

An Examination of the Impact of Medical-Surgical Nursing Unit Configuration on
Nurses' Communication Using Space Syntax Theory

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As a healthcare interior designer, I have been fortunate to gain experience in designing nearly every type of space within a healthcare facility. Throughout each project, a key theme for all design decisions developed around patient-centered design. Many times during the design process, I found myself asking, “what does that do for the staff?” or “what could be done to make nurses more comfortable, efficient, and safe?” It was around this time in my professional life that I began my journey in pursuit of a master’s degree to explore these issues in greater detail.

This topic developed over several months as I started to explore the work environments of nurses. Each class was instrumental in helping me take a step closer to narrowing this topic and I am grateful for all the insight provided by the instructors.

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DEDICATION

This thesis is dedicated to the special people in my life who offered their support during this process. First, I'd like to extend a dedication to my parents for their constant encouragement. Thank you for always believing in me and giving me the extra push when I needed it. I could not have done this without you. I would like to offer a special dedication to my mother, a registered nurse of 30 years. Ever since I was young, I have looked up to you for your skills and dedication to nursing. When I think back to very early discussions on this topic, I was inspired by you and wanted to find ways, as a designer, to create better work environments for all nurses. This study was a small step toward achieving that goal, but I hope architects and designers will also be inspired by nurses like you to design better environments for nurses everywhere.

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ABSTRACT

The work environment of nurses is complicated, stressful, detail-oriented, and influences patient outcomes. Communication between nurses and members of the patient care team is critical to the delivery of quality healthcare and also builds social support among nurses. This exploratory study focuses on the influence of medical-surgical nursing unit design on nurses' communication. Space syntax theory was used as this study's theoretical framework and explored for its applicability to the study of medical-surgical nursing unit design.

This study was conducted in three parts: 1) a comprehensive literature review, 2) a review of medical-surgical nursing unit floor plans for two constructs of space syntax theory (visibility and accessibility), and 3) informal, semi-structured interviews. Findings of this exploratory study's literature review indicate that the majority of research focusing on the work environment for nurses in an urban medical-surgical nursing unit is quantitative, and therefore lacks a rich description of the nurses' perspectives of their work environments. Based on the literature review, the following findings were identified in the context of space syntax theory a) a relationship exists between the variables of the designed environment and interpersonal communication; b) the layout configuration of medical-surgical nursing units affects nurses' communication and social support; and c) medical-surgical nursing unit plan configurations vary and may not always reflect available quantitative research.

The initial findings from the floor plan analysis indicate that space syntax theory applied to the study of healthcare environments may create confusion due to the

complexities of the theory's constructs and study methods. Interviews provided several personal experiences and, upon initial review, may provide contradictory information to the earlier findings of space syntax theory.

This study seeks to build a foundation of knowledge for future qualitative research using space syntax theory for the study of medical-surgical nursing unit design's influence on nurses' communication.

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CHAPTER 1. INTRODUCTION

Background and Context

The delivery of healthcare affects our lives. We depend on healthcare services to maintain healthy lifestyles, manage diseases, and overcome illnesses. The quality of healthcare delivery is influenced by external factors such as regulations and insurance reimbursements, and internal factors such as organizational culture, staff efficiencies, and patient safety initiatives (Erenstein & McCaffrey, 2007; MacDavitt, Chou, & Stone, 2007). Since the publication of the 1999 Institute of Medicine's (IOM) *To Err is Human*, the need to reduce medical errors has been recognized, subsequently receiving much needed public attention. In response to the public attention over the past 10 years, most hospitals in the United States have adopted a patient-centered organizational approach with the primary goal to reduce medical errors (Institute of Medicine, 2004c; Joseph, 2006; Reiling, Hughes, & Murphy, 2009; Stone, Hughes, & Dailey, 2008).

Patient-centered approaches range from patient-focused services such as same-day surgery to improved facility designs that include single patient rooms. This shift in focus has resulted in positive adjustments for our healthcare delivery system that include improved patient outcomes, reduced medical errors, and improved patient satisfaction ratings (Reiling, Hughes, & Murphy, 2008; Schweitzer, 2004; Stone, Hughes, & Dailey, 2008; Ulrich & Zimring, 2004; Ulrich, et al., 2008).

These improvements have also greatly impacted the patient care environment, but sometimes to the detriment of those who provide the care. For example, the change from

double patient rooms to single patient rooms has been shown to help decrease medical errors and nosocomial infections (Ulrich et al., 2008); however, this design change has made new inpatient nursing units larger with longer corridors, which subsequently increases walking distance for nursing staff and members of the patient care team (Hendrich, Show, Skierczynski, & Lu, 2008; Ritchey & Pati, 2008).

The Importance of Nurses to the Delivery of Healthcare in Hospitals

Nurses are some of the most important professionals responsible for the delivery of quality healthcare in hospitals (Browne, 2009; Clarke, 2007; MacDavitt et al., 2007). There are nearly 5 million nurses in the United States (Bureau of Labor Statistics, 2009); and of them, 2.5 million are registered nurses. Approximately 59% of registered nurses work in hospitals (Bureau of Labor Statistics, 2009). The growth rate for this occupation is expected to grow at a much faster rate than many other occupations through 2016 due to the greater number of health issues presented by the aging population (Bureau of Labor Statistics, 2009).

A nursing shortage is present in U.S. healthcare. Concern of the shortage will continue as the need to not only replace experienced nurses leaving the occupation due to retirement and stress, but also as the growing healthcare industry attempts to fill the increasing need for nurses.

Nurses are very versatile, shown by their ability to treat patients, educate patients and the public about health issues, provide emotional support to patients and their families, document medical histories, perform diagnostic tests, and administer treatment and medications (Bureau of Labor Statistics, 2009). Nurses are the only healthcare

professionals in a hospital to be involved with direct patient care 24 hours a day, 7 days a week (Clarke, 2007).

Recurrent themes in nursing literature have routinely explored the effect of stress on this profession, which has been identified as a damaging factor to the delivery of quality patient care (Browne, 2009). The organizational work environment of nurses can contribute to employee stress outcomes such as occupational health, job satisfaction, and decisions to leave a job or profession entirely (MacDavitt et al., 2007). Recent attention has focused on investigations to determine how healthcare organizations can improve the work environment for staff and healthcare professionals, including physicians, therapists, pharmacists, and nurses, among others.

The work environment of nurses includes organizational factors such as management, schedules, shiftwork, and complying with guidelines (Bureau of Labor Statistics, 2009). The physical design of a nursing unit can also influence the work environment of hospital nurses. During the healthcare construction boom of the 1990s, hospital designs implemented new trends in layouts such as acuity adaptable rooms and decentralized nursing units. These designs are being studied to increase nursing time spent with the patients, reduce walking distance for nursing staff, and reduce medical errors (Ulrich & Zimring, 2004; Ulrich, et al., 2008). While there is evidence that these are positive improvements for nurses and patients, little research has been conducted on how these facility designs influence communication patterns, perceptions of social support, and overall job satisfaction relative to nurses. The majority of research on nursing communication in nursing units has been quantitative in nature. Studies that have

quantitatively measured these outcomes seldom consider the physical design of the nursing environment as a variable.

A few qualitative studies have emerged (Atwal & Caldwell, 2006; Johnson & Barach, 2008); however, further qualitative research is needed to identify how hospital nurses perceive their spaces and how their environments influence their moods, stress, and satisfaction levels. An example of using qualitative methods to study healthcare work environments is Johnson and Barach (2008). Johnson and Barach used qualitative methods examine the design of healthcare organizations, specifically “for the study of the people, processes, and patterns that make up the daily work of providing health care” (p. 191). Their research focused on the organizational factors for healthcare organizations and also mentioned the contributing influence of the physical design; however, physical design was not a major component of their study.

This chapter provides background information on why it is important to understand the nursing work environment. When caring for patients, nurses are responsible for establishing a plan of care, administering medication, recording patient information, and providing direction to other members of the patient care team (Bureau of Labor Statistics, 2009). This highly involved profession can incur emotional costs to the individual such as high stress levels due to job demands. The emotional well-being of nurses is a concern that warrants further research. In this chapter, several topics will be reviewed. First, the stakeholders of quality nursing care are discussed, then the challenges facing the nursing profession, and finally, the factors influencing the nursing work environment and how the built environment has been studied to influence human

behavior. The chapter concludes with an explanation of the intended research approach, assumptions, and research questions for this exploratory study.

Stakeholders of Quality Nursing Care

Several key stakeholders are associated with maintaining quality nursing care in hospitals (see Figure 1). The six stakeholders include patients, families of patients, healthcare professionals, healthcare organizations, communities, and society. Each stakeholder will be noted and how they are affected by the quality of nursing care will be described. The stakeholders range from a micro level, consisting of the patients and their families, and healthcare professionals, to a wider macro level, as indicated in Figure 1 by healthcare organizations, communities, and society.

An unarguable theme in healthcare literature is that patients, involved at a micro level, could be considered the most important stakeholder. Patients expect a safe visit to a hospital and associate a high level of health outcomes with the quality of their care. A visit to the hospital several decades ago used to come with trust and certainty that the patient was receiving the best care available. In today's consumer-driven healthcare market, a visit to the hospital now comes with worry and uncertainty. Hospital-acquired infections and medical errors are now among the leading causes of death in the United States (Institute of Medicine, 2000). Hospitals are dangerous and stressful environments for patients, families, and those who work in hospitals (Ulrich et al., 2008). Hospitals function 24 hours a day and 365 days a year. People who work in hospitals are subjected to the risks involved with secondary infections, physical injuries, and stressful job demands.

While encountering a stay at a hospital, families of patients are also invested stakeholders in the quality of care for their loved ones in addition to being able to maintain their daily living activities. Healthcare professionals, explicitly nurses as the focus for this study, maintain a dual interest in quality nursing care. This dual interest is found in both individuals working in a profession and the profession as a whole with a goal of advancing the practice of nursing (Clarke & Donaldson, 2008). Healthcare professionals are also invested in decreasing stress levels, creating a healthier work environment, and improving overall job satisfaction (AACN, 2005; AONE, 2004; Clark, 2009).

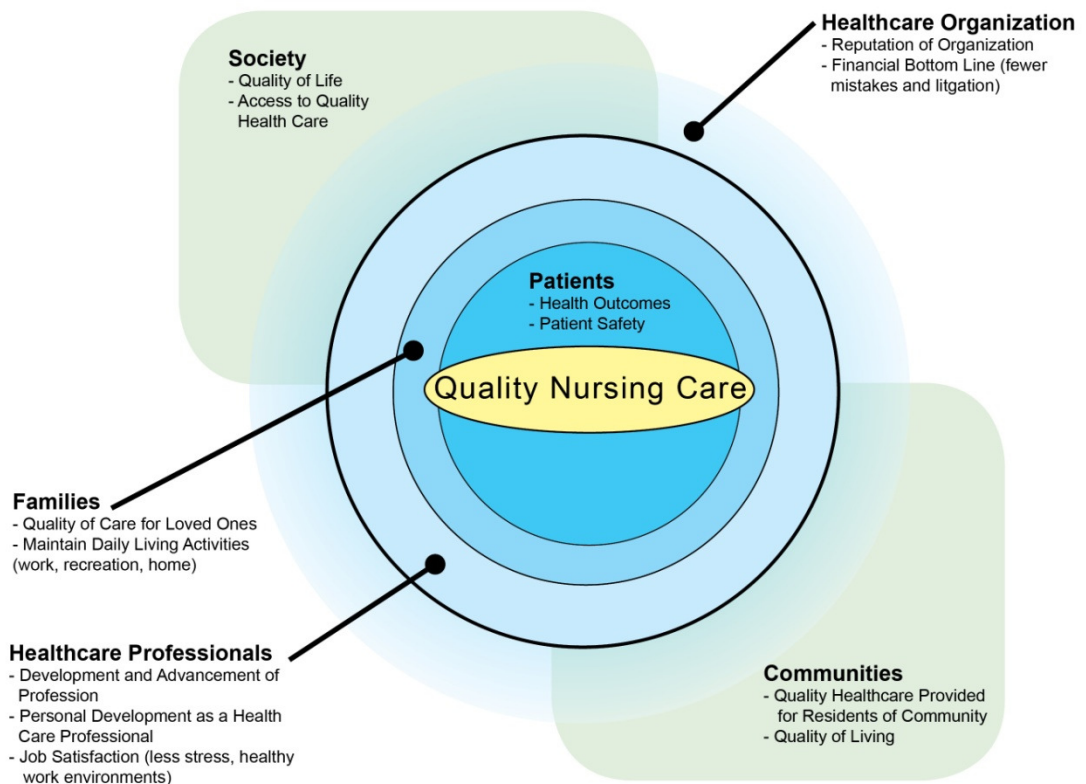


Figure 1. Key Stakeholders for Quality Nursing Care in Hospitals

As a stakeholder, healthcare organizations associate quality nursing care with their public relations. Hospitals are struggling to maintain adequate nursing levels due to declining reimbursements (insurance, Medicare, etc.) and pressures to trim their nursing budgets (Clarke, 2007). Inadequate numbers and quality of nursing staff can greatly impact patient safety issues. The recent public attention to patient safety creates a very watchful American consumer of healthcare services (Clarke, 2007). A poor quality reputation due to negative media coverage will generate a poor public perception of an organization. Hospitals with high quality reputations are associated with patients choosing to receive their care at that hospital (Romano & Zhou, 2004). And, in the case of elective procedures, where the decision of where to receive a procedure is most often decided by the patient, the patient's hospital of choice can have a huge impact on an organization's bottom line.

Communities in which the hospital is located have an interest in quality nursing care for the purposes of maintaining or advancing the quality of life for the community residents. Nurses provide preventative care and acute care to all populations of a community, including newborns, children and adolescents, adults, and the elderly (Bureau of Labor Statistics, 2009).

As the final macro level stakeholder, society holds an interest in maintaining healthcare access for improving the quality of human life and maintaining healthy, functioning societies. The United States has a well-established healthcare system, despite the shortage of available nursing staff in some areas. Some nurses choose to travel to provide care to patients in areas of the country or world where there is a shortage of

health workers (Bureau of Labor Statistics, 2009). While each stakeholder may have slightly different objectives, each is interested in quality nursing care. Moreover, the six stakeholders' views of healthcare delivery can be positively or negatively affected by their perception of the quality of nursing care. The following segment will review stakeholders' challenges to the delivery of healthcare in the United States.

Stakeholders challenging the delivery of healthcare.

Quality healthcare stakeholders have recognized that the challenges facing the nursing profession and the healthcare industry are important to patient safety (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Atencio, Cohen, & Gorenberg, 2003; Berry & Parish, 2008; Clarke & Donaldson, 2008). There is a growing awareness between the connections of qualified staffing and safety outcomes (Clarke, 2007). Despite budget issues and workforce shortages, stakeholders continue to seek improvements in the delivery of quality healthcare.

In the present era of safety report cards for hospitals, there is added pressure to improve the quality of patient care. The 2010 adverse effects report for Minnesota hospitals noted that half of medical errors didn't happen in places such as the operating room where one might expect; rather, the events occurs in environments such as inpatient rooms where new procedures are taking place (Lerner, 2010). Another example of safety reporting in Pittsburgh noted a reduction in two common hospital-acquired infections. Reasons for the decrease were attributed to better air circulation devices, isolation rooms, and greater use of private rooms (Fabregas, 2010).

The relationship between nursing activities, physical design attributes, and patient outcomes is steadily being realized as a result of patient safety reporting. With annual reports for hospitals, a reputation for quality patient care is broadcast to the public and available to those nurses seeking employment opportunities. Organizations struggling to recruit and retain qualified and experienced nurses continue to see the value of achieving high levels of quality patient care as the appropriate tactic to maintain their reputations with all stakeholders, ultimately responsible for their future success.

Challenges Facing the Nursing Profession

Quality healthcare is dependent on quality nursing care. Therefore, comprehending issues affecting the nursing profession are central to the discussion of quality healthcare in the United States. Nursing professions in the United States are a unique subculture in our society that have seen many challenges in recent years and will continue to be impacted by greater demands in the years to come (HRSA, 2004; Institute of Medicine, 2004b). Two primary challenges facing this profession are a workforce shortage and high stress due to job demands. The following segments will describe these issues, starting with the current workforce shortage.

The nursing shortage.

The nursing profession is experiencing critical shortages of available workers for all types of healthcare facilities (HRSA, 2004). This is most prevalent in the United States, impacted by an aging workforce population, decreased graduation rates, and professional burnout. The recession of the late 2000s has somewhat eased the shortage, however projections for shortages of nursing professionals is still expected to reach

260,00 registered nurses by 2025 (Buerhaus, Auerbach, & Staiger, 2009). Buerhaus and coauthors also noted this projected shortage would be twice as large as the shortage experienced in the U.S. in the mid-1960s. Several research studies have looked at the impact of nursing shortages on patient outcomes, which has led to increased efforts to retain current nurses (Atencio et al., 2003; Lynn & Redman, 2005). While low wages continue to rank as a high contributor to the shortage, other reasons cited for the nursing shortage include undesirable hours, negative perceptions of the healthcare work environment, and the perception of nursing as a non-rewarding career (Buerhaus, Donelan, Ulrich, DesRoches, & Dittus, 2007). The following segments highlight additional contributors to the nursing shortage including retirement, low graduation rates, and exiting from the profession due to high stress or burnout.

Retirement.

Changing demographics of the nursing population will have a negative impact on workforce availability. An aging workforce will soon encounter retirement and exiting from the profession at a rate that will be detrimental to the current supply and demand. This group of nurses has already worked later into their lives due to the increased demand for many healthcare services (Clarke, 2007). Many current nurses are between 50 and 60 years of age with retirement typically occurring between ages 62 and 65 (HRSA, 2004). Conversely, the number of graduates into the field is not enough to fill the expected need for nursing professionals, leaving an even greater gap of experienced nurses to handle mentoring and the high demands of this profession (HRSA, 2004).

Graduation rates.

Enrollment in nursing schools is increasing slightly, by 1.1% (Atencio et al., 2003); the projected graduation rates will still come up short to meet the workforce gap. It is believed that to meet the projected demand for nurses by 2020, U.S. nursing education programs must graduate approximately 90% more nurses relative to baseline measures, which currently show a slight decrease in graduates. There is also a concern of available nursing educators. The average age of an educator is 49 years, growing a concern of eventual mass retirement. Also, the number of nursing students in graduate programs is declining (27.5%) (Atencio et al., 2003), adding to the concern of available future educators. The number of new nursing graduates could be greatly impacted by the shortage of nursing educators.

Burnout.

The nursing profession is characterized by high stress levels due to job demands, nature of work, and working conditions (Foxall, Zimmerman, Standley, & Bene, 1990). Nursing and occupational literature have found high levels of job stress to result in feelings of inadequacy, self-doubt, lowered self-esteem, irritability, depression, somatic disturbance, sleep disorders, and burnout (Foxall et al., 1990; International Council of Nurses, 2009; Maslach & Jackson, 1986). The International Council of Nurses (ICN) identifies the six major sources of stress for nurses:

- dealing with death and dying,
- coworker conflict,
- inadequate preparation to deal with emotional needs of patient and families,
- lack of staff support,
- workload, and

- uncertainty concerning treatment plans. (ICN, 2009, para. 1).

Nurses are also exposed to stress by serving as the primary, central contact for all patient care. They interact with patients, families, physicians, nurses, social workers, and other healthcare professionals on a daily basis. The job of a nurse requires multidisciplinary communication for “the coordination of a healthy collaborative environment” (Browne, 2009, p. 257).

Under these conditions, organizations are realizing the importance of recruiting and retaining quality nursing staff and are putting efforts into improving the work environment through a multi-angle approach ranging from better work hours and policies to improved facility design (Aiken et al., 2002; Clarke, 2007; Meraviglia et al., 2008; Mrocek, Mikitarian, Vieira, & Rotarius, 2005). The challenges of a workforce shortage and high stress need to be addressed by other improvement strategies that focus on better work environments. Additional factors that influence the nursing work environment are described below.

Factors that Influence Hospital Nursing Work

The work environment of hospital nurses is chaotic, stressful, and requires careful multi-tasking to successfully carry out detailed activities. Medical errors, patient outcomes, and staff satisfaction are routinely measured outcomes for nursing. Unfortunately, constant measurement of these outcomes have been shown to increase stress levels for nurses (Aiken et al., 2002; Clarke & Donaldson, 2008) and create unhealthy work environments. An unhealthy work environment has been characterized by the American Association of Critical Care Nurses (AACN) as being associated with

medical errors, poor healthcare delivery, increased stress, professional dissonance, and decreased recruitment and retention (AACN, 2008). These outcomes are impacted by the organizational and physical work environment of nurses and are directly related to a healthcare organization's bottom line and reputation for quality healthcare.

Strategies to improve the work environment for nurses encompass organizational structure, work load, patient ratios, and psychosocial factors (Clarke & Donaldson, 2008; Parker, Axtell, & Turner, 2001; Stone et al., 2008). Of particular importance for this study is the consideration of psychosocial factors to improve social support and decrease stress for nurses. With improved social support, nurses will experience less stress and therefore be able to perform their tasks better. Methods to improve social support include a detailed look at how communication, one of the key factors to building social support, occurs on a hospital medical-surgical nursing unit. Communication among nurses is an imperative of patient care delivery (Schweitzer, 2004) and for building an efficient patient care team (Clark, 2009).

Efforts to improve the work environment are supported by goals to increase efficiency, improve patient recovery and satisfaction scores, improve communication between staff members, and retain staff (Clarke & Donaldson, 2008; Joseph, 2006; Parker, Axtell, & Turner, 2001; Stone et al., 2008). Overall work environment improvements need to be a comprehensive effort, as no single component can be successful in accomplishing these goals (Hendrich & Chow, 2008; Stone et al., 2008). To be successful, improvements to organizational and design characteristics should be considered and implemented together. Organizational improvements have been

extensively studied to improve performance and leadership, and reduce medical errors (Harrison, Henriksen, & Hughes, 2007; Meraviglia et al., 2008; Shirey, 2006). Additional approaches to improve the work environment now consider how the built environment can also impact staff efficiency and work processes, communication, and satisfaction for both staff and patients (Berry & Parish, 2008; Joseph, 2006; Mroczek et al., 2005; Paul, 2005; Pricewaterhouse Coopers, 2004; Ulrich & Zimring, 2004; Ulrich et al., 2008).

Opportunities for communication between individuals can be positively or negatively influenced by the design of a nursing unit. The next segment will specifically address physical components of the nursing environment that can influence communication.

Built Environment and Its Influence on Nursing Behaviors

Our everyday lives are complex, especially when we begin to analyze social relationships. Buildings and their interior environments have the ability to directly influence our social interactions and therefore, our social relationships (Hillier, 1996; Hillier & Hanson, 1984). The manner in which individuals move through their built environments influences how and when they are able to communicate with others. The relationship between the built environment and its influence on the work of nurses is no exception.

The spatial characteristics of any built environment offer social consequences for the occupants of that space (Hillier, 1996; Hillier & Hanson, 1984). Examples of spatial characteristics include aesthetic, geometrical, physical, and technological properties of boundaries (i.e., walls, ceilings, floors) that inherently define the spaces we experience in

a built environment (Rashid, 2009). These boundaries allow visibility (or sightlines) into some spaces and limit visibility to other spaces. The theory of space syntax is often used to study these boundaries and their effect on human behavior in a designed environment. A detailed understanding of any complex environment is a necessary step to improving healthcare interior design, as noted by Reiling, Hughes, and Murphy (2008).

Understanding the interrelationships between humans, the tools they use, and the environment in which they live and work, is basic to any study of the design of a healthcare facility and its effect on the performance of the nurse and other caregivers who interface with the facility and its fixed (e.g., oxygen and suctioning ports on the wall of a patient room) and moveable (e.g., a patient bed) equipment and technology. Humans do not always behave clumsily and humans do not always err, but they are more likely to do so when they work in a badly conceived and designed health care setting. (p. 1)

Nursing behavior is no exception to this concept. Nurses work in a fast-paced environment and they depend on the environment to support their daily work activities. Studies have shown that errors occur in nursing units due to environmental factors such as low light levels and inadequate space for working (Joseph, 2006). Additional research has shown the physical environment to contribute to nursing inefficiencies by unit configurations that increase walking distances and decrease staff visibility (Joseph, 2006). Studying the physical environment's influence on nursing behavior is important to patient and staff outcomes.

Problem Statement

Nursing units are characterized by the number of patient rooms, location of support areas, and location and number of nurse work stations. New designs for medical-surgical nursing units have been introduced by healthcare designers over the past decade. Until the early 1990s, most units were built with a traditional centralized model, characterized by a large, centrally-located nurse work station in proximity to patient rooms and support spaces.

More recent designs have seen the implementation of a decentralized model, characterized by several, smaller nursing work stations dispersed throughout a nursing unit located closer to patient rooms. Research indicates that decentralized nursing unit design has positive influences for staff and patient outcomes; shown by the length of time nurses spend with patients, reduced walking distances, and reduced medical errors (Gurascio-Howard & Malloch, 2007). However, considerably less research has been conducted on how decentralized nursing unit design impacts communication opportunities for nursing staff. During their careers, nursing staff and other members of the patient care team who have typically been accustomed to gathering at a centralized nurse work station may have the experience of working in a new, decentralized nursing unit layout.

The nurse work station in a centralized model has become known as a central area to congregate and share information about patient care and engage in a social nature for the purposes of generating social support within a unit (Gurascio-Howard & Malloch, 2007). Decentralized nursing unit design disperses the central gathering space as smaller

areas throughout a nursing unit, thereby also dispersing visual and physical connections for nursing staff (Gurascio-Howard & Malloch, 2007). This decrease in visibility can reduce the opportunities for communication, which could hinder perceived social support on a nursing unit. Decreased levels of social support have been shown to add to job stress and dissatisfaction of nurses (Hutchinson, 1999; Langford, Bowsher, Maloney, & Lillis, 1997; Spitzer, Bar-Tal, & Golander, 1995). Little qualitative research exists about nurses' perceptions of nursing unit design and its impact on patient care team communication. Communication is linked to social support; with high levels of social support, nurses will feel less stress in their work environment. The physical work environment can be designed to better support nurses communication needs. Qualitative research is needed to further identify these knowledge shortages in healthcare design as they relate to nurses' communication and social support.

Statement of Purpose

The purpose of this study is to identify factors that are related to how the design of a medical-surgical nursing unit influences nurses' communication. Communication on a nursing unit is directly connected to quality nursing care, patient safety, and a healthy work environment (AACN, 2005; AONE, 2004). Previous research on this topic has quantitatively measured types of communication and frequency of interaction, but has provided limited research of the impact of design on communication. This study will explore the use of qualitative research methods for medical-surgical nursing unit design within the theoretical framework of space syntax. The qualitative approach in this study will add to the understanding of healthcare design's existing quantitative research by

looking further at the relationships between the variables in this complex environment. This study is exploratory in nature and seeks primarily to open discussion and opportunities for future research.

Research Approach

Space syntax theory states that our relationships, behaviors, and interactions between groups and individuals are influenced by the structure of the built environment and emulates a social logic (Bafna, 2003; Hillier, 1996). Space syntax will serve as the theoretical framework for organizing this study and will also be used to analyze medical-surgical nursing unit floor plans according to the theory's constructs.

This exploratory study will examine literature, research findings, and transcripts of nurse interviews for how the design of the physical environment impacts communication among nurses in an urban hospital's medical surgical nursing unit. Specifically, opportunities for interaction between nurses will be explored. Application of space syntax theory constructs (visibility and accessibility) to this study will support a better understanding of nurses' daily communication opportunities and could influence spatial layout design decisions for future medical-surgical nursing unit design.

To identify these interactions, a comprehensive literature review of the nursing profession, medical-surgical nursing units, and the theory of space syntax was conducted. Key themes identified from the literature search included job satisfaction, stress, social support, communication, and the built environment's impact on human behavior. Based on the findings from the literature review, an analysis of medical-surgical nursing unit plans was conducted to apply and evaluate space syntax constructs as to their possible

applicability to gaining further knowledge about the influence of the design of the physical space as an influence on nursing communication. In addition to the literature review and plan analysis, exploratory interviews with two nurses and one health unit coordinator were conducted.

Assumptions

This exploratory study assumes that the design of any nursing unit is influenced by myriad of factors – most importantly, the need for patient safety. Discussion in this study takes into consideration the need to balance patient-centered design and design that supports staff communication, as both are central to positive healthcare outcomes. It is also assumed that design of a nursing unit alone cannot determine overall job stress and satisfaction. Organizational culture, nurse-to-patient ratios, and personal life issues also influence a nurse’s perception of job stress and satisfaction. Attention to each area of the nursing work environment will help to improve job satisfaction and reduce stress. Design in this context refers to the physical attributes of a nursing unit such as the space planning, wall heights, and furniture layouts.

Research Questions

The central research question formulated for this study was:

1. Does the design of a medical-surgical nursing unit in an urban hospital influence communication and social support opportunities for nurses?

The secondary questions included:

2. Does medical-surgical nursing unit design influence visibility between nurses?

3. Does medical-surgical nursing unit design influence accessibility to nurses and other members of the patient care team?

Definitions and Key Terms

Several key terms are used to define a study of the influence of the built environment on nursing communication. To provide a clear understanding of some key terminology used throughout this study, the following definitions are provided.

Space syntax: theoretical framework for studying spatial layouts and their effects on behavior, movement, and interaction

Medical-Surgical Nursing unit: care unit in a hospital for patients requiring 24 or more hours of care for postsurgical recovery and patients recovering from varying levels of medical diagnoses; typically consists of patient rooms, nurse work stations, support areas, and circulation

Patient care team: a collection of healthcare professionals and non-healthcare professionals who are involved in a patient's care. The team typically includes: nurses, health unit coordinators, support staff, physicians, therapists, dieticians, pharmacists, social workers, psychologists, complementary therapy specialists, spiritual advisors, volunteers, families of the patient, and the patient. (This is explained in greater detail in Chapter 2, Table 1.)

Social support: the assistance and protection given to others, especially to individuals

Organizational culture: refers to the norms, values, and beliefs within an organization

Organizational climate: refers to employees' perception of the organizational culture

Burnout: based on Maslach's Burnout Inventory (Maslach, 1986) and characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment

Work Environment (of a hospital): the elements of an individual's or group of individuals' work context that can include work processes, technology, organizational culture, and physical design

Significance of the Study

The significance of this study is multifaceted. First, this study will bring added awareness to how the design of medical-surgical nursing units can influence nursing communication. Designers will be able to use this awareness to study in greater detail the effects of design characteristics on a nursing unit. Second, those making decisions about new building projects will be aware of nurses' perceptions and their needs on a nursing unit. With this awareness, designers and healthcare administrators will be better informed to make decisions regarding capital improvements that enhance the work environment. This study aims to increase predictability for human behavior in a designed environment. Reducing opportunity for error in design will create better interior designers, more satisfied healthcare clients, and ultimately, better healing environments for patients. To fully understand design actions, a rich description of the environmental context from the perspective of those who use a space is sought. Johnson and Barach (2008) posited about qualitative methods in healthcare organization research:

Qualitative methods can play an important role in the design of healthcare facilities, because they provide insight into the complexities of the design and provision of healthcare. A well-designed qualitative study can help gain insight

into how people interact with patients, other providers, technology, and the environment. Qualitative data can in a short time help the design team rapidly focus on the priorities of the design process. Qualitative tools can help focus the quantitative hypothesis and thus greatly enhance the pace and efficiency of the data collection. Robust qualitative methods are meant to complement quantitative methods to arrive at a better understanding of how patient outcomes are influenced by the design of the process and the healthcare facility. (p. 202-203)

While it is not feasible to control all of the variables, especially human behavior, it is important to seek ways to predict behaviors of certain groups and make appropriate design decisions to support their needs. The work environment of nurses is complicated, stressful, detail-oriented, and directly related to patient outcomes. A clear understanding of how nurses behave as a result of their physical work environment is important to designing better healthcare environments. Healthcare environments must not only support the healing process and offer a safe environment for patients; it must also provide an efficient and safe environment for workers. There is a growing need for quality nursing care at a time when there is a shortage of nurses. The U.S. healthcare system cannot survive without nurses. Actions need to be taken to improve the work environment of nurses to better support their needs, including efforts to improve nursing team communication.

Chapter 2 provides a detailed literature review of important issues facing the nursing profession. The literature review will also discuss medical-surgical nursing units and the built environment's influence on human behavior through space syntax theory.

CHAPTER 2. LITERATURE REVIEW

Overview and Method

This chapter reviews current literature on 1) the nursing profession, as nurses are members of the patient care team; 2) healthcare interior design as related specifically to the medical-surgical nursing unit; and 3) space syntax theory to establish a basis for future research regarding the impact of medical-surgical nursing unit configuration on nurses' communication. Throughout this chapter, relevant concepts, themes, and variables will be identified and defined as they relate to the study of nursing communication in an urban hospital's medical-surgical nursing unit. Previous research on medical-surgical nursing unit design and factors that influence the nursing work environment will be explored.

The review of literature was conducted to gain knowledge of these topics and to determine how they are situated within the larger context of inquiry related to healthcare interior design and human behavior, and to build upon a broader theoretical scheme (Bloomberg & Volpe, 2008). It is necessary to help the researcher "gain a deeper understanding of the interrelationships and intersections between the subject matter under consideration and other subject areas" (Bloomberg & Volpe, 2008, p. 47). This chapter will establish the background needed for recommending future qualitative research in medical-surgical nursing unit design. Future implementation of this exploratory qualitative research will be discussed in greater detail in Chapters 3 and 4.

A hospital construction project is unarguably expensive. However, when looking at annual costs for a hospital, 82-94% of all expenses are for employee salaries and

benefits. The remaining costs account for operations and maintenance (3-6%) and construction costs (5-7%) (Solucient, 2004). These facts motivate us to understand why the design of work environments must be improved. Interior designers need to understand the nursing profession for the purposes of designing better healthcare environments, not only for the patients but for the caregivers.

This chapter begins with a review of the nursing profession, including this profession's involvement within the patient care team, tasks and patient care outcomes, factors that influence job satisfaction and stress, and issues affecting the nursing profession. The review of literature then looks at communication in the workplace, beginning with the types of communication, followed by an examination of communication as an important factor in building social support.

Following the discussion of communication is a review of medical-surgical nursing units, including its history and functionality as well as variations in design. This chapter concludes with a detailed review of space syntax, the theoretical framework being used to organize this study. This theory's history and early applications are discussed first, followed by an examination of recent applications to office environments. Space syntax theory and its constructs are then explored for use and applicability in healthcare environments, specifically to medical-surgical nursing units. Models will graphically show the interconnectedness of these variables. Factors that influence them are presented in Chapter 4.

To conduct this literature review, multiple sources of information were accessed, including professional and academic journals, books, textbooks, and Internet sources.

These sources were found through the University of Minnesota Libraries database search engines such as PubMed and LexisNexis, as well as general Internet searches conducted via the Google search engine. No specific time frame was established for inclusion of literature; however, a deliberate effort was made to review publications within the past 10 years. For sources older than 10 years, the inclusion criteria of these older documents is a result of historical reference or a lack of availability to more current, significant research. The search for relevant topics included literature from a range of study areas that include nursing, interior design and architecture, patient care teams, communication, medical-surgical nursing unit operations, psychology, occupational health, and environmental behavior literature. It was necessary to engage in multiple study areas for this literature review because of the multidisciplinary approach that is often taken to study many of the variables under consideration. Most of these topics have been studied by multiple professions and through different perspectives, creating a complex field for this current exploratory study. This thorough approach provides a clear and balanced picture of leading concepts for this study (Bloomberg & Volpe, 2008).

Each section of the literature review is summarized with a synthesis of that topic's relative importance to the study. The conclusion at the end of this chapter illustrates how the information gathered from this literature review has informed the researcher's understanding of the subject matter, how the knowledge contributes to the conceptual framework, and how the findings will contribute to implications of this study.

Extensive research is available about nursing care and evidence-based nursing practice methods; however, considerably less research is available on the physical

environment's influence on nursing care. Studies show that elements of the hospital work environment contribute to inefficiencies and stress for the healthcare work force. In particular, nurses are affected by inefficient work processes, design of the physical space, gaps in technology, and unsupportive organizational cultures (Hendrich et al., 2008). These factors have also contributed to nurse "burnout," one of the leading results of severe stress and job dissatisfaction and directly affects staff recruitment and retention (Aiken et al., 2002). There is also a substantial amount of literature pertaining to communication among healthcare professionals, including hospital nurses. Many of these studies have looked at patient outcomes as a measurement of the success of a communication improvement initiative. Less research has been conducted to measure nursing professionals' stress as a result of decreased social support from poor communication, i.e., how communication, or lack of it affects nurses personally in the hospital setting. This literature review can identify for interior design practitioners and healthcare professionals aspects requiring further exploration about how to design environments that are more supportive of nursing communication. The nursing profession will be explored first.

The Nursing Profession

This section will cover aspects of the nursing profession. The first discussion will cover strata within the nursing profession, followed by involvement within the patient care team, nursing tasks, patient care outcomes factors that influence job satisfaction, and job stress and burnout. The section concludes with a closer look at issues facing the nursing profession and professional influences.

Strata within the Nursing Profession

Nurses are stratified by education, specialization, and work environment; each will be explored. Nursing is the largest labor force in U.S. hospitals and nurses are the only healthcare professionals involved in direct patient care 24 hours a day, 7 days a week (Bureau of Labor Statistics, 2009). Of the nearly 5 million nurses employed in the United States, 2.5 million (50%) are registered nurses, 749,000 (approximately 15%) are licensed practical nurses, and 1.7 million (35%) are nursing assistants or aides (Bureau of Labor Statistics, 2009). Nurses are commonly referred to as the “first line of defense” for most hospital patients (Bureau of Labor Statistics, 2009; Clarke, 2007; MacDavitt et al., 2007).

The strata of nurses currently working in U.S. hospitals include registered nurses (RN) and licensed practical nurses (LPN). Working closely with RNs and LPNs are certified nursing assistants (CNA). Education levels vary for each level of nurse, with RNs requiring more education than LPNs. RNs require a bachelors of science in nursing and advanced practice nursing requires at least a masters degree. LPNs typically require a vocational or technical education with programs lasting about a year prior to licensing. Both RNs and LPNs require substantially more education than CNAs. CNAs require training and a competency evaluation (Bureau of Labor Statistics, 2009). A typical nursing team for a medical-surgical unit is comprised of RNs, LPNs, and CNAs.

The nursing profession carries unique demographic characteristics. Nurses in the United States are predominately female, comprising nearly 95% of the workforce. The number of male nurses is gradually rising in overall employment statistics and now make

up 5.7 % of the workforce (NACNEP, 2008). As a female-dominated field, several implications have arisen that concern stakeholders. Females still tend to carry the responsibility of caring for children, aging parents, and household chores in addition to their job responsibilities. This raises concerns over the stress levels of the majority of our employed nurses, due to the longer work hours and resulting fatigue from multiple life responsibilities (Institute of Medicine, 2004b). Also, the nursing professional is less ethnically diverse than most professions in the United States, with a predominately white, non-Hispanic population of 88.4% and only 10.6% of RNs reported as non-white in 2004 (NACNEP, 2008). Age is another concerning demographic for nurses. This profession is, on average, older than most professions in the country. Nearly 74% of nurses are over 40 years of age (NACNEP, 2008). The steady decline of nurses due to retirement will affect the healthcare industry with the growing healthcare needs of aging baby boomers over the next few decades. Concern over aging and retirement for nurses is discussed in greater detail in a following segment.

Nurses work long hours, usually in the form of shifts. Most nurses work a typical 8- or 12-hour shift, but some shifts have exceeded 12 hours, posing serious threats to nurses' health. Extended fatigue can impact human performance and subsequently become a dangerous threat to patient safety (Institute of Medicine, 2004c).

Most nurses develop an area of specialization. Areas of specialization for nurses range from perioperative (assisting surgeons) nurses to pediatric oncology. Depending on the specialization, the work environment will vary. Examples of work environments for specialized nurses include ambulatory care, critical care, emergency departments, hospice

and palliative care (providing care focused on maintaining quality of life for terminally ill patients) facilities, psychiatric clinics, rehabilitation clinics, and medical-surgical units (Bureau of Labor Statistics, 2009).

This study focuses on the work environment of medical-surgical nurses. Medical-surgical nurses are typically located within medical-surgical nursing units in hospitals and provide medical care to patients with various medical and surgical diagnoses (Bureau of Labor Statistics, 2009).

A wide range of nursing professionals exist in our healthcare system. The intent of this study is not to generalize for all nursing professionals, but rather to begin a discussion on the specific needs of medical-surgical nurses. The next segment will discuss the nurse's role in a hospital system, beginning with their involvement in the patient care team.

Involvement within the Patient Care Team

A multidisciplinary patient care team approach involves medical professionals from a variety of specialties and it is an increasingly accepted approach to patient care. Under a multidisciplinary patient care approach, nurses make up just a portion of the overall patient care team. The patient care team is a collective grouping of all medical and non-medical professionals involved in a patient's care. The following table shows the depth of personnel involved in a common multidisciplinary care team (see Table 1).

Role	Internal	External	Brief Description
Patient	X		Person receiving care. Involved and empowered by the decision-making process. Assistance provided by patient care team members (Snyder & Lindquist, 2006).
Nurse – RN	X		Coordination with all members of patient care team. Transfer of information between shifts and day-to-day patient care discussions (nurse/nurse interaction) (Leppa, 1996).
Nurse – LPN	X		Transfer of information between shifts and day-to-day patient care discussions (nurse/nurse interaction) (Leppa, 1996).
Nursing Assistants (CNAs)	X		Under direct supervision of nursing staff, perform routine, hands-on tasks directly related to patient care. Report changes in patient's status to supervising nurse (Bureau of Labor Statistics, 2009).
HUC (Health Unit Coordinator)	X		Responsible for non-nursing care at nursing stations such as form processing and relaying information to patient care team members (NAHUC, 2009).
Support Staff	X		Support staff may include clinical manager, SWAT nurse, house supervisor as a resource to help manage teams and resources (Health Workforce Solutions and RWJF, 2008).
Physician/Specialist	X	X	Assess, diagnose, and prescribe treatment for patients. Coordination with patient care team (Bureau of Labor Statistics, 2009).
Therapists (Speech, Physical, Occupational, Respiratory)		X	<i>Speech Therapist (ST)</i> : Coordinate with physicians, psychologists, social workers, and other therapists for direct patient care related to communication and swallowing disorders (Bureau of Labor Statistics, 2009). <i>Physical Therapist (PT)</i> : Discussion occurs between nurse and PT for safe patient handling and movement (Nelson, 2006). <i>Occupational Therapist (OT)</i> : Coordination to help patients maintain or improve skills needed for daily living activities (Bureau of Labor Statistics, 2009). <i>Respiratory Therapist (RT)</i> : Coordination of respiratory care assessment and treatment, under the direction of the physician (Bureau of Labor Statistics, 2009).
Dietician		X	Coordination with physicians and nurses for nutritional services for patient (Bureau of Labor Statistics, 2009).
Pharmacist		X	Coordination and monitoring of medication during patient's stay on medical surgical unit (ASHP, 2009).
Social Worker/ Psychologist		X	Coordination with patient care team (patient, family members, nurses) for patient's needs after discharge from hospital (Bureau of Labor Statistics, 2009).
Complementary Therapy Specialist		X	Close collaboration to refer patient to complementary therapist and/or to collaborate for complementary therapy to be incorporated during patient stay (Snyder & Lindquist, 2006).
Spiritual Advisors		X	Provide comfort, companionship, conversation, and consolation for patients and family. Main contact with nurse (Moeller, 1999).
Volunteers		X	Assist with non-medical activities for patient and family such as recreation, conversation, entertainment, wheelchair pushing, and administrative duties (Aragaki, Saito, Takahashi, & Kai, 2007).
Family Members	X	X	Supporting role for care of patient. Coordination with nurses and social workers (Timby & Smith, 2006).

Table 1. The patient care team for a multidisciplinary patient care approach. Each role is indicated with their internal or external (or both) contact with patient care.

Table 1 outlines the role of individuals involved in the patient care process and indicates whether they are involved from an internal, external, or dual focus. The care process not only involves medical professionals, such as nurses, physicians, and therapists, but also includes spiritual advisors, family members, and the patients themselves (Leppa, 1996; Snyder & Lindquist, 2006; Timby & Smith, 2006). Nurses are the primary contact for all those involved in a patient's care, creating a complex system of communication responsibilities (Leppa, 1996). Internal members of the patient care team are often physically located on the medical-surgical nursing unit during their shift. In the case of non-medical members of the patient care team, such as family members, their presence on the medical-surgical nursing unit may be seen as internal due to their relationship with the patient. External members of the patient care team are typically not physically located on the medical-surgical nursing unit during their shifts or work hours. These individuals may conduct rounds or a special visit, based on a referral or as a component of routine care, to the patient who is currently residing in a medical-surgical nursing unit room (Bureau of Labor Statistics, 2009; Nelson, 2006).

This outline of the multidisciplinary team highlights the complexity of communication needs in which nurses are involved on a daily basis. Communication among members of the patient care team is important to the patient care process. Studying how and when nurses communicate with each other could help interior designers create more effective environments and support nursing staff. In addition to communication skills, nursing tasks can involve physically demanding work. Both aspects are discussed in the following section.

Nursing Tasks

Primary responsibilities of nurses include daily monitoring and critical management of patient care (Aiken et al., 2002; Benner et al., 2002). Nurses serve as the primary contact for all patient care. RNs are involved in treating patients, education of patients and their families, and providing emotional support to patients and their families. RNs work to establish a plan of care or work to implement an existing plan of care. Tasks involved in a well-developed care plan include administering medication, checking medication dosage and avoiding interactions, administering therapies and treatments, patient observation, and consulting with physicians and other medical professionals. RNs may also act in a supervisory role to provide direction to LPNs and CNAs for patient care (Bureau of Labor Statistics, 2009).

Nurses are also involved in daily work activities that involve physical demands. During the course of a patient's stay at a hospital, a patient may not be able to move on their own, and often require the assistance of a healthcare professional. The responsibility of helping patients move in their beds and helping with transfers to wheelchairs often falls on the nurse assigned to that patient. Addressing patient mobility can be dangerous for nurses. Nursing musculoskeletal injuries have seen a significant rise in the healthcare environments, ranging from nursing homes to hospitals (Nelson, 2006). To accommodate safety practices in hospitals, many nursing units have implemented team nursing practices and employ nursing aides to help with patient mobility (Nelson, 2006).

Facets of the nursing profession, including involvement with the patient care team, nursing tasks, and physical work demands, are important to the understanding of

how nurses perform their daily work routines. Understanding the complex issues surrounding nursing work can assist interior designers in developing a more informed foundation upon which to base design decisions. Designers can begin to understand the many variables that contribute to nursing work environments. The following segment will discuss issues related to patient care outcomes.

Patient Care Outcomes

The primary goal of hospitals is to provide health-related services to patients. Hospitals and patients desire optimal patient outcomes. Several important contributors to patient care outcomes and how nurses are involved with these contributors will be described. These contributors include patient safety, nurse staffing ratios, organizational climate, and working hours.

Patient safety.

Nurses' ultimate responsibility is to patient safety, which is directly related to measuring patient outcomes (Clarke & Donaldson, 2008; Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002). The nursing profession has been a leader in patient care outcomes research. Numerous journals (i.e., *Journal of Nursing Administration*, *MedSurg Nursing*, *Journal of Advanced Nursing*) are dedicated to nursing care practices and assuring best practices for quality patient care. Research on patient care outcomes has received a substantial amount of attention in nursing literature. Attributes of patient care outcomes range from nurse staffing levels (Clarke & Donaldson, 2008; Needleman et al., 2002) to organizational climate (Hendrich & Chow, 2008). The Institute of Medicine's (IOM) Committee on the Adequacy of Nurse Staffing in Hospitals and Nursing Homes

reported, “historically, the hospital has been at the core of the U.S. healthcare system, and nursing services are central to the provision of hospital care” (p. 1) and “nursing is a critical factor in determining the quality of care in hospitals and the nature of patient outcomes” (Wunderlich, Sloan, & Davis, 1996, p. 92).

Several databases that report on quality have been formed since the publication of the 1996 IOM report. These reporting databases, such as the National Database for Nursing Quality Indicators (NDNQI), work unofficially in a collaborative manner to provide access to documents containing research for quality of nursing care in acute settings. These reports are excellent sources for nursing care activity and related patient outcomes reports (Clarke & Donaldson, 2008). They provide evidence that the profession of nursing is serious about improving the quality of care.

Clarke and Donaldson (2008) describe the variables involved in measuring patient outcomes for quality nursing care as to include work processes, technology infrastructure, organizational culture, and physical design. Located within these variables are several contributing factors that influence the quality of care nurses provide, including the systems within nurses work, staffing levels, and the availability and organization of other staff members. These factors need to be considered in the discussion on medical-surgical nursing unit design. The following segments provide a review of prominent themes in the literature relating to patient care outcomes; starting with nurse staffing ratios, followed by organizational climate and working hours.

Nurse staffing ratios.

Several studies have examined the effect of nurse staffing levels on the quality of care in U.S. hospitals. Needleman, Buerhaus, Mattke, Stewart, and Zelevinsky (2002) reviewed nurse staffing levels in 799 hospitals in 11 states to conclude that staffing levels are associated with quality of care for hospitalized patients. Lower rates of adverse outcomes were found in the proportion of hours of nursing care by RNs and a greater number of hours of care per day by RNs. Additional studies (Clarke, 2007; Wunderlich et al., 1996) have shown similar or mixed results, depending on the sample size. Findings indicate that lower staffing ratios are preferred to maintain high quality patient care.

As a result of this information, interior designers need to be aware that medical-surgical nursing unit design plays an important role in how nurses access patient rooms and nurse staffing ratios; taking into consideration the distance between patient rooms which allows more direct patient care time and is critical for allowing lower nurse staffing ratios. (Additional discussion of nurse staffing ratios is addressed in a later section.) With a strong focus on patient outcomes and quality improvement, the nursing profession is establishing itself as a leader in quality improvement initiatives. The next segment will review another component contributing to patient care outcomes, organizational climate.

Organizational climate.

Another determining factor of patient outcomes is the organizational climate. Stone, Hughes, and Dailey (2008) conducted a review of literature about patient safety and outcomes and found several studies that investigated organizational climate and

patient safety outcomes. The research team determined, despite a few differences in research design, improved patient safety outcomes as a result of a positive organizational climate. Some of the characteristics of a positive organizational climate included a safe hospital work environment, good communication, supportive supervisor/manager, improved interdisciplinary communications, and minimal conflict. Further details regarding organizational work climates are discussed in a later section.

Working hours.

Working hours are another factor contributing to patient outcomes. Many nurses are working extended hours to cope with the current shortage of nurses. A study of this trend of extended hour staffing has found as an outcome “potentially hazardous conditions for patient safety” (Rogers, Hwang, Scott, Aiken, & Dinges, 2004, p. 202). Risks of making an error were shown to significantly increase when nurses had worked longer than 12-hour shifts or more than 40 hours per week (Rogers et al., 2004).

As has been discussed, many factors are involved in measuring patient outcomes, making it difficult to measure the effectiveness of any one factor. Any design strategies to improve the medical-surgical nursing unit must take into consideration the full spectrum of influencing factors.

Factors that Influence Job Satisfaction

To examine influences on job satisfaction, occupational health literature was reviewed for factors that contribute to good occupational health and for general job satisfaction characteristics. Following a review of the occupational health literature, the nursing literature was then reviewed to explore which factors influence nursing job

satisfaction. Deliberate attention was given to literature focusing on medical-surgical nurses; however, the literature review was expanded to include multiple nurse specialty areas, because nursing units share a similarity in function and nurses.

It is important to look for consistent themes (i.e., stress from patient care, stress from work tasks and responsibilities) across a range of nurses because the themes may help designers identify additional areas of concern for work-related stress and satisfaction beyond those of medical-surgical nurses in the future. Themes identified throughout the literature include personality fit, work hours, leadership, organizational climate, and stress levels.

Occupational health plays an important role in overall job satisfaction. The basic concepts for occupational health focus on reducing occupational stress and psychosocial risk management. Many organizations have implemented an occupational health management program and believe strongly that reducing stress and psychosocial risk will improve the organizational bottom line by developing more productive employees (Adkins, 1999). Some functions of occupational health programs include prevention and intervention tactics to reduce or prevent stress and risk for employees. While the majority of research has focused on the occupation health of office employees, the occupational health of employees at a hospital, likewise, can benefit from programs and initiatives that help to reduce stress and psychosocial risk (Sauter, Murphy, & Hurrell, 1990).

Several theoretical frameworks found in the occupational health literature underpin our understanding of occupational job satisfaction. Several theories fall into a class of theories known to the occupational health psychology field as P-E theories.

These theories focus on the person (P) in an environment (E) and the fit between; or, the interaction of the person and his/her environment. One of the theories often cited in occupational literature is Holland's Personality-Work Environment Congruence Theory. This theory explains that an individual's attraction to his/her work environment is based on his/her personality. A poor fit with the work environment indicates a higher likelihood of changing jobs or careers. Individuals have a tendency to move to more congruent environments that match their personalities. A lack of congruence with an individual's work environment indicates a low level of job satisfaction (Donohue, 2006).

Another theory that is found in occupational literature is the Minnesota Theory of Work Adjustment (TWA) (Dawis & Lofquist, 1984). This theory focuses on the person and the person's behavior. It recognizes that the person does not exist alone, or in a vacuum, but rather the person always exists in an environment (Dawis, 2005). This theory is of particular interest to those studying designed environments.

Findings from occupational health literature can be correlated to the study of people in environments and assist interior designers to create environments that support them. The approach of occupational health psychologists differs from the approach of design researchers, but nonetheless, both groups are studying people as they are affected by a particular environment.

Job satisfaction characteristics need to be understood for any study of the work environment as it is a major contributor to worker stress. Job satisfaction is multidimensional. Factors that influence job satisfaction include social support (Baruch-Feldman & Schwartz, 2002); the nature of work; human resources, such as advancement

opportunities and salaries; and the organizational environment (Boswell, Shipp, Payne, & Culbertson, 2009).

Nursing literature on job satisfaction carries several of the common themes found in occupational health literature. The major themes found in the nursing literature that focus on job satisfaction include healthy workplaces, safety in the workplace, staffing and work hours, opportunities for growth, and organizational climate (AbuAlRub, 2004; Aiken et al., 2002; Jennings, 2008; Parkes, 2003; Ruggiero, 2005; Upenieks, 2002). Recent research on job satisfaction for nurses highlights the importance of job satisfaction among nurses as a means by which to minimize the current threat of unsafe healthcare environments due to staff shortages (Atencio et al., 2003; Lynn & Redman, 2005; Ruggiero, 2005).

Ruggiero (2005) recommends improvements to scheduling and stress interventions as a possible way to improve job satisfaction and improve recruitment and retention for nurses. Previous studies of job satisfaction have focused on autonomy and organizational variables with less attention on personal health issues (Parker et al., 2001). Ruggiero (2005) noted that researchers have explored relationships between job satisfaction and psychological empowerment, career satisfaction, job commitment, autonomy, control over practice, professional relationships, organizational environment, and educational preparedness.

Ruggiero (2005) also studied shift worker health, particularly sleep problems and depression, along with demographic variables of nurses. The results of Ruggiero's study have indicated several factors strongly related with job satisfaction. These factors

include depression, emotional stress, and number of weekends off per month. Even though Ruggerio's (2005) study of 3,472 nurses found no relationship between age and job satisfaction, she recommended further research on the impact of age and job satisfaction.

The literature on nursing job satisfaction continues to grow at a time when organizations need to consider greater investments in retaining and recruiting quality nurses. This review of nursing literature is somewhat limited due to the broad and diverse nature of nursing literature. However, literature was reviewed to the degree necessary to gather dominant themes and identify contributing variables as related to the greater system of nursing work environments. Literature is limited on how the physical work environment influences a nurse's level of job satisfaction. This study will seek to contribute to knowledge of this subject, while taking into account to the aforementioned job satisfaction variables. The next section reviews variables of job stress and burnout for nurses.

Job Stress and Burnout

Several theoretical frameworks are found in the occupational health literature that focus on job stress. The Karasek Job Demand-Control model (Karasek, 1979) is used often in occupational health literature. It studies adverse health outcomes from high strain jobs that are characterized by low control (limited freedom to decide how to meet the demands of the job). "Job demands" refer to the "psychological job demands or the perception of the workload, the work rhythm and possible conflicting demands" (Pelfrene et al., 2002, p. 44). "Job control" refers to the worker's perceived amount of freedom to

decide how to meet the demands or how to perform tasks. The theory states that “most adverse health outcomes are characterized by the combination of high demands and low control” (p. 44). This theory also considers levels of social support as a “buffer” to job stress (Pelfrene et al., 2002). Social support is reviewed in greater detail in a following section.

In a profession that varies in its level of autonomy, the nursing profession is strained from a demanding workload that can cause work system failures and interruptions such as medication order errors, obstacles for obtaining equipment and supplies, and staffing issues (Tucker & Spear, 2006). Stress experienced on the job is a highly subjective experience. Studies have shown that stress is a contributing factor to organizational shortcomings such as inefficiencies, increased staff turnover, higher absenteeism because of sickness, and decreased job satisfaction (Wheeler & Riding, 1994). Extreme stress has the potential to lead to both individual and group burnout (Garman, Corrigan, & Morris, 2002).

Burnout is characterized by depersonalization, emotional exhaustion, and negative feelings toward personal accomplishments (Maslach & Jackson, 1986). Studies have shown that nearly 40% of hospital nurses have exceeded the normal levels for burnout and that 1 in 5 nurses intend to leave their current jobs within a year (Aiken et al., 2002). Nurses leaving their jobs or the profession because of stress or job dissatisfaction have a significant impact on the labor supply. In a study of staff satisfaction, 41% of nurses noted they were dissatisfied with their jobs and 22% planned to leave their positions

within one year (Aiken et al, 2002). These statistics could have enormous implications for hospital organizations and patient care.

Aiken et al. (2002) found that nurses were more likely to experience burnout and job dissatisfaction from high patient-to-nurse ratios, caused by higher emotional exhaustion due to the increased work load of more patients. This study found that nurses with high patient-to-nurse ratios were more than twice as likely to experience burnout and almost twice as likely to be dissatisfied with their jobs than those nurses working with lower patient-to-nurse ratios. This study influenced legislation and suggested that investment in nurse staffing could avoid preventable mortality attributed to lack of staffing and also help retain qualified nurses (Aiken et al., 2002). The following section dives deeper stress, burnout, and other issues challenging the nursing profession.

Issues Facing the Nursing Profession

The nursing profession is challenged with a workforce shortage. As has been discussed, this shortage is characterized by nurses leaving the profession and a lack of new entrants into the field. The following segments describe the nursing shortage and how it is affecting the nursing profession.

The Nursing Shortage

There is currently a shortage of nurses available to work in U.S. healthcare facilities (Atencio et al., 2003; Buerhaus et al., 2007; HSM Group, Ltd, 2002; Lynn & Redman, 2005). Shortages are projected to hit record highs by 2025; nearly 260,000 registered nurses are needed (Buerhaus et al., 2009). A 2004 report by the Health Resources and Services Administration (HRSA) developed to help national, state, and

local organizations plan for workforce shortages, projects that if current trends continue, only 64% of the nursing demand will be met. Figure 2 illustrates this projected shortage and the subsequent gap in the available nursing workforce.

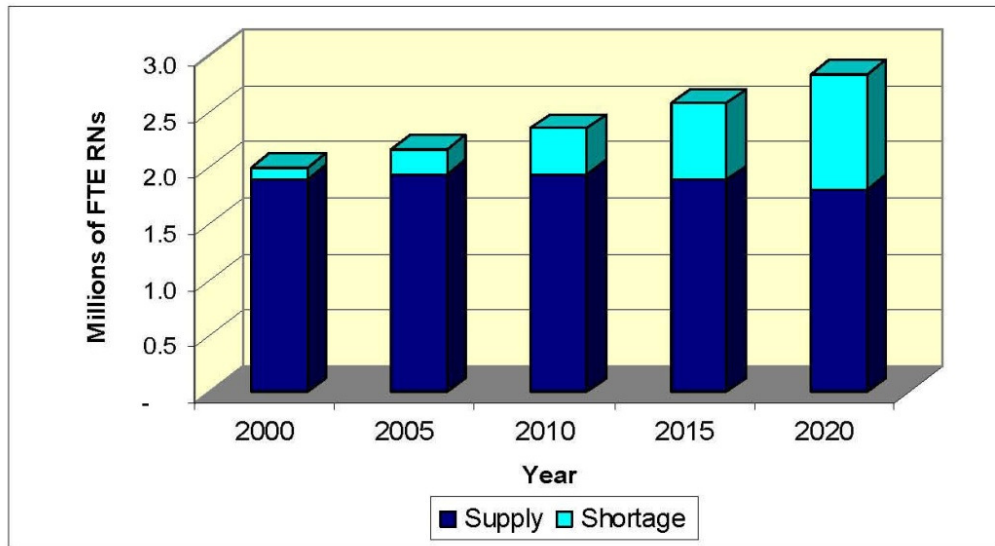


Figure 2. Projected U.S. FTE RN Shortages, 2000 to 2020. Adapted from “What’s behind the HRSA’s projected supply, demand, and shortage of registered nurses?” Copyright HRSA (2004, p. 27).

The nursing shortage has been perceived as a detriment to quality nursing care and work environment by causing unnecessary delays in patient care, higher reported patient complaints, and interfering with staff communication (Buerhaus et al., 2007). The limited supply of current and future nurses emphasizes the importance of an organization’s role in retaining their current labor force (Hendrich & Chow, 2008). Reasons for the shortage include retirement, a decision to leave the profession due to excessive stress or burnout, and a decision by the nurse to work part time (Lynn & Redman, 2005).

Aging workforce and retirement.

The aging workforce is a significant concern facing hospitals. Approximately one-third of the nursing work force is at or nearing retirement age, creating a large and increasing exit rate for these professionals in the next few years (Atencio et al., 2003). Figure 3 shows the projected nursing population by age category through 2020. The lines show the relative percentage of RNs at each age group for each decade under review and for projections through 2020.

RNs are retiring at rates faster than the graduation rates of new nurses to replace them (Lynn & Redman, 2005). Figure 4 shows projected graduation rates and RN demands through 2020. According to these figures, even if nursing schools produce 60% more graduates, the demand will still be greater than the supply necessary to fulfill nursing needs. This predicament places tremendous responsibility on nursing schools to recruit and graduate quality nursing students in the next decade.

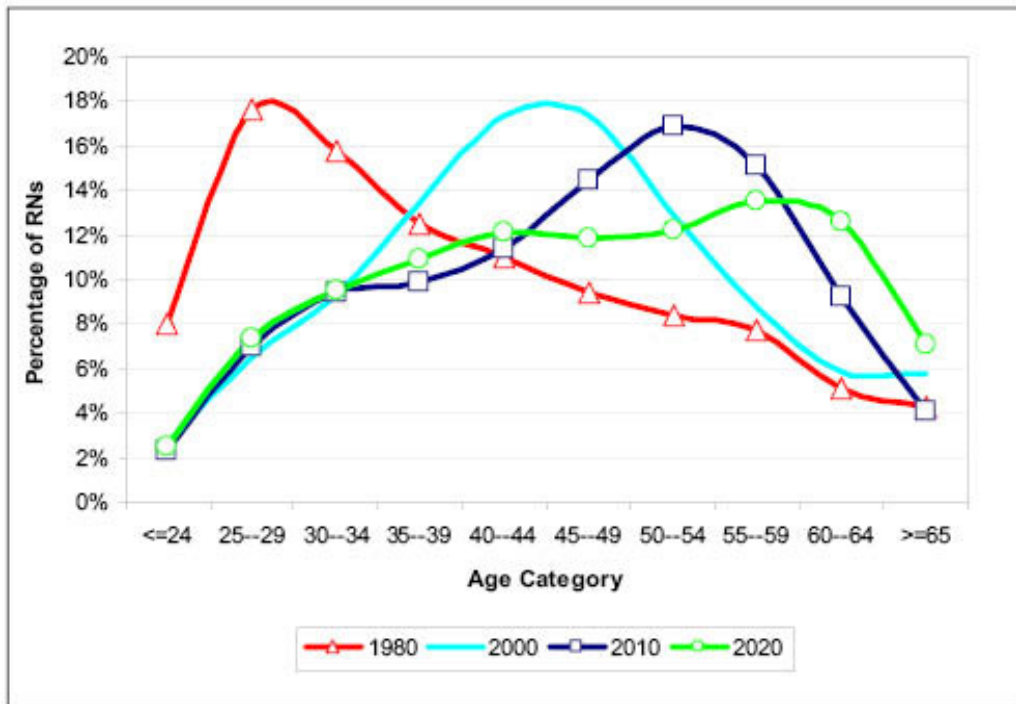


Figure 3. Age Distribution Trend of the RN Population. Adapted from “What’s behind the HRSA’s projected supply, demand, and shortage of registered nurses?” by Health Resources and Services Administration. Copyright HRSA (2004, p.4).

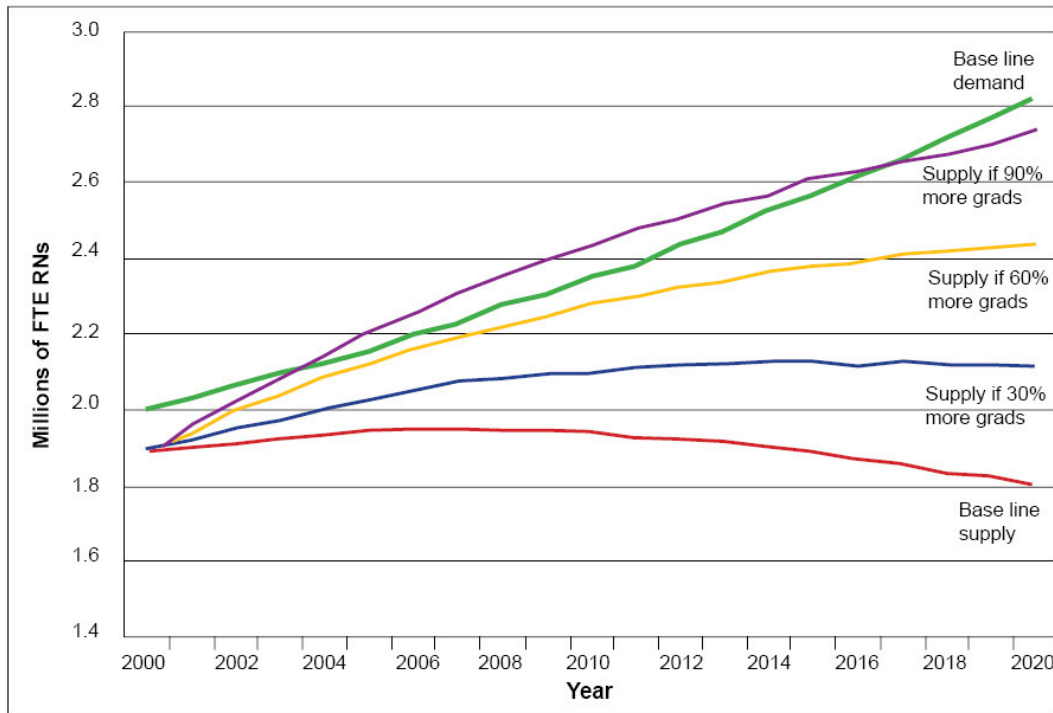


Figure 4. FTE Supply Implications of Changes in Projected Number of New Graduates from U.S. Nursing Programs. Adapted from “What’s behind the HRSA’s projected supply, demand, and shortage of registered nurses?” by Health Resources and Services Administration. Copyright HRSA (2004, p.10).

With the large exit rate of experienced nurses, the remaining nursing staff are likely to be consumed by patient care responsibilities, missing out on opportunities for mentoring while on the job. Older, more experienced nurses in the workforce are an important part of daily nursing activity, as they offer valuable mentoring to less experienced staff (RWJF, 2006). By losing the knowledge of experienced (i.e., “expert”), older nurses, organizations could be negatively affected in terms of team performance and productivity. The Robert Wood Johnson Foundation (2006) acknowledged, “costs of lost knowledge are difficult to quantify, and most organizations do not know where they are vulnerable in terms of the loss of knowledge” (p. 10).

Impact of shortage on patient care.

The primary impact of the nursing shortage is directly related to patient outcomes. In the event of a shortage on a nursing unit, patient-to-nurse ratios will many times increase. A 2002 report found that for every patient over a 4:1 patient-to-nurse ratio, there occurred a 7% increase in the chance of failure to rescue and in the likelihood of the patient dying within 30 days of admission. These rates continued to grow for each additional increase in the patient-to-nurse ratio (Aiken et al., 2002). The nursing shortage has a real impact on the quality of nursing care and patient outcomes during a hospital stay.

Impact of shortage on an organization.

As mentioned previously, patient-to-nurse ratios increase due to shortage of nursing staff and negatively influence patient outcomes. Errors are more likely to occur due to an increased case load and work demands. In the case of litigation, western civilization has historically held individuals, nor necessarily organizations, responsible for errors occurring to patients. Litigation, or the threat of litigation, has resulted in strict safety programs and the need to address lower patient-to-nurse ratios. Human tendency is to blame individual actions rather than situation factors (Institute of Medicine, 2004b). Such cases can cost a hospital millions of dollars.

Increased ratios also have an effect on job satisfaction. Aiken et al. (2002) found a 15% increase in job dissatisfaction and a 23% increase in the odds of burnout for each patient over the 4:1 patient-to-nurse ratio. Increases in job dissatisfaction and burnout

increase turnover for an organization, which leads to the need to replace the vacant positions.

Facilities with high turnover rates incur high costs to find replacement nurses. The cost to replace one medical-surgical nurse (RN) can range between \$30,000 and \$67,100 (Jones, 2005; Stone et al., 2008). Another study found replacement costs ranging from \$92,000 to \$145,000, depending on the specialty (Atencio et al., 2003). Replacement costs include human resource expenses for advertising the vacant position, interviewing, cost to hire traveling nurses, overtime for current nurses, temporary replacement costs for per diem nurses, lost productivity, training, and terminal payouts (RWJF, 2006).

These costs are a substantial concern for any hospital. One report analyzed these rates by looking at the national average turnover rate for hospitals, which is about 21.3%. Giving the example of a hospital with 100 nurses, a hospital could incur replacement expenses over \$1.9 million annually just for the medical-surgical nurses (HSM Group, 2002).

Impact of shortage on society.

Nursing shortages are linked to negative patient outcomes and can impact how society views the U.S. healthcare system. People want to live in areas with reputable, quality healthcare that is easily accessible to them. With a poor reputation for quality healthcare in a particular community or region, individuals may choose to receive their care elsewhere. Areas also exist with little access to healthcare. For many rural communities, a visit to a hospital could be 35 miles away for a critical access hospital

(Reinerston-Sand, 2009). The nursing shortage also reaches to rural areas of healthcare, where recruitment may be more difficult (Rural Assistance Center, 2009).

Professional Influences

External influences on the nursing profession such as achieving magnet status and implementing guidelines from professional organizations are emerging. Professional organizations and status recognition are now seen as strong players in the quest to improve the work environment. The majority of these strategies start with a primary focus on improving the organizational climate. Following, are several examples of external professional influences, including magnet hospital status and nursing organizations' initiatives, which are positively affecting hospital organizations in the United States.

Magnet hospitals.

Some hospitals across the United States are, surprisingly, not experiencing effects from the nursing shortage. Research indicates that these hospitals' "magnet" status is the reason behind their nursing success. Magnet hospital status began in 1995 by the American Nurse's Credentialing Center (ANCC) and the American Nurses Association (ANA) to provide a peer reviewed hospital evaluation based on 14 standards of nursing care. This multistage process includes a quantitative and qualitative review of an organization's structure, process, and outcome delivery methods. The goal of this program is to improve nursing practice environments and retain valued nursing staff (Wagner, 2005).

Magnet hospitals in the United States have, on the average, performed better than non-magnet hospitals when measuring turnover, vacancy rates, and higher job satisfaction. Several important characteristics of a magnet hospital include an emphasis on participatory management, value of professional nursing, and systematic communication between clinical nurses and leadership. Many hospitals are now looking at the magnet hospital model to implement a program to help attract and retain nurses (Upenieks, 2005). Elements that have made magnet hospitals a success – specifically ways that support communication, should be taken into consideration when designing new medical-surgical nursing units.

Professional organizations.

Two prominent nursing organizations have released standards for elements of a healthy work environment. The American Organization of Nurse Executives (AONE) (2004) and the American Association of Critical-Care Nurses (AACN; 2005) document the importance of collaboration, communication, accountability, and recognition of the role of nursing. The AONE formed the Nursing Organization Alliance to establish their recommended principles and elements of a healthful practice/work environment. The first two principles and elements listed include a “collaborative practice culture” and “communication rich culture” (AONE, 2004).

Another organization has also established protocol for healthy work environments. The AACN’s Healthy Work Environments initiative documents requirements for the achievement of a healthy work environment, which includes skilled communication, true collaboration, effective decision making, appropriate staffing,

meaningful recognition, and authentic leadership (AACN, 2005). These two organizations' initiatives reflect the level of importance they place on developing work environments to support collaboration and communication for the nursing profession.

Professional organizations are actively involved in promoting healthy work environments for nurses. It is well documented in the professional organizations' initiatives that communication is valued and needs to be improved. Organizational factors, combined with the design of a medical-surgical nursing unit should be conducive to promoting communication and collaboration. The next section will take a closer look at how the physical environment plays a role in worker satisfaction and in supporting communication.

Organizational Ecology

An examination of how people interact with each other at work and with their environments is the study of "organizational ecology." Organizational ecology describes the relationship between workers and their environment.

Work and workers are convened in space and time and how those kinds of decisions both affect and are affected by decisions about the nature of information technology, the design of work processes, human resource policies and practices, and ultimately the organization's philosophy and values. (Becker & Steele, 1995, p. 6).

This holistic view studies work environments, including the people both as workers and as a component of the work environment.

Becker and Steele (1995) identify three key elements of organizational ecology: 1) decisions about the physical settings in which work is carried out; 2) decisions about the processes used for planning and designing the workplace system; and 3) decisions about how space, equipment, and furnishings are allocated and used over time. Becker and Steele (1995) also note the importance that these factors include, among multiple other considerations, the nature of the work and business processes themselves. However, the physical environment is only one consideration when studying organizational ecology. Other factors must be considered too if the desired environmental change is to be achieved.

An organizational ecology framework (Becker & Steel, 1995) provides evidence that change cannot occur simply by altering the physical environment; but rather, change needs to occur in tandem with other workplace influences to be successful.

Organizational ecology is linked to worker well-being by providing a work environment that balances organizational factors with several other major contributors to worker well-being. These factors include managerial style, demands of work, individual preferences, and organizational culture (Becker & Steele, 1995). As they note,

Combined with the knowledge about individual and group behavior, these factors are the elements, the kit of parts, that together constitute the raw materials of organizational ecology. How they are organized, which pieces are included or emphasized, and how they are shaped and used in practice define not just organizational ecology but ultimately organizational effectiveness. (Becker & Steele, 1995, p. 17)

Several terms are found in the literature to describe the organizational environment. “Work environment,” “organizational culture,” and “organizational climate” are often used interchangeably, but it should be noted that each has a distinct definition. The term “work environment” is found in both nursing practice literature and design literature. Depending on the type of study, this term can have different meanings.

Nursing practice references the work environment as a collective unit of organizational structure, culture, staffing, and settings (Hendrich & Chow, 2008; Institute of Medicine, 2004b); design literature most often refers to the work environment as the physical setting for a particular group of workers (Joseph, 2006; Rashid & Zimring, 2008). It is necessary to be aware of this difference to make certain that different themes emerge correctly and are considered appropriately.

Another term that is used in the nursing literature is “organizational climate.” Organizational climate has been defined to encompass work characteristics such as decision making, leadership, and working conditions (Clarke, 2006). MacDavitt et al. (2007) conducted a literature review for “organizational climate” within the nursing literature and identified eight domains and 15 constructs for their integrative model of organizational climate. Located within these domains is a dedicated focus on healthcare worker outcomes. The focus of the literature for healthcare worker outcomes, as an outcome of the organizational climate includes: intention to leave, job satisfaction, burnout, retention of nurses, and occupational hazards. This research team also reported a well-documented relationship between nurses’ intentions to stay at their current job and

perceived staffing levels, and general perceptions of organizational features such as collaboration and communication (MacDavitt et al., 2007).

“Organizational culture” is a somewhat intangible term, not consistently used in the occupational health literature (Scott-Findlay & Estabrooks, 2006). Multiple definitions have been found, with a central idea that includes the norms, values, and beliefs within an organization (Gershon, Stone, Bakken, & Larson, 2004). The organizational climate of an organization most closely reflects the employees’ perceptions of organizational culture (Gershon et al., 2004; MacDavitt et al., 2007).

Shirey (2009) conducted a qualitative descriptive study of the relationship between organizational culture and healthy work environments by using a stress and coping lens. Figure 5 identifies the relationship among variables: authentic leadership, organizational culture, and healthy work environments. Organizational culture was found to influence perceptions of stress, empowerment, and role satisfaction, suggesting that organizational culture and leadership are important contributors to creating and sustaining healthy work environments (Shirey, 2009).

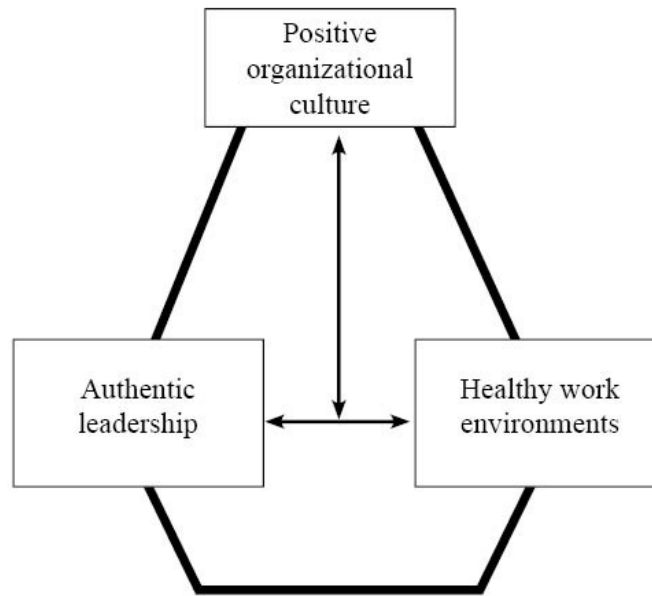


Figure 5. Relationship among variables: Authentic leadership, organizational culture, and healthy work environments. Adapted from “Authentic leadership, organizational culture, and healthy work environments.” By M. R. Shirey, *Critical Care Nursing Quarterly*, 32(3), p. 190. Copyright by Critical Care Nursing Quarterly (2009).

As researchers of healthcare environments, it is important to understand all factors and variables involved with strategies to improve job satisfaction and medical-surgical nursing unit design. As stated previously, no single variable will solve medical-surgical nursing issues; rather, multiple variables must be considered for their interconnectedness for determining design solutions, including influences of the nursing shortage, professional influences, and organizational climate. The next section explores communication as an important variable influencing medical-surgical nursing issues and healthcare design.

Communication

Communication is apparent in our everyday lives. Dating back to the early teachings of Aristotle and Plato, communication is seen as “a necessary skill for participation in civic life” (Wood, 2009, p. 2). Communication forms range from one-on-one interaction to family discussions, professional interactions, and oral traditions. Our individual identities are created through interpersonal communication. Interpersonal communication also builds personal, social, and professional relationships. Because of the interrelationships between humans, behaviors, and environments, communication is studied through an interdisciplinary lens (Wood, 2009).

Communication has been studied extensively in both office work environments and in nursing practice research. This section will first review office communication literature followed by nursing literature. The research available from office communication literature is applicable to nursing environments, because the team structures that are often studied in office environments are also found in nursing environments. Communication is a common contributor to stress among individuals and among teams.

Two theoretical frameworks, Social Information Processing Theory (Salancik & Pfeffer, 1978), and Uncertainty Reduction Theory (Berger & Calabrese, 1975), have been used to study the effects of poor communication and stress. These theories were used to inform Miller, Ellis, Zook, and Lyles’ (1990) model that proposes ways in which communication variables (participation in decision making and social support) lead to two stress variables (perceptions of satisfaction and personal accomplishment) and

ultimately to job dissatisfaction and burnout for employees of a hospital unit (Miller et al., 1990).

The following segments provide details about types of communication that include face-to-face communication, digital communication, and nonverbal communication, as well as the differences between informal and formal communication. A discussion of perceptions of good communication, barriers to effective communication, and how new generations are changing the way individuals communicate follows. The section concludes with a review of communication in the workplace and in healthcare nursing units. Throughout, examples of how communication is used in healthcare settings have been included to help focus the topic of communication on its importance to nurses in the medical-surgical nursing unit.

Types of Communication

Humans utilize multiple methods of communication each day. We may talk to our family members over breakfast, present a report to a group of coworkers, call a friend on our way home from work, and catch up with friends and family via email in the evening. Communication can be verbally, nonverbally, or digitally communicated. Representing a complex system, communication is studied by many researchers. Wood (2009) describes the composition of communication as an interrelated set of variables.

Because interpersonal communication is systematic, situation, time, people, culture, personal histories, and so forth interact to affect meanings. We can't just add up the various parts of a system to understand their impact on communication. Instead we have to recognize that all parts of a system interact;

each part affects all others. In other words, elements of communication systems are interdependent, each element is tied to all the other elements. (Wood, 2009, p. 22)

Communication is a process between two or more people. The process of communication is evolving continuously and present in every relationship. Research has shown us that relationships are not static; they change over time. Family and social relationships may grow deeper over years of interaction. Work relationships may also strengthen over time and with increased communication (Wood, 2009). It is with this knowledge, that more importance should be placed on creating opportunities for effective communication in the workplace.

Knowledge of the types of communication in the workplace can contribute to the design of appropriate environments that encourage various types of desired communication. The following segments outline types of communication, starting with face-to-face communication, then moving to nonverbal communication, and continuing with digital communication. Then, formal and informal communication – both of which are present in the workplace, will be discussed.

Face-to-face communication.

Face-to-face communication is defined as “a system of communication behaviors that may fall anywhere from unplanned, serendipitous interaction (e.g., chance encounters in the corridor) to planned, collaborative interaction (e.g., highly ‘formal’ interactions that may last for hours)” (Rashid, 2009, p. 62). Visual access to others is important in an individual’s pursuit of face-to-face communication. When we can

visually see someone, we can determine if it is an appropriate time to approach that individual to engage in communication (Becker & Sims, 2001). Their behavioral cues and body language tell us if they are “available.”

If we see that an individual is busy with a current task or pre-engaged in a conversation, we are able to avoid interruptions to their current process, and wait for a more appropriate time to approach for conversation. These visual cues influence our communication patterns (Becker & Sims, 2001). Becker and Sims (2001) noted that open environments and awareness of an individual’s visual cues helped others time their interactions so they were less likely to be viewed as interruptions. An unexpected revelation by Becker and Sims found “more visual contact actually contributes to fewer unwanted interactions, not more, by changing not so much the frequency as the timing of serendipitous communication” (p. 21).

Face-to-face communication is common in work environments, including healthcare environments. Within most hospitals today, nurses and other members of the patient care team engage in “frequent, short, on-the-fly conversations in corridors, around nursing stations, and in non-medical areas such as break rooms” (Becker, 2007, p. 59). Even in the age of digital communication prevalence, clinical staff may prefer face-to-face communication for exchanging information and decision support (Coiera & Tombs, 1998; Parker & Coiera, 2001). Approximately 60% of clinician time in clinics is devoted to direct communication with other staff (Tang et al., 1996). In a study of staff communication transactions in a hospital with a mature computer-based record system, Safran, Sands, & Rind (1999) found that 50% of all information transactions were done

through face-to-face communication. Rashid (2009) suggested that for the success of a face-to-face communication system, those participating in this behavior must be “sufficiently close to each other” (p. 62). Rashid (2009) further explained the need for the lack of barriers to visual and verbal access for participants to engage in synchronous communication. These research findings reinforce the importance of designing optimal environments for face-to-face communication.

Although many positive outcomes have been studied for clinical face-to-face communication, it is important to understand that face-to-face communication can also have negative influences on the culture of a work environment (Becker & Sims, 2001). This type of communication can be disruptive to others in a nearby setting and be cause for errors due to lack of concentration due to excessive noise and interruptions. Face-to-face communication can also be seen as a form of interruption for a focused employee trying to complete a task (Rashid, 2009). It should be noted that face-to-face communication is not always preferred or welcomed, and design recommendations for medical-surgical nursing units need to consider appropriate strategies to accommodate privacy needs for both nurses and patients.

Nonverbal communication.

Nonverbal communication involves our body’s response to interaction. Examples include nodding, winking, eye contact, and body movement. Nonverbal communication is symbolic, arbitrary, ambiguous, and abstract (Wood, 2009). To experience nonverbal communication, we most often need to be in the presence of the person with whom we are communicating, e.g., engaging in face-to-face interaction. Nonverbal communication

is less apparent in digital communication such as emailing and texting. The next segment will review characteristics of digital communication.

Digital communication.

Communication technologies are affecting the method, timing, and content of interaction (Breslin, Greskovich, & Turisco, 2004). Technology is accelerating just as quickly, if not quicker, as the pace of organizational change in business environments. With these changes, building design has also changed to help generate new structures for helping individuals and groups of people facilitate communication (Penn, Desyllas, & Vaughan, 1999). Providing areas for social interaction and for using wireless devices (e.g., laptops, handheld devices) has become the standard rather than the exception.

The healthcare work environment is no exception to the effects of changing technology. Technology is playing an increasingly important role in how nurses and other patient care team members communicate. Wireless networks and handheld and ear devices are now used to deliver patient information more quickly than face-to-face communication, which typically requires time to locate the person with whom you need to speak. Some systems are now available that will automatically track the physical location of a nurse, or other patient care team member to help with communication efforts on a large unit (Hendrich & Chow, 2008).

Informal communication.

Much of the information presented in this segment was found in literature on office environment design and communication studies. The information was determined relevant to this study, because of the interactions between coworkers that occur between

nurses on a nursing unit. The difference occurs in the setting in which the communication takes place, office or nursing unit. As has been noted, opportunities for communication occur when there is a presence of two or more people in face-to-face settings (Whittaker, Frohlich, & Daly-Jones, 1994). Often times, this communication occurs through opportunistic meetings in open areas such as corridors, gathering spaces, and open office environments (Penn et al., 1999). Informal communication is defined by a message being determined by the conversing individuals and is not predetermined like formal communication (Coiera, Jayasuriya, Hardy, Bannan, & Thorpe, 2002). Informal communication is very frequent in the workplace and takes on the role of execution of work-related tasks, coordination of group activities, transmission of office culture, and social team building (Whittaker et al., 1994). While other forms of communication exist in the workplace such as phone and email, estimates of time spent engaging in informal communication in the workplace range between 25% and 70% (Whittaker et al., 1994).

One important characteristic of informal communication that has been studied is the physical location of those engaging in face-to-face communication. Research shows the importance of physical proximity to support frequent, opportunistic conversations. It was also noted that trends such as telework (i.e., working from a remote location) and mobile devices (i.e., phones) are substandard ways to support informal communication (Whittaker et al., 1994).

Informal communication was found to be the primary form of communication in the study of staff communication in an emergency department. Coiera et al. (2002) found 90% of information transactions in an emergency department were informal rather than

formal. The emergency department, along with other healthcare departments such as critical care and medical-surgical nursing units, are viewed as high-interaction workplaces and dominated by informal communication processes among employees.

Formal communication.

Formal communication is defined by a predetermined structure for delivering a message to an individual or group of people (Coiera et al., 2002). Formal communication, sometimes referred to as programmed interaction, most often takes place in meeting spaces such as offices or conference rooms. Assigning a time and place to conduct interaction among a group of people eliminates the random chance meetings and opportunities for informal communication (Penn et al., 1999).

In summary, communication is diverse, evolving, and necessary to maintain relationships. Forms of communication vary depending on the situation and the message being delivered. Verbal, nonverbal, and digital communication are present in our daily relationships and in our workplaces. Communication can be formal, such as a scheduled meeting; or informal, such as an impromptu or opportunistic conversation in a hallway. The focus of this exploration is to study opportunities for verbal, informal, and opportunistic communication rather than formal, planned communication. The need to understand communication types and how communication is achieved between two or more coworkers is necessary as this study focuses on how the built environment influences nursing communication on a nursing unit. The next segment will review barriers to communication.

Barriers to Effective Communication

As it has been discussed, communication is an important contribution to maintaining and building relationships. This is important in our personal lives as well as our professional lives. To fully understand the process of communication, it is important to understand what factors are involved in preventing effective communication. Wood (2009) outlines factors that influence our perceptions of communication. Physiology, age, culture, cognitive ability, and self are all viewed as influences on how we view everyday communication.

Studies have been conducted to investigate barriers to effective team communication. Several factors that were noted included gender differences, education levels, team size, instability of the workforce and assignments, absence of a common purpose, and inhibiting physical environments (Iedema, Long, Carroll, Stenglin, & Braithwaite, 2005; Kalisch & Begeny, 2005; West & Pillinger, 1996). Being able to see the person you wish to communicate with increases effective communication. Several studies have also explored the issues involved when looking for someone on a nursing unit. They determined that nurses spend from 10% to 25% of their time looking for other staff members (Linden & English, 1994; Miller, Deets, & Miller, 1997).

Geographical separation of teams as a physical barrier on a medical-surgical nursing unit can also be a hindrance to communication. In a report focusing on teamwork in primary healthcare, geographic separation was noted to be an issue for some teams that may contribute to team ineffectiveness (Royal Pharmaceutical Society of Great Britain, 2000). Kalisch and Begeny (2005) reported the likelihood of effective teamwork

increasing when there are adequate sightlines (i.e., being able to see other nurses) on a nursing unit. They further elaborated on the need for teams to be in close physical proximity to each other to increase opportunities for synergistic cooperation.

These are examples of inhibiting physical environment characteristics that can compromise a person's ability to quickly locate and communicate with a specific person. Characteristics that encourage communication as outlined by this study's theoretical framework, space syntax, are discussed in more detail in a following section.

Generational Preferences for Types of Communication

The work environment will soon experience the largest generational interrelationship the United States has ever seen with four prominent and distinct generations co-existing in the workplace (Becker & Sims, 2001). The current workforce has been successful at integrating the Matures (those born before 1946), Boomers (those born between 1946 and 1960), and Generation X (those born between 1961 and 1979) (Becker & Sims, 2001). Generation X employees tend to be more informal and direct with their communication style. This generation relies heavily on communication through email (Becker & Sims, 2001). Until recently, Generation X has been the biggest contributor for new workplace technology integrations, such as email. Soon, the workforce, including nursing, will see Generation Y (those born 1980-2000) instigate additional technological changes in communication. This generation is "technologically sophisticated, has positive expectations, and a desire for collective action" (Swenson, 2008, p. 65).

Generation Y uses the latest technology as a primary means of communication, yet surprisingly retains their skills in verbal communication (Melik, 2007). They have been exposed to advanced forms of technology communication since birth and have used this as a way to influence innovative practices (Becker & Sim, 2001). Generation Y, also known as the Millennials, Generation Next, and the Echoboomers, perceives verbal and nonverbal messaging differently than previous generations (Swenson, 2008). Becker and Sims (2001) found Generation Y is not as attracted to formalized communication as previous generations; therefore a larger focus on informal communication may dominate future communication research.

When studying communication in any type of work environment, an extensive survey of generational preferences for communication should be considered before implementing improvement strategies. Design strategies, which will be discussed in a following segment, may vary take a very different direction in the future depending on communication preferences of multiple generations.

Importance of Workplace Communication

Communication among team members in office workplaces has been well documented (Becker, 2007; Cross, Borgatti, & Parker, 2002; Darling & Dannels, 2003; Parker et al., 2001). Equally documented are communication structures for both formal, planned interaction and informal, unplanned interaction. Becker and Steele (1995) noted that regardless of the type of communication, constant communication is the 'glue' that holds teams together. However, the challenge remains how to properly configure buildings and office layouts to support the dynamics of team communication both

formally and informally. Though the information in this segment was found primarily in literature that focused on communication in office environments, the findings are applicable to healthcare environments because patient care teams are similar in structure to office teams.

Importance of communication for team performance.

Nurses work in teams, whether as a team of nurses or a team of multidisciplinary members. Therefore, the need exists to address opportunities to improve team performance through communication. The performance of nursing teams directly affects care delivery and unit operations (Kalisch & Begeny, 2005). High-performing teams have been credited with improving patient care, increasing staff satisfaction, enhancing organizational effectiveness, and strengthening the delivery of care (Clark, 2009; Kalisch & Begeny, 2005; Leppa, 1996).

The size of a team is important. With each additional member, the number of one-to-one interactions increases. Interaction is the form of communication being measured. Kalisch and Begeny (2005) provide examples of a small team of three having only three one-to-one interactions; a team of four as having six instances of one-to-one interactions; and a team of 12 having encounters through 66 different one-to-one interactions. This represents an incredible number of different interactions taking place within a given team. Communication is highly important in team performance; in cases of extremely large teams, visibility of one another is especially important to allow for team members to know one another's strengths and vulnerabilities (Kalisch & Begeny, 2005).

In earlier work of studying communication behaviors in hospital settings, Coiera and Tombs (1998) suggested, that “the health care system seems to suffer enormous inefficiencies because of poor communication infrastructure and practices” (p. 673). Studies have since reviewed the communication system for healthcare settings and confirmed Coiera and Tombs’ findings (Boyle & Kochinda, 2004; Coiera et al., 2002; Manojlovich & Antonakos, 2008). The healthcare work environment is characterized as an interruptive workplace. Repeated, unwanted interruptions can lead to inefficiency in practice (Coiera & Tombs, 1998). Interruptions can occur with phone calls, pages, and face-to-face interactions. The majority of these interruptions by the patient care team members are attempts to seek information from colleagues (Coiera & Tombs, 1998). Coiera and Tombs (1998) found a preference exists for seeking information from colleagues over referring to printed materials, as most questions referred to a specific diagnosis or treatment and written information can be unclear or poorly communicated (Coiera & Tombs, 1998).

Communication has been extensively studied in most occupational fields. The information presented in this segment began with findings from occupational health and office settings studies followed by findings from nursing communication literature. Organizations seeking to improve team performance, worker satisfaction, and overall organizational health often put their efforts to communication improvement initiatives (Boyle & Kochinda, 2004; Manojlovich & Antonakos, 2008; Penn et al., 1999; Whittaker et al., 1994). Communication also serves an important role by reducing stress through building social support from friends, family, and co-workers (Cross et al., 2002; Langford

et al., 1997). The following segment describes the importance of social support for individuals.

Importance of communication for building social support.

As discussed previously in the literature review, one of the important occupational health psychology theories is Karasek's Job Demand-Control model. This model identifies social support as an important "buffer" to a person's stress level at work. Low social support or isolation can contribute to negative job outcomes. Workplaces with high social support help protect the workers from the negative effects of high strain jobs (Pelfrene et al., 2002). Nursing is one profession often characterized by high strain and high stress. It is therefore important to the exploration of nursing work environments to consider how social support influences job satisfaction and stress. The following section defines social support and discusses research for social support in the workplace.

Social support in the workplace.

Social support is defined in multiple ways in the literature. Most nursing literature on social support have narrowed the definition to encompass "a supportive climate and environment" (Hutchinson, 1999, p.1521). A broad definition in the literature is "the assistance and protection given to others, especially individuals" (Langford et al., 1997, p. 95). Social support is an effective method to mitigate the level of stress felt by employees. One important contributor to building social support in the work environment is strong communication and interaction among staff (Shirey, 2004). Architects and interior designers can have a direct influence on these types of relationships by the design

of the facility. Schweitzer (2004) stated “design that encourages positive interactions among staff could promote greater job satisfaction” (p. S-73).

Social support for nurses.

AbuAlRub (2004) found that perceived social support among hospital nurses increased the level of reported job performance and decreased the level of reported job stress. He also found a close relationship between job stress and job performance. Those who felt higher levels of stress reported a lower performance rating in their jobs than those who felt lower levels of stress. This finding was supported by the results of Erenstein and McCaffrey’s 2007 study of nurse retention. In their study, social support was found to be a determining factor in nurses feeling less job stress. They also found that a positive work environment, characterized by high social support and low stress, is essential for the retention of nurses. Nursing efficiency can be improved by creating a more supportive work environment that limits stress and physical burdens of nursing practice, which then has the potential to increase job satisfaction and staff retention (Hendrich et al., 2009).

Hendrich et al. (2009) notes considerations for the physical design of a nursing unit should include configurations that allow open and accessible communication opportunities between all members of a patient care team. These characteristics will help built stronger organizational support for nurses and help to streamline work processes and communication (Hendrich et al., 2009). Becker (2007) expands on the importance of communication in a nursing unit:

Nursing time spent in social interaction with other caregivers may contribute to care through indirect means, such as alerting nurses to emergent situations. Both planned and unplanned encounters occur throughout a nursing shift and are important contributions to efficient nursing. (p. 58)

In summary, the review of the literature on social support offers evidence that a strong relationship exists between communication, social support, job stress, and satisfaction. However, in developing a theoretical model, it should be noted that social support is a buffer between work stress variables and not a main outcome or effect for an individual or group of people (Spitzer et al., 1995). The next segment will focus more directly on communication in a nursing unit.

Communication in a Nursing Unit

The role of communication in a nursing unit environment is becoming increasingly important with the current nursing shortage and issues surrounding quality of patient care. Tucker and Spear (2006) noted that a major contributor to the complexity of the work nurses perform comes from the coordination role that each nurse plays. This coordination role requires a nurse to communicate with other members of the patient care team to order blood tests, radiology tests, and physical therapy, to name a few. Nurses must have continuous knowledge of what other members of the patient care team are doing, adding to their already heavy cognitive load. Several studies were noted by Tucker and Spear (2006) for tracking the amount of time nurses spend coordinating care activities, which was found to be between 34% and 49% of a typical work shift.

Gurascio-Howard and Malloch (2007) compared the two most commonly found nursing unit designs, centralized and decentralized, to study the relationships between patient care team communication, direct care time with patients, types of activities, number of visits, and response time to patient needs. Their study provides an important mixed methods foundation for studying communication in medical-surgical nursing units.

In Gurascio-Howard and Malloch's (2007) study, data were analyzed from 502 communication episodes, not including patient conversations. Of the 502 communication episodes, 56% were from the decentralized unit and 46% were from the centralized design. The research team coded the data for communication type and for initiator or receiver of the communication. It was found that an RN working in a decentralized unit spent more time (31% to 83%) for all communication types except patient information. These results further suggest that in a decentralized unit, the greater the number of patients and greater number of staff requires additional collaboration time. It was also noted that the alcoves in the decentralized unit provide closer proximity to patients for the nursing team and increases collaboration opportunities for at least two patient care team members. Results also suggest that centralized units increase opportunities for RNs to communicate with the health unit coordinator (HUC) and for RN networking and mentoring.

Gurascio-Howard and Malloch (2007) did not use a theoretical framework to structure their investigation of communication. Also, the generalizability of their findings is limited, due to the sampling of only eight RNs. Of the eight RNs, four RNs were on a centralized nursing unit and four were on a decentralized unit. The methods used in this

study to measure types of communication and amount of time spent communicating on a nursing unit were largely quantitative; qualitative methods, including interviews and shadowing were not included.

Many patient care teams are now multidisciplinary and play a prominent factor in healthcare delivery. Communication among team members is particularly important to achieve high levels of quality patient care. Borrill et al. (2001) conducted a national study of patient care teams in the United Kingdom and noted the importance of professionals working and learning together for the most cost-effective outcomes for patients and clients. It was also noted that often times the communication among these team members is informal, unplanned, and opportunistic.

The vast majority of literature available focuses on the relationship between patient care outcomes and communication. There is considerably less research on the relationship between good communication and staff satisfaction.

Impacts on patient care.

The majority of literature about face-to-face communication in clinical settings focuses mostly on how it affects patient outcomes. A study conducted in Australia found poor communication to be associated with 17% of system problems. Within those system problems, 84% of them were determined to be potentially preventable. Specifically within the intensive care units, 2% of all activity includes patient care team communication; however, this accounted for 37% of all errors reported (Coiera et al., 2002).

The recent development of a new measurement tool to study nurse-nurse collaboration identifies five domains: problem solving, communication, coordination, shared process, and professionalism (Dougherty & Larson, 2010). This tool seeks to improve nurse collaboration to reduce medical errors and improve patient care and nurses' job satisfaction. These studies are examples of several that indicate a strong correlation between poor communication and patient care.

Impacts on staff.

Communication is also found to impact team collaboration and performance; collaboration and team performance are intrinsically tied to each other (Clark, 2009; Kalisch & Begeny, 2005; Lindeke & Sieckert, 2005). Most teams are formed with common goals, not unlike patient care teams on a medical-surgical nursing unit who have a goal of caring for a patient and obtaining optimal outcomes. Nursing staff were found to have higher job satisfaction, lower burnout rates, and more intention to stay at their jobs after reporting a higher level of teamwork (Rafferty, Ball, & Aiken, 2001). The following segment discusses communication as a factor in building collaboration and team performance and as a necessary contributor in "communities of practice," a term commonly referred to in healthcare practices as a group of people who have a common understanding and seek to share information (Lesser & Prusak, 2000).

Collaboration and team performance.

In healthcare settings, collaboration is imperative to provide care for patients. Collaboration can occur in face-to-face communication and through technology such as email. In the demanding and rapid-paced settings of certain healthcare units, there is no

second chance to communicate effectively as the results of collaboration among patient care team professionals can have positive or negative outcomes (Lindeke & Sieckert, 2005). Effective collaboration requires a good team structure, enforced through team building. Teams must have mutual respect and common goals to obtain optimal team performance. Teams perform better when they know each others' strengths and weaknesses and are able to assist in problem solving (Kalisch & Begeny, 2005). High-performing teams also share space together, known as collocation. Collocation is defined as "the location of the team in the same physical facility so that they share resources and a common arena, which provides the setting for individual team interaction" (Clark, 2009, p. 225). Collaboration resulting from working in a shared space leads to rich networking and facilitates communication because patient care team members are more likely to interact due to their close proximity to each other (Clark, 2009).

Communities of practice.

Communities-of-practice is a common framework to describe the role of communication among teams in a healthcare facility. The communities-of-practice framework provides a way to analyze group interactions and relationship development in a practice setting. Nursing staff, like other medical professionals, rely on each other for information sharing and are involved in learning by participation for much of their knowledge sharing, which helps to develop more competent teams (Lesser & Prusak, 2000). The building of trust within these communities of practice is beneficial for those involved with them. Feldman (1987), in a study of organizational communication, found

that once someone was a trusted member of a team, they found it easier to access information and solicit feedback from others on the team. Much of this communication is informal, which plays an important role in building coworker relationships. Stronger coworker relationships can positively affect worker effectiveness and commitment (Becker, 2007).

Technology.

Healthcare professions have quickly adopted new technology for patient care and team communication. Examples include electronic medical records (EMRs) and nurse locator systems. These technologies have been introduced to decrease medical errors, increase patient safety, and increase the direct time nurses spend with patients (Gozdan, 2009). In a study of nurse communication, the nurse locator system was found to decrease the time needed to locate other members of the patient care team, increased direct patient care, and increase opportunities for team communication (Gurascio-Howard & Malloch, 2007).

Technology use on a medical-surgical nursing unit should be considered when studying communication (Ritchey & Pati, 2008). However, as previously discussed, there may be generational differences for using technology that could impact future design recommendations for medical-surgical nursing units. The next section of the review of literature outlines details of the medical-surgical nursing unit, starting with its history, purpose, and functional aspects.

Medical-Surgical Nursing Unit

The majority of attention in healthcare design research has been given to the design of the nursing unit and how it can directly or indirectly impact work efficiency, staff fatigue, worker and patient safety, and reduce nosocomial infection rates (Berry & Parish, 2008; Chaudhury, Mahmood, & Valente, 2009; Pati, Harvey, & Barach, 2008; Rashid & Zimring, 2008; Ulrich et al., 2004). Less research has studied how the design of nursing units influences staff for informal communication, learning opportunities, job stress, and satisfaction (Becker, 2007).

Several researchers are turning their attention to the nursing work environment and its impact on nursing staff and organizational outcomes. Hendrich et al. (2009) recognize the influence that design can have on the nursing unit. They state, “altering the nurse work environment, therefore, has the potential to influence nurse workload, satisfaction, burnout, and retention, as well as patient safety and overall mortality” (Hendrich et al., 2009, p.18).

The following segments review aspects of a typical medical-surgical nursing unit starting with the history, functions, general characteristics, and nurse-to-patient ratios. The review then turns to the design characteristics of a modern medical-surgical unit, exploring the differences between centralized, decentralized, and hybrid models.

History of Nursing Unit Design and Early Efficiency Studies

Hospitals, including nursing units, have a relatively short history from a design study perspective, unlike other building types such as cathedrals. Bobrow and Thomas (2000) describe design layouts for some of the earliest nursing units were dictated by the

method of construction and structural limits, rather than by human factors and needs. These small units were often associated with a religious organization and as such, were constructed as part of an abbey. These early hospitals included areas for growing agricultural products, such as herbs, to be used for medical treatment.

Hospitals grew in size over time, and by the 15th-century developed primarily in major cities, yet still remained affiliated with a religious organization such as Milan's Brunelleschi's Ospedale Santa Maria Nuova and Rome's Santo Spirito (Bobrow & Thomas, 2000). Further advancement in nursing unit design saw the implementation of the Nightingale Plan in the middle of the 19th-century, named after famed nursing pioneer Florence Nightingale. This architecturally, more open plan included through cross-ventilation and a nurses' station at the point of entry to the nursing unit. This plan was shown to be very efficient for its time and became the standard in hospital design for many decades (Bobrow & Thomas, 2000).

Most of the advancements in nursing unit design came in the late 19th-century. Bobrow and Thomas (2000) described the many construction technologies that were introduced during this time that allowed longer structural spans, vertical movement with elevators, and air conditioning. These advancements allowed hospitals to evolve in their role for the treatment of diseases. Not only did the design and construction of nursing units change during this time, medical practices were also evolving through new research. This new medical research emphasized efficiency in operation, eventually yielding highly functional nursing units. However, the design of these units often neglected the patient's

and family's needs for an emotionally supportive environment (Bobrow & Thomas, 2000).

One hospital to implement several remarkable concepts that led to modern nursing unit design was John Hopkins University of Baltimore School of Medicine (Maryland) in 1875. These were some of the first nursing units to experiment with circular, square, and octagonal configurations. An important aspect to all of these configurations was the location of patient beds, which were no longer lined along the exterior walls and made visible from the central nursing desk. These models became the eventual foundation for the circular designs for many units in the 1950s (Bobrow & Thomas, 2000).

The open wards of early nursing units became increasingly unfavorable due to the noisy conditions and lack of privacy for patients. In the 1960s, the open ward was replaced by a double-loaded corridor with smaller patient rooms on each side of the corridor. This change in design created larger nursing units and subsequently forced nurses to walk more miles each day while providing care for their patients (Bobrow & Thomas, 2000).

After World War II, the United States saw the introduction of the Hill-Burton Act. This act gave communities an opportunity to build "a local hospital that reflected the latest trends" (Bobrow & Thomas, 2000, p. 137). Unfortunately, most of these hospitals were not built to reflect the latest trends, but were constructed following the rather outdated U.S. Public Health Service guidelines that had been developed from old patterns of planning. These Hill-Burton hospitals have served their useable lives and are many of

the hospitals that are currently being replaced with today's healthcare construction boom (Bobrow & Thomas, 2000).

Some of the earliest research studies on nursing unit design focused on efficiency and traffic patterns. Bobrow and Thomas (2000) explained a study during the 1950s by researchers at Yale University in which they identified 14 traffic patterns that were determined to make up 91% of nursing unit traffic. This was one of the first tools for architects to evaluate design configurations and their influence on costs of operation. In the mid-1960s, several limitations of this study emerged. One limitation pointed out that the distance traveled between a patient room and a service room was only important if it were used with high frequency. Nursing unit design responded to these studies by providing dispersed supply centers outside of each patient room.

Another study on nursing unit efficiency was conducted by the Georgia Institute of Technology that calculated the cost of employee travel time with the frequency of travel, leading to the pro-rated cost of construction. This study was noted to be "a very effective way of evaluating the relative insignificance of construction costs over the lifetime of a building" (Bobrow & Thomas, 2000, p.138). The Georgia Institute of Technology study indirectly led to the analysis of per diem cost of construction, considered to still be an effective way to evaluate the significance of construction costs over a lifetime of a building.

Modern nursing unit design is comprised of established, recognized, efficient layout configurations including the double-loaded corridor, race track, and compact square (rectangle or circle) and are diagramed in Figure 6. The double-loaded corridor

configuration first became popular in the 1900s and is still seen in modern nursing unit design, most often as a race track configuration (Bobrow & Thomas, 2000). These configurations are generally found in groupings or in pods, depending on the size of the hospital (see Figure 7). Groupings typically consisted of three or four of the same configuration, each connected by hospital infrastructure and support spaces. In both Figures 6 and 7, the “N” indicates the location of the nurse work station(s).

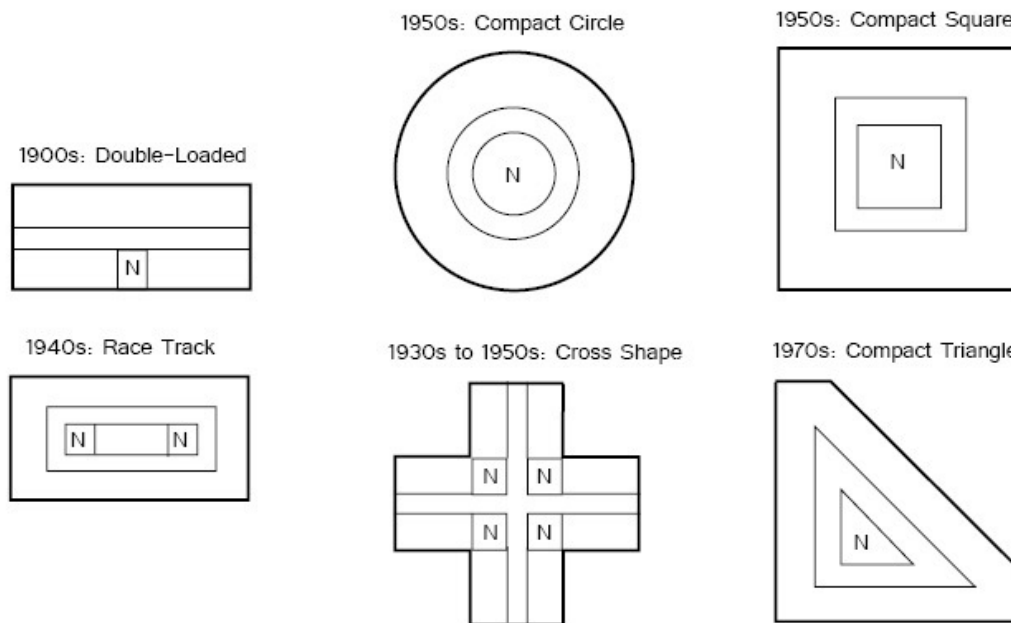


Figure 6. Generic plans of common nursing unit forms. Adapted from “Inpatient care facilities,” in S. Kliment (Ed.), *Building Type Basics for Healthcare Facilities*, p. 140. Copyright 2000 by John Wiley & Sons, Inc.

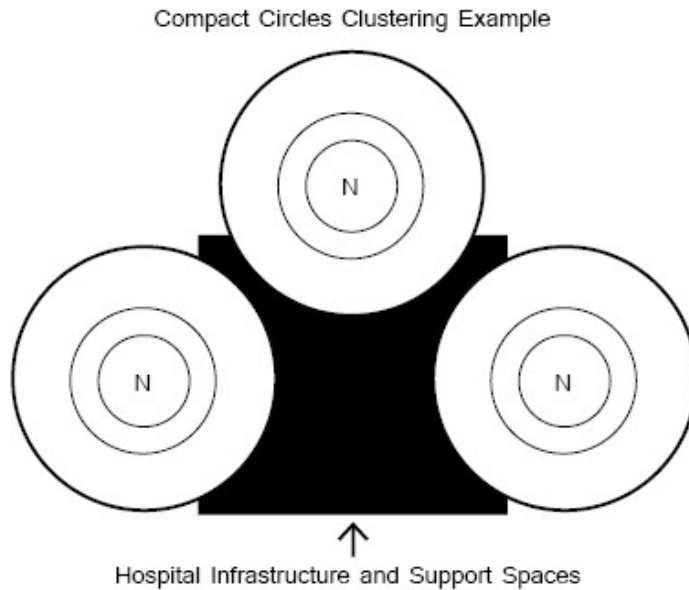


Figure 7. Clustering (grouping) example of early nursing unit planning concept showing compact circles.

During the 1950s and 1960s, most nursing unit designs show a central work core with some smaller support functions dispersed throughout the unit in the form of pass-through “nurseservers” located adjacent to patient rooms. These nurseservers store supplies for the convenience of staff. This design was seen as a highly efficient configuration during the day with peak nursing ratios, but did not work well during night shifts with low nurse ratios (Bobrow & Thomas, 2000).

Another variation of this type of nursing unit is seen in the cross shape configuration, popular from the 1930s to the 1950s (see Figure 7). The 1950s and 1970s witnessed several new geometries for nursing unit configurations. The compact circle, compact square or rectangle, and compact triangle were designed with patient rooms arrayed around a central point, a nurse station. With these configurations, travel distances

are averaged between patient rooms and distance to support areas are minimized. While this type of configuration was originally evaluated by the studies at Yale to be “the most efficient plan designed to date” (Bobrow & Thomas, 2000, p. 140), working in a circle, for example, has some inherent problems. In a circular layout, the number and size of patient rooms are dictated by the planning program and ultimately control the diameter of the circle. These configurations also constrain the construction of additional rooms, limiting future flexibility of the nursing unit. Additional patient towers were added to many of these Hill-Burton hospitals, but with separate circulation and elevators, creating confusing orientation and wayfinding for patients and staff (Bobrow & Thomas, 2000).

During the 2000s, the design of nursing units has begun to transition from multiple-bed patient rooms to single-bed patient rooms (American Institute of Architects, 2006). This change is due to several research studies that show single patient rooms to contribute to the reduction of hospital-acquired infections through reduced airborne infection; fewer medical errors due to lower noise levels, better lighting, and acuity-adaptable rooms; and improved patient sleep through noise reduction (Ulrich & Zimring, 2004; Ulrich et al., 2008). Several technological introductions are also changing the way nursing units are designed. These technologies include bedside charting and computer-operated medicine dispensing.

To summarize, medical-surgical nursing units have a relatively short design history and have seen constant configuration change. New findings are influencing medical-surgical nursing unit design, which could likely see more changes in the future. It is important to understand both the history of medical-surgical nursing units and the

possible directions these units may take in the future. Research is the most powerful tool to influence future designs. The next segment will review the basic functions of a medical-surgical nursing unit.

Functions of a Medical-Surgical Nursing Unit

Nursing units are defined as care units where patients who require a hospital stay for more than 24 hours are admitted and assigned a room. Several types of nursing units exist within most hospitals. As previously noted, the focus of this study is medical-surgical nursing units. In this type of unit, medical professionals provide care 24-hours a day for patients recovering from surgery and general medical conditions. Patients in this type of unit are of a mixed population with a diverse range of diagnoses (Hendrich et al., 2008), ranging from recovery from routine surgery such as an appendectomy to injuries sustained in a motor vehicle accident. The intensity of care patients receive in a medical-surgical nursing unit is less than the care available in other types of units such as an intensive care unit, a step-down unit (e.g., required level of care between intensive care and medical-surgical), or a specialty care unit (e.g., pediatrics or cardiac) (Bobrow & Thomas, 2000; Hendrich et al., 2008).

General Characteristics

Nursing units make up almost half of the total area of most modern hospital facilities, depending on range of services offered (Institute of Medicine, 2004b; Ritchey & Pati, 2008). Attention to the design of these units is important as it ultimately influences patient outcomes, quality of care, provider satisfaction, and financial outcomes (Ritchey & Pati, 2008). The types of spaces typically found within a medical-surgical

nursing unit include patient rooms, nursing station(s), core support space, and corridors. The number of patient rooms will vary depending on the size of the hospital. Rooms on a nursing unit may be either single or double occupancy, depending on when the facility was built. Since the adoption of new guidelines standards in 2006, most newly constructed nursing units in the United States follow the American Institute of Architects (AIA) Guidelines for the Construction of Health Care Facilities (2006) recommendation for single patient rooms. The Joint Commission (2007), the accreditation organization for hospitals, has also adopted these guidelines, making single patient rooms standard for new healthcare nursing units. Although this is not a legal requirement, the majority of hospitals adhere to AIA Guidelines guidelines to be approved by the Joint Commission, a requirement to receive Medicare reimbursement.

Size.

At this time, no industry standards exist to help healthcare organizations and designers define the size of nursing units. The Advisory Board (2007), a leading provider of healthcare benchmarking data, recommends that for efficient operation, a nursing unit should not exceed 36 beds. Ritchey and Pati (2008) classified unit size as being “large” if a unit had more than 32 beds and “small” unit if it had less than 22 beds.

The size of the medical-surgical nursing unit is important, because number and clustering of rooms is important to patient assignments for nursing staff. This nurse-to-patient ratio, sometimes referred to as patient-to-nurse ratio, has been studied and found to be a factor in job stress, effectiveness, and patient outcomes (Aiken et al., 2002).

The configuration of patient rooms and support areas determine the distance members of the patient care team must travel to provide patient care (Ritchey & Pati, 2008). Often the number of rooms and clustering of patient rooms is determined by the organization's adopted care delivery models and staffing ratios.

Nurse-to-patient ratios.

Several care delivery models exist for nursing units. The design of the nursing unit, at its most basic function, needs to support the care delivery model that has been accepted by a particular nursing unit. For many of the patient care models, typical ratios are found to be 1:4 or 1:5 RN-to-patient ratio during day shifts. This ratio can go as high as 1:6 or 1:8 during night shifts. In addition to the RN ratio, most units will have additional nurses and unlicensed assistants (LPNs and CNAs) for each shift to provide peer support and back-up (Ritchey & Pati, 2008).

Design of a Medical-Surgical Nursing Unit

Overall, limited research is available on medical-surgical nursing unit design. This section will first review the basic design structure and components of a medical-surgical nursing unit. Discussion will then be turned to recent medical-surgical nursing unit studies.

Two distinctive models for medical-surgical nursing unit design have been typical in healthcare facilities since the 1950s. A traditional approach is most commonly associated with *centralized* design, which has one main nursing station that is central to the patient rooms in that area. At the start of the 21st-century, nursing units were introduced to the concept of *decentralized* design, which places smaller nursing work

stations throughout a unit, closer to patient rooms. This type of layout nearly eliminates the need for one large central nurse station. A third, more recent design evolved from these two models. A *hybrid* unit design includes a larger nursing unit with several “touchdown” areas located throughout the nursing unit and closer to patient rooms. Touchdown areas are typically designed to offer a place for quick charting and include a small writing surface, preferably not located in a high-traffic location. Design characteristics for each of these layouts are discussed in more detail in the following paragraphs. The design descriptions are applicable to the majority of types of nursing units, noting exceptions with some specialty units such as behavior health.

Common to each of these designs is the nursing station, but their location and quantity vary depending on the layout. The nursing station is the main work area for nurses. Activities at the nursing station include charting, phone calls, and collaboration with the patient care team. Communication that occurs at the nursing station has been studied as an important factor in the daily work activities of nurses (Becker, 2007; Gurascio-Howard & Malloch, 2007; Rashid, 2009).

Recent articles examine nursing unit design as a variable in patient care team communication, work activities, and technology (Becker, 2007; Bromberg, Bajaj, Kelly, & Redman, 2006; Gurascio-Howard & Malloch, 2007; Rashid, 2009; Ritchey & Pati, 2008). Ritchey & Pati (2008) state “the unit design and configuration must support team interactions and communication, provide places for the team members to work and acquire supplies at the point of service, and maintain proximity to the point of service [the patient]” (p. 128).

Communication needs are gaining the attention of the research community. Several recent studies have suggested that the design of the medical-surgical unit influences staff communication (Becker, 2007; Gurascio-Howard & Malloch, 2007; Hendrich et al., 2009). Nursing stations serve as important locations for both work-related interaction and for social interaction (Hendrich et al., 2009). Both work-related and social interaction includes communication related to patient care and important education opportunities for nursing staff (Wakefield, 2002).

Pati, Harvey, and Cason (2006) conducted an exploratory study of inpatient unit flexibility. This qualitative study was conducted with 48 interviews across six hospitals in the United States. Their findings suggest that flexibility takes on different meanings for different types of healthcare professionals. Of particular importance for this current exploratory study, was the meaning of flexibility for nursing staff and direct caregivers, stated as “the ability to multitask and multiskill to optimize patient care, maximize efficiency, and address unique situations” (p. 214). Data analysis suggested the following physical design variables as influential to caregivers’ perception of adaptability and flexibility:

- (a) peer line of sight;
- (b) patient visibility;
- (c) multiple division and zoning options;
- (d) proximity of support;
- (e) resilience to move, relocate, and interchange units;
- (f) ease of movement between units and departments; and
- (g) multiple administrative control and service expansion options. (Pati et al., 2006, p. 215)

This analysis illustrates the complexity of studying nursing units and highlights the importance of peer line of sight (i.e., sightlines, visibility) for nursing staff from a qualitative perspective. The researchers noted several implications for inpatient unit design based on the information gathered relating to improving peer visibility:

- (a) simply shaped unit configuration that permits as much distal visibility as possible,
- (b) corner locations of any caregiver workstations within the support core, and
- (c) backstage corridors linking caregiver stations that may be designed within the core space. (Pati et al., 2006, p. 216)

They also identified several design characteristics that can create obstructions to peer visibility, including

- (a) double-loaded corridors of patient rooms extending off of and beyond a racetrack configuration, (b) curvilinear corridor configurations (particularly with the dramatic increase in size of today's patient rooms), (c) charting alcoves that are so deep that sight lines are lost, and (d) opaque support cores that obstruct visibility across a unit. (Pati et al., 2006, p. 216-217)

These design recommendations are, no doubt, difficult to balance with multiple considerations of patient visibility, zoning, and proximity of support areas.

To have a deeper understanding of these issues, the following segments will review the characteristics of centralized nursing unit design, decentralized nursing unit design, and hybrid nursing unit design.

Centralized design.

Centralized nursing stations include one large area (or multiple areas depending on size and configuration) designed to serve as the 'hub' of all communication, charting,

and support functions. When a larger unit is designed with a central nurse station, several challenges need to be addressed including acoustics and longer walking distances for caregivers (Joseph, 2006). In modern nursing unit design, concerns over walking distance have been addressed by incorporating additional support spaces for supplies and medications to reduce the need for nurses to walk to a central location for these items (Joseph, 2006). The design of a centralized location for all members of a patient care team to congregate can encourage open communication and peer mentoring; however, it can also lead to excessive noise and disorder on a unit (Bromberg et al., 2006).

Larger units are often divided into small units called “subunits” or “clusters.” Subunits of 4 to 16 patient rooms with an associated nurse work station are intended to make the unit more manageable for staff and diffuse noise and activity levels throughout a unit. This type of design can also create an isolation factor for staff when they do not have direct visibility of their peers for mentoring and support (Pati et al., 2008).

Smaller unit design is better-suited for a centralized nursing station configuration than larger units. Several benefits of smaller unit design include a quieter environment, decreased walking distance, and better sightlines for the patient care team to develop a sense of camaraderie, thereby reducing feelings of isolation (Ritchey & Pati, 2008).

An advantage of the centralized nursing unit model is that it allows for staff communication and incorporates a recognized central area for gathering for all members of the patient care team. This happens naturally and more often with the centralized unit than a decentralized unit because of the need for staff members to access the support functions of this nursing station. This frequency of interaction is important for building

strong relationships and social support (Clark, 2009; Penn et al., 1999). A generic layout of a centralized nursing unit is shown in Figure 8.

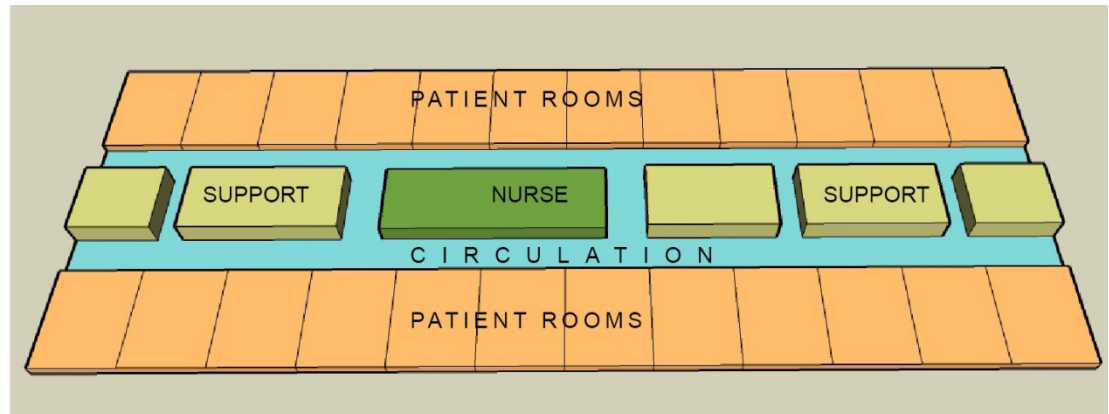


Figure 8. Generic centralized nursing unit plan showing proximity of patient rooms, nurse station, support spaces, and circulation.

Decentralized design.

Recent medical-surgical nursing unit design has shown a strong tendency towards decentralized unit configuration designs (Malkin, 2008). Decentralized nursing stations typically eliminate the need for allocating space in the center of a unit by creating smaller charting stations for one to two nurses just outside the patient rooms; typically one small station for each set of two to six rooms. (Ritchey & Pati, 2008; Schweitzer, 2004). A generic layout of a decentralized nursing unit is shown in Figure 9. Decentralized configurations are typically designed with an observation window provided at the wall separating the smaller charting stations outside the patients' rooms and the patient room itself. These windows allow for observation from across the corridor from a distributed central nursing station (Malkin, 2008).

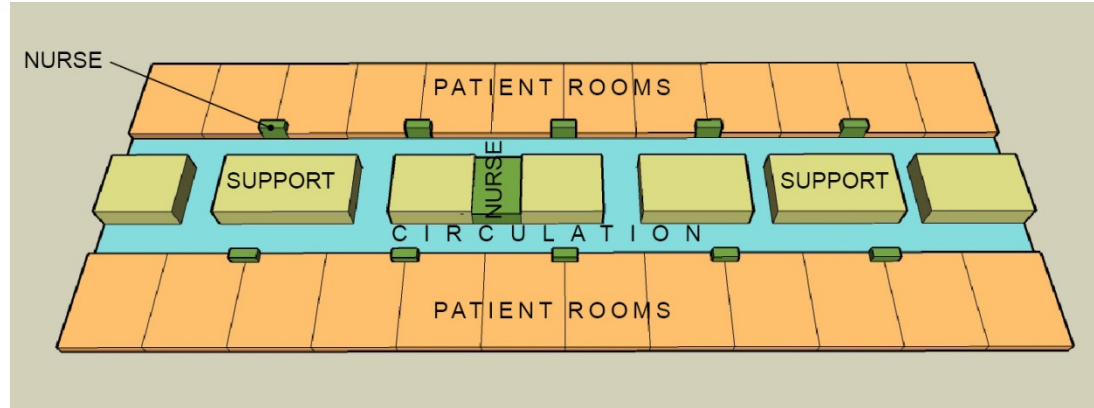


Figure 9. Generic decentralized nursing unit plan showing proximity of patient rooms, nurse station, support spaces, and circulation.

Decentralized nursing station design has been determined to be beneficial for reducing the walking distance for nursing staff (for supplies and patients) and increasing visibility of patients (Joseph, 2006). One concern with this type of design is the lack of frequent face-to-face communication for patient care team members, which could decrease the social support they feel during a typical work shift (Joseph, 2006; Tyson, Lambert, & Beattie, 2002). This layout configuration of a nursing unit can drastically affect communication patterns among patient care team members. Unlike a centralized design model, in an absolute decentralized design model there is no longer a central, recognized area for the patient care team to come together. Often times the design incorporates several smaller areas for central computer charting and administrative duties (Joseph, 2006), but the majority of nursing work is to be conducted at the decentralized work areas.

Patient care team members working in physically separated areas that reduce the number of opportunities for face-to-face communication (Rashid, 2009), could contribute feelings of isolation (Hendrich et al., 2009; Joseph, 2006). Complete isolation of individual patient care team members is not recommended for optimal patient care and nursing performance (Hendrich et al., 2009). A balance between maintaining communication and mentoring opportunities, and designing for a desired level of peer and patient visibility is recommended (Flynn, 2005; Ritchey & Pati, 2008). To meet this need, some recent designs have experimented with a hybrid design approach, which is a combination of aspects of the traditional centralized model and the decentralized model.

Hybrid design.

A third type of nursing unit design is growing in popularity. This is a hybrid of the centralized and decentralized model. A generic layout of a hybrid nursing unit is shown in Figure 10. The hybrid model contains medium-sized nurse stations for collaboration with nurse charting stations, or “touchdown” stations located throughout the unit. This model is commonly referred to as a ‘new’ centralized model. This type of design benefits from having a centralized area for team gathering and information sharing complemented by smaller work areas for quick charting and related work activities. Flynn (2005) reviewed the benefits of hybrid models for nursing units and suggested that designs that provide centralized nurse meeting areas as well as decentralized nurse stations may strike a balance between centrality of patient assignments and the socializing features of central spaces.

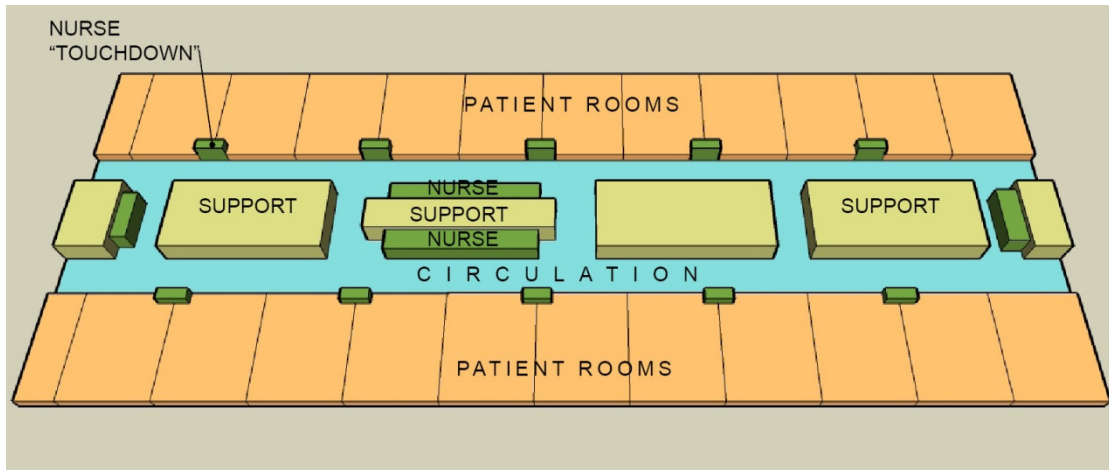


Figure 10. Generic hybrid nursing unit plan showing proximity of patient rooms, nurse station, support spaces, and circulation.

The field of nursing unit research is still relatively new and continues to grow each year. Even though many studies have been conducted (Becker, 2007; Gurascio-Howard & Malloch, 2007; Hendrich et al., 2008; Hendrich et al., 2009; Pati et al., 2008; Ritchey & Pati, 2008), the research on nursing unit models is insufficient to determine optimal models for any given type of care. Studies of nursing units are generally mixed methods; quantitative in nature augmented by some qualitative data to support the quantitative findings. Each type of unit can vary greatly depending on number of beds, preferred patient-to-nurse ratios, and adopted care delivery models. A variety of factors are considered by a hospital organization when determining a preferred model to build. Also, the amount of flexibility needed in a nursing unit design to accommodate changes in care delivery models, technology, and staffing is still being determined.

Research for healthcare facilities has grown substantially over the past 10 years in response to the related construction boom of the late-1990s and early 2000s. It is

unfortunate that many of the factors that are being studied now will not produce results in time for application to near future construction. However, researchers will inform future designs and construction of healthcare facilities, including medical-surgical nursing units. The next section will discuss in further detail how the built environment influences human health and how space syntax theory can provide an appropriate theoretical framework for conducting future research on medical-surgical nursing units.

The Built Environment and Health

The effects of the built environment on human health have been studied since the start of the 20th-century, gaining more research attention in the 1960s and 1970s. Many of the earlier studies of the built environment focused on either the space itself or on the people using the space. As a result, a gap occurred by not studying the interaction between the two (Hillier & Hanson, 1984). Theories to study the built environment have been borrowed from other fields of study such as history, behavioral studies, psychology, ecology, and sociology (Hasell & Peatross, 1991). A specialized area of focus for studying the built environment and human behavior emerged and became known as environmental psychology (Kopec, 2006). Kopec (2006) describes the field of environmental psychology and the relationship between humans and their environments as follows:

The human-environment relationship can be examined from a broad range of perspectives, all of which acknowledge that environments have components that people use to classify and therefore to comprehend their surroundings. These components relate to people's environmental preferences, and the way in which

people interpret them directly relates to their levels of stimulation. Environmental psychology may be defined as the study of symbiotic relationships between humans and their environments: A stimulus causes an action, which causes an event, which in turn causes another action, and so on. Understanding the relationship between stimulation and human responses is an important component of good design. (p. xv)

The academic study of environmental psychology has grown in popularity as exemplified by the publication of several academic journals dedicated to the study of how the built environment influences human behavior. Designers of the built environment can now apply theories to inform their predictions (i.e., hypothesis) for design decisions, evaluate outcomes of their design solutions, and use that information to inform future designs. This approach reduces a designer's opportunity to act without knowledge of the possible effects of their design decisions (Hasell & Peatross, 1991).

Several theories were considered to underpin this study. A theory that provided a framework for analyzing a designed environment and its interaction with human behavior was required. Space syntax was determined to be the best fit for the study of medical-surgical nursing units and how the design influences nursing communication. The following segments will provide an overview of space syntax theory, its history, constructs, and applications to office and healthcare environments.

Space Syntax Theory

Space syntax is a relatively new theory for the study of a designed environment. Developed in 1984 by Bill Hillier and Julienne Hanson, space syntax is a framework for

studying “the layout of space and its connectedness to other spaces – permeability, visibility, and so forth – is capable of influencing (and being influenced by) social behavior” (Hasell & Peatross, 1991, p. 54). Space syntax looks at the organization of spatial configurations as a determinant in building social relationships. The six constructs of space syntax are:

- boundary partitions (openness);
- depth (path length);
- connectivity;
- rings, circuits, and chains (accessibility);
- degree of control; and
- line of sight (visibility). (Ziesel, 2006, p. 344-345)

Space syntax theory grew out of the need to develop a tool to help designers understand how the built environment influences behaviors in everyday life. Hillier and Hanson (1984) formed this theory after unsuccessful attempts to use older, existing theories to study everyday behaviors in the built environment. It is important to understand the historical context of this theory prior to working with its constructs. A brief history of previous theories that helped to develop space syntax is outlined below.

History and predecessors.

Several theories that studied human behavior in spaces served as predecessors to space syntax theory. Christopher Alexander’s Pattern Language Theory (1977) focused on hierarchical forms of spatial arrangements. Pattern language is a practical guide to help architects and interior designers through the design process by using entities called patterns. Each of these patterns represents a description of an environmental problem that occurs repeatedly in our daily environments, “accessible green” and “positive outdoor

space” (Alexander, Ishikawa, & Silverstein, 1977). At the heart of each pattern, we find a description of “the physical and social relationships that are required to solve the stated problem, in the stated context” (Alexander et al., 1977, p. xi). An example given by Alexander is to examine people’s behaviors in gardens. When looking for a place to sit, most people will choose an area that offers solitude and quiet versus an area that is open and subject to noise. Hillier and Hanson (1984) found this theory to be too limited and restricted with contingent properties of configurations, or patterns, to be applicable to the study of human behavior and space.

Another predecessor of space syntax theory, is the work of Roger Barker’s (1968) *Ecological Psychology*. Barker focused on how human behavior is a result of social contexts and accessibility. His theory studies how behaviors are linked between individual and environmental influences, based on standing patterns of behavior and the physical setting. Barker examines how the behavior of an individual may not be unique to that individual, but it is unique to the setting. For example, behavior in a classroom may involve lecturing, raising hands, and taking notes; however, when an individual leaves that setting, the behavior changes.

Yet another predecessor to space syntax theory is Basil Bernstein’s theoretical framework for sociology, *Class, Codes and Control*. Introduced in 1975, *Class, Codes and Control* serves as a language for spatial analysis. Bernstein’s work defines space as having the ability to control human behaviors by means of spatial boundaries. These ‘rules’ can influence users’ decisions to interact, based on how open or closed a particular environment is designed. The example commonly given for Bernstein’s work is a more

open plan that can be used to encourage interactions and flexibility of use versus a more enclosed plan that does not allow for choice of interaction and flexibility of use (Hasell & Peatross, 1991). His theory is based on socio-linguistic codes that define social interactions and relationships (Bernstein, 1975). This theory has several characteristics that transfer easily to space syntax and is better suited for studying space and social behavior than Alexander's work. Like Barker's (1986) work, Bernstein's (1975) work is another good example of a theory that is set up to study behaviors within a specific environment. These previous theoretical frameworks were important to the eventual development of space syntax theory.

Definition.

In 1984, Bill Hillier and Julienne Hanson published their first book on space syntax, *The Social Logic of Space*. A follow-up book was published by Hillier in 1996, titled *Space is the Machine*. Similar to these aforementioned theories, the reasoning for the study of humans in space is the notion that space is experienced (Hillier, 1996). Hillier describes space as how we experience everyday life; by how we eat, interact, shop, avoid things, and come together in groups. Our activities are dictated by our surroundings. Many people probably would not stop to think twice about surroundings influencing their behaviors, as they believe that they control how they behave. However, the built environment does contribute directly to social outcomes (Hiller, 1996) and will be discussed in the context of space syntax theory.

Definitions for space syntax vary greatly in the literature. Due to the theory's complexity and broad applications, researchers define a focus that is applicable to their

area(s) of research. The definition of space syntax can best be described by the creator of the theory, Bill Hillier, who in his own words stated:

Space syntax... is a set of techniques for the representation, quantification, and interpretation of spatial configuration in buildings and settlements. Configuration is defined in general as, at least, the relation between two spaces taking into account a third, and, at most, as the relations among spaces in a complex taking into account all other spaces in the complex. Spatial configuration is thus a more complex idea than spatial relation, which need invoke no more than a pair of related spaces. (Hillier, Hanson, & Graham, 1987, p. 363)

Space syntax was first applied to the study of humans' early settlements and then expanded to analyze interior environments. One of the first examples outlined by Hillier and Hanson (1984) was the study of several small villages in 19th-century France. They sought to define some of the spatial properties within each of the settlements and then as a collection.

Figure 11 is an interface map showing closed and open parts of a settlement from 19th-century France. It was used in a comparison study of how a particular development changed over the past half-century. The settlement plan is shown on the left; the plan on the right is the settlement plan analyzed using space syntax theory. Each dot and loop combine to form the boundary of each estate. These loops represent movement options for the users of this settlement. The locations of line intersections indicate areas of possible interaction between individuals.

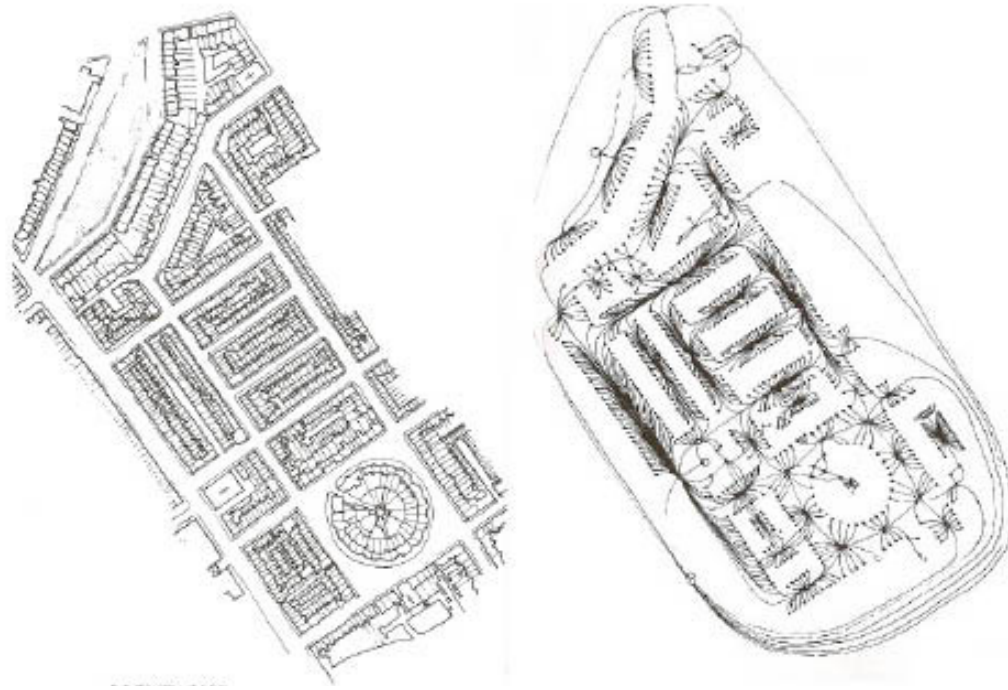


Figure 11. Example of settlement analysis using space syntax. Somerset Town, London, in the 19th-century. Adapted from “The Social Logic of Space,” by B. Hillier & J. Hanson, 1984, p.134-135. Copyright 1984 by Cambridge University Press.

Two concepts lay the groundwork for the construction of space syntax theory. First, as a conceptual model, space syntax theory begins to build a case for investigating social behaviors within spatial patterning. Second, space syntax theory seeks to establish a new method of spatial analysis with the intent of bringing order to an otherwise random process (Hillier & Hanson, 1984). Underlying this theory is the concept of spatial patterns carrying social information and content.

Space syntax is a complex theory, offering several applications and a wide range of combinations that are available for exploring designed environments. This complexity could also be a deterrent for use by some researchers. However, the current goal of using

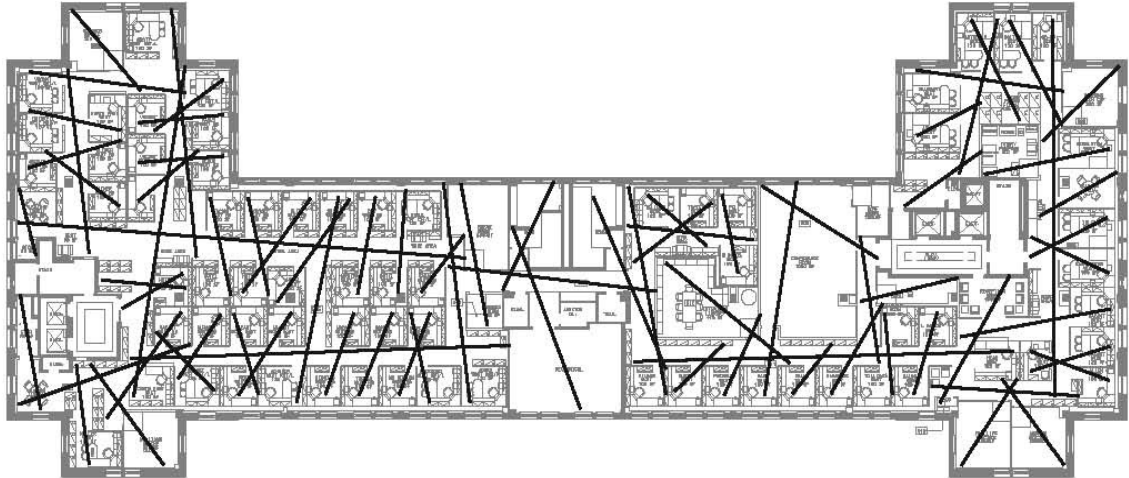
this theory is to explain how and where individuals communicate in a built environment. Understanding these behaviors could help designers to formulate a more predictable response to spatial configurations (Hendrich et al., 2009). Following is a detailed discussion of space syntax theory's constructs and variables.

Constructs and variables.

Concepts found within space syntax theory are described by the terms *integrated* and *segregated*. According to Ortega-Andeane, Jimenez-Rosas, Mercado-Domendch, & Estrada-Rodriguez (2005), a space is considered *integrated* “when the other spaces have a relative shallowness in relation to it” and a space is considered *segregated* “when the other spaces have a relative depth in relation to it” (p.14). Shallowness and depth refer to the number of movement opportunities between two spaces. These concepts are often illustrated using an axial map of a floor plan.

The axial map in Figure 12 shows how the process of overlaying lines for travel pathways indicates the degree of connectivity between spaces. For each intersection of lines, this is considered a separation between spaces. Actual distance is not calculated, rather a numerical value is assigned. For example, a distance of three or four is assessed. This can also be done for analyzing visual connectedness of spaces. The more intersections between two spaces is a determinant for the level of segregation for those spaces. For example, when a person walks from their workstation in an open office environment and “crosses” three axial lines on his/her way to the mail room, the space between his/her workstation and the mail room is said to have a depth of three, a relatively shallow space and could be considered integrated compared to other spaces that

would require “crossing over” six or more axial lines, which could be considered segregated space.



*Figure 12. An office layout with its axial map. Adapted from “Spatial layout and face-to-face interaction in offices – an study of the mechanisms of spatial effects on face-to-face interaction,” by M. Rashid, K. Kampschroer, J. Wineman, & C. Zimring, 2006, *Environment and Planning B: Planning and Design*, 33, p. 828. Copyright 2006 by Pion.*

Propositions within this theory help explain behavior by studying patterns of movement and accessible locations within a given environment. A closer look at how people engage in formal and informal communication in the built environment could result. Informal communication is very important to high stress professions because it builds another level of social support within a team structure (Allen & Hecht, 2004).

Space syntax theory allows an investigation of how spatial layouts affect opportunities to communicate with other individuals. A major resource for any organization is not only their employees, but the space they occupy (Rashid, Kampschorer, Wineman, & Zimring, 2006). When using space syntax theory, another

proposition is found in the assumption that there is an important relationship occurring between space and human interaction (Rashid et al., 2006).

Ziesel (2006) offers a detailed outline of the constructs identified by space syntax theory. These six constructs are shown in Figure 13. The first construct is *boundary partitions*. When defining a space, boundaries must be designated that will clearly outline the separations of different spaces. Depending on the degree to which a space is divided, the number of boundary partitions will increase or decrease. This is also known as *openness*. *Depth* is the second construct. As noted previously, this theory does not deal directly with measurement or distance. Depth is measured by counting how many different spaces one must pass through to connect with the desired space. The third construct of space syntax theory is the *connectivity* of spaces. It is measured by counting the number of spaces that are directly connected to another space.

CONSTRUCT	DESCRIPTION
Boundary Partitions (Openness)	The degree of spatial enclosure in a setting
Depth (Path Length)	The number of spaces a person would have to pass through going from one space to another
Connectivity	For a single space, the number of other spaces directly connected to it For a convex graph, represents the number of other spaces directly accessible from it For an axial graph, the number of axial lines that cross another axial line
Rings, Circuits, and Chains (Accessibility)	Representations of spatial configurations in which a person passing through a series of spaces would end up back at the original space
Degree of Control	Calculated characteristic implies a social or behavioral correlate to the physical relationships of spaces in plan (i.e. degree of control a person feels over social interactions)
Line of Sight (Visibility)	Represents the opportunity of people moving through a sequence of spaces to see into other adjacent spaces

Figure 13. Six constructs of space syntax. Adapted from *Inquiry by design*, by J. Ziesel, 2006, p. 344-345. Copyright 2006 by W.W. Norton & Company. (Note: Bolded text indicates the terms used to identify the constructs discussed in this exploratory study.)

The fourth construct is measured by reviewing the *rings, circuits, and chains* found on a convex map. Convex maps are formed by tracing over a plan (most examples involved a settlement or something of larger scale) and indicating each “space” by a small circle, or node, and then drawing lines to connect these circles whenever the convex spaces share a face or part of a face (to form a convex shape) (Hillier & Hanson, 1984; Ziesel, 2006). These are basic spatial configurations that allow the inhabitant to end up back at the starting point after moving through the layout. Depth and connectivity are also considered to be characteristics of these configurations. The measurement of rings, circuits, and chains of a space is also a measure of the *accessibility* of a space.

The fifth construct is the *degree of control* that places implicit social or behavioral actions as correlates of the physical space. A person moving through a layout has a certain expectation of interaction, which is influenced by the depth of the space. Ziesel (2006) explains that “if a person walking between two spaces has to pass through or by a third space, the person in the intervening space is assumed to have greater control” (p. 345). The sixth construct is *visibility*, or the *line of sight*. This is also a behavioral characteristic. For each set of axial lines that cross on a map, an opportunity for individuals or groups to visually connect and create an experience for the inhabitant is realized (Ziesel, 2006).

Space syntax offers a method to see space as it is formed through inhabitation (Hendrich et al., 2009). It looks at how areas are connected to other areas and which units are located between other units with the goal of determining social relevancy (Bafna, 2003). One of the main constructs of this theory line of sight, involves the principle of

blocking of vision and/or blocking access between parts of a space by a boundary partition or series of partitions. Depending on how far one area is separated from another area, the interior designer is able to create areas of mutual isolation (Hendrich et al., 2009). This isolation is a necessary accommodation for many of the tasks individuals perform in a work environment, such as communication between nurses at a centralized nursing station (Hendrich et al., 2009).

Space syntax applications to office environments.

Space syntax has been most commonly applied in design research to study office environments. Space syntax started gaining momentum in the late 1990s and early 2000s as a method for studying open office behavior. Space syntax is gaining recognition in the academic design research arena with journals, such as *Environment and Planning B: Planning and Design*, which dedicates special issues to publish space syntax-related research. Conferences, such as the International Space Syntax Symposium, have also been developed to share research findings and applications.

The majority of the research being shared about space syntax theory is directly related to open office environments or city planning. This segment will present several studies that have used space syntax to study office environments. An understanding of how space syntax theory has been used in the past and to what extent knowledge has been created as a result of using this theory can help inform the theory's application to the study of medical-surgical nursing unit design.

Rashid et al. (2006) conducted four case studies about face-to-face interaction in offices using elements of space syntax to explore the spatial layouts at four moderately

large offices. Spatial layouts were studied for their effects on occupant movement and visible copresence. Movement is defined as the number of people moving along a path of observation. The other variable in this study is visible copresence, defined as the number of people visible from a path of observation. The model developed by Rashid et al. (2006) is shown in Figure 14; it depicts spatial variables as inputs to spatial behaviors to determine organizational outcomes (communication). This model provides an important framework for the current study by referencing the relationship between spatial variables and communication.

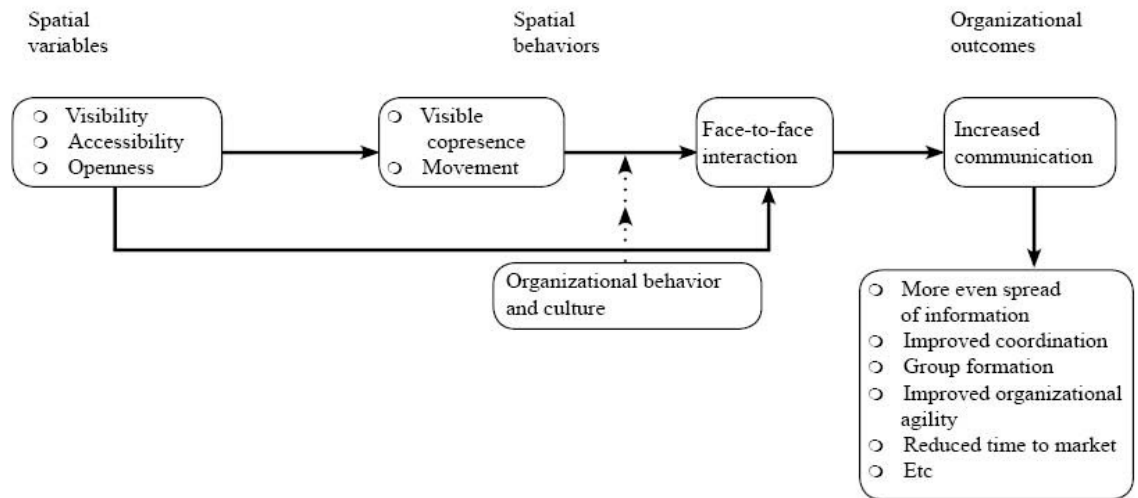


Figure 14. The workplace-interaction model. Describes the relationship among space, behaviors, and organizational outcomes. Adapted from “Spatial layout and face-to-face interaction in offices – an study of the mechanisms of spatial effects on face-to-face interaction,” by M. Rashid, K. Kampschroer, J. Wineman, & C. Zimring, 2006, *Environment and Planning B: Planning and Design*, 33, p. 827. Copyright 2006 by Pion.

In the Rashid et al. (2006) study, each of the four case studies were analyzed with axial maps and observation route maps. One finding of the studies revealed that the

relationships between visible copresence and face-to-face interaction were significant and consistent in all four case studies. This finding has significance because it suggests that visible copresence is important for face-to-face interactions regardless of movement. This finding supports earlier office interaction studies from Hall (1966) and Parsons (1976), which found that interactions between office workers were more likely to occur when two or more workers see each other. In the Rashid et al. study, an important limitation noted is that the findings may not be sufficient to suggest that spatial layout alone can “generate, sustain, and increase interaction without the necessary changes in the attitudes, programs, and policies of an organization” (2006, p. 842). While this study was conducted on office environments, it is similar to the methodology that will be described for use in the current study.

Another study on office environments was presented at the International Space Syntax Symposium in 2007. Wineman and Adhya (2007) used space syntax theory to try to predict the influence of spatial and psychosocial factors on job satisfaction. This study utilized a survey questionnaire to gather data from 329 employees at four offices in the United States. The data were analyzed first using regression analysis, then followed by path analysis. The space syntax variables of connectivity and integration (local and global) were studied using a computer-based program. Findings from this study informed the design recommendations presented by the research team. Wineman and Adhya (2007) recommended the following design strategies to enhance connectivity and local integration:

- 1) create circulation spaces with multiple connections;
- 2) minimize the number of dead end circulation spaces;
- 3) design “neighborhoods” as networks of well-connected circulation spaces; and
- 4) group offices into well connected “office pods” so that members of the group can easily interact with one another; at the same time multiple pods should be well connected so that there is a healthy support system among the pods. (p. 13)

Their study focused primarily on privacy perceptions in open office environments and suggested that other variables – specifically visibility control, also affected workers’ perceptions of privacy.

A more recent study of open office environments analyzed the visibility and accessibility of two office floor plans. Rashid, Wineman, and Zimring (2009) sought to 1) measure and evaluate changes in patterns of accessibility and visibility due to changes in office layout, 2) understand the effects of layout changes on observed behavior, and 3) determine the effects of layout changes on environmental perception. The first analysis was conducted on the existing floor plan prior to an organization’s move to the new space. The second analysis was conducted using the same space syntax variables (visibility and accessibility) for the new floor plan. In addition to plan analysis, field observations and a questionnaire were used to collect data. This study is an example of a mixed methods approach to studying office environments using both quantitative and qualitative research methods.

Findings from this study suggest that the new office environment provided better visibility and accessibility and increased face-to-face communication among employees. Similar to the Rashid et al. (2006) study, the study conducted by Rashid, Wineman, and Zimring (2009) noted the limitation that interaction in offices are affected by more than

just design changes; organizational culture and functions were cited as influences. Their study was presented via analyzed floor plans using axial maps, an approach relative to this current study.

Another study of open office environments used space syntax on a pre-post comparison of an organization before and after moving to a new space (Sailer, Budgen, Lonsdale, Turner, & Penn, 2009). Utilizing both qualitative and quantitative methods to capture data, plan analysis, observations, staff questionnaires, and semi-structured interviews were conducted to “underline the importance of spatial configuration for organizational performance” (p. 096:3). Two case studies were presented for discussion and floor plans were shown to compare the differences between the old and new spaces for each. Findings from the two studies indicated increased interaction and collaboration due to changes in space syntax-driven spatial configurations implemented in the new spaces (Sailer, Budgen, Lonsdale, Turner, & Penn, 2008; Sailer et al., 2009).

These aforementioned studies indicate the wide application of space syntax theory to studying office environments and offer an important structure for expanding the use of this method to study additional environmental types. The following section will focus application of this theory to healthcare environments, and then specifically as applied to medical-surgical nursing units.

Space syntax applications to healthcare environments.

The use of space syntax theory as a framework to study healthcare environments is a relatively new concept to healthcare design research. This literature review includes

several recent publications of healthcare design research on nursing units using space syntax theory.

Rashid (2009) used space syntax theory to explain the relationship between space and knowledge in a healthcare environment. Using explanations of strong and weak programs, Rashid explained the relationship and sequences of spaces within a building as important parts of predictable and unpredictable occupant behavior and also as important components of knowledge-building. Important to this current study, Rashid (2009) focused on sightlines, or visibility, and spatial structure of a built environment as a determinant for face-to-face communication in hospitals. No inclusion of hospital plan axial maps to show sightline analysis were included in this article, though Rashid included a previous example of an axial map used for analyzing an office floor plan to describe the process and encourage its application for future study of hospital floor plans. Unique to this study, Rashid (2009) placed equal importance for this type of study to benefit both patient care and staff communication.

The following segment highlights additional research that has been published using space syntax theory as it has been applied in healthcare environments research. Studies that focused on medical-surgical units were highlighted during this literature review, as they have the most direct relationship with the current study.

Application to a medical-surgical nursing unit study.

The complexity of a nursing unit has been documented in previous research, but with the majority of attention being given to patient-centered design innovations and staff efficiencies (Chaudhury et al., 2009; Hendrich et al., 2008; Hendrich et al., 2009; Pati et

al., 2008). One example of a study of the physical layout using space syntax theory is the Hendrich et al. (2009) time-motion study of a medical-surgical nursing unit. Through the study of how nurses move in medical-surgical units, the research team was able to concentrate on the physical characteristics of a nursing unit that facilitated certain behaviors. This primary goal of this study was to examine how nurses adopt movement strategies based on their patient assignments and the unit configuration. The secondary goal of this study was to identify characteristics of the unit layout that influenced the amount of time nurses actually spent in direct patient care inside the patient room. The research team explored the applicability of space syntax theory to healthcare environments as a tool to predict human behaviors as a result of specific spatial configurations (Hendrich et al., 2009).

To illustrate this method's application to nurse work environments, this research team isolated one variable to review. The space syntax construct of *Path length*, or *depth*, was used to study the travel distance between locations on a nursing unit. The complexity of space syntax theory creates some difficulty in its use. Path length in this study was defined as the distance traveled during certain types of activities or between locations, such as the nursing station and patient room. Space syntax theory was applied to an existing time-motion study data set. The Hendrich et al. (2009) study provides an example of quantitatively using space syntax theory constructs for studying nurse work environments, specifically with a focus on how the unit configuration affects nursing time spent in direct contact with patients. Additional constructs, *connectivity* and *step*

depth, will be the focus of future studies by the same research team (Hendrich et al., 2009).

An exploratory study (Pati et al., 2008) was conducted using qualitative methods through interviews, however did not directly apply space syntax theory to structuring the research questions. The data analysis provided insight to the importance of visibility (a construct often studied) on a medical-surgical nursing unit. Through the interviews, it was noted that peers value direct line of sight:

A key factor influencing effective teaming is peer lines of sight. Direct visibility of peers enhances efficiency and provides a sense of safety and security for caregivers. Obstructed peer lines of sight increase stress by reducing the perceived and actual availability of help, opportunity for mentoring and socialization, and potential for de-stressing. Moreover, in crisis or stressful situations, clinical staff revert to their senses rather than technology, and hence the importance of peer visibility. Stress levels increase and perceptions of flexibility decrease when nurses feel they are operating alone. The above factors could impede or improve one's ability to be flexible to new or unique situations, and constitute an issue affecting direct caregivers. (Pati et al., 2008, p. 216)

This study will focus on two constructs of space syntax theory. *Visibility* and *accessibility* constructs (see Figure 13) (Ziesel, 2006) will be isolated to analyze communication in medical-surgical nursing unit design. This exploration can be used as an evaluation tool for future medical-surgical nursing unit studies. Hendrich et al. (2009), describes space as “configured primarily by blocking vision, access, or a combination of

these two factors between adjoining spaces” (p. 12). By purposely building boundary partitions within a given space to meet programmatic needs, designers begin to take away the visibility between users of the space.

For example, assume two rooms are immediately adjacent and divided by full height walls with doors on opposite sides. An occupant is located in each room but without any knowledge that another occupant is within a few feet. Now assume the rooms are divided by a partial height wall. Each occupant would be able to visually see the other, his/her existence would be known. It is this knowledge of another existing person that creates opportunities for communication to occur. Without visual accessibility to other building occupants, the opportunity for face-to-face communication to occur is reduced. Conversely, depending on the type of organization, activity, or facility, face-to-face communication may not be a desired outcome; therefore, design can positively affect that goal by including purposeful boundary partitions. However, in several case studies of office environments, face-to-face communication was a preferred means of idea sharing between employees (Rashid et al., 2006).

In summary, this chapter included a literature review to document current and historical information on the nursing profession, medical-surgical nursing units, and the theory of space syntax. Throughout the literature review, variables that influence job stress and satisfaction for nurses were also described. These variables include communication, social support, and demographics (age, gender).

Overall, existing research on the physical layouts of medical-surgical nursing units is limited. Taking into consideration the small amount of research that is available

on medical-surgical nursing units, and even less research available on using space syntax theory to study medical-surgical nursing units, the goal of this study is appropriate within those confines for the following reasons.

Space syntax theory is relatively young in interior design research, especially for healthcare environments. Additional research is needed in this area of healthcare design. The purpose of this exploratory study is to provide the first steps to advance the use of this theoretical framework to study medical-surgical nursing units and expand the body of knowledge. The following chapters present the research method, analyze the information gathered from this literature review, floor plan analysis, and nurses' interviews and recommend future steps in the study of the influence of medical-surgical nursing unit design on communication among nurses.

CHAPTER 3. METHODS

Research Design

An exploratory research study was conducted to determine how the design of urban medical-surgical nursing units influences nurses' communication, and subsequently perceived social support. This qualitative study was developed using the framework of Hillier and Hanson's (1984) theory of space syntax. This theory is based on six constructs that describe how spatial configurations influence human interaction and behaviors (see Figure 13), namely, openness, depth, connectivity, accessibility, degree of control, and visibility (i.e., sightlines). Methods used in this study included a comprehensive literature review looking at the nursing profession, occupational health, communication, and design literature; floor plan analysis using the findings from the literature review; and exploratory semi-structured interviews of two nurses and one health unit coordinator. The structure and methods for this study will be reviewed in further detail throughout this chapter, starting with characteristics of a qualitative study.

Characteristics of a Qualitative Study

Qualitative research methods possess several unique characteristics that make a qualitative approach appropriate for this study. First, while several studies have been conducted on impacts of nursing unit design, they have mostly been quantitative in their methodology. Quantitative approaches are useful for gathering frequency, type, and location for communication outcomes, but do not describe or explain reasons behind the numerical data (Bloomberg & Volpe, 2008; Creswell, 2009). Qualitative methods tell a story and gather in-depth descriptions of a topic (Bloomberg & Volpe, 2008; Creswell,

2009). Qualitative data can add to our understanding by providing a more humanistic explanation for why certain behaviors occur in healthcare settings. Johnson and Barach (2008) further elaborate on the use of qualitative research for healthcare organizations with the following statement:

Qualitative methods offer unique tools and skill sets to help understand the needs of patients, providers, and administrators while complementing and providing context to traditional quantitative methods. Sometimes, even when the quantitative results are clear, we would like to understand more about the contextual environment of the quantitative results. Research questions that are designed to understand the system that is producing the results, to explore how interdependent individuals and groups function (or fail to function), and to connect the research to reality may be best answered by qualitative methodologies. (p. 192)

As the focus of this study is to explore how the designed environment of a medical-surgical nursing unit influences nurses' communication, a qualitative approach to this type of study is imperative to developing a complete understanding of how nurses behave in this environment. This study is grounded in a review of literature with the intent to lay the foundation for future, additional studies' use of space syntax theory as applied to healthcare environments. The information gathered in this study is intended to provide richness of meaning relative to the research problem, rather than finding generalizable results.

Assumptions of the Study

There are several assumptions relative to this qualitative study. Qualitative inquiry involves inductive data analysis, use of a theoretical lens, an interpretive form of inquiry, and develops a holistic account of the issue under study (Creswell, 2009). The first assumption of inductive data analysis informs us that qualitative researchers “build their patterns, categories, and themes from the bottom up, by organizing the data into increasingly more abstract units of information” (p. 175). When analyzing data, the researcher looks to establish a set of themes to organize the collected data and eventually develop broader theories of relationships.

The second assumption defines qualitative inquiry through the use of a theoretical lens. A study is often situated around the social, political, or historical context of the issue under study. These lenses, or perspectives, provide an orientation for viewing the study. These perspectives include feminist perspectives, racialized discourses, critical theory, queer theory, and disability inquiry. The third assumption involves an interpretive form of inquiry in which the researcher’s interpretation of the information is influenced by prior understandings of the subject matter. The fourth assumption for qualitative inquiry involves holistic account reporting. This process involves reporting “multiple perspectives, identifying the many factors involved in a situation, and generally sketching the larger picture that emerges” (Creswell, 2009, p. 176).

This study is descriptive due to its emphasis on exploring definitions involved with medical-surgical nursing unit design and space syntax theory. In addition to defining nursing units and the theoretical framework, historical perspectives were also explored.

This process of exploring definitions and historical perspectives establishes relationships between the theory of space syntax and the design of nursing units. Historical analysis is included in this study to provide an understanding of why the theory of space syntax was chosen as a framework for studying healthcare environments and also to further explore the limited history of studying medical-surgical units from a design perspective. The historical references provide a rich description to complete this holistic approach to studying medical-surgical units in an urban hospital.

A fifth assumption for this exploratory study is the application to urban medical-surgical nursing units. These nursing units support patient populations and nurse staffing for urban cities and differ in number of patient rooms and hospital infrastructure from hospitals located in rural areas. Rural hospitals, such as critical access hospitals, are typically limited to the number of patient rooms they can build and therefore, are limited by the opportunities for arranging a small number of rooms.

The sixth assumption of this study involved the timeline for the design and completion of nursing units under review. This study focused on medical-surgical nursing units that had been designed and completed within the past five years. Designs prior to the start of the 21st-century were not included due to changes in what is now considered standard medical-surgical nursing unit design (i.e., single patient rooms vs. multiple occupancy rooms).

Data Collection

Data collection was conducted in three parts: 1) a review of literature for findings relative to the nursing profession, medical-surgical nursing units, and space syntax

theory, 2) application of space syntax theory for analysis of medical-surgical nursing unit floor plans, and 3) semi-structured interviews of nurses and a health unit coordinator.

Review of literature.

First, an extensive review of literature was conducted. Several strategies were employed to identify sources for the review. The first step involved a keyword search within relevant library databases. Keywords included the following: nursing unit, medical-surgical, work environment, communication, design, facility design, stress, social support, patient outcomes, sight lines, visibility, accessibility, and teams/teamwork. These keywords were used alone and in combination with each other for the purposes of narrowing the search results to articles with the highest relevancy. To further narrow the search results, limitations were set within the search parameters to only include articles between 2000 and 2009. As the process continued over time, a final search was done to gather newer journals published in late 2009 and early 2010.

The second step involved identification of articles through a systematic review of journals relevant to the areas of healthcare design, nursing research, and occupational health. Once articles had been identified, a final step was taken via a review of the reference lists included with the most relevant articles to identify additional primary resources of literature that addressed nursing work environmental issues. The journal articles, books, book chapters, and reports reviewed and analyzed for this study are noted in the References.

This literature review was conducted in three stages. The first stage was a review of the nursing profession. This stage included exploring the role of nurses in a hospital,

the current issues facing this profession, and what factors contribute to nurses' overall job satisfaction. In the early phase of this stage, several key concepts were identified and required further exploration. These concepts included workplace stress and social support; which were further explored through reviewing occupational health literature. Another concept that was identified as a key component to the nursing profession was communication; which was explored in greater detail through a review of communication literature. This stage of the literature review was the most complex; however, provided the necessary background to move forward with the study of medical-surgical nursing unit design's influence on nurses' communication.

The second stage of the literature review included an exploration of medical-surgical nursing units. This stage was conducted to develop a full understanding of how medical-surgical nursing units have been studied, which theories and methods have been used, and what information has been found from these studies. This review also explored the historical development of nursing unit layouts from the mid-1900s to today's standards.

The third stage of the literature review was a thorough review of the theoretical framework, space syntax. This review included looking at the historical development of this theory, its earlier application to office environments studies, and finally how space syntax has been used more recently to study healthcare environments.

Floor plan review and analysis.

The second part of data collection involved an analysis of three medical-surgical nursing unit floor plans using two space syntax constructs, accessibility and visibility,

and findings from the literature review. The plans were acquired from a local architecture and design firm. Each of the medical-surgical nursing units is located in an urban location and was put into operation between 2000 and 2008, following current design guidelines.

Interviews.

The third part of data collection consisted of semi-structured interviews with two nurses and one health unit coordinator from a local, urban hospital. The interviews conducted for this study were not intended to gather extensive, rich description; but rather to pre-test interview questions based on the information gathered from the literature review and from the plan analysis for use in a future mixed methods study. Interview questions are included in Appendix A.

The interviews were conducted during the daytime shift of two RNs and one health unit coordinator from a medical-surgical nursing unit. This nursing unit was also used as one of the floor plan analyzed during the second part of data collection. Interviews consisted of 14 semi-structured, open-ended questions of an exploratory nature, and took approximately 30-45 minutes each. Questions were developed based on the theoretical framework of space syntax. The content of the interviews was recorded with a tape recorder and documented through field notes. Raw interview data were transcribed by the researcher and coded for key themes.

Participants were selected because of their association with a particular nursing unit and represented a convenience sample. Approval for the interviews of human subjects was given through the University of Minnesota Institutional Review Board. Each participant signed a consent form prior to answering any questions.

In summary, qualitative data collection can vary greatly depending on the type of study and information sought. Data collection for this study occurred through a review of literature, textbooks, and online resources, and also through a document review of modern architectural plans for medical-surgical units. Throughout the data collection stages, the theoretical framework was used to guide the search for keywords and to determine a method of document review for the architectural floor plans.

Role of the Researcher

In a qualitative study, the researcher is personally involved in the data collection and becomes a key instrument for recording and interpreting the information. The role of the researcher needs to be understood and clearly described. For that purpose, Creswell (2009) notes that the researcher must identify biases, values, and personal background. These issues may shape the researcher's interpretation of the collected data. The researcher needs to remain highly objective in carrying out a study. This is a difficult task for any researcher because of how the data are collected. Methods included interviews and observations, which are subjective and open for interpretation. Qualitative research, by its very nature, is "a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2009, p. 232). The meanings of the collected data are interpreted by the researcher according to the researcher's understanding of the participants' realities, from which the researcher attempts to reconstruct into useable information (Lincoln & Guba 1985; Merriam, 1998).

The researcher's initial interest in healthcare professions began early in life having been raised by a mother who is an RN. This lifelong experience influenced the

researcher by showcasing the important role nurses play in our healthcare system and society. The researcher is an interior designer with a B.S. from an accredited interior design program within a university, and has worked at a large architectural/interior design firm in Saint Paul, Minnesota. During her professional career, she developed a specialty in healthcare design. The researcher has been involved in healthcare projects ranging from replacement hospitals to small department remodeling projects. During this time, the researcher has gained experience working with healthcare professionals by conducting user group meetings and design meetings. Having witnessed complete transformations of several healthcare facilities, the researcher strongly believes in producing healing environments for the patients in all types of healthcare facilities.

However, the researcher also believes that while the majority of attention during the past decade of design has been focused on patient-centered design initiatives, much needed attention has not been given to designing better environments for those individuals who provide care for those patients. The researcher recently participated in informal observations of nursing behavior on a medical-surgical nursing unit. Involvement in this task educated the researcher on the daily tasks and communication needs of nurses on this type of unit. The information gleaned from these observations were used to help frame the initial inquiry for this exploratory study.

While all attempts to eliminate bias have been utilized in this study, it is important to provide this information to expose any potential bias that may have been inadvertently incorporated into this study. Since this research was gathered through already published sources, researcher neutrality was maintained throughout the data collection process.

Trustworthiness

The issue surrounding verification, reliability, and trustworthiness in qualitative research has been the subject of much debate in the research community. The topic is increasingly difficult to conceptualize when one needs to consider that each perspective, or viewing lens, calls for different methods of verification or reliability. This study of medical-surgical nursing units and how their design influences communication among nurses is considered an ethnographic study. According to Creswell (2007), the criteria for a good ethnographic study include a clear identification of a culture-sharing group, with which medical-surgical nurses are identified; the specification of culture themes for this culture-sharing group, which have been identified as daily activities of patient care; and an explanation of how the culture-sharing groups works, which has been identified throughout the literature review.

Limitations

There are several limitations to this study. The findings are presented in the framework of space syntax theory. Different findings may have been uncovered if alternate theories were used to underpin this study. Another limitation is the use of literature. The majority of literature accessed was published in American or English journals. Literature that was published in non-American and non-English journals could provide additional insight for nursing research, healthcare design research, and the use of space syntax theory. It is noted, however, that this is a study of American medical-surgical nursing units and was not intended to be generalizable to other types of nursing units, nor other countries' models of healthcare.

Another limitation of the study is the number of plans analyzed. A small number of plans were analyzed using space syntax constructs. Should a larger number of plans be analyzed, different findings could result. It is also noted that the plans that were analyzed were gathered from one architecture and design firm, and notably, a particular 'style' of design could have resulted in these plans.

The small number of interview data collected is also a limitation to this study. It was shown to be helpful to conduct these interviews as a pre-test of the questions in preparation for a larger study. The data collected was not enough to fully extrapolate themes from the raw data.

The complexity of space syntax theory is also a limitation for this study. It could take years of study to fully comprehend the intricacies and complex formulas. The basic concepts of space syntax theory have been presented, and two constructs were applied in this study. Other studies using space syntax theory may focus on a different construct or combination of constructs, which also create difficulty in analysis or comparison of findings across studies. Also, common to the application of space syntax theory are computer applications to study movement patterns. This analysis method could be considered as another approach to enhance this exploratory study.

Delimitations

This study has a limited scope by only addressing communication as it relates to improving social support and reducing job stress. Nursing units are complex and have numerous factors working simultaneously, making it difficult to study any one, specific

factor. This study specifically does not address other important factors of communication on a medical-surgical nursing unit.

An example of a factor that is not addressed in this study is acoustics, specifically the noise created from nurses and other staff gathering at central nursing stations through numerous verbal communications occurring at a given time. Noise levels impact the quality and quantity of sleep for patients and need to be controlled (Ulrich et al., 2008). Noise has also been found to contribute to medical errors by distracting nursing staff and interrupting their performance (Ulrich et al., 2008). There are also additional factors that contribute to nurses' stress levels that have not been addressed in this study. Examples of these factors include access to daylighting and views, lighting levels, and work-related physical activity (Ulrich et al., 2008).

In conclusion, the method selected for this study is appropriate for developing a qualitative exploratory study of urban, medical-surgical nursing unit design. The process revealed many variables that may require additional, future exploration — some through qualitative methods and others through quantitative methods. The intent of developing this study was to qualitatively examine medical-surgical nursing units via space syntax theory, invite discussion on the topic, and advance the consideration of qualitative research methods for study of healthcare environments.

CHAPTER 4. FINDINGS AND ANALYSIS

The purpose of this study is to identify factors that are related to how the design of a medical-surgical nursing unit influences nurses' communication. A goal of this study was to better understand how space syntax theory can be applied to medical-surgical nursing units for the purpose of providing insight to the design of work environments for nurses in an urban hospital. This chapter presents the findings from the literature review, the exploration of space syntax theory relative to the design of medical-surgical nursing units through an exploratory application to floor plans of existing medical-surgical nursing units, and data collected through exploratory interviews.

The first part of this chapter summarizes the findings from the comprehensive literature review. This literature review consisted of three phases: an in-depth exploration of the nursing profession, a historical review of the development and study of medical-surgical nursing units, and an examination of space syntax theory. This review was based on the following research questions:

The central research question formulated for this study was:

1. Does the design of a medical-surgical nursing unit in an urban hospital influence communication and social support opportunities for nurses?

The secondary questions included:

2. Does medical-surgical nursing unit design influence visibility between nurses?
3. Does medical-surgical nursing unit design influence accessibility to nurses and other members of the patient care team?

The second part of this chapter presents findings from the process of reviewing several contemporary medical-surgical nursing unit floor plans of urban hospitals. These plans were reviewed via two constructs of space syntax theory, accessibility and visibility. The third part of this chapter presents a brief overview of initial findings from three, semi-structured exploratory interviews. This chapter concludes with an analysis of the cumulative findings.

Findings from the Literature Review

Following is a discussion of the findings from the literature review. The literature review provided an opportunity to generate a better understanding of the reality of work environments for nurses. The emphasis throughout this study was to explore the relationships between work environment variables, ranging from individual differences to the physical environment. Quotations have been included throughout to illustrate perspectives and complexity of the subject matter.

The Nursing Profession

The nursing profession is complex, rapidly changing, and psychologically and physically intense. At the same time, nurses are responsible for patient safety, optimal care delivery, and patient outcomes (Bureau of Labor Statistics, 2009; Clarke, 2007; Clarke & Donaldson, 2008; Institute of Medicine, 2000; Institute of Medicine, 2004b). Nurses are involved with nearly every aspect of a care plan for a patient. Nurses coordinate care plans with other members of the patient care team, working simultaneously for the health needs of the patient. The patient care team in a multidisciplinary care model is made up of the patients themselves, plus nurses (RNs,

LPNs, CNAs), health unit coordinators, support staff, physicians and specialists, therapists, dietitians, pharmacists, social workers, complementary therapy specialists, spiritual advisors, volunteers, and patients' families (see Table 1). Each person on the patient care team is involved with multiple tasks and often employs a range of technology for patient care and communication. In addition to the heavy work demands involved with caring for a patient, the nurse is typically responsible for the difficult task of communicating with all members of the patient care team (Leppa, 1996). Nurses are an essential component to quality healthcare in the United States.

Our healthcare system faces many challenges. One of the most concerning challenges is the shortage of nurses. The growing U.S. nursing shortage will continue to be a concern for stakeholders of quality nursing care for the next decade and beyond (Buerhaus et al., 2009; HRSA, 2004). Society, communities, healthcare organizations, and the nursing profession will potentially be negatively affected by a lack of qualified nurses to care for a growing and aging patient population. Contributing to the nursing shortage are aging and retiring nurses; job stress and burnout; and a gap in new graduates to fill the need (Atencio et al., 2003; HRSA, 2004; Lynn & Redman, 2005). Healthcare organizations need to take a closer look at strategies to improve the work environment for this profession, with the goal of retaining qualified nurses and recruiting new nurses into their systems. Strategies to improve the work environment of nurses include safety and medical error reduction, reduction of fatigue and stress, improved staffing and patient ratios, and improved organizational structures (Clarke & Donaldson, 2008; Hendrich & Chow, 2008; Institute of Medicine, 2004c; Needleman et al., 2002; Rogers et al., 2004).

A growing concern for the nursing profession is stress and potential burnout. Burnout from a profession most often results in an individual's decision to leave to a job and often times, the profession entirely (Aiken et al., 2002; Boyle, Grap, Younger, & Thornby, 1991; Maslach & Jackson, 1986). Factors that contribute to severe stress and potential burnout include a lack of perceived social support, inadequate staffing, job demands, poor communication, and personal life struggles (Baruch-Feldman et al., 2002; Jenkins & Elliot, 2004; Jennings, 2008; Judkins & Ingram, 2002). It has been well documented that severe stress is not caused by a single action or influence, rather a combination of multiple influences. Therefore, efforts to reduce stress should not be focused on a single influence; rather efforts need to be multifaceted to mitigate several stressors, reducing overall stress.

One of the most important influences on reduction of work stress is the presence of social support (Baruch-Feldman et al., 2002; Jennings, 2008). As nurses feel more stress, they rely more on social support (Jennings, 2008). Social support has been associated with workplace outcomes such as job satisfaction and moderating the effects of stress and burnout (Baruch-Feldman et al., 2002). In a study of nurses in acute mental health settings, higher levels of support from nurse coworkers were associated with lower levels of emotional exhaustion, a key contributor on the road to professional burnout (Jenkins & Elliot, 2003). AbuAlRub (2004) also reported on the importance of social support for hospital nurses. The results of that investigation of 263 American nurses and 40 non-American nurses indicated that perceived social support from coworkers both enhanced their level of reported job performance and decreased their perceived stress

levels. The same study also concluded that the positive effects of social support were related to higher nurse retention rates. Communication is valuable in building social support (Jennings, 2008). Social support, in turn, can also alleviate some of the negative communication found in workplaces. Jenkins and Eilliot (2003) found that social support may also be useful in alleviating or buffering the effects of negative communication.

In consideration of the factors contributing to social support as an outcome of communication and its influence on stress for individuals in a work environment, as gleaned from the literature review, the following model has been developed (see Figure 15). This model is applicable to studying nurses in their work environments as many of the factors gleaned from the literature on occupational health were also found in nursing literature.

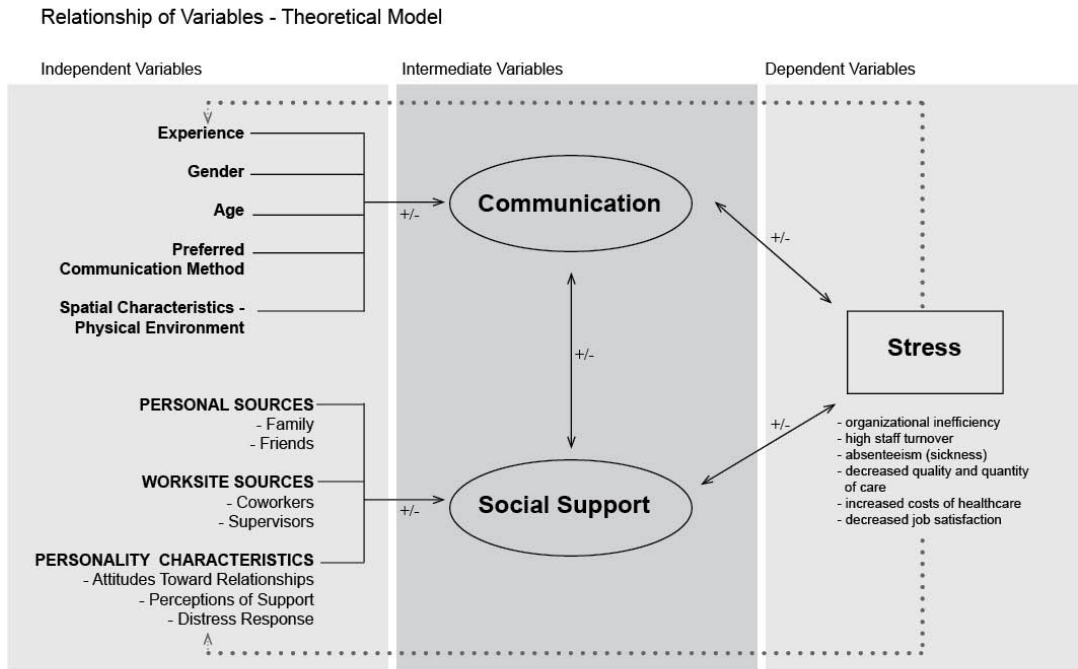


Figure 15. Model showing relationships between variables that contribute to an individual's stress in a work environment.

Figure 15 shows a model of the variables involved in influencing communication and social support, factors which ultimately influence the level of perceived stress. With poor communication and low levels of social support, an individual is likely to feel higher stress levels and less satisfied with their job (Baruch-Feldman et al., 2002; Jennings, 2008). Efforts to reduce stress can come from multiple sources, as indicated in the model (see left column) by independent variables that influence communication and social support.

Communication.

Several factors can impede or support communication. Figure 15 shows the relationship between variables that influence communication in the work environment. A

person's experience with communication is an influencing factor on the quality of communication. Demographics, such as gender and age, directly influence an individual's ability to send and receive communication and also affect an individual's preferred communication method.

Preferred communication methods such as face-to-face communication, electronic communication such as email and text messaging, and verbal communication such as phone communication are influencing factors on how a person communicates. Spatial characteristics of the physical environment, such as walls and room layouts also influence the quality of communication. Communication is also directly related to perceptions of social support for individuals in a work environment. The outcomes of successful communication and feelings of a high level of social support directly influence an individual's stress level and subsequently, job satisfaction.

Social support.

As modeled in Figure 15, social support interacts with communication and influences a worker's stress. There are three primary variables that contribute to social support: personal sources, worksite sources, and personality characteristics. Factors influencing social support can come from personal sources such as relationships an individual has with family and friends. Social support can also come from worksite sources from the relationships an individual has with coworkers and supervisors (Baruch-Feldman et al., 2002). Social support is also influenced by personality characteristics including an individual's attitudes toward relationships; whether a person is open to receiving help and also to the extent a person feels she/he has received adequate social

support to deal with a given situation (perceptions of support); and an individual's distress response (Baruch-Feldman et al., 2002).

Stress.

As shown in the model (Figure 15), stress is influenced by communication and social support. Occupational health literature indicates several outcomes as a result of low levels of both communication and social support. Examples of these negative outcomes include organizational inefficiency, high staff turnover, absenteeism, decreased quality and quantity of care, increased costs of healthcare, and decreased job satisfaction. These negative outcomes can be eased by increasing the level of good communication and increasing social support.

A goal of this study is to explore how interior design can influence staff communication on a nursing unit, thereby impacting perceived nurse stress levels. Stress levels for individuals working in the nursing profession is a concern for stakeholders of quality nursing care and can be difficult to study because stress is not experienced on the same level by all individuals (Jenkins & Elliot, 2003; Jennings, 2008; Rashid & Zimring, 2008). Depending on one's psychosocial needs and coping skills, stress levels could be different and difficult to measure.

The designed environment of a healthcare facility, in particular a medical-surgical nursing unit, may trigger stress for a nurse based on the way that individual conducts a task and the needs that nurse has for completing her/his work (Becker, 2007; Gurascio-Howard & Malloch, 2007; Rashid, 2009). The relationship between the physical environment and stress has also been examined by Rashid and Zimring (2008). They

conducted a review of empirical literature on the relationships between the indoor environment and stress, specifically in healthcare settings. They provided a conceptual framework in the form of a model (see Figure 16) to help organize their study of healthcare work environments.

A Conceptual Framework Describing How the Physical Environment May Set In Motion a Process Leading to Stress

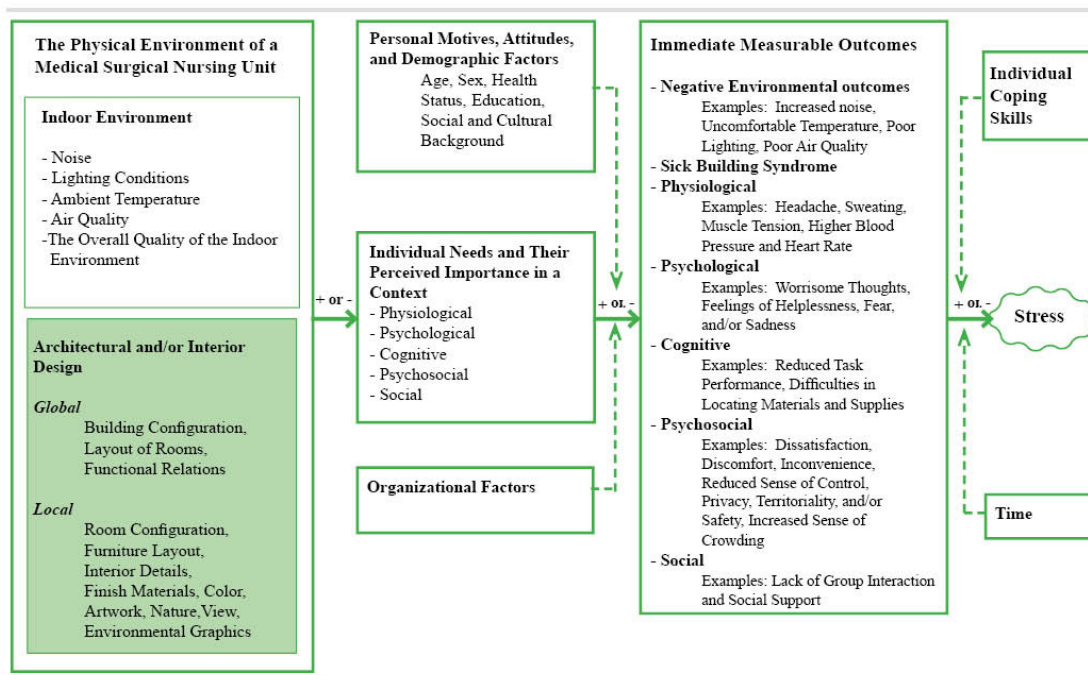


Figure 16. Conceptual framework describing how the physical environment may set into motion a process leading to stress. Adapted from “A review of the empirical literature on the relationships between indoor environment and stress in health care and office settings: Problems and prospects of sharing evidence,” by M. Rashid & C. Zimring, 2008, *Environment and Behavior*, 40, p. 153. Copyright 2008 by *Environment and Behavior*.

Rashid and Zimring divided the independent variables of the physical environment of a medical-surgical nursing unit into two main categories: indoor environment and architectural and/or interior design. Indoor environment elements include noise, lighting conditions, ambient temperature, air quality, and the overall

quality of the indoor environment; whereas architectural and/or interior design variables are segmented into global and local characteristics. Global characteristics include elements such as building configuration, layout of rooms, and functional relations. Local characteristics include room configuration, furniture layout, interior details, finish materials, color, artwork, nature, view, and environmental graphics. The indoor environment and architectural and/or interior design variables are shown to influence individual needs and their perceived importance in a context. Contextual variables include physiological, psychological, cognitive, psychosocial, and social characteristics. Organizational factors and personal motives, attitudes, and demographic factors are shown in the model to influence stress levels.

Rashid and Zimring's (2008) model further indicates the immediate measurable outcomes that result from the combined influence of the physical environment of a medical-surgical nursing unit; individual needs and their perceived importance in a context; personal motives, attitudes, and demographic factors; and organizational factors. These immediate measurable outcomes include negative environmental outcomes such as increased noise and poor lighting; sick building syndrome; physiological outcomes such as headaches and higher blood pressure; psychological outcomes such as feelings of helplessness and fear; cognitive outcomes such as reduced task performance; psychosocial outcomes such as dissatisfaction and reduced sense of control; and social outcomes that include lack of group interaction and social support.

The impact of the combination of these outcomes' influence on stress levels of workers on a medical-surgical nursing unit are affected by individual coping skills and

the duration of time an individual is exposed to these effects. Clearly, this model identifies the medical-surgical nursing unit's physical environment as a contributor to stress. The following segment will present an overview of the findings of the literature review for medical-surgical nursing units.

Medical-Surgical Nursing Units

The medical-surgical nursing unit serves as a workplace for nurses and members of the patient care team (Bureau of Labor Statistics, 2009). Medical-surgical nursing units are places of constant activity. They function every day of every year. Their ultimate goal is to provide a safe, healing environment for patients (Bobrow & Thomas, 2000). Secondary to that goal is to provide a healthy work environment for the patient care team (Ulrich et al., 2008). The medical-surgical nursing unit's physical environment affects nurses' safety, well-being, and effectiveness (Henrich et al., 2008; Stone et al., 2008; Ulrich & Zimring, 2004; Ulrich et al., 2008). For a medical-surgical nursing unit to run efficiently and safely, approaches to improve each area need to be addressed. As stated by Hendrich et al. (2008),

A holistic approach is needed whereby people, process, and technology come together harmoniously in a physical space to produce the maximum medical-surgical unit efficiency. Changes to the process and technology of documentation, communication, and medication handling, as well as the physical design of units, could benefit nursing efficiency and the safe delivery of care. (p. 33)

The healthcare environment is undoubtedly complex. Hendrich and Chow (2008) outlined a model to display the variables involved in a typical nurse work environment.

Though not specifically noted to be a medical-surgical nursing unit, it is appropriate to include their findings here because a medical-surgical nursing unit is influenced by the characteristics identified, as gleaned from the literature review. Their model shows four main constructs: organizational culture, technology infrastructure, work processes, and physical design (see Figure 17).

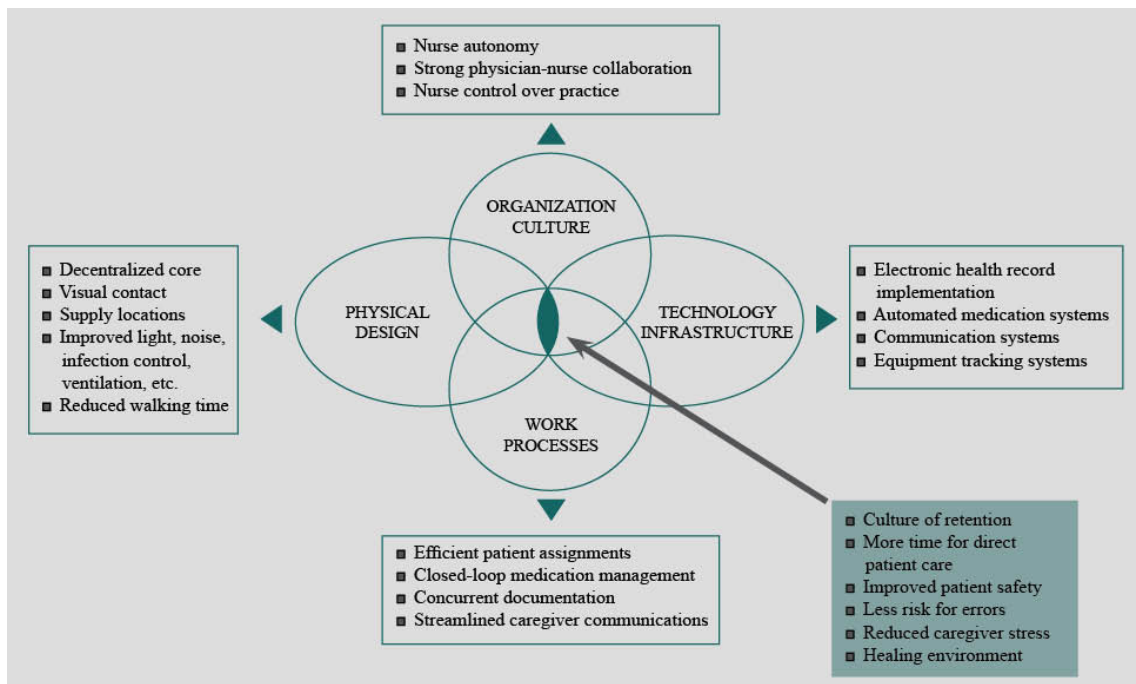


Figure 17. The interface between unit physical design, organizational culture, technology, and work processes in creating a culture of retention and safety. Adapted from “Maximizing the impact of nursing care quality: A closer look at the hospital work environment and the nurses’ impact on patient-care quality,” by A. Hendrich & M. Chow, *Healthcare Leadership*, 2008, p. 20. Copyright 2008 by Institute of Technology and The Center for Health Design.

Associated with each of these constructs are multiple factors that comprise the role of each construct in influencing patient care quality. Within the construct of organizational culture, three attributes are necessary to achieve the desired outcome:

nurse autonomy, strong physician-nurse collaboration, and nurse control over practice. Technology infrastructure is an increasingly important construct to the nursing work environment and patient care quality and consists of electronic health record implementation, automated medication systems, communication systems, and equipment tracking systems. Work processes that have been targeted by recent literature for needed improvement include the attributes of efficient patient assignments, closed-loop medication management, concurrent documentation, and streamlined caregiver communication. The physical design of the work environment is also included in this model with five attributes contributing to desired outcomes: decentralized core; visual contact; supply locations; improved light, noise, infection control, ventilation, etc.; and reduced walking time. Of particular importance to this exploratory study is the identification of visual contact (i.e., visibility) in the work environment and walking time (i.e., accessibility). Inclusion of this factor illustrates the theoretical framework for this study which uses the two space syntax constructs of visibility and accessibility.

At the center of the model is an area where these constructs combine in synergistic fashion to create a culture of nurse retention, more time for direct patient care, improved patient safety, less risk for errors, reduced caregiver stress, and a healing environment. This model emphasizes the complexity and difficulty of aligning multiple constructs and their related factors in the context of healthcare environments to achieve desired outcomes. Though the literature discussed the relationship between the physical environment and nurses' stress, this is one of few models that includes the physical environment as a contributing factor to the nursing work environment.

Research on medical-surgical nursing units is limited and, collectively, tends to focus on patient safety and staff efficiency. As an example of several studies that have been conducted on medical-surgical nursing units, Chaudhury, Mahmood, and Valente (2009) focused their study on the effect the physical environment has on nursing errors and inefficiencies. Through their focus group interviews and extensive literature review, they found the major issues surrounding design-related characteristics to have an effect on medication ordering, storage, delivery, dispensation, preparation, administration, and errors. Chaundhury, Mahmood, and Valente (2009) further recommended design characteristics to create a balance between patient accessibility and reduction of disruptions, automation, minimization of staff fatigue, and promotion of a culture of safety.

Further research is needed to employ theory as a design tool in healthcare design. Medical-surgical nursing units are at a design crossroads. Not enough is known about the effects of the three most popular design models: centralized, decentralized, and hybrid. New, hybrid models (see Figure 10) are being implemented into hospital nursing units. Some research has been conducted that compares centralized to decentralized models (Gurascio-Howard & Malloch, 2007; Hendrich et al., 2008; Hendrich et al., 2009), but often omits analysis of the hybrid model. This omission may be influenced by the lack of a true definition of a hybrid model and the large variation in designs available for study.

Space Syntax Theory

People affect their environments and environments affect people (Hillier, 1996; Hiller & Hanson, 1984). All of our behaviors and decisions are in some way affected by

the environments that constantly surround us. To study the influence of the built environment, theory is developed and used to frame design research. Space syntax theory was selected for this exploratory study because of its ability to explain and predict human behavior within the context of a designed environment. Space syntax theory consists of six constructs: openness, depth, connectivity, accessibility, degree of control, and visibility (Ziesel, 2006). Two constructs of space syntax theory were identified for use in this study because of their important role in the study of communication within medical-surgical nursing units: visibility and accessibility. These constructs influence the way people communicate and use their physical work environment and have been selected by other researchers for studying communication within a designed environment (Pati et al., 2008; Rashid, 2009; Rashid et al., 2006).

This study focuses on exploring the influence of the physical environment of a medical-surgical nursing unit on nurse communication, a factor that contributes to social support and thereby, when insufficient, can lead to increased job stress. Communication can be impaired by characteristics of the physical environment such as walls and layouts that reduce visibility and accessibility to other members of the patient care team. Using space syntax theory to study the physical work environment of a medical-surgical nursing unit could help to determine design direction for future medical-surgical nursing units that enhance nurse communication.

Much of the research using space syntax theory focuses on communication or movement in office environments. A review of office communication research was

conducted to gain perspective on how this theory has been established as a viable tool for studying behavior in a designed environment.

The information gleaned from reviewing office communication literature is applicable to studying nursing unit communication. Healthcare environments, much like office environments, consist of workers that are grouped together in teams (i.e., patient care team) and thrive on communication and collaboration (Clark, 2009; Kalisch & Begeny, 2005). The majority of literature on healthcare communication rarely mentions the physical environment as a catalyst for creating opportunities for communication; however, we know through architecture and interior design research that the physical environment can be used as a tool to improve communication among teams in workplace settings (Becker, 2007; Gurascio-Howard & Malloch, 2007; Rashid, 2009; Rashid et al., 2006; Rashid et al., 2009). Becker and Steele (1995) emphasize the influence of our environments on our behaviors as it relates to teamwork in office settings:

Physical design, by itself, will not change behavior patterns and guarantee teamwork. It can make some activities more likely than others, and when it is in tune with the social system, it can create the kind of lively, interactive setting that supports teamwork and collaboration. (p. 85)

Space syntax theory is helpful to the study of the relationships between communication, social support, and design, which can be demonstrated through the use of sightlines (i.e., visibility) between peers on a nursing unit. Several studies have focused on how the design of nursing units affects communication. These studies emphasized the importance of promoting good communication through opportunistic

meetings and peer lines of sight (i.e., visibility between individuals). Several of these studies have employed space syntax theory as a framework in healthcare research (Becker, 2007; Gurascio-Howard & Malloch, 2007; Hendrich et al., 2009; Rashid, 2009).

Effective communication does not just happen. Individuals involved in the exchange of information are just as important as the environment in which the exchange occurs. Studies have shown that face-to-face communication between members of the patient care team within nursing units is influenced by the physical layout of the nursing unit (Becker, 2007; Gurascio-Howard & Malloch, 2007; Rashid, 2009; Ritchey & Pati, 2008). Examples of design characteristics include full height walls, which can block visibility and accessibility to others on the unit. Decentralized nursing stations with no central point of gathering, can create feelings of isolation for nursing staff (Ritchey & Pati, 2008). The size and configuration of the layout also determines how visible other members are to each other.

Even though a decentralized model offers better sightlines to patients, patient care team members are susceptible to feelings of isolation from their peers due to such a configuration (Ritchey & Pati, 2008). Ritchey and Pati (2008) recommend units be designed “to provide a peer line of sight, so staff members know where others are should the need for assistance arise” (p. 130). Visibility of other staff also offers better opportunities for mentoring by more experienced nurses and helps to create a better environment for interdisciplinary interaction. Buckingham and Coffman (1999) reported the importance of staff relationships, especially with unit supervisors, as a critical factor in determining staff satisfaction.

To summarize, this study indicates that the environment is one of many factors operating within the complexities of the nursing work environment. These factors determine the stress levels and job satisfaction for nurses. A model was developed to display the variables as identified in the literature review (see Figure 18). The independent variables found in the literature include demographics and design characteristics. Demographics of an individual or group of individuals influence communication and perceptions of social support. The built environment, indicated by “design” in the model, influences how communication occurs. The intermediate variables of communication and social support have a mediating effect on each other and on an individual’s stress, the dependent variable. An individual’s stress is an influencing factor in determining overall job satisfaction. While this model graphically shows the interrelationships between the variables, a deeper understanding is still needed about how and why these outcomes occur.

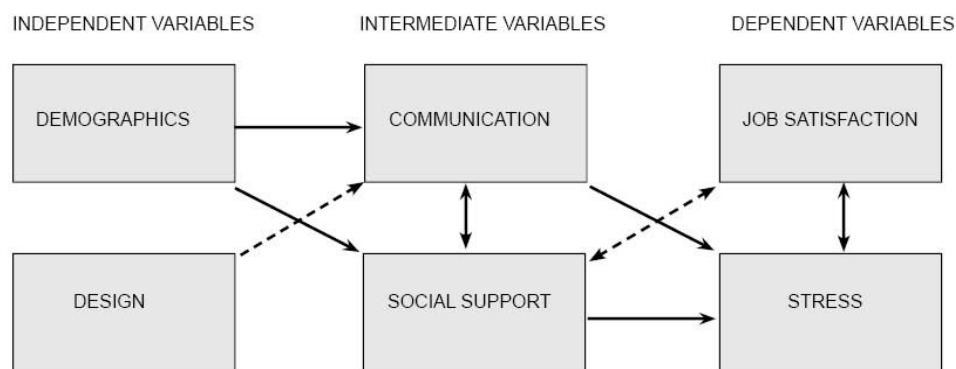


Figure 18. Relationships of independent, intermediate, and dependent variables. Relationships are shown between sets of variables. Solid lines indicate a strong relationship. Dashed lines indicate that a relationship exists, but not enough research exists to confirm a strong relationship.

Improvements to the work environment may help to increase overall job satisfaction for nurses. Job satisfaction is a multidimensional phenomenon and it encompasses factors such as working conditions, autonomy, staffing levels, decision-making involvement, salary and benefits, and opportunities for advancement (Ruggerio, 2005). Nursing unit designs that strive to support communication for the purposes of building social support can contribute to the complex issue of job satisfaction; however these outcomes (communication and social support) cannot be achieved as an isolated event. Just as job satisfaction is multidimensional, so must be the approach to improving it.

The next section of this chapter discussed findings from the plan analysis of three medical-surgical nursing unit floor plans via two constructs of space syntax theory.

Floor Plan Review and Analysis

This study includes a document review to analyze medical-surgical nursing unit floor plans in the context of space syntax theory. These architectural floor plans were designed recently by a local healthcare architecture and design firm and represent contemporary healthcare design practices for urban hospitals. The floor plans were analyzed for compliance with two space syntax constructs: accessibility and visibility. It should be noted that these floor plans were not originally designed with these constructs guiding the design process. This analysis was intended to determine the level of compliance with two constructs of space syntax theory by these existing medical-surgical nursing units. Analysis of accessibility and visibility within these plans is a method by

which to test the application of space syntax to a medical-surgical nursing unit to determine if the spaces are likely to support nurses' communication.

Method for Floor Plan Review and Analysis

Plans were reviewed for two constructs of space syntax. Plans were annotated relative to areas that did (complied) or did not (non-compliance) support communication via accessibility and visibility. The intent was to examine different types of medical-surgical nursing unit layouts as they are currently designed to determine their level of compliance with two space syntax theory constructs.

The medical-surgical nursing unit plans were designed between 2002 and 2009 by the same architecture and design firm. Each plan was constructed as shown and all units are currently in operation. Table 2 identifies a few descriptive statistics of each plan utilized in this review process. The reviewed plans are shown in their annotated form as Figures 19-21.

	Plan A	Plan B	Plan C
Square Footage	34,000 s.f.	28,000 s.f.	18,000 s.f.
Configuration	Centralized (6 pods)	Centralized (4 pods)	Hybrid
Number of Patient Rooms	45	32	20
Unit Size	Large	Medium	Small

Table 2. Descriptive statistics for medical-surgical nursing unit floor plans selected for document review using accessibility and visibility constructs of space syntax theory.



Figure 19. Plan A: Centralized medical-surgical nursing unit model with six pods, each with a varying number of patient rooms. Nurse stations vary in size and in proximity to patient rooms and to each other.

Notes:

- Nurse stations (A, B, C, D, E, F) are highlighted. Thin solid lines indicate sightlines from a standing location at a nurse station. Visibility is reduced to other nurse stations due to full height walls between them (shown on the plan in thick black lines).
- Black dotted lines indicate path movement options along the main circulation routes throughout the medical-surgical nursing unit.
- Curved corridors limit visibility down corridors due to diminishing viewing points that naturally occur along a curved path.
- No decentralized nurse stations nor charting stations are provided; however, some of the “centralized” stations (B, E, F) are smaller in size and limit the number of people who can use them at any given time. The larger nurse stations (A, C, D) allow for more people to be present and interact.
- Nurse stations that bridge main circulation routes (C, D, E, F) create an open visibility between the corridors and offer more accessibility to other nursing staff.
- Some patient rooms are not within nurses’ sightlines and/or between nursing stations.

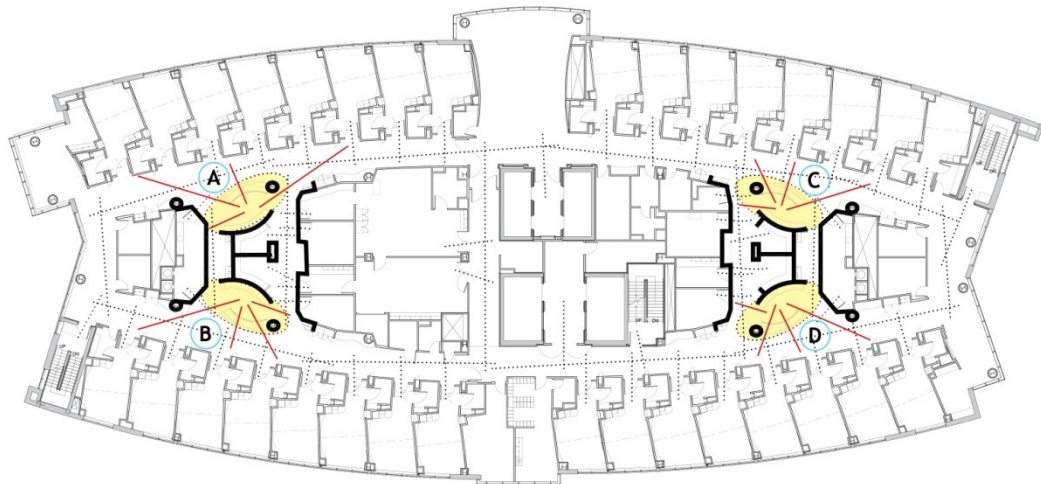


Figure 20. Plan B: Centralized medical-surgical nursing unit model with four pods of eight beds each. Each nurse station and pod are similar in size and proximity to patient rooms and to each other.

Notes:

- Nurse stations (A, B, C, D) are highlighted. Thin solid lines indicate sightlines from a standing location at a nurse station. Visibility is reduced to other nurse stations due to full height walls between them (shown on the plan in thick black lines).
- Black dotted lines indicate path movement options along the main circulation routes throughout the medical-surgical nursing unit.
- Curved corridors limit visibility down corridors due to diminishing viewing points that naturally occur along a curved path.
- No decentralized nurse stations nor charting stations are provided.
- Some patient rooms are not within nurses' sight lines and/or between nurse stations.

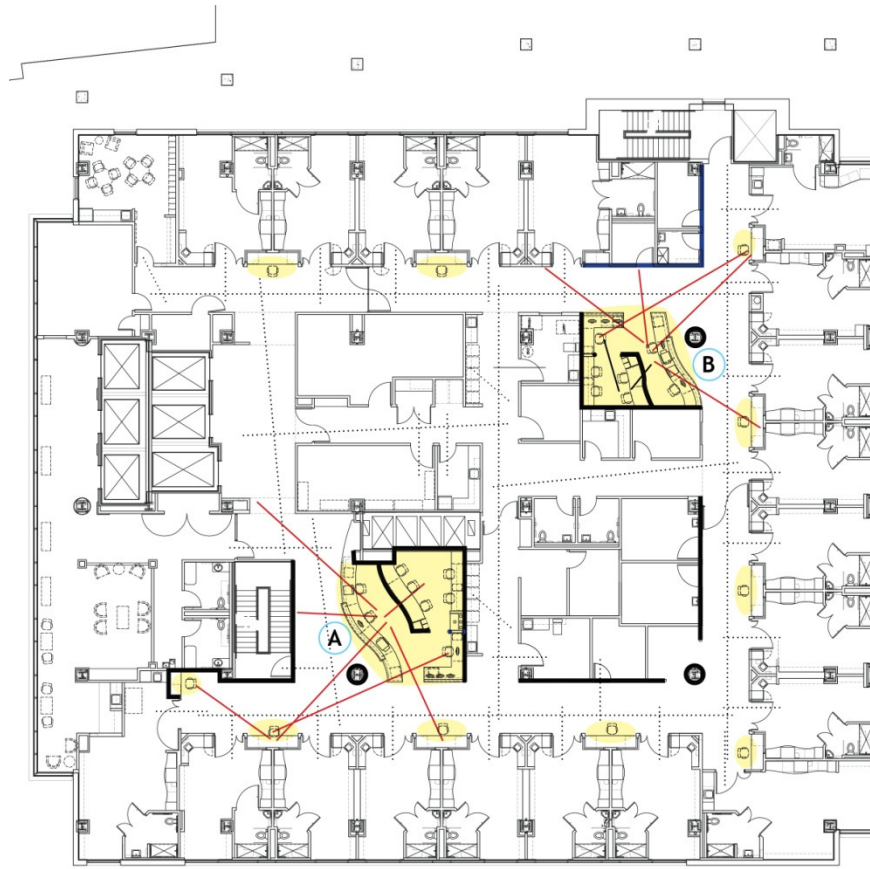


Figure 21. Plan C: Hybrid medical-surgical nursing unit model with two centralized pods and decentralized nurse stations located between every two patient rooms. Ten total decentralized nurse stations are provided and are generally the same size and in similar proximity to patient rooms and to each other.

Notes:

- Nurse stations (A, B) are highlighted. Thin solid lines indicate sightlines from a standing location at a nurse station. Visibility is reduced to other nurse stations due to full height walls between them (shown on the plan in thick black lines).
- Black dotted lines indicate path movement options along the main circulation routes throughout the medical-surgical nursing unit.
- Straight corridors are good for maintaining visibility in one corridor, but impair visibility around corners. The deep floor plate does not allow adequate visibility between main circulation paths (corridors).

- Decentralized nurse stations are provided throughout. Several of these stations are in locations with limited or no visibility of a larger nurse station and may create feelings of isolation.
- All patient rooms are within direct visibility of either a decentralized nurse station or one of the centrally-located nurse stations.

Floor Plan Review Discussion

It appears that the compliance with visibility and accessibility constructs depends greatly on the overall building floor plate. Deeper floor plans (building shape) (i.e., Figure 21) will offer different sightlines, or visibility, than more shallow floor plans (i.e., Figure 19); likewise with convex (i.e., Figure 20) versus concave (i.e., Figure 19) curved building shapes. Each floor plan will be reviewed in detail below.

Figure 19 is a relatively shallow floor plate and was designed with a concave curve on one side. The number of nurse stations for a unit of this size creates more opportunities for interaction among nursing staff, no matter where a nurse is located on the unit. Regardless of a nurse's location between patient rooms, she/he is likely to be near a nurse station and have access to computers, supplies, and other nursing staff. The concave curved corridor also appears to limit sightlines down the corridor whereas the straight corridor offers longer sightlines.

Figure 20 has four nurse stations located in pairs (A and B; C and D) on the unit. This configuration offers visibility to the majority of patient rooms from a standing location at each unit; however, a few rooms are not within view from each nurse station. Visibility to other nurse stations is reduced through the convex curved corridors and full

height walls, accessibility between two nurse stations (A and B; C and D) is offered by close proximity and semi-controlled corridors between the nurse stations.

Figure 21 is a hybrid unit, planned with several decentralized nurse charting areas throughout the unit with two larger nurse stations (A and B) on opposite ends of the deep floor plate. Visibility between the two larger nurse stations (A and B) cannot be achieved due to the necessary shared support areas located between the stations and the full height walls to create those spaces. The decentralized stations offer segmented viewing of other nursing staff if nursing staff are expected to remain at their respective decentralized stations. Accessibility between the two larger nursing stations (A and B) is deep in terms of separation, creating longer walking distances for nurses. A nurse would need to walk and make at least four turns to arrive at the other nurse station. However, this issue is minimized because of the inclusion of decentralized stations throughout the unit, offering more opportunities along the path of travel for communication to occur between two or more nurses. It is uncertain what types of communication technology are utilized on this unit. Technology could enhance communication opportunities between the stations and perhaps reduce walking distance and the need to physically locate other nurses.

In summary, analysis of these plans in context of accessibility and visibility constructs of space syntax theory has highlighted several important findings. First, visibility can be affected through placement of full height walls and column location. These types of obstructions to direct visibility of other nurses on a unit reduce the number of opportunistic meetings for communication as a result of not being able to see who is available. Accessibility (i.e., ease of physically locating another nurse) is affected by

lengths of paths of travel and location of support areas. Longer support cores reduce the access between main circulation routes; however, there is an important need for the appropriate location of these areas. A greater number of medical-surgical nursing unit floor plans need to be analyzed for similarities and differences according to nursing unit configuration.

Exploratory Interviews

Three exploratory interviews were conducted as a method to further explore the findings from both the literature review and floor plan review and analysis. Participants for interviews were selected through a convenience sample from contacts the researcher had made on previous project assignments. Two registered nurses and one health unit coordinator were interviewed. Interviews were conducted at the participants' job site during their lunch break in a break room located within their nursing unit. The average length of time for each face-to-face interview was 25 minutes. A series of 14 questions were presented to each participant (see Appendix A). The researcher began by asking each participant to describe their role on the patient care team, followed by more direct questions on communication methods and feelings of social support. The interviews concluded with questions regarding the participants' satisfaction with their workplace and how it helps them function or impairs their ability to function.

Participants for these interviews had worked on two different nursing units over the past 12 months. Their original unit was not of contemporary design and much smaller than the new, contemporary unit they transferred to while the original unit was being remodeled. The participants' original unit was then remodeled with basic finish upgrades

and conversion of double patient rooms to single rooms. Upon the completion of the original unit, the participants were offered the choice of continuing to work on the new, contemporary unit or to return to their original unit. It was verbally communicated to the researcher that nearly 90% of nurses chose to return to the original unit. The responses gathered reflect a comparison of the two units from the participants' perspectives. Generally, this preference derived from the nurses' dislike of the new, contemporary unit design and several organizational issues.

Through basic plan analysis, the two constructs of visibility and accessibility appeared to support findings from the literature review and theoretical framework. However, upon gathering experiential data from nurses who worked in the nursing unit shown in Plan A (Figure 19), it was discovered that users of this space experience it much differently than designers and critics of plans. Overall, the responses indicate that individuals can experience feelings of isolation on a plan type similar to Plan A (shown in Figure 19). The following quotations were gathered from the semi-structured, open-ended interview questions regarding feelings of isolation.

Question:

- Have you ever felt isolated on your nursing unit? If so, please describe.

Responses:

Not on this unit [referring to the previous unit]. When we were on the new unit, *always* [emphasis added] felt isolated, always because the halls were so long. And you would not hardly see the other nurses from the other side or the other end 'cause they would be in a different. (RN #1, female, estimated age between 40-50)

I didn't really like the really long halls [referring to the new unit]. I didn't like that you, you'd stick your head out the door and you'd see no one! Looking for anyone to help you, didn't like that. *(RN #1, female, estimated age between 40-50)*

I sit up there [referring to nursing station/HUC station] all by myself. I mean, the charge nurse is with me. But on the weekends when it's generally quieter, I might not see anyone for a little bit. Or talk to anybody. So I do feel isolated, because I'm not wandering the halls like [the nurses]. 'Cause we generally don't typically chit chat at the desk. People who come to the desk are busy. So like if I do see them at the desk, it's not to be like "how's it going?" It's like all work related. *(HUC #1, female, estimated age between 25-30)*

When asked about types of communication used for daily work activities, participants described how they communicate with each other and difficulties with their communication methods. The following quotations were gathered from the same participants who worked on Plan A when asked about communication.

Questions:

- What methods of communication do you use for daily work activities?
- How do you use technology in your communication needs?
- Can you think of alternative communication methods to improve communication among the patient care team?

Responses:

You want to see an example of poor communication...It's [new contemporary nursing unit] beautiful, it's got many desks, but the doctors would come in and they weren't sure where their charts were, I mean, it's usually in the same spot, but, over here, everything is centrally located and you have areas throughout the floor to work in. *(RN #1, female, estimated age between 40-50)*

The charts are there [central nurse station in original nursing unit]. The charge nurse is there. Our unit coordinator is there. And sometimes it's not very convenient to be talking away on these Voceras [hand-held communication devices] about stuff. It's better to communicate in person. Or if there is a privacy issue and you can't be standing in the hall talking about a patient or a problem or a... face to face communication. Meds come up there too. Medications. *(RN #1, female, estimated age between 40-50)*

From these few quotations, a rich description is starting to be formed that may contradict some earlier findings and confirm other findings. For example, the floor plan of the nursing unit that the participants work on was included in the floor plan review and analysis and was described as having good accessibility and visibility between several nurse stations. This is in conflict with some of the responses from the participants that described reduced sightlines (i.e., visibility) to others on the unit. The responses were in agreement, however, with the reduced sightlines (i.e., visibility) from the configuration of the curved corridors, which limit visibility down a long corridor. Responses from those

interviewed illustrate the importance of verifying findings through multiple methods for future research.

The findings from these interviews are limited due to the small number of participants. A greater number of responses would strengthen the findings and create a better opportunity to define themes from the raw interview data. Additionally, the interview data was also weakened by the questions asked. Several of the questions were determined to be leading and may have affected objective responses from the participants. Future studies should consider including interview data with a revised questionnaire.

Analysis

Humans are remarkably adaptive to their environments. Whether it is at home or at work, humans will find a way to function and live their daily lives, sometimes despite barriers and unsupportive environments. As noted by Becker and Steele (1995),

The problem is not that people cannot overcome their surroundings. We all do, in ways conscious and unconscious, with efforts large and small. We cope, but the cost can be high. Overcoming places that reduce our effectiveness and threaten our dignity always takes time and energy. (p. 6)

The findings presented in this study support Becker and Steele's (1995) assumption about individuals in their work environments, and in this study, nurses working in medical-surgical nursing units. This section will present the researcher's analysis of the findings of this exploratory study in context of the three research questions posed in Chapter 1, in preparation for future research of urban medical-surgical nursing

units using space syntax theory. The findings will be analyzed using the research questions as a framework.

Research Question:

1. Does the design of a medical-surgical nursing unit in an urban hospital influence communication and social support opportunities for nurses?

A relationship exists between the variables of the designed physical environment, communication, social support, and stress in medical-surgical nursing units. Findings from the literature identify the relationships between the many variables of an individual's stress, perceived social support, and communication in a designed environment. Findings from the plan review and interviews identify the complexity of understanding how the designed environment is interpreted by designers and experienced by users of the space; indicating that there may be some difficulty in achieving consensus for which design configurations are preferred for communication. The designed environment can be used as a tool for enhancing opportunities for communication. With increased communication, a nurse is likely to feel more adequate social support and less overall stress in their work environment.

Research Questions:

2. Does medical-surgical nursing unit design influence visibility between nurses?
3. Does medical-surgical nursing unit design influence accessibility to nurses and other members of the patient care team?

Nurses working on a medical-surgical nursing unit are affected by the layout configuration of their unit in terms of factors that contribute to communication. Medical-

surgical nursing unit configuration can be designed to fulfill space syntax constructs, specifically visibility and accessibility, to enhance nurse team communication through improved sightlines and improved accessibility to other nurse stations. At the same time, designers need to consider other consequences of these design configurations. To create improved sightlines, floor plans may have fewer full height walls. This design implication will most likely reduce sound absorbing qualities and create louder environments for patients and staff. The reduction of full height walls may also reduce the number of areas for private conversations to occur, jeopardizing patient confidentiality. Designers seeking to increase visibility on a medical-surgical nursing unit may consider an alternative to the reducing the number of full height walls by incorporating more transparency (i.e., glass) between areas with full height walls, especially on units designed with deep building floor plates. Full height walls with glass will provide opportunities for nursing staff to visually locate other nursing staff for communication purposes and also maintain better acoustics and offer areas more suitable for private conversations.

This chapter has presented findings from three data collection methods. From these findings, the complexity involved is understood when studying communication in healthcare environments, particularly medical-surgical nursing units. The final chapter will provide a summary and recommendations for future research.

CHAPTER 5. CONCLUSION AND RECOMMENDATIONS

The importance of retaining and recruiting nursing staff in a time of severe workforce shortages will be at the center of many healthcare organizations' challenges for the next decade. Recruitment and retention can be achieved through improved work environments. Decreasing job stress and improving overall job satisfaction are directly involved in retaining current staff, while creating healthy work environments helps recruit new nursing staff and satisfy current staff. Several strategies for creating healthier work environments have been discussed in the literature review with a focus on how interior design can have a contributing role in reducing stress and improving job satisfaction.

The role of the physical environment of a medical-surgical nursing unit in creating a healthy work environment for nursing staff has been discussed throughout this qualitative assessment. Of particular importance is the influence the physical environment has on communication opportunities for social support for members of the patient care team. In this study, space syntax theory was used to explore the feasibility of applying its constructs to future research on medical-surgical nursing unit designs. Space syntax theory contains six constructs: openness, depth, connectivity, accessibility, degree of control, and visibility. In the context of two space syntax theory constructs, accessibility and visibility, it appears that certain characteristics of the built environment have a direct influence on how people behave and communicate in a space, as applied to three medical-surgical nursing unit plans.

It is unclear at this time if any medical-surgical nursing units have been designed from the beginning of the design process using space syntax theory constructs. Researchers could analyze plans using these constructs to frame research questions and predict behavior, and subsequently, have findings impact their future designs. This exploratory study may be limited due to the application of only two space syntax constructs; however, that decision was supported by several previous studies that applied one or two constructs in lieu of all six constructs (Hendrich et al., 2009; Rashid et al., 2006).

The knowledge and expertise of a healthcare interior designer are continually put to the test when designing a complex environment such as a nursing unit. No design should compromise patient safety, nor should any design contribute to medical errors. One of many concerns when designing a medical-surgical nursing unit is the balance of patient safety, staff efficiency, and healing environment factors such as acoustics, wayfinding, daylighting, and connections to nature. Beyond the constructs examined in this study, many other factors are equally important relative to patient care. An example would be noise on a medical-surgical nursing unit that can negatively impact the healing process and contribute to medical errors. Designs that improve communication through peer visibility between nurse stations need to be considered carefully in light of other factors such as noise and privacy. Designers need to consider acoustics within nursing units because the inclusion of more open spaces within a unit can create more opportunities for sound transmission. Openness within an environment has the potential to increase noise levels. Considerations for sound absorbing materials and rules for noise

generation should be addressed. Quieter spaces are preferred for patients for better quality sleep and for nurses' need to concentrate (Ulrich et al., 2008).

Additional privacy needs for discussing private patient information should also be addressed according to the Health Insurance Portability and Accountability Act (HIPAA) recommendations. By adding more open spaces to increase visibility, nursing units may be compromised in terms of providing areas to discuss private information and thereby jeopardizing patients' confidentiality.

Design opportunities are often limited by the need to meet so many key demands simultaneously. In cases of remodeling existing medical-surgical nursing units, certain designs may not be possible due to size constraints and location of mechanical systems. Designers will need to make a deliberate effort to analyze availability of space, client goals, and program requirements, and balance them with the needs of the patient and the patient care team to have efficient work environments that also support nurses' communication, thereby reducing nurses' stress.

Contemporary design practices for medical-surgical nursing units vary greatly between hospitals, architecture and design firms, and regions of the United States. New construction of medical-surgical nursing units has the unique opportunity to "get it right" and reflect good design practices mostly gathered from observing the AIA Guidelines for the Design and Construction of Hospitals and Health Care Facilities. As we begin a new decade of changing healthcare, designers must respond by considering how external and internal forces will change how healthcare is delivered. New technology, younger generations, a continuing nursing shortage, and healthcare reform legislation will greatly

influence the healthcare workforce. The designed environment is a contributing factor to the efficiency, safety, and health of healthcare staff, especially nurses and should be given appropriate attention in research fields.

The majority of research that is available on nursing work environments is quantitative, and therefore lacks a rich description of the nurses' perspectives of their work environments. As it was found with this study, nurses on a particular unit shared their experiences, through interviews, with their work environment in a much different way than expected through the earlier efforts of using plan analysis and findings from the literature review. Efforts to produce more qualitative research will provide designers with information necessary to understand how changes to the physical environment, analyzed through a theoretical framework, actually affect the users of the spaces they design.

Implications

The implications of this exploratory study using qualitative methods to review relevant literature, review and analyze floor plans, and conduct interviews could help inform future research for medical-surgical nursing units. Healthcare interior designers and other built environment designers need more research grounded in theoretical frameworks such as space syntax theory. Much of the research that is done for healthcare design has been conducted only in the past few years. As the body of research grows, researchers need to take an approach that considers and weighs multiple factors of the complex healthcare environment. As stated by Jain Malkin (2008),

It is clear that a bifurcation – or split – exists in ongoing research. Organizations ... are focusing their research on the complexity of the work environment,

physical space, and technology, which is, of course, essential. Effects of the built environment are not being measured, which is not to say they think it's unimportant and has no impact, as all of these organizations... are sensitive to the synergistic relationship between care and environment. Healthcare cannot be separated from the settings in which it is delivered. The point is that the built environment is not a variable in any of their ongoing research. These are the most comprehensive studies being carried out to date, and the impact will be enormous. (p. 120)

The research community is gradually pulling together research on specific areas of healthcare design. There needs to be a simultaneous interaction with the clinical research community when studying any aspect of the healthcare environment, as stated in one example by Malkin (2008),

... CHD [Center for Health Design] and AIA [American Institute of Architects] have been sponsoring research based on the impact of the built environment on patient safety, patient clinical outcomes, and a variety of other issues, but there is no integration between this research and the various studies of clinical care at the bedside. Parties on both sides are well-intentioned and respectful of each other, but it isn't clear how and when the respective findings will be knit together to provide a holistic approach to the design of inpatient units. (p. 120)

The information provided by this study seeks to expand the discussion among design practitioners and healthcare professionals. The choices that are made for a new medical-surgical nursing unit have implications for patients, families, and the patient care

team, with the patient of greatest concern. While the majority of research that is currently available on medical-surgical nursing units focuses on patient safety, patient outcomes, staff efficiencies, or medical error reduction, this study focused on how medical-surgical nursing unit design influences communication for nurses. It explored accessibility and visibility as measures of communication and social support among nurses on a medical-surgical nursing unit and demonstrated the benefits of applying a theoretical framework to the design process used by interior designers and others. The following section describes recommendations for future research.

Recommendations for Future Research

Based on the analysis of available literature for the nursing profession, medical-surgical nursing units, and space syntax theory, it is understood that interior design for healthcare environments is complex and requires in-depth knowledge of intricate work processes, technology, space needs, and implications of design characteristics. The following questions are recommended for future research:

1. What communication methods are preferred by younger generations and will these preferences change the way communication-supportive environments for healthcare are designed?
2. What specific design elements of medical-surgical nursing units impair or support face-to-face communication for the patient care team?
3. How can privacy and plan openness for visibility be balanced to support multiple needs on a medical-surgical nursing unit?

4. How do nursing unit models (centralized, decentralized, hybrid) vary in terms of fulfilling visibility and accessibility constructs of space syntax theory? Does one model achieve more success for implementing these constructs?
5. Can a space syntax theory-inspired design for a medical-surgical nursing unit successfully increase face-to-face communication and social support for the patient care team?

Medical-surgical nursing unit plan configurations vary. Centralized, decentralized, and hybrid models can all reflect good design practices as defined by the AIA Guidelines for the Design and Construction of Hospitals and Healthcare Facilities (now called the FGI Guidelines for the Design and Construction of Hospitals and Healthcare Facilities) and the Joint Commission that promote single patient rooms and types of spaces needed. Future discussion on medical-surgical nursing unit design should consider space syntax constructs during the design process.

The use of space syntax theory for analyzing medical-surgical nursing unit floor plans is perhaps an overly inconclusive process, to the point of creating confusing findings and making it difficult to implement in the design of these spaces. The sheer complexity of this theory creates certain difficulties to use it consistently and with trustworthiness. Using axial maps to model the relationships of the different constructs can, at times, be confusing, unclear, and overwhelming to the researcher. As noted previously, researchers are investigating the application of space syntax theory to seek ways to simplify its application to healthcare environments (i.e., reviewing for just one

construct). Future research should also investigate methods to model all six constructs and find ways to analyze floor plans using them.

One approach may be to establish a hierarchy of movement and visibility for floor plan analysis. Answers to the following questions should be considered:

- 1) Should there be primary and secondary movement patterns or visibility preferences?
- 2) Do movements to areas that are less occupied or accessed (i.e., storage rooms) maintain the same connectivity as movement to high occupancy or high access areas (i.e., nursing stations)?
- 3) Is it necessary or preferred to maintain visibility to all areas or a medical-surgical nursing unit?
- 4) What are the outcomes of too much visibility in a medical-surgical nursing unit?

These are just a few examples of questions to consider for future plan analysis using space syntax theory.

Another consideration when using space syntax theory is to combine plan analysis with interviews and behavioral mapping. Some companies are using advanced technology to track movement patterns of people in office environments. This type of data collection could help to establish hierarchies of movement and occupied areas, and also verify analysis of space syntax constructs. Figure 22 shows an example of movement tracking in an office environment.

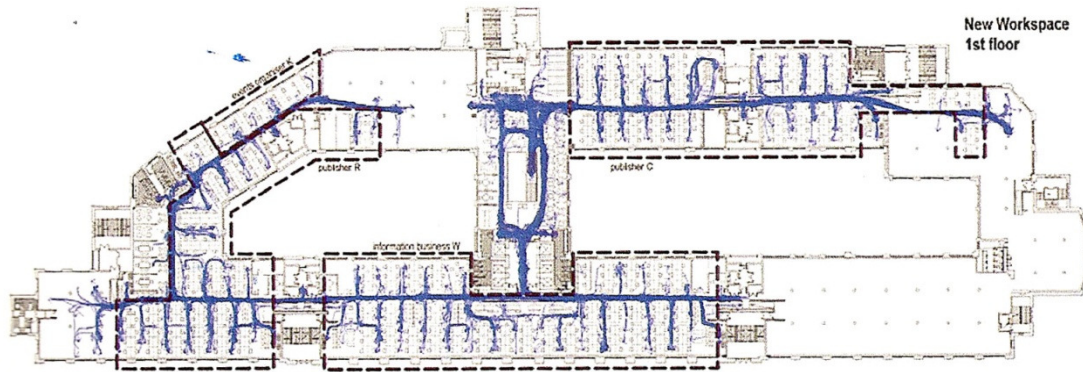


Figure 22. Example of movement tracking in an office environment. Adapted from “Comparative Studies of Pre and Post: How Changing Spatial Configurations Affect Organizational Behaviors,” by K. Sailer, A. Budgen, N. Lonsdale, A. Turner, & A. Penn, 2009, Proceedings of the 7th International Space Syntax Symposium. Stockholm, Sweden. p. 096:7. Copyright 2009 by the International Space Syntax Symposium.

Based on the review of current literature and examining research methods for relevant studies, it is determined that most research for nurses’ communication and design of medical-surgical nursing units is quantitative and fails to give a voice to the nursing profession. It is recommended that future research involves mixed methods as the research approach for the purposes of involving nurses in data collection through interviews, observations, behavioral mapping, and focus groups. Data collection could also include interviewing patients to gather their perspectives on how visible nurses are to them and how noisy the environment is throughout multiple shifts. More architecturally-open floor plans could create better sightlines for both patients and nurses; however, the open floor plans could also reduce sound absorption from lack of walls and the resulting noisier unit would not be an environment conducive to quality patient sleep, could reduce

needed spaces for quiet concentration, and even negatively impact privacy and confidentiality.

Additional recommendations include expanding the study to include medical-surgical nursing units of varying sizes and configurations. Further research should also include comparisons of rural and urban medical-surgical nursing units. Exploration of different types of nursing units should also be included in future studies. Examples could include critical care, cardiac, pediatric, and other specialty care nursing units. Similarities exist between most nursing units, yet slight differences could be revealed through mixed methods data collection.

A suggested protocol for a future study includes a mixed methods approach through the use of floor plan analysis, interviewing, behavioral mapping, and demographic data collection. The first step in a mixed methods study would be to obtain a computer drafted floor plan of the medical-surgical nursing unit for the purposes of constructing an axial plan for selected space syntax constructs. Axial lines would need to be added as an overlay to the floor plan to study sightlines (visibility) and movement patterns (accessibility). Sightlines to patient rooms and to other nursing stations would be reviewed, as both are equally important in the design of a nursing unit.

The next step in the study would include interviews of nursing staff on that same unit. This is an important step to verify the information gathered from the plan analysis. User perceptions and designer/critic perceptions may vary greatly, as noted early in this study from the exploratory interviews. The interview protocol included in Appendix A showed weakness and needs to be improved for future studies by rewording several

questions with the goal of gathering responses that are more descriptive of their work environments.

The third step in the study would include behavioral mapping of the nurses on the unit. Behavioral mapping is important to verifying nurses' movement and tasks throughout multiple shifts. This information needs to be triangulated with the information from the plan analysis and interviews.

The final step in the study would be to gather demographic data of the nurses on the unit to track age, gender, and other information such as preferred communication types and comfort levels of using different types of communication. Additional studies may also include collecting data on medical errors and noise complaints as they will also be affected by nursing unit configuration and nurses' communication. By using a mixed methods approach and gathering multiple sources of data, the researcher will be able to study the space syntax compliance level of the unit and make design recommendations for an environment that could enhance nurse communication and social support through an understanding of the theoretical framework of space syntax. This type of mixed methods approach could be developed into a comprehensive protocol for a post-occupancy evaluation of medical-surgical nursing units.

A gap exists in our knowledge of how the built environment affects the users of the spaces that designers perceive as thoughtfully designed. With a better understanding of how users are affected by certain design characteristics, we can achieve a higher level of predictability for human behaviors through design. This understanding will also enable humans to use less adaptive behaviors to function in their work environments. The work

environments of nurses should meet and exceed goals for efficiency, safety, ergonomics, and communication needs. This study, which applied space syntax theory to evaluate medical-surgical nursing unit environments as an influence on communication and social support of nurses, will add to the body of knowledge that seeks to inform future healthcare design.

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Appendix A

Interview Protocol Project: Nurses and Communication on a Medical-Surgical Nursing Unit

Time of Interview:

Date:

Place:

Interviewer: Stefnee Trzpuć

Interviewee:

Position of Interviewee:

Project Description (read to participants): Nursing unit design has changed drastically over the past decade. More emphasis has been placed on patient-centered care, which has been seen in many design improvements such as acuity adaptable rooms and decentralized nursing stations. Emerging design needs to also consider staff communication and need for social support, which may affect current nursing unit design criteria. This project is to gather information on nurse perceptions of their work environment, specifically as it related to communication and social support.

QUESTIONS:

- A) Describe your role as a member of the patient care team.
 - a. What has been the most challenging part of your role on the patient care team?

- B) What methods of communication do you use for daily work activities?
 - a. How do you use technology in your communication needs?
 - b. Can you think of alternative communication methods to improve communication among the patient care team

C) During a typical work shift, how often do you need to locate another nurse for patient care needs and for what purposes?

a. Have you ever felt isolated on your nursing unit? If so, please describe.

[Segue: Now I want to ask a few questions about social support. What does social support mean to you?]

D) Do you feel you have adequate social support on your nursing unit?

a. How do you access social support – formally?

b. How do you access social support – informally?

E) Describe your satisfaction with your workplace.

a. What about the nursing unit works best to help you function?

b. What about the nursing unit doesn't work and impairs your work ability?

F) Is there anything I may have missed that you would like to add to our discussion?

(Thank the individual for participating in this interview. Assure him or her of confidentiality of responses and potential future interviews.)