger facility" (CDC, 2008, para. 4).

It is important to note that, after October 1, 1990, skilled nursing, nursing home, or intermediate care facilities that meet nursing home reform requirements by the Omnibus Budget Reconciliation Act of 1987 were reclassified as "nursing facilities" (CDC, 2008).

Overview of the Nursing Home Industry

National trends and recent studies provide compelling evidence that, as the U.S. population ages, the demand for nursing homes will increase. Additionally, despite increasing healthcare costs, restricted resources, and declining use, the nursing home industry will likely need to improve its quality of care and efficiency in order to meet the nation's growing demand for nursing care for the elderly.

Growing Elderly Population

In 2011, the leading edge of the baby-boomer generation in the United States will turn 65 years old, which will significantly increase not only the number of retirees in the nation but also the need for additional long-term care options for at least the succeeding two decades (Kemper, Komisar, & Alecxih, 2005/2006). Indeed, according to nationwide statistics, the growing elderly population over the past several years has already intensified demands for a greater number of long-term care facilities, such as nursing homes. From 1993 to 2005, the U.S. population of individuals over 65 years old increased 5%, from 32,901,811 to 36,790,000, and individuals over 85 years old increased more than 20% (National Center for Health Statistics, 2007). Likewise, the

need for long-term care increased. In 1999, nearly 1.5 million people over 65 years old were residents of nursing homes. By 2005, almost 9 million people over 65 years old needed long-term care and, by 2020, that number is expected to rise to 12 million people (Kemper et al., 2005/2006).

An increase in the elderly population's life-span expectancies may also create an expanded need for long-term care services in the United States. In 2005, the average life span after 65 years old was 17.8 years; 69% of people over 65 years old needed some type of long-term care during the remainder of their life span; and the average length of time for long-term care was 3.0 years (2.2 for men and 3.7 for women) (Kemper et al., 2005/2006). Spillman and Lubitz (2002) calculated that an individual's extended life span in the next 20 years increases one's chance of entering a nursing home to 46%.

Increasing Healthcare Costs and Expenditures

In addition to needing more long-term care services, the growing elderly population in the United States will likely face financial challenges due to extra costs related to extended healthcare needs, such as nursing home care. In 2004, the nation's elderly already represented the largest percentage of persons with overall out-of-pocket healthcare expenses. More than 96% of individuals over 65 years old had such expenses, and 44% to 51% of those expenses were for more than $1,000 per year (National Center for Health Statistics, 2005, 2007). In 2005, 7% of personal healthcare expenditures was for nursing home care (National Center for Health Statistics, 2007). The monthly/daily costs for nursing home care are significant. In 2004, facilities with fewer than 50 beds on average charged $5,708 per month, and facilities with 200 and more beds charged $6,162

per month (National Center for Health Statistics, 2007). From 1999–2004, the average monthly charge per resident increased from $3,531 to $5,690 (National Center for Health Statistics, 2007). In 2007, the daily room rate for a single occupancy nursing home room ranged from a minimum of $60 in Pennsylvania to $850 in Alaska, with a national average of $204.95 (Genworth Financial, Inc. & National Eldercare Referral Systems, 2007).

The aging population is not the only entity in the United States that may face financial burdens due to the rising costs of long-term care and its growing demand. The nursing home industry and U.S. government agencies and programs, such as Medicare and Medicaid, will also likely need to address a rise in expenditures for increased long-term care demands. For example, from 1990–2007, nationwide nursing home care expenditures increased from $52.7 billion to $121.9 billion (National Center for Health Statistics, 2005, 2007). From 1990–2004, the percentage of Medicare expenditures on skilled nursing facilities increased from 3.7% to 9.9%, which, in dollar terms, represents more than a 600% increase ($2.5 billion to $16.9 billion) (National Center for Health Statistics, 2005, 2007).

Recent Nursing Home Decline Versus Expected Increased Demand

In the face of increasing healthcare costs and rising expenditures, the nursing home industry also confronts the challenge of addressing a decline in the number of nursing homes over the past several years. In 1998, the number of nursing facilities in the United States exceeded 17,300, but by 2003 the number had decreased by almost 1,000 (National Center for Health Statistics, 2005, 2007).

Bishop (1999) noted that, in general, overall use of nursing homes was declining and, specifically, elderly Americans were reducing their use of nursing home care. Grabowski (2001) provided possible explanations for this decline, including the substitution of home health agencies, assisted living facilities, board and care homes, continuing care retirement communities, and social health maintenance organizations for nursing home care. Researchers have also suggested that informal care provided by family members may be another substitute for nursing home care and other forms of institutional care for the elderly. For example, Van Houtven and Norton (2004) analyzed informal care by adult children and found that it reduces the use of formal home health care and delays entry to nursing homes. Van Houtven and Norton also noted that, although home care is a substitute for nursing home care, it works only for a particular type of elderly patient; thus, aging individuals and their families may choose other substitutes for nursing home care, which include institutional types of care such as home health agencies and assisted living facilities. Therefore, the current decline in the volume and use of nursing home care may be due to the aging population's increased use of other care options for the elderly.

Despite the decreased number and use of nursing home facilities in the United States, an increased demand for nursing home care is nevertheless expected to occur due to the nation's growing elderly population (White, 2005). The need for improved quality of care in nursing homes will likely also increase, along with the need for additional policies and oversight to assure quality of care (White, 2005).

Indeed, the nursing home market in the United States is already highly regulated by federal and state governments. The Nursing Home Reform Act, under the Omnibus Budget Reconciliation Act of 1987 (also known as "OBRA 1987"), was an attempt by the U.S. government to regulate and improve the quality of nursing home care, based on recommendations presented in a report by the Institute of Medicine's Committee on Nursing Home Regulation (1986). The OBRA 1987 legislation aimed to address three basic elements related to monitoring quality of care in nursing homes: standards, surveys, and inspection process (Kumar, Norton, & Encinosa, 2006). However, in a study that analyzed the effect of OBRA 1987 on improving the quality of nursing home care, as measured by residents' outcomes, results were mixed. Findings revealed that, initially, the implementation of OBRA 1987 had a negative effect on the quality of care in less profitable nursing homes, yet the legislation improved quality of care in more profitable facilities (Kumar et al., 2006).

Current regulations and measures to enhance quality of care in U.S. nursing homes may not be adequate to address the nation's anticipated demand for increased nursing facilities and improved care for the elderly. As White (2005) suggested, nursing facilities will need to address significant improvements in the quality of care in order to provide optimal services for an increasing number of aging adults.

In summary, according to national statistics and current research, the growing elderly population in the United States will increase the demand for long-term care services, such as nursing home care, and for improved measures to ensure the quality of care for aging adults. Furthermore, the nation's escalating healthcare costs will create

financial challenges not only for aging consumers but also for the nursing home industry, which has recently experienced a decline in the number and use of facilities. In order to meet the anticipated demand for increased, improved care, nursing home administrators and policymakers will likely need to understand not only the concept and successful attributes of quality of care but also efficient and cost-effective methods that help produce and enhance quality of care efforts and outcomes.

Quality of Nursing Home Care

Ensuring the quality of nursing home care has been a longstanding concern among healthcare professionals, organizations, and researchers, as well as U.S. government agencies charged with regulating the nation's nursing home industry (e.g., see Nyman, 1989). Nursing home quality of care is important as a fundamental value for society, providing care to the nation's elderly population.

Defining Quality of Care and Identifying Associated Indicators

Healthcare organizations and researchers have spent considerable effort trying to pin down and develop an overall definition of "quality of care" and identify specific indicators associated with quality of care. In 1990, the Institute of Medicine (IOM) defined quality of care as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (pg. 21). Since then, through its "Quality Initiative," the organization has published a series of comprehensive reports to reinforce its definition with additional research and recommendations that focus on improving the quality of the nation's healthcare (Institute of Medicine, 2009).

However, according to Huston (2003), the Institute of Medicine's definition of quality of care, although widely accepted, makes a number of problematic assumptions. First, "desired health outcomes" are only one indicator of quality, and the relationship between quality of care and good health outcomes is not always direct and simple. Second, the definition of "current professional knowledge" is "a moving target for even the most dedicated providers" (Huston, 2003, p. 297). Another problem is that different individuals, such as physicians and patients, may have divergent perceptions of quality. As Bostick et al. (2006) noted, "Quality is a difficult concept to capture directly; therefore, measures of quality are a proxy of quality, either as resident or facility outcomes" (p. 372). Furthermore, Phillips, Shen, Chen, and Sherman (2007) suggested currently used quality indicators are "less than ideal" in reflecting the quality construct (p. 683). Thus, defining quality of care and identifying its indicators remain ongoing topics of interest, as evident in IOM's "Quality Initiative" and the growing amount of research that addresses aspects related to quality healthcare.

Developing a definition of nursing home quality of care has been equally challenging and is the subject of numerous studies. Researchers have discussed various dimensions of nursing home quality of care (e.g., quality of life, residents' satisfaction, and clinical care), using a wide range of indicators and study methods.

In an effort to define quality of nursing home care, researchers have also used a variety of study approaches and examined different measures that may help identify nursing home quality of care. For example, using a multidimensional theoretical model, Rantz et al. (1998) engaged three focus groups of nursing home professionals from three

communities in central Missouri to help define nursing home quality of care. The researchers asked participants to answer the following questions: "What is nursing home care quality? What conceptual model reflects all of the dimensions of nursing home care quality? And, what measures of nursing home care quality are logically derived from the conceptual model?" (p. 32). Interestingly, the researchers' analysis of results revealed two core variables: interaction and odor. Among other related concepts were "environment, milieu, individualized care and treatment, safety, staff, and quality measures" (p. 34). Rantz et al. also noted that a "focus on financial gain without regard for or understanding of services needed by residents" could be the central characteristic of nursing homes that exhibited poor quality (p. 35).

Other researchers have used a variety of facility-specific, state, and national data resources to identify and evaluate measurements or indicators of nursing home quality of care. For example, Berg et al. (2002) reviewed facility-specific sources of information to describe the identification and evaluation of long-term care quality indicators. In their study, the researchers reviewed 143 quality indicators—of which only 22 were recommended for comparing performance across nursing homes—that met particular criteria such as content validity, consistency over time, validity in representing quality in quality domains, distributional characteristics, stability, and cross-state consistency. Initially recommended quality indicators were classified in four domains: function; clinical complexity (divided into quality indicators related to symptoms or conditions and quality indicators related to process of care); psychology; and pharmacotherapy. In addition to identifying and evaluating overall quality indicators, the researchers found

that prevalence- and incidence-based quality indicators (e.g., use of physical restraints) were more consistent than change-based quality indicators (e.g., decline in activities of daily living).

Mor, Berg, et al. (2003) used national- and state-specific Minimum Data Set information to study quality performance measures in nursing home facilities. The researchers examined sample size, measure stability, creation of ordinal ranks, and risk adjustment as applied to aggregated facility quality indicators. They reported that current nursing home quality indicators "are multidimensional, and quarterly estimates of incidence-based measures can be relatively unstable, suggesting the need for some averaging of measures over time" (p. 37).

Other researchers have noted similar difficulties related to identifying reliable, stable measures of quality nursing home care, which, in turn, often lead to contradictory study results. For example, O'Neill et al. (2003) found that most studies examining nursing home quality of care use CMS-issued survey deficiency scores as measures of quality. Yet, as O'Neill et al. (2003) noted, facilities receive deficiency scores only if their quality of care is below a certain level, and it is possible that various facilities with zero deficiencies still provide care at different levels of quality. O'Neill et al. (2003) concluded that the same deficiency score among various facilities does not assure the same level of quality at each facility. On the other hand, Hilliard (2005) noted that quality measures serve as indicators of existing problems and work as a starting point for further review. Although these two studies used quality indicators and quality deficiencies as

measures for nursing home care, each study's approach and measures have different attributes and, so, may suggest different results.

Although numerous studies used a variety of methods, many researchers have used Donabedian's (1980) Structure-Process-Outcome model to identify and examine indicators associated with nursing home quality of care (Sainfort et al., 1995; Unruh & Wan, 2004; Weech-Maldonado, Meret-Hanke, et al., 2004). The structure component of Donabedian's three-part model represents the relatively stable human, physical, and financial characteristics of nursing homes, including staffing types and levels, the size of the nursing home, organizational characteristics (e.g., not-for-profit ownership vs. for-profit ownership, as well as independent and chain ownerships), and financial indicators (e.g., patient care costs and nursing home profits).

The model's second component, process, represents activities between nursing home staff and residents. For example, according to the National Quality Measures Clearinghouse (2005a, 2007d, 2007h, 2007i, 2007j), quality measures in the process domain include the percentage of eligible and willing long-stay residents who were assessed and given pneumococcal and influenza vaccinations, the percentage of residents who have or had a catheter inserted and left in their bladder, the percentage of residents who were physically restrained, and the percentage of patients with appropriate treatment for pain.

The outcome component of Donabedian's model, in relation to nursing home care, represents any changes in the resident's health status that can be attributed to healthcare received at the nursing home. For example, nursing home outcome measures

include the percentage of residents who have pressure sores, the percentage of low-risk residents who lose control of their bowels or bladder, the percentage of residents who have become more depressed or anxious, the percentage of residents who lose too much weight, and the percentage of residents with moderate to severe pain (National Quality Measures Clearinghouse, 2007a, 2007b, 2007c, 2007e, 2007f, 2007g).

Despite Donabedian's recommendation that the quality of healthcare services be analyzed in terms of all three of the Structure-Process-Outcome model's components, researchers often analyzed the components separately or only looked for causal links between some but not all of the components (Unruh & Wan, 2004). This limited approach may weaken the significance and scope of their findings and produce unclear or incomplete results. In general, most of the studies on nursing home quality focused on the relationship between structure and quality (e.g., the effect of different staffing characteristics on quality of care) or on the relationship between the environment and quality of care (e.g., the effect of competition or payment methods on quality of care). Some studies combined both structural and environmental factors and their effect on quality. The division between the process and outcome components in the literature is not clear; researchers used different quality indicators, often combining both the process and outcome quality measures in their analysis.

In summary, the difficult but important task of defining nursing home quality of care is evident in the growing amount of research that addresses both the overall concept and its specific indicators. However, researchers vary greatly in the designs of their studies, using diverse quality measures and indicators to assess nursing home quality of

care. Even when researchers apply the same model, Donabedian's Structure-Process-Outcome model, they often do not use the full model to examine the relationships or interrelationships between all three of the model's components. Consequently, study results are often inconsistent among the large body of empirical research in this field.

Organizational Characteristics and Quality of Care Studies

Following Donabedian's SPO framework, the next part of this chapter presents studies of quality of care in relation to certain organizational characteristics, such as staffing, ownership, size and others.

Staffing type and level and quality of care.

A wide range of studies have focused on nursing home staffing and its effect on nursing home quality of care, producing an abundant mix of results. The majority of findings demonstrate a clear relationship between nursing home quality of care and staffing and skill-mix levels, along with other staff-related variables (e.g., care procedures and organizational improvement efforts). The large number of studies in this area differs significantly in terms of definitions used and measures of staffing and quality indicators, which makes it difficult for analysis and comparison. Among commonly employed staffing measures are hours per resident day for registered nurses, licensed practical nurses nurse assistants and nurse aides, and skill mix, or staffing hours or certain professional categories as a proportion of total staffing hours. There two general categories of quality measures commonly employed: quality deficiencies (or citations) and quality indicators, such as catheters use, use of physical restraints, pressure sores, incontinence, weight loss, bedfast and decline in activities of daily living (ADL).

Most researchers have found that a higher staff-to-residents ratio is correlated with higher quality of care in nursing homes (Bostick et al., 2006; Burgio et al., 2004; Harrington et al., 2000; Hickey et al., 2005; Schnelle et al., 2004; Weech-Maldonado, Meret-Hanke, et al., 2004; Zhang & Grabowski, 2004).

Bostick (2004) examined the associations between nurse staffing hours and 6 quality indicators: physical restraints, weight loss, incontinence, activities of daily living decline, pressure ulcers, and problem behaviors toward others. The study found that increase in registered nurse staff hours is associated with better quality indicator scores for pressure ulcers. Zhang, Unruh, Lku, and Wan (2006) studied the effect of nursing staffing on quality of care. The study included staff hours per resident day for registered nurses, LPN and nurse aides, as well as professional staff (RNs and LPNs) hours per resident day; the quality measure in the study included catheter use, use of physical restraints and pressure sores. The study found a non-linear relationship between minimum nurse staffing and quality.

Hickey et al. (2005) examined staffing level and pressure sores. The study used staffing levels and staff mix, staff turnover, and changes in staffing patterns as measures of staffing. While the study did not find a linear association between staffing levels and pressure ulcer rates, they found that changes in staffing patterns (decrease in overall staffing levels or a change in staffing mix) are related to the quality of nursing home care.

Arling, Kane, Jueller, Bershadsky, and Degenholtz (2007) studied the relationship between nursing home staffing level, care received by individual residents, and resident quality-related care processes and functional outcomes. The quality indicators were

physical restraints, range of motion, toileting program, and training in ADLs and ADL decline, mobility decline, and worsening behavior of residents. The study found that "staffing level (licensed and unlicensed) was unrelated to any of the care processes or outcome measures, although higher overall staffing was associated with more time devoted to direct resident care" (p. 672).

Konetzka, Stearns, and Park (2008) studied the relationship between staffing and residents' outcome in nursing homes. The study considered two measures of staffing (care hours per resident-day and skill mix, or RN staffing hours as a proportion of total staffing hours) and two measures of outcome (incidence of pressure sores and urinary tract infections) and found that higher RN staffing significantly decreases the likelihood of both adverse outcomes, while increase in skill mix only reduces the incidence of urinary tract infections.

Dellefield (2006) studied the relationship between pressure ulcer prevalence and organizational factors such as total nurse staffing levels, specialization, centralization, nursing wages, and facility ownership on a sample of 897 California nursing homes. The study found that only a small amount of the variation can be explained by organizational variables; higher prevalence of pressure ulcers was associated with lower licensed nurse centralization and facilities participating exclusively in the Medicaid program.

Bates-Jensen, Schnelle, Alessi, Al-Samarrai, and Levy-Storms (2004) found that staffing level was the strongest predictor of time observed in bed after controlling for resident functional measures, compared to resident functional status.

Akinci and Krolikowski (2005) examined staffing levels and quality of care in northeastern Pennsylvania nursing homes and found that a reduced staffing level, measured as nurse staffing hours per resident per day for RNs, LPNs, and nurse aides, from higher staffing numbers may negatively affect the facilities' quality of care, measured as number and type of deficiencies. Harrington et al. (2000) reached similar conclusions in their study of nursing home staffing and its relationship to nursing home total deficiencies, quality of care, quality of life, and other deficiencies. The study found that a lower number of registered nurse hours and nursing assistant hours was associated with total deficiencies and quality of care deficiencies, while fewer nursing assistant staff and other care staff hours were associated with quality of life deficiencies.

Castle (2002) investigated the characteristics of nursing homes with persistent poor quality in the staff's use of physical restraints and found a negative relationship between use of physical restraints and staffing levels, as well as a positive relationship between Medicaid census and average activities of daily living levels.

Decker (2006) analyzed the relationship between nursing home staffing and quality of care and found inconsistent outcomes. Decker suggested that a possible reason for these inconsistencies might be that the effect of staffing differs for long-stay and short-stay nursing home residents and, likewise, for residents' particular outcomes, such as death or discharges. Decker proposed that a higher versus lower number of regularly scheduled registered nurses in nursing homes may reduce the need for residents' hospitalization; however, Decker also noted that an increased number of registered nurses does not seem to affect nursing home residents' mortality or discharge rates.

Castle and Engberg (2008) examined the cross-sectional association between use of agency and regular staff for nurse aides, licensed practical nurses, and registered nurses, and quality, using a single quality factor constructed from the 14 quality measures in Nursing Home Compare. The study found that an increased number of agency registered nurse staff was associated with better quality factor scores, especially in the presence of high levels of regularly employed licensed practical nurses, while more agency nurse aides resulted in a smaller increase in quality, compared to the use of an equivalent number of regularly employed nurse aides.

Bostick et al. (2006) reviewed 87 studies that examined staffing in relationship to the quality of care in nursing homes and found a "proven association between higher total staffing level (especially licensed staff) and improved quality of care" (p. 366). The staffing level of a nursing home therefore should be included in quality analysis.

Ownership and chain membership

Other important structural characteristics are ownership status and chain membership of a nursing home, which are often combined in analysis. Findings from several studies demonstrate a correlation between for-profit nursing home facilities and reduced quality of care, measured in deficiencies or quality indicators. Harrington et al. (2001) used multivariate analysis to investigate investor ownership of nursing homes and whether it affects quality of care. In their analysis, investor ownership predicted 0.679 additional deficiencies per home, and chain ownership predicted an additional 0.633 deficiencies. Harrington et al. reported that their findings demonstrate that, compared to

not-for-profit (NFP) nursing homes, for-profit (FP) facilities not only provide lower quality care but also have lower nurse staffing rates.

O'Neill et al. (2003) also found a correlation between profit and quality among FP and NFP facilities. In their study involving 1,098 nursing homes in California, the researchers examined the relationships among profit, quality, and ownership. They used net income margin (net income divided by total healthcare revenue) as a measure of profit. Findings revealed that the FP nursing homes in their sample provided significantly lower quality of care measured as deficiency citations than did the NFP nursing homes. Furthermore, in the sampled FP facilities, profit above a certain level was correlated with a higher number of deficiencies; no such correlation existed for the sampled NFP nursing homes.

Grabowski and Hirth (2003) investigated competitive spillovers across NFP and FP nursing homes, in consideration of two market models: the asymmetric information model and the full information model. They found that an increase in the NFP market share leads to quality improvement for FP nursing homes as well as to overall quality of nursing home care. The authors noted that using a dummy variable for ownership status lacks the relative prevalence of FP and NFP nursing homes in the market; therefore, the coefficient may be biased toward zero. They proposed also that this fact may explain the difference between quality of care and ownership in the following instances: identical quality across FP and NFP facilities, better quality in NFP nursing homes, or mixed evidence in this question.

Hillmer et al. (2005) reviewed the literature on the association between profit status and the quality of nursing home care and found that FP nursing homes systematically provide lower quality of care than NFP nursing homes. Thus, based on the results from several studies, FP nursing homes generally provide lower quality of care compared to NFP facilities. These findings suggest that, when identifying characteristics associated with quality care in nursing homes, ownership status and system membership are important features to consider.

Nursing home size

Nursing home size is rarely a separate variable in quality studies; rather, size is viewed as one of many nursing home characteristics or control variables. For example, Harrington et al. (2000) reported that smaller, nonprofit or government-owned nursing homes had fewer deficiencies, while a higher percentage of Medicaid residents was associated with more deficiencies. Rantz et al. (2004) found no significant differences in costs, staffing, or staff mix across the groups of nursing homes with different quality outcomes; however, they noted that small nursing homes with up to 60 beds were more likely to have good resident outcomes.

A low number of beds was one of the characteristics associated with a higher likelihood of nursing home closings (Castle, 2006a), along with lower Medicaid reimbursement rates, high competition, FP status, lower resident census, higher Medicaid occupancy, and lower quality of care.

Wan, Zhang, and Unruh (2006) found that smaller size was associated with better quality of care, measured as catheter use, restraints use and pressure sores. Along with

smaller size, they found that better quality nursing homes were "for-profit, caring for more Medicare residents, having residents with lower acuity levels, being located elsewhere than the South, having a high level of nurse staffing, and certified with lower frequencies of nursing care deficiencies" (p. 974).

Zinn, Mor, Feng, and Intrator (2009) investigated the determinants of performance failure in U.S. nursing homes, defining performance failure as termination from the Medicare and Medicaid programs. The study found that poor prior financial and quality performance and the introduction of case mix reimbursement increases the risk of failure, while larger size is protective, decreasing the likelihood of termination from the Medicare and Medicaid programs.

The findings of previous research supported Donabedian's SPO model, which views size as a structure component; size of nursing home should be considered in quality analysis.

Although there are other factors that affect quality of nursing home care, such as quality improvement efforts and effective leadership willing to embrace quality improvement and group process (Berlowitz et al., 2003; Rantz et al., 2004), organizational culture (Rahman & Schnelle, 2008) and others, this study does not address those, and limits organizational characteristics to size, staffing level, ownership and chain membership.

Environmental Factors and Quality of Nursing Homes

There is research that focuses on the effect of environmental factors on the quality of nursing home care. In most cases research would assess the effect of several

environmental factors, such as the effect of changes in healthcare policy, market competition or concentration, excess demand, presence of a certificate of need law, and availability of substitutes.

Prospective Payment System

The implementation of Medicare's modified Prospective Payment System (PPS) for facilities providing long-term skilled nursing and rehabilitation services generated a wide range of findings from numerous studies examining the effect of PPS on the quality of care.

In 2002, Chen and Shea (2002) warned that, instead of an increase in efficiency, the PPS reimbursement modifications for nursing home costs might result in a decrease in quality. Indeed, findings from a subsequent study (Konetzka et al., 2004) revealed a negative correlation between the PPS and nursing home levels of staffing, which, as described earlier in this chapter, affect nursing home quality. In contrast, White (2005/2006) reported a correlation between the implementation of the PPS and a small but positive change in staffing in skilled nursing facilities. However, White noted also that, among FP facilities, the elimination of cost reimbursements is associated with a large decline in nurse staffing.

Findings from other studies suggest that modified PPS reduces the number of Medicare-subsidized days in nursing homes, which, consequently, lowers reimbursement levels and affects the quality of care. In their analysis of nursing homes Chen and Shea (2004) considered the effect of PPS on nursing homes. They reported that more than 68% of the facilities in their sample produced fewer than the optimal scale of Medicare days.

They cautioned also that the financial pressures caused by the Medicare PPS for skilled nursing facilities may further reduce the number of Medicare days for nursing homes, leading to a reduction in the amount of public reimbursement that nursing homes receive and, that this in turn, may lower the quality of care.

Konetzka et al. (2004) reported a similar link between the PPS reimbursement modifications and reduced quality of care in nursing homes, measured as the number of regulatory deficiencies, defined as an unweighted count of health deficiencies recorded in OSCAR. In their study, the researchers combined information retrieved from the Minimum Data Set and the Online Survey, Certification and Reporting database to examine the relationship between Medicare's payment changes and the quality of nursing homes, located in five states, for long-stay residents. Study results indicated that the long-stay residents in their sample received a low quality of care, likely due, they indicated, to low reimbursement levels related to the PPS's Medicare payment guidelines.

In the years both before and after the implementation of Medicare's modified PPS, findings from several other studies demonstrated that public reimbursement, which includes Medicare and Medicaid, affects nursing home quality of care. In 1996, Cohen and Spector found that both the level and approach of Medicaid reimbursement affect nursing home quality, as measured by case-mix-adjusted staff-to-resident ratios. Grabowski and Castle (2004) found an additional correlation between reimbursement and quality of care. Using 1991–1999 data from the Online Survey, Certification and Reporting system, they conducted a longitudinal study that examined the concentration of low- and high-quality care within particular nursing homes. Their findings revealed a

correlation over time between low- and high-quality nursing home care in certain facilities and public reimbursement as well as asymmetric information. Furthermore, Grabowski (2001, 2004) analyzed the relationship between Medicaid reimbursement and the quality of nursing home care and found a positive effect of reimbursement on quality, measured as a proportion of residents with pressure ulcers, physical restraints, catheters and feeding tubes. He noted also that, although Medicaid rates of reimbursement are generally lower than Medicare rates, Medicaid is the dominant purchaser of nursing home services and the most important financial resource for nursing homes.

Competition

Competition is another important factor for nursing home quality. Castle et al. (2007) examined changes in quality measure scores on the Nursing Home Compare Web site and determined that improvement of quality measures is more likely to occur in nursing home markets with the highest competition and lowest average occupancy rates. High competition was one of the characteristics associated with a higher likelihood of nursing home closings (Castle, 2006a), along with small size, lower Medicaid reimbursement rates, FP status, lower resident census, higher Medicaid occupancy, and lower quality of care.

Starkey et al. (2005) studied market competition and nursing home quality of care and found that some forms of competition, such as nursing home substitutes, active certificate of need laws and the level of excess demand are significantly related to nursing home quality, measured as use of catheters and physical restraints, pressure sores and mood and cognitive decline. On the other hand, the study did not find a relationship

between quality of care and purchasing power of Medicaid, measured as a percentage of Medicaid residents in the county, or market concentration, measured as private Herfindahl-Hirschmann index. According to the authors, a large percentage of Medicaid recipients among nursing home residents in the market often represents a low level of competition.

Konetzka, Norton, and Stearns (2006) also analyzed the impact of excess demand for nursing home care on the payer mix of both public and private reimbursements. They noted that revenues from private-pay patients are often used to help subsidize low-pay Medicaid residents. When an excess demand for nursing home care occurs, facility administrators have greater freedom to accept or reject a patient. Because administrators usually prefer to fill the facility's beds with more profitable private-pay or Medicare patients, Medicaid patients are often accepted last, assuming they require the same level of care as do private-pay or Medicare patients. However, Konetzka et al. noted also that the current literature does not support the excess-demand framework: they hold that due to a decline in nursing home occupancy rates during recent decades and despite increasing demands for long-term care, nursing home administrators no longer have the freedom to choose lucrative private-pay versus public-pay patients. Instead, they have to compete for any type of resident, whether public- or private-pay.

Grabowski (2004) also used excess demand as a market characteristic in his study of Medicaid payment and nursing home quality. In his study excess demand was measured as the number of empty beds per 1000 non-institutionalized elderly individuals;

among other market characteristics that the study used were the number of elderly per square mile, the Herfindahl-Hirschmann index and median per capita county income.

Based on the literature, there are a number of important environmental factors, that need to be taken into account for quality analysis. Market concentration, availability of nursing home substitutes, presence of active certificate of need law and excess demand are among commonly used measures of competition.

Payer mix

Payers are one of the major forces in the environment that affects the structure and behavior of nursing homes. There are three major payers for nursing home care: Medicaid, Medicare and private residents, and the mix of public- and private-payers plays an important role in the nursing home industry. Medicaid is an exceptionally significant resource for nursing homes, because it pays approximately 50% of all nursing home expenditures and provides residents for 70% of all bed days (Grabowski, 2001). At the same time, Medicaid payment rates are usually lowest in comparison with Medicare and private residents. For example, in 1999, nursing home average monthly charges per resident were $3,505 for the Medicaid program and $5,764 for the Medicare program comparing to $3,947 for private-pay residents, including those with private health insurance (National Center for Health Statistics, 2005), which may be explained by the significant difference between the type of care required by Medicaid and Medicare patients.

Mukamel, Spector, and Bajorska (2005) noted that, in the early 1990s, nursing homes preferred Medicare and private-pay residents to Medicaid residents because of the

higher payment rates. The authors added that now, due to changes in the competition for long-term care, nursing homes must compete for Medicaid residents as well as for Medicare and private-pay residents.

Grabowski, Angelelli, and Mor (2004) studied the effect of Medicaid payment rates on quality of nursing homes, measured as pain, pressure ulcers and use of physical restraints. They found a positive relationship between payment rates and pressure sores and physical restraints.

Castle (2005a) examined the relationship between quality of care and private-pay census. He used the following care procedures for residents as measurements of quality: use of physical restraints, urethral catheterization, and psychotropic medication, as well as treatment of pressure ulcers and contractures, Results from his study revealed a correlative and predictive relationship between the use of physical restraints and psychotropic medications and private-pay census, while other indicators were less important. The results of this cross-sectional study showed that higher quality nursing homes were more likely to have a higher private-pay census than were lower quality nursing homes. The change score analyses showed that nursing homes could increase their private-pay census by increasing quality. On the other hand, the cross-sectional nature of the study does not rule out the possibility of reverse causality, when higher quality of care attracts more private-pay residents.

In summary, nursing homes are dependent on a payer mix of both public and private reimbursements to help finance their efforts to provide quality care. However, as evident in a variety of study findings, modified policies regarding Medicare

reimbursements have negatively affected nursing homes' quality of care. Additionally, due to a recent decline in occupancy rates, nursing homes must increase their efforts to compete for public- and private-pay resources

As noted by Banaszak-Holl, Zinn, and Mor (1996) "responsiveness to the needs of key constituents" is "critical to competitive viability" (p. 102). The present study includes payers' position as one of the factors of environment.

Pay-for-Performance program

The Pay-for-Performance (P4P) program is a relatively new approach to promote healthcare quality and efficiency by offering financial rewards to healthcare organizations that provide improved quality of services and the efficient use of resources. Sometimes P4P is also referred to as "Value Based Purchasing" (Mollot, Rudder, & Samji, 2008, p. 3) and can take different forms, from relatively simple rewards for better quality to substantive changes in the reimbursement system. Quality Monitoring for Medicare Global Payment Demonstrations: Nursing Home Quality-Based Purchasing Demonstration report (White et al., 2006) identified a set of measures that should be included in the performance evaluation initially. The categories are nursing home staffing and turnover, rate of potentially avoidable hospitalizations, MDS-based resident outcome, and outcomes from state survey inspection. This project offers two basic approaches to evaluation. The first approach is based on "performance in the demonstration year compared to the baseline distribution" (White et al., 2006, p. 16), allowing nursing homes to monitor their performance and to plan for quality improvement. The second approach

is based on relative ranking during each demonstration year, allowing for "more uniform distribution of points associated with each measure (White et al., 2006, p. 17).

Jiang, Friedman, and Begun (2006) in their study on hospitals' response to P4P programs noted that healthcare organizations may respond to P4P programs with strategies that improve costs and quality of care to affect the survival of an organization in a competitive environment. Thus, U.S. states with active nursing home P4P programs may generate an incentive for nursing homes to improve quality and efficiency, and therefore, the presence of a P4P program should be considered in the analysis of nursing home performance.

Quality of Care and Financial Indicators

Numerous studies have examined the quality of care in nursing homes and its effect on the costs of care. Weech-Maldonado, Shea, and Mor (2006) found a non-monotonic relationship between lower quality, as measured by the frequency of staff's treatment of residents' pressure ulcers and the rate of mood decline, and total patient care cost for 749 nursing homes in five states.

Weech-Maldonado et al. (2003a) found that nursing homes (located in New York, Kansas, Vermont, Maine, and South Dakota) with better outcomes and processes of care "were able to achieve lower patient care costs and report better financial performance" (p. 201). Contrary to most other studies, this study did not find a relationship between structural quality measured as registered-nurse-staffing ratio and process quality.

Anderson et al. (2003) found that quality improves with the increase of patient care costs, while Hicks et al. (2004) found that quality may have a significant negative

financial effect on costs, although each individual quality measure made only a small contribution.

Because increasing quality may raise the cost of services faster than it raises revenues, it is logical to assume a trade-off between quality of care and profit (O'Neill et al., 2003). However, studies of this relationship have produced varying results. Findings from some studies confirm the assumption of a trade-off between quality of care and profit (e.g., Hillmer et al., 2005; O'Neill et al., 2003). Other findings demonstrate a correlation between higher quality of care and better financial performance (e.g., Castle, 2005a; Weech-Maldonado, Neff, & Mor, 2003a).

At the same time Zinn et al. (1994) in their study of strategic group membership, nursing home performance, and strategic behavior, noted that, although most other industries use profitability as a measure of performance, profit is not the primary indicator of performance in nursing homes. Thus, while financial indicators may be associated with quality of nursing home care, this study will not use financial measures of performance. This will be left for future research.

Efficiency of Nursing Homes, Using Data Envelopment Analysis

In 1983, Nunamaker and Lewin used a technical efficiency score obtained through Data Envelopment Analysis (DEA) to measure routine nursing service efficiency. Since then, healthcare researchers in the United States and worldwide have extensively used DEA to assess technical efficiency at different levels of decision-making units, such as health management organizations (Bryce, Engberg, & Wholey, 2000) and hospitals (Ferrier & Valdmanis, 2004; Grosskopf, Margaritis, & Valdmanis,

2001; Harris, Ozgen, & Ozcan, 2000; Harrison, Coppola, & Wakefield, 2004; Harrison & Sexton, 2006; O'Neill, 1998; Ozcan, 1995; Wang, Ozcan, Wan, & Harrison, 1999). Researchers have also used DEA to study changes in hospitals' technical efficiency due to the impact of policy, technology, and environmental issues: for example, the correlation between information system integration and efficiency in urban hospitals (Lee & Wan, 2003); the impact of managed care penetration and hospital quality on efficiency in hospital staffing (H. Brown, 2002; Mobley & Magnussen, 2002); and the competitive behavior of hospitals (Chirikos & Sear, 1994). Although most researchers have applied DEA to examine efficiency at the hospital level, some have applied DEA at the managerial level (O'Neill, 2005; O'Neill & Dexter, 2004).

As noted above, numerous studies from the United States and other nations have addressed the efficiency of nursing homes, and many researchers have applied DEA in their investigations. The large number of studies attests to the varied categories of nursing home efficiency. Some of the categories are technical efficiency, cost efficiency, managerial efficiency, resource allocation efficiency, size efficiency, and production efficiency. To examine the various categories, researchers have employed a wide range of factors related to nursing home efficiency, such as ownership, system membership, and others. Below are several of the more salient studies that have examined a range of factors in measuring efficiency.

Ozcan et al. (1998) used DEA to determine the technical efficiency of skilled nursing facilities in the United States. Using a 10% national sample of 324 facilities, the authors concluded that profit status affects facilities' mode of production. Results from

the study indicated that the best of the sample's FP nursing homes had a level of technical efficiency 0.86 times higher than the most efficient of the sample's NFP nursing homes. Additionally, the best larger facilities were "0.89 times more efficient than the best smaller facilities" (p.211). Thus, the authors concluded that greater efficiency correlates with higher occupancy rates and a larger percentage of Medicaid patients, while lower efficiency correlates with lower occupancy rates and a higher percentage of Medicare patients.

Knox, Blankmeyer, and Stutzman (2006) investigated relative efficiency among NFP nursing facilities in Texas and found that the private, secular NFP nursing homes in their sample were the most efficient, followed by religious-affiliated NFP facilities and, next, government-owned NFP facilities. When allocation efficiency was included in the analysis, the private, secular NFP nursing homes were significantly more efficient than the religious-affiliated NFP homes.

Vitaliano and Toren (1994) used a stochastic frontier approach to analyze efficiency in 164 skilled nursing facilities and 443 combination skilled and health-related facilities located in New York during 1987–1990. They reported no change in cost efficiency occurred throughout the selected time period in both the NFP and FP facilities in their study sample. In their study, Anderson, Lewis, and Webb (1999) examined efficiency among nursing home chains and NFP facilities. Using data from the National Nursing Home Survey, they found that chain affiliation and NFP status reduce efficiency and performance.

Other studies have addressed the efficiency of nursing homes managed by chains. For example, using a study sample of 163 Michigan nursing homes, Fizel and Nunnikhoven (1993) found that the chain nursing homes had a higher mean level of efficiency than the independent facilities. Kleinsorge and Karney (1992) examined the causes of inefficiency in decision-making units within a nursing home chain. Results from their study suggested that the inclusion of quality measures may change the estimated nursing home efficiency.

Gertler and Waldman (1994) analyzed managerial efficiency and quality in FP and NFP nursing homes. Results indicated that the FP facilities in their study sample had approximately 15.9% lower costs than the NFP facilities, but the NFP facilities provided 3.9% higher quality than the FP facilities.

In a study examining the link between compensation and performance in FP and NFP nursing homes in Texas, Knox, Blankmeyer, and Stutzman (2004) used cost and profit functions to measure facility performance according to efficient resource allocation by members of the firm's management team. Findings revealed that the highest paid administrators in the study's sample allocated their firm's resources in the most efficient way. Furthermore, chain administrators were significantly superior in resource allocation, even when they received less compensation than independent administrators. Concurrently, findings indicated no difference between rural and urban administrators in their overall ability to allocate resources.

Björkgren, Häkkinen, and Linna (2001) reported inefficient resource allocation in their study of 64 long-term care units in Finland. The researchers used DEA to measure

nursing care efficiency in terms of cost, technical, allocation, and scale efficiencies. They observed a substantial variation in efficiency between units. Study findings revealed that larger units operate more efficiently than smaller units. Björkgren et al. (2001) concluded that allocation inefficiency is the result of using what they considered to be too many registered nurses and nurse aides and too few licensed practical nurses.

Table 1 presents inputs and outputs used to calculate efficiency of nursing homes in a number of studies. Although DEA allows researchers to combine different types of inputs (e.g., financial, human, and physical resources), most of the studies listed in Table 1 use labor inputs or different measures and combinations of measures of nursing home staff. As outputs, the studies listed in the table used either the number of residents/patients or the number of resident days.

As Jacobs, Smith, and Street (2002) noted, efficiency has become a key interest for policymakers in most healthcare systems, partly because the aging populations "pose challenges for the design of health systems and expectations are becoming even more challenging" (p. 1). The wide range of study topics, methods, and findings that have addressed the various forms of nursing home efficiency and related factors illustrate the difficulty in precisely measuring nursing home efficiency. Likewise, studies that have investigated the relationship between nursing home quality and efficiency are similarly complex and varied.

Nursing Home Performance

The concept of healthcare performance is complex and difficult to measure. Rosenfield and Branch (2005) proposed that the main components of nursing home

Table 1. Measures of Inputs and Outputs in Data Envelopment Analysis Models for Nursing Homes Used in Healthcare Research

Authors	Inputs	Outputs
Nyman & Bricker (1989)	Total nursing hours, total social workers hours, total therapists hours, total other workers hours	Patients of skilled nursing facility, intensive care facility, limited care, personal care, residential care patients
Sexton, Leiken, Sleeper, & Coburn et al. (1989)	6 labor inputs	Medicaid, non-Medicaid days
Nyman, Bricker, & Link (1990)	11 labor inputs	Number of intensive care facility patients
Fizel & Nunnikhoven (1993)	Registered nurses hours, licensed practical nurses hours, and nurse aides/orderlies hours	Skilled nursing facility patient days and intensive care facility patient days
Kooreman (1994)	Physicians, nurses, nurse trainees, therapists, general staff, and other personnel	Patients classified as physically disabled, psycogeriatrically disabled, full-care and daycare
Rosko et al. (1995)	FTE-RNS, FTE-LPNS, FTE-NAS, rehabilitation personnel (p. 1010), FTE and other personnel	Skilled nursing facility days and intensive care facility days
Ozcan et al. (1998)	Beds, FTE, operational expenses	Self-pay inpatient days, government-pay inpatient days
Fried, Schmidt, & Yaisawarng (1999)	FTE-RNS, FTE-LPNS, other, and nonpayroll expenses	Inpatient days of skilled care and inpatient days of intermediate care.
Björkgren, Häkkinen, & Linna (2001)	FTE-RNS, FTE-LPNS, FTE-NAS, beds (proxy for capital)	Case-mix adjusted patient days
Anderson et al. (2003)	6 financial indicators	Total beds, net profit
Laine, Linna, Noro, & Häkkinen (2005)	FTE-RNS, FTE-LPNS, FTE-NAS, unit size (beds)	Case-mix weighted patient days
Duffy et al. (2006)	Multiple combinations in 8 models	

Notes: FTE = full-time equivalent; FTE-RNS = full-time equivalent registered nurses; FTE-LPNS = full-time equivalent licensed practical nurses; FTE-NAS = full-time nurse aides.

performance are quality of living, medical health, and cost. They suggested also that the sources of performance are management and operations, facilities, and community relations. The variety and multifaceted nature of these components create challenges in identifying specific measures to assess nursing home performance. As described below, previous research efforts to identify measures of nursing home performance reveal the multidimensional aspects not only of the concept of performance, which includes efficiency, but also its impact on quality care.

Several other researchers have also recognized the "multidimensional" aspects of performance and nursing home quality of care, as well as the need to choose valid measures. Consequently, the literature includes numerous studies that have investigated a variety of performance measures. For example, in their study that examined performance measurement and benchmarking in residential and nursing homes, Mor, Angelelli, et al. (2003) concluded that the multidimensionality of quality measures may account for a relatively low correlation among different quality measures and, thus, no single measure is suitable for all situations. They determined that performance, based on the comparison of different quality indicators (e.g. benchmarking), can be used to assess providers and their performance in regard to average or to certain standards. However, the authors observed many technical problems related to quality measurement in their study, including small sample size, aggregation of data, risk adjustment, and ascertainment biases.

Similarly, Zinn, Mor, Feng, and Intrator (2007) reported on the complex nature of measuring performance. In their study on the impact of strategic adaptation on nursing

home performance, the authors noted that because "organizational performance is a multidimensional concept, no one single measure captures its complexity" (p. 1205). Thus, for their study, the authors used multiple measures of economic performance, such as occupancy and payer mix.

Numerous other researchers have also used a wide variety of measures to assess nursing home performance. For example, Kane, Arling, Mueller, Held, and Cooke (2007) described a pay-for-performance system developed for Minnesota nursing homes, using a quality score as a measure of performance. The quality score was composed of five elements: staff retention, staff turnover, use of the pool of staff, nursing home quality indicators, and survey deficiencies. Likewise, Zinn et al. (1994) used a number of quality indicators to measure performance in their study of strategic group membership, nursing home performance, and strategic behavior. The authors noted that, although most other industries use profitability as a measure of performance, profit is not the primary indicator of performance in nursing homes. Thus, they measured performance using a variety of quality indicators (prevalence of pressure ulcers, use of catheters and restraints) and technical efficiency scores (efficiency of service provision). Laine, Finne-Soveri, et al. (2005) noted two more important elements for assessing performance: efficiency and quality of care for the elderly. They suggested that both elements are essential for measuring nursing home performance.

Thus, numerous studies illustrate the complexity and variety of ways to measure nursing home performance. Because the purpose of the present study is to assess the

relationship between the quality and the efficiency of nursing homes, this paper examines the combination of both as a measure of performance in nursing homes.

Studies of the Relationship Between Nursing Home Quality and Efficiency

Many U.S. and worldwide researchers have focused on the correlation between quality of care and efficiency in nursing homes. Due to the complex nature of both concepts and to the researchers' varied use of study samples, methods, and application of different indicators and factors related to quality care and efficiency, findings reveal diverse and sometimes conflicting ideas. The following summary of the literature illustrates this diversity.

Rosko et al. (1995) analyzed ownership, operating environment, and labor efficiency among 461 freestanding nursing home facilities located in Pennsylvania. They found that, instead of quality characteristics, the major factors related to nursing home efficiency in their sample were type of ownership, occupancy rate, size, wage rate, payment source, and per capita income. In taking quality of care into account, Rosko et al. included rates of pressure ulcers, catheter use, and restraint use as quality control variables. For case-mix control variables, they used a case-mix index, the proportion of residents over 85 years old, rates of live discharge, and the proportion of residents who were classified as "confused." Although Rosko et al. included numerous quality variables in their study, their findings on efficiency and quality were based on nursing homes from only one state in the United States; thus, the results of their study may be difficult to apply to all nursing homes in the United States.

Duffy et al. (2006) reported no evidence of a correlation between efficiency and quality of care. In their study, they applied DEA on a sample of 69 nursing homes in Texas to demonstrate DEA's ability to identify the best performing facilities in long-term care. The authors used the percentage of residents not suffering from pressure sores as the only measurement of quality, though they acknowledged that pressure sores are only one measure of outcome quality in long-term care.

Although Duffy et al. (2006) found no evidence of a correlation between efficiency and quality of care, they also reported that the FP nursing homes in their sample were consistently more efficient than the NFP facilities. This particular finding supports study results from an earlier study by Anderson et al. (2003), who analyzed data on 487 Florida nursing homes and found that FP status, size, and room utilization were positively related to efficiency among the facilities in their study sample. Anderson et al. also reported that chain affiliation seemed to be correlated with efficiency; however, when quality, measured as a state inspection score, was included in their model, no significant correlation was found.

Laine et al. (2004) reported a mix of results in their study that examined the association between productive efficiency and clinical quality in institutional long-term care facilities for the elderly in Finland. The researchers used cross-sectional data from 122 wards in Finnish health-center hospitals and residential homes during 2001 and applied DEA to create a production frontier. In this case, technical inefficiency in production was specified as a function of ward characteristics and clinical quality of care. Study results revealed no overall systematic association between technical efficiency and

clinical quality of care. However, technical efficiency among the study's sample was positively associated with a prevalence of pressure ulcers, which is an indicator of poor quality of care.

In a subsequent study by Laine, Linna, Noro, and Häkkinen (2005), findings revealed an association between cost efficiency and quality of care. The study examined the association between quality of care and cost efficiency in Finnish institutional long-term care wards for the elderly. Using stochastic frontier cost function, the researchers found that the average cost inefficiency among the wards was 22%. They also reported an association between several clinical quality indicators and cost inefficiency. In their study sample, a higher prevalence of pressure ulcers was associated with higher costs, and a higher prevalence in the use of depressants and hypnotic drugs was associated with increased inefficiency.

Blank and Eggink (2001) studied 110 Dutch nursing homes to examine a quality-adjusted cost function. They found that quality is partly endogenous and is negatively related to the input costs of nurses and other personnel, the number of daycare patients, and the market concentration. In another study of Dutch nursing homes, Kooreman (1994) assessed technical efficiency with respect to the use of labor inputs and found that 50% of the nursing homes in his sample were efficient. Study results also revealed some evidence of a trade-off between labor input efficiency and the quality of care.

Although DEA was used in research of nursing home quality and productivity, most of the studies restricted quality measures to pressure ulcers, catheters and restraints use (Rosko et al., 1995; Zinn et al., 1994), pressure sores (Duffy et al., 2006) and

deficiencies or inspection scores (Anderson et al., 2003; Fizel & Nunnikhoven, 1993). Another potential problem is the fact that all the studies involving quality were based on a sample of a single state, such as Pennsylvania (Rosko et al., 1995; Zinn et al., 1994), Florida (Anderson et al., 2003), Michigan (Fizel & Nunnikhoven, 1993), or a relatively small sample, such as 69 facilities (Duffy et al., 2006).

Although a number of studies have analyzed the efficiency of nursing homes with regard to the quality of care provided, based on the literature review, few investigations have attempted to incorporate efficiency into a broader model of quality in terms of its structure, process, and outcome components. In addition, most studies of the correlation between quality of nursing home care and efficiency are based on European long-term care facilities, and analyses of nursing home technical efficiency in the United States tended to employ relatively small samples or were based on a sample from only one state. Because the current study described in this dissertation intends to explore the relationship between quality of care and efficiency in nursing homes, it uses efficiency scores and included a wide range of quality indicators for a large sample of nursing homes throughout the United States.

Summary

Numerous researchers have studied various aspects of nursing home care quality, using a wide range of quality indicators, different organizational and environmental factors affecting the quality of services provided, and different quantitative and qualitative methods. Similarly, there have been numerous studies on nursing home

efficiency; however, these studies are varied in sample size, variables used, and conclusions reached.

The current study uses a relatively large number of quality indicators. As a proxy for the structure component in the SPO framework, the study uses staffing level, size, ownership, and chain membership. A number of quality measures from the OSCAR database are used for process and outcome components.

Although there are a number of nursing home efficiency studies, most were based on limited samples and none used efficiency in combination with the SPO model. In contrast, the present study uses a large national sample and incorporates an efficiency score into a structure-process-outcome relationship as a measure for process component.

CHAPTER 3: THEORETICAL FRAMEWORK

This chapter describes the theoretical framework and conceptual model used in the study to assess the relationship between efficiency and quality of nursing home care. Donabedian's (1980) Structure-Process-Outcome (SPO) model is often used to evaluate the quality of nursing home care. For this study, hypotheses based on the SPO model were developed to assess the relationship among quality components in nursing homes. The study also uses the resource dependency theory (Pfeffer & Salancik, 1978) as a general framework to examine the organizational and environmental factors affecting nursing home efficiency and quality of care. Hypotheses based on the resource dependence theory were developed to analyze the relationship among quality components and organizational and environmental factors in nursing homes. The resource dependence theory and Donabedian's SPO model are combined in this study to provide a general theoretical framework for analyzing the predictors of efficiency and the quality of care in U.S. nursing homes.

Donabedian's Structure-Process-Outcome Quality Framework

Developed in 1980, Donabedian's SPO framework is commonly used to assess quality in healthcare settings, including nursing homes. The SPO framework views quality as a three-part model that includes the following components: structure, process,

and outcome. According to Donabedian, the structure component is composed of the following characteristics:

> …the relatively stable characteristics of the providers of care, of the tools and resources they have at their disposal, and the physical and organizational settings in which they work. The concept of structure includes the human, physical and financial resources that are needed to provide medical care. (Donabedian, 1980, p. 81)

Donabedian defined the process component as a "set of activities that go on within and between practitioners and patients" (p. 79). He defined the outcome component as "a change in the patient's current and future health status that can be attributed to antecedent health care" (p. 83).

Donabedian (1980) also described a duality in the SPO framework's components of structure, process, and outcome. He claimed that, when used as alternative approaches, process and outcome are deeply interrelated, and "when the causal relationship between process and outcome is established, either can be used to make valid inferences about quality" (p. 103). Although not all process measures are highly correlated with outcomes, Donabedian noted that researchers often use either process or outcome to study healthcare quality. However, he also explained that, in cases when the causal relationship between process and outcome is confirmed, process and outcome become not alternatives but two approaches with equal power.

Donabedian's (1980) presentation of the SPO model, as shown in Figure 2, clearly assumes a causal relationship among the three components. However, Unruh and Wan (2004) reported that researchers frequently use SPO components separately as

Figure 2. Donabedian's Structure-Process-Outcome Model

Source: Donabedian, A. (1980). **The definition of quality and approaches to its assessment. Exploration in quality assessment and monitoring. Volume 1** (p. 83). Ann Arbor: MI: Health Administration Press.

indicators of quality, or they look for causal links between the structure component and the process and outcome components. Unruh and Wan also noted that the full SPO model is rarely used and that a model of the interrelationship between all three components is even more rarely used.

Researchers use Donabedian's (1980) SPO model to evaluate not only the relationship between the structure, process, and outcome components of healthcare quality, but also the factors affecting quality of care. For example, Glickman et al. (2007) used the SPO model to analyze healthcare organizational attributes of quality improvement from a management perspective. Upenieks and Abelew (2006) used the model to evaluate the magnet hospital designation process. According to Weech-Maldonado, Meret-Hanke, et al. (2004), most healthcare studies examining the effect of nurse staffing on the quality of care use Donabedian's SPO framework. The SPO model has been used to study a wide variety of healthcare conditions in numerous settings, such as the use of radiotherapy in oncological emergencies in Germany, Austria, and Switzerland (Christian et al., 2007); antenatal care in Vietnam (Trinh, Dibley, & Byles, 2007); hospital departments in Sweden (Kunkel, Rosenqvist, & Westerling, 2007); health information systems in Nigeria (Adindu & Babatunde, 2006); primary care in Belgium

(De Maeseneer & De Sutter, 2004; van Driel, De Sutter, Christiaens, & De Maeseneer, 2005); mental health in the Netherlands (Ravelli, Buwalda, Slooff, Schrijvers, & van Engeland, 2003); and cancer (Miller, Montie, & Wei, 2005; Perrin, 2002).

The Structure-Process-Outcome Model in Studies of Nursing Home Quality of Care

Donabedian's (1980) SPO model is also an effective tool for assessing quality of care in nursing homes. Consequently, numerous researchers have incorporated the SPO model and its three components in their studies related to factors that affect nursing home quality care. For example, Unruh and Wan (2004) analyzed quality study models in the nursing home industry and divided them into SPO and SPO-like frameworks and non-SPO frameworks. Based on their findings, the authors provided an SPO systems framework for nursing home care quality, applying all three of the model's components. They identified contextual factors that directly affect organizational factors and nurse staffing (two, interlinking structure components), which affect nursing care (process component) and, in turn, influence the residents' quality of care (outcome component).

In addition to being an effective tool, the SPO model's three-part framework and its use in a variety of studies demonstrate the complexity of identifying relationships among the model's components, associated factors, and significant indicators that define nursing home quality of care and efficiency. The following summary of a selected number of previous studies illustrates the use of the SPO framework and the subsequent diversity of findings related to nursing home quality of care. The framework and findings from these previous studies influenced the choice of the present study's theoretical framework and conceptual model related to nursing home efficiency and quality of care.

Structure and process

Perrin (2002) noted that the relation of the SPO model's outcome component to the structure and process components is critical because a healthcare organization can control its structure and process to affect outcomes. In an earlier investigation, Sainfort et al. (1995) also observed a relationship between structure and process and emphasized the importance of studying the SPO's structure component in order to analyze process and outcomes. In their study, Sainfort et al. evaluated 24 models to analyze the sources of variation in measuring nursing home quality according to the SPO framework. They applied a previous model to a sample of 104 Wisconsin nursing homes to determine whether the relationship among quality components depends on the concept used. They found a strong correlation between the structure and process components ($r = 0.593$), as well as a correlation between process and outcome ($r = 0.391$) and between structure and outcome ($r = 0.274$). Their findings demonstrated causal links between structure, process, and outcome. The highest correlation was between structure and process, which emphasizes the significance of studying structure to analyze process and outcomes.

In the same study, Sainfort et al. (1995) also noted that the structure components in their SPO model "theoretically represent necessary but not sufficient conditions for quality" (p. 65). They also noted that to achieve a completely sufficient measure of nursing home quality, researchers must include indicators for each subdimension of the SPO framework and use a causal model with incorporated feedback loops.

According to Donabedian (1980), the structural component of quality "embraces the number, distribution, and qualification of professional personnel, and…the number,

size, equipment and geographical disposition of hospitals and other facilities" (p. 81). Following this definition, the structure component of a nursing home includes the number and type of personnel, the number and type of beds, and measures of capital expenses to represent forms of equipment.

Based on Donabedian's (1980) definition of the structural component of quality, researchers have used a number of measurements to assess the structure of nursing homes. For example, Weech-Maldonado et al. (2003a) used a registered nurse staffing mix (the ratio of registered nurse full-time equivalents to total nurse staffing full-time equivalents) as a measure of structural quality. To measure the quality of process, they included the use of physical restraints and catheters; for outcome measures, they included the prevalence of pressure ulcers and patient declines in mood and cognitive abilities. Zinn et al. (2005) listed ownership, chain affiliation, size, occupancy, and hospital-based versus freestanding status as structural characteristics in nursing homes.

Sainfort et al. (1995) raised a question about the multidimensionality of the structural component of quality or, as they phrased it, the "theoretical difference between elements of structural quality and elements traditionally regarded as organizational characteristics" (p. 80). They offered a definition of organizational slack as being nursing home structural characteristics that management can control more easily, compared to other variables. These controllable structural characteristics include, for example, staffing, direct care expenditures, case-mix, and social services activity. Sainfort et al. noted that, although some characteristics of nursing home structure (e.g., profit status or chain affiliation) and operating environment (e.g., Medicaid reimbursement rate or

availability of private-pay residents) are more stable than other characteristics, these particular characteristics might indirectly affect process or outcome quality through indicators of organizational slack. The authors suggested that a more accurate model of the relationship between structure, process, and outcome will distinguish between organizational slack (e.g., staffing, expenditure, and case-mix) and noncontrollable elements of structure (e.g., profit status or chain affiliation).

Structure, efficiency, and quality of care

According to Donabedian (1980), structure indicates only general tendencies and is relevant to quality only to the extent that structure affects the probability of good performance. Donabedian noted that "good structure, that is, a sufficiency of resources and proper system design, is probably the most important means of protecting and promoting the quality of care" (p. 82). Thus, good structure depends on a proper system design and a sufficient amount of resources.

Although efficiency may be reached without a proper system design (e.g., efficiency at the expense of quality), a proper system design usually presupposes the efficient use of resources with an appropriate level of quality of care. The efficient use of beds and staff, or the high efficiency of a nursing home, may be viewed as evidence of a proper system design. On the other hand, a proper system design may not be enough to create a good structure if an organization lacks the resources for appropriate functioning. A situation in which critical resources are not easily available or are uncertain causes an organization to become more dependent upon the sources of these resources and creates the need for management to seek opportunities to secure more resources.

Although structure is an important factor of quality, Donabedian (1980) noted that structure, because of its relative stability, does not fit for the purposes of continuously monitoring quality of care. The relationship between nursing home structure and outcome quality may be difficult to detect because some elements of structure (e.g., number of beds) do not change often. On the other hand, as Donabedian further suggested, if certain procedures are associated with good results, then "the mere presence or absence of these procedures…can be accepted as evidence of good or bad quality" (p. 83).

Process measures and efficiency

Shortell and Kaluzny (2006) provided a list of examples of process performance measures in different domains of healthcare organization activity. Among the process measures for clinical care, they listed effectiveness, productivity, and efficiency. Effectiveness measures included clinical aspects such as the rate of nosocomial infections or the rate of postsurgical wound infections. Productivity measures included indicators such as the ratio of total patient days or total admissions to the total staffing full-time equivalent. Shortell and Kaluzny's productivity measures are similar to the additional measure of process that the current study uses: an efficiency score calculated by Data Envelopment Analysis. Efficiency measures in Shortell and Kaluzny's study included the average cost per patient and the average cost per admission.

In summary, as evident in previous studies, Donabedian's (1980) SPO model is an effective tool for analyzing nursing home quality of care and efficiency. The model depicts a causal relationship between the structure, process, and outcome components of quality healthcare. According to Donabedian, the structure component of quality is a

relatively stable characteristic of a healthcare organization and includes human, physical, and financial resources. Pfeffer and Salancik's (1978) resource dependence theory provides the framework to further examine the organizational and environmental factors affecting nursing home quality of care and efficiency.

Resource Dependence Theory

In their study on the structure of organizations, Pfeffer and Salancik (1978) developed the resource dependence theory, which is an open system perspective. Scott (2003) distinguished three perspectives used in the study of organizational structure, especially in the last century: organizations as rational, natural, or open systems. The rational system perspective views organizations as instruments used to achieve certain goals. The natural system perspective views organizations as collectives. Both perspectives represent systems separate from the environment and are considered closed systems. Scott noted that the open system perspective emphasizes the interaction between an organization and its environment, in which "environments shape, support, and infiltrate organizations" (p. 29). Thus, the open system perspective, such as the resource dependence theory, emphasizes organizational adaptation and views organizations as organic, living systems rather than as mechanistic tools for achieving goals.

Overview of the Resource Dependence Theory

According to Pfeffer and Salancik's (1978) resource dependence theory, no organization can create all the resources necessary for its survival. Furthermore, an organization's resources are controlled by others in the environment, such as other organizations or groups of organizations, which create dependence. An organization

seeks to decrease its dependence by acquiring valuable resources and actively increasing its chances for survival by employing specific strategies in response to environmental pressure. To improve its chances for survival, an organization creates interorganizational relationships. Organizations with the best access to resources, such as customers and suppliers, have the most power in the market and a better chance for survival.

According to Pfeffer and Salancik (1978), two key constructs in the theory of dependence are environmental uncertainty and competition. In a highly uncertain environment, an organization is motivated to secure resources. Competition is created by an organization's need to vie with other organizations for scarce resources. Moreover, a high level of competition generates the need for an organization to form a relationship with others in order to secure and protect resources.

The theory of dependence also acknowledges that, in response to environmental uncertainty and competition, organizations may have to develop interdependent relationships with others, even if the relationships create dependence and reduce the power of the organization (Pfeffer & Salancik, 1978). Thus, the theory's construct of interdependence refers to organizations creating links with each other to protect resources and to survive. Among the factors affecting the magnitude of interdependence are the importance of resources and the other organization's level of control over resource allocation (Pfeffer & Salancik, 1978).

According to Hatch (1997), resources that are necessary for an organization but controlled by other organizations in the environment include "raw materials, labor, capital, equipment, knowledge and outlets for its products and services" (p. 78). Because

an organization depends on these resources, the environment's other organizations and groups that provide the resources obtain a level of power over the organization. In turn, as Hatch observed, the environment uses this power "to make demands on the organization for such things as competitive price, desirable products and services, and efficient organizational structures and processes" (p. 78). Thus, as Luke and Walston (2003) noted in their discussion on the resource dependence theory, "managing the exchanges and relationship with interdependent organizations may be more important to survival than managing production efficiencies" (p. 299).

Pfeffer and Salancik (1978) noted that two additional important factors in the resource dependence theory are the size of an organization and the role of managers. The authors state that, compared to small organizations, large organizations have greater internal resources, which may help them accommodate more easily to environmental changes. The theory also views managers as proactive players in complex environments. Managers scan the environment to detect risks, look for business opportunities, reduce uncertainty, and seek ways to lessen dependencies.

One of the weaknesses of the resource dependence theory is that it states an organization seeks to be independent from others; however, a purely self-sufficient organization is rare. Nevertheless, the theory is useful in analyzing an organization's survival tactics and strategies.

According to Scott (2003), the strategies an organization may use to adapt to the environment can be defined as buffering tactics (to protect the organization's technical core) or bridging tactics (to secure the organization in relation to the environment). To

protect its technical core from environmental uncertainty, an organization may take the following proactive measures: forecast expected changes; create a slack of certain resources, especially critical resources (stockpiling); or actively stimulate demand and motivate suppliers during slack periods (leveling). Other buffering tactics include preprocessing inputs before they enter the technical core (coding) or adjusting the scale of an organization.

Based on Pfeffer and Salancik's (1978) interdependence construct in the resource dependence theory, Scott (2003) also described the common types of bridging tactics that organizations use in response to the environment. Bridging tactics can be positioned on a continuum of a relationship formed to reduce the impact of future environmental uncertainty. The relationship continuum can span from mergers (two or more organizations transform into a single entity) to contracting (two or more organizations keep relative independence from each other, being tied together only by particular contract conditions). Thus, bridging tactics bring together multiple organizations to pursue common objectives. Bridging tactics include cooptation, in which representatives of external groups form a decision-making body for an organization; joint venture, which is created by two or more organizations to reach a common goal; strategic alliances, in which two or more organizations combine their efforts and resources to reach a common goal; and associations, which bring together multiple organizations to pursue common objectives.

The resource dependence theory is widely used in general healthcare research, as well as in long-term care research. For example, Zinn et al. (1999) used the resource

dependence theory in their study of organizational and environmental factors associated with nursing home participation in managed care.

Banaszak-Holl et al. (1996) analyzed the impact of market and organizational factors on nursing care facilities' service innovation, based on the resource dependence perspective. Starkey et al. (2005) used the resource dependence theory to study the relationship between market competition and nursing home quality. Dansky et al. (1996) applied this perspective to analyze hospital referrals to home health agencies.

The Resource Dependence Theory Applied to the Nursing Home Industry

As described earlier, environmental uncertainty and competition are two important constructs of the resource dependence theory. An organization is dependent on a number of resources and must often compete with others to acquire these resources, In their study of resource dependence and nursing homes, Zinn, Weech, and Brannon (1998) identified the intensity of market competition as an important characteristic of the industry's environment.

Aside from nursing homes competing with each other for the same resources, numerous other organizations (e.g., home health agencies and assisted living facilities) compete with nursing homes for the same set of patients. Starkey et al. (2005) noted that such competitors are likely to absorb certain types of patients, such as private-pay patients, who are the most valuable resource for nursing homes. The same residents also often require a lower amount of service resources than public-pay residents, making private-pay residents a relatively profitable resource for a nursing home.

Nursing homes depend on numerous important resources, including the number and type of residents, the number and type of personnel, and financial resources. The three major financial resources in the nursing home industry are payments from Medicaid, Medicare, and private-pay residents. Although Medicaid pays for most nursing home services, it has the lowest per-day rates among all the payers. Medicare has higher payment rates; however, because Medicare pays for limited after-hospital stays, the program usually includes a restricted amount of services in nursing homes. Private-pay residents are generally the most lucrative financial resource for nursing homes.

In response to competition and environmental uncertainty (e.g., escalating healthcare costs, declining financial resources, increasing demands for services), nursing homes must develop interdependent relationships with others in order to survive in the market. However, these relationships create dependence and nursing homes lose a level of power over resource allocation. As a major purchaser of nursing home care, Medicaid sets the payment rates that nursing homes depend on in order to provide this federally-funded program for their residents. Furthermore, in order to receive Medicaid residents, nursing homes must offer a certain level of care, as mandated by the Medicaid program.

Demands created by the nursing home industry's environment and by interdependent relationships generate the need for facilities to provide improved services, such as quality of care and higher productivity in the form of increased efficiency. Moreover, as Mukamel, Spector, and Bajorska (2005) noted, in providing both clinical care and a living environment, nursing homes must allocate their "revenue-constrained resources" (p. 1040) for heterogeneous groups of patients, depending on the market's

environment. For example, both private- and public-pay nursing home residents are interested in high quality and high efficiency services, but from different perspectives. For private-pay residents or their families, quality of care may be a factor in choosing a nursing home with a reputation for high quality.

Price is also an important factor for private-pay residents, especially because private-pay rates are generally higher than public-pay rates. In order to attract more lucrative, private-pay residents, a nursing home must offer an acceptable price for quality services, which can be achieved by the efficient use of resources. On the other hand, Medicare-paid residents mostly are transferred from hospitals and often do not have the time to shop for high quality nursing home care. Thus, their demand for quality services is not as high as the demand from private-pay residents. Similarly, Medicaid-paid residents must accept nursing home care and often do not have much choice in terms of quality of care. To protect these residents, the Centers for Medicare and Medicaid Services create standards of care, requiring nursing homes to provide at least a minimally acceptable level of quality. Although Medicaid rates are lower than private-pay rates, the program is a major purchaser of nursing home services; thus, in order to survive with low payments, a nursing home must seek to increase its efficiency.

Hatch (1997), based on Pfeffer and Salancik's (1978) resource dependence theory, recommended sorting resources according to their scarcity and criticality or, in other words, their availability and importance. Compared to resources that are easily available or less important, resources that are both scarce and critical greatly affect an organization's behavior, creating a deeper dependence.

Scott (2003) noted that it is impossible to "understand the structure or behavior of an organization without understanding the context within it operates" (p. 118). Thus, it is necessary to include environmental characteristics in an analysis of the nursing home industry.

In an examination of organizational environment, Choo (2001) described three factors that affect an organization's resource dependence: munificence, concentration, and interconnectedness. Relating these factor's to Pfeffer and Salancik's (1978) resource dependence theory, Choo wrote:

> Resource dependence is affected by munificence, or the abundance of resources; concentration, the extent to which power and authority in the environment is dispersed; and interconnectedness, the number and pattern of linkages among organizations in the environment. The degree of dependence would be great when resources are scarce, and when entities in the environment are highly concentrated or interconnected. (para. 29)

Choo's (2001) terms can also be combined with Hatch's (1997) classification of resources to describe the nursing home industry's environment. The concept of munificence may be viewed as an opposite of scarcity; thus, a nursing home would actually have to respond to the degree of available resources in the environment. The concept of concentration may be viewed as the number and strength of players in the nursing home market and may reflect the availability of resources as well as the structure of the industry itself. Zinn et al. (1998) indicated that an increased concentration in the nursing home market creates less competition. The concept of interconnectedness, on the other hand, is closer to the idea of resource criticality, because "the number and pattern of

linkages among organizations in the environment" (Choo, 2001, para. 29) depends on how important the resource is for an organization. For example, in the nursing home industry, residents are the most important resource for a facility's functioning. However, as a major purchaser of nursing home services, Medicaid controls this resource. In order to receive residents from the Medicaid program, a nursing home must provide a standard of quality care. Additionally, in order to survive with Medicaid payments, which are lower than payments from other sources, a nursing home must be efficient.

The conceptual framework in Figure 3 demonstrates the general relationships and links between the constructs of the resource dependence theory and Donabedian's SPO model. The framework is used in the current study to assess the relationship between quality of care and efficiency in nursing homes.

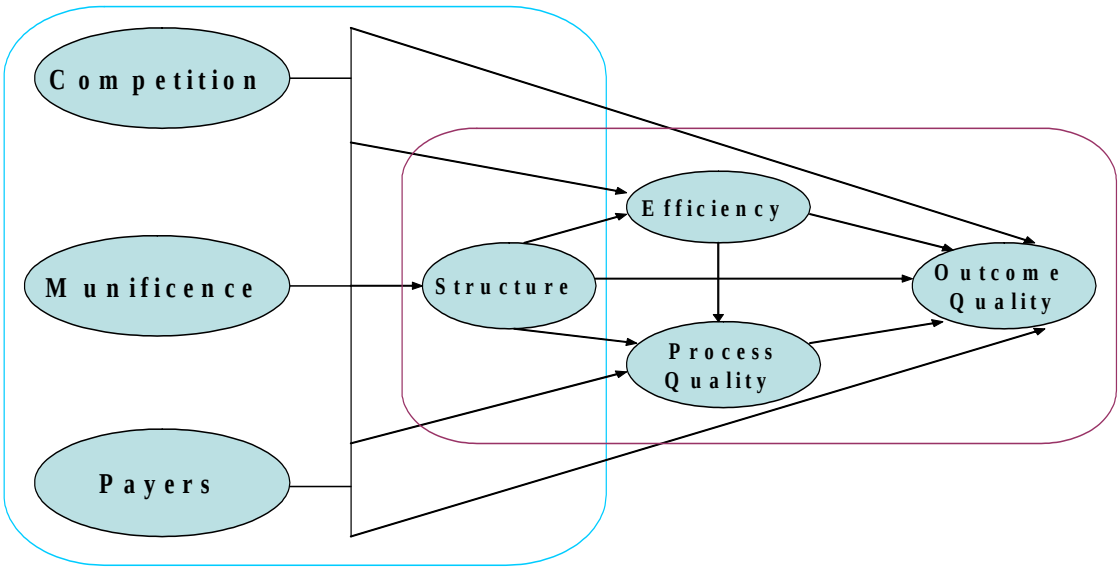


Figure 3. Conceptual Framework of the Study, Combining the Resource Dependence Theory with Donabedian's Structure-Process-Outcome Model for Nursing Home Efficiency and Quality Analysis.

Study Hypotheses

The resource dependence theory emphasizes an organization's adaptation to the environment. Because an organization cannot produce all of its necessary resources, it must adapt to the environment, in some cases, by changing its organizational structure. Donabedian (1980) divided healthcare quality into structure, process, and outcome components, in which structure affects process and, in turn, process affects outcome. The present study's nine hypotheses are described below, according to the study's conceptual framework, and are presented in two sections, representing the use of the resource dependence theory and of Donabedian's SPO quality model.

Environment and Nursing Home Quality and Efficiency

Competition

According to the resource dependence theory, an important environmental factor mediating organizational change is the intensity of market competition (Zinn et al., 1998). A more competitive environment is characterized by a greater number of organizations vying for the same resources and, so, may increase the need for organizational changes in order to secure these resources. In the nursing home market, facilities may respond to higher levels of competition by improving quality of care as a differentiation strategy and/or by adopting a more efficient use of available resources. Based on these factors, the following three hypotheses were developed for the current study:

H1. A higher level of competition in the market is associated with higher efficiency of nursing homes.

H2. A higher level of competition in the market is associated with higher nursing home process quality of care.

H3. A higher level of competition in the market is associated with higher nursing home outcome quality of care.

Market competition may be displayed in different forms and measured by different indicators. Although researchers usually use the Herfindahl-Hirschmann index to measure competition, other factors that affect the level of competition must be considered. The current study views competition as a construct presented by several measurements.

Research evidence suggests that nursing homes must compete with other substitutes for long-term care services. Numerous studies of long-term care have addressed the availability of substitute care options, such as hospital-based nursing homes, home health agencies, assisted living facilities, continuing care communities, and informal care provided by family members (e.g., Charles & Sevak, 2005; Starkey et al., 2005; Van Houtven & Norton, 2004). The presence of substitutes in the nursing home market generally increases consumers' options. Consequently, the increased availability of different options for the same type of services may lead a consumer to base his or her choice of an institution on both quality of care and an affordable price for services. In addition, long-term care alternatives may provide services for patients with fewer needs (Mukamel et al., 2005), which may leave the more needy or difficult patients for nursing homes to provide services for and, in turn, increase the facilities' need for service-related resources. Thus, a greater number of long-term care substitutes in the market may restrict

the price for nursing home services and increase the need for efficiency. To compete for consumers, nursing homes may have to improve not only their technical efficiency in order to offer affordable prices but also their quality of care.

The complexity of the environment refers to the number and type of forces affecting an organization, including competitors, suppliers, and payers. According to Dansky et al. (1996), the number and type of competitors reflect the environmental complexity. The researchers suggested that an urban environment is usually more complex than a rural environment. In a complex environment, nursing homes are pressured to improve their efficiency. Thus, the lower level of competition in rural areas may not provide incentives for nursing homes to improve quality and efficiency.

In order to assess the effect of market competition on efficiency and quality of care in nursing homes, the current study views competition as a latent variable presented by three indicators. These indicators are the Herfindahl-Hirschmann index, the number of nursing home substitutes in the market, and urban versus rural location.

Munificence

Munificence represents the availability of resources in the environment. For nursing homes, examples of these resources include the number and type of personnel, the number and type of residents, and sources of payment.

In one sense, the munificence of resources is connected to the competition level in the market. For example, a lower number of competitor nursing homes in an area may create a higher availability of nurses to employ. However, these constructs do not always have a direct relationship. A greater number of available personnel for a nursing home

may be not be related to the actual level of competition if the number of competitive organizations in the market is not taken into account. In general, one may argue that a lower amount (or scarcity) of available resources may hinder the way a nursing home operates. In order to provide an adequate volume of services despite restricted resources, a nursing home may have to improve its efficiency. Based on these assumptions, the following hypothesis was developed for the study:

H4. A lower availability of resources in a market is associated with higher efficiency of nursing homes.

The availability of qualified and competent staff is in important resource for nursing homes. In recent healthcare literature, the topic of a trend depicting a shortage of nursing staff has been widely discussed (e.g., Kany, 2004; Mion, 2003; Ponte, 2004). Although a nursing shortage presents a challenge for all types of healthcare settings, the problem may be more acute for nursing homes, which rely heavily on nurses to provide labor-intensive care. The current nursing shortage not only presents an economic problem in finding and retaining nursing staff but also increases the degree of uncertainty in the environment.

A stable nursing staff provides many benefits, such as comfortable communication with residents and fellow personnel and a familiarity with the facility. Findings from numerous studies have demonstrated the positive relationship between nurse staffing and quality of care in nursing homes (e.g, Bostick et al., 2006; Burgio et al., 2004; Hickey et al., 2005; Schnelle et al., 2004; Weech-Maldonado, Meret-Hanke, et al., 2004; Zhang & Grabowski, 2004). However, Decker (2006) noted that some

inconsistencies in results may be explained by the difference between short-stay and long-stay residents.

In addition to registered nurses, nursing homes employ a variety of other personnel. Researchers have analyzed the substitution of lower-level staff for registered nurses in nursing homes (e.g., Cavanagh & Bamford, 1997). Although this substitution may be viewed as a tactic to reduce a dependence on registered nurses and/or to reduce the cost of services, a nursing home needs a supply of lower-level personnel to fulfill its mission. Because the nursing shortage may affect a nursing home's ability to employ and retain registered nurses, nurse aides, who are not required to have a specialized education, may do a large part of the work. Castle, Engberg, and Men (2007) conducted a study of nursing home staff turnover in relation to quality of care and found that, in order to increase efficiency, it is important for nursing homes to retain and recruit nurse aides, due to the low cost of their services.

Furthermore, Castle and Engberg (2008) analyzed the relationship between nurse aide agency staffing and quality of care in nursing homes and found that, in general, high levels in the use of nurse aide agency staffing are associated with low quality of care. This finding reconfirms the need for nursing homes to retain and recruit their own nurse aides. Additionally, assuming nurse aide positions may be especially attractive for potential employees living in areas with a high unemployment rate, nursing homes in these areas may find it easier to hire nurse aides than facilities in areas with low unemployment rates.

Another key resource for a nursing home is its residents. A higher number of elderly people in the market may provide a larger pull of resources in the form of consumers or long-term residents of nursing homes. In its publication titled "Improving the Quality of Long-Term Care", the Institute of Medicine (2001) noted that, out of nearly 9 million people who used long-term care in 1994, over 6.5 million were over 65 years old. However, to accurately assess the availability of residents for a nursing home, research must take into account the number and size of nursing homes in the market.

Mukamel et al. (2005) noted that, in the early 1990s, nursing homes preferred Medicare and private-pay residents to Medicaid residents. Now, due to changes in the competition for long-term care, nursing homes must compete for Medicaid residents as well as for Medicare and private-pay residents. A higher number of elderly people in the long-term care market may create a higher demand for nursing home care. It may also create a situation in which, despite a high price and low quality of care, potential nursing home residents must accept whatever they can get in order to confirm their space in a facility. On the other hand, in a market with a relatively low number of potential residents (both private- and public-pay), the need for nursing homes to compete for each resident may be higher, creating the need for facilities to improve quality and increase efficiency in order to attract all levels of residents.

Excess demand is an important issue concerning the availability of resources. Nyman (1989) hypothesized that nursing homes in areas with excess demand for nursing home care may provide lower quality services because they do not have to compete for customers. The author noted that a direct measure of excess demand (represented by the

number of patients waiting for admission to a nursing home) is not available; so, he used the average number of empty beds as a proxy measure. According to Nyman's findings from his sample of nursing homes in Wisconsin, every additional empty bed was associated with 5–6 fewer Class C violations of the Medicaid certification code. Thus, because excess demand reflects a situation in which the demand for nursing home care is higher than the supply, it is possible that nursing homes do not have an incentive to improve quality of care in order to attract residents. Excess demand also may lower the need to increase efficiency because the beds are filled regardless of price or cost of care.

Among the measures of excess demand provided in the literature are the average number of empty beds as a proxy for excess demand (Nyman, 1989) and occupancy rates (Rosko et al., 1995). Zinn et al. (2007) noted that the national occupancy rate fell from 93% in 1977 to 87% in 1995 and to 83% in 2003. The authors proposed that managers closely monitor occupancy rates and remain motivated to take action if a decline in occupancy rates appeared likely. The current study uses occupancy rates as a measure of excess demand.

In order to evaluate the effect of resource availability on nursing home efficiency, this study views munificence as a latent variable presented by four indicators. The indicators include the following market characteristics that affect munificence: the percentage of elderly in the population who are over 65 years old, the potential excess demand for nursing home services, the availability of registered nurses, and the unemployment rate to determine the availability of other nursing home staff (e.g., nurse aides).

Payers' position

Payers are one of the major forces in the environment that affects the structure and behavior of nursing homes. Payers provide necessary resources, but they also can impose certain requirements on nursing homes. They may demand high quality of services and/or place stipulations on the way nursing homes provide their services. Payers also may require lower price levels, which may affect a nursing home's processes and outcomes because the ability to secure inputs varies with how much a facility is paid. For example, in order to secure resources from Medicaid (a significant source of payment for nursing home care), a facility may have to follow Medicaid recommendations. Similarly, in order to increase the number of private-pay residents (another significant source of payment), a nursing home may have to improve its quality of care as well as maintain an attractive price for residents. Thus, as Starkey et al. (2005) noted, buyers (payers) control a necessary resource for nursing homes and may require accommodations in the form of price reductions or higher quality of care. Improving quality and efficiency may be viewed as an organization's attempt to satisfy the needs of "key resource-providing constituents" (Lucas et al., 2005, p. 70). Based on these factors, the following hypotheses were developed for the current study:

H5. A stronger position of payers in a market relative to nursing home providers is associated with higher efficiency of nursing home services.

H6. A stronger position of payers in a market relative to nursing home providers is associated with higher process quality of nursing home services.

H7. A stronger position of payers in a market relative to nursing home providers is associated with higher outcome quality of nursing home services.

The mix of public- and private-payers plays an important role in the nursing home industry. As a major purchaser of long-term care services, Medicaid is an exceptionally significant resource for nursing homes. Medicaid pays approximately 50% of all nursing home expenditures and 70% of all bed days (Grabowski, 2001). In 1999, nursing home average monthly charges per resident were $3,505 for the Medicaid program and $5,764 for the Medicare program, and the percentage of nursing homes' primary sources of payment was 58.7% from Medicaid residents and 14.7% from Medicare residents (National Center for Health Statistics, 2005). In the same year, the average monthly charge for private-pay residents, including those with private health insurance, was $3,947 (National Center for Health Statistics, 2005). Taking into account that Medicare usually does not pay for long-term nursing home care, one may conclude that, compared to Medicaid residents, private-pay residents are a more valuable resource for nursing homes (Starkey et al., 2005).

It is also important to note that the demand for nursing home care differs for Medicaid-eligible and private-pay patients (Reschovsky, 1998). According to Starkey et al. (2005), a large percentage of Medicaid recipients among nursing home residents in the market often represent a low level of competition; thus, nursing homes with a large percentage of Medicaid recipients may lack the incentive to improve efficiency and quality of care. On the other hand, Zinn et al. (2007) argued that a nursing home's ability to attract residents from relatively more lucrative sources (such as Medicare residents and

private-pay residents) was “an indicator of the effectiveness of payer-mix management” (p. 1206). The researchers used the total census of nursing home residents to measure payer-mix performance as the percentage of private-pay residents and the percentage of Medicare-paid residents. The issue of Medicaid rates and their effect on quality of care is complicated, and nursing homes in states with a strong presence of the Medicaid program may have more incentive to comply with quality and efficiency requirements.

The Pay for Performance (P4P) program is another potential payer that may influence the structure and behavior of nursing homes. The P4P program is a relatively new approach to promote healthcare quality and efficiency by offering financial rewards to healthcare organizations that provide improved quality of services and the efficient use of resources. According to Kuhmerker and Hartman (2007), P4P programs are viewed as a means to create a link between healthcare spending and quality and efficiency of care. The authors noted that P4P programs most often are used in Medicaid-managed care and non-nursing home settings and that 34 new and existing programs are operating nationally. However, as presented in a special report of the Long Term Care Community Coalition, evidence demonstrates a growing number of P4P programs in long-term care:

> “Pay for performance” is a growing movement in healthcare that seeks to motivate providers to give better care through financial incentives or rewards for better performance. It is a largely unproven concept, particularly in regard to nursing home care; experience to date is very limited and, while there is a growing body of information, there are limited data on the actual costs and benefits of pay for performance (P4P) programs. (Mollot et al., 2008, p. 2)

In their study on hospitals' response to P4P programs, Jiang et al. (2006) reported that the results of P4P program participation might be weaker in areas with strong market forces. They suggested that, among their study sample, an existing high level of competition in the market could already have stimulated higher than usual performance levels, despite P4P reward incentives. Nevertheless, according to the authors, healthcare organizations that respond to P4P programs with strategies that improve costs and quality of care may affect the survival of an organization in a competitive environment. Thus, U.S. states with active P4P programs may generate an incentive for healthcare facilities, including nursing homes, to improve quality and efficiency.

Attracting an increased number of private-pay residents may serve as an additional incentive for nursing homes to provide quality care and efficient services. Private-pay residents are an important nursing home resource because of the higher rates they pay, compared to public-pay rates (Weech-Maldonado et al., 2003a). Additionally, private-pay customers are usually in a better position than Medicare and Medicaid customers to choose among a selection of their preferred nursing home options and, so, may be more likely to be sensitive to prices and to perceived quality of care. Medicare residents usually go to a nursing home immediately after a hospital stay and, therefore, do not have the time and the ability to search for the best facility. Similarly, Medicaid residents typically must accept a nursing home regardless of its quality. Private-pay residents (or their families), however, rely on their personal finances or insurance companies to pay for nursing home care. Consequently, when choosing a facility that

meets their needs, potential private-pay residents may be especially attentive to the quality-price ratio in a nursing home.

Along with their status as a lucrative resource for nursing homes, private-pay customers' ability to pick and choose among a selection of preferred facilities may likely create an incentive for nursing homes to provide quality care and affordable rates that suit private-payers' needs and demands. Indeed, Rosko et al. (1995) viewed customers' per capita income as a reflection of "pressure for efficiency imposed by self-pay nursing home residents and their families" (p. 1012). The researchers suggested that a decrease in private-pay residents' per capita income may cause an increased price sensitivity for these residents, which, in turn, may increase incentives for price competition among nursing homes. By employing a more efficient use of their resources, nursing homes may be able to reduce their costs and, in turn, offer lower, more affordable rates that may attract a greater number of private-pay residents.

Research findings also reveal that, in response to low quality of care, nursing home residents in for-profit facilities and in facilities with excess capacities are more likely to transfer to another facility than residents in not-for-profit facilities (Hirth, Banaszak-Holl, Fries, & Turenne, 2003). The residents' choice to transfer is significant because it represents the reaction of customers to poor quality of care and, therefore, may be an additional incentive for a nursing home to improve quality of care. Another important example of informed and discriminating consumers is the growing number of people who have access to the Internet. Due to increasing online use, more customers have greater access to information that may affect their choice of nursing homes and their

perception of quality care. Consequently, in markets with a high level of competition, nursing homes may have an incentive to improve their quality of care to attract valuable customers, especially those who have the opportunity to research their options and make a conscious choice about their preferred option for nursing home care.

After noting that a greater demand for limited resources creates a higher need to secure key resources, Zinn et al. (1998) viewed the presence of a total quality management program as an organization's visible effort to respond to the needs of external and internal constituents. Nyman (1989) reported that nursing homes may use quality differentiation to attract more customers, including customers who are less responsive to price increases.

In order to assess the effect of payers on nursing home performance, the present study views the factor "payers' position" as a latent variable presented by three indicators. These indicators are the percentage of Medicaid-paid nursing home residents, the presence of a P4P program, and the average household income of potential private payers.

The Relationship Between Efficiency and Quality of Care

As described by Ozcan (2008), a healthcare organization's performance consists of two components: efficiency and effectiveness. The efficient use of resources, reflected in higher technical efficiency, is a process measure of performance in providing care (Shortell & Kaluzny, 2006). Although productivity may affect the process and outcome components of quality, its effect, according to Donabedian's SPO model, may be stronger on process quality than on outcome quality and, through process quality, affect outcome.

In studies that address nursing home productivity in the United States, researchers analyzed different aspects of nursing home performance and environment. However, the studies' results may be limited due to sample restrictions and the small number of quality measures. For example, Zinn et al. (1994) studied strategic groups and nursing home performance reflected in efficiency and quality of care. Although findings revealed that not-for-profit facilities provide better quality of care, the study was based only on facilities in Pennsylvania and used only pressure ulcers, catheter use, and restraint use as quality measures. Anderson et al. (2003) studied nursing home quality of care, chain affiliation, profit, and performance. They found that for-profit facilities are more efficient and that chain affiliation does not impact efficiency if quality is controlled. However, their study was based only on nursing homes in Florida and used only inspection scores as a measure of quality. In a sample of 69 nursing homes, Duffy et al. (2006) demonstrated the usefulness of the efficiency score as a benchmarking method for the long-term care industry. The authors used the prevalence of pressure sores as a measure of quality; however, they acknowledged that the prevalence of pressure sores is only one of many measures of outcome quality. Fizel and Nunnikhoven (1993) analyzed the efficiency of for-profit nursing home chains. Their sample included 104 for-profit nursing homes located in Michigan in 1987. The researchers found that chain nursing homes have a higher mean level of efficiency than independent facilities. However, the study included only for-profit facilities and used only deficiencies as a measure of quality. Rosko et al. (1995) analyzed the efficiency of 461 nursing homes in Pennsylvania. They used pressure sores, restraint use, and catheter use as measures of quality.

Despite numerous studies on nursing home productivity, a literature search did not reveal any study that used a wide range of process and outcome measures of quality on a national sample in order to examine the relationship between productivity and quality of nursing homes. The current study intends to fill this gap in the literature.

As reflected in the study's hypotheses below, Donabedian's SPO framework predicts a causal relationship between the structure, process, and outcome components of nursing home quality:

H8. Higher efficiency of nursing homes is more likely to be associated with higher process quality.

H9. Higher efficiency of nursing homes is more likely to be associated with higher outcome quality.

The present study uses process and outcome measures of clinical care as latent variables presented by several indicators. The Online Survey, Certification and Reporting database provided the clinical indicators used in the study. Based on the National Quality Measures Clearinghouse description of measurement domains, quality measures in the study are identified as process-domain or outcome-domain latent variables with several indicators for each variable. Previous studies often employed the use of catheters and physical restraints as a measure of process-domain quality (Amirkhanyan, 2008; Weech-Maldonado, Mor, and Oluwole, 2004). Other process-domain measures include pneumococcal and influenza vaccinations and appropriate treatment for pain (National Quality Measures Clearinghouse, 2005, 2007i, 2007j). Outcome-domain quality measures include pressure sores, loss of bowel or bladder control, increased depression or anxiety,

weight loss or gain, and moderate to severe pain (National Quality Measures Clearinghouse, 2007a, 2007b, 2007c, 2007e, 2007f, 2007g).

In the study's conceptual model, structure is viewed as a latent variable presented by six indicators. These six indicators are size of nursing home (number of beds), system membership, ownership status, number of registered nurses, number of licensed practical nurses, and number of nurse aides.

Organizational characteristics affect an organization's ability to use and allocate resources. In order to assess the effect of the environment on nursing home performance, it is necessary to include these characteristics in the analysis. Because technical efficiency is characterized by an input/output ratio, larger nursing homes, in some cases, may have an advantage. For example, according to the Centers for Disease Control and Prevention (2008), nursing homes must have at least one full-time registered or licensed practical nurse. Because large nursing homes have a high number of beds to accommodate more residents, the ratio of nurse hours per resident becomes lower as the number of residents increases.

Research evidence suggests size is an important characteristic of nursing homes' structure. In a study of efficiency of long-term care units in Finland, results showed that larger units in the sample operated more efficiently than smaller units (Björkgren, Häkkinen, & Linna, 2001). Size was among the major factors of efficiency in a study of Pennsylvania freestanding nursing facilities (Rosko et al., 1995). A low number of beds and low resident census were among characteristics of nursing homes that closed from 1992 to 1998 (Castle, 2006a). According to the Online Survey, Certification and

Reporting database, the size of nursing homes in the United States ranges from 2 to 1,670 beds. In order to take into account the possible effect of size on the nursing home efficiency score, the current study limited its sample to facilities with 20 to 360 beds, which includes 99.3% of the total number of non-hospital-based nursing homes in the Online Survey, Certification and Reporting database.

System membership may provide a nursing home with more available resources. Findings from a study of for-profit independent and for-profit chain nursing homes showed that nonsystem membership is consistently associated with low efficiency scores; thus, chain nursing homes have a higher mean efficiency than independent nursing homes (Fizel & Nunnikhoven, 1993). Additionally, chain nursing homes' administrators are significantly superior in resource allocation (Knox et al., 2004), a characteristic that may also lead to a higher level of technical efficiency. Another factor is the ability of chain facilities to reallocate resources and patients. Although Anderson et al. (1999) found that chain affiliation and not-for-profit status reduces the operational cost efficiency of nursing homes, a more recent study by Anderson et al. (2003) concluded that chain affiliation does not impact efficiency if quality is included as a control variable.

Research evidence suggests that for-profit nursing homes may operate differently from not-for-profit facilities. Rosko et al. (1995) found that, although not-for-profit nursing homes might increase their efficiency as a response to environmental pressure, for-profit facilities demonstrate higher efficiency regardless of environmental and regulatory pressures. Ozcan et al. (1998) also noted that for-profit and not-for-profit skilled nursing facilities operate with significantly different modes of production, with

for-profit facilities demonstrating higher efficiency than not-for-profit nursing homes. Chou (2002) found differences in quality between for-profit and not-for-profit nursing homes in the presence of asymmetric information. Duffy et al. (2006) tested several efficiency models for differences in performance between for-profit and not-for-profit nursing homes. They noted that "in general, for-profit nursing homes are motivated to be more efficient in their use of resources than are non-profit nursing homes" (p. 243). Thus, in order to assess the effect of the environment on nursing home performance, as well as the relationship between productivity and quality of care, the current study includes profit status (or ownership) as a measure of structure.

The study's potential contribution to the current body of knowledge includes the use of a wide range of quality measures. Because these measures are intended for consumers to use as they consider their choices of a nursing home, facilities may pay special attention to these quality indicators. The study also incorporates nursing home productivity, measured as an efficiency score, into a broader model of the structure, process, and outcome components of quality. As Mullan and Harrington (2001) noted, it is important to understand the relationship between the elements of the model in order to ensure good outcomes.

The current study's conceptual model is presented in Figure 4. The model reflects the hypothesized relationships among constructs, with solid arrows showing the nine hypothesized relationships and dotted arrow showing other relationship included in the model. Control variable is not shown.

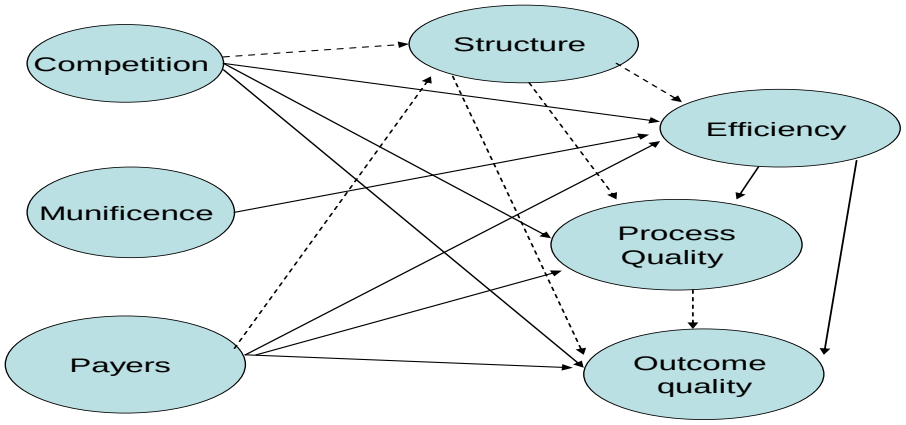


Figure 4. Conceptual Model of the Study, with Solid Arrows Showing the Hypothesized Relationships

Summary

As presented in this chapter, the theoretical framework of the study combines Donabedian's (1980) SPO model of quality and Pfeffer and Salancik's (1978) resource dependence theory. Donabedian stated that quality of care may be analyzed in terms of its structure, process, and outcome components, which have a causal link. According to Donabedian, the structure component of quality is a relatively stable characteristic of an organization and includes human, physical, and financial resources. When measured as an efficiency score, the productivity of a nursing home presents a ratio of inputs and outputs in the form of a single indicator; thus, productivity may be used as an additional measure of the process component of quality. The resource dependence theory states that no one organization can create all of its necessary resources. In order to survive in the market, an organization must adapt to the environment. Consequently, environment may affect the structure of an organization as well as its quality of services.

In the present study, the SPO model and the resource dependence theory are combined to provide a general theoretical framework for analyzing the predictors of efficiency and the quality of care in U.S. nursing homes. Nine hypotheses were developed to assess the relationships among quality components in nursing homes, as well as the relationships among quality components and organizational and environmental factors in nursing homes. Table 2 presents a summary of the study's hypotheses. The study's conceptual model reflects the hypothesized relationships among constructs.

Table 2. Summary of Study Hypotheses

	Construct / Variable	**Relationship**
H1	Competition to efficiency	+
H2	Competition to process quality of care	+
H3	Competition to outcome quality of care	+
H4	Munificence to efficiency	–
H5	Payers' position to efficiency	+
H6	Payers' position to process quality of services	+
H7	Payers' position to outcome quality of services	+
H8	Efficiency to process quality	+
H9	Efficiency to outcome quality	+
Note: H = Hypothesis.		

Chapter 4 describes the study's methodology in relation to the developed hypotheses. The chapter also describes the sampling process, variables used in the analysis, sources of data, and statistical techniques and tests corresponding to the study's stages of analysis.

CHAPTER 4: METHODOLOGY

This chapter presents the design of the study, identifies the theoretical constructs, indicates the sources of the data, and describes the research sample and sampling process. Variables and measures are defined, and the analytical approach that addresses the research questions is presented. The study concerns the relationship between quality of care and efficiency of nursing homes, as well as characteristics of nursing homes that provide high quality services and are highly efficient. This chapter also describes the specific methodology for the analytical approaches used in the research, such as Data Envelopment Analysis, structural equation modeling, and logistic regression.

Research Design and Data Sources

The study uses a nonexperimental cross-sectional design based on a random sample from national data on nursing homes in 2008. The data for the study were extracted from two, large, secondary databases—the Online Survey, Certification and Reporting database and the Area Resource File database—as well as from federal agencies, such as the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis, and a variety of other sources described subsequently.

The Online Survey, Certification and Reporting (OSCAR) database is provided by the Centers for Medicare and Medicaid Services (CMS) in cooperation with each U.S. state's long-term care surveying agencies. The database provides the results of Medicare

and Medicaid inspection surveys at nursing facilities and includes the operational characteristics and aggregate patient characteristics for each nursing home. An inspection takes place at least once during a 15-month period (American Health Care Association, 2009). The OSCAR database is the most frequently used data source in studies of staffing and quality in nursing homes (Bostick et al., 2006), and it is in the list of most reliable data sources for information on staffing and quality of care. According to Zhang and Wan (2005), governmental agencies and researches confirm the accuracy, validity, and reliability of OSCAR data before it is published. In the present study, OSCAR data were used to calculate the efficiency of nursing homes based on the type and number of staff and beds, which are used as inputs, and on resident-days by source of payment, which are used as outputs.

The Area Resource File database (www.arfsys.com) includes over 6,000 variables for each county in the United States and is widely used for healthcare-related research. The study used the database for information about the munificence of nursing home environment, such as nursing home location and number of home health agencies in a market. Due to data availability, the study also used data on nursing home environments from governmental agencies such as the U.S. Bureau of Labor Statistics (www.bls.gov) and the U.S. Bureau of Economic Analysis (www.bea.gov).

Study Sample and Sampling Process

The study's unit of analysis is an individual CMS-certified nursing home located in the United States. Preliminary analysis of the data showed that out of 15,777 U.S. nursing homes in the OSCAR database in 2008, 1,244 (or 7.9%) had to be excluded from

the study population due to their hospital-based designation. This reduced the study's potential sample to 14,533 facilities. Hospital-based nursing homes and hospital long-term care units were excluded from the study because they serve a different set of patients than do freestanding nursing homes (Rosko et al., 1995). The second reason for exclusion is because hospital-based nursing homes are basically part of a hospital, and one cannot assume that efficiency of such a unit is similar to independent facilities; it is also a challenging task to separate resources directed to the long-term care unit of a hospital from the hospital's overall resources and, therefore, it is difficult to compare efficiency with free-standing facilities.

The size of non-hospital-based nursing homes in the OSCAR database ranges from 2 to 1,670 beds, which poses a question of possible distortion of efficiency scores, as one cannot assume the same production mode for facilities of such different sizes. Thus, for the purpose of proper Data Envelopment Analysis, the study population excluded outliers and was limited to facilities with 20 to 360 beds, which represent 99.3% of all non-hospital-based nursing homes in the OSCAR database. This reduced the study's potential population to 14,384 facilities.

Preliminary analysis of data also showed that there is a large range of occupancy rates among nursing homes. The study excludes facilities with occupancy rates lower than 5% and higher than 100% as not typical for the population. Thus, the total number of facilities in the study is 14,307 (mean size = 110 beds; *SD* = 52.9; SPSS 17.0 software). The study used a 10% random sample of the total population, or 1,430 facilities.

In order to assure proper sample size for the study, several approaches were estimated. Yamane's (1967) simplified formula for sample size calculation yielded a sample size of 1,031 facilities with a precision level equal to 0.03. Thus, the study's 10% sample exceeds minimum requirements. The following simplified formula was used, as developed by Yamane:

$$n = \frac{N}{\left(1 + N(e)^2\right)}$$

where n = sample size

N = population size

e = precision level

A more conservative approach for large populations was developed by Cochran (1963), as presented in the formula below:

$$n = \frac{Z^2 pq}{e^2}$$

where n = sample size

Z^2 = the abscissa of the normal curve that cuts off an area α at the tails (set as 95% confidence level)

p = estimated proportion of an attribute

q = (1-p)

e = precision level

According to the Cochran formula used for the study, the minimum sample size should be 1,068 facilities. Again, the study's 10% random sample exceeds the minimum.

Finally, the sample size was checked against commonly used statistical tables, such as the table provided by Grembowski (2001). According to the table, a sample size for a population of 15,000 with a 3% precision level and confidence interval of 95% and P = 0.5 equals 1,034 facilities. Again, the study's 10% random sample exceeds the required minimum sample size.

The final sampling process is presented in Figure 5.

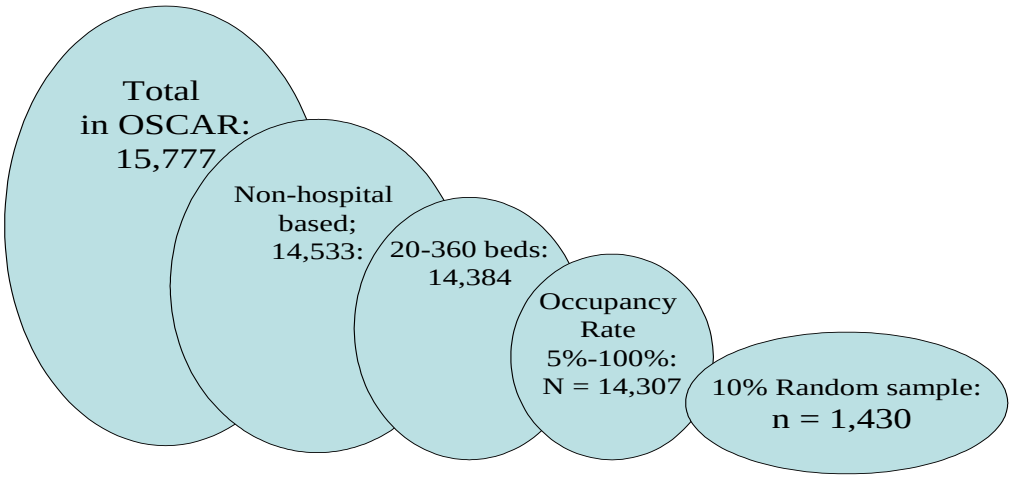


Figure 5. Sampling Process for the Study, Based on Nursing Home Data from the Online Survey, Certification and Reporting (OSCAR) Database.

Data from the study's nursing home sample were evaluated in several stages, including descriptive analysis, calculation of efficiency scores through Data Envelopment

Analysis, structural equation modeling for hypotheses testing, and logistic regression for analyzing high-performance facilities in the sample. A detailed description of data analyses is provided later in this chapter, following the identification of variables, as presented in the next section.

Variable Identification and Measurement

The theoretical framework of this study combines the resource dependence theory and Donabedian's Structure-Process-Outcome (SPO) model to analyze the effect of three constructs derived from the resource dependence theory (competition, munificence, and payers' position) on the three components of the SPO model. The study model has eight latent variables and 29 indicators, or observed variables. Latent variables are variables that cannot be observed directly; rather, they are inferred through a mathematical model that presents indicators, or observed variables, which allow indirect observation of latent variables. Structural equation modeling perceives a group of indicators as one variable. Table 3 describes the study's eight latent variables and their related indicators, or observed variables. Some of the variables represent characteristics in the nursing home market, which, in this study, is defined as a U.S. county where a nursing home is located.

Resource Dependence Constructs

The conceptual model of this study has three constructs derived from the resource dependence theory: competition, munificence, and payers' position. The study views each of these constructs as latent variables presented by specific indicators, as described below.

Table 3. Definition, Data Source, and Measurement of Study's Latent Variables and Their Related Indicators for Hypotheses Testing

Latent Variable and Associated Indicators (with corresponding abbreviation)	Definition	Data Source	Measurement
Competition (to test H1, H2, and H3)			
Herfindahl-Hirschmann index (HHI)	Sum of the squared market share of number of beds for nursing homes in a U.S. county	OSCAR	Continuous
Number of substitutes (SUB)	Number of home health agencies in a U.S. county	ARF	Continuous
Location (LOC)	From 1 (most rural) to 9 (most urban location)	ARF	Ordinal
Munificence (to test H4)			
Population over 65 years old (P65B)	Number of individuals over 65 years old in a county, divided by number of nursing home beds in the county	US census bureau	Continuous
Excess demand (EXDEM)	Percentage of empty nursing home beds in a U.S. county	OSCAR	Continuous
Registered nurses (NURS)	Number of registered nurses per 10,000 individuals in the county	Kaiser Family Foundation / statehealthfacts.org	Continuous
Unemployment (UNEMP)	Number of unemployed persons per nursing home bed in a county	U.S. Bureau of Labor Statistics	Continuous
Payers' position (to test H5, H6, and H7)			
Proportion of Medicaid patients (MCAID)	Percentage of Medicaid-funded residents among nursing home residents in a U.S. county	OSCAR	Continuous
Presence of Pay-for-Performance program (P4P)	Presence of a P4P program for nursing homes in a state	Quality, Transparency, and Prevention Workgroup	Binary

Table 3 (continued)

Latent Variable and Associated Indicators (with corresponding abbreviation)	Definition	Data Source	Measurement
Per capita income (INC)	Average annual personal per capita income in a U.S. county	U.S. Bureau of Economic Analysis	Continuous
Structure			
Size (BEDS)	Total number of beds	OSCAR	Continuous
System membership (SYS)	1 = belongs to a system; 0 = independent	OSCAR	Binary
Ownership (for-profit) status (FP)	1 = for-profit; 0 = others	OSCAR	Binary
Staff – Full-time equivalent (FTE) registered nurses (RNS)	Number of FTE-RNS in a facility	OSCAR	Continuous
Staff – FTE licensed practical nurses (LPNS)	Number of FTE-LPNS in a facility	OSCAR	Continuous
Staff – FTE nurse aides and trainees (NAS)	Number of FTE-NAS and trainees in a facility	OSCAR	Continuous
Efficiency (to test H1, H4, H5, H8, and H9)			
Efficiency score (DEA)	Data Envelopment Analysis (DEA) score	OSCAR	From 0 to 1
Process quality (to test H2, H6, and H8)			
Catheter use (CAT)	Percentage of residents with indwelled or external catheter, except those with catheter on admission	OSCAR	Continuous
Physical restraints (RES)	Percentage of residents physically restrained, except those admitted with an order for restraints	OSCAR	Continuous
Pneumococcal vaccination (PV)	Percentage of residents who received a Pneumococcal vaccination	OSCAR	Continuous
Influenza vaccination (FV)	Percentage of residents who received an influenza vaccination	OSCAR	Continuous

Table 3 (continued)

Latent Variable and Associated Indicators (with corresponding abbreviation)	Definition	Data Source	Measurement
Pain management program (PAIN)	Percentage of residents on a pain management program	OSCAR	Continuous
Pressure sores/ulcers (ULC)	Percentage of residents with pressure sores/ulcers	OSCAR	Continuous
Outcome quality (to test H3, H7, and H9)			
Bedfast or in a chair (BF)	Percentage of residents who are bedfast or in a chair all or most of the time	OSCAR	Continuous
Depression (DEPR)	Percentage of residents with documented signs and symptoms of depression	OSCAR	Continuous
Bladder incontinence (BLA)	Percentage of residents occasionally or frequently incontinent of bladder	OSCAR	Continuous
Bowel Incontinence (BOW)	Percentage of residents occasionally or frequently incontinent of bowel	OSCAR	Continuous
Weight (WT)	Percentage of residents with unexpected weight loss or gain	OSCAR	Continuous
Control			
Acuity index (AI)	Combination of residents' range of activity of daily living dependencies and special treatment measures in each facility	OSCAR	Continuous
Notes: ARF = Area Resource File database; H = Hypothesis; OSCAR = Online Survey, Certification and Reporting database.			

Competition indicators

Although many nursing home researchers have used the Herfindahl-Hirschmann index as the sole measure of market competition in the nursing home industry, this

indicator, which is calculated as the sum of the squared market shares for nursing homes in the market, does not include other aspects of market competition, such as the presence of substitutes for nursing home care. Thus, as a latent variable, competition was measured in the present study by three indicators: the Herfindahl-Hirschmann index, the number of nursing home substitutes in the market, and nursing home location. These indicators were used to test the study's Hypotheses 1, 2, and 3, which address the association of competition in the nursing home market with nursing home efficiency, process quality of care, and outcome quality of care, respectively.

In this study, the Herfindahl-Hirschmann index is a continuous variable calculated as the sum of the squared market share of the number of beds for nursing homes located in a U.S. county, with higher values reflecting lower competition. Based on previous research (Banaszak-Holl et al., 1996; Cohen & Spector, 1996), the literature suggests that a U.S. county may be a "reasonable approximation of the market for nursing home care, given patterns of funding and resident origin" (Grabowski & Hirth, 2003, p. 7). However, Zwanziger, Mukamel, and Indridason (2002) warned about the use of a county as a market proxy for nursing homes because they found that markets for urban nursing homes might consist of only a fraction of a county. Nevertheless, the county is used often as a unit of measure for nursing home markets (Mukamel et al., 2005; Zinn, Mor, Feng, & Intrator, 2007) and, consequently, was used as a unit of measure in the current study.

To measure competition, the present study also uses substitutes in the nursing home market as a continuous variable. Starkey et al. (2005) used the number of home health agencies, as well as the number of hospital-based skilled nursing facilities relative

to the over-65-year-old population (per 1,000), to represent potential nursing home substitutes. In the present study, however, nursing home substitutes were calculated as the number of home health agencies in a U.S. county. Data were obtained from the Area Resource File (ARF) database.

Location is used in the study as an ordinal variable representing the continuum of a rural or urban location of a nursing home. Ordinal data from the ARF database were used for structural equation modeling to test the study's hypotheses. Although the OSCAR database provides a binary variable for a nursing home's urban or rural location, data from the ARF database fit better for the purposes of structural equation modeling and provide a more detailed description. For some of the study's variables, data were obtained from the ARF database; however, for most of the variables, the ARF data were outdated. Although it is reasonable to assume that the urban-rural continuum code in ARF is relatively stable within recent years, it is difficult to assume that other measures, such as the unemployment rate, did not change over time.

Although the study uses an urban-rural continuum with data obtained from the ARF database and used for hypotheses testing in structural equation modeling, the study also uses a binary variable for a nursing home's urban or rural location for logistic regression to evaluate nursing home performance. Data for the binary, urban-or-rural variable were obtained from the OSCAR database.

Munificence indicators

Munificence, the second construct of the study's conceptual model, reflects the availability of nursing home resources and is viewed as a latent variable presented by

four indicators. Each indicator represents a market characteristic that affects nursing home munificence (or resources): the population of individuals over 65 years old, excess demand, nursing staff, and unemployment rate. These indicators were used to test the study's Hypothesis 4, which addresses the association of munificence (or resources) in the nursing home market with efficiency.

The potential availability of nursing home residents is used as a continuous variable in the study, calculated as the number of individuals over 65 years old in a county, divided by the number of nursing home beds in a county. Data from the U.S. Census Bureau Web site (www.census.gov) were used to obtain the population over 65 years old per nursing home bed in U.S. counties.

Excess demand in the nursing home industry is also used as a continuous variable, measured by the percentage of empty nursing home beds in a county (Nyman, 1989). Data for the excess demand indicator were retrieved from the OSCAR database.

The availability of nursing staff is another continuous variable used in the study to measure munificence. This indicator was calculated as the total number of registered nurses per 10,000 individuals in the county's population. The number of registered nurses in a county was calculated based on data from the ARF database and from Kaiser Family Foundation / statehealthfacts.org (2008). The source of information on the Kaiser Family Foundation Web site was the U.S. Bureau of Labor Statistics.

Another munificence indicator and continuous variable—the availability of nonprofessional personnel—was measured by the percentage of unemployed persons in a county. Unemployment rates and annual averages of labor force data by county were

obtained from the "Databases, Tables & Calculators by Subject" link on the U.S. Bureau of Labor Statistics Web site (http://www.bls.gov/data).

Payers' position indicators

In order to assess the effect of payers on nursing home performance, payers' position is viewed in the study as a latent variable presented by three indicators: the proportion of Medicaid patients, the presence of a Pay-for-Performance program, and per capita income. These indicators were used to test the study's Hypotheses 5, 6, and 7, which address the association of the position of payers in the nursing home market with nursing home efficiency, process quality of services, and outcome quality of services, respectively.

In this study, the proportion of Medicaid residents is a continuous variable, calculated as the percentage of Medicaid-funded nursing home residents among all nursing home residents in a county. Data for this payers' position indicator were based on information from the OSCAR database.

The presence of a Pay-for-Performance program for nursing homes in a state is used in the study as a binary variable. Data for this variable were retrieved from Table 1 in the Quality, Transparency, and Preventive Workgroup's (n.d.) working paper on the nursing home Pay-for-Performance program.

Average per capita income is used as a continuous variable, calculated at the county level and measured in thousands of dollars. For average annual income, the study uses the definition provided by the U.S. Bureau of Economic Analysis (2008): "Per capita personal income is calculated as the personal income of residents of a given area

divided by the resident population of the area. In computing per capita personal income, BEA [Bureau of Economic Analysis] uses the Census Bureau's annual midyear population estimates" (para. 12). The income data were retrieved from the "Local Area Personal Income" link on the U.S. Bureau of Economic Analysis Web site (http://www.bea.gov/regional/reis).

Donabedian's Structure-Process-Outcome Components

Donabedian's SPO model assumes a causal relationship between structure, process, and outcome. In the present study, the three components of the SPO model are viewed as latent variables.

Structure

The study measured the structural component of quality in Donabedian's SPO model by assessing nursing homes' system membership, ownership status, number of beds, and number of full-time equivalent registered nurses, licensed practical nurses, and nurse aides. Data for each of the indicators for the study's structural latent variable were obtained from the OSCAR database.

Process

In the present study, the process component of quality in the Donabedian's Structure-Process-Outcome model is divided into two separate latent variables: an efficiency score and process quality indicators. Although both variables measure nursing home process, the nature of the observed variables is different. Thus, to facilitate the study's structural equation modeling, the process component of Donabedian's SPO

model is represented by the dual latent variables of process efficiency and process quality.

An efficiency score derived from Data Envelopment Analysis is used as a continuous variable to test the study's Hypotheses 1, 4, 5, 8, and 9. These hypotheses address the association of nursing home efficiency, measured as efficiency score for each nursing home in the study sample, with competition in the nursing home market, the availability of market resources (munificence), payers' position, process quality, and outcome quality, respectively. Efficiency scores range from 0 to 1, with a larger number representing higher efficiency. A detailed description of the study's efficiency score as a latent variable is provided later in this chapter, under the section entitled "Efficiency Analysis."

Process quality indicators are used to test the study's Hypotheses 2, 6, and 8, which address the association of process quality with competition in the nursing home market, payers' position, and nursing home efficiency, respectively. The study uses six indicators that are included in the National Quality Measures Clearinghouse (www.qualitymeasures.ahrq.gov) description of process-domain measures for quality of care: the percentage of residents with a catheter inserted or left in their bladder; the percentage of physically restrained residents, except those admitted with an order for restraints; the percentage of residents who received a Pneumococcal vaccination; the percentage of residents who received an influenza vaccination; the percentage of residents on a pain management program; and the percentage of residents with pressure

sores or ulcers. Data for all of the six process quality indicators were obtained from the Online Survey Certification and Reporting database.

Outcome

The outcome component in Donabedian's SPO model is used as a latent variable to test the study's Hypotheses 3, 7, and 9, which address the association of nursing homes' quality of care outcomes with competition in the nursing home market, payers' position, and nursing home efficiency, respectively. To assess outcome quality, five indictors from the National Quality Measures Clearinghouse description of outcome-domain measures for care are used: the percentage of residents who are bedfast or in a chair all or most of the time; the percentage of residents with documented signs and symptoms of depression; the percentage of residents occasionally or frequently incontinent of bladder; the percentage of residents occasionally or frequently incontinent of bowel; and the percentage of residents with unexpected weight loss or gain. Data for each of these outcome quality indicators were retrieved from the OSCAR database.

Control Variable

For its eighth latent variable, the study uses a control variable, which is measured by one indicator: an acuity index modeled after "the OSCAR-based acuity index" used in a study by Feng, Grabowski, Intrator, and Mor (2006, p. 1323). According to Feng et al., "This index combines a range of activity of daily living (ADL) dependencies and special treatment measures for all residents in each facility, expressed as a weighted sum of specific resident characteristics" (p. 1323). The acuity index is used in the current study

to take into account the difference in nursing homes' patient-mix, and therefore, the inputs required for services.

Data Analysis: Descriptive

The first stage of the study's data analysis was descriptive. The descriptive approach was used to assess the general characteristics of data and to detect missing values. Descriptive statistics included frequencies, means, and standard deviation and were calculated using SPSS 17.0 statistical software.

To assure that the sample reflects the study population, a number of statistical tests were performed. To compare the mean values of the sample and the population, a *t*-test was performed, with an assumption of equal variance for all study variables, using Daniel's (2005) test formula:

$$t = \frac{\bar{y}_1 - \bar{y}_2}{\sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}}$$

with pooled variance estimate as a weighted average of the two individual-group variances.

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

where n = group size

y = mean values of groups

s = group variance

In order to compare proportions of sample and population, a *z*-test was performed, using Daniel's (2005) test formula:

$$z = \frac{p - p_0}{\sqrt{\frac{p_0(1 - p_0)}{N}}}$$

where p = is population proportion

n = total size

The tests confirmed the representativeness of the study's sample. Additional analysis was performed to describe other characteristics of the nursing homes in the sample. Although the tests were performed for most of the variables, the decision of representativeness was based on the nursing homes' size, ownership, system membership, and percentage of Medicaid residents.

Efficiency Analysis: Data Envelopment Analysis

The second stage of the study's analysis used Data Envelopment Analysis (DEA) and the DEA-Solver program to obtain a score that evaluates the efficiency of nursing homes. Although previous investigations on nursing home quality and productivity have used DEA, most of the studies restricted quality measures to pressure sores or ulcers, catheters use, and restraints use (Duffy et al., 2006; Rosko et al., 1995; Zinn et al., 1994) and to deficiencies or inspection scores (Anderson et al., 2003; Fizel & Nunnikhoven,

1993). Furthermore, studies in the literature that involved nursing home quality were merely based on data from a sample in a single U.S. state (Anderson et al., 2003; Fizel & Nunnikhoven, 1993; Rosko et al., 1995; Zinn et al., 1994) or on data from a relatively small sample (Duffy et al., 2006). To overcome these deficits in the literature, the current study uses DEA to evaluate a wide range of process and outcome quality measures on a large, national sample of nursing homes in order to evaluate nursing home efficiency.

The Use of Inputs and Outputs in Data Envelopment Analysis

The DEA approach developed by Charles, Cooper, and Rhodes in 1978 examines the technical, allocative, and scale efficiency of decision-making units. Technical efficiency refers to the ability of an organization to produce a maximum amount of output, given a certain amount of input. Allocative efficiency refers to the ability of an organization to produce an optimal mix of inputs and outputs based on available resources, such as technology and equipment.

According to Duffy, Fitzsimmons, and Jain (2006), DEA is a nonparametric technique that creates a relative efficiency frontier based on a combination of inputs used and outputs produced by an organization. The DEA approach assumes that not all organizations are efficient, and the analysis uses linear programming modeling to convert multiple inputs and outputs into a single indicator score ranging from 0 (inefficient organization) to 1 (efficient organization). Efficient units form the production frontier, which envelopes the positions of inefficient units. Technical efficiency is reached in DEA when no further decrease in any input may be realized without decreasing outputs or increasing another input or set of inputs (Duffy et al., 2006).

Among the advantages of DEA are the ability to handle multiple input and multiple output models and to compare directly against a peer or combination of peers. An important feature of the method is that it does not require an assumption about a functional form relating inputs to outputs. The DEA method also allows different units of measurement for inputs and outputs, such as the number of full-time employees and number of resident-days. On the other hand, the approach allows for relative comparison only, without regard to possible absolute efficiency; therefore, DEA results are heavily dependent on the selected sample. Nevertheless, DEA is an appropriate way to analyze and compare efficiency of nursing homes.

If the DEA model emphasizes the reduction of inputs to improve efficiency for inefficient organizations, the model is referred to as "input-oriented." The input-oriented model is often used in healthcare research because it is generally assumed that healthcare managers have better control over inputs (such as staff or operating expenses) than over outputs (such as the number of discharges or patient-days). In contrast, the output-oriented model emphasizes proportional augmentation of lacking outputs and may be appropriate in a situation where the healthcare manager can increase the output of the organization (Ozcan, 2008). In studies of nursing home efficiency, researchers use the input-oriented model more often because of managers' ability to control inputs (Ozcan, Wogen, & Mau, 1998).

The current study uses a DEA input-oriented model with constant returns to scale to calculate efficiency scores for the sample's nursing homes. The distinction between constant returns to scale (CRS) and variable returns to scale (VRS) is based on an

assumption about scale economy that changes (in VRS) or does not change (in CRS) along with an increase of the size of an organization. The CRS model assumes a linear change in outputs in relation to change in inputs, while the VRS model assumes that the relationship between inputs and outputs is not necessarily linear. Organizations recognized as efficient by the CRS model are also recognized as efficient in the VRS model; but the reverse is not necessarily true. The CRS model is appropriate for research that uses size grouping for analysis, such as in the current study. The CRS approach also provides information about ways to improve efficiency by analyzing slacks of inefficient decision-making units or recognizing an opportunity to reach efficiency by a decrease in inputs.

In the current study, the efficiency scores (θ_o) for a group of nursing home facilities ($j = 1 \ldots n$), based on selected outputs (y_{rj}, $r = 1, \ldots, s$) and inputs (x_{ij}, $i = 1, \ldots, m$), is calculated using the fractional programming formula (Ozcan, 2008, as adapted from Charnes & Cooper, 1980):

$$\textit{Maximize } \theta_o = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}}$$

$$\textit{subject to } \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1$$

$$u_r, v_i \geq 0 \quad \textit{for all } r \textit{ and } i.$$

where y_{ro} = selected output "r" produced by each facility

in the set "*o*"

x_{io} = selected input "*i*" used by each facility in the set "*o*"

y_{rj} = selected output "*r*" produced by facility "*j*"

x_{ij} = selected input "*i*" used by facility "*j*"

u_r and v_i = the weights assigned to output "*r*" and input "*i*" obtained from DEA.

The current study uses five selected input variables and three selected output variables to calculate a DEA efficiency score for the sample's nursing homes. As presented in Table 4, the input variables include nursing home labor resources and total number of beds; the output variables include nursing home resident census by source of payment. All the data is obtained from OSCAR database.

Nursing Home Input Variables

Labor expenses consume about 75% of total expenditures for an average nursing home ("Group Purchasing's Impact on Spending Examined," 2005). Therefore, in calculating a nursing home efficiency score through DEA, the current study uses labor inputs represented by the number of full-time equivalent nursing home staff members, according to staff category. Bostick, et al. (2006) noted that most nursing home studies used separate measures for registered nurses, licensed practical nurses and certified nursing assistants. While some studies used hours worked by different types of staff (Fizel and Nunnikhoven, 1992, 1993; Nyman and Bricker, 1989), most others use FTE as labor input (Rosko et al., 1995; Ozcan et al., 1998; Björkgren, et al., 2001; Laine, et al., 2005); the proposed study will use FTE by staff category to measure labor input.

Table 4. Nursing Home Inputs and Outputs for the Data Envelopment Analysis Model

	Description	Variable # in OSCAR
Inputs		
FTE-RNS	Sum of full-time and part-time RNS for a facility	#212-217
FTE-LPNS	Sum of full-time and part-time LPNS for a facility	#241-243
FTE-NAS	Sum of full-time and part-time NAS for a facility	#179-181
FTE-Others	All other staff, except RNS, LPNS, and NAS	Sum of all FTE variables minus sum of RNS, LPNS, and NAS
Beds	Total number of beds in a facility	#148
Outputs		
Medicare residents	Number of residents funded by Medicare	CENMCARE #32
Medicaid residents	Number of residents funded by Medicaid	CENMCAID #31
Other residents	Total number of residents minus Medicare and Medicaid residents	CENOTHER #48

Notes: FTE = full-time equivalent; LPNS = licensed practical nurses; NAS = nurse aides; OSCAR = Online Survey, Certification and Reporting database; RNS = registered nurses.

Staff categories in the study's labor inputs include full-time equivalent (FTE) medical personnel (specifically, registered nurses, licensed practical nurses, and nurse aides) and other FTE nursing home personnel. Although CMS-certified nursing homes are required to employ a registered nurse for a defined number of hours per week, lower level personnel (e.g., licensed practical nurses, nurse aides, and other staff) perform a significant amount of work for long-term residents. Therefore, it is important to include these types of nursing home staff as separate labor inputs for an efficiency score.

Definitions for the study's staff categories were obtained from the CMS. According to Form CMS-671 – Long Term Care Facility Application for Medicare and Medicaid**,** registered nurses are "persons licensed to practice as registered nurses in the state where the facility is located" (CMS, 2002, p. 3). These individuals include "geriatric nurse practitioners and clinical nurse specialists who primarily perform nursing, not physician-delegated tasks (p. 3)" In the same document, licensed practical/vocational nurses are defined as "persons licensed to practice as licensed practical/vocational nurses" (p. 3). Certified nurse aides are

> individuals who have completed a State approved training and competency evaluation program, or competency evaluation program approved by the State, or have been determined competent as provided in 483.150(a) and (3) and who are providing nursing or nursing-related services to residents. (p. 3)

Nurse aides in training are

> individuals who are in the first 4 months of employment and who are receiving training in a State approved Nurse Aide training and competency evaluation program and are providing nursing or nursing-related services for which they have been trained and are under the supervision of a licensed or registered nurse. (p. 3)

Nurse aides in training are included in the number of nurse aides in this study because they perform the same functions as nurse aides.

Although directors of nursing and nurses with administrative duties are professional registered nurses, they do not perform direct care functions, according to CMS and OSCAR definitions. For this reason, they are not included in the number of registered nurses used in the study's analysis.

Data on labor inputs in the present study were obtained from the OSCAR database. In order to calculate the number of FTE registered nurses (RNS), licensed practical nurses (LPNS), and nurse aides (NAS), the following formula was used:

FTE (RNS, LPNS, or NAS) = Full-time FTE + 0.5*Part-time FTE + contract FTE

The staff category "FTE-Others" was calculated as the total sum of all FTE staff categories minus the sum of FTE-RNS, FTE-LPNS, and FTE-NAS. The staff category of FTE-Others includes full-time, contract, and part-time equivalents, as defined in Form CMS-671 – Long Term Care Facility Application for Medicare and Medicaid (CMS, 2002) and included in the OSCAR database. Table 5 lists and defines the staff categories used in the study's "FTE-Others" labor input variable.

In addition to labor input variables, the study uses a capital input variable represented by the size of a facility (measured in the total number of beds). As noted earlier in this chapter, the study excludes nursing homes with fewer than 20 and more than 360 beds. Although the total population of nursing homes in the United States includes facilities ranging from 2 to 1,670 beds, 99.3% of all non-hospital-based nursing homes in the OSCAR database are within the range of 20 to 360 beds. Restriction on the size of nursing homes included in the study assumes similarity in the production function

Table 5. Definitions of Other Nursing Home Personnel, With Corresponding Variable Labels from the Online Survey, Certification and Reporting (OSCAR) Database

Position	Definition as identified by the Centers for Medicare and Medicaid Services	Variable Label
Director of Nursing	Professional registered nurse(s) administratively responsible for managing and supervising nursing services within the facility.	RNDON (216-218)
Nurses with Administrative Duties	Nurses (RN, LPN, LVN [licensed vocational nurse]) who, as either a facility employee or contractor, perform the Resident Assessment Instrument function in the facility and do not perform direct care functions.	NRSADM (176-178)
Medication Aides/ Technicians	Individuals, other than a licensed professional, who fulfill the State requirement for approval to administer medications to residents.	MEDAID (167-169)
Housekeeping Services	Services, including those of the maintenance department, necessary to maintain the environment. Includes equipment kept in a clean, safe, functioning and sanitary condition. Includes housekeeping services supervisor and facility engineer.	HOUSE (163-165)
Other	Record total hours worked for all personnel not already recorded, (e.g., if a librarian works 10 hours and a laundry worker works 10 hours, record 00020 in Column C [of "Facility Staffing" in *Form CMS-671 – Long Term Care Facility Application for Medicare and Medicaid]*).	OTHER (194-196)
Mental Health Services	Staff (excluding those included under therapeutic services) who provide programs of services targeted to residents' mental, emotional, psychological, or psychiatric well-being.	MENTL (173-174)
Pharmacists	The licensed pharmacist(s) who a facility is required to use for various purposes, including providing consultation on pharmacy services, establishing a system of records of controlled drugs, overseeing records and reconciling controlled drugs, performing a monthly drug regimen review for each resident.	PHARM (203-205)
Dietitian	A person(s), employed full, part-time or on a consultant basis, who is either registered by the Commission of Dietetic Registration of the American Dietetic Association, or is qualified to be a dietitian on the basis of experience in identification of dietary needs, planning and implementation of dietary programs.	DIET (154-156)

Table 5 (continued)

Position	Definition as identified by the Centers for Medicare and Medicaid Services	Variable Label
Food Service Workers	Persons (excluding the dietitian) who carry out the functions of the dietary service (e.g., prepare and cook food, serve food, wash dishes). Includes the food services supervisor.	FOODS (158-160),
Occupational Therapists	Persons licensed/registered as occupational therapists according to State law in the State in which the facility is located. Include OTs [occupational therapists] who spend less than 50 percent of their time as activities therapists.	OTS (188-190)
Occupational Therapy Assistants	Person(s) who, in accord with State law, have licenses/certification and specialized training to assist a licensed/certified/registered Occupational Therapist (OT) to carry out the OT's comprehensive plan of care, without the direct supervision of the therapist. Include OT Assistants who spend less than 50 percent of their time as Activities Therapists	OTAST (185-187)
Occupational Therapy Aides	Person(s) who have specialized training to assist an OT to carry out the OT's comprehensive plan of care under the direct supervision of the therapist, in accord with State law.	OTAID (182-184)
Podiatrists	Persons licensed/registered as podiatrists, according to State law where the facility is located, to provide podiatric care.	PODS (209-211)
Dentists	Persons licensed as dentists, according to State law where the facility is located, to provide routine and emergency dental services.	DENTS (150-152)
Physical Therapists	Person(s) licensed/registered as physical therapists, according to State law where the facility is located.	PT (231-233)
Medical Director	A physician designated as responsible for implementation of resident care policies and coordination of medical care in the facility.	MEDIR (179-172)
Physical Therapy Assistants	Person(s) who, in accord with State law, have licenses/certification and specialized training to assist a licensed/certified/registered Physical Therapist (PT) to carry out the PT's comprehensive plan of care, without the direct supervision of the PT.	PTAID (225-227)

Table 5 (continued)

Position	Definition as identified by the Centers for Medicare and Medicaid Services	Variable Label
Physical Therapy Aides	Person(s) who have specialized training to assist a PT to carry out the PT's comprehensive plan of care under the direct supervision of the therapist, in accord with State law.	PTAST (228-230)
Speech-Language Pathologists	Persons licensed/registered, according to State law where the facility is located, to provide speech therapy and related services (e.g., teaching a resident to swallow).	SPEECH (221-223)
Therapeutic Recreation Specialist	Person(s) who, in accordance with State law, are licensed/registered and are eligible for certification as a therapeutic recreation specialist by a recognized accrediting body.	RECTH (234-236)
Qualified Activities Professional	Person(s) who meet the definition of activities professional at 483.15(f)(2)(i)(A) and (B) or 483.15(f)(2)(ii) or (iii) or (iv) and who are providing an on-going program of activities designed to meet residents' interests and physical, mental or psychosocial needs.	ACTTHRST (137-139)
Other Activities Staff	Persons providing an on-going program of activities designed to meet residents' needs and interests.	OTHACT (191-193)
Qualified Social Worker(s)	Person licensed to practice social work in the State where the facility is located, or if licensure is not required, persons with a bachelor's degree in social work, a bachelor's degree in a human services field including but not limited to sociology, special education, rehabilitation counseling and psychology, and one year of supervised social work experience in a health care setting working directly with elderly individuals.	SOCWK (218-220)
Other Social Services Staff	Person(s) other than the qualified social worker who are involved in providing medical social services to residents. Do not include volunteers.	OTHSOC (200-202)
Administration	The administrative staff responsible for facility management such as the administrator, assistant administrator, unit managers and other staff in the individual departments, such as: Health Information Specialists (RRA/ARTI), clerical, etc.	ADMIN (140-142)

Table 5 (continued)

Position	Definition as identified by the Centers for Medicare and Medicaid Services	Variable Label
Physician Extender	A nurse practitioner, clinical nurse specialist, or physician assistant who performs physician delegated services.	DOCXT (206-108)
Other Physician	A salaried physician, other than the medical director, who supervises the care of residents when the attending physician is unavailable, and/or a physician(s) available to provide emergency services 24 hours a day.	OTHDOC (197-199)
Note: positions as identified by the Centers for Medicare and Medicaid Services [CMS, 2002] in Form CMS-671 – Long Term Care Facility Application for Medicare and Medicaid)		

of the entire sample. This approach facilitates using the capital input variable of the total number of beds to reasonably calculate the efficiency score for the entire sample.

Nursing home output variables.

The output variables for the study's DEA model are based on the number of nursing home residents by source of payment. Two of the three payer-source outputs are measured by the number of residents who are funded by Medicare and who are funded by Medicaid. The third payer-source output (identified as "Other residents") is the total number of residents minus Medicare and Medicaid residents. Data on all three of the output variables were obtained from the OSCAR database.

Hypotheses Testing: Structural Equation Modeling

The third stage of analysis used structural equation modeling to test the study's hypotheses. Nine hypotheses were developed for testing in the study:

H1. A higher level of competition in the market is associated with higher efficiency of nursing homes.

H2. A higher level of competition in the market is associated with higher nursing home process quality of care.

H3. A higher level of competition in the market is associated with higher nursing home outcome quality of care.

H4. A lower availability of resources in a market is associated with higher efficiency of nursing homes.

H5. A stronger position of payers in a market relative to nursing home providers is associated with higher efficiency of nursing home services.

H6. Stronger position of payers in a market relative to nursing home providers is associated with higher process quality of nursing home services.

H7. Stronger position of payers in a market relative to nursing home providers is associated with higher outcome quality of nursing home services.

H8. Higher efficiency of nursing homes is more likely to be associated with higher process quality.

H9. Higher efficiency of nursing homes is more likely to be associated with higher outcome quality.

As described earlier in this chapter, the study model has eight latent variables and 29 indicators, or observed variables, to measure the associations in the hypotheses. To assess the relationship between variables, the study used structural equation modeling (SEM), applying the LISREL 8.8 statistical software. The SEM approach serves purposes

similar to multiple regression, but it also allows one to take into account the interaction of variables and the possibility of more complicated relationships. The advantage of the SEM approach is that path models are "conceived as explicitly causal," and path coefficients represent "the direct causal influence or the predictor variable on the endogenous variable" (Millsap, 2002, p. 258). In SEM terminology, latent variables are unobserved variables, or constructs (factors), measured by indicators or observed variables, sometimes called "manifest variables" or "reference variables." For example, according to the conceptual framework in the present study, market competition may affect the structure of a nursing home as well as its quality of care. In addition, there is a direct link between structure and quality, and SEM is the most appropriate way to assess these relationships.

The SEM process consists of two steps. The first step, validating the measurement model, is done through confirmatory factor analysis. The second step uses path analysis with latent variables. According to Kenny (1998), in practice both models are simultaneously estimated by SEM programs.

Using the LISREL 8.8 statistical program, the current study's analysis of linear structural relations consists of a measurement model and a structural equation model. The measurement model specifies how the latent variables or constructs are measured by indicators, or observed variables. The relationship between observed measures and factors, or the linear factor analysis model, can be presented in the following formula developed by Kaplan (2000):

$$x = \Lambda_x \xi + \delta$$

where x **=** is *q x 1* vector of observed indicators

Λ_x **=** *q x k* matrix of factor regression weights (loadings)

ξ **=** *k x 1* vector of *k* common factors that are mathematical measures of the latent variable

δ **=** *q x 1* vector of unique variables that contain both measurement error and specific error

The structural equation model represents the causal relationship between latent variables (Kaplan, 2000). The coefficients of the structural equation model are interpreted as "the net effect of one predictor variable on Y_1 when the effects of other predictor variables are simultaneously considered" (Wan, 2002, p. 86). Kaplan's (2000) formula for the structural equation model was used in the current study:

$$\eta = B\eta + \Gamma\xi + \zeta$$

where η **=** a m x 1 vector of endogenous latent variables

B **=** m x m matrix of regression coefficients relating the latent endogenous variables to each other

Γ **=** m x k matrix of regression coefficients relating endogenous variables to exogenous variables

ξ **=** k x 1 vector of exogenous latent variables

ζ **=** m x 1 vector of disturbance terms

The composite reliability for endogenous latent variables in the structural equation model were calculated using the following formula (Raykov, 1998):

$$\text{Composite reliability} = \frac{\left(\sum_{i=1}^{q} \lambda_{yi}\right)2}{\left(\sum_{i=1}^{q} \lambda_{yi}\right)2 + \sum_{i=1}^{q} Var(\varepsilon_i)}$$

where λ = factor loadings

$Var(\varepsilon)$ = error variance for corresponding indicators

The SEM analysis to test the study's hypotheses was performed in three steps: model specification, parameter estimation, and model fit evaluation with model modification, if necessary (Millsap, 2002; Schumacker & Lomax, 2004). The study model is presented in the Fugure 6 below with the exogenous latent construct labeled as ξ and presented in circles, and related indicators presented in squares. Measurement errors of indicators are labeled as δ. The relationship between latent variables and related indicators is labeled as λ and single-arrow line. The factor loadings, represented by lambda values, are estimated parameters which reflect the strength of the relationship

between the construct and variables. In a model depicted below the error of the observed dependent variable is depicted as ε; the error of the observed independent variable depicted as δ. Endogenous latent variables are depicted as η, exogenous latent variables – ξ; indicators or dependent and independent variables are represented by Y and X, respectively. Estimated parameters include coefficients relating the latent dependent variables to indicators (Λy) and the independent latent variable to indicators (Λx), coefficients interrelating latent dependent variables (B), coefficients, relating independent latent variables to dependent latent variables (Γ). Other parameters are variances and covariance among latent independent variables (Φ), variances and covariance among disturbances (Ψ), variances and covariances among errors in measured dependent (Θε) and independent (Θδ) variables. The hypothesized relationship in the model will be presented by parameters:

- ΓA_{21} (competition to efficiency)
- ΓA_{31} (competition to process quality)
- ΓA_{41} (competition outcome quality)
- ΓA_{22} (munificence to efficiency)
- ΓA_{23} (payers to efficiency)
- ΓA_{33} (payers to process quality)
- ΓA_{43} (payers to outcome quality)
- BE_{32} (efficiency to process quality) and
- BE_{42} (efficiency to outcome quality)

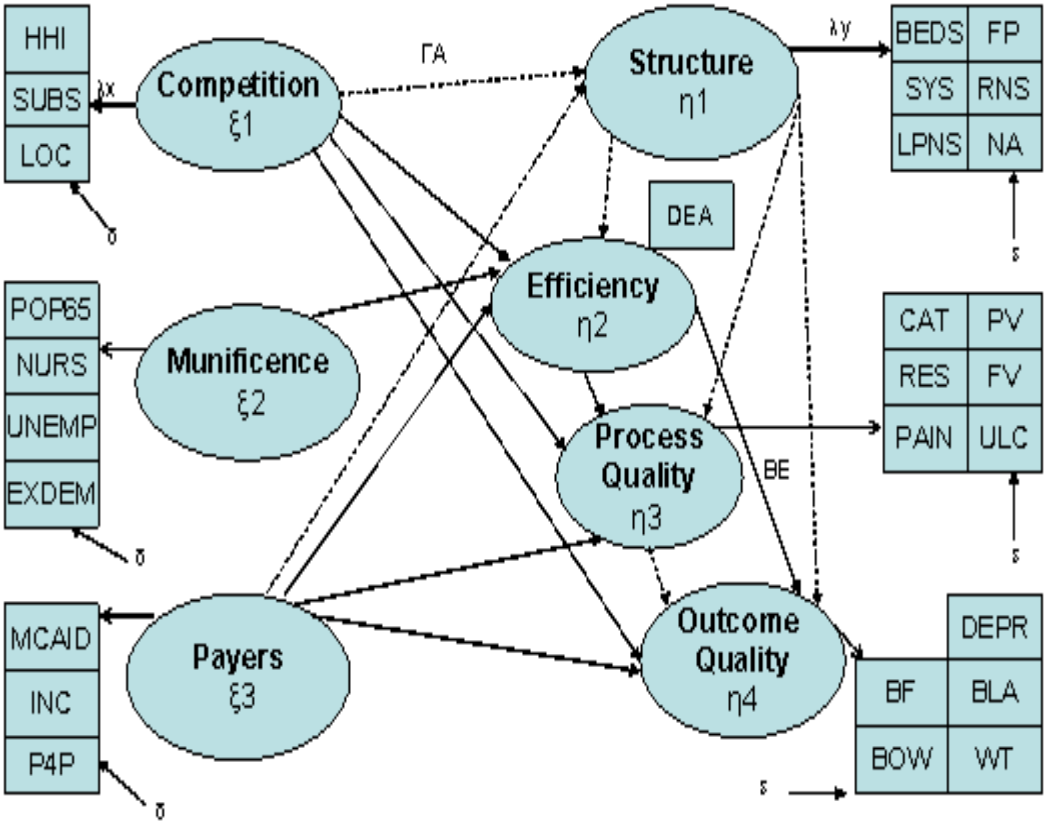
and assessed by respective path coefficients and their significance based on a completely standardized solution provided by the LISREL 8.8 statistical program. The study's control variable (acuity index) is included in the structural equation model. Figure 6 presents the study's structural equation model, with hypothesized association paths between variables depicted by solid arrows. For the purpose of clear demonstration of the hypothesized relationship, the control variable is not shown on the Figure 6.

Model Specification

Model specification is based on the theory behind a study's hypotheses and is created before data collection and analysis. After obtaining the current study's sample data and descriptive analysis of the data, a covariance matrix was created to proceed to the model estimation. A misspecified structural equation model may result in biased parameter estimates or specification error, in which case the model may be statistically unacceptable and require modification. Under-identification of the structural equation model may occur if information in the covariance matrix does not allow for unique determination of one or more parameters, in which case additional steps are required to resolve the problem.

Parameter Estimation

Parameter estimation involves the use of fitting function to minimize the difference between the sample covariance matrix and the model covariance matrix. Model testing determines how well the data fit the proposed model in two general ways. The first way examines the fit of the entire model; the second way examines the fit of individual parameters.



Notes*:* BEDS = size; BF = bedfast or in a chair; BLA = bladder incontinence; BOW = bowel incontinence; CAT = catheter use; DEA = Data Envelopment Analysis; DEPR = depression; EXDEM = excess demand; FP = ownership status; FV = influenza vaccination; HHI = Herfindahl-Hirschmann index; INC = per capita income; LOC = location; LPNS = licensed practical nurses; MCAID = proportion of Medicaid patients; NAS = nurse aides; NURS = nursing staff; P4P = presence of Pay-for-Performance program; P65B = population over 65 years old; PAIN = pain management program; PV = Pneumococcal vaccination; RES = physical restraints; RNS = registered nurses; SUB = number of substitutes; SYS = system membership; ULC = pressure sores/ulcers; UNEMP = unemployment rate; WT = weight.

Figure 6. Structural Equation Model for Assessing Nursing Home Quality of Care, with the Study's Nine Hypothesized Association Paths between Variables Depicted by Solid Arrows (control variable, acuity index, not included).

Goodness-of-Fit Indices

After parameter estimation, the study's structural equation model fit was evaluated. As Millsap (2002) noted, there are two general types of fit indices for SEM: global fit and local fit. Global fit indices assess the fit of a model as a whole, while local fit indices evaluate specific parts of a model. In the current study, various global fit indices and a comparative fit index were used to evaluate model fit.

According to Hooper, Coughlan and Mullen (2008), chi-square statistic, as a statistical significance test, is "sensitive to sample size" and "nearly always rejects the model when large samples are used" (p.54). The current study used root mean square residual, standardized root mean square residual, and root mean square error of approximation for global fit indices. Root mean square residual is based on the same idea as linear regression and measures the difference between the sample covariance matrix and the model fitted matrix, with a lower value indicating a better fit. For standardized root mean square residual, values less than .05 are considered to be a good fit for the model. Root mean square error of approximation provides estimation with an adjustment for degrees of freedom. Values less than .05 are consistent with a good fit for the model, and values between .05 and .08 are consistent with a fair fit. Other types of fit indices are based on comparing the proposed model with a highly restricted base model (often null model with no correlation among variables).

A comparative fit index was also used to evaluate the study's structural equation mode, with values above .95 reflecting a good fit. The model evaluation also included an

analysis of the elements in the sample residual covariance matrix. Root mean square residual was computed based on this information.

Performance Analysis: Logistic Regression

The fourth stage of analysis employed logistic regression to evaluate nursing home performance. For an accurate evaluation of nursing home performance, it is necessary to include both efficiency and quality of care in the analysis. Although many studies have incorporated quality in analyzing nursing home productivity, most investigations limited quality to only a few indicators. The current study includes a large number of quality measures from the OSCAR database.

In order to account for the quality of provided services, a quality score was calculated for each facility in the study's sample. To obtain the quality score, the data on a nursing home were compared to the national average value, similar to the hospital quality score used by Swanson (2006). For each quality measure, a nursing home was assigned a score of 1 if the measure was below, or better than, the national average and a score of 0 if the measure was above, or worse than, the national average, with a higher quality score reflecting higher quality of care. Two measures in the study, the percentage of residents who received a Pneumococcal vaccination and the percentage of residents who received an influenza vaccination, have a different nature, in that a higher percentage represents higher quality of care. Therefore, these measures received reverse scores. Thus, for these two measures, a nursing home received a score of 0 if the measure was below the national average and a score of 1 if the measure was above the national

average. Based on an analysis of the total quality score, the study marked a nursing home as “high quality” if it was within a certain percentile of the quality score distribution.

Although some researchers in the nursing home industry use quality indicators as the key measure for performance, Ozcan (2008) noted that performance consists of two components: efficiency and effectiveness. The importance of nursing home efficiency originated from general concerns over rising healthcare costs and a growing demand for long-term care. Nursing homes must deal with an increasing population of aging individuals who need services and, at the same time, must do so with limited resources. According to Duffy et al. (2006), nursing home productivity or, in other words, the ability to provide the most outputs with the fewest resources, is a critical operational and policy component for today’s long-term care facilities (p. 232).

Because nursing home performance includes both high quality of care and efficient services, a separate analysis was performed to assess the characteristics of efficient facilities that provide high quality services. A nursing home is defined as a high performer based on both an efficiency score and a quality score. Facilities with a high score on both measures were marked as high performers. Logistic regression predicted the likelihood of high performance for a nursing home, based on an analysis of other factors. To assess the probability of high performance in a nursing home, the following model was used:

High performance = f (competition, munificence, payers, structure)

Logistic regression for the model was based on the following formula from “Logistic Regression” (2002):

$$\theta = \frac{e^{(\alpha+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_i x_i)}}{1+e^{(\alpha+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_i x_i)}}$$ with logit transformation as

$$\text{logit}[\theta(x)] = \log\left[\frac{\theta(x)}{1-\theta(x)}\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i$$

The overall fit of the model was assessed with chi-square statistics, and the significance of individual predictors were assessed with a Wald test. The chi-square indicates an adequate explanation of the outcome variable by the model. Significant Wald statistics indicated that a variable is a significant predictor of high quality care.

In addition to a facility's overall quality index, it is useful to analyze the possible difference in separate quality indicators. To assess the relationship between the efficiency of a nursing home and the quality of care provided, quality indicators were compared for efficient and inefficient nursing homes in the study's sample. Nursing homes were divided into groups with high and low efficiency, based on their efficiency score. Although it may seem natural to divide all nursing homes on a base of average efficiency, it was still necessary to analyze the distribution of the efficiency score to find the best division line. A *t*-test was performed to compare the mean values of quality indicators in nursing homes with high efficiency and in nursing homes with low efficiency. Based on the variance of the two groups, the following *t*-test formula developed by Daniel (2005) was used either for an equal or an unequal variance:

$$t = \frac{\bar{y}_1 - \bar{y}_2}{\sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}}$$

where y = mean values of groups

s = group variance

n = group size

Summary

As described in this chapter, the study's methodology incorporates a variety of analyses and data sources to evaluate the relationship between quality of care and efficiency of nursing homes and to assess characteristics of nursing homes that provide high quality services and are highly efficient. The study uses a nonexperimental cross-sectional design to analyze a 10% random sample of nursing homes (n = 1,430) based on national data of nursing home facilities in 2008. Data for the study's sample were obtained from two, large, secondary databases, the OSCAR database and the ARF database, as well as from federal agencies, such as the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis, and a variety of other sources.

For use in testing the study's nine hypotheses, eight latent variables and 29 indicators, or observed variables, were identified. The latent variables are based on the study's theoretical framework, which combines the resource dependence theory and Donabedian's SPO model. Additional variables were also identified for data analysis.

Data on the study's sample were analyzed in four key stages. First, descriptive analysis served to assess the general characteristics of data and to detect missing values. It was also used to assure that the study sample reflects the population. Next, efficiency

scores for the sample were calculated, using a DEA input-oriented model with constant returns to scale. The third stage of analysis used structural equation modeling to test the study's hypotheses. Finally, logistic regression analyzed nursing home performance among the sample to identify facilities with high-performance characteristics. The results for each stage of statistical analysis are presented in Chapter 5.

CHAPTER 5: RESULTS

This chapter presents the results of the statistical analysis of the study's sample of nursing homes. The chapter includes the descriptive statistics employed in the study and the test of significance confirming the representativeness of the sample. The chapter also provides a description of the variables used in the study, the results of Data Envelopment Analysis (DEA) to calculate efficiency scores among the sample, a description of the quality score for nursing homes in the sample, the results from structural equation modeling and how they relate to the study's hypotheses regarding nursing home quality and efficiency, and the results of logistic regression to asses high performing nursing homes that provide high quality services.

Descriptive Statistics

For the purposes of the study, a 10% random sample was taken from the population of nursing homes, which excludes hospital-based facilities and nursing homes with fewer than 20 and more than 360 beds to assure proper efficiency analysis. Facilities with an occupancy rate lower than 5% and higher than 100% were also excluded from the study population as being not typical for nursing homes.

The total number of the nursing homes for the study population was 14,307 facilities, and the sample size was 1,430 facilities. Nursing home data were retrieved from the Online Survey, Certification and Reporting (OSCAR) database. Descriptive

statistics employed in the study included frequencies, means, and standard deviations and was calculated using SPSS 17.0 statistical software. Table 6 and Table 7 provide a general description of the study's sample and total population.

Online *z*-test calculation (Dimension Research, Inc., 2005b) and online *t*-test calculation (Dimension Research, Inc., 2005b) were used to verify the representativeness of the study sample. The *z*-values of the test for proportions are presented in Table 6. Considering all of the variables, there were no statistically significant differences between the study sample and total population parameters at the 95% confidence level. Similarly, as presented in Table 7, the *t*-test for means revealed no statistically significant differences for all of the variables between the sample and population parameters at the 95% confidence level. Because there is no difference between the sample and population, it can be assumed that the sample represents the population. Therefore, the sample can be used and generalized with confidence in interpreting the results of the study.

The study model has eight latent variables and 29 indicators, or observed variables, for hypotheses testing. Table 8 provides the data source, mean values, and standard deviation of the observed variables for the study sample (n = 1,430). The information outlined in Table 8 was used for structural equation modeling to test the study's hypotheses.

The study used an input-oriented DEA model with constant returns to scale to calculate efficiency scores for the sample. Data for all of the variables in the analysis were extracted from the OSCAR database. The choice of inputs and outputs for the analysis was based on literature review. Commonly used inputs for nursing home

Table 6. Characteristics of Nursing Homes in the Study Sample and Population

Variable	Sample – 10% of Total Study Population (*n* = 1,430)		Total Study Population (*N* = 14,307)		*z*-test Value
	n	%	*N*	%	
Urban	945	66.1	9,518	66.5	0.207
System membership (yes)	793	55.5	7,925	55.4	0.016
For-profit	1,011	70.7	10,316	72.1	1.093
Government	58	4.1	588	4.1	0.021
Not-for-profit	361	24.8	3,368	23.5	1.062
U.S. census division					
East North Central	285	19.9	2,851	19.9	–0.035
East South Central	86	6.0	943	6.6	0.79
Middle Atlantic	138	9.7	1,516	10.6	1.072
Mountain	65	4.5	652	4.6	–0.049
New England	99	6.9	971	6.8	0.131
Pacific	154	10.8	1,503	10.5	0.26
South Atlantic	227	15.9	2,123	14.8	1.003
West North Central	190	13.3	1,875	13.1	0.151
West South Central	186	13.0	1,873	13.1	0.044

Table 7. Characteristics of Continuous Variables for the Study Sample and Population

Continuous Variable	10% Sample (n = 1,430)		Total Study Population (N = 14,307)		*t*-test Value
	Mean	*SD*	Mean	*SD*	
Size (total number of beds)	110.09	52.288	109.84	52.878	0.1706
Percentage of Medicaid residents	62.5	20.77	62.2	21.13	0.5127
Percentage of Medicare residents	13.8	11.77	13.6	11.97	0.6034
Percentage of other residents	23.7	17.41	24.2	18.01	1.004
Activities of daily living (ADL) index	9.97	1.398	9.96	1.383	0.2605
Acuity index (ACUINDEX)	10.19	1.477	10.18	1.470	0.2452
Acuity index (PROPAC)	105.44	25.430	105.77	25.002	0.4752
Percentage of residents without ADL limitations	.04	.087	.04	.084	0
Percentage of residents with 5 ADL limitations	.50	.210	.50	.210	0
Percentage of residents with 4 ADL limitations	.28	.186	.28	.183	0
Percentage of residents with 3 ADL limitations	.04	.051	.04	.054	0
Percentage of residents with 2 ADL limitations	.07	.072	.07	.070	0
Percentage of residents with 1 ADL limitation	.07	.076	.07	.079	0
Average number of ADL limitations	3.95	.583	3.95	.583	0

Table 8. Observed Variables for Structural Equation Modeling

Latent Variable and Associated Observed Variables (with corresponding abbreviation)	Data Source	Mean	*SD*
Latent Variable: Competition			
Herfindahl-Hirschmann index (HHI)	OSCAR	1965.29	2307.490
Number of home health agencies in a county (SUB)	ARF	31.23	85.207
Location – Urban-rural continuum (LOC)	ARF	2.97	2.315
Latent Variable: Munificence			
Population over 65 years old, per nursing home bed in a county (P65B)	U.S. Census Bureau	21.82	11.8202
Percentage of empty nursing home beds in a county (EXDEM)	OSCAR	1.62	2.7593
Number of registered nurses in a county (NURS)	Kaiser Family Foundation / statehealthfacts.org	5929.08	11936.931
Number of Unemployed persons per nursing home bed in a county (UNEMP)	U.S. Bureau of Labor Statistics, OSCAR	4.80	1.3363
Latent Variable: Payers' Position			
Percentage of Medicaid nursing home residents in a county (MCAID)	OSCAR	63.27	9.0945
Presence of a Pay-for-Performance program for nursing homes (P4P)	Quality, Transparency, and Prevention Workgroup	0.25	0.435
Average annual income (INC)	U.S. Bureau of Economic Analysis	34301	9388.89
Latent Variable: Structure			
Total number of beds (BEDS)	OSCAR	110.09	52.288
System membership (SYS)	OSCAR	0.55	0.49719
Ownership (for-profit) status (FP)	OSCAR	0.70	0.45530
Full-time equivalent registered nurses (RNS)	OSCAR	4.92	5.5744

Table 8 (continued)

Latent Variable and Associated Observed Variables (with corresponding abbreviation)	Data Source	Mean	*SD*
Full-time equivalent licensed practical nurses (LPNS)	OSCAR	13.90	21.1496
Full-time equivalent nurse aides and trainees (NAS)	OSCAR	37.43	28.6863
Latent Variable: Efficiency			
Efficiency score from Data Envelopment Analysis (DEA)	OSCAR	0.854	0.1452
Latent Variable: Process Quality			
Percentage of residents with catheters (CAT)	OSCAR	1.71	2.5595
Percentage of residents with physical restraints (RES)	OSCAR	4.76	6.2259
Percentage of residents who received a Pneumococcal vaccination (PV)	OSCAR	57.54	32.0991
Percentage of residents who received an influenza vaccination (FV)	OSCAR	69.78	24.5197
Percentage of residents on a pain management program (PAIN)	OSCAR	26.09	23.2733
Percentage of residents with pressure sores/ulcers (ULC)	OSCAR	3.04	3.0046
Latent Variable: Outcome Quality			
Percentage of bedfast residents (BF)	OSCAR	3.59	4.9355
Percentage of depressed residents (DEPR)	OSCAR	50.27	21.5591
Percentage of residents with bladder incontinence (BLA)	OSCAR	55.37	15.4781
Percentage of residents with bowel incontinence (BOW)	OSCAR	43.99	16.8625
Percentage of residents with unexpected weight loss or gain (WT)	OSCAR	8.21	6.8747
Latent Variable: Control			
Acuity index (AI)	OSCAR	10.19	1.4774
Notes*:* ARF = Area Resource File database; OSCAR = Online Survey, Certification and Reporting database.			

efficiency analysis are the number of beds and labor inputs in the form of either full-time equivalents or the number of hours for different personnel types; the commonly used outputs are either the number of residents by their type or the number of resident-days (Nyman & Bricker, 1989; Fizel & Nunnikhoven, 1993; Rosko et al., 1995; Ozcan et al., 1998; Anderson et al. 2003; Laine, Linna, Noro, & Häkkinen; 2005; Duffy et al., (2006). Table 9 presents information on the variables used for Data Envelopment Analysis.

Table 9. Input and Output Variables Used in the Model for Data Envelopment Analysis

Variable	Mean	*SD*
Input		
Full-time equivalent registered nurses	4.9	5.57
Full-time equivalent licensed practical nurses	13.9	21.15
Full-time equivalent nurse aides and trainees	37.4	28.69
Full-time equivalent others	36.0	37.31
Total number of beds	110.1	52.29
Output		
Medicare residents	12.5	11.38
Medicaid residents	58.6	37.78
Other residents	20.3	18.65

Quality measures in the study include process quality variables and outcome quality variables. Quality measures were used to calculate the quality score for the nursing homes in the sample. The data for quality measures were obtained from the OSCAR database and are summarize in Table 10. The table provides mean values and

Table 10. Mean Values and Standard Deviation for Quality Measures

Variable	Maximum	Mean	*SD*
Percentage of residents with indwelled or external catheter, except those on admission (CAT)	40.00	1.71	2.5595
Percentage of residents physically restrained, except those admitted with an order for restraints (RES)	53.85	4.76	6.2259
Percentage of residents who received a Pneumococcal vaccination (PV)	100.00	57.54	32.0991
Percentage of residents who received an influenza vaccination (FV)	100.00	69.78	24.5197
Percentage of residents on a pain management program (PAIN)	100.00	26.09	23.2733
Percentage of residents with pressure sores/ulcers, except those who had pressure sores/ulcers on admission (ULC)	48.39	3.04	3.0046
Percentage of residents who are bedfast or in a chair all or most of the time (BF)	55.10	3.59	4.9355
Percentage of residents with documented signs and symptoms of depression (DEPR)	100.00	50.27	21.5591
Percentage of residents occasionally or frequently incontinent of bladder (BLA)	100.00	55.37	15.4781
Percentage of residents occasionally or frequently incontinent of bowel (BOW)	100.00	43.99	16.8625
Percentage of residents with unplanned or significant weight loss/gain (WT)	62.26	8.21	6.8747

standard deviations for all the quality measures that are used in the current study. The table also provides maximum values of the measures. Because minimum values for all the quality measures that were used in the current study were equal to zero, they are not shown in the table.

To analyze the factors affecting the performance of nursing homes, the study applied logistic regression, using a variety of binary independent variables. The study used the following available binary variables: urban location, presence of a Pay-For-Performance program in the state where a nursing home is located, system membership, and for-profit status. The study also used the following continuous variables: population over 65 years old, excess demand, registered nurses per nursing home bed, unemployment rate, Medicaid share of nursing home residents, and average income. All of the variables were constructed based on the fourth quartile of distribution, with the exception of binary variables provided by the OSCAR database (location, system membership, and profit status). For the continuous binary variables, either the fourth quartile of distribution was used as a group divider or, in some cases, the cutoff point for binary variables was defined as closest to the fourth quartile logical number. The binary variables used in the study for logistic regression analysis are summarized in Table 11 (including mean and standard deviation values), followed by a description of each variable.

The study's binary variable for market concentration is based on the Herfindahl-Hirschmann Index (HHI), which is the sum of the squared market share of the number of beds for nursing homes in a county. As a binary variable, market concentration was set as *HHI_75 = 1* for counties with an HHI lower than 363, representing a lower level of market concentration and higher level of competition. For counties with an HHI higher than 363, the variable was set as *HHI_75 = 0*, representing a higher level of market concentration and a lower level of competition.

Table 11. Binary Variables for Logistic Regression Analysis

Variable (with corresponding abbreviation)	Binary = 0			Binary = 1		
	n	Mean	*SD*	*n*	Mean	*SD*
Competition						
Market concentration (HHI_75)	1,072	2553.69	2391.075	358	203.39	92.865
Number of substitutes (HHA_75)	1,083	3.66	3.622	347	117.29	141.906
Urban location (URBAN)	483	0		947	1	
Munificence						
Population over 65 years old, per nursing home bed (P65_75B)	1,007	16.4502	4.74285	423	34.5930	13.68020
Excess demand (EXDEM_75)	1,085	.1257	.05208	345	.3279	.08291
Registered nurses per bed (RN_BED_75)	1,070	1.0873	.38383	360	2.3820	.68728
Unemployment (UNEMP_75)	1,074	2.9542	1.10757	356	7.6639	2.64140
Payers' position						
Medicaid share (MC_75)	1,081	59.6206	6.87995	349	74.5647	4.84012
Pay-for-Performance program (P4P)	1,067	0		363	1	
Average annual income (INC_75)	1,075	30016	4482.75	355	47280	8378.22
Structure						
System membership (SYS)	637	0		793	1	
For-profit status (PROF)	389	0		1,011	1	

The binary variable for the number of nursing home substitutes was set as *HHA_75 = 0* for counties with 14 and fewer home health agencies, which is 75% of the sample. The variable was set as *HHA_75 =1* for counties with more than 14 agencies, representing a higher level of competition from substitutes.

Although the study uses an urban-rural continuum with data obtained from the Area Resource File database for hypotheses testing in structural equation modeling, for logistic regression, the study uses a binary variable for an urban or rural location of a nursing home, based on information from the OSCAR database. The binary variable was set as *URBAN = 1* for an urban location and as *URBAN = 0* for a rural location.

The binary variable for the population of individuals over 65 years old was set as *P65B_75 = 0* for counties with fewer than 25 people over 65 years old per nursing home bed, indicating a lower possible demand for long-term care. The population variable was set as *P65B_75 =1* for counties with a higher number of elderly people over 65 years old per nursing home bed.

The binary variable for excess demand was set as *EXDEM_75 = 0* for counties with a percentage of empty beds less than 23%, which is 76% of the study's sample. The excess demand variable was set as *EXDEM_75 = 1* for counties with a percentage of empty beds more than 23%, indicating a higher level of excess demand.

The binary variable for the number of registered nurses potentially available in a county was set as *RN_BED_75 = 0* for counties with fewer than 1.73 nurses per nursing home bed, which is 74.8% of the study's sample. The variable was set as *RN_BED_75 = 1* for counties with more than 1.73 nurses per bed, indicating a greater availability of nurses.

The binary variable for unemployment is based on the number of unemployed persons instead of the unemployment rate in order to relate the number of unemployed individuals in a county who are available for employment per nursing home bed. This

would not be possible using the unemployment rate. The unemployment binary variable was set as *UNEMP_75 = 0* for counties with fewer than 5.24 unemployed individuals per nursing home bed. The variable was set as *UNEMP_75 = 1* for counties with more than 5.24 unemployed individuals, indicating a higher availability of nonprofessional nursing home personnel.

The binary variable for the percentage of Medicaid-funded nursing home residents in a county was set as *MC_75 = 1* for the highest quartile of distribution with values more than 69%. The Medicaid-share variable was set at *MC_75 = 0* for counties with less than 69% of Medicaid residents in the total census, representing the purchasing power of the Medicaid program.

The binary variable for the presence of a Pay-for-Performance (P4P) program was set as *P4P = 1* if a nursing home is located in a state with an active P4P program. Otherwise, the P4P binary variable was set as *P4P = 0* if a nursing home is located in a state without a P4P program.

The binary variable for average annual personal income was defined as the highest quartile. Based on data retrieved for the study's sample, 1,075 facilities are located in counties with an average annual income lower than $38,281 (set as *INC_75 = 0*), and 355 nursing homes are located in counties with an average annual income higher than $38,281 (set as *INC_75 = 1*).

The binary variable for system membership was set as *SYS = 1* if a nursing home belongs to a chain. Otherwise, the system membership variable was set as *SYS = 0* for independent facilities.

The binary variable for for-profit status was set as *PROF = 1* for for-profit nursing homes. The for-profit variable was set as *PROF = 0* for all other facilities, which are not-for-profit and governmental nursing homes included in the study's sample.

In addition to the binary variables described above, the size of a nursing home, or the number of beds in a facility, is another important variable used in the study's logistic regression analysis. The nursing home size variable for logistic regression (*SIZE_Group*) was set by the highest frequency of the number of nursing homes beds and divided into four size group values: *SIZE_Group = 0* was set for facilities with 20–60 beds; *SIZE_Group = 1* was set for facilities with 61–120 beds; *SIZE_Group = 2* was set for facilities with 121–180 beds; and *SIZE_Group =3* was set for facilities with more than 181 beds. The selection of group size in the study is similar to the selection used by Hicks et al. (1997), who grouped nursing homes in three categories: small (up to 60 beds), midsized (61–120 beds), and large (more than 121 beds). However, Hicks et al. (1997) had only three size groups; for the current study, it seemed reasonable to add a fourth size group, following a similar division rule. Data on the size groups used for logistic regression in this study are presented in Table 12.

Table 12. Size Group Variable for Logistic Regression Analysis

Variable Value	Number of Beds	*N*	Mean	*SD*
0	20–60	286	48.62	10.848
1	61–120	695	96.84	17.936
2	121–180	330	148.76	18.335
3	181-360	119	228.00	40.006

Data Envelopment Analysis

Data Envelopment Analysis (DEA) scores were calculated in order to determine the efficiency of nursing homes in the study's sample. Using the input and output variables presented in Table 9 as efficiency measures, the DEA scores for facilities in the sample were calculated using an input-oriented, constant returns to scale model. The DEA-Solver program served as a tool to calculate efficiency scores.

Among the study's sample, 149 facilities (10.4%) had an efficiency score of 1, which indicates perfect efficiency. The average efficiency score of nursing homes in the sample was 0.854 (0.079 minimum value; 0.145 standard deviation). There were 532 nursing homes with an efficiency score lower than the mean value for the sample.

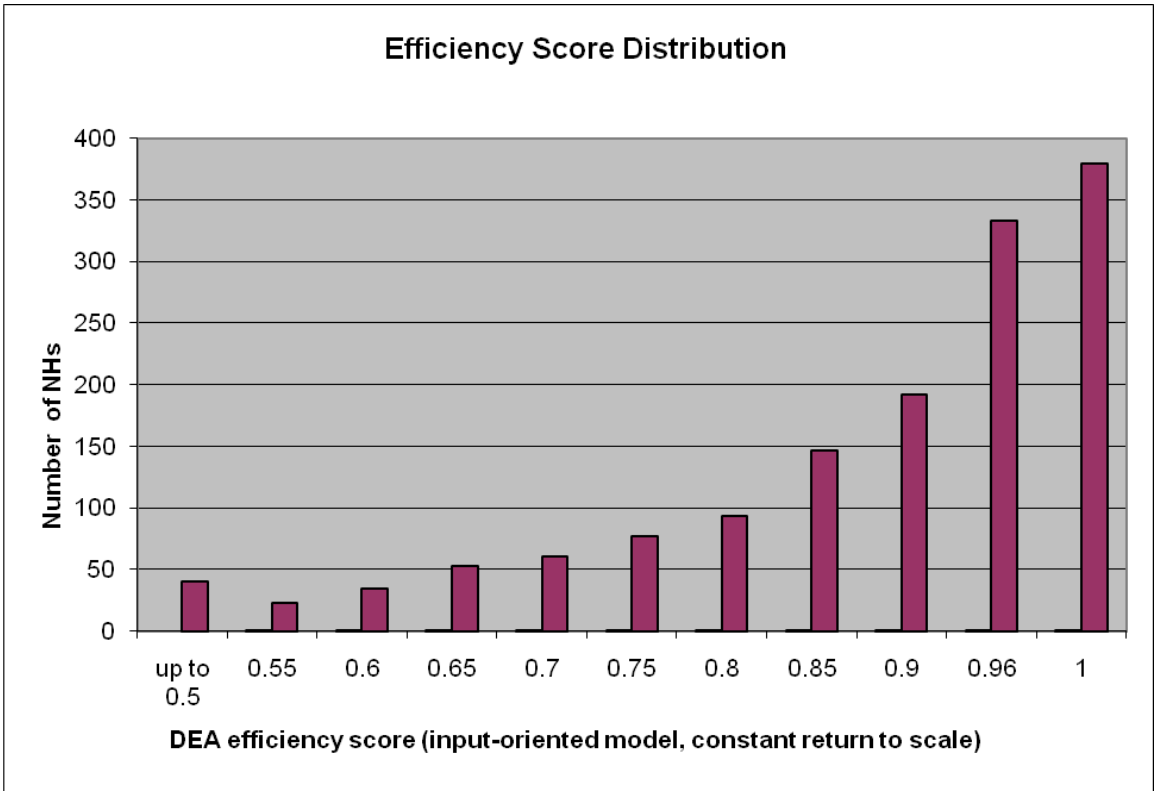
The mean and standard deviation values of efficiency scores for the nursing homes in the study's sample are provided in Table 13. According to the sample data, comparison between facilities located in rural versus urban counties shows that the average efficiency score is higher among urban nursing homes. System membership does not affect the efficiency score. For-profit facilities tend to be less efficient than non-profit and governmental nursing homes. Nursing homes in counties with annual income lower than average tend to be less efficient, with the difference between the facilities being statistically significant.

The DEA scores were then transformed into dichotomous values representing efficient or inefficient nursing homes. In order to divide the sample into high-efficient and low-efficient nursing homes, the highest quartile of efficiency score distribution was used.

Table 13. Efficiency Scores (Input-Oriented, Constant Returns to Scale Model)

Variable	Efficiency Score (Constant Returns to Scale)		Difference (Statistical Significance)
	Mean	*SD*	
Urban (*n* = 945)	.86864	.1379	.0440 (.000)
Rural (*n* = 485)	.82464	.1545	
System membership (*n* = 793)	.85096	.1413	.0062 (.426)
No system membership (*n* = 637)	.85715	.1499	
Income < 38.000 (*n* = 1,064)	.84531	.1495	.0327 (.000)
Income > 38.000 (*n* = 365)	.87806	.1290	
For-profit (*n* = 1,011)	.84472	.1426	.0307 (.000)
Not-for-profit and governmental (*n* = 419)	.87543	.1492	
Acuity index above average (*n* = 819)	.86322	.1348	.0222 (.004)
Acuity index below average (*n* = 611)	.84097	.1572	

For the constant returns to scale efficiency score, the following binary variable was created: *EFF_75 = 1* for facilities with an efficiency score of 0.96 and higher, and *EFF_75 = 0* for nursing homes with an efficiency score lower than 0.96. As a result, 373 (26.08%) of the nursing homes in the sample were marked as efficient. Forty nursing homes had an efficiency score lower than 0.5. Figure 7 presents the distribution of efficiency scores based on 0.05 increments, with one exception: The last score in the figure shows the number of facilities with an efficiency score from 0.96 to 1.00, which is correspondent with the number of efficient nursing homes (373) for the binary efficiency variable.



Notes. DEA = Data Envelopment Analysis; NHs = nursing homes.

Figure 7. Efficiency Score Distribution, According to Data Envelopment Analysis Model with Constant Returns to Scale.

The average efficiency score among highly efficient facilities was 0.986 (*SD* = 0.014), among others the score was 0.808 (*SD* = 0.142), and the difference in score was 0.179 ($p < 0.001$). Table 14 presents the mean values of the quality measures for efficient and inefficient nursing homes as well as the difference between the means and statistical significance of *t*-test for equality of mean (using SPSS 17.0 statistical software). The table also provides data on the mean values for other variables used in the statistical model, along with the *t*-test results.

Table 14. Comparative Variable Description for Efficient and Inefficient Facilities

Variable	Efficient Nursing Homes (n = 373)		Inefficient Nursing Homes (n = 1,057)		t-test for Means (df = 1428)
	Mean	*SD*	Mean	*SD*	Mean Difference
Herfindahl-Hirschmann index	1867	2259.0	1999	2324.4	130.79
Number of home health agencies	33.84	90.417	30.31	83.315	–3.53
Location – Urban-rural continuum code	2.82	2.301	3.02	2.318	0.203
Population over 65 years old, per nursing home bed	22.45	11.427	21.59	11.953	–0.851
Excess demand (percent of empty beds in a county)	0.126	0.08325	0.192	0.10761	0.066***
RNS per 100,000 individuals in a county's population	7141.6	13784.40	5501.2	11188.51	–1640.4**
Unemployment	4.86	1.458	4.77	1.290	–0.09
Percent of Medicaid residents in a county	63.38	9.829	63.23	8.825	–0.156
Average annual income	35283	10039.4	33955	9128.0	–1328**
Total number of beds	104.3	56.21	112.1	50.70	7.86**
Process Quality and Outcome Quality Measures					
Percentage of residents with a catheter (CAT)	1.67	1.898	1.73	2.756	0.053
Percentage of residents physically restrained (RES)	4.28	5.494	4.93	6.458	0.647*
Percentage of residents who received a Pneumococcal vaccination (PV)	60.94	32.477	56.34	31.894	–4.60**

Table 14 (continued)

Variable	Efficient Nursing Homes (n = 373)		Inefficient Nursing Homes (n = 1,057)		t-test for Means (df = 1428)
	Mean	*SD*	Mean	*SD*	Mean Difference
Percentage of residents who received an influenza vaccination (FV)	71.51	24.021	69.17	24.676	–2.33
Percentage of residents on a pain management program (PAIN)	28.07	23.561	25.40	23.142	–2.672*
Percentage of residents with pressure sores/ulcers (ULC)	2.85	2.448	3.11	3.176	0.261
Percentage of residents who are bedfast or in chair all or most of the time (BF)	2.91	4.127	3.83	5.172	0.92***
Percentage of residents with documented signs and symptoms of depression (DEPR)	49.68	23.595	50.48	20.801	0.798
Percentage of residents occasionally or frequently incontinent of bladder (BLA)	56.66	17.006	54.91	14.883	–1.75*
Percentage of residents occasionally or frequently incontinent of bowel (BOW)	43.58	17.927	44.15	16.477	0.564
Percentage of residents with unplanned or significant weight loss/gain (WT)	7.68	6.772	8.39	6.904	0.719*
Acuity index	10.15	1.729	10.21	1.378	0.054
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$					

As shown in Table 14, higher efficiency of nursing homes is associated with high excess demand in a county, a high number of registered nurses, and a higher average annual personal income in a county . Quality measures associated with a high efficiency score are the use of physical restraints, the Pneumococcal vaccination rate, pain management, bedfast residents, bladder incontinence, and unplanned or significant weight loss or weight gain.

Quality Score

In order to compare the quality of nursing home services, a quality score was calculated, similar to the quality score that Swanson (2006) used for hospitals. Table 10 presents information on the quality measures used to calculate a quality score and provides the mean value and standard deviation for each quality measure. Table 10 also presents the maximum values of the quality variables. Because the minimum value for all of the variables was equal to zero, it is not shown in the table.

To obtain a quality score, each quality measure for each nursing home was assigned a score. A facility received a score of 1 if the measure was below, or better than, the average national value. A facility received a score of 0 if the measure was above, or worse than, the average national value. Two variables in the model, the percentage of residents who received a Pneumococcal vaccination and the percentage of residents who received an influenza vaccination, have a reverse score due to the nature of the measures, in which higher values represent better results. Table 15 provides the number of nursing homes in the sample with quality measures higher and lower than the national average value.

Table 15. Number of Nursing Homes with Quality Scores Above and Below National Average for Each Quality Indicator

Variable (with corresponding abbreviation)	Below Average (Score = 0)		Above Average (Score = 1)	
	n	%	*n*	%
Percentage of residents with indwelled or external catheter, except those with catheter on admission (CAT)	548	38.3	882	61.7
Percentage of residents physically restrained, except those admitted with an order for restraints (RES)	530	37.1	900	62.9
Percentage of residents who received a Pneumococcal vaccination (PV)	619*	43.3	811*	56.7
Percentage of residents who received an influenza vaccination (FV)	559*	39.1	871*	60.9
Percentage of residents on a pain management program (PAIN)	621	43.4	809	56.6
Percentage of residents with pressure sores/ulcers, except those who had pressure sores/ulcers on admission (ULC)	596	41.7	834	58.3
Percentage of residents who are bedfast or in a chair all or most of the time (BF)	500	35.0	930	65.0
Percentage of residents with documented signs and symptoms of depression (DEPR)	749	52.4	681	47.6
Percentage of residents occasionally or frequently incontinent of bladder (BLA)	776	54.3	654	45.7
Percentage of residents occasionally or frequently incontinent of bowel (BOW)	763	51.5	694	48.5
Percentage of residents with unplanned or significant weight loss/gain (WT)	595	41.6	835	58.4
* Reverse coding due to nature of the quality indicators.				

Among the nursing homes in the sample, only 10 facilities exceeded the national average on all of the 12 quality measures. However, none of the nursing homes had a quality score of zero. Table 16 reports the distribution of the total quality scores in the study's sample. The distribution of quality scores was close to normal, as is shown in Figure 8.

Table 16. Total Quality Score Distribution

Total Quality Score	Frequency	Percentage	Cumulative Percentage
1.00	9	.6	.6
2.00	33	2.3	2.9
3.00	75	5.2	8.2
4.00	142	9.9	18.1
5.00	217	15.2	33.3
6.00	316	22.1	55.4
7.00	268	18.7	74.1
8.00	208	14.5	88.7
9.00	118	8.3	96.9
10.00	34	2.4	99.3
11.00	10	.7	100.0
Total	1430	100.0	

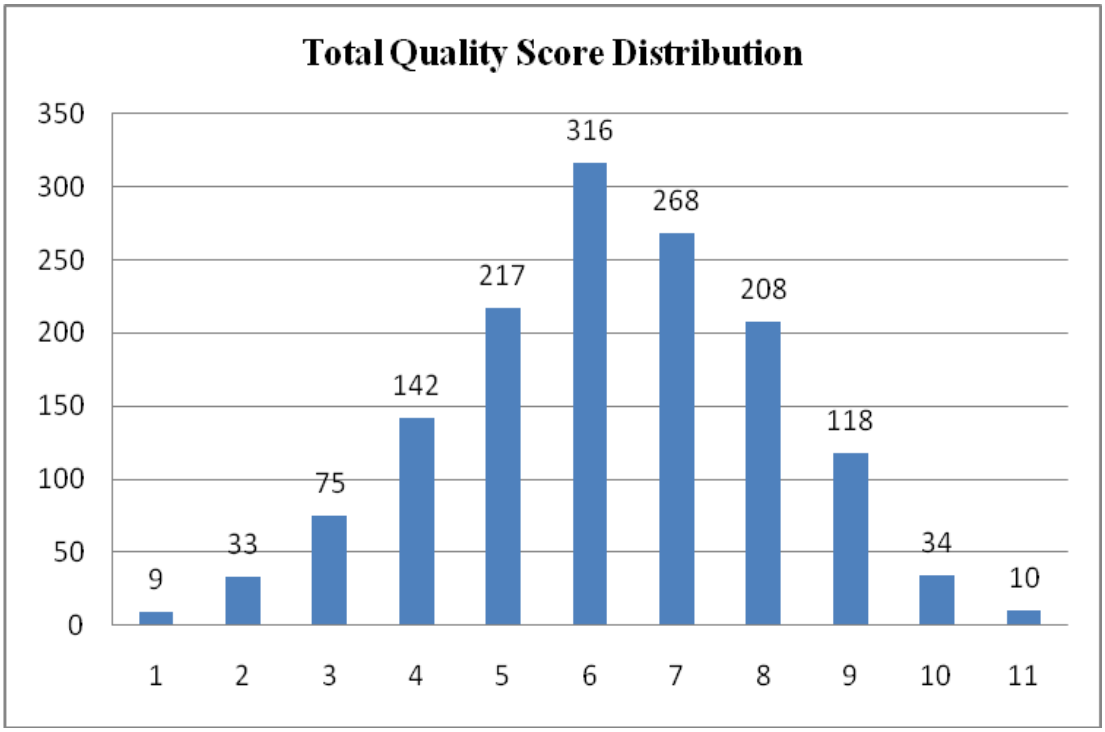


Figure 8. Distribution of Nursing Home Quality Scores.

In the next stage of quality analysis, all of the nursing homes in the sample were divided into high and low quality facilities. The total quality score was equal to the sum of the quality score for each indicator. The cutoff point for assigning a nursing home as a high quality facility was a total quality score of 8 or higher. This cutoff point was chosen as the closest to the fourth quartile of distribution. There were 370 nursing homes with a total quality score of 8 or higher, which was 25.9% of the total sample. Table 17 reports the quality scores for the high and low quality nursing homes in the study's sample.

Structural Equation Modeling

The study used structural equation modeling for hypothesis testing. The study model has eight latent variables and 29 indicators, or observed variables, to measure the associations in the hypotheses (see Table 8 in this chapter). Two of the latent variables, efficiency (DEA) and the control variable (acuity index), have only one observed variable each. For the dependent latent variable "efficiency," the path coefficient was set at one, and an error term was set at zero. With 29 observed variables, the original model had 435 available degrees of freedom. Eighty-three parameters were assessed. The final model has 352 degrees of freedom.

Because the study's conceptual framework was based on Donabedian's SPO model and the resource dependence theory, one of the quality measures (pressure sores/ulcers) was reassessed for the statistical analysis. Most of the studies in the literature combined pressure sores with catheter use and the use of physical restraints in their analysis, which involved using process measures and outcome measures together.

Table 17. Nursing Homes with High and Low Quality Scores

Variable	High-Quality Nursing Homes (n = 370)		Low-Quality Nursing Homes (n = 1,060)		t-test for Means (df = 1428)
	Mean	*SD*	Mean	*SD*	Mean difference
Herfindahl-Hirschmann index	1626.6	2027.79	2061.7	2373.15	435.20***
Number of home health agencies	40.9	99.69	28.5	80.45	–12.40**
Location – Urban-rural continuum code	2.85	2.368	3.00	2.300	0.149
Population over 65 years old, per nursing home bed	21.1	10.62	22.0	12.14	0.88
Excess demand (empty beds per 10,000 population)	1.73	2.342	1.59	2.867	–0.139
Registered nurses in a county	7911	14180.3	5365	11159.3	–2546***
Unemployment	4.8	1.26	4.8	1.36	0.05
Percentage of Medicaid residents in a county	62.37	9.724	63.52	8.895	1.157*
Average annual income	35930	10338.5	33838	9051.8	–2092.9***
Total number of beds	108.99	56.368	110.41	51.088	1.416
Data Envelopment Analysis score	0.856	0.1578	0.853	0.1414	–0.0028
Acuity index	9.56	1.592	10.37	1.392	.817***
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$					

Based on information from the U.S. Department of Health and Human Services and from the Centers for Medicare and Medicaid Services, the National Quality Measures Clearinghouse (2007a, 2007b) describes pressure sores mostly as an outcome measure. However, according to the American Medical Directors Association, the percentage of patients with a documented assessment of pressure ulcers, using a formal wound staging classification, is viewed as a process measure (National Quality Measures Clearinghouse, 2005b). Because the prevalence of pressure sores is generally believed to depend on the care provided by nursing home staff, the measure was included in the process latent variable for the current study.

Another model modification included free error covariance between two measures of process quality: the percentage of residents who received a Pneumococcal vaccination and the percentage of residents who received an influenza vaccination. The rationale for this modification was that these two processes often take place within a period of limited time and are likely to be provided by the same personnel. Although they are two separate measures, the modification took into account a similar mode of delivery.

According to Bentler and Chou (1987), the ratio of sample size to the number of estimated parameters should be at least 5:1, assuming normal distribution. The ratio of at least 10:1 is "more appropriate for arbitrary distribution" (Bentler & Chou, 1987, p. 91). The authors also noted that this ratio should be even higher in order "to obtain trustworthy *z*-tests on the significance of parameters" (p. 91). In the current study, the ratio of sample size to the number of free parameters in the model exceeds the minimum

requirement and equals 17:1. This high ratio is important because of the binary nature of some indicators and certain non-normal distribution of the efficiency score.

However, a relatively large sample influences fit statistics, such as chi-square fit index, when relatively small effects can be detected and are significant, which increases the probability of a Type II error. According to Kenny (2008), chi-square is a reasonable measure of fit for models with up to 200 observations; for larger models, chi-square is almost always statistically significant. Because the current study uses a model with 1,430 observation, it follows that chi-square should not be used as a major measure of model fit.

Model fit was assessed using root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR), provided by the LISREL 8.8 statistical program. The RMSEA of the study's model was equal to 0.076, which proposes adequate fit. The SRMR is a difference between observed covariance and predicted covariance. A SRMR value of 0.8 or less is considered a good fit. The study's model had a SRMR value equal to 0.079, which proposes adequate fit.

Table 18 provides information on all the fit indices reported by the LISREL 8.8 statistical program used for the study. Not all of the fit indices have the same weight in assessing the model fit. For model fit justification, the study used the comparative fit index (CFI). Although the study's CFI is relatively low (0.76), the overall model fit may be assessed as reasonable, because CFI decreases as the number of observations increases.

Table 18. Model Fit Indices Provided by the LISREL 8.8 Statistical Program

Model fit indices reported by LISREL 8.8 (*df* = 352)	Value
Minimum fit function chi-square	3043.70 (*P* = 0.0)
Normal theory weighted least squares chi-square	3273.55 (*P* = 0.0)
Estimated noncentrality parameter (NCP)	2921.55
90% confidence interval for NCP	2742.07; 3108.39
Minimum fit function value	2.13
Population discrepancy function value (F0)	2.04
90% confidence interval for F0	1.92; 2.18
Root mean square error of approximation (RMSEA)	0.076
90% confidence interval for RMSEA	0.074; 0.079
P-value for test of close fit (RMSEA < 0.05)	0.00
Expected cross-validation index (ECVI)	2.41
90% confidence interval for ECVI	2.28; 2.54
ECVI for saturated model	0.61
ECVI for independence model	8.77
Chi-square for independence model with 406 degrees of freedom	12477.67
Independence – Akaike Information Criterion **(**AIC)	12535.67
Model AIC	3439.55
Saturated AIC	870.00
Independence – Consistent AIC (CAIC)	12717.36
Model CAIC	3959.58
Saturated CAIC	3595.46
Normed fit index (NFI)	0.74
Non-normed fit index (NNFI)	0.72
Parsimony normed fit index (PNFI)	0.64
Comparative fit index (CFI)	0.76
Incremental fit index (IFI)	0.76
Relative fit index (RFI)	0.70
Critical N (CN)	182.88
Root mean square residual (RMSR)	0.079
Standardized root mean square residual (SRMR)	0.079
Goodness of fit index (GFI)	0.86
Adjusted goodness of fit index (AGFI)	0.83
Parsimony goodness of fit index (PGFI)	0.70

The composite reliability for endogenous latent variables in the model was equal to 0.732 and was calculated by the following formula:

$$\text{Composite reliability} = \frac{\left(\sum_{i=1}^{q} \lambda_{yi}\right)2}{\left(\sum_{i=1}^{q} \lambda_{yi}\right)2 + \sum_{i=1}^{q} Var(\varepsilon_i)}$$

where λ = factor loadings

Var(ε) = error variance for corresponding indicators

Because composite reliability is used as an analogy for Cronbach alpha, the value suggests adequate factor loading for the endogenous variables.

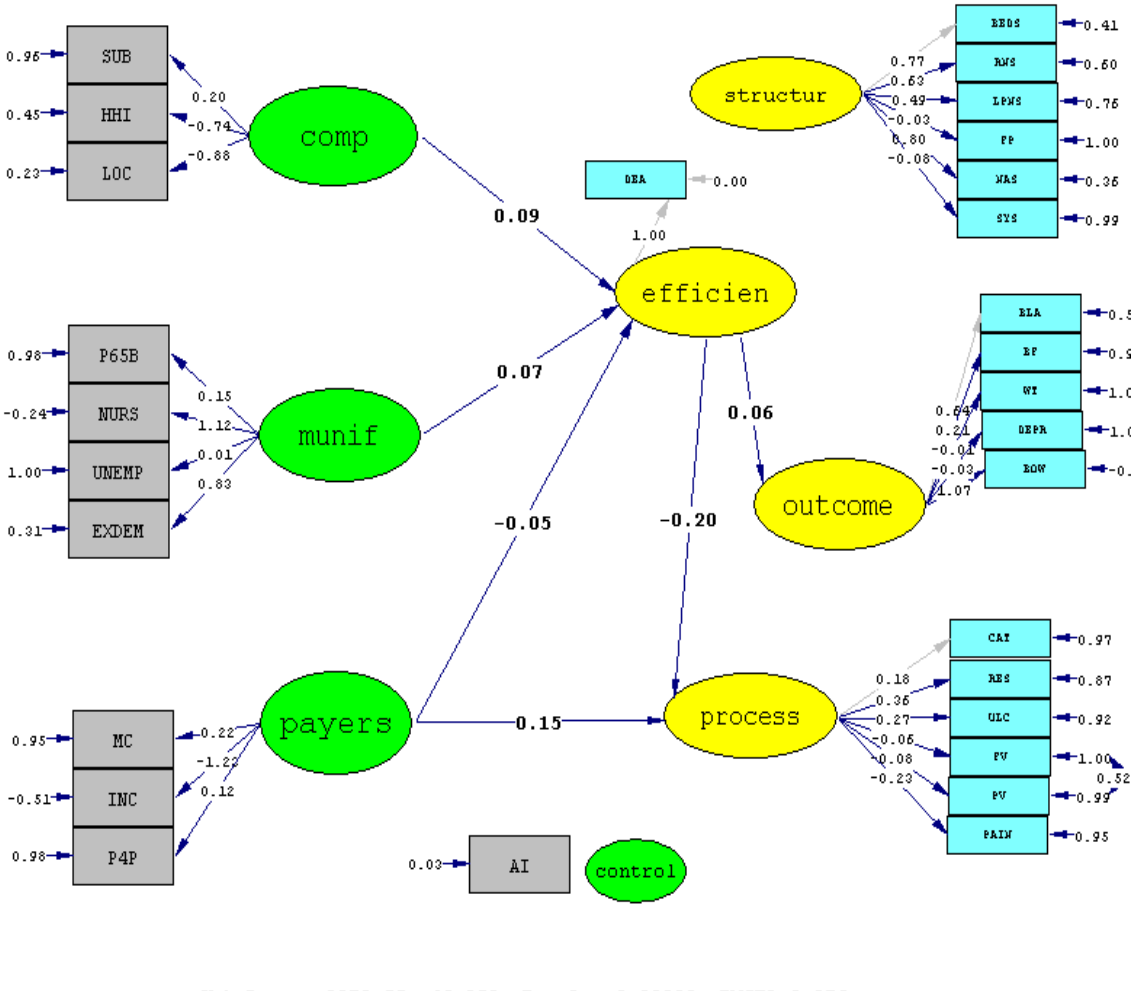
The composite reliability index for exogenous-variables was relatively low (0.49). Among indicator variables contributing to the relatively low index are the unemployment rate (with factor loading of 0.01 and error variance of 1.00) and the presence of Pay-for-Performance programs for nursing homes (with factor loading of 0.12 and error variance of 0.98). Exclusion of these two indicators would significantly improve the reliability index up to 0.7; however, for hypothesis testing, the study includes all the listed variables. Analysis of the standardized residuals for the model revealed also that the largest absolute residuals were for the same unemployment rate variable (14.80 for the covariance between unemployment and Medicare share and –14.27 for the covariance between unemployment and average income). At the same time, exclusion of this variable from the model would not change the number of supported hypotheses, and the study includes all the listed variables.

Out of the nine hypothesized relationships in the study, six path coefficients had a *t*-value over 1.96, which coordinates with the critical value of a *z*-test based on a 0.95 confidence level for a model with more than 120 observations. Table 19 presents the study's hypothesized relationships and corresponding completely standardized path coefficients and *t*-values. Path coefficients are presented in Figure 9. To provide a clear view of path coefficients and, therefore, a better understanding, only statistically significant coefficients are shown Figure 9.

Table 19. Model Path Coefficients and Corresponding *t*-Values for the Hypothesized Relationships

	Hypotheses (Hypothesized Relationship)	Coefficient	*t*-Value
H1	Competition to efficiency (+)	**0.09**	**2.65**
H2	Competition to process quality of care (+)	0.08	1.09
H3	Competition to outcome quality of care (+)	0.04	1.22
H4	Munificence to efficiency (–)	**0.07**	**3.26**
H5	Payers' position to efficiency (+)	**–0.05**	**–2.06**
H6	Payers' position to process quality of services (+)	**0.15**	**2.48**
H7	Payers' position to outcome quality of services (+)	–0.03	–1.16
H8	Efficiency to process quality (+)	**–0.20**	**–2.95**
H9	Efficiency to outcome quality (+)	**0.06**	**1.99**

Notes. H = Hypothesis; values in bold represent statistically significant path coefficients



Notes. AI = acuity index; BEDS = size; BF = bedfast or in a chair; BLA = bladder incontinence; BOW = bowel incontinence; CAT = catheter use; comp = competition; DEA = Data Envelopment Analysis; DEPR = depression; efficien = efficiency; EXDEM = excess demand; FP = ownership status; FV = influenza vaccination; HHI = Herfindahl-Hirschmann index; INC = per capita income; LOC = location; LPNS = licensed practical nurses; MC = proportion of Medicaid patients; munif = munificence; NAS = nurse aides; NURS = nursing staff; P4P = presence of Pay-for-Performance program; P65B = population over 65 years old; PAIN = pain management program; PV = Pneumococcal vaccination; RES = physical restraints; RNS = registered nurses; structur = structure; SUB = number of substitutes; SYS = system membership; ULC = pressure sores/ulcers; UNEMP = unemployment rate; WT = weight.

Figure 9. Path Coefficients for the Structural Equation Model (the LISREL 8.8 statistical program).

The results of structural equation modeling supported three out of the nine study hypotheses. The three supported hypotheses were H1, which assumes a positive association between competition and efficiency; H6, which assumes a positive association between payers' position and process quality of services; and H9, which assumes a positive association between efficiency and outcome quality.

It is also interesting to note that, for three of the study's hypotheses, structural equation modeling (SEM) led to statistically significant coefficients with an opposite direction of relationship. The SEM analysis of H4, which hypothesizes that a lower availability of resources in a nursing home market is associated with higher efficiency of nursing homes, showed, instead, that a higher availability of resources is associated with higher efficiency.

The SEM analysis of H5, which hypothesizes that a stronger position of payers in a nursing home market is associated with higher efficiency of nursing home services, indicated, instead, that a stronger position of payers is associated with lower efficiency. Some possible explanation of this difference are discussed in Chapter 6.

Finally, the SEM analysis of H8, which hypothesizes that higher efficiency of nursing homes is more likely to be associated with higher process quality, indicated, instead that higher efficiency is associated with lower process quality. The complex relationship between latent variables, presenting stronger payers' position, efficiency and process quality are discussed in more detail in Chapter 6.

The study used logistic regression to assess the characteristics of nursing homes that efficiently provide high quality services. To facilitate the assessment, all of the facilities in the sample were divided into two groups. The first group included nursing homes with an efficiency score of 0.96 or higher and a quality score of 8 or higher, which represented the fourth quartile for both measures. The group had 106 (7.4%) nursing homes marked as high performers. All of the other facilities were placed in a second group and marked as low performers. Logistic regression was applied to the binary variable of nursing home performance. Tables 11 and 12 describe the independent variables used for logistic regression.

In the logistic regression model, higher competition in the county was presented by three separate measures (market concentration, number of substitutes and location). In general, none of the measures of competition had a statistically significant effect on nursing home performance.

Among the measures of munificence included in the model, only two had a statistically significant relationship with the dependent variable. Higher excess demand was associated with lower chances of being a high performer, with a coefficient of 0.278 ($p < 0.001$). A higher number of registered nurses in the county was associated with almost a 50% lower chance of being a high performer, with a coefficient of 0.555 ($p < 0.10$). The other measures of munificence, the population over 65 years old per nursing home bed and unemployment, did not have a statistically significant effect on being a high performer.

Variables representing the position of payers in the market were presented by the proportion of Medicaid residents in a county, the average annual personal income in a county, and the presence of an active Pay-for-Performance program in the state where a nursing home was located. None of the variables had a statistically significant effect on the dependent variable of payers' position.

Other variables were size group, system membership, for-profit status, and the acuity index. An increase in the number of beds (size group) and a for-profit status of a nursing home were associated with lower chances of high performance. For-profit facilities were almost 50% less likely to be high performers ,with a logistic regression of coefficient 0.562 ($p < 0.01$). Additionally, each ascending size group decreased the probability of high performance by approximately 25% (coefficient = 0.768, $p < 0.05$). The coefficients and related statistics for the logistic regression analysis of high performers are provided in Table 20.

With the statistical analyses described in this chapter, it is possible to now consider the hypotheses made using the conceptual model. Table 15 provides a list of the hypotheses in this study as well as path coefficients and their statistical significance. Three hypotheses from the conceptual model were supported by structural equation modeling. The level of competition, measured by HHI, the number of substitutes in the market and geographical location, is associated with higher efficiency of nursing homes. Stronger position of payers in the market, measured as high presence of Medicaid program, average personal income and Pay-for-Performance for nursing homes, is associated with process quality of care.

Table 20. Logistic Regression Model Results for High Performers

Variable (with corresponding abbreviation)	B	S.E.	Wald	Sig.	Exp(B)
Market concentration (HHI_75)	–.004	.363	.000	.991	.996
Number of substitutes (HHA_75)	.304	.347	.768	.381	1.355
Urban location (URBAN)	.175	.290	.364	.546	1.191
Population over 65 years old, per nursing home bed (P65B_75)	.216	.335	.413	.520	1.241
Excess demand (EXDEM_75)	–1.280	.353	13.133	.000	.278
Registered nurses per bed (RN_BED_75)	–.590	.345	2.918	.088	.555
Unemployment (UNEMP_75)	.396	.355	1.248	.264	1.486
Medicaid share (MC_75)	.059	.265	.050	.823	1.061
Pay-for-Performance program (P4P)	–.436	.273	2.540	.111	.647
Average annual income (INC_75)	.235	.270	.757	.384	1.265
Size group (SIZE_group)	–.264	.128	4.269	.039	.768
System membership (SYS)	–.031	.213	.021	.885	.970
For-profit status (PROF)	–.576	.221	6.763	.009	.562
Acuity index (ACUINDEX)	–.408	.072	32.389	.000	.665
Constant	2.194	.734	8.921	.003	8.968
Notes. –2 Log likelihood 681.745 Cox & Snell R Square 0.05 Chi-square 73.818 for df =14, p =0.000; predicted percentage correct 92.7					

Efficiency of a nursing home is associated with higher outcome quality of care. It is also interesting to note that 3 hypotheses had statistically significant coefficients of the opposite direction. Higher efficiency is associated with lower process quality, and higher availability of resources is associated with higher efficiency. Munificence is associated with higher efficiency. These hypotheses will be discussed later in Chapter 6 as well as possible reasons for the findings and the implications of these results.

Summary

As demonstrated in this chapter, the study used numerous variables and a variety of statistical analyses to examine the relationship between efficiency and quality of nursing home care and to determine the characteristics of nursing homes that achieve high quality and high efficiency. The descriptive analyses provided information about the study's variables as well as a comparison of the study sample (1,430 nursing homes) and study population (14,307 nonhospital-based nursing homes with 20–360 beds an an occupancy rate higher than 5%). Additional analyses included DEA to obtain efficiency scores for nursing homes, structural equation modeling for hypotheses testing, and logistic regression analysis to view the characteristics of efficient nursing homes that provide high quality services.

The DEA results revealed that the average efficiency score in the sample was 0.854, with 373 nursing homes having a score of 0.96 or higher. These facilities were coded as efficient nursing homes. The cutoff point of 0.96 was chosen as being closest to the fourth quartile of efficiency score distribution. Based on the DEA results, the environmental factors associated with high efficiency are high excess demand in a

county, a high number of registered nurses, and a higher average annual personal income in a county. Quality measures associated with a high efficiency score are the use of physical restraints, the Pneumococcal vaccination rate, pain management, bedfast residents, bladder incontinence, and unplanned or significant weight loss or weight gain. The *t*-test results for efficient and inefficient nursing homes in the sample are provided in Table 14.

The total quality score for the nursing homes in the sample was calculated based on a comparison with the national average value for all 11 quality measures used in the study. The average total quality score in the study's sample was 6.22 (*SD* = 1.888). Among the sample, 370 (25.9%) nursing homes scored 8 or higher, which was coded as high quality. The cutoff point was chosen as closest to the fourth quartile of total quality score distribution. A comparison between nursing homes with low and high total quality scores revealed a statistically significant difference for variables representing the level of competition in a county, the number of registered nurses in a county, and the average annual personal income in a county. The *t*-test results for the sample's nursing homes with high and low quality scores are provided in Table 17.

The hypotheses of the study were tested by structural equation modeling (SEM), using the LISREL 8.8 statistical program. Out of nine hypothesized relationships, three hypotheses had statistically significant path coefficients supporting the hypothesized direction. Hypothesis 1, which assumes a higher level of competition in the market is associated with higher efficiency of nursing homes, was supported in the analysis. A DEA score was used in the study to measure nursing home efficiency. Measures used for

competition were the Herfindahl-Hirschmann index, the number of substitutes in the market, and location. Based on the SEM results, competition positively affects efficiency, with a path coefficient 0.09 (*t*-value = 2.65). SEM results also supported Hypothesis 6, which assumes a stronger position of payers in a market relative to nursing home providers is associated with higher process quality of nursing home services. Measures used for payers' position were the percentage of Medicaid residents in a county, the presence of a Pay-for-Performance program, and the average annual income in a county. Measures for process quality were the percentages of nursing home residents with catheters, with physical restraints, who received a Pneumococcal vaccination, who received an influenza vaccination, who were on a pain management program, and who had pressures sores or ulcers. The SEM analysis showed that a stronger position of payers in the market positively affects process quality of care, with a path coefficient of 0.15 (*t*-value = 2.48). Finally, SEM results also supported Hypothesis 9, which assumes higher efficiency of nursing homes is more likely to be associated with higher outcome quality. Measures for outcome quality were the percentages of nursing home residents who were bedfast or in a chair, showed signs and symptoms of depression, had bladder incontinence, had bowel incontinence, and had unexpectedly lost or gained weight. The SEM analysis showed that efficiency positively affects outcome quality of care, with a path coefficient of 0.06 (*t*-value = 1.99).

Structural equation modeling also revealed other statistically significant path coefficients among the study's hypotheses, but with an opposite direction of relationship. The analysis showed a positive relationship (not the assumed negative relationship in

Hypothesis 4) between munificence and efficiency, with a path coefficient of 0.07 (*t*-value = 3.26), The munificence variable was measured in the study by a county's population over 65 years old, excess demand in a county, the number of registered nurses in a county, and the number of unemployed people in a county. The SEM analysis also showed a negative relationship (not the assumed positive relationship in Hypothesis 5) between payers' position and efficiency, with a path coefficient of –0.05 (*t*-value = –2.06). Finally, the SEM analysis also revealed a negative relationship (not the assumed positive relationship in Hypothesis 8) between efficiency and process quality, with a path coefficient of –0.20 (*t*-value = –2.95). The path coefficients and corresponding *t*-values for all nine of the study's hypothesized relationships are provided in Table 19.

The study also included further analysis to determine the characteristics of nursing homes that display high efficiency and high quality of services. In the sample, 106 (7.4%) facilities were defined as "high performers," based on their high efficiency score and high total quality score. Logistic regression was performed to analyze factors that influence the probability of being a high performer. Coefficients for logistic regression on high performing facilities in the study's sample are provided in Table 20. A more complete discussion on the results of the logistic regression analysis is presented in Chapter 6.

In addition to further discussion on the purpose, methods, findings, and limitations of the study, Chapter 6 presents the implications and conclusions arising from the results. The chapter also offers recommendations for future research.

CHAPTER 6: DISCUSSION AND CONCLUSIONS

This chapter offers a brief summary of the study, addressing its purpose, theory, design, and methods. The summary is followed by a review of the research questions and their respective hypotheses. Consideration is given to performance analysis, practice and policy implications of the findings, and theoretical implications of the findings. Contributions arising from the study to the body of knowledge of health services research are discussed. Limitations to the study are enumerated, and areas of future research are suggested. Conclusions arising from the study's key findings are also offered.

Summary of the Study

The purpose of this study is to examine the relationship between the efficiency of nursing homes and the quality of services as well as to analyze the characteristics of efficient facilities that provide high quality care. The statistical analysis model was created using Donabedian's Structure-Process-Outcome model and the resource dependence theory as the general framework. Structural equation modeling was used to test the study hypotheses, which examined the relationship between environmental factors and efficiency and the quality of nursing homes. A logistic regression model examined the relationship between high performance, measured as high efficiency and high quality of care, and facility and market characteristics. As a measure of efficiency,

the study used an efficiency score calculated by Data Envelopment Analysis (DEA) for an input-oriented model with constant returns to scale. The unit of analysis for the study was a nursing home; the market for a nursing home was defined as the county in which the facility is located.

In this study, environmental factors (competition, munificence of resources, and payers' position) were viewed as latent variables, presented by a number of indicators. Competition was represented by three observed variables: the Herfindahl-Hirschmann index for market concentration, the number of substitutes in the market, and the rurality index (location). Munificence was represented by the number of the population over 65 years old per nursing home bed, the number of registered nurses per nursing home bed in the county, the unemployment, and excess demand, measured as the percentage of empty nursing home beds. Payers' position was represented by three observed variables: the proportion of Medicaid residents in the market, the average annual personal income, and the presence of an active Pay-for-Performance program for nursing homes in the state where a nursing home is located.

Dependent variables in the study (efficiency, process quality, and outcome quality) were also viewed as latent variables, presented by a variety of indicators. The latent variable for efficiency had only one indicator, an efficiency score calculated by a DEA input-oriented model with constant returns to scale. Process quality was represented by the percentage of residents with catheters, with physical restraints, with pressure sores/ulcers, who received a Pneumococcal vaccination, who received an influenza vaccination, and who were on a pain management program. Outcome quality was

represented by the percentage of residents with depression, with bladder incontinence, with bowel incontinence, with unexpected weight change, and who were bedfast or in a chair all or most of the time.

The study model also included an acuity index as the control variable and latent variable for the structure of a nursing home, represented by size (number of beds), system membership, ownership status, and the number of registered nurses, of licensed practical nurses, and of nurse aides. Structure was included in the model to assure proper analysis, but no hypotheses were developed in relation to the structure of a nursing home.

Discussion of Hypotheses and Research Questions

This section presents the hypotheses and research questions in relation to the results of the statistical model. The study has two research questions:

1. What is the relationship between the quality of care and the efficiency of nursing homes?
2. What are the characteristics of efficient nursing homes that provide high quality services?

In this chapter, the hypotheses are discussed in clusters that relate to the respective research questions to which they are related. This is because the hypotheses are so interrelated that an independent discussion of each one may not lead to optimal meaning. Thus, in this chapter and for the purpose of a meaningful discussion, the hypotheses are clustered as follows:

Market competition: H1, H2, H3

Munificence: H4

Payer position: H5, H6, H7

Structure, process, outcome: H8 and H9

The first research question was addressed in hypotheses H1 through H9. The hypotheses of the study were tested by structural equation modeling, using the LISREL 8.8 statistical program. (The path coefficients and corresponding *t*-values are provided in Table 19 of Chapter 5.)

The general fit of the model was measured by the comparative fit index (CFI = 0.76) and by the composite reliability index for endogenous latent variables. The index scores were adequate. The choice of indicators, however, may present some questions, which are discussed later in this chapter.

As stated by the resource dependence theory, the intensity of market competition is an important environmental factor (Zinn et al., 1998). In the nursing home market, facilities may respond to higher levels of competition by improving the quality of services and/or efficiency as a differentiation strategy. Based on these factors, the study hypothesized a positive relationship between market competition and nursing home efficiency and between market competition and the process and outcome quality of care.

H4. A higher level of competition in the market is associated with higher efficiency of nursing homes.

H5. A higher level of competition in the market is associated with higher nursing home process quality of care.

H6. A higher level of competition in the market is associated with higher nursing home outcome quality of care.

Only one of the hypotheses related to the level of competition, H1, was supported by the statistical results in the study. The level of competition was measured by the Herfindahl-Hirschmann index, the number of substitutes in the market, and geographical location. Study analyses of these measures indicated that the level of competition is associated with higher efficiency of nursing homes. The statistical model for the study found a positive relationship between competition and efficiency of nursing homes, with a path coefficient of 0.09 (*t*-value 2.65). Although the path coefficients relating competition with process (H2) and with outcome quality (H3) were positive (0.08 and 0.04, respectively), the results were not statistically significant.

An assumption in the study's theoretical framework was that munificence affects nursing home behavior. That is, in a situation with lower availability of resources, an organization must improve efficiency in order to secure resources. For example, if a nursing home does not have a sufficient number of nurse aides available, it has to find a way to become more efficient with the staff it has. Therefore, based on this assumption, the study hypothesized that lower availability of resources in a market is associated with higher efficiency of nursing homes.

H4. A lower availability of resources in a market is associated with higher efficiency of nursing homes.

The study's results, however, did not support Hypothesis 4. In fact, findings suggested a positive relationship between the availability of resources and efficiency, with a coefficient of 0.07 (*t*-value = 3.26). That is, according to the study's findings, in markets with higher availability of resources (e.g., greater availability of people to fill

nurse aides positions, due to higher unemployment rates; or greater availability of potential residents, measured as the number of the population over 65 years old per nursing home bed), nursing homes have higher efficiency.

The nature of the measures employed may provide some explanation for this counterintuitive finding regarding the availability of resources and efficiency of nursing homes. Because unemployment is often related to tight economic conditions, it may also result in an increase of efficiency. Thus, a poor economy results in both unemployment and the need to increase efficiency. The number of registered nurses in a market, on the other hand, represents resource availability, but the availability of registered nurses does not take into account the current rate of employment of the nurses. For example, a county with a large hospital may have a relatively high number of registered nurses, but the actual availability of registered nurses for a nursing home in the same county might be low. It may be reasoned, therefore, that the presence of a large hospital near a nursing home may provide an incentive for higher nursing home efficiency.

Another munificence measure in this study was that of excess demand. The initial choice of this variable was based primarily on its use in the healthcare research literature, such as in the works of Nyman (1989), Grabowsky and Castle (2004), and Konetzka et al. (2004). Although the researchers used varying measures of excess demand, such as the percentage of empty beds in the market (Nyman, 1989) or the number of empty beds per 1,000 individuals in a population (Grabowsky & Castle, 2004), all of the researchers agreed that these variables are proxy measures for excess demand, which could be measured more directly by waiting lists for nursing homes. Both proxy measures of

excess demand in fact present the usage of nursing homes. Therefore, instead of measuring the number of potential residents who can occupy the beds immediately when beds are available, these indicators represent an average occupancy rate or availability of beds. In both cases, the use of these measures as indicators of munificence is questionable, because it can be argued that munificence should represent resources available for nursing homes in the market, not the results of their activity.

As one of the major forces in the nursing home environment, payers provide necessary resources. However, payers also may demand higher quality of services or may require lower price levels, both of which may affect a nursing home's performance. Following the resource dependence framework, the study hypothesized that a stronger position of payers in a market relative to nursing home providers is associated with higher efficiency of nursing home services, as well as with higher process and outcome quality of care.

H5. A stronger position of payers in a market relative to nursing home providers is associated with higher efficiency of nursing home services.

H6. A stronger position of payers in a market relative to nursing home providers is associated with higher process quality of nursing home services.

H7. A stronger position of payers in a market relative to nursing home providers is associated with higher outcome quality of nursing home services.

Results in the study supported only one of the hypothesized relationships regarding payers' position: H6. According to the study's findings, a stronger position of payers in the market (measured as the percentage of Medicaid residents, the presence of a

Pay-for-Performance program, and the average annual income) positively affects process quality of care (path coefficient = 0.15, *t*-value = 2.48). The effect of payers' position on outcome quality was small and insignificant. Results also revealed a statistically significant negative relationship between payers' position and nursing home efficiency (path coefficient = –0.05, *t*-value = –2.06). Two possible explanations of the unexpected relationship between the variables are discussed below.

One of the indicators of payers' position that raises concern is the presence of a Pay-for-Performance (P4P) program for nursing homes. In general, P4P is planned as a tool to increase nursing home incentives for better performance; however, the programs differ among the states in terms of measures used for good performance. Among the indicators are direct care staffing, special dementia units, high Medicaid utilization, occupancy rates, staff turnover, survey results, residents' satisfaction, and council resolution rates (Henshaw, n.d.). Some of these indicators are likely to be related to the quality of care, such as staffing, staff turnover, or survey results; for others, such as special dementia units, the relationship to quality of care or nursing home efficiency is not clear. Therefore, the effect of the presence of a P4P program on the quality and efficiency of nursing homes is also questionable.

Nursing homes can aim their efforts at improving quality as a way to satisfy the payers in the market; however, the value of efficiency to payers is not so clear. First, the chosen measure of efficiency—the efficiency score calculated by DEA—may differ from the definition of efficiency help by payers. For example, one of the indicators provided on the Nursing Home Compare Web site (www.medicare.gov/NHCompare/) is the

number of nursing staff hours per resident day, with the assumption that a higher number of hours represents better quality. This assumption is generally supported by healthcare research on the relationship between staffing and quality of care, as described in Chapter 2. On the other hand, the same measure may be viewed as an input-over-output ratio, or as an efficiency measure with opposite direction, when a higher number represents lower efficiency. Thus, if payers' concern about high quality is accommodated by a nursing home, it may result in lower efficiency, which may explain the negative coefficient between payers' position and the efficiency of nursing homes.

Thus, only two of the study's seven hypotheses derived from the resource dependence theory were supported by the study's results: H1 and H6, which address the association between competition and efficiency and between payers' position and process quality of services, respectively. The last two hypotheses of the study, H8 and H9, were based on Donabedian's Structure-Process-Outcome (SPO) model.

Donabedian's SPO framework predicts a causal relationship between the structure, process, and outcome components of quality; therefore, this study hypothesized a positive relationship between the efficiency of nursing homes and process quality (H8) and between the efficiency of nursing homes and outcome quality (H9). The study hypotheses rely on Donabedian's SPO model to predict causal relationships between process and outcome. This study defines efficiency as a process component of an organization, as described in Chapter 3.

H8. Higher efficiency of nursing homes is more likely to be associated with higher process quality.

H9. Higher efficiency of nursing homes is more likely to be associated with higher outcome quality.

The study results supported the hypothesis of a positive relationship between efficiency and outcome quality (H9), with a path coefficient of 0.06 (*t*-value = 1.99). However, the analysis found a negative relationship between efficiency and process quality, with a path coefficient of –0.20 (*t*-value = –2.95). Efficiency is generally viewed as an input-to-output ratio, and an increase in efficiency means either a decrease in inputs or an increase of outputs. This study used the number and type of personnel and the number of beds as inputs; the outputs for the model were the number and type of residents by payer source. Therefore, the negative relationship between efficiency and process quality may be explained by the nature of both the efficiency measure and process quality measures. Efficiency increases if a nursing home has, for example, fewer nurses per resident. However, better process quality (e.g., less catheter use) requires more personnel time per resident. Thus, higher efficiency may lead to lower process quality. At the same time, the statistical results in this study supported H9, demonstrating a positive relationship between efficiency and outcome quality.

The relationship between process quality and outcome quality was beyond the scope of this study; nevertheless, the path between process quality and outcome quality was included in the model to insure proper model structure. Based on the study's results, process quality was negatively related to outcome quality, with a coefficient of 0.11 (*t*-value = 3.08). This finding may require additional analysis in future research.

Thus, a notable question remains regarding the relationship between payers' position, efficiency, and process quality, with the possibility of a mediating effect of efficiency in the study's model.

Performance Analysis

The study did not have any hypotheses directly related to the analysis of nursing home performance, but an exploratory analysis was performed to investigate the factors affecting nursing home quality and efficiency. The analysis is described in Chapter 5. The study defines a nursing home as a high performer if the nursing home has an efficiency score of 0.96 or higher and has a quality of care measure higher than the national average for 8 of 11 indicators. Both cutoff points are close to the fourth quartile. The analysis indicated that only 7.4% of nursing homes in the sample could efficiently provide high quality services, which was defined as high performance in the study.

Logistic regression was performed to find the factors that affect high performance. Independent variables in the analysis reflected both environmental factors and certain organizational characteristics. The choice of environmental factors was based on the same assumptions as for hypotheses testing: Measures of competition, munificence, and payers' position as factors may affect the likelihood of high performance.

An acuity index was inserted in the model as a control variable. In order to facilitate the interpretation of the logistic regression coefficients, most of the variables were transformed into binary variables. The description of the binary variables used for

logistic regression is presented in Table 11 of Chapter 5. An additional variable, size group, is presented in Table 12 of Chapter 5.

Among the factors that demonstrated statistically significant coefficients in the regression were the size of a facility, the availability of registered nurses, excess demand, and for-profit status. Coefficients for the logistic regression model are presented in Table 20 of Chapter 5.

According to the results of the regression, nursing home size is negatively related to the probability of high performance; thus, with an increase in one size group level, the likelihood of being a high performer for a nursing home decreases by about 25%. For-profit facilities, compared to those in the category of not-for-profit and governmental facilities, have a 45% lower likelihood of being high performers. Because high performance in this study was defined as both high efficiency and high quality of care, these results were notable.

According to the literature, for-profit status is often related to poorer quality of care, while not-for-profit status is related to lower efficiency. However, the results of the current study's analysis did not support the findings of the study by Anderson et al. (2003), in which the authors found that "controlling for quality, the profit status of the firm and room utilization rates are positively related to efficiency" (p. 43), as measured by a DEA score. This difference in findings may be due to Anderson et al. using different quality measures (e.g., inspection scores), study sample (Florida only), and inputs and outputs for the DEA analysis (e.g., financial data, bed days).

Two market characteristics in the present study were statistically significant relative to high performing nursing homes: the number of registered nurses per nursing home bed and the county level occupancy rate. Nursing homes in counties with more than 1.73 registered nurses per nursing home bed had a 45% lower likelihood of being high performers. As discussed previously, the number of registered nurses is not a clear measure of resource availability. Thus, the measure required additional adjustments.

Higher excess demand, measured as the percentage of empty nursing home beds in a county, was strongly associated with lower chances of nursing homes being high performers ($exp(B) = 0.278$, $p < 0.001$).

Although other variables in the regression were not significant, the lack of significance may be viewed as a useful finding. For example, the location, unemployment rate, number of substitutes in the market, and percentage of Medicaid residents in the county were not found to be significant, which might indicate that high performance may be achieved anywhere.

Practice and Policy Implications

Concern about accelerating healthcare expenditures emphasizes the need to provide care in the most efficient way, which means providing services with the best possible input-to-output ratio. However, higher efficiency of an organization should not compromise the quality of the services provided. Thus, this study addressed both quality and efficiency.

The study provides evidence of the trade-off between efficiency and process quality, in which higher efficiency of a nursing home is associated with lower process

quality of care. Findings in the study also suggested that higher efficiency is associated with higher outcome quality. Recently, the Centers for Medicare and Medicaid Services (2008) launched a demonstration of the Nursing Home Value-Based Purchasing project, which includes numerous performance measures. Findings from the current study may serve as important resources in assessing the contribution of the project and considering the measures used with relation to the project's incentives.

Scale proved important. A notable finding in this research suggests that providing high quality care may be more likely in smaller nursing homes than in larger ones. Furthermore, there were a sufficient number of smaller nursing homes that were efficient to argue that smaller nursing homes need not be inefficient. The findings cannot support a recommendation that owners of nursing homes build only small facilities in the future nor that regulators and payers favor smaller nursing homes. There are, however, considerations to be given, at both practice and policy levels, to the matter of scale as an important factor in assuring high quality care.

Another implication arising from the findings of this study has to do with how the methodology potentially impacts residents and their families. These are populations who have a vested interest in cost and quality of care. They would profit from the establishment of a service that guides them in their search for an optimum intersection between cost and quality at the level of individually identified nursing homes. The results of this study suggest that it is feasible to apply the methodology at the county level to create a cost/quality profile for individual facilities, thereby informing the purchasers of nursing home services in a way not previously available.

Similarly, state and federal level regulators who are concerned with efficiency and quality may find the methodology useful in their work. This applies also to third party payers, both private and public.

Theoretical Implications

Because this study used the resource dependence theory in combination with Donabedian's SPO model as a general framework, it did not set out to prove either of the two approaches. Nevertheless, the effect of competition, which is viewed in the resource dependence theory as a predictor of organizational behavior, was supported in the study's finding that higher market competition leads to higher efficiency of nursing homes. According to the resource dependence theory, power is also an important factor. The power factor was partially supported in the study's analysis, in which a stronger payer position was positively correlated with process quality but negatively correlated with efficiency. Although the study's results supported two hypotheses derived from the resource dependence theory (H1 and H6), five hypotheses derived from the theory were not supported (H2-H5, H7). Additionally, although the effect of environmental factors on organizational structure was not included in the hypotheses, findings from the study confirmed the relationship between the structure of a nursing home and competition and payers' position.

On the other hand, a relatively low number of supported hypotheses raises a concern of the applicability of the resource dependency theory to the study questions. Additional analysis is necessary to determine if the difference between the hypothesized

relationship and the results of the statistical model is related to the choice of indicators, representing latent variables, or is related to the choice and interpretation of the theory.

Using efficiency as an additional measure of process for Donabedian's SPO model, the study's results indicated a complicated relationship between nursing home efficiency and quality. Although all three SPO relationships were not hypothesized in the study (only process and quality), the statistical model included the path from structure to process quality and from process quality to outcome quality in order to assure proper model assessment. Indeed, findings confirmed the effect of structure on outcome quality, with a coefficient of 0.11 (*t*-value 3.08). In addition, the results of structural equation modeling revealed a complex relationship between efficiency and quality of care, as described previously in the discussion of the study's hypotheses. The negative effect of efficiency on process quality, which can be explained by the nature of both variables, emphasizes the importance of understanding the mechanisms of nursing home performance.

The study provides a good example of combining two theoretical frameworks to examine nursing home efficiency and quality of services and to identify the characteristics of efficient facilities that provide high quality care. Donabedian's SPO model used in combination with the resource dependence theory resulted in a statistical model that allowed an adequate statistical fit for assessing the study's hypotheses.

Contribution to Health Services Research

The study's contribution to the body of knowledge is noteworthy. Compared to most of the previous studies reviewed in the literature, the present study combined both

efficiency measures and quality measures for analysis. In addition, one of the key features of the study is the use of structural equation modeling (SEM) for simultaneous assessment of the complex relationship between environmental factors, efficiency, and quality measures. Although SEM is used primarily in the field of social sciences, the present study provides evidence that the SEM methodology can be successfully applied to research in the health services field.

The study's success in combining the use of Donabedian's SPO model with the resource dependence theory is another significant contribution to health services research. Certainly, the SPO model is widely used in healthcare research, in a broad sense, and in studies of nursing home quality. However, previous investigations included a limited number of quality indicators. In contrast, the present study used the SEM opportunity to analyze a number of quality indicators, grouped as process measures and outcome measures. The study also introduced nursing home efficiency in the SPO model to analyze the interplay of efficiency and quality of care. The study findings revealed a complex relationship between nursing home efficiency and quality of care. Although findings suggested that efficiency is positively related with outcome quality, results also indicated that efficiency has a negative relationship with process quality measures. The possibility of a trade-off relationship between efficiency and quality requires additional analysis in future studies.

Limitations

The study's limitations are related to data sources, the choice of variables, and methodology. Although the Online Survey, Certification and Reporting (OSCAR)

database was listed as the most reliable source of nursing home information by some researchers (e.g. Zhang and Wan , 2005), Kash, Hawes, and Phillips (2007) warned that certain types of personnel may be over-reported in the OSCAR database, compared to other sources. Furthermore, Konetzka et al. (2006) noted that OSCAR data are available only at the facility level, consist of self-reported data, and do not allow for extensive case-mix control. Despite these warnings, the OSCAR database was used in the present study under the assumption that possible errors are distributed evenly among the facilities.

Bostick et al. (2006) also warned about the inconsistency of state surveyors, which may lead to inconsistent deficiency scores given to nursing homes. Although this concern might be a serious problem for some research, the variables in this study were constructed on quality measures, not on deficiency scores, and, therefore, were not susceptible to bias.

The quality score for this study was calculated based on national average values, in which a nursing home in the study's sample received one point if its quality indicator was higher than the national average value. However, one could use certain standards to define a facility as high quality (e.g., a percentage of catheter use) instead of relying on average values. Also, due to data availability, the study variables did not distinguish between high-risk and low-risk residents for certain quality measures, such as residents with pressure sores/ulcers. Furthermore, the study's list of quality measures was not comprehensive because it did not include other important indicators, such as the prevalence of urinary tract infections.

Another limitation is the study's use of variables that represent environmental factors in nursing homes. Environmental factors must be reviewed with care. As described earlier in this chapter, additional variables are required in some cases for better analysis of environmental factors. For example, if other healthcare employers are not taken into account, the number of registered nurses is not likely to be an accurate measure of nurses' availability.

The study's limitations also concern methodology. Although SEM is a powerful statistical method, model evaluation in the SEM process cannot exclude the possibility of equivalent models, or models that provide the same fit statistics with a different path structure. Although the study's SEM model was built on the SEM theory and included logical paths for assessment, the probability of an equivalent SEM model with different path structures still exists.

Another concern with the study's methodology is related to the cutoff point for the DEA efficiency score to define efficient facilities. The study used the fourth quartile; however, it is difficult to determine if a significant difference exists between nursing homes with efficiency scores of 0.96 and 0.955. The same concern may be raised for a quality score, defined as 8 or higher. Additional studies that include sensitivity analysis are needed to analyze the potential difference caused by the choice of a particular cutoff mark.

Areas of Future Research

Several directions are recommended to further the findings of this study. For example, the division between high performers among the study's nursing home sample

was based mostly on the fourth quartile of variable distribution. There is a possibility, that some of the nursing homes in this study were marked as low performers, although the difference in either the efficiency score or the quality score was small. Therefore, further research is needed to analyze if the results of the study depend on the choice of a particular cutoff point. It would be useful also to see if there is a difference between clearly inefficient facilities and facilities that are in the middle of or on the bottom of the score distribution. The same group division is applicable to the quality score, which would allow a comparison of high performers with medium and low performers, applying multivariate logistic regression.

The size of a nursing home, represented by the number of beds in a facility, was one of the most persistent factors in all of the current study's analyses. Thus, another area of research might consider a similar analysis for separate groups of nursing home size.

Another recommended topic for future research is the choice of variables and latent variables. For example, this study used the percentage of Medicaid residents in a U.S. county to assess payers' position. It is unknown if higher Medicaid payments affect nursing home behavior. Most of the research in the literature assumed that private pay residents are the most lucrative payers and, therefore, are the most attractive residents for nursing homes. Because Medicaid payment rates differ from state to state, it would be useful to see if there is a difference between states with Medicaid payments significantly lower than the average private rate and states with Medicaid payments close to the average private rate.

Because DEA is a comparative technique and because an efficiency score may be calculated for only a particular sample of nursing homes, nursing home administrators are not likely to use DEA scores for efficiency assessment. Further analysis is needed to compare a calculated efficiency score with a variety of other efficiency measures that are easier for managers to obtain and employ (e.g., registered nurses' daily hours per residents).

Wan et al. (2006) recommended using multilevel modeling to investigate nursing home quality, which incorporates resident-level data with facility-level data. With proper modification, a study model that includes resident-level data may enrich the research.

The current economic crisis in the United States may likely change certain environmental characteristics, such as the nation's unemployment rate or average annual income. The effect of these changes on the use of nursing homes can be multi-directional. In some cases, the increased unemployment rate may provide an opportunity to take care of the elderly at home; in other cases, the decrease in assets, especially among the elderly, may lead to Medicaid eligibility and an increased opportunity to enter a nursing home. Due to the variety of potential economic changes that will likely affect the long-term care industry, the relationship between the efficiency of nursing homes and the quality of services remains an important area of future research.

Conclusions

The study analyzed the effect of environmental factors (market competition, the availability of resources, and payers' position) on nursing home efficiency and quality of care. The study also determined the characteristics of the high performing nursing homes

that efficiently provide high quality services. Structural equation modeling provided support for three of the study's hypotheses, relating market characteristics to the quality of care and efficiency of nursing homes.

Assessment of the effect of some environmental factors on nursing home efficiency and quality revealed that a higher level of competition is positively related to the efficiency of nursing homes; however, the effect of competition on the quality of care is not significant. A stronger payers' position is positively related to process quality of care. The study found a complex relationship between quality measures and efficiency: although efficiency is positively related to the outcome quality, efficiency negatively affects process quality. It is important for healthcare and nursing home policymakers to take into account this relationship in order to obtain an optimum level of efficiency without compromising the quality of care.

Summary

This chapter presents a summary of the study findings and their interpretation in relation to the study hypotheses. The chapter addresses also the practice, policy and theoretical implications of the study findings, as well as study limitations and areas of future research.

The findings of the study provide a contribution to understanding the relationship between efficiency of nursing homes and the quality of care provided. The possibility of a quality and efficiency tradeoff should be considered in policy making related to nursing home care, such as requirements for value-based purchasing systems or performance assessment.

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