

NURSES' ASSESSMENT OF ENVIRONMENTAL COMFORT IN THEIR PHYSICAL
WORK ENVIRONMENTS

By

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To all nurses for being part of such an altruistic profession, specifically my mom

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LIST OF ABBREVIATIONS

ASHRAE	American Society of Heating, Refrigeration, and Air-conditioning Engineers
COW	Computer-On-Wheels
DiCONFON	Standardized survey developed to measure workplace environmental comfort
GRET	Work Environments Research Group
HIPPA	Health Insurance Portability and Accountability Act
HVAC	Heating, Ventilation, and Air Conditioning
IAQ	Indoor Air Quality
ICU	Intensive Care Unit
IESNA	Illuminating Engineering Society of North America
IRB	Institutional Review Board
IV	Intravenous
OMNICELL	Automated medication distribution cabinet
OSHA	Occupations Safety and Health Administration
PCA	Patient Care Assistant
RN	Registered Nurse
Wall-A-Roo	Wall mounted work stations

Abstract of Thesis Presented to the Graduate School
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The key nurse work areas (nurse station, medication dispensing area, and supply room) in four medical-surgical nursing units were under study at two healthcare facilities in north central Florida. Registered nurses answered a detailed questionnaire concerning the conditions encompassing (1) lighting, (2) noise level, (3) thermal quality, (4) spatial factors, and (5) privacy of their work areas. Focus groups and researcher observations were also conducted to identify how design conditions impact their perceived environmental comfort. These data were used to characterize which level of environmental comfort the nurses were experiencing, interpreted with Jacqueline Vischer's model of Environmental Comfort (2007). In particular, two units (Units C and D) from the South Tower demonstrated a higher overall environmental comfort than the remaining two nursing units (Units A and B) from the North Tower. The spatial factors were consistently the lowest rated condition on each of the four units. In sum, the results confirmed the important role of design on enhancing registered nurses' work flow, and the meaningful insights on workspaces in healthcare environments that can be gleaned from the staff perspective.

CHAPTER 1 INTRODUCTION

As humans we are influenced by the spaces we inhabit; for example, when entering a dimly lit concert hall one may instinctively lower their voice due to the surrounding physical cues, or while having a meal inside a fast food restaurant customers may find themselves eating more quickly due to the bright colors, lights, furniture and relatively hard surfaces throughout the space. Likewise, the physical environment of a healthcare setting can have an effect on the productivity of the occupants- specifically the caregivers (State of the Field Report, 2009; Cesario, 2009). “Our actions, thoughts and feelings are shaped not just by our genes and neuron-chemistry, history and relationships, but also by our surroundings” (Gallagher, 1993). The field of environmental psychology implies a dynamic and reciprocal relationship between individuals and the environment in which they occupy (Frumkin, 2005). Research confirms this notion; Ulrich et al. conducted a review of empirical research and found over 2,000 studies that offer insight into the relationship between the physical design of hospitals and key outcomes (2008). Three types of general outcomes surfaced in the literature review: patient safety, other patient outcomes, and staff outcomes (Ulrich et al., 2008). Compared to the research on patient outcomes, a limited amount of environmental research has addressed nursing staff outcomes (Ulrich, 2010).

Given that nurses are the primary care givers in the hospital workplace it would be beneficial to investigate the affects of the physical environment on this critically important group of personnel. Traditionally the design of health facilities has emphasized the functioning of medical technology which often produced hospitals that were operationally effective but psychologically “hard” (Mycek, 2007). These large and

often impersonal institutions omitted the caregivers' psychological and social needs from the healing design equation. Fortunately, there is a broad movement to implement evidence based principles in the design and construction of the healthcare facility (Ulrich, 2010). The Center for Health Design defines evidence based design as the process of basing decisions about the built environment on empirical research to achieve the best possible outcomes (2008). Just as medicine has increasingly moved toward evidence based treatments where clinical choices are informed by research, the design of health facilities is increasingly guided by research linking hospitals' physical environments to healthcare outcomes (Hamilton, 2003). This evidence-based design (EBD) process utilizes research from multiple professions involving healthcare such as environmental science, interior design, architecture, engineering, etc. to make building decisions (Cesario, 2009). The goal of EBD is to create an environment that promotes healing, supports family involvement, facilitates efficient staff performance, and reduces stress in all users of the facility (Brown & Gallant, 2006). There is an increasing understanding that an appropriately designed built environment can help create a safe, nurturing, and positive work environment for caregivers; and help achieve organizational and business objectives (Joseph, 2011).

When looking from hospital to hospital around the United States it is apparent that there are multiple design solutions for nursing work areas which vary considerably, yet due to the gaps in the research, it is unknown if nurses perceive certain approaches or design attributes as more or less effective for supporting their tasks (Ulrich, 2010). Therefore this study explores nurse work areas from two hospital facilities- a new construction versus a longstanding hospital- through a multi-site field study assessment.

This in-depth investigation of four nursing units involved on-site observations, photographs and physical measurements of environmental characteristics, surveys, and focus group sessions. Five environmental conditions constituted by lighting, noise level, thermal quality, spatial factors, and privacy were assessed in the key nurse work areas- nurse station, medication dispensing area, and supply room- of each unit. End results of this study were synopses of each nursing unit that revealed key considerations relating to nurses' environmental comfort. To enrich the findings, narratives were created that holistically capture the nurses' first-hand experiences and perceptions of their work environments.

Theoretical Model

A theoretical model will be used in this study to provide an understanding of human interaction with the environment. The model developed by Vischer (2007) explores the phenomenon called environmental comfort. This ecological model suggests that when a person behaves in a work environment they are experiencing a level of environmental comfort that can be placed on a continuum. The environment is characterized according to three hierarchical interrelated categories: physical comfort, functional comfort and psychological comfort.

Figure 1-1 illustrates the levels of environmental comfort through the depiction of the 'habitability pyramid' (Vischer, 2005). At the foundation of the pyramid is physical comfort which involves the satisfaction of basic human needs such as safety, hygiene and accessibility; these needs are generally met through the application of current building codes and standards. Functional comfort is defined in terms of ergonomic support of user's performance of work-related activities. The top level of environmental comfort- psychological comfort- results in feelings of belonging and control over the

workspace through choice and information provided to the employee (Vischer, 2007). Conversely, functionally uncomfortable workspaces require employees to make excessive adjustments in order to adapt to the conditions in which they have to work. Uncomfortable conditions are deemed adverse if they draw energy out of the worker and affect work performance.

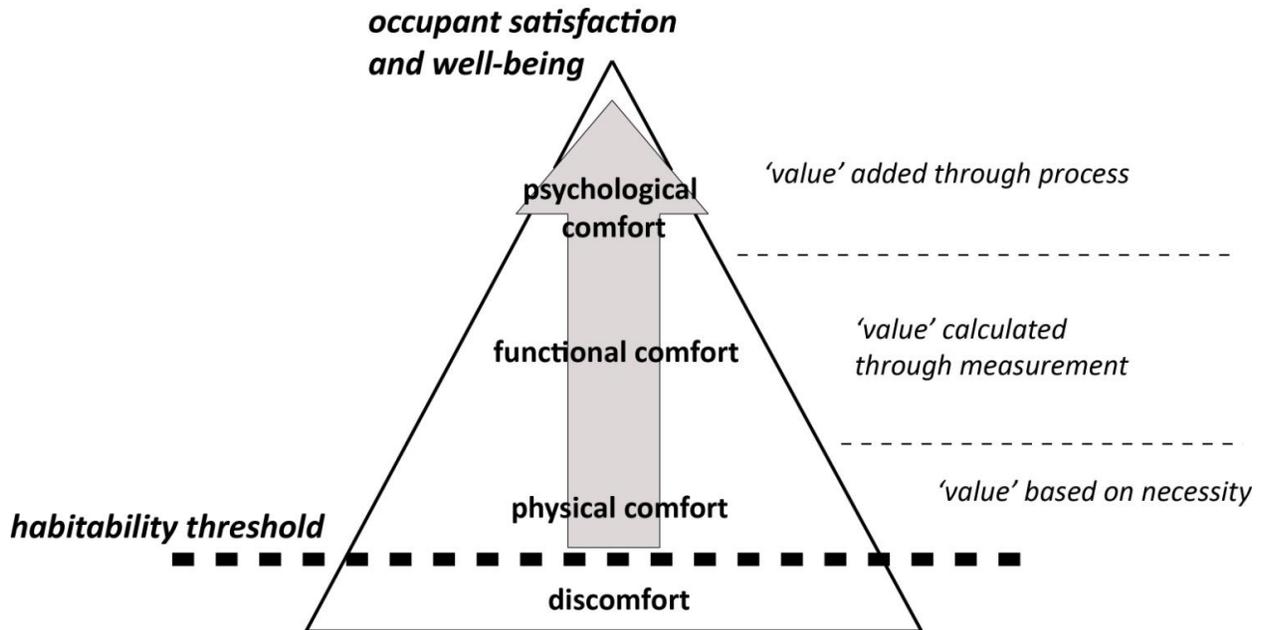


Figure 1-1. The habitability pyramid. [Adapted from Vischer, J. C. (2005). Space meets status: Designing workplace performance. (Page 85, Figure 4-2) London: Routledge.]

In summary, every workspace can either hinder or facilitate a user's task. A supportive workplace encourages worker performance, allowing occupants to conserve their energy for the tasks, as opposed to expending it to cope with adverse environmental conditions. The more support workers receive from the physical environment in completing their tasks, the more comfortable the workspace (Vischer, 2007). Therefore, improving the environmental comfort of a workspace can affect the worker's performance and higher levels of achievement can be reached.

Purpose

The purpose of this study is to further investigate how the designs of nurses' work areas relates to registered nurses' (RNs) perceived environmental comfort. This study assesses hospital workplace conditions through the theoretical lens of the environmental comfort model proposed by Jacqueline Vischer (2007). The theory of environmental comfort is most often applied to office space design and employee behavior (Jacqueline Vischer, personal communication, April 3, 2012); however, this study begins to bridge the gap into other work settings by applying the theory of environmental comfort to the healthcare work environment. This study will examine whether the framework and the corresponding DiConFon questionnaire (Vischer, 2010) extend into a healthcare workplace in an applicable way.

The findings from this research will relate to the environmental comfort model through the analysis of human interaction with the work environment. Increased awareness of the characteristics of nurse work areas that nurses perceive as comfortable enables designers to understand the impact of specific variables, such as lighting, noise level, thermal qualities, spatial factors, and privacy, in order to design supportive environments.

Significance

The need to investigate the design of healthcare environments is especially pertinent given that "the built environment is a powerful force in patient care" and when the work areas are properly designed "care providers [can] do their work more effectively" which in turn raises job satisfaction (Malkin, 2008). Ulrich and colleagues state that supportive design in staff areas can be a positive feature in marketing a facility to prospective employees; in increasing productivity or efficiency; enhancing job

satisfaction; and perhaps reducing turnover (2004). The designs of nurse work environments are often critical in order to attract and retain high quality nursing workforce. When hospitals retain their nursing workforce costs associated with voluntary RN turnover is minimized (Buerhaus et al., 2009) which is estimated as \$82,000 to \$88,000 per RN (Jones, 2008). However, the reality is that there is a shortage of registered nurses, which is estimated to escalate to about 500,000 by 2025 in the U.S. (Buerhaus, Staiger, & Auerbach, 2009). The PricewaterhouseCoopers' Health Research Institute report noted that hospitals can save from \$1.7 to \$5.4 million per year, if the average annual RN turnover ranges between 17.1% and 5.5% respectively (2007).

A main predictor of voluntary nurse turnover is job satisfaction (Hayes et al., 2006; Holtom, Mitchell, Lee, & Eberly, 2008). Job satisfaction is important because it diminishes the effects of a number of adjustable work environment factors on turnover intention (Kovner, Brewer, Greene, & Fairchild, 2009; Lee, Gerhart, Weller, & Trevor, 2008). Therefore, identifying the aspects related to nurses' job satisfaction, like a supportive physical work environment (Mroczek et al., 2005, Tyson, Lambert & Beattie, 2002), further develops an evidence base framework from which designers and hospital management can build effective strategies for improving nurses' job satisfaction.

The majority of empirical literature on the design of healthcare settings have focused on the impact of the physical environment on nurses' job performance/efficiency and has identified noise (e.g., Bayo, Garcia, & Garcia, 1995; Blomkvist, Eriksen, Theorell, Ulrich, & Rasmanis, 2005; Hodge & Thompson, 1990; Topf, & Dillon, 1988), lighting (e.g., Alimoglu & Donmez, 2005; Mroczek, Mikitarian, Vietra, & Rotarius, 2005; Scott, 2004), and nursing unit and patient room design (e.g.,

Janssen, Harris, Soolsma, Klein, & Seymour, 2001; Page, 2004) as environmental features that can negatively contribute to staff job performance. Most of these studies indicate that noise from various sources, artificial lighting/inadequate lighting, improper or inadequate ventilation, and disorienting layouts of nursing units create a negative impact on nursing staff that leads to fatigue, stress, or burnout (Mahood, Chaudhury, & Valente, 2011). While the results of these studies are important contributions to this field of research, more studies are needed to develop a greater understanding of the physical components nurses themselves consider influential to their performance. This information would be invaluable to healthcare providers, administrators, and design professionals because it provides an opportunity to reexamine hospital design to place emphasis on improving staff outcomes.

Research Questions

In order to examine the affect of the interior design features of health care facilities on the nurses' environmental comfort, one must understand the relationship between the activities and behaviors associated with nursing and the work environment of medical-surgical nursing units. A multi-site field study analysis of two hospitals was employed as a means to understand this relationship. The research questions central to this study are summarized as follows:

1. What level of environmental comfort (physical, functional, and psychological) characterizes the work spaces in hospital environments which are under study, as perceived by the nursing staff?
2. How important are the design considerations of lighting, noise levels, privacy, thermal quality, and spatial factors in relation to perceived environmental comfort?
3. What other design considerations impact the perceived environmental comfort?

4. How do the nurses' perceptions of their environmental comfort level compare between the two hospital settings?
5. How do the nurses' recommendations for improvements to their work areas relate to physical, functional, or psychological dimensions of perceived environmental comfort?

Assumptions

A number of assumptions underlie this study. First, it assumed that all data were collected under normal working conditions at the two healthcare facilities, without any extraneous circumstances affecting the employees' responses to the study. For example, if the hospital had recently laid off a large number of employees, or if employees had an unusually large workload, this might negatively impact employee morale causing potential impact on employees' responses. Finally, it assumed that all participants provided truthful and accurate answers when completing questionnaires and participating in focus group discussions concerning their workplace experiences.

Delimitations

Data was largely based on the registered nurses' self-reported assessments of perceived environmental comfort through the use of questionnaires and focus group sessions. A total of 17 registered nurses working for Shands Healthcare participated in the study. Despite the small sample size of the nursing staff and the corresponding limitation for generating quantifiable data, focus groups with participants uncovered rich in-depth qualitative data that added to the study's findings. Second, since the research setting involved two hospitals from a single healthcare system, Shands Healthcare, the findings may not represent all hospital facilities.

Conclusion

A greater understanding of the workplace conditions that registered nurses perceive as influential to their performance would be invaluable to design professionals. However, the large number of important issues that remain under-researched is sobering (Ulrich, 2010). As a result, this study investigated the role of interior design in influencing registered nurses' perceived environmental comfort. A multi-site field study of two hospitals from the Shands Healthcare system was conducted through focus groups, questionnaires, photography, and on-site observations. Two medical-surgical units from each hospital were studied, making a total of four units. The end product of this study is detailed profiles of the units, including perceived environmental comfort levels, as well as two narrative accounts of employees' experiences in the workplaces.

CHAPTER 2 LITERATURE REVIEW

The challenge for design professionals lies in creating healthcare facilities that are functionally supportive of patient care while simultaneously fostering health and wellbeing for both the patients and the staff. Registered nurses are the primary patient care givers on a daily basis and consequently they have a significant vested interest in the design of a hospital workplace. Therefore, consulting the nurses who interact within the hospital offers unique insights to design professionals; for instance, they are able to determine the factors that the nurses find to be effective in creating the best possible healing environment for the patient, as well as what nurses have discovered to be important to their productivity. Research has found that a well designed physical environment can positively impact the nurses. As Cesario (2009) suggests, “Ergonomic design of healthcare facilities, when combined with considerations regarding air quality, noise level, and light, can positively affect the health and productivity of nurses (p. 293).” However, the opposite is also true in that a poorly designed space can hinder the productivity of the nurses. This is why understanding the design preferences of nursing staff is essential in order to provide a work environment supportive of their needs.

Introduction

The review of the literature examines environmental design of health care work areas. Vischer’s theoretical model (2007) provides a conceptual framework that focuses on the relationship between individuals and their physical work environment. The review will begin by examining the history of medical care environments, followed by reviewing the typical demands on nursing staff. Specific environmental concerns that need to be addressed when designing or evaluating supportive environments for nursing staff will

also be discussed (i.e., lighting, noise level, thermal qualities, spatial factors, and privacy). This chapter will conclude by discussing ways to establish environmentally comfortable work areas for registered nurses.

Theoretical Frame Work: Environmental Comfort

Vischer's model of environmental comfort (2007) provides a theoretical framework for examining how individuals perceive their work environments and suggests methods of measuring the impact of environmental conditions in the workplace. This classic model has been widely cited over the past twenty years; the repertoire of topics investigated by Vischer and her colleagues includes building evaluation, users' needs in buildings, indoor air quality, user-manager communication, facilities management, and architectural programming. A number of her peer-reviewed journal publications can be found in the *Journal of Environmental Psychology*, *Architectural Science Review*, *Building Research and Information*, and *Stress and Health*. While the majority of her research findings are applied to office space design and employee behavior (Jacqueline Vischer, personal communication, April 3, 2012), this study begins to bridge the gap into other work settings by applying the theory of environmental comfort to the healthcare work environment.

This theoretical model of environmental comfort serves as the lens through which the data in this study will be analyzed. In this model, comfort is conceptualized as a rising continuum of physical, functional, and psychological comfort. Viewing comfort as a continuum is a way to assess the overall quality of the work environment and to prioritize change according to what is anticipated to have the greatest impact.

At the foundation of the continuum is the category of physical comfort, which includes the nonnegotiable prerequisites for a habitable work environment such as

enough light, no extreme temperatures of too hot or too cold, safe noise levels, and an adequate number of functioning toilets. These conditions are usually met through building codes and regulations which ensure the public's health, safety, and welfare. "Without physical comfort the building is inhabitable: that is to say, if occupants' health or safety and basic convenience are in question, then other aspects of environmental comfort are of little consequence (Vischer, 2005, p. 84)." The next element of environmental comfort is identified as functional comfort. According to Vischer (2005), the environment must support work-related activities and specifically functional comfort is described as: "A functionally comfortable workspace is a tool for work: not just lighting, but the right lighting for the task, not just ventilation, but clean conditioned air that is free of contaminants, not just heating, but thermal comfort (p. 84)." Further, the ability to turn on a light, control the room's temperature levels, or personally manipulate the environment in other ways increases your psychological comfort- the last level of environmental comfort- because it gives you practicality of having a task light, but also the perception of control in being able to manipulate that light. Psychological comfort also incorporates territoriality: psychological comfort depends on owning, controlling and having responsibility for territory. Being deprived of personal territory in a work environment can cause stress, produce low morale, and sometimes aggression in the form of resistance to change.

Medical Care Environments

Healthcare facilities have gone through many transformations throughout history, in both positive and negative directions. Ancient Greek healing temples are one example of the earliest attempts at creating a holistic healing environment. These early healing centers were sited among shrines, libraries, theaters, spas, gymnasiums, and

gardens, often drawing from the healing powers of nature. Essential for restoring health, they integrated exercise, visual and performing arts, and nature; however, such diligent attention to the healthcare environment was later neglected. Instead, facilities became unkempt and dirty overcrowded wards that developed into institutions regarded as places for disposal and even death (de Vos, 2004). At the end of the 19th century a nurse named Florence Nightingale challenged the lack of regard for creating healing environments and brought the importance of the physical environment in quality patient care back to the forefront. Through her efforts, hospital design once again incorporated the use of natural light, warmth, cleanliness, and a maximum number of patients in clinical areas (de Vos, 2004; McCullough, 2001).

Modern advancements in medical technology later became integral in reforming hospital design yet again. This period in health care history concentrated on creating buildings that reduced infection and succeed as functionally efficient delivery platforms for new medical technology. This emphasis on functional efficiency and the pathogenic conception of disease and health often resulted in institutional and stressful environments detrimental to care quality (Ulrich, 1992; Ulrich et al., 1991) and once again, these large and often impersonal institutions omitted the patients' and caregivers' psychological and social needs from the healing design equation.

Fortunately, current trends in healthcare have reverted back to the healing environments first demonstrated by the ancient Greeks and much later by Florence Nightingale. Inspired by the Asclepius hospitals in ancient Greece, Angelica Thierot founded the Planetree healthcare model with the modern day vision that "the ideal hospital would combine the best of spas with the best of hotels and the best of

hospitals, to become a truly healing environment, where just being there is healing.” The Planetree concept has spread quickly and hospital administrators are acknowledging that this holistic approach to healing is the “right thing to do” (Mycek, 2007).

Research regarding the impact of the healthcare environment on healthcare outcomes has been growing rapidly in recent years (Joseph et al., 2011) and design professionals recognize the value of designing medical care facilities based on rigorous empirical research (Cesario, 2009). This evidence-based design (EBD) process utilizes research from multiple professions involving healthcare such as environmental science, interior design, architecture, engineering, etc. to make building decisions (Cesario, 2009). The goal of EBD is to create an environment that promotes healing, supports family involvement, facilitates efficient staff performance, and reduces stress in all users of the facility (Brown & Gallant, 2006). At the same time, the design should produce measurable improvement in the facility’s clinical outcomes, economic performance, employee productivity, customer satisfaction, and cultural congruency (Hamilton, 2003). Numerous peer-reviewed journal articles have collected empirical evidence which demonstrate connections between the environmental design of healthcare facilities and outcomes that are important for patients, families, healthcare staff, and healthcare organizations (Ulrich et al., 2008). As a result, the field of EBD is gaining recognition and credibility. There is an increasing understanding that an appropriately designed built environment can help to improve patient outcomes; create a safe, nurturing, and positive work environment for caregivers; and help achieve organizational and business objectives (Joseph, 2011). So much so that the Center for Health Design’s Evidence-based Design Accreditation and Certification program awards credentials to individuals

who demonstrate a thorough understanding of how to apply an evidence-based process to the design and development of healthcare settings (Joseph, 2011). The environmental research applicable to this study will be discussed in-depth later in the chapter.

Nursing Staff Demands

When studying the design of nursing work areas it is critical to be aware of the exceptional demands nurses face on a daily basis. An understanding of how nurses spend their time managing numerous responsibilities is necessary to illustrate which duties prioritize themselves through the monopolizing of time. The landmark study “How do Medical-Surgical Nurses Spend their Time?” conducted by Hendrich, Chow, Skierczynski, & Zhenqiang (2008) identifies how nurses’ allocate their work hours in real-time and work contexts and is one of the few studies that measures this holistically. The researchers undertook a time and motion study of 767 nurses from 36 medical-surgical units who participated in research protocols designed to assess how nurses spend their time, nurse location and movement, and nurse physiologic response. Nurses’ time was divided into categories of activities (nursing practice, unit-related functions, nonclinical activities, and waste, seen in Figure 2-2) and locations (patient room, nurse station, on-unit, off-unit, seen in Figure 2-2) during a ten hour shift (Hendrich, et al., 2008).

Findings indicate that more than three quarters of all reported time was devoted to nursing practice. The three subcategories that accounted for most of nursing practice time were: documentation (35.3%; 147.5 minutes), medication administration (17.2%; 72 minutes), and care coordination (20.6%; 86 minutes); these activities were found to be performed most often in the nurse station and in other administrative areas

throughout the unit (excluding patient rooms). For that reason, the nurse work areas under investigation in this study will occur in the zones in which nurses spend the majority of their time- the nurse station, medication dispensing area and supply room (see Figure 2-2). Hendrich et al. (2008) used activity categories (i.e., nursing practice, unit-related functions, nonclinical activities, and waste) to comprehensively define nurse workflow tasks. These activity categories will be defined below with the purpose of providing understanding of the registered nurses' daily responsibilities.

Nursing practice. Hendrich et al. (2008) demonstrated that the nurses under study devoted 417 minutes (77.7%) of their 10-hour shift on nursing practice-related activities. Nursing practice activities include five subcategories: (1) patient care activities, (2) care coordination, (3) medication administration, (4) documentation, and (5) assessment/reading vital signs. *Patient care activities* consists of nurses' time spent with tasks such as bathing, conducting intervention activities such as intravenous (IV) site changes, and preparing the patient for hospital admission or discharge, plus assessing patient care while off-unit. *Assessment/reading vital signs* involve direct patient care of physically assessing the patient. Interestingly, in the study conducted by Hendrich et al. (2008) patient assessment only comprised 7.2% (31 minutes) of nursing practice time. *Documentation* of patient care and completing other bureaucratic tasks has been unanimously cited as representing a heavy demand on nurses' time. Besides being time-consuming, required documentation is often redundant, irrelevant, not followed-through (Page, 2004; Hendrich et al., 2008) and results in reduced time for the monitoring of patients through direct therapeutic care. *Care coordination* is defined as the communication of any information regarding a patient's care and case delivery plan.

In the study by Hendrich et al. (2008), it accounted for approximately one-fifth of nursing time. *Medication administration* involves preparation of medication and subsequent delivery to the patient.

Unit-related functions. Unit related tasks include nurses' time spent with activities such as preparing equipment, using a fax or copy machine, and transporting patients between departments. Although these tasks do not account for a significant amount of nurses' time (2.8% of a 10-hour shift), they may contribute to inefficiencies and physical fatigue (Hendrich et al., 2008).

Nonclinical activities. A portion of a nurses' work day (12.6 %, or 67.9 minutes of a 10-hour shift) involves nonclinical activities such as personal time, patient/family care, and administration/teaching (Hendrich et al., 2008).

Waste. The final activity category indicative of nurses' time is labeled as waste by Hendrich and colleagues (2008). Behaviors within this category include waiting, looking/retrieving, delivering- many of which are "hunting and gathering" behaviors. A significant portion of registered nurses' time is spent with non-nursing activities such as performing housekeeping duties or performing ancillary services such as the delivery of food trays or medical equipment or supplies (Page, 2004). The inefficient assignment of activities impacts nurses' primary care responsibilities, such as patient vigilance, provision of therapeutic patient care, and interaction with patients and family members (Page, 2004).

Environmental Conditions

An extensive review of literature was conducted in the area of health care design and nurse performance. As illustrated in Figure 2-1, the subsequent overview explores

the following environmental variables that can contribute to nurses' performance:

lighting, noise level, thermal qualities, spatial factors, and privacy.

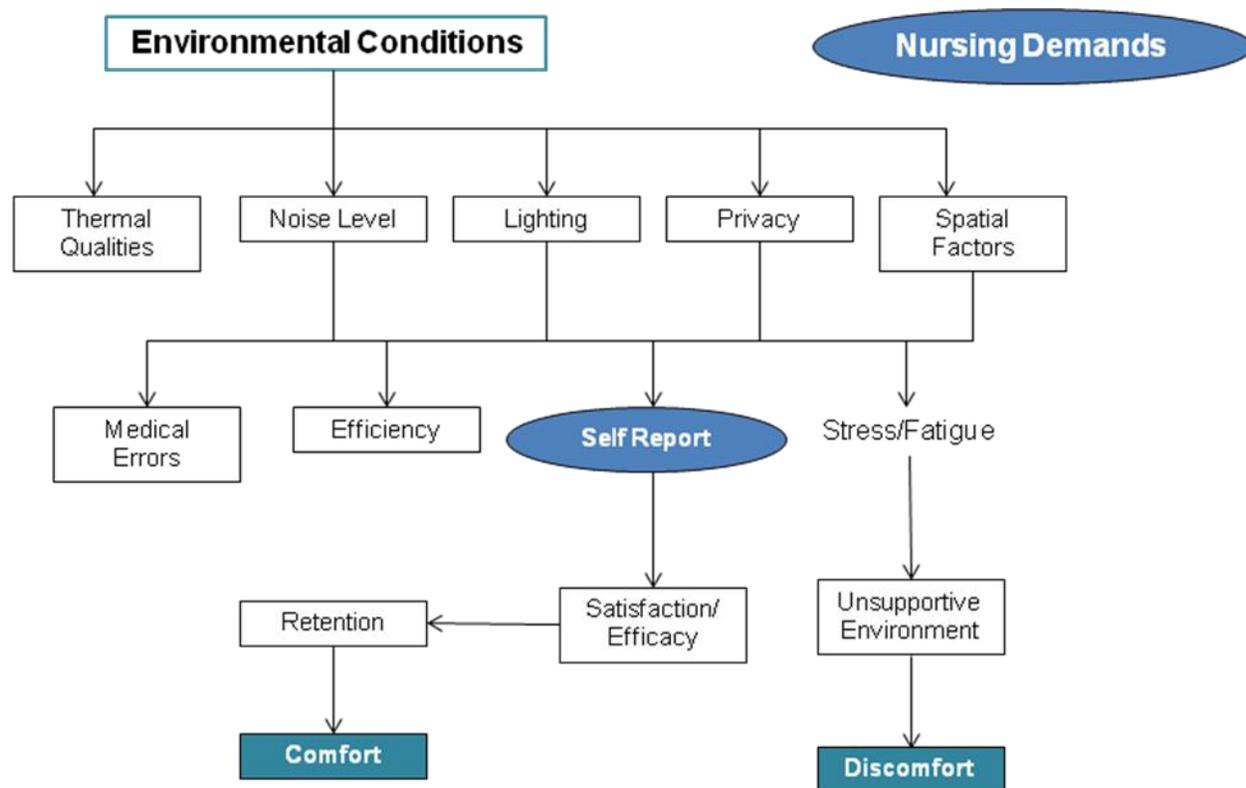


Figure 2-1. Concept map.

Lighting Most medical facilities are lit by a combination of daylight (natural light) and electric light sources (artificial light) (Applebaum, et al., 2010). Research has found that lighting conditions, such as quality, level, and type (natural or artificial light) may affect nurses' performance (Chaudhury et al., 2009). A study of 141 nurses in Turkey found that as exposure to daylight increases, nurses are less likely to experience stress and dissatisfaction with their jobs, reducing their levels of burnout (Alimoglu & Donmez, 2005). On the other hand, a different study determined that exposure to artificial lights cause nurses to feel drained, having a negative effect on their productivity (Scott, 2004). Fluorescent tube light is commonly mentioned by caregivers as one of the most draining

aspects of work (AHRQ, 2010). Therefore, it appears that nurses are more satisfied with, and function more effectively, in an environment that facilitates the use of natural light, with minimal artificial lighting (Chaudhury et al., 2009).

Center for Health Design researchers confirm that the most evident effect of light on human beings is that of making vision possible which allows the performance of visual tasks. The need for light increases as someone ages because of reduced transmittance of aging eye lenses (Edwards & Torcellini, 2003). This is significant because the nursing work force is aging (Applebaum et al., 2010). Therefore, it is necessary to critically assess the illumination levels available for different types of tasks performed by the aging nurse workforce.

Electrical light sources can have different effects on the human body depending on the wavelength or spectral distributions. Full-spectrum fluorescent lighting has similar properties to that of natural light, however, most artificial light sources lack the spectral distribution needed for complete biological functions (Edward & Torcellini, 2002). According to Boyce and colleagues (2003), the nature of the task as well as the amount, spectrum, and distribution of the light affects the level of worker performance.

Results from a large-scale study of the effects of different illumination levels on pharmacists' prescription-dispensing error rates strongly suggested that such errors are reduced when work-surface light levels are relatively high (Buchanan et al., 1991). In this study, three different illumination levels were evaluated (450 lux; 1,100 lux; 1,500 lux). Medication dispensing error rates were 2.6% at 1,500 lux, compared to a higher error rate of 3.8% at an illumination level of 450 lux. Therefore, lower light levels in medication dispensing areas can be expected to worsen error rates.

Noise level According to the World Health Organization (Berglund, Lindvall, & Schwela, 1999) and the U.S. Environmental Protection Agency's Office of Noise Abatement and Control, hospital noise levels are recommended to be a maximum of 45 dB during the day and 35 dB at night. Sound levels exceeding these recommendations could produce stress, however, noise in hospitals often exceed the recommended levels with background noise levels typically ranging from 45-68dB, and peaks commonly exceeding 85-90dB (Blomkvist et al., 2005). The research reviewed suggests two general reasons for the excessive noise in hospitals: (1) noise sources are abundant including telephones, staff voices, trolleys, and paging systems among other, and (2) the environmental surfaces such as floors, walls, and ceilings often create poor acoustic conditions because they usually reflect rather than absorb noise (Ulrich et al., 2004). Inadequate acoustic environments may interfere with communication between patients and nurses or between healthcare employees, resulting in compromise of patient confidentiality (Page, 2004; Chaudhury et al., 2009; Cesario, 2009).

Many researchers have examined the effects of noise on patients, but comparatively few studies are available that explore the effects on healthcare staff (Applebaum et al., 2010, Chaudhury, 2009). Healey, Primus, and Koutaintji (2007) found that noise may be linked to staff medical errors. There is also evidence that high noise levels have adverse affects on nurses such as increased stress and annoyance, fatigue, emotional exhaustion, and burnout (Joseph & Ulrich, 2007, Topf & Dillon, 1988). As feelings of noise-related stress and burnout increase, this can lead to an increase in turnover intention (Applebaum et al., 2010). A study by Blomkvist and colleagues (2005) examined the effects of noise levels over a period of three months on a group of

coronary intensive-care nurses. The researchers collected psychosocial work environment data from start and end of each of the morning, afternoon, and night shifts during which either sound reflecting or sound absorbing tiles were installed. Lower noise levels due to the sound absorbing tiles were found to have positive effects on staff, including reduced perceived work demands, increased workplace social support, better speech intelligibility, and an improved quality of care for patients. These positive outcomes for the staff have the potential to decrease nurses' turnover intention (Applebaum et al., 2010).

Thermal quality Research reveals a link between the building's interior environment and the health of the people in it (Kopec, 2006). According to Redlich (1997), one of caregivers' most common environmental health issues are problems associated with indoor environments. Indoor air quality of hospitals can be linked with health problems including airborne infection outbreaks, latex allergies, and exposure to chemical agents, anesthetic gases and pharmacological agents that can spread throughout the hospital (Brownson, 2000). As defined by the American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE), acceptable indoor air quality is "air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction" (ASHRAE, 2001).

Maintaining safe air quality has been associated to health and lower stress levels in the workplace. The quality of air at work is often regarded as one of the most important factors in the building. Feeling as though the air in the workplace is of poor

quality can result in dissatisfaction with one's job and the work environment (Mroczek, 2005).

Odors are negative components of air quality. Olfactory receptors have a direct connection to the limbic system, the brain's emotional hub, and are therefore smells are more memorable than sights or sounds because they often provoke emotional responses (Jones, 1996). The perception of odor is dominated by the pleasant or unpleasant dimension. Medicinal smells, which can be perceived as negative odors, arouse anxiety, fear and stress; while pleasant aromas, such as the scent of vanilla and essential oils of particular flowers and fruits, can reduce blood pressure, slow respirations and lower pain perception levels (Jones, 1996). The presence of negative odors in the healthcare environment may lead to increased nursing stress, which leads to job dissatisfaction and eventually turnover intention.

Spatial factors Studies show that the layout of a nursing unit and the arrangement of the nurse work areas in relation to one another has a direct impact on nurse productivity and fatigue levels (Carayon, Alvarado, & Hundt, 2003; Ulrich, 2006). The nurse station is the primary work area on a nursing unit, and nursing units have typically been organized around a central nurse station where unit reception, charts, orders, medications, and supplies are often located in one place (McCarthy, 2004; Zborowsky et al., 2010). Thus, nurse stations are important hubs of activity where almost all types of hospital functions overlap (Broomberg, 2006) but, unfortunately, the centralized nurse station forces nurses to “spend most of their time away [from the patients]” (McCarthy, 2004, p. 406).

Nurses walk an average of three miles hunting and gathering supplies during a ten hour shift which is identified as wasteful activity (Hendrich et al., 2008; Ulrich, 2006). However, recent studies have found that thoughtful floor layouts and the implementation of decentralized nursing stations reduce staff walking which translates into more time spent on patient care activities, especially when supplies are stored near patient rooms (Hendrich & Lee, 2005; IOM, 2004). Advances in information technology such as electronic medical records have enabled nurses to move away from traditional centralized paper-charting stations to smaller, decentralized work stations which are located closer to patient rooms (Zborowsky et al., 2010). Although decentralized nurse stations may reduce walking distance, nurses report feeling more isolated from their colleagues and losing the sense of camaraderie in comparison to centralized nurse stations (Tyson et al., 2002). The “hybrid” nurse station model consists of decentralized nurse stations located near the patient rooms as well as a collaborative centralized nurse station; this offers an alternative solution to help maintain staff communication in addition to decreasing travel distances (Zborowsky et al., 2010).

Additional factors, such as ergonomic design, are important to create the optimal conditions for workers to perform their tasks efficiently and safely (Carayon, Alvarado, & Hundt, 2003). Workstation design and spatial comfort affect both collaborative teamwork productivity and individual task performance (Vischer, 2005). If the task requires long conversations or lengthy paperwork procedures ergonomics become especially important (Brand, 2009). Improving ergonomics in the work environment primarily creates a safer and more healthful workplace. The organization may experience other benefits as well such as increased productivity, work quality, and

morale. Kroemer and Kroemer (2001) reviewed ergonomic elements of design; they recommended that nurses' work stations should be designed to meet the requirement of nurses spending a significant time standing. For instance, sufficient space should be provided for the nurses' feet to enable movement close to the counter. The built environment should be convenient and accessible and should enable patients to connect with staff members, should be conducive to the patients' sense of well-being, should be safe and secure, and should foster connections to the outside world (Lowers, 1999).

According to Springer (2007), the workplace should be designed to adapt to workers. Workers may be able to accommodate poor design and hostile environments, but adaptation takes a toll on users, causing decreased performance and fatigue. Appropriately adaptive equipment and environments relieve strain on the workers by reducing their need to adapt to shortcomings in the workplace (2007). Providing ergonomically correct work surfaces, heights, and access for staff can reduce injuries and therefore lessen stress and risk for the caregiver staff.

Privacy Studies have found that nurses prefer unit layouts in which they have a visual link to the patients, yet have audio privacy (Chaudhury et al., 2009). Additionally, a sense of personal space provides employees with the opportunity to balance privacy with interaction. Nurses often need a place to focus on a task, have a private conversation or phone call, or distance themselves from interruptions. In a healthcare environment it is important to provide personal work zones for employees who seek privacy (Mudgett, 2000). Workers assess their privacy at two levels: the functional level, related to separateness and freedom from distraction in order to concentrate, and the

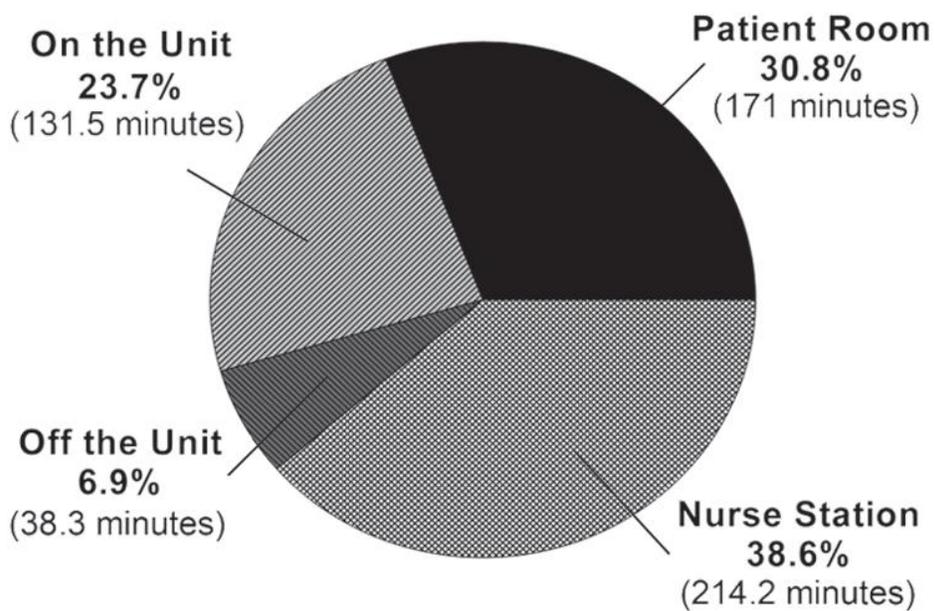
psychological level, related to exclusivity, status in the organization, and environmental control (Vischer, 2005). Since clinical work can be considered as both individual and collaborative in nature, the nursing work environment must aim to achieve maximum interaction while at the same time not affecting concentrated individual work (Haynes & Price, 2004).

Confidentiality is a concern that is seen in research studies which have found physicians and nurses very frequently breaching patient confidentiality and privacy by talking in spaces where they are overheard by others (Ubel, Zell, & Miller, 1995). The significance of the issue is pointed out in the example of a study in an emergency department that showed that 100 percent of physicians and other clinical personnel committed confidentiality and privacy breaches (Mlinek & Pierce, 1997). HIPAA, the Health Insurance Portability and Accountability Act of 1998, has underscored the importance of providing necessary precautions to safeguard the confidentiality of staff conversations with and about patients. While the importance of the physical environment for patient confidentiality may seem self-evident, only a few studies have directly examined the role of unit design or architecture.

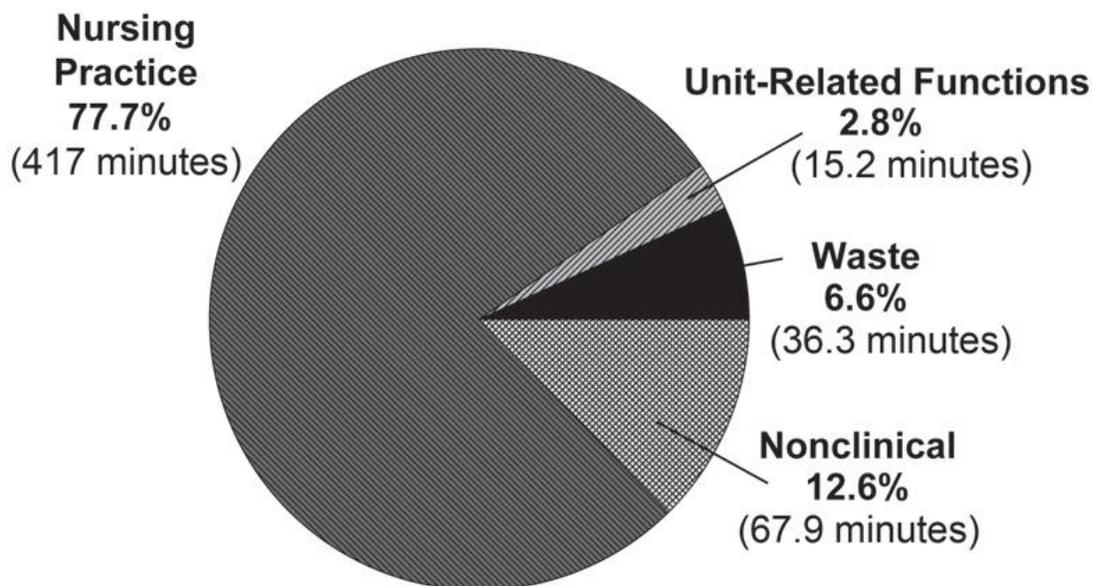
Summary of Literature Review

The preceding review of the literature discussed the history of medical care environments, followed by reviewing the typical demands of registered nursing staff. Additionally, the review examined the design of healthcare work areas which revealed specific environmental conditions essential to designing or evaluating supportive environments for nursing staff (i.e., lighting, noise level, thermal qualities, spatial factors, and privacy). A well-supported nursing staff is integral to the functioning of a hospital facility and there is mounting evidence that the physical environment impacts many

aspects of employee well-being and productivity such as job performance, job satisfaction, and employee fatigue and injuries (Applebaum, Fowler, & Fiedler, 2010). Design professionals can optimize the overall healthcare experience for employees by understanding how the design of the healthcare facility impacts the staff member's perceptions of their environment and then subsequently using this knowledge to make design decisions (Mroczek, Mikitarian, Vieira, & Rotarius, 2005). The theoretical model of environmental comfort provides a conceptual framework that focuses on the relationship between individuals and their physical work environment which will serve as the lens through which the data in this study will be analyzed.

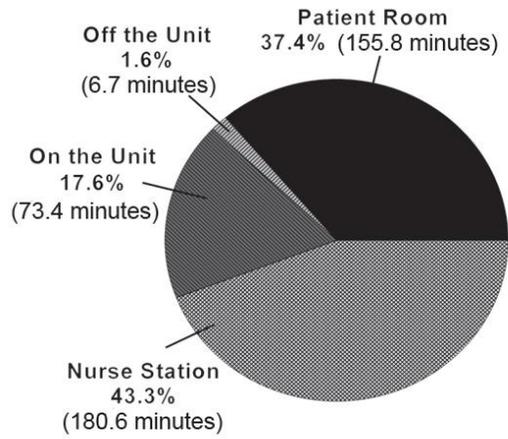


A

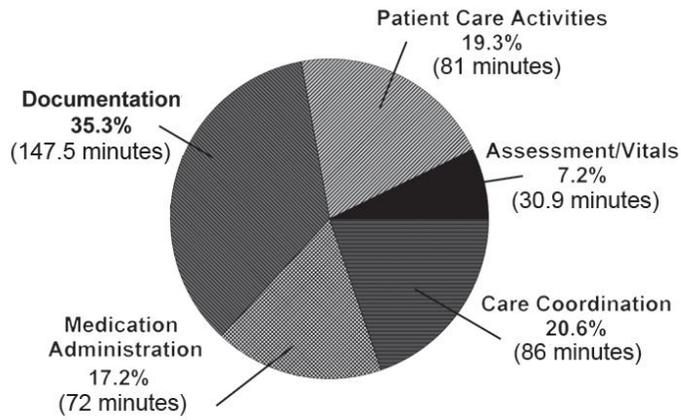


B

Figure 2-2. Analysis of how and where nurses spend their time. A) Reported nurse time spent by location. B) Reported nurse time spent by category. C) Nurse practice by location. D) Nurse practice by subcategory.



C



D

Figure 2-2. Continued

CHAPTER 3 RESEARCH METHODOLOGY

This study explores the linkage between the design of nurse work areas and registered nurses' perceived environmental comfort. As follows, the phases of investigation were threefold. The first phase aimed at gaining a general understanding of the usage and perceived functionality of the key nurse work areas: the nurse station, the medication dispensing area, and the supply room. Aspects of the RNs satisfaction with their work areas were revealed in this phase through the use of surveys. The second phase objectively assessed the participants' operative activities in each work area under study. This involved observations of the nurses performing their daily tasks in relation to the physical characteristics of the nursing units. The third and final phase captured nurses' subjective perceptions of their comfort level in the workplace environments. Exploring the nurses' point of view through targeted surveys and focus group discussions revealed key considerations relating to environmental comfort. To enrich the findings from each of phase of the study, two workplace narratives were created that are set in the new and existing healthcare facilities under study. These narrative scenarios holistically reveal the nurses' experiences and perceptions of their work environment. Employing narratives as a tool for analysis of nurses' perception of the design of their work areas revealed key dimensions of environmental comfort, and will pave the way of research-informed design choices in future clinical settings.

Ethical Considerations

The University of Florida Institutional Review Board (IRB) and Shands HealthCare (i.e., the organization in which the data collection took place) reviewed the design of the study, research methodology and procedures. IRB approvals for the study

can be found in Appendix A. Four nursing units were selected from the Shands facilities to participate in the study under the condition that the units were medical/surgical patient care units. Medical/surgical units were chosen as the type of unit to be studied because of their ubiquity in acute care hospitals. The target population of the study was, therefore, registered nurses working in adult medical, surgical, and/or medical-surgical acute care (non-ICU) inpatient units. After consulting a Shands staff member and determining four units that met the criterion, the unit's participation was requested through a letter to the nurse managers of the units explaining the purpose of the study and the amount of time required for participation, refer to Appendix B. Upon written agreement from the nurse managers, the investigation proceeded.

Throughout the study the nurse managers acted as a liaison between the researcher and the sample of participating nurses on their respective units in order to protect the identity of the nurses. The researcher supplied the nurse managers with a "letter of invitation" (Appendix C) which they then emailed to each of the registered nurses on their unit encouraging participation in the study. The nurses were informed that participation in the study was not a requirement for their employment, nor would it impact performance evaluations or potential for continued employment or promotion. The participants could withdraw from the study at any time for any reason, and all information was treated confidentially.

Research Design

This multi-site field study employs mixed methods that are further enriched with workplace narratives revealing perceptions of the nursing staff under study. More research on understanding nurses' perceptions of the built environment will yield, "insight into the performance of the built environment can be found through post-

occupancy evaluations and controlled studies. However, if such studies don't uncover how and why people use these spaces the way they do they may not have a strong impact on healthcare building design" (Chalfont & Rodiek, 2005). With narrative inquiry the study aims to answer the "how" questions about the physical environment's impact on nursing personnel. These types of questions are often answered through qualitative research.

Data from qualitative studies can be derived from interviews and focus groups, researcher observations, and analysis of documents and materials such as detailed descriptions, pictures, and records gathered from the research setting. Qualitative research delves into perceptions and experiences in the environment with a depth and richness of data that often not captured using quantitative methods (State of the Field Committee, 2009). The qualitative research method is useful for healthcare investigations because it is difficult to quantitatively measure emotions that care providers may frequently experience such as relief, fear, joy, and surprise. The result of this qualitative study is a detailed, complex report that takes the reader within the setting being studied and expresses narratives of the participants (Creswell, 2003) that can be found in discussion chapter.

Participants

The total sample of registered nursing staff (n=17) voluntarily and anonymously participated in the study. Exclusion criteria included RNs who worked in an advanced practice capacity, this is, managers, clinical nurse specialists, educators, and/or practitioners. Participant demographic data was not collected, however, the literature reveals that the registered nursing workforce is predominately female (94.6%) (Page,

2004) with an average of 46 years of age, which is older than the total U.S. workforce standard (U.S. Department of Health and Humans Services, 2010).

Research Setting

A case study is an in-depth investigation of a single instance, and represents a holistic approach to research (Sommer & Sommer, 2002). Case studies can be done alone or together to compare across projects (Yin 1994). According to the suggestion of Yin (2003), the case selection was based on two factors: feasibility and sample variation in crucial categories. The first factor, feasibility, was largely determined by the hospitals' willingness to participate in the study and to provide the required information. Not only did this include the provision of resources, (e.g. to release staff members from work to participate in the data collection), it also included the hospitals' readiness to let the researcher access it. To satisfy the second factor – sample variation in crucial categories – the definition of crucial categories needs to be determined. As nurse work areas are investigated, cases that contain comfortable vs. uncomfortable environments need to be differentiated. The selection of multiple cases is based on experimentation logic, i.e. replication logic. Each case must be carefully selected so that it either (a) predicts similar results (a literal replication) or (b) produces contrasting results but for predictable reasons (a theoretical replication) (Yin, 1994). In this study two case study settings were chosen based on the predicted contrasting results of comfortable vs. uncomfortable environments.

This study was conducted in two separate hospital facilities which are a part of the healthcare organization, Shands HealthCare. Located in north central Florida, the Shands hospital system offers a broad range of inpatient and outpatient settings. Established in 1958 as a teaching hospital, Shands HealthCare has since expanded

medical services to include nine not-for-profit hospitals. From this pool, two of the Shands HealthCare facilities, (1) Shands at the University of Florida and (2) Shands Cancer Hospital at the University of Florida, were selected as the settings for the study. Due to the close proximity of the two hospitals and their geographic locations with respect to one another, the community and staff often refer to the buildings as the North and South Towers. For ease of understanding, Shands at the University of Florida will be referred to as the “North Tower” which is the long-standing facility where as the newer Shands Cancer Hospital at the University of Florida will be referred to as the “South Tower”.

Shands Cancer Hospital	Shands Health Science Center
“South Tower”	“North Tower”
Opened in 2009	Opened in 1958
468,436 sq. ft.	1,129,462 sq. ft.
192 patient beds	852 patient beds
400 RNs	1300 RNs
Units C and D	Units A and B

Figure 3-1. Comparison of research settings.

The North Tower

Shands at the University of Florida is an 852-bed tertiary care center with approximately 1,300 RNs (Hospitals and Services). This 1,129,462 square foot facility was built in the late 1950s and the building has expanded through renovations and numerous smaller additions. Two nursing units, referred to as Unit A and Unit B, were selected from the North Tower to participate in the study under the condition that the units were medical/surgical patient care units.

Unit A Unit A is a cardiovascular medical unit supporting treatment of pre-and-post-heart transplant patients and other cardiothoracic surgery patients (such as aorta

and valve repair, and coronary bypass). At capacity, the unit can accommodate 35 patients; the average number of patients is 27.6 and the average length of stay is 2.96 days. Unit A typically staffs at a one-to-five nurse-to-medical-surgical patient ratio and a one-to-four nurse-to-intermediate care patient ratio. A day shift is typically staffed with three unit secretaries/monitor technicians, nine registered nurses, one charge nurse, one clinical leader, and one nurse manager. Other hospital staff that can be found working on the units include physicians, therapists, environmental service, food service, and medical students.

Unit A building characteristics As illustrated in Figure 3-2, Unit A consists of 13 single patient rooms and 11 shared patient rooms and is spread over an area of 14,000 square feet. The configuration of Unit A is referred to as a “racetrack” design because the patient rooms are pulled to the outside walls creating a support space in the center area (Verderber, 2000). The core service area in the middle of the unit contains the nurse station (Figure 3-6), supply room (Figure 3-8), soiled linen rooms, shafts for mechanical requirements, general storage, staff offices, break room, and the staff restroom. The windows on the unit are located in the patient rooms leaving all staff/support spaces windowless.

All medications are administered from an automated distribution cabinet, manufactured by Omnicell, which is located on each hospital unit. To dispense medication, there must be a patient’s medication order in the system. Once an order is selected, the dispensing cabinet opens and the medication is dispensed. Every dose is released individually from the dispensing cabinet such as pre-filled syringes, vials, oral solid medication and ampoules. The pharmacy department refills and updates the

cabinet throughout the day. Each dispensing cabinet incorporates a keyboard, a screen and a magnetic card reader allowing interfacing with a central workstation for purposes of automatic record keeping and patient billing for each medication dose dispensed. Nurses access the system by entering their assigned password or conducting a finger print scan. The Omnicell system is used as the primary means of medication administration in both the North and South Towers; however the physical spaces housing the Omnicell cabinets vary greatly between the two facilities.

Unit A does not have a dedicated medication room. As illustrated in Figure 3-7, Unit A's primary medication dispensing area contains an Omnicell cabinet located in the back of the nurse station. The Omnicell is accessible from the rear entrance into the nurse station. Nurses are also provided a mobile medical cart with lockable storage (see Figure 3-10) that is located outside the patient rooms. After retrieving the medications from the Omnicell the nurses use the medical cart as a work surface for preparing and storing medications.

Unit B Unit B is a general unit that most frequently supports the treatment of cardiac illness, respiratory issues, and diabetes. At capacity, the unit can accommodate 36 patients; the average number of patients on the unit at any given time is 30.9 and the average length of stay is 3.43 days. Unit B is typically staffed at a one-to-five nurse-to-patient ratio, however this ratio can vary depending on the shift and the amount of patients being serviced at the time. A day shift is typically staffed with two unit secretaries, eight registered nurses, one charge nurse, one clinical leader, and one nurse manager.

Unit B building characteristics Unit B consists of 12 single-patient rooms and 12 shared-patient rooms and is spread over an area of 14,000 square feet (Figure 3-3). Nearly identical in design-layout to Unit A, this unit's central nurse station and nurse support spaces are located in the center of the unit and the patient rooms are located around the perimeter. The nurse station (Figure 3-12) in Unit B has a somewhat different configuration than Unit A due to the two entry points in rear of the nurse station as opposed to a single rear entryway. Unit B's primary medication dispensing area (two Omnicell cabinets) is integrated in the back of the nurse station (Figure 3-13), and again mobile medical carts are placed outside the patient's room as a work surface to prepare medications (Figure 3-10).

The South Tower

Opening in November of 2009, the Shands Cancer Hospital is the newest addition to the healthcare complex. The facility is 468,436 square feet with 192 private beds and approximately 400 RNs servicing the hospital (Hospitals and Services). Two nursing units, referred to as Unit C and Unit D, were selected from the South Tower to participate in the study under the condition that the units were medical/surgical patient care units.

Unit C The majority of the patient population serviced in Unit C is from pancreaticobiliary and colorectal surgery services. The unit also frequently cares for minimally invasive surgery (bariatric) and breast/melanoma/sarcoma/endocrine patients. The most frequent types of patient illnesses treated on the unit include small bowel obstruction, pancreatitis, and colon/rectal cancer. Unit C accommodates a maximum of 24 patients, with an average census of 22. The unit's average length of stay is 3.5 days and is most commonly staffed at one-to-five nurse-to-patient ratio. The day shift in this

unit is typically staffed with two support technicians, five registered nurses, a charge nurse, a clinical leader and a nurse manager. As seen in the other units under study, additional hospital staff can be found working on this unit at any given time including physicians, therapists, environmental service, food service, and medical students.

Unit C building characteristics Unit C contains 24 private patient rooms over 15,800 square feet. This unit's primary nurse work area includes a hybrid nurse station model with a centralized nurse station as well as a series of small decentralized nurse stations located just outside each patient room. The decentralized nurse stations are equipped with computers, task lamps, and lockable storage. The physical lay-out of the unit can be seen on the floor plan diagram in Figure 3-4. Adjacent to the centralized nurse station (Figure 3-15) was the designated medication dispensing room (Figure 3-16). Two password protected Omnicell distribution cabinets are located in this locked room which is accessible from either hallway. Access to the medication room is granted after entering a unique code in the door's key pad. The medication room contains shelving with the supplies necessary to administer IVs, a computer with a barcode scanning gun, a small refrigerator, a sink, and a counter top used as a work surface. The counter space is divided in to two areas with the use of a splash guard. The medication preparation area is separated from the sink by the splash guard; this is to avoid splashing and contamination of medication. Supplies for medication preparation such as pill crushers and splitters are required to stay in this prep area, and medication preparation is prohibited on the countertop opposite side of the splash guard.

Unit D The majority of the patient population serviced in Unit D is from surgery services. Unit D accommodates a maximum of 24 patients. The day shift in this unit is

typically staffed with two support technicians, five registered nurses, a charge nurse, a clinical leader and a nurse manager. As seen in the other units under study, additional hospital staff can be found working on this unit at any given time including physicians, therapists, environmental service, food service, and medical students.

Unit D building characteristics Identical to unit C, Unit D contains 24 single patient rooms over 15,800 square feet. The physical lay-out of the unit can be seen on the floor plan diagram in Figure 3-5. This unit's primary nurse work area also includes a hybrid nurse station model with a centralized nurse station (Figure 3-18) and a series of small decentralized nurse stations located outside each patient room. Just west of the centralized nurse station is the medication room (Figure 3-19) and the supply room (Figure 3-20) is located just east of the nurse station. Two Omnicells are located in the medication room along with a sink, storage cabinets, a computer with a barcode scanning gun, a small refrigerator and countertop work surface. The counter space is divided in to two areas with the use of a splash guard.

Summary of nursing units

The unit configuration of the four medical/surgical units under study is commonly referred to as a "racetrack" design. This typology places patient rooms on the perimeter of a corridor and staff support spaces on the interior of the loop. The main distinction between the layouts of the units lies in the support spaces in the center of the unit. The centralized support spaces include clean and soiled utility rooms, a nourishment room, a staff break room, management offices, additional storage space, and medication dispensing areas. Units A and B do not have designated medication rooms; the medication dispensing cabinets are located in the back of the nurses' station.

Conversely, Units C and D have medication dispensing rooms that are only accessible through the use of a key code. Unlike Units A and B, the medication dispensing rooms in Units C and D contain counter space, a sink, and other medical supplies.

One element that all four units have in common is centralized nurse stations; however none of them are laid out exactly the same. Units C and D have decentralized nurse stations located outside of the patient rooms to supplement the centralized nurse station. Table 3-1 compares the square footage amounts of the nurse work areas.

Table 3-1. Summary of units.

Unit	Gross sq. ft. of unit	Central nurse station	Medication dispensing area	Supply room	Total sq. ft. of nurse work areas	Percentage of nurse work area sq. ft. to gross sq. ft. of unit
Unit A	15,850	1,127.59	196.88	266.00	1590.47	7.11%
Unit B	15,850	977.12	211.12	287.03	1475.27	9.31%
Unit C	16,950	572.14	184.21	192.75	949.10	5.6%
Unit D	16,950	582.75	186.86	192.75	962.36	5.68%

Data Collection

The present study proposed two overarching questions to assess the environmental comfort levels of hospital work areas. (1) What level of environmental comfort (physical, functional, or psychological) characterizes the work spaces in hospital environments which are under study, as perceived by the nursing staff? (2) How important are the design considerations of lighting, noise levels, privacy, thermal quality, and spatial factors in relation to perceived environmental comfort? To address these questions the participants employed in two healthcare facilities completed three sequential phases of data collection: Preliminary Staff Survey; Field Observations and Measurements; Standardized Survey (Vischer, 2010) and Focus Groups.

Phase I: Preliminary Staff Survey

The first phase of the research involved surveying the aggregate nursing staff at both hospitals under study. A cross-sectional, self-administered questionnaire was developed to provide a basis for determining which nursing work areas would be studied further in the subsequent phases of the study. To this end, an online survey was given to potential participants in order to collect data on their perceptions of the environment. A hyperactive link to the survey was distributed via email to each registered nurse employed in the two hospitals, and the employees voluntarily chose to answer the survey questions. In order to initiate participation in the web-based survey, the subjects had to click on the provided web-link that was included in the e-mail letter. After clicking on the provided web-link, the participants were taken to the SurveyGizmo web-based platform where they had to anonymously log in to the survey. This procedure allowed the nurses to protect their identities, and after the survey period was over, the researcher gained access to the data through SurveyGizmo.com. The electronic survey provided an overall understanding of the usage and perceived functionality of each nursing work area.

It is important to note that this initial survey was comprised of a portion of relevant questions taken from a larger study being conducted by the Facilities Development Department of Shands HealthCare, Flad Architects from Madison, Wisconsin and the University of Virginia. Permission to use 5 selected items relating to this study was given by the principle investigators and helped inform this study. The selected questions were on the topics of noise, size, layout, location, and lighting in regards to the nurse station, the medication dispensing area and the supply room. The responses to these questions helped focus the subsequent data collection. The results

revealed that the nursing work areas yield opposing amounts of satisfaction; This lead to further examination of these areas in order to determine which environmental characteristics are having the greatest impact on the nursing staff.

Phase II: Field Measurements and Observations

The second phase of the research methodology included the collection of facility data; field measurements of physical characteristics and photographic documentation; and observations of the nursing staff. This information was useful in creating a nursing unit profile, specifically pertaining to the nurse work areas to be studied: the nurse station, the medication dispensing area, and the supply room. The following details outline each step.

Phase II: Collection of existing facility information The first step of phase II involved collecting existing data from the healthcare organization's facility manager and the units' nurse managers. This offered a descriptive account of the physical characteristics of the nursing units including the square footages of each unit, floor plans of the unit, locations of various nursing work areas, and other valuable information which built the groundwork for the researcher to expand upon.

Phase II: Photographic documentation and field measurements An onsite walk-through oriented the researcher to the units and provided the opportunity to capture the physical characteristics of the nursing work areas through photographs. Select photographs were then used in phase III, focus groups. Measurements of the light levels and sound levels in each of the nurse work areas were conducted through the use of a light meter and decibel meter instruments.

Phase II: Observations The final step of phase II was a series of focused observations of the staff performing their daily activities in the primary work areas. This

methodological approach was selected because it allowed the researcher to study and understand the function of each unit without actually participating. Two observations were completed in each work area between 8:30am and 5pm during a typical week day shift (see Appendix D). The observation consisted of a twenty-minute window where each of the specific work areas - the nurse station, medication dispensing area, and supply room - were observed to better understand how well the unit functioned. Data collection assessed: who was using the various work areas, how many people were in the area, and how the staff worked in the area. Other data such as tasks (the types of tasks and the needs related to the tasks) and physical characteristics of each nursing work area (spatial allowances, noise sources, lighting, etc.) were also captured during some of the observations.

Phase III: Standardized Survey and Focus Group

The third and final phase of the data collection involved surveying and conducting focus groups with nursing staff from each unit. The survey was distributed to the participants at the start of the four focus group sessions which were conducted in the break rooms of the respective nursing units. The survey inquired further about the nurses' perspective of the designs of the nurse work areas and addresses the study's first research question by evaluating which level of environmental comfort characterizes the nurse work area.

Phase III: Standardized survey A modification of the DiConFon survey (Vischer, 2010), a 52-item questionnaire for gauging occupants' feelings and judgments concerning building performance, was administered to the participants. The DiConFon survey was adapted for this study to include 35 specific feature evaluations which were rated on a five point scale and one open-ended question. The 35 items were chosen on

the basis that these items formed 5 key dimensions applicable to the health care workplace: lighting, noise level, thermal quality, spatial factors, and privacy. The following questions were omitted from the original questionnaire because they were irrelevant to the scope of this research study or the questions were not applicable to the healthcare work environment: 1-6, 11, 14, 16, 22, 23, 27, 29-31, 36, 37, 41, 44, 46. Furthermore, questions 28 and 40 were separated to create two additional questions. The separation of these questions allowed the participants to provide more in-depth responses regarding noise sources and lighting levels. Additionally, minor adjustments were made to the wording of the survey questions; for example, the British spelling of odour and colour were interchanged with the American-English spellings of the words. A copy of the instrument, in its original form and the modified version, can be found in Appendices E and F.

Vischer's theoretical model of the worker-workspace relationship in which stress and comfort play a critical part suggests a methodological approach on which to base empirical studies. Vischer's research on stress in the work environment typically focuses on psychosocial factors that affect job performance, strain and employee health, and addresses the growing body of work on the environmental psychology of workspace. Her theory of environmental comfort can be applied to the relationship between worker behavior and physical features of the work environment. This framework can usefully be applied to analyze the physical environment in which people work, in terms of the control they have over their space. The questionnaire is designed so that the information derived from it may be directly applicable to building-related and workplace-related issues (Vischer, 2005).

The pencil and paper survey required approximately 5 minutes of time to complete. This survey provided a clear understanding of the nurses' perception of the environmental comfort level (physical, functional, psychological) of their work areas. After the nurses completed the survey the researcher facilitated focus groups to identify design variables which impact the environmental comfort of the nursing staff; recommendations for improvements of the work areas were also discussed.

Phase III: Focus groups The focus group discussions were held for approximately 20 minutes and provided insights into the nursing work areas on the unit (not surfacing through the surveys alone). Topics of discussion included: how the centralized nurse work station, medication dispensing area, and supply room meets the needs of the nurses; why the built environment does or does not meet the needs and support the tasks of the nursing staff, and what preferences nursing staff have when it comes to the areas that they use and work in most often. The conversation was guided by the use of photographs of the nurses' work areas which allowed the nurses to be certain of which area in particular was under discussion. The researcher used audio recording devices during the discussions which allowed the researcher to perform content analysis of the data.

The focus group discussion entailed a series of discussion prompts that were divided into the following three sections: the nurse station, medication dispensing area, and supply room. The discussion was further divided into five sub-sections on the basis of the effects of the environmental conditions: lighting, noise level, thermal quality, spatial factors and privacy. The focus group format entailed open-ended questions resulting in unstructured in-depth discussions between the nursing staff. In an

unstructured interview the main goals are to “explore all the alternatives in order to pick up information, to define areas of importance, and to allow the respondent to take the lead to a great extent (Sommer & Sommer, 2002, p. 114).”

The researcher asked participants about the facts of a matter as well as their opinions. This method assures complete freedom in the terms of the wording that can be used and the way questions are explained to the respondents (Kumar, 2005). According to McArthur (2010), open-ended questions are a powerful tool to use in a consultation. They are characterized by questioning which opens a line of inquiry and permits full elaboration of content. This is in contrast to closed-ended questioning which can shape a response and typically derives a single word answer to a specific question.

Summary of Research Methodology

This multi-site field study involved two hospital facilities referred to as the North Tower and the South Tower. Within this setting, two medical/surgical units were selected from each hospital in which to conduct the research study. The methodology entailed three phases of research: (1) an initial survey to gain a general understanding of the usage and perceived functionality of the key nursing work areas: the nurse station, the medication dispensing area, and the supply room; (2) observation of the participants’ performing their daily activities in each work area; (3) surveys and focus group discussions to capture nurses’ perceptions of the lighting, noise level, thermal qualities, spatial factors, and privacy. The data were analyzed through the lens of Vischer’s environmental comfort theory to evaluate nurses’ overall perception of healthcare work areas.

Table 3-2. List of environmental conditions and their subcategories under study.

Comfort category	Environmental items rated by occupants
Lighting	Overall lighting
	High light levels
	Low light levels
	Light reflections on surfaces or screens
	Access to daylight
Noise level	General noise distractions
	Noises from voices
	Noises from equipment
Thermal quality	Temperature comfort
	General temperature
	Temperature shifts
	Ventilation comfort
	Air freshness
	Odors
Spatial factors	Furniture layout of nurse station
	Size of nurse station
	Nurse station work surfaces
	Computer configuration
	Personal storage space
	Work storage space
Privacy	Visual privacy
	Conversation privacy
	Telephone privacy

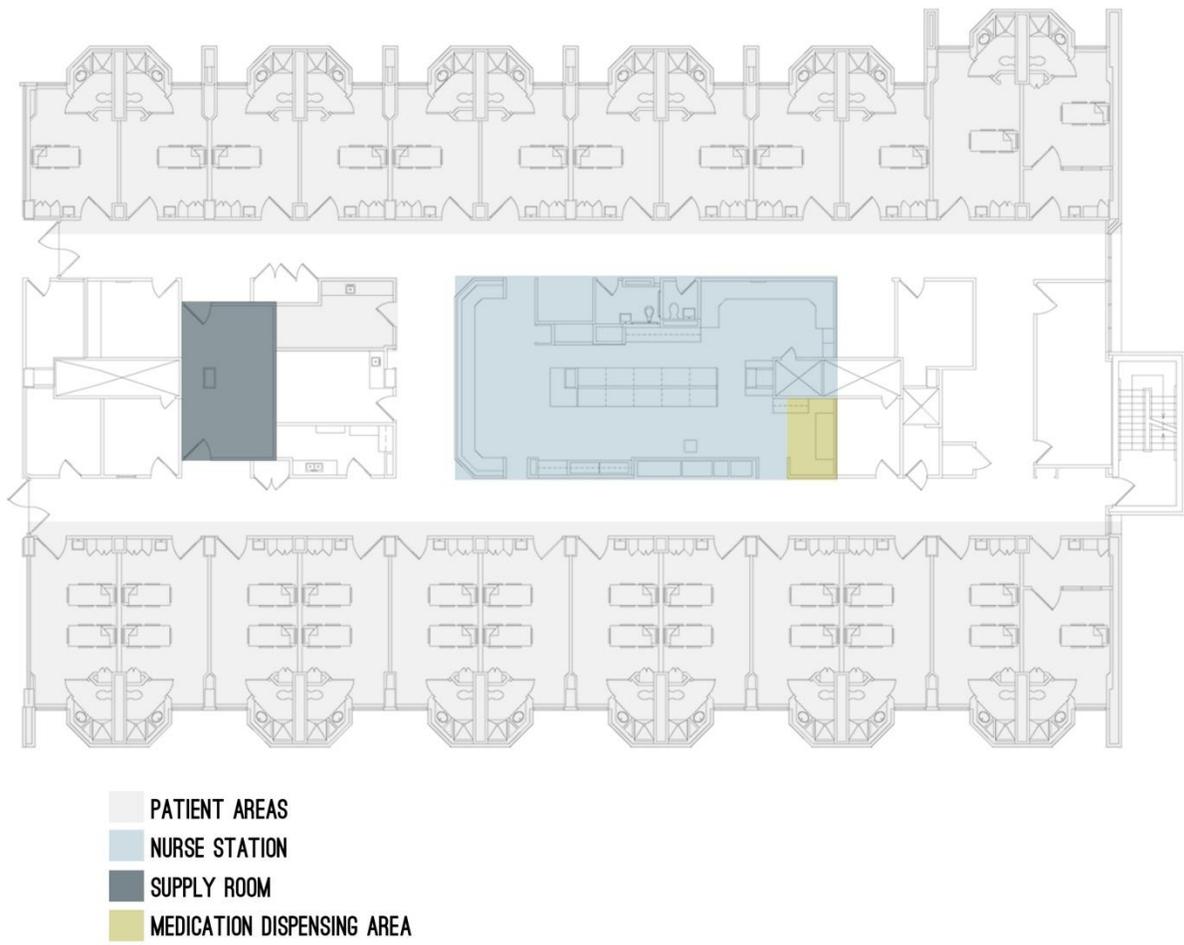


Figure 3-2. Unit A floorplan.

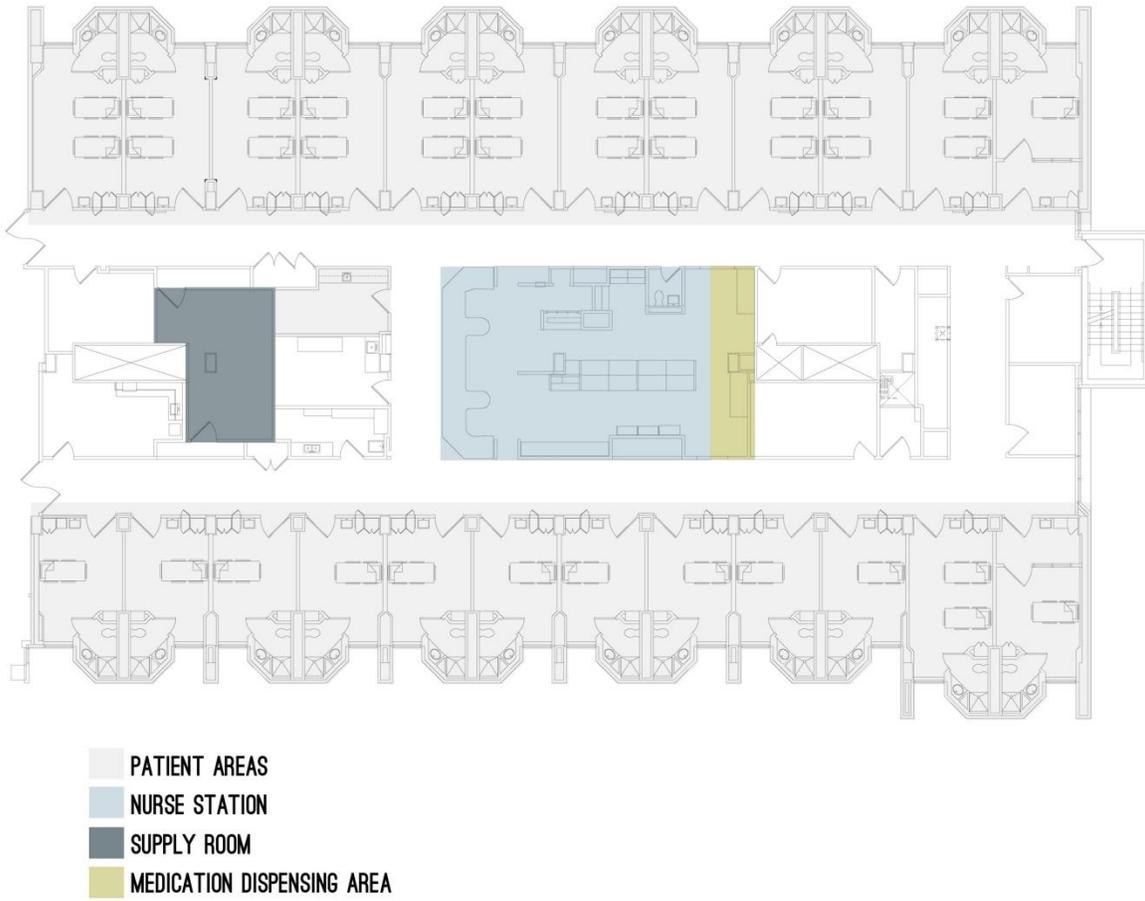


Figure 3-3. Unit B floorplan.

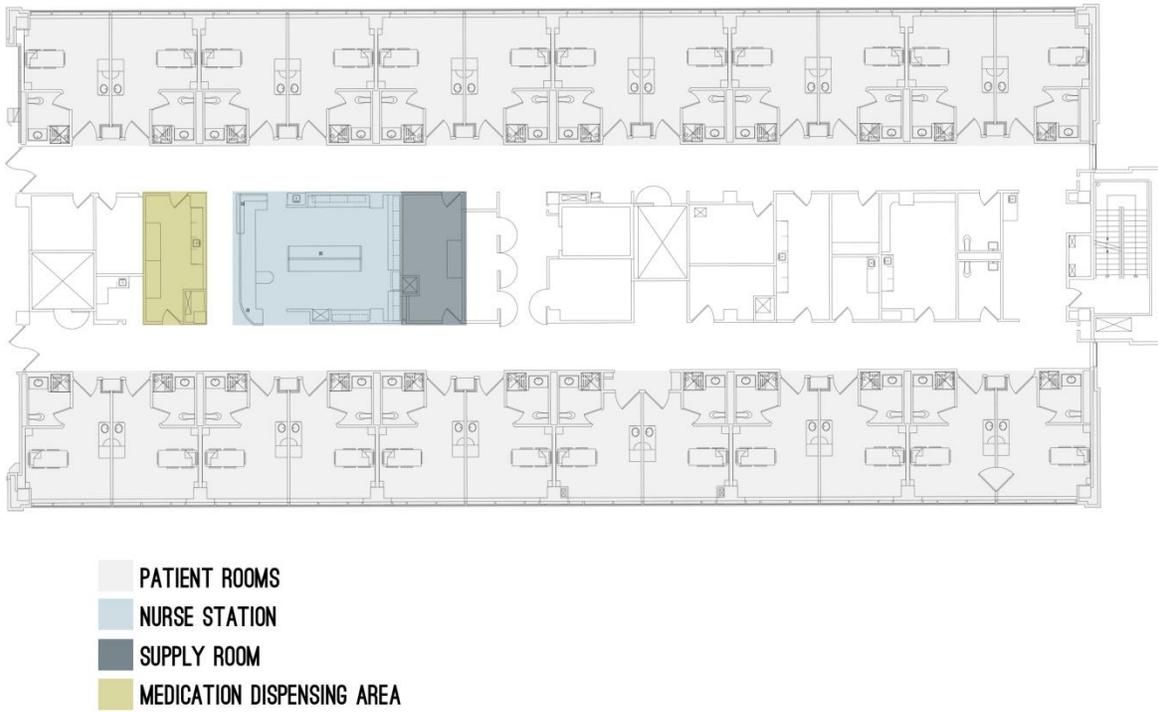


Figure 3-4. Unit C floorplan.

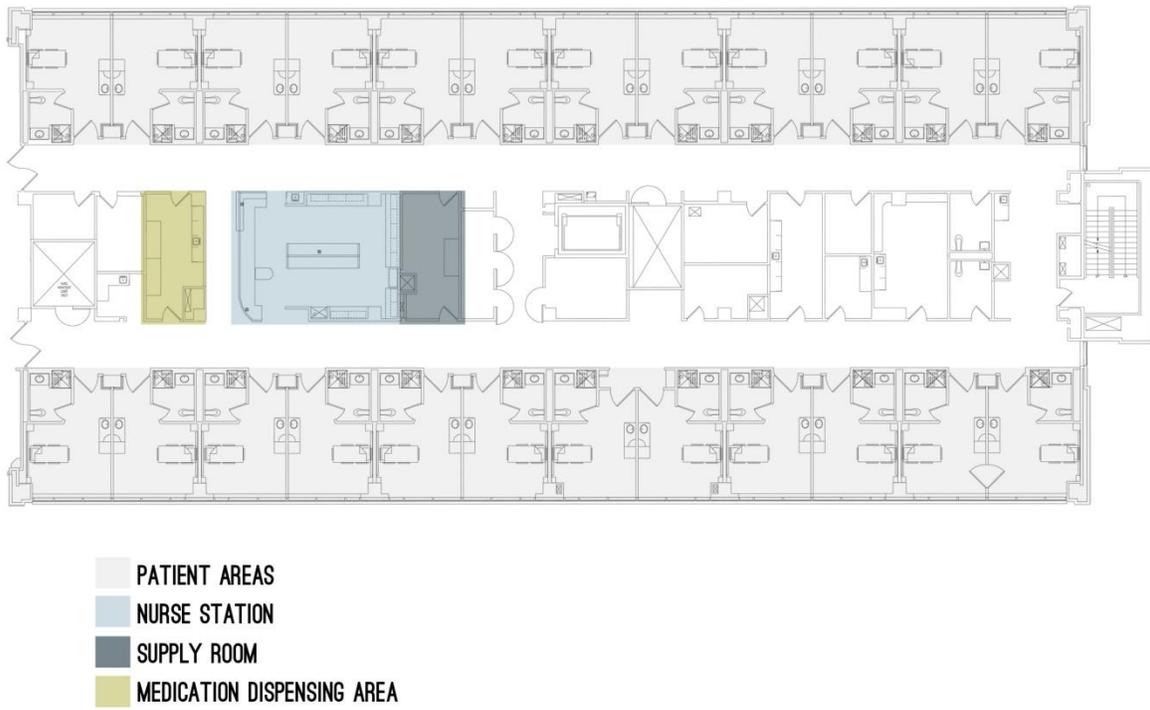


Figure 3-5. Unit D floorplan.



A



B

Figure 3-6. Unit A nurse station. A) Exterior. B) Interior. (Photographs courtesy of author, Paige Prebor)



Figure 3-7. Unit A medication dispensing area. (Photographs courtesy of author, Paige Prebor)



A



B

Figure 3-8. Unit A supply room. A) Supply room color-coded shelving. B) A corner of the supply room contains the electrical equipment for the computer network. (Photographs courtesy of author, Paige Prebor)



Figure 3-9. Unit A corridor. (Photograph courtesy of author, Paige Prebor)



Figure 3-10. Unit A medication cart. (Photograph courtesy of author, Paige Prebor)



Figure 3-11. Unit A task chair and COW located outside patient room. (Photograph courtesy of author, Paige Prebor)



A



B

Figure 3-12. Unit B nurse station. A) Exterior. B) Interior. (Photographs courtesy of author, Paige Prebor)



A



B

Figure 3-13. Unit B medication dispensing area. A) View of Omnicell at rear of nurse station. B) View of Omnicell from corridor. (Photographs courtesy of author, Paige Prebor)



A



B

Figure 3-14. Unit B supply room. A) Cabinet used as a make-shift work surface to hold computer, hand-held barcode scanner, and various supplies. B) Color-coded shelving. (Photographs courtesy of author, Paige Prebor)



A



B

Figure 3-15. Unit C centralized nurse station. A) Exterior. B) Interior. (Photographs courtesy of author, Paige Prebor)



A



B

Figure 3-16. Unit C medication dispensing area. A) View of Omnicells and a computer which is located on a mobile cart. B) Sink separated from medication preparation area through the use of a splash guard. (Photographs courtesy of author, Paige Prebor)



A



B

Figure 3-17. Unit C supply room. A) Color-coded shelving. B) Hand-held barcode scanner, Omnicell, and color-coded shelving. (Photographs courtesy of author, Paige Prebor)



A



B

Figure 3-18. Unit D centralized nurse station. A) Nurse station reception. B) Nurse station exterior with hand washing station. (Photographs courtesy of author, Paige Prebor)



A



B



C

Figure 3-19. Unit D medication dispensing area. A) Sink separated from medication preparation area through the use of a splash guard. B) Omnicells. C) Computer located on counter top. (Photographs courtesy of author, Paige Walker)



A



B

Figure 3-20. Unit D supply room. A) Omnicell. B) Color-coded shelving. (Photographs courtesy of author, Paige Prebor)

CHAPTER 4 RESULTS

This chapter examines the ways in which different environmental conditions affect user comfort. Vischer's theoretical framework of environmental comfort ranks workplace environments in a rising continuum of physical, functional, and psychological comfort. At the base of the continuum is the category of physical comfort, which includes the nonnegotiable prerequisites for a habitable work environment such as enough light, no extreme temperatures of too hot or too cold, safe noise levels, and an adequate number of functioning toilets. These conditions are usually met through building codes and regulations which ensure the public's health, safety, and welfare. The next element of environmental comfort is identified as functional comfort. A functionally comfortable environment is supportive of work-related activities, as Vischer explains: "A functionally comfortable workspace is a tool for work: not just lighting, but the right lighting for the task, not just ventilation, but clean conditioned air that is free of contaminants, not just heating, but thermal comfort (2005, p. 84)." Further, the ability to turn on a light, control the room's temperature levels, or personally manipulate the environment in other ways increases the psychological comfort - the last level of environmental comfort - because it provides the practicality of having a task light, but also the perception of control in being able to manipulate that light. The habitability pyramid (Figure 2-1) illustrates how the three levels of comfort are not mutually exclusive or even truly separate, but merge together as a continuum, from the basic needs of physical comfort, through the task-related needs of functional comfort, to the emotional needs of psychological comfort.

Five research questions were posed to identify and compare the environmental comfort levels of hospital work areas among registered nurses. The nurses' completed the DiConFon survey (Vischer, 2010) inquiring on the environmental conditions of lighting, noise level, thermal quality, spatial factors, and privacy in relation to the nurse station, the medication dispensing area, and the supply room of their respective units. The environmental conditions were rated on a five point scale, where 1 is uncomfortable and 5 is comfortable. Mean values were derived from the data to represent the comfort level of each environmental condition. This data, along with the focus group dialogs and the researcher's observations, was triangulated to answer the following research questions.

Research Question One

What level of environmental comfort (physical, functional, and psychological) characterizes the work spaces in hospital environments which are under study, as perceived by the nursing staff?

This question analyzes the registered nurses' feelings and judgments concerning the built environment of their workplace with the intention of identifying which level of environmental comfort they are experiencing.

Unit A

Mean scores were calculated for each of the five environmental conditions addressed in the DiConFon survey. The mean scores of the five categories are presented in bar charts in Figure 4-5 through Figure 4-9. The bar charts illustrate that the conditions of Unit A range between $\bar{x} = 2.0$ and $\bar{x} = 3.4$, where the lowest ranked environmental condition is the noise level ($\bar{x} = 2.0$) and the highest ranked condition is the lighting ($\bar{x} = 3.4$). The mean calculations reveal that the nurses perceive a relatively low amount of comfort in multiple dimensions of their workplace. Congruently, the RNs

verbalized their experiences and perceptions regarding the comfort of their work areas during the focus group session; observation data gave further insight into the unit and to the users who worked in the various work areas. Table 4-1 displays the sample means and standard deviation scores for each question from the DiConFon survey. This information reveals key considerations relating to environmental comfort which is dissected below.

Table 4-1. Assessment of environmental factors – Unit A (n=3).

Comfort category	Environmental items rated by occupants	Mean	SD
Lighting quality	Overall lighting	3.33	1.15
	High light levels	3.67	1.15
	Low light levels	3.67	1.15
	Light reflections on surfaces or screens	3.33	0.58
	Access to daylight	3.00	2.00
Noise level	General noise distractions	3.33	0.82
	Noises from voices	3.00	1.10
	Noises from equipment	3.33	0.82
Thermal quality	Temperature comfort	3.00	0.00
	General temperature	3.00	0.00
	Temperature shifts	3.00	0.00
	Ventilation comfort	3.00	0.00
	Air freshness	2.33	0.58
	Odors	2.66	0.58
Spatial factors	Furniture layout of nurse station	2.33	0.58
	Size of nurse station	3.33	1.15
	Nurse station work surfaces	2.67	1.15
	Computer configuration	3.00	1.00
	Personal storage space	2.33	0.58
	Work storage space	2.33	0.58
Privacy	Visual privacy	2.33	0.58
	Conversation privacy	2.33	0.58
	Telephone privacy	2.33	0.58

Lighting As the highest ranked environmental condition, the lighting was not perceived as a concern by the nurses on Unit A. During the focus group discussion the nurses said that the lighting was “fine” and “not a problem”. However, they indicated that they would like views to the outdoors with accompanying natural light. The break room

is the only staff space on Unit A that has access to a window, and the nurses mentioned that the vertical blinds were usually closed so they rarely saw the view overlooking the tree-tops and nearby parking garage. It was noted during the observation periods that the nurses have access to light switches to operate the lights throughout the unit; during the observations the canister lights at the front of the nurse station were turned off and the rest of the nurse station was lit with 2x4 recessed fluorescents.

The nurses perceive the overall lighting on Unit A as functionally comfortable due to their expressed satisfaction with the amount of light and their control over the fixtures; however, the lighting is not characterized at the top level of the environmental comfort continuum, psychological comfort, because the nurses are lacking proximity to windows in their work areas. Daylight is deficient on Unit A and this has a pronounced effect on the nurses' psychological comfort.

Noise level Noise levels from voices and equipment were rated as loud and distracting by the RNs on Unit A. Complementing the survey results, it was apparent during the focus group discussion that the noise level was a concern:

Nurse 2: All the telemetry machines are always going off. It's definitely noisy but I guess you get used to it. And the thing that really gets me is when I'm stressed out and all that noise is going on and then the [resident] flute player comes. And the flute player doesn't relax me it's just like one more noise! I'm like, 'oh my gosh!' I can't stand it!

Nurse 3: Yeah, uh-huh, one more irritation!

Nurse 1: I'm like, 'stop it!'

Nurse 2: Right! And when I get in the car my husband will have the music playing and I have to turn it off because I don't want to hear anything. But what are you going to do about that?

Nurse 1: Nothing. The noise level overall on the unit is loud- telemetry alarms, bed alarms, bathroom alarms... (trails off).

Nurse 2: Sometimes people are yelling. Like there are some people with really loud voices, and they talk real loud.

The noise sources on the unit are both the medical equipment and the voices of other staff members. Vischer (2005) explains the relationship between noise and the levels of environmental comfort as such:

Noise control has an important effect on psychological comfort, in much the same way as privacy. Intrusive noise does more than distract people from their work; it also confirms a lack of control over one's accessibility. Functionally, problems arise for most people because their attention is distracted by noise nearby when they are trying to concentrate on a task. Physical comfort comes in to play where sound levels are so high that users become fatigued and strained struggling to hear in adverse acoustic conditions, even risking deafness (p. 100).

According to the environmental comfort theory the conditions in Unit A correspond to the lowest level of the comfort continuum, physical comfort, because the nurses are often aggravated and distracted from the surrounding sounds resulting in increased fatigue at the end of the day. The nurses' have a lack of control over the intrusive noise, ruling out the top levels of the comfort continuum.

Thermal quality The nurses assessed the thermal qualities neutrally in both the survey and the focus group session; they acknowledged that people don't often agree on what temperature is comfortable:

Nurse 1: I'd put our thermostat on 85° but some other people would put it on 60°.

Nurse 2: The thing too with here is that the air conditioning is old in this building. The air conditioning has issues. Because like in the patient's room the person will be too hot or too cold, and they will come and we will say 'there is only so much we can do'. And it's because the way it is, it's too old and has problems so they can only do so much. The staff usually- if they get too cold- they will get a blanket out of the blanket warmer but now that is forbidden.

The thermal condition on Unit A does not meet the top tier of the comfort continuum, psychological comfort, because the nurses are lacking the aspect of control

over their thermal condition due to the old air conditioning system and due to the wide variation in how people experience thermal comfort. However, the nurses do not express continual thermal discomfort that cannot be moderated by the use of added clothing; therefore, the thermal comfort on the unit is best categorized in the functional comfort level.

Spatial factors As seen in Table 4-1, the furniture layout of the nurse station was rated at a mean value of $\bar{x} = 2.33$. During the observations it was immediately noted that the nurse station was not furnished suitably. The nurses in Unit A are lacking adequate seating with computers to complete required paperwork, and their functions are often slowed down due to this impediment. The nurses explain:

Nurse 1: There isn't enough room in the nurse station during shift change, or enough chairs to give report, because everyone sits at the same time to give report.

Nurse 2: Yeah you've got to grab [the chair] and growl!

When a nurse comes across an available chair in Unit A they will often move it in to the hallway and chart "illegally" in order to be close their patients' rooms while completing their computer tasks. One nurse admitted that although they are not permitted to sit in the hallway because it is a fire hazard she brings her own stool from home, places it in the corridor near the patient rooms, and sits on it while charting at her computer on wheels (COW) (see Figure 3-11). She is quoted saying, "No one is supposed to be sitting in the halls but people do because they need to take a rest and sit at their computer."

The other nurses expanded on this topic:

Nurse 1: We're not supposed to sit in the hallways, but yet we're supposed to be close to our patients! And there ain't no way I'm standing for 12 hours to be near their rooms. I like to be by my patients so I can see if there are

any issues, I hear them getting out of bed, or I hear them calling out for help or whatever. So I don't usually sit at the nurses' station to be honest. I sit in the hallway.

Nurse 2: Yeah before we got more people at their COWs trying to sit near their patients I'd try to do acuities and the whole nurse station would be full. Everybody, the PCAs [patient care assistants], the nurses, everybody, would be there trying to . . . [trails off] . . . so I'd go to the Wall-a-Roo [wall mounted work station] to do the acuities on the wall, but that was a thrash because I had to find somewhere to put my book that I was using, and I'd do the acuities standing up. I didn't have enough space to put my stuff, and I wanted some coffee but I couldn't have coffee because I'm not allowed to in the hallway. And then there was no stool! So I'd have to go grab a table, a bed side table, to sit on as my stool because I wasn't going to stand there and do them, so ya know, that's kinda crazy. You'd see a lot of people sitting on bedside tables and starting acuities at the Wall-a-Roos, which was forbidden, but we did it anyway.

The RNs are unable to find a place to sit and are being deprived of a basic workplace expectation negatively impacting psychological, functional, and physical comfort levels. The nurses are experiencing discomfort (below the habitability threshold).

Privacy As the second lowest rated environmental condition on Unit A, privacy is a concern for the majority participants in this study. The nurses discuss their experiences in the medication dispensing area:

Nurse 1: Without fail you're trying to pull meds and someone inevitably runs into you. Transporters are running over you, the dietary girl hits you with the food tray cart and x-ray takes you out with their machine.

Nurse 3: We get phone calls left and right, people still bother you left and right, and patients walk by.

Nurse 1: And the pharmacy tech is standing behind you knocking saying, 'I have fifteen things to go, come on!'

Nurse 3: I've even had management bother me when I'm trying to get meds by walking up and talking to me!

Nurse 1: Me too! They tried to make cubby holes to make it better, but it's still . . . yeah.

Nurse 2: I think it's improved but I don't think there is any way around it. And even then you still have a phone so they can find you.

Nurse 1: The patients can even be looking for you, and then they go in the medicine area!

The expressed lack of privacy is psychologically and functionally taxing; psychologically, the nurses appear to lack control over their environment, and functionally this interferes with concentration. This indicates that the nurses are experiencing the next lower level, physical comfort.

Summary of Unit A From the amalgamation of the low survey ratings of the environmental conditions supplemented with the feedback in the focus group discussion, RNs appear to be more comfortable with the functional comfort levels of lighting and thermal quality than with the physical comfort levels associated with the noise level and privacy conditions (Figure 4-1).

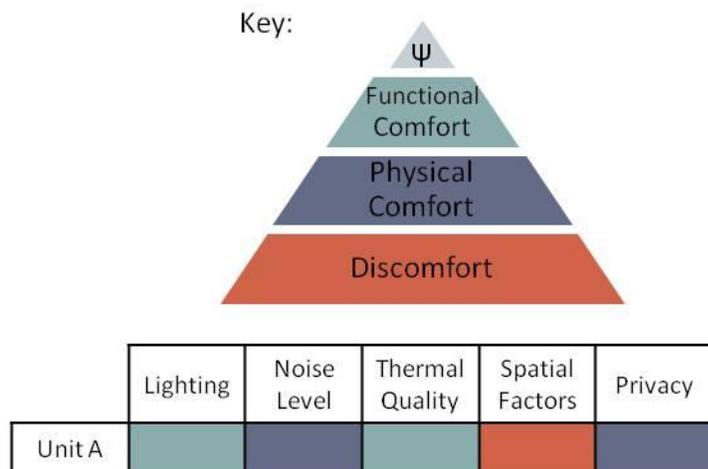


Figure 4-1. The nurses' perceived environmental comfort levels of Unit A.

The nurses find themselves distracted and interrupted almost continually throughout the day. Although the conditions causing the most discomfort in this unit were related to spatial factors and these were associated with the highest discomfort level. Barriers to

productivity include inadequate task seating and work surfaces, and they are often displaced into the corridors to chart which puts the occupants' safety in question.

Unit B

The bar graphs in Figures 4-5 through Figures 4-9 present the mean values of each environmental condition of the work areas in Unit B. The lowest ranked environmental factor is thermal quality ($\bar{x} = 3.0$), while the highest ranked factor is lighting ($\bar{x} = 3.52$). Table 4-2 shows the mean and standard deviation scores for each condition question in the DiConFon survey.

Table 4-2. Assessment of environmental factors – Unit B (n=5).

Comfort category	Environmental items rated by occupants	Mean	SD
Lighting quality	Overall lighting	4.0	1.22
	High light levels	4.4	0.55
	Low light levels	3.6	1.52
	Light reflections on surfaces or screens	4.0	1.22
	Access to daylight	1.6	0.55
Noise level	General noise distractions	3.0	0.71
	Noises from voices	3.2	0.45
	Noises from equipment	3.8	0.45
Thermal quality	Temperature comfort	1.8	0.84
	General temperature	4.6	0.55
	Temperature shifts	3.2	1.30
	Ventilation comfort	2.6	1.14
	Air freshness	3.0	0.71
	Odors	4.4	0.55
Spatial factors	Furniture layout of nurse station	3.4	0.89
	Size of nurse station	3.2	1.30
	Nurse station work surfaces	2.6	1.34
	Computer configuration	4.0	0.71
	Personal storage space	3.0	0.89
Privacy	Work storage space	3.2	1.48
	Visual privacy	3.0	1.58
	Conversation privacy	3.4	1.52
	Telephone privacy	3.0	1.22

Lighting Although the rating for lighting fell between average and good in the survey, it still presented a concern for the nurses in Unit B. For instance, the recessed

canister lights in the dropped ceiling of the medication dispensing area are intentionally turned off by the nurses because the lights generate an uncomfortable amount of heat when standing under them. However, this results in the nurses performing their tasks in less than optimal lighting conditions. According to the environmental comfort theory, the need for good lighting is critical because the nurses are counting and dispensing medication, yet the heat radiating from the fixtures causes discomfort.

Further, the nurses do not have control over the lights on the east side of the unit; one nurse explains, “The hallway doesn’t have a light switch, so the lights are on 24/7. That’s the only lighting issue I have. There is no controlling it. So this side stays bright.” The nurses also expressed the desire for more windows and natural light in the unit. Unfortunately the only rooms on the unit with access to windows are the patient rooms and administration offices. The lighting conditions on Unit B do not meet the top tier of the criterion of psychological comfort given the lack of natural light and control over lighting conditions. Additionally, the lighting in the medication dispensing area is insufficient for the type of work being performed; therefore, this represents physical comfort: the lowest tier of the theoretical continuum.

Noise level During the focus group discussion, the nurses commented on the ambient noise on their unit:

Nurse 1: There is no privacy.

Nurse 2: And it is loud.

Nurse 5: *We are loud!*

Nurse 3: I don’t think it has to do with the nurse station, I think it’s us.

Nurse 5: Yeah it’s the staff. I have to be honest: we’re loud.

The nurses suggested that the noise in the area could best be controlled through rules about behavior like keeping voices low and implementing more 'quiet time' on the unit. The noise conditions are best characterized at a functional level because the nurses are experiencing unwanted sound, but it is not putting them at risk for hearing loss nor did they express concerns about noise exhaustion. Noise exhaustion would be defined as sound levels so high that users become fatigued and struggle to hear in adverse acoustic conditions. However, the noise is intrusive, distracting, and the nurses' do not have control over their surrounding noise levels.

Thermal quality The thermal quality of Unit B is rated as the lowest environmental condition ($\bar{x} = 3.0$). The nurses' average reasons for their assessment became clear in the focus group dialog:

Nurse 1: It's hot on the unit. It's always hot.

Nurse 2: On the unit? Yeah, it is hot. It's kind of warm right now, but this feels good compared to what it's usually like!

Nurse 3: There are thermostats and we are supposed to have control over the A/C ourselves, but it doesn't work.

Nurse 2: It's a decoy!

Nurse 3: We've been told by the maintenance guy that that's just the way it is, and that it costs too much money to fix it or something . . . But I was like 'it's hot!'

Nurse 4: Uh-huh. Yeah. It's too hot!

This conversation reveals key thermal quality issues: the unit's thermostat is not working properly, and when the staff reported the issue to maintenance they were not given a solution or any expectation of it being repaired. Vischer (2005) explains that having a sense of control over the environment is essential to reach the level of psychological comfort: "Psychologically, thermal comfort is affected by the

responsiveness of facilities managers and getting results from service calls. The reassurance of a responsible management, and the evidence that someone has acted to allay one's concerns, has an important impact on psychological comfort (p. 91)." Unit B is lacking thermal control and this is adversely affecting the nurses. Therefore, nurses in Unit B seem to be experiencing the lowest level on the environmental comfort continuum, the physical comfort level.

Spatial factors Another prevalent topic of the focus group discussion was the absence of proper furnishings and equipment necessary for the RNs to perform their daily responsibilities. There are not enough chairs on the unit to service all the staff members, and many of the chairs are broken and the height can no longer be adjusted. One nurse expressed physical effects from sitting in the chairs: "I'm tall and I can't sit down. One chair is stuck in the low position and it just kills my knees to sit down and try and get back up." Another nurse states, "They are in dire need of some new office chairs up there. We're fighting to grab a chair and computers. There aren't enough COWs either!"

The broken and inefficient amount of chairs and COWs on Unit B confines the unit's environmental comfort to a physical level. Vischer (2005) notes that "in terms of physical comfort, worker's health and well-being may suffer when furniture is old, un-ergonomic for computer use, and difficult to use (p. 93)."

However, when considering the use of space on the unit, particularly regarding the staff restrooms, Unit B is experiencing a level of discomfort (the level below the habitability threshold):

Nurse 1: We need two staff bathrooms.

Nurse 3: *Oh yeah!*

Nurse 5: We have a shower room in the back – useless – that is being used as a storage room. Can we convert that in to a bathroom? It's easy! The piping and everything is there, the water.

Nurse 3: Yeah I think that space is bigger than our break room! And we only have one toilet for all of us!

When the single staff toilet located on Unit B is occupied the staff member is required to come back at another time, or leave the unit in search of an available staff toilet; this is a lack of a basic convenience. Other topics related to the unit's spatial conditions were discussed during the focus group as well such as the supply room having no work surfaces to prep medical supplies, and the isles of the nurse station being too narrow and crowded making it difficult to maneuver with a COW. On the continuum of the environmental comfort theory, the physical comfort level implies an adequate number of work surfaces, task chairs, as well as toilets for employees. Since Unit B does not offer these components the RNs are experiencing discomfort on a regular basis.

Privacy During the focus group discussion, the nurses mentioned two design components of the unit that increased their sense of privacy: (1) the individual mobile carts assigned to each nurse (see Figure 3-10) and (2) the privacy panel on the front of the nurse station (Figure 3-12). In the following example, the nurses discuss the mobile carts:

Nurse 1: I like having the little carts out there.

Nurse 3: It's like having your own little private work area.

Nurse 2: Yeah it's just kind of private and everything is available right there, like your syringes, your pill crushers, your cups, alcohol pads, everything is there in that. And you're able to kind of get out of the way.

Nurse 1: It's your own private little storage thing, like if you know that you have a patient who is on a lot of antibiotics you can get the little mini-bags and put them in there for the day. So, it's something that you can lock up.

The nurses' personal carts offer them a place to store supplies and prepare medications; however, the carts are located in the corridors where visual privacy, conversation privacy, and telephone privacy are nearly nonexistent. According to the environmental comfort theory, while the nurses' are lacking privacy on the functional level (freedom from distractions in order to concentrate) they do have control and ownership for their personal territory which led to satisfaction. According to Vischer (2005), "Psychological discomfort occurs where there is a mismatch between a person's expectation of privacy and their perception of the privacy they have (p. 96)." So while the nurses on Unit B do not have enclosure and exclusivity in their immediate workplace, the key components of comfortable privacy meets their expectations. The nurses acknowledged that the nature of their work involves contact with many people, patients and staff, and involves constant movement; they do not want, or expect, private offices. Yet a degree of privacy is appreciated.

For example, the privacy panel on the front of the nurse station offers the nurses the opportunity to sit without being seen (albeit in a crowded place that does not always have a chair). A nurse describes her experience, "I like it [the privacy panel] because if I'm charting down that place that I said is a problem because it is so crowded, my patient can't look down there and see me and holler at me. I don't want to be seen."

Taking into account the nurses' perception of their personal territory on the mobile carts, the nurses' perceive a degree of psychological comfort. However, the nurses are lacking control over their environment and their exclusivity, and the nurses'

distractions often inhibit their concentration. This indicates that the nurses are experiencing the lower level of the continuum, physical comfort.

Summary of Unit B When examining the survey results in conjunction with themes from the focus group discussion, it appears that the RNs are more comfortable with the noise level (functional comfort level) and privacy (functional comfort level) than with the lighting (physical comfort level) or thermal conditions (physical comfort level). Yet, the conditions causing the most discomfort in this unit related to spatial factors. For example, the nurses do not have an adequate amount of task chairs, computers, or work surfaces, and they need more staff toilets on the unit.

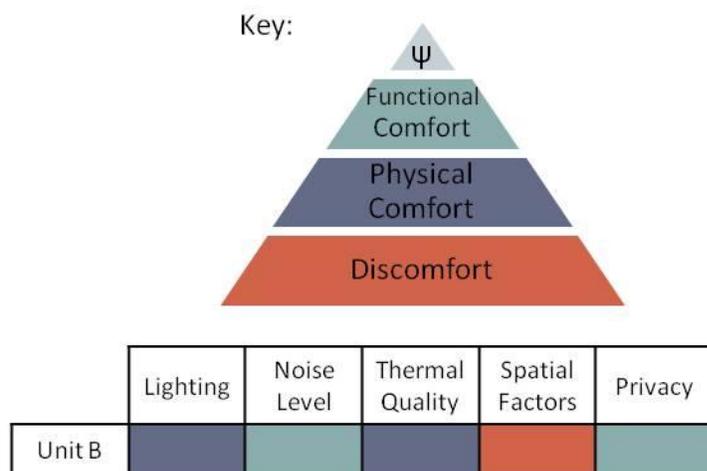


Figure 4-2. The nurses' perceived environmental comfort levels of Unit B.

Unit C

The bar graphs in Figure 4-5 through Figure 4-9 illustrates the results of the collective DiConFon questions by displaying the calculated mean values of the category responses. The lowest ranked environmental factors in Unit C includes both the privacy and the noise level at mean values of $\bar{x} = 3.33$, while the highest ranked factor is lighting at a mean value of $\bar{x} = 4.23$. Table 4-3 shows the mean and standard deviation

scores for each of the five categories of questions from the DiConFon survey regarding the work environment in Unit C.

Table 4-3. Assessment of environmental factors – Unit C (n=6).

Comfort category	Environmental items rated by occupants	Mean	SD
Lighting quality	Overall lighting	4.33	0.52
	High light levels	4.50	0.55
	Low light levels	4.00	0.63
	Light reflections on surfaces or screens	4.00	0.63
	Access to daylight	4.33	0.52
Noise level	General noise distractions	3.00	0.71
	Noises from voices	3.20	0.45
	Noises from equipment	3.80	0.45
Thermal quality	Temperature comfort	4.16	0.75
	General temperature	3.33	0.82
	Temperature shifts	4.00	0.63
	Ventilation comfort	4.00	0.63
	Air freshness	4.00	0.00
	Odors	4.00	0.00
Spatial factors	Furniture layout of nurse station	4.17	0.75
	Size of nurse station	4.60	0.52
	Nurse station work surfaces	4.33	0.82
	Computer configuration	3.50	0.84
	Personal storage space	4.17	0.41
	Work storage space	4.17	0.75
Privacy	Visual privacy	3.17	1.47
	Conversation privacy	3.50	0.84
	Telephone privacy	3.33	0.82

Lighting The survey results reveal a mean value of $\bar{x} = 4.23$ for the overall comfort of the lighting. The nurses discussed lighting during the focus group, with a strong emphasis on the natural light:

Nurse 1: The only light I don't like is the overhead light in the patient room.

Nurse 2: Uh-huh, but I love the windows; it offers a lot of light. The best thing about this building is the windows. There is a lot of natural light and I love the view out the windows.

Nurse 3: If you are on this side [of the building] during the day the windows actually warm the rooms up. A lot of the patients actually complain of it getting warm because the sun is actually beaming in there.

Nurse 1: That's true, yeah but I like the windows.

Nurse 3: Yeah the windows are good. A lot of patients like it. I think it's just healthy overall, just wellbeing.

The results in this study replicate the well established findings that daylight has a pronounced effect on psychological comfort. The tasks performed by RNs do not require natural light, but they value proximity to windows, daylight and outdoor views (Scott, 2004). As discussed in the literature review, healthcare research indicates that views of nature and access to natural light can have positive effects on the nurses' performance and stress levels (Chaudhury et al., 2009; Alimoglu & Donmez, 2005). During the observations of Unit C the nurses were noted adjusting the light levels of the medication room and nurse station. With functionally supportive lighting, and psychologically comfortable amounts of natural light, the nurses seemed to achieve the level of psychological comfort.

Noise level During the focus group discussion, it became apparent that the general noise in the unit was a concern:

Nurse 1: I know there have been times where I'm in a patient room and I can hear the conversation outside the door. And um, I don't think they are trying to talk loudly or anything, they are just using inside voices, but it can still be heard.

Nurse 3: Noise, that's the closer you get to the nurse station, but I don't [trails off]... I think it's pretty quiet in the [patient] rooms when you close the doors. I think the closer you are to the nurses' station the more noise you can hear, and that is something that we could probably control better, but I don't think that's a building problem.

Nurse 4: If you close the patient doors it helps with the noise and traffic outside.

Nurse 2: I go hide in the medication room to be honest. It's so quite. That's a good spot where you are in there by yourself and that's important because you're doing medicine. That's my favorite part, is the medication room.

Nurse 4: You can actually try to chart a little bit in there because sometimes you can sit out in the hallway [decentralized nurse station] and it's like constant. But if you go in there it's like little things can wait, and you can

get something done, whereas if you're sitting out, those little things will keep being tagged on you.

The nurses' task performance is negatively affected by the amount of distractions which interfere with their concentration. The RNs recounted their attempts to control the noise levels by shutting patient doors or retreating into the medication room. The findings suggest that their working environment is best described as meeting the functional comfort category.

Thermal quality Each nursing work area, as well as each patient room, has a thermostat that controls the temperature of that space. The nurses expressed that the temperatures in the building are "great" and if they feel uncomfortable then the thermostats, or amount of clothing, can be adjusted. The nurses in Unit C seem to be experiencing the highest level on the environmental comfort continuum of psychological comfort, in terms of thermal conditions.

Spatial factors The nuances of workstation layout and ergonomics were the greatest concern for the nurses on Unit C. For instance, the nurses commented on the location of the patient nourishment supplies:

Nurse 5: In the cupboard where we have supplies like juices, drinks, cereal- the computer is below that cabinet which makes it really hard to access it.

Nurse 3: Yeah it should be in a separate area 'cause that's like right over the computers and everybody is on top of whoever is sitting there . . . like our cupboard space is right there so they have to reach over, like she said, and get under and you can hardly find the little key hole to unlock the cabinet.

Nurse 5: Yeah, it'd be good if they held the supplies at the back of the nurse station.

Nurse 3: Other units stock these in different places; we just need a locked cabinet.

Nurse 2: Yeah we have them put in the nurse station, not a nourishment room.

The inconvenient location and size of the computer in the medication room was also verbalized:

Nurse 1: I really wish we had a larger computer in there.

Nurse 2: You know what, I think if it was higher, because I found myself like hunched over.

Nurse 4: Yeah, somehow the placement of that computer is inconvenient to me. And I would like a larger screen.

Nurse 2: And higher up. Yeah. And I'm not that tall.

Nurse 2: Because the supply scanner is always falling. Like when you're on the computer you're always knocking it and hitting it.

The laptop computer in the medication room is sitting on a rolling cart (seen in Figure 3-16a) which places the computer at an uncomfortable height and position. Additionally, the nurses find the location of the nourishment supplies in the nurse station inconvenient. However, the nurses expressed satisfaction with many other factors of their work areas; for example, the furniture layout and size of the nurse station, and the amount of work and personal storage is highly rated by the nurses. Therefore, the nurses seem to be experiencing a level of functional comfort regarding the spatial factors of the work areas.

Privacy The level of perceived privacy was rated as one of two lowest conditions on the unit ($x = 3.33$). The nurses expressed that they are often distracted by nearby noise making it difficult to concentrate on a task. However, the nurses appreciate being able to work in an enclosed medication area with minimal distractions in addition to having personal territory provided through decentralized nurse stations. According to the environmental comfort theory the nurses seem to perceive functional comfort in their work areas.

Summary of Unit C When viewing the survey results in conjunction with the focus group discussion, it appears that the nurses on Unit C are more comfortable with the lighting and thermal qualities of their unit than with the noise level and privacy. Therefore, the work environment has two perceived comfort levels: psychological and functional. The noise on the unit is distracting to the nurses, particularly when they frequently hear one another's personal conversations. However, the conditions causing the most adverse effect on comfort were related to the spatial factors (functional comfort level), which becomes quite problematic in the medication room as the nurses access the space multiple times a day.

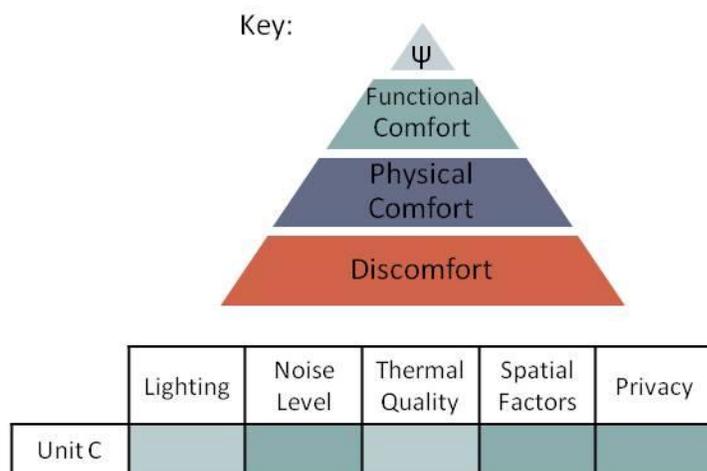


Figure 4-3. The perceived environmental comfort levels of Unit C.

Unit D

The graphs in Figure 4-5 through Figure 4-9 illustrate the mean values of the responses regarding the five environmental conditions on Unit D. The survey results showed that the nurses perceive the environmental factors quite positively, with 4 of the 5 factors ranking above a $\bar{x} = 4.0$. The lowest ranked dimension is thermal quality with a mean value of $\bar{x} = 3.83$ and the highest ranked dimension is spatial factors with a

mean value of $\bar{x} = 4.89$. This suggests that the nurses are experiencing comfort and support in multiple dimensions of their workplace. Table 4-4 shows the mean and standard deviation scores for each of the five categories of questions from the modified DiConFon survey regarding the work environment in Unit D.

Table 4-4. Assessment of environmental factors – Unit D (n=3).

Comfort category	Environmental items rated by occupants	Mean	SD
Lighting quality	Overall lighting	4.33	0.58
	High light levels	4.67	0.58
	Low light levels	4.33	0.58
	Light reflections on surfaces or screens	3.67	1.53
	Access to daylight	4.67	0.58
Noise level	General noise distractions	4.33	0.58
	Noises from voices	4.00	1.00
	Noises from equipment	4.33	0.58
Thermal quality	Temperature comfort	4.67	0.58
	General temperature	3.33	0.58
	Temperature shifts	2.33	1.15
	Ventilation comfort	4.00	0.00
	Air freshness	4.00	1.00
	Odors	4.67	0.58
Spatial factors	Furniture layout of nurse station	4.67	0.58
	Size of nurse station	4.67	0.58
	Nurse station work surfaces	5.00	0.00
	Computer configuration	5.00	0.00
	Personal storage space	5.00	0.00
	Work storage space	5.00	0.00
Privacy	Visual privacy	4.67	0.58
	Conversation privacy	4.17	1.33
	Telephone privacy	4.00	1.00

Lighting The sample of nurses in Unit D are experiencing the highest level on the environmental comfort continuum, the psychological comfort level, in terms of lighting (i.e., $\bar{x} = 4.33$ for the overall lighting comfort). The medication room, nurse station, and decentralized nurse stations are supplied with task lights that can be adjusted based on the nurses' needs. Similar to Unit C, the nurses expressed satisfaction with both the levels of artificial light and natural light on the unit. According

to one nurse, the natural light is “the best part about the hospital,” and her colleagues in the focus group agreed with her observation.

Noise level During the focus group discussion it was apparent that the noise level on the unit was a concern for the nurses:

Nurse 1: There’s not really a private area here because you can hear everything that people are saying.

Nurse 2: Yeah. Even from in here [the break room] you can hear people talking out there.

Nurse 1: Yeah. It’s very . . . [trails off] . . . You can hear it clearly!

According to the survey results, the greatest source of unwanted noise on the unit comes from voices. Conversations are easily overheard which lends itself to HIPAA violations if patient cases are being discussed within earshot of others. The researcher noted during observations that she could hear conversations at the centralized nurse station from various other parts of the unit. The nurses mentioned during the focus groups that they “don’t realize how loud they get” because everyone is trying to have their own conversations. Functionally, nurses are trying to concentrate on a task but their attention is distracted by adjacent noises. According to the environmental comfort theory, these types of experiences are indicative of a functional comfort level which does not support optimal work environments.

Thermal quality The thermal quality is the lowest ranked environmental condition in Unit D at a mean value of $\bar{x} = 3.93$, but that still indicates good performance. Nonetheless, the nurses participating in the focus group seem fairly content with the thermal control and quality of the unit:

Nurse 1: The temperature we can pretty much adjust it; it doesn’t seem to be a big issue.

Nurse 2: Yeah there is a thermostat in the med room, one in the supply room, and two in the hallways near the nurse station that we can change whenever we want.

Similar to Unit C, each nursing work area has a thermostat that controls the temperature of that space. The nurses expressed contentment with the temperatures in the building and if they feel uncomfortable then the thermostats, or amount of clothing, could be adjusted.

Spatial factors The unit's spatial factors seemed to have both positive and negative features. In general, nurses were satisfied with the hybrid design of the centralized and decentralized nurse stations. The decentralized nurse stations provide greater visibility and accessibility to the patient rooms, and at the same time the decentralization provides reduced interruptions from coworkers and seemed effective in diminishing noise disruptions that normally occur in a typical centralized nurse station. On the other hand, the size of the medication room seemed less than ideal from the perspective of a few nurses. The amount of counter space was perceived as insufficient and physical computer access is inconvenient. During the observation period, the researcher noted a sign posted near the computer station with a word of caution: "Door will hit you! Danger! Stand beyond this tape!" Obviously this suggests previous mishaps.

Privacy The perception of privacy on Unit D varies depending on the work area. For example, the medication room and supply room provide a supportive amount of visual privacy:

Nurse 1: I seem to like the medication area to be in a separate locked area because I don't get as many interruptions. I like it.

Nurse 2: Or like patients - they're not able to just stand there and watch what you're doing. I like the privacy. And it feels more secure and safe.

Nurse 1: The phone can still ring, however you can put it on hold or whatever, but yeah definitely if you're standing in the hall there's going to be different people stopping you, asking you different things, but in there you're closed off.

The enclosed medication area offers a place for the nurses to prepare medical supplies with limited distractions. However, the nurses appeared less satisfied with the privacy in the nurse station, as well as other areas throughout the unit, such as the patient rooms and hallway work stations. As discussed above, the conversation and telephone privacy was a concern for the nurses because they frequently overheard each other's conversations. The nurses mentioned in the focus group that this poses a confidentiality concern to staff and patients. Therefore, given that the nurses have the ability to retreat into the medication room for increased privacy, the environmental comfort level is best categorized as functional comfort.

Summary of Unit D The results from the questionnaires and focus groups show similarities between the perceived environmental comfort in Unit C and Unit D.

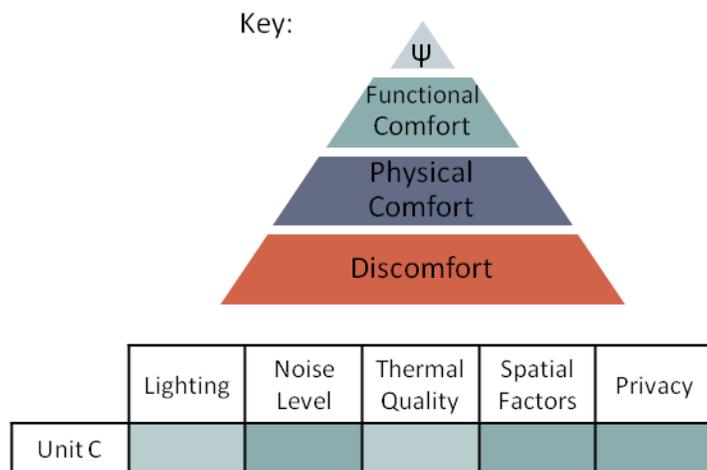


Figure 4-4. The perceived environmental comfort levels of Unit D.

The nurses on Unit D are more comfortable with the lighting (psychological comfort level) and thermal qualities (psychological comfort level) than with the noise

level (functional comfort level) and the privacy (functional comfort level). The noise on the unit is distracting to the nurses and they often lack the ability to have a private conversation. However, the conditions causing the most adverse effect on the user’s comfort were related to spatial factors (functional comfort level), again, particularly in regards to the medication room.

Research Question Two

How important are the design considerations of lighting, noise levels, thermal quality, spatial factors, and privacy in relation to perceived environmental comfort?

This question inquires about the significance of the conditions posed in the environmental comfort theory. The study found that each of the five environmental conditions are determined to be important to the nurses’ environmental comfort. This was established in two ways: (1) through the literature review, which compiled existing research on the importance of the conditions, and (2) the study participants’ environmental comfort appears to be impacted by the conditions posed in the theory.

Lighting	Noise Level	Thermal Quality	Spatial Factors	Privacy
<ul style="list-style-type: none"> • Supportive • Unsupportive 	<ul style="list-style-type: none"> • Unsupportive 	<ul style="list-style-type: none"> • Supportive • Unsupportive 	<ul style="list-style-type: none"> • Supportive • Unsupportive 	<ul style="list-style-type: none"> • Unsupportive

Figure 4-5. Supportive and unsupportive environmental features.

Figure 4-5 displays which conditions were found to be supportive of the nurses’ tasks, and which were found to be barriers to the nurses’ tasks – and in three cases there were instances of both supportive and unsupportive features.

Research Question Three

What other design considerations impact the perceived environmental comfort?

The third question offers the opportunity to evaluate which other design considerations, if any, impact the nurses' perceived environmental comfort beyond the lighting, noise level, thermal quality, spatial factors, or privacy dimensions of the environmental comfort model.

During the observations, focus group discussions, and open ended survey results, the general census was that the proximity of the nurse work areas in relation to each other and in relation to the patient rooms was critical to nurse operation. While the proximity of work areas to patient rooms is not addressed in the environmental comfort theory, it seems to be an important factor in determining environmental comfort. The importance of this topic was revealed by the nurses' dialog across the four focus groups. The nurses in Unit A and Unit B expressed that the medications and supplies should be located closer to each other. Similarly, the nurses in Unit C and Unit D articulated that the supply room is in an inconvenient location causing additional walking.

In Unit A the locations of the supply room and the medication dispensing area (Omniceil) are inconvenient relative to the patients' rooms:

Nurse 3: I don't like how far the Omnicell is when you have [patient] rooms 1 through . . . [trails off] . . . how far you've got to walk down there to get your meds. I mean you're back and forth, back and forth.

Nurse 1: I think the frustrating part is that now all three Omnicells are basically in the back of the unit. All your supplies are in the front and all your Ominicells are in the back.

Nurse 2: Yeah, so you either have easy access to the meds and bad access to the supplies or the other way around.

Nurse 3: It's a good way of getting exercise. I always lose a couple pounds on my work week!

While one nurse mentions in jest the exercise benefits to retrieving supplies, the inconvenient location of items ultimately slows down the work processes and can consume too much of the nurses' time; ultimately productivity. The RNs from Unit B share their frustration with a nearly identical situation:

Nurse 1: You have to pull your meds from the Omnicell and then come down here to the supply room and get your IV tubing and then go find somewhere else to set it up.

The nurses explain that the medication dispensing areas on Unit A and Unit B do not house the medical items necessary for administering an intravenous drip feed (IV). On Unit A the IV supplies are located in a separate room across from the nurses' station, and on Unit B they are located in the supply room. This is an inconvenience because the nurses must take two trips - one to the Omnicell that stores the IV medication, and then another trip to an Omnicell that stores the IV bag and tubing. The nurses on Unit C and Unit D also share a similar concern:

Nurse 1: I feel as though some areas could be changed slightly to make the workflow easier for the nursing staff. In terms of workflow I'd like to see some supplies centralized a little bit better because we end up going from the clean holding [supply room] over to the med room because some of the lab supplies are in clean holding [supply room] but not in the medication room.

Likewise, a Unit D nurse expressed that the location of the supply room is not central on the unit and is very inconvenient. Patient rooms at the extreme ends of Units A and B measured 87 linear feet from the nurse station in one direction and 105 linear feet in the other; Patient rooms at the extreme ends of Units C and D measured 45 linear feet from the nurse station in one direction and 145 linear feet in the other. Additionally, a walk from the most remote patient room to the supply room was around 115 linear feet in

Units C and D vs. 135 linear feet in Units A and B. Therefore, the nurses' in both hospitals are expending time and energy to gather supplies due to the poorly situated medication area and supply room.

Studies show that the layout of a nursing unit has a direct impact on nurse productivity and fatigue levels (Carayon, Alvarado, & Hundt, 2003; Ulrich, 2006). Walking has been identified as a major time consumer for nurses who walk an average of 3 miles during a ten hour shift (Hendrich et al., 2008); Thoughtful design helps decrease nurses' fatigue by reducing the amount of walking distance on the job. Although this condition is not addressed in the environmental comfort theory, the configuration of a workplace, in this case, specifically the locations of the nurse station, medication dispensing area, and supply room, is an important design consideration that impacts the nurses' perceived environmental comfort and physical fatigue.

Research Question Four

How do the nurses' perceptions of their environmental comfort level compare between the two hospital settings?

The fourth question compares the nurses' perceptions in the two hospitals under study: the North Tower (containing Unit A and Unit B), and the South Tower (containing Unit C and Unit D). The perceptions of the nurse work areas were compared within and among the facilities regarding the five key dimensions: noise level, lighting, temperature and air quality, spatial comfort, and privacy. These comparisons of comfort levels across sample groups are presented in Table 4-5 through Table 4-10.

Lighting The results in Table 4-5 show comparable ratings of the lighting among the four units for all the physical dimensions except for one. A considerable difference was found in the access to daylight score between the four groups. The nurses in the

South Tower (Units C and D) view their access to daylight as better than the staff in the North Tower (Units A and B). Additionally, the nurses on Unit A rated the access to daylight more highly than the nurses in Unit B. This is noteworthy because the nurses on Unit A have slightly more access to daylight than do their Unit B counterparts. The break room in Unit A contains a window, while all the staff spaces in Unit B are windowless; suggesting that access to even one window can improve the nurses' perception of daylight adequacy.

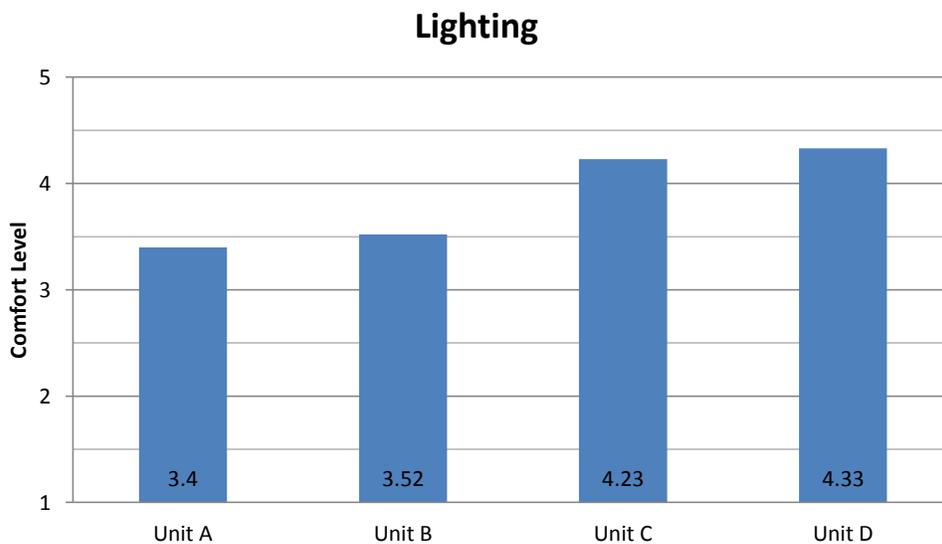


Figure 4-5. Unit comparison: lighting.

Noise level The data implies a perceived difference in the noise level between the four groups. The general noise distractions of Unit A were rated as most problematic across the units (see Table 4-6).

As seen in Table 4-7, the nurses in Unit A experience noises from voices and the noises from equipment as noisier than the other units' ratings. The bar graph in Figure 4-6 displays the mean values of the survey responses regarding noise level.

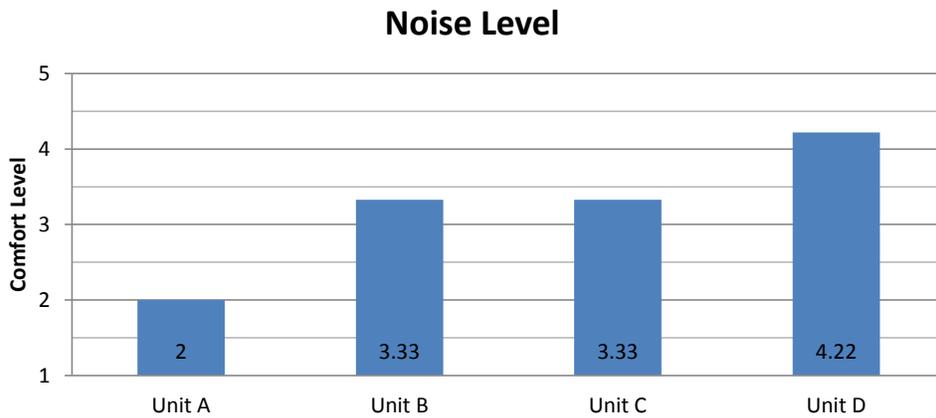


Figure 4-6. Unit comparison: noise level.

Thermal quality A difference surfaced in the temperature comfort ratings between the four groups. Unit B rated the temperature as warmer and more uncomfortable than the other units (see Table 4-8). This is due to the unit's malfunctioning air-conditioning system revealed in the focus group discussion.

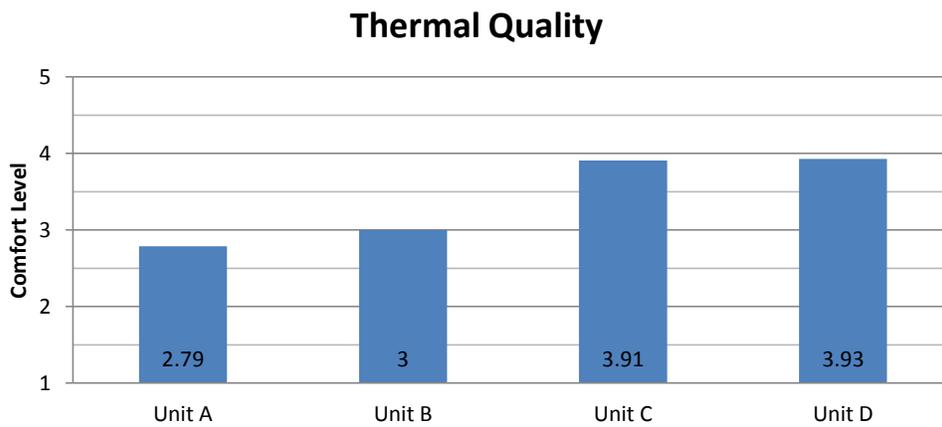


Figure 4-7. Unit comparison: thermal quality.

Spatial factors The results in Table 4-9 showed different perceptions of the spatial factors across the four units for all the physical dimensions. The nurses in the

South Tower (Units C and D) view the furniture layout and size of their nurse station as more comfortable than the other two units. Units C and D rate the nurse station work surfaces, storage for personal effects, as well as work storage as more adequate when compared to the staff in the North Tower (Units A and B).

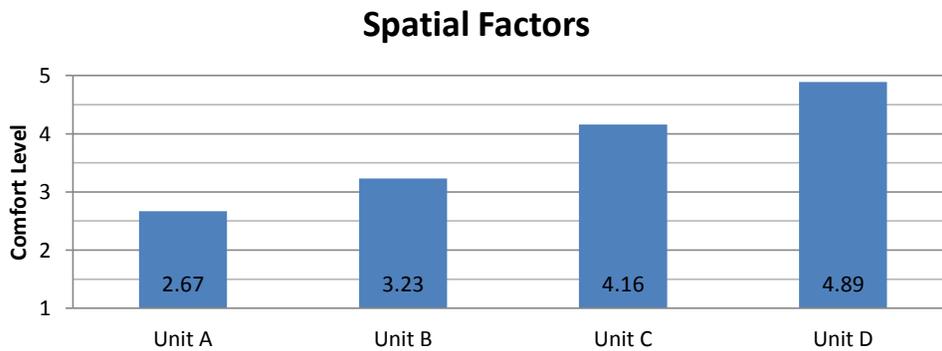


Figure 4-8. Unit comparison: spatial factors.

Privacy The privacy ratings were compared among nurses from the four units under study. The results in Table 4-10 identified comparable ratings on the three privacy factors: visual privacy, conversation privacy, and telephone privacy.

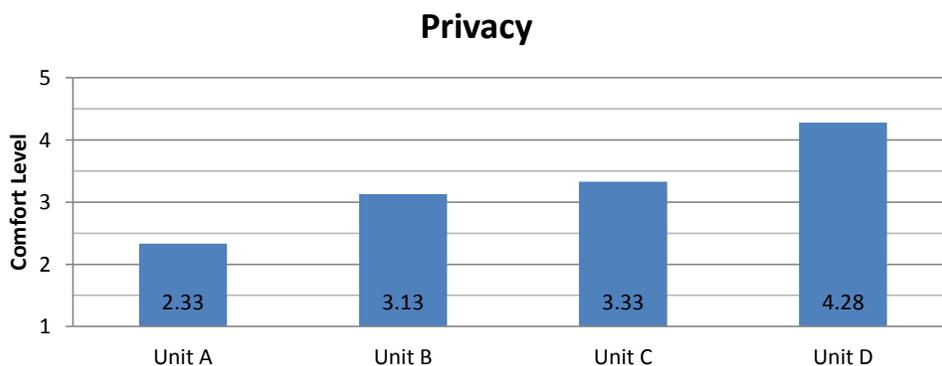


Figure 4-9. Unit comparison: privacy.

	Lighting	Noise Level	Thermal Qualities	Spatial Factors	Privacy
Unit A	Light Blue	Dark Blue	Light Blue	Red	Dark Blue
Unit B	Dark Blue	Light Blue	Dark Blue	Red	Light Blue
Unit C	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
Unit D	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue

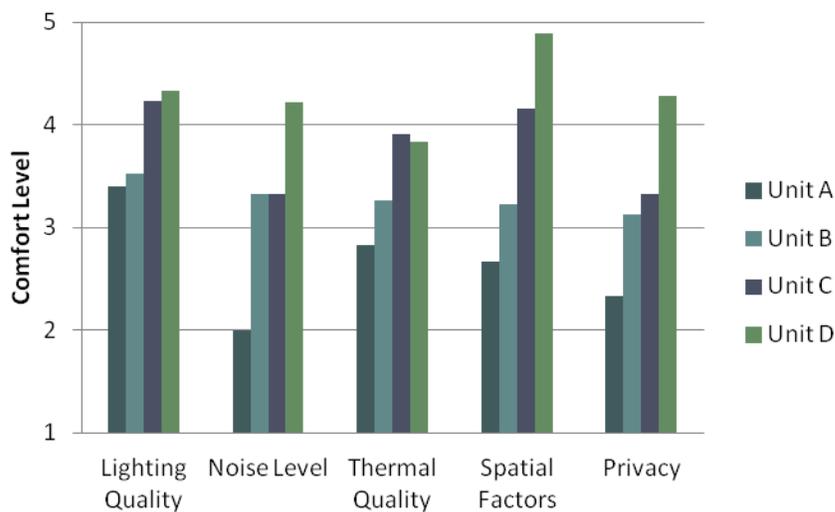
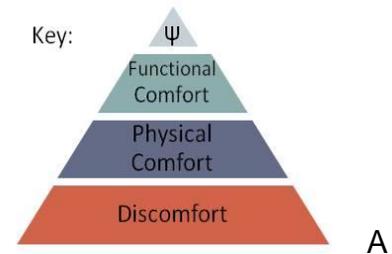


Figure 4-10. Unit comparison. A) Nurses' perceived environmental comfort levels. B) Bar graph illustrating mean values of the five environmental conditions.

Research Question Five

How do the nurses' recommendations for improvements to their work areas relate to physical, functional, and/or psychological dimensions of perceived environmental comfort?

During the focus groups the participants made recommendations for improvements to their work areas. Their responses address the final research question of this study and frame the overall recommendations from the findings. The implications of the results address the three categories of environmental comfort: physical, functional, and psychological.

Unit A

The nurses on Unit A unanimously recommend that decentralized nurse stations be added outside the patient rooms to provide an area to sit and chart near their patients. The nurses explain:

Nurse 1: I think that is the whole key thing- if you have a nice comfortable area where you can sit by your patients that would be perfect.

Nurse 2: Kind of like they have [in the South Tower]. They've got the little cubbies in the hallway with the stools where they have storage space with computers. And you can make a nice visual [eye contact] on the patient. They're secluded and they have drawers.

Implementing this recommendation would improve the environmental comfort level threefold: (1) the spatial factors could improve by decreasing crowding in the nurse station, increasing the nurses' amount of storage, and the number of seating areas; (2) the noise levels could decrease through the decentralizing of the nurse station; (3) the nurses would gain greater privacy (personal territory). The addition of decentralized nurse stations also would increase the visibility to the patients' rooms, and create closer proximity to their patients. The first and most important design recommendation would be to design decentralized nurse stations rather than allowing work areas to form organically in the hallways as an afterthought.

Unit B

The nurses on Unit B overwhelmingly agree that additional task chairs were desperately needed on the unit. The lack of seating was quite problematic and one nurse voiced that "they are in dire need of some new office chairs." They also recommend that future nurse stations be designed with wider aisles than the current nurse station. The nurses' dialog refers to the issue:

Nurse 3: On the back side [of the nurse station], it's just too crowded. On the other side where people are trying to sit, where there is the [storage unit], there is the crash cart, and there is where we used to keep our sodas and stuff, and people are trying to get through there all the time especially with a COW. It just ain't happening.

Nurse 2: By the cabinets. Yeah, right by the charge nurse's desk. The aisles all need to be twice as wide.

Nurse 3: From 7 to about 10 o'clock all the doctors, nurses, residents, everybody is in there so it's just slammed full. It's pretty much full all day, and it's just crazy.

The size of the nurse station is not large enough to meet the needs of all the staff members, and they also would prefer more seating options. Investments to improve the physical comfort, such as providing additional task chairs, are fully worth making because without physical comfort people cannot or will not perform their work there, at least, not well (Vischer, 2005). The addition of task chairs would make it easier on the nurses to perform their tasks.

It was noted that the nurses have strong opinions regarding the spatial layout, etc. of their work areas. For example, both the medication dispensing area and supply room lack work surfaces. The nurses often use the patient's bedside table to prep their antibiotics and IV bags, or arrange their medical supplies, which is not its intended use.

The nurses recommend adding more work surfaces:

Nurse 1: There is no counter space in the supply room. None. If you've got, like I said, antibiotics and IV bags it'd be a nice place to get stuff ready to go. Like if you have a new patient and they're going to be on fluids or something then it'd be nice to have a place to spike your bag and prime it and get it ready so you can just walk in the room and get things going.

Nurse 2: It'd be nice because right now we have to set it up outside. That was the one thing that I liked in the South Tower about the counter space. That was the only time I used it but it was nice when you have it all set up and everything you need is right there. We have to use the little bedside table in the room to do anything, which is cluttered up with a lot of the patients stuff.

The staff prefers multiple work surfaces throughout the unit. It was pointed out that additional counter space would save travel time and reduce potential for errors, as the nurses walk back and forth several times between the medication room and patient rooms. Discomfort would be eased if additional work surfaces were added in the medication dispensing area and supply room.

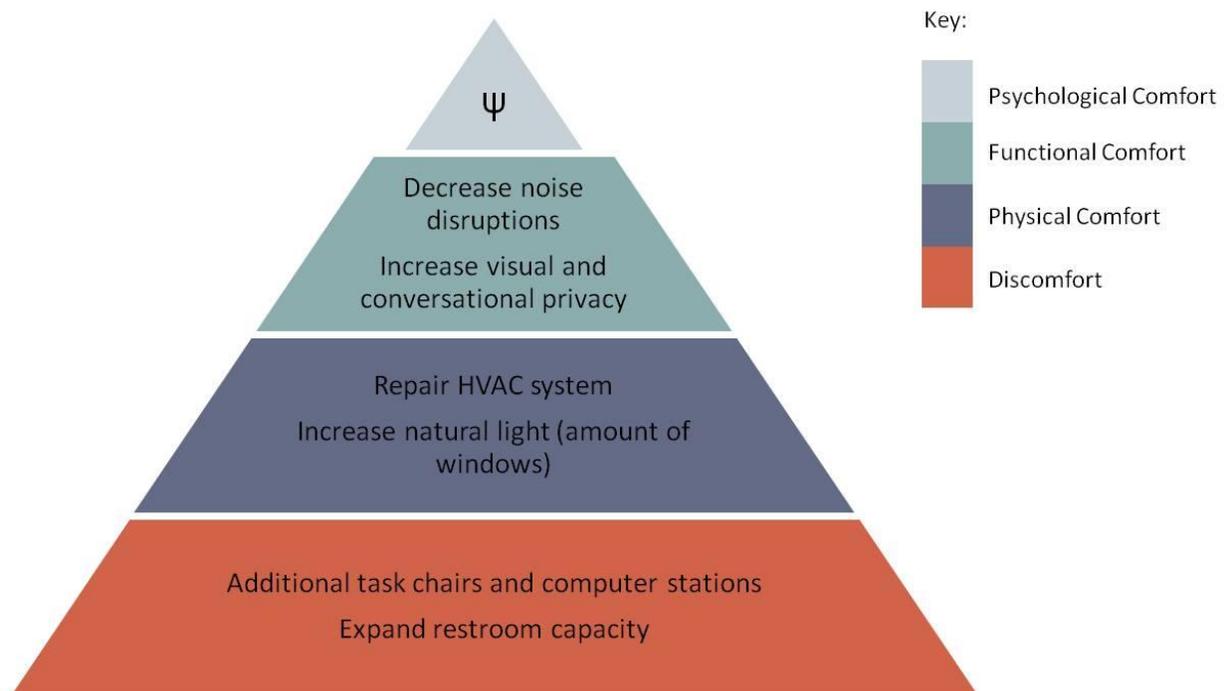


Figure 4-11. Nurses' recommendations for improvements to their work areas.

Unit C

As discussed in research question one, the nurses on Unit C suggest that the nourishment supplies be moved to a more convenient location. Currently these supplies are located in upper cabinets of the nurse station making access difficult when staff members are sitting at the workstation below. The lock on the cabinet is inconvenient to open, and the nurses constantly have to reach over other employees to retrieve the

supplies. The RNs prefer the nourishment supplies to be in a locked cabinet in the nourishment room, or to be in the back area of the nurse station that is less inhabited, to diminish the interruptions in the nurse station.

Additionally, the computer configuration in the medication room was a concern for the nurses. The laptop computer is placed on a mobile cart that is ergonomically uncomfortable. The nurses frequently find themselves hunched over the computer, and they recommend a larger screen with an adjustable arm to enable modifying the height and angle of the screen. In the computer's current location the nurses find themselves unintentionally knocking the hand-held supply scanner out of the holster. The nurses would prefer a more supportive arrangement that would reduce fatigue and inefficiencies.

The general consensus was that the counter space in the medication room is insufficient. During the 9AM medication rounds multiple nurses needed access to the medication room at one time and they are struggling to use the allotted amount of prep space. The comfort of the nurses would increase if the medication room was large enough to support small groups of nurses at once rather than 1-2 at a time.

Unit D

The nurses overwhelmingly recommend additional space in the medication room of Unit D. The nurses are having the same issue as the RNs in Unit C; they would like more horizontal surfaces to prep medications. The nurses in Unit D expressed that when there are multiple nurses in the medication room at one time there is not enough space for them to spread out comfortably. Also, the nurses explained that the refrigerator and computer are inconveniently located because when you are accessing these items you get "bopped by the door." When the pharmacy staff is refilling the

Omnicell there is not enough circulation space with the pharmacy cart in the room, discussed in the following comment:

Nurse 1: My only thing is that I guess you're not supposed to use the counter that's nearest to the sink to prepare things, so that doesn't give us much space on the opposite side but I don't know what can be done about that. Because there are many of us in there at the same time so we gotta spread out somewhere. We can't cluster up in that one little section there. We're supposed to prepare our meds there, not over here, I guess because of the splashing of the water . . . but generally everything is in a good position. I don't find any other problems. The refrigerator is in a bad place I guess, bending down you get bopped by the door.

Nurse 2: Yeah, or if pharmacy is replacing meds sometimes, with their cart in there it is pretty tight near the door area.

Nurse 3: In that general area [in the medicine room] it's not a good place to be.

The nurses' discomfort in the medication room could be eased through the addition of counter space. It is noteworthy that future medication rooms should be designed with more circulation space to accommodate medical carts and at least three staff members at a time.

Conclusion

This chapter assesses hospital workplace conditions through the theoretical lens of the environmental comfort model proposed by Jacqueline Vischer (2007). The framework ranks workplace environments in a rising continuum of physical, functional, and psychological comfort. Five research questions were posed and addressed to identify and compare the environmental comfort levels of hospital work areas among registered nurses. The nurses' completed the DiConFon survey (Vischer, 2010) and participated in focus group discussions inquiring of the environmental conditions of lighting, noise level, thermal quality, spatial factors, and privacy in relation to the nurse station, the medication dispensing area, and the supply room of their respective units.

This data, along with the focus group dialogs and the researcher's observations, was triangulated to answer the research questions. According to the results, the nurse work areas in Unit A and Unit B appear to be experiencing a lower level of environmental comfort than Unit C and Unit D. The spatial factors of the nurse work areas seem to be less than ideal from the perspective of the nurses on each unit under study.

Table 4-5. Comparison of nurses' perceptions of light quality.

Physical dimensions	Unit A (n=3)		Unit B (n=5)		Unit C (n=6)		Unit D (n=3)	
	Mean	S D						
Overall lighting (1- Uncomfortable; 5- Comfortable)	3.33	1.15	4.0	1.22	4.33	0.52	4.33	0.58
High light levels (1- Uncomfortable; 5- Not a problem)	3.67	1.15	4.4	0.55	4.50	0.55	4.67	0.58
Low light levels (1- Uncomfortable; 5- Not a problem)	3.67	1.15	3.6	1.52	4.00	0.63	4.33	0.58
Light reflections (1- Uncomfortable; 5- No glare)	3.33	0.58	4.0	1.22	4.00	0.63	3.67	1.53
Access to daylight (1- Inadequate; 5- Adequate)	3.00	2.00	1.6	0.55	4.33	0.52	4.67	0.58

Table 4-6. Comparison of nurses' perceptions of noise qualities.

	Unit A (n=3)		Unit B (n=5)		Unit C (n=6)		Unit D (n=3)	
Physical dimensions	Mean	S D						
General noise distractions (1- Too distracting; 5- Comfortable)	1.67	0.58	3.0	0.71	3.33	0.82	4.33	0.58

Table 4-7. Comparison of nurses' perceptions of noise qualities.

Physical dimensions	Unit A (n=3)		Unit B (n=5)		Unit C (n=6)		Unit D (n=3)	
	Mean	S D						
Specific noises from voices (1- Too noisy; 5- Comfortable)	2.34	1.15	3.2	0.45	3.00	1.10	4.00	1.00
Specific noises from equipment (1- Too noisy; 5- Comfortable)	2.00	1.00	3.8	0.45	3.33	0.82	4.33	0.58

Table 4-8. Comparison of nurses' perceptions of temperature and air quality.

Physical dimensions	Unit A (n=3)		Unit B (n=5)		Unit C (n=6)		Unit D (n=3)	
	Mean	S D	Mean	S D	Mean	S D	Mean	S D
Temperature comfort (1- Uncomfortable; 5- Comfortable)	3.0	0.0	1.8	0.84	4.16	0.75	4.67	0.58
General temperature (1- Too cold; 5- Too warm)	3.0	0.0	4.6	0.55	3.33	0.82	3.33	0.58

Table 4-9. Comparison of nurses' perceptions of spatial comfort.

Physical dimensions	Unit A (n=3)		Unit B (n=5)		Unit C (n=6)		Unit D (n=3)	
	Mean	S D						
Furniture layout of nurse station (1- Uncomfortable; 5- Comfortable)	2.33	0.58	3.4	0.89	4.17	0.75	4.67	0.58
Size of nurse station (1- Uncomfortable; 5- Comfortable)	3.33	1.15	3.2	1.30	4.60	0.52	4.67	0.58
Nurse station work surfaces (1- Inadequate; 5- Adequate)	2.67	1.15	2.6	1.34	4.33	0.82	5.0	0.00
Computer configuration-keyboard, screen, mouse, etc. (1- Uncomfortable; 5- Comfortable)	3.00	1.00	4.0	0.71	3.50	0.84	5.0	0.00
Storage for personal effects (1- Inadequate; 5- Adequate)	2.33	0.58	3.0	0.89	4.17	0.41	5.0	0.00
Work storage space (1- Inadequate; 5- Adequate)	2.33	0.58	3.2	1.48	4.17	0.75	5.0	0.00

Table 4-10. Comparison of nurses' perceptions of privacy.

Physical dimensions	Unit A (n=3)		Unit B (n=5)		Unit C (n=6)		Unit D (n=3)	
	Mean	S D						
Visual privacy in nurse station (1- Uncomfortable; 5- Comfortable)	2.33	0.58	3.0	1.58	3.17	1.47	4.67	0.58
Conversation privacy (1- Uncomfortable; 5- Comfortable)	2.33	0.58	3.4	1.52	3.50	0.84	4.17	1.33
Telephone privacy (1- Uncomfortable; 5- Comfortable)	2.33	0.58	3.0	1.22	3.33	0.82	4.00	1.00

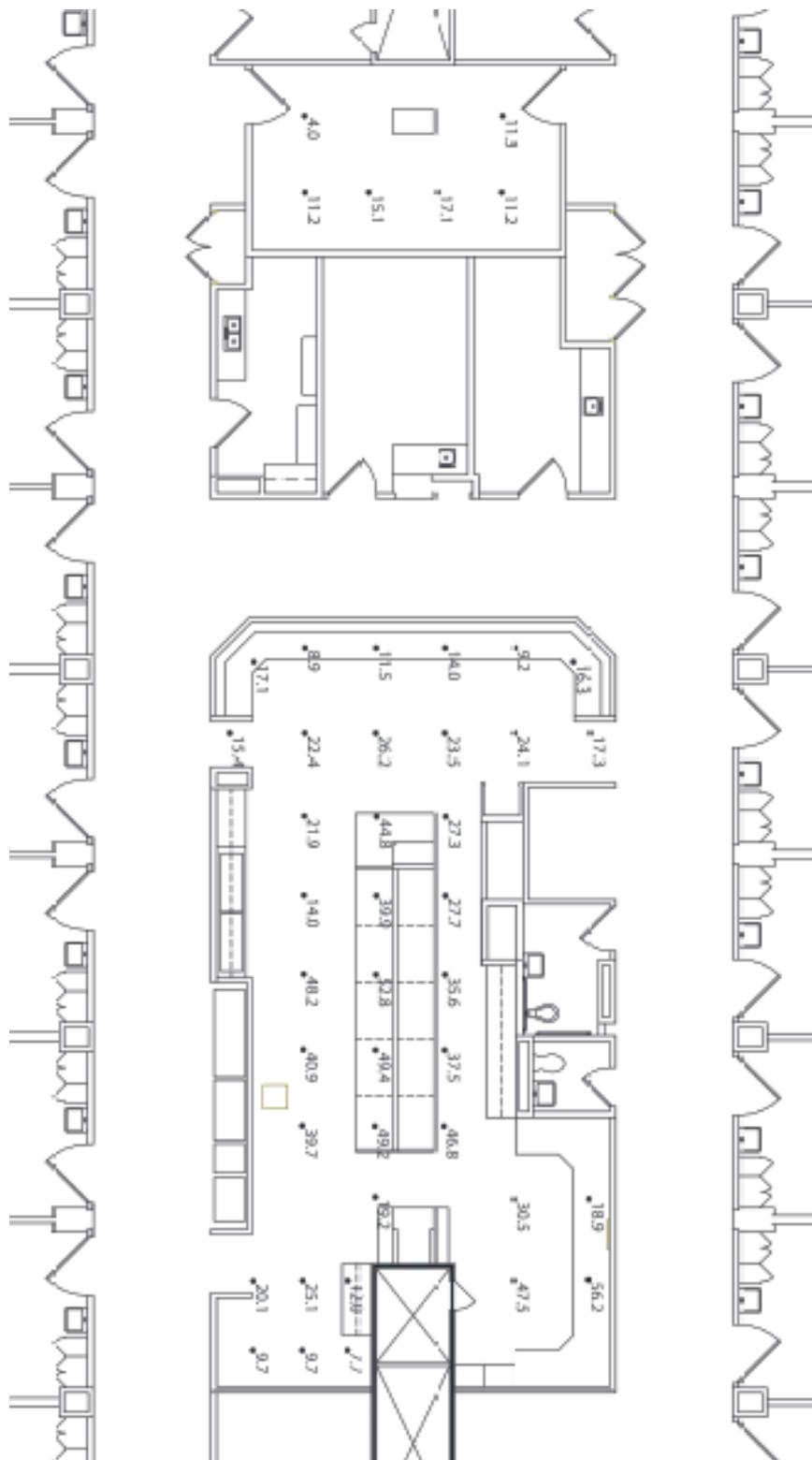


Figure 4-12. Unit A light measurements.

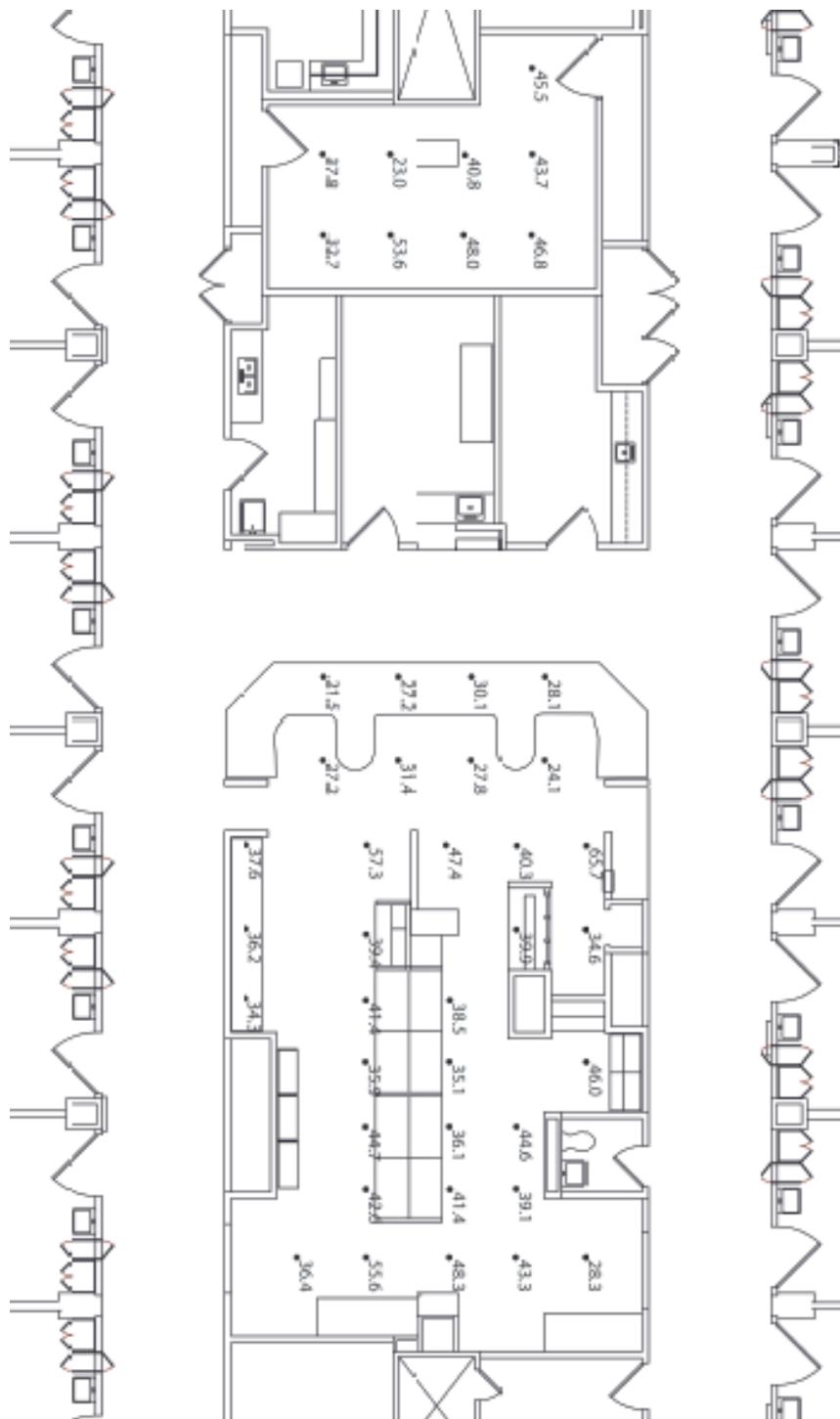


Figure 4-14. Unit B light measurements.

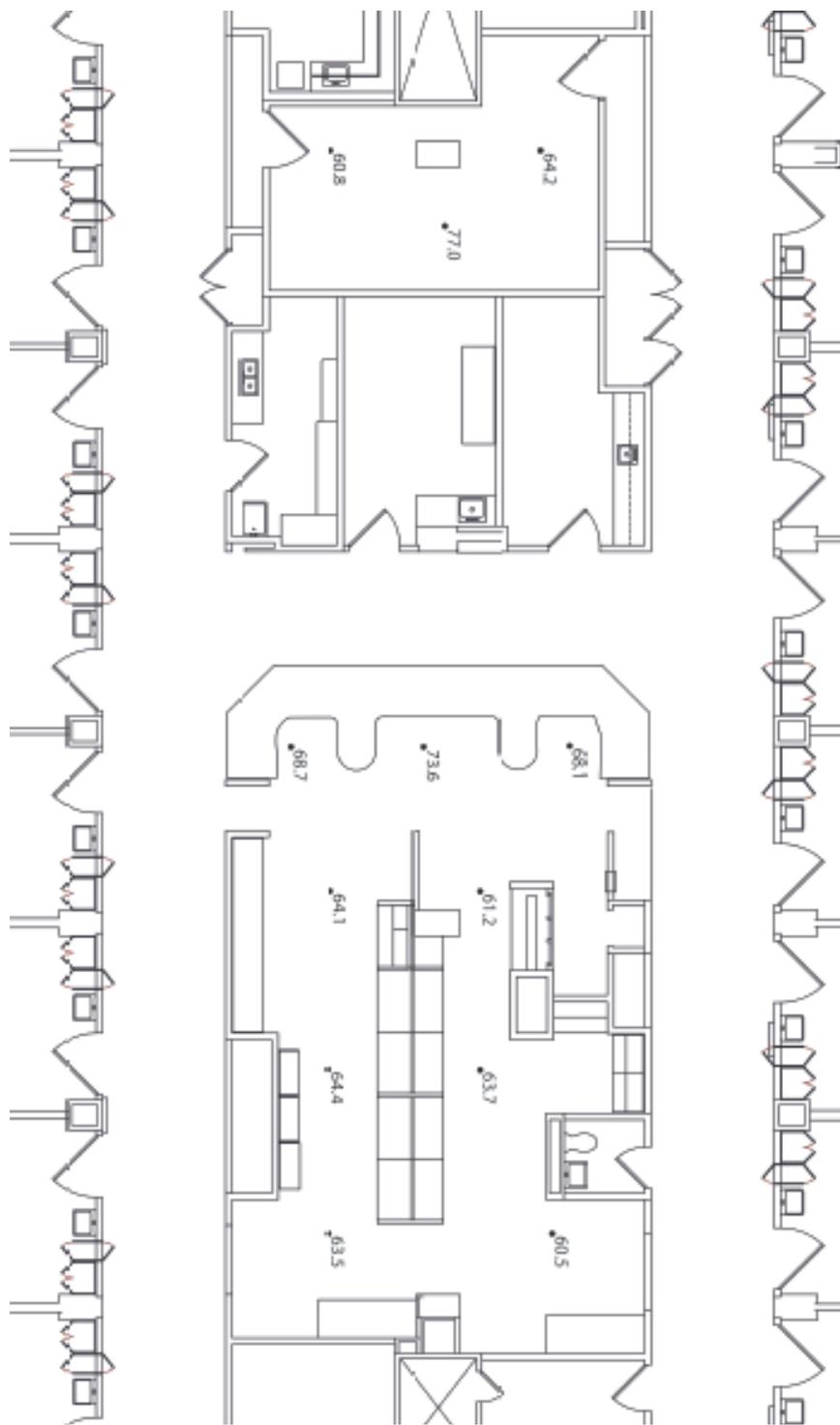


Figure 4-15. Unit B sound measurements.

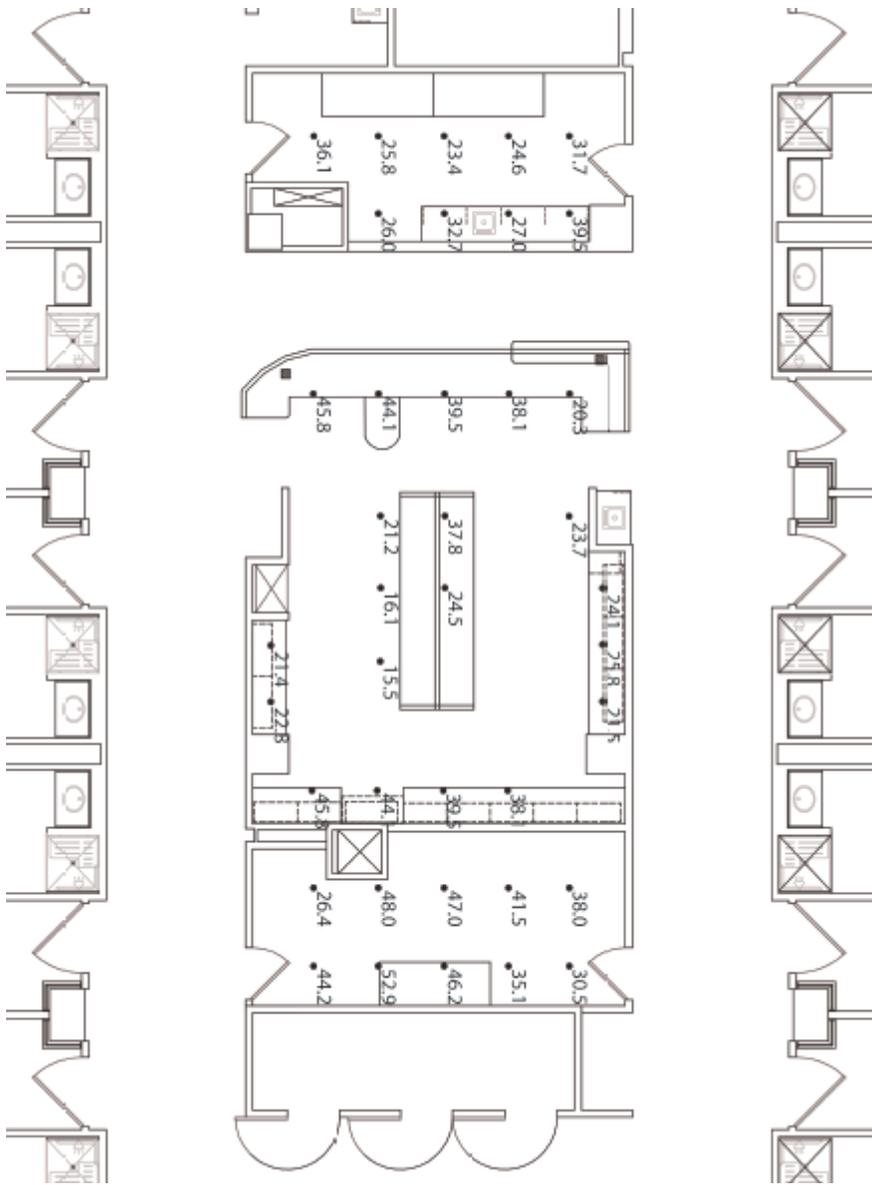


Figure 4-16. Unit C light measurements.

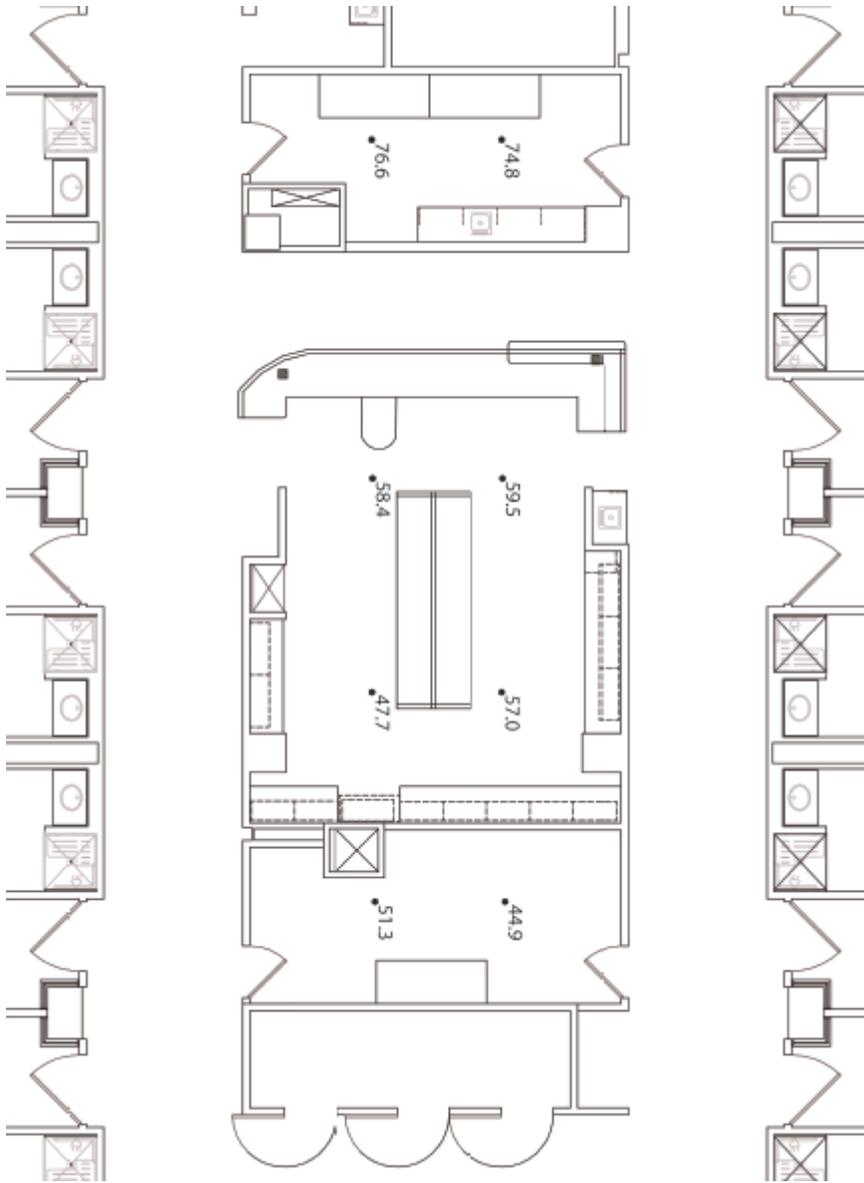


Figure 4-17. Unit C sound measurements.

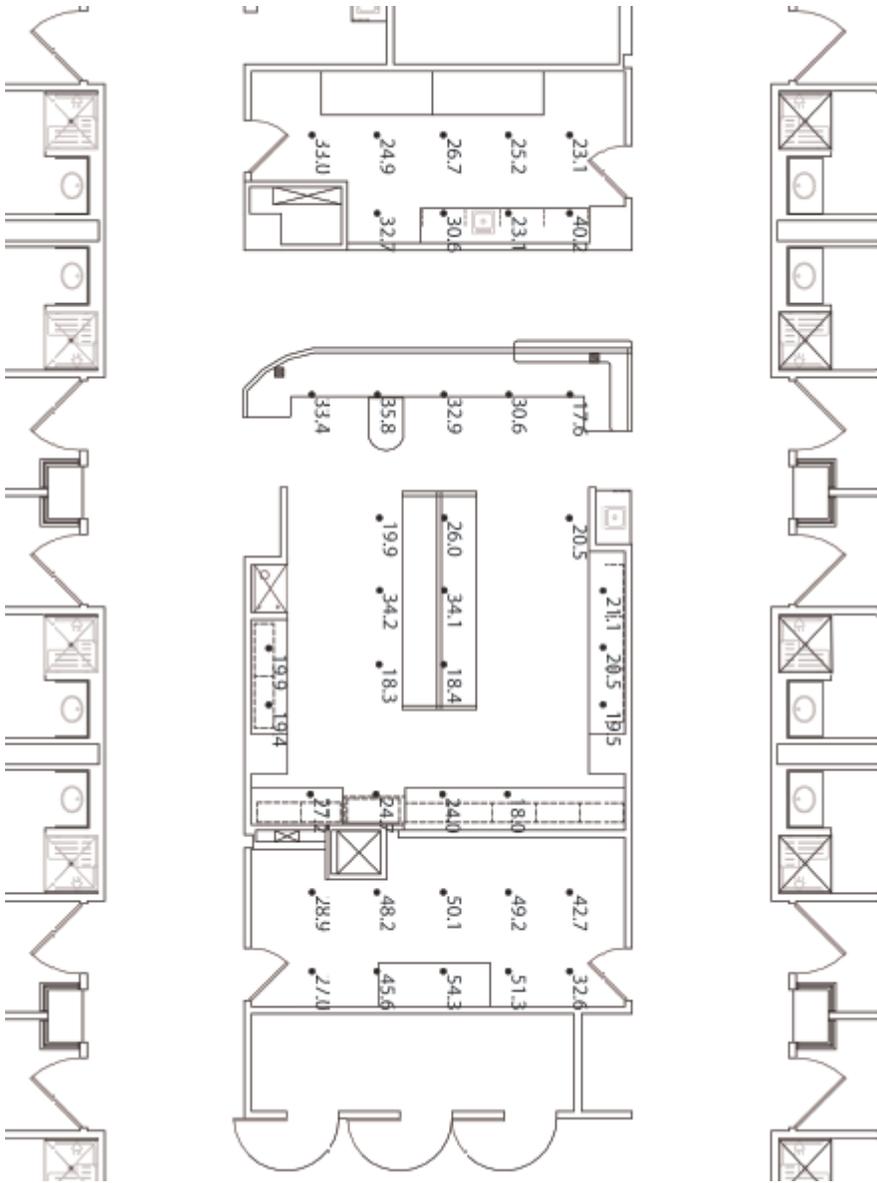


Figure 4-18. Unit D light measurements.

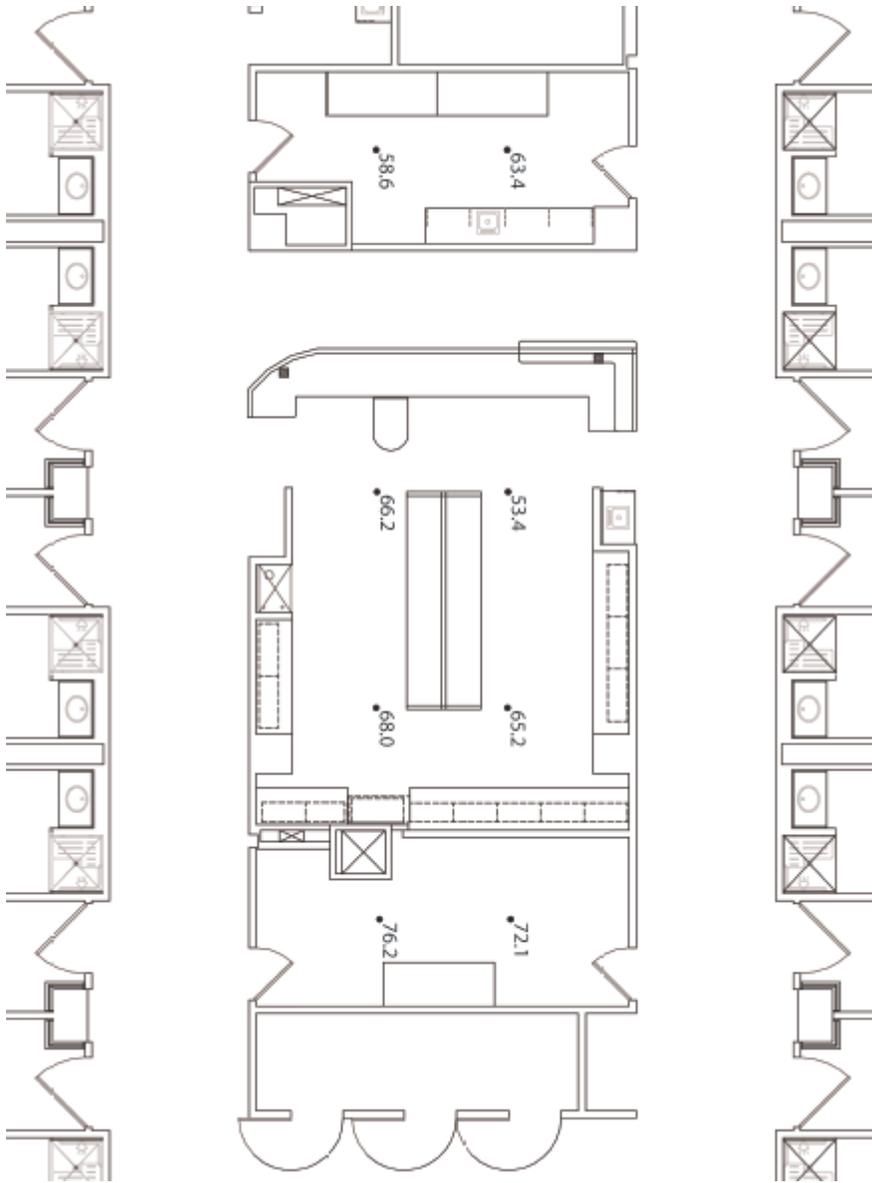


Figure 4-19. Unit D sound measurements.

CHAPTER 5 DISCUSSION

The purpose of this field study was to more thoroughly understand registered nurses' perceptions regarding how the interior environment in a healthcare facility contributes to their perceived performance. This study involved two hospital facilities referred to as the North Tower and South Tower and two medical/surgical units were selected from each hospital facility as the research settings. Three primary nurse work areas were under study from each unit: (1) the nurse station, (2) the medication dispensing area, and (3) the supply room. Jacqueline Vischer's model of environmental comfort (2007) provided a theoretical framework for examining how individuals perceive these work environments. This theory and research program investigating the impact of environmental conditions in the office workplace has been widely cited in the literature over the past twenty years. The repertoire of topics investigated by Vischer and her colleagues includes building evaluation, users' needs in buildings, indoor air quality, user-manager communication, facilities management, and architectural programming. A number of her peer-reviewed journal publications can be found in the *Journal of Environmental Psychology*, *Architectural Science Review*, *Building Research and Information*, and *Stress and Health*. While the majority of her research findings are applied to office space design and employee behavior (Jacqueline Vischer, personal communication, April 3, 2012), this study begins to bridge the gap into other work settings by applying the theory of environmental comfort to the healthcare work environment.

This study identifies and compared the environmental comfort levels among four nursing units by employing the DiConFon survey (Vischer, 2010), observations, and

focus group discussions. The elements of this model were researched by measuring the RNs perceptions of the lighting, noise level, thermal quality, spatial factors, and privacy pertaining to the primary nurse work areas. As a result these work areas were categorized based on which level of environmental comfort (physical, functional, or psychological) characterized them best.

The environmental comfort model ranks comfort in a rising continuum of physical, functional, and psychological comfort (Figure 1-1). At the base of the continuum is the category of physical comfort, which includes the nonnegotiable prerequisites for a habitable work environment such as enough light, no extreme temperatures of too hot or too cold, safe noise levels, and an adequate number of functioning toilets. The next category of environmental comfort is identified as functional comfort. According to Vischer, functional comfort “links users’ assessments of their environment to the requirements of the tasks they are performing (2008).” In other words, it poses the question: does the environment support work-related activities? Further, the ability to personally manipulate the environment, such as turn off a light, close a door for added privacy or adjust the temperature on the thermostat increases psychological comfort—the last level of environmental comfort.

To identify and compare the environmental comfort levels of hospital work areas among registered nurses, five research questions were addressed. The final step was to create narratives entitled “All in a Day’s Work” which tie all of the model’s factors together as a real-life example showing how lighting, thermal comfort, noise level, spatial factors, and privacy link together to determine which level of environmental comfort the RNs are perceiving. This study provides insight into the efficacy of the

nursing units as examined in this thesis research that can be used to plan future nurse work areas. The following section of the study employed narrative inquiry to delve even more deeply into the nurses' workspace experience.

Narrative Inquiry

“By definition, narrative inquiry is a qualitative method for questioning and analyzing information that has a form and protocol in a story (Dohr & Portillo, 2011, p. 29).” Narrative research is frequently used to carry out qualitative research and has recently gained popularity, particularly in nursing (Holloway & Freshwater, 2007). The contribution of the narrative approach to nursing and allied professions' knowledge and practice is reasonably well documented (Holloway & Freshwater, 2007); for example, see Jones, 1990; Younger, 1990; Darbyshire, 1995; Greenhalgh and Hurwitz, 1998; Charmaz, 1999; Aranda and Sreet, 2000; Hurwitz et al., 2004; Price, 2011. There are a number of applications and benefits of narratives in nursing research which are outlined by Frid and colleagues (2000):

The narrative creates an innovative imitation of something that previously occurred by imitating the practical action. However, the narration does not function as repetition – it creates a new reformulated description. The narrative is thereby able to cast new light on that which has previously been experienced as familiar (p. 697).

Additionally, “narrative inquiry holds much potential for interior design, where stories frame central issues and relationships between humans and places (Dohr & Portillo, 2011, p. 29).” Due to the increase in narrative research in both the fields of interior design and nursing, this method was selected to develop and analyze the study findings. It is worthy to acknowledge that sampling in narrative research can rely on a very small number of people as depth rather than breadth is sought. As Patton (2002, p. 245) states about all qualitative research: “The validity, meaningfulness and insights of

qualitative inquiry have more to do with the information richness of the cases selected and the observational/analytical capabilities of the researcher than with the sample size.”

The subsequent narratives fall into the category of *research narrative* because they were formed by collecting several types of information – focus group data, observations, and empirical findings. Research narratives are triangulated, whereby “multiple sources of data are gathered and compared for veracity”; they are verifiable, authoritative, and add to the body of knowledge (Dohr & Portillo, 2011, p. 44).

Orientation to Narrative

The following true life narratives are based on employees’ accounts of their experiences working at two Shands HealthCare hospitals: the North Tower (University of Florida Health Science Center) and the South Tower (Cancer Hospital at the University of Florida). Each story hypothetically follows two registered nurses working on a medical-surgical unit in their respective hospital as they perform their daily tasks. The narratives illustrate how the nurses function in the unit’s built environment as well as how they perceive the built environment affecting their comfort.

In the first narrative, entitled “All in a Day’s Work: North Tower” portrays a typical work day of two main characters: Carol, an experienced RN in her forties, who has worked at Shands for nine years, and Amber who is in her early twenties and just joined the Shands hospital system in Gainesville a few months earlier. The following story illustrates an eight hour shift on a medical unit at the University of Florida Health Science Center and gives insight into how the environment supports or inhibits productivity on a day to day basis.

All in a Day's Work: North Tower

To the untrained ear, the constant beeping, ringing, and buzzing accompanied by the sound of carts rolling through the corridors might seem a bit strange. To Carol, a seasoned nurse with about twenty-four years under her drawstrings, it's just a regular Tuesday afternoon.

Carol removes her glasses to rub her tired eyes. She hasn't taken a break in years. At least that's how she feels. Since she has arrived to the unit the night nurse gave her a report on each of the patients' conditions, then she attended an impromptu staff meeting, followed by a hurried session of passing out the first round of meds to her patients. Now she is carefully examining the long list of medications she'll be administering during the rest of her shift.

"This would be so much easier if I had a real chair, and a place to park my COW," Carol thinks out loud. Instead, she found a bedside table to sit on and claimed a spot in the corridor. As she's working you'll notice that she gets up about every ten minutes or so and rolls her shoulders forwards and then backwards. The poor thing looks terribly uncomfortable. Apparently that is why Amber, the nurse down the hall, brought her stool from home to sit on. It's nothing special- no casters to make it roll and no levers to adjust the height- just something better to perch on than a bedside table.

Of course the nurses are not supposed to be sitting in the corridor but there isn't enough space for everyone at the nurse station. The computers are usually being used by physicians, unit clerks, nursing students, and everyone is a bit tired of fighting for a seat. So, the next best option is to, well, chart at the COW in the hallway. The problem is patients and families see the nurses in the hall and think they are just twiddling their thumbs or doing something non-work related. They don't realize that they are doing important things so the nurses constantly get interrupted. A family member will ask where the nearest vending machine is. Management will pass along a message. Recovering patients will request a cup of ice. The interruptions are endless.

"Good afternoon, how are you feeling Mr. Stemm?" Carol cheerfully says as she walks into the room where a groggy-eyed patient welcomes her as cheerfully as possible, considering that he's still in pain from his surgery. "It's time for your blood pressure medication, okay? Here is a cup of water, and after you take your pills I need to listen to your heart."

He does his best to accommodate her requests, shifting his weight so she can listen to his heartbeat. "Everything is sounding great," she says with a

smile. "If you need anything feel free to call my phone or press this button right here on your bed."

It didn't take long for Carol to realize that Mr. Stemm was going to be her easiest patient to work with today. He's very accommodating, and doesn't abuse the 'call whenever you need something' offer. Mrs. Anderson on the other hand is a different story. She's an older woman who doesn't blink an eye at calling for the smallest of matters. As a matter of fact, Carol's answering one of her phone calls right now.

"Hello, this is Carol. Oh, hi Mrs. Anderson. No, of course I haven't forgotten about you! I'm bringing your extra pillow right now. Yes, I will come as quickly as possible. Yes, I do realize you've been waiting on me. Alright I'll see you in just a second."

Amber overhears Carol's phone conversation and laughs. "Don't you wish you could throw that phone out the window sometimes?" she says jokingly. "What window?" Carol says. "There aren't any in a miles radius!"

Knock, knock. "Mrs. Anderson? Wow! You have a lot of family visiting you! I have your extra pillow right here. Is there anything else I can get you? Sure, I will be right back with some apple juice. Enjoy your time with your family."

Carol heads for the nourishment room and feels herself break into a light perspiration. Becoming flushed hampers the professional image she works so hard to maintain. Quickly stopping to adjust the thermostat, a facilities maintenance man interrupts her, "I'm sorry to say that we've been working on the staff thermostat, but without doing a complete overhaul there is only so much we can do in an old building like this."

Just then, their attention is caught by a nursing student across the hall fanning herself with a bright pink notebook. "Well, as you can see, it's really an issue trying to work up here when everyone is sweating all day," Carol says.

"Yes ma'am I understand. The whole thing needs to be replaced, and unfortunately there is no telling when I will get the 'O.K.' to do something that extensive. But, as soon as the opportunity arises I'll be back."

That certainly isn't the first time I've heard that, Carol thinks to herself. She hurries off to retrieve the apple juice hoping to avoid another phone call from Mrs. Anderson.

Amber glanced up at the clock. It is 3:45 PM and she is behind on her duties for the day. She begins to retrieve Mr. Rowe's medication from the Omnicell when all of a sudden she hears, "Hey! I've been looking for you all over this place!" Amber looks over her shoulder to find Mr. Rowe standing five feet away in his hospital gown.

"Mr. Rowe, I'm dispensing medication right now. Actually, I'm dispensing your medication right now, and I need to concentrate. I will come by your room when I'm done." She proceeds to select the medication, and then the dosage when once again she can sense someone standing over her shoulder. She looks over expecting to still see Mr. Rowe, but it's the environmental services worker with her cart.

"Oh excuse me, I'll get out of your way!" Amber says. The woman thanks her, maneuvering the cart into the nurse station by making a three point turn.

Finally Amber opens the drawer of the Omnicell and gets the medication.

Eight hours later, with the end of her shift in sight, Amber gives report to the night nurse and retrieves her belongings from the locker. She stops at the restroom on the way out only to find it occupied. No surprise there since the entire staff of about 20 people share one toilet, which is frequently messy.

Carol walks by speaking a word of advice, "You know you're probably better off heading to the restroom in the lobby." Agreeing, Amber turns toward the elevator.

As she's waiting she reflects on her day's work. As tough as her job is, she goes home nearly every day feeling a sense of satisfaction for helping others. This fulfillment is priceless.

Interpretation

The narrative "All in a Day's Work: North Tower" illustrates the built environment at Shands Health Science Center, following two employees as they perform their daily tasks necessary to care for their patients. The two main characters in the story are Carol, an older more experienced RN, and Amber, a young relatively new nurse on the unit. Yet despite the differences in age and job level, both employees participate in the same activities, including administering medication and responding to various patients'

needs. Through these characters' experiences one can see the role of interior design in promoting, or in some cases hindering, workplace comfort.

The narrative can be divided into five major themes based on the model of environmental comfort. These themes are the key environmental conditions of the theory: (1) lighting, (2) noise level, (3) thermal qualities, (4) spatial factors, and (5) privacy.

When examining the relationship between the *lighting* of the nurse work areas and the nurses' perceptions of their environmental comfort in the narrative, the characters expose their dissatisfaction with the amount of natural light in their work areas by exaggeratedly stating that they have no access to windows within a mile radius. During this scene their underlying frustration is revealed regarding both the windowless nurse work areas as well as the constant ringing of the mobile phones. While natural light isn't necessary for the nurses to complete their tasks, it shows the value employees place on visual access to the outdoors.

The next concept explored in the narrative is *noise level*. This topic was examined indirectly as the nurses completed their tasks throughout the day. The opening sentence of the narrative sets the ambiance, stating that a typical day on the unit included "constant beeping, ringing, and buzzing accompanied by the sound of carts rolling through the corridors." One source of unwanted sound the narrative features is the noise made from the mobile phones that the nurses carry with them ubiquitously. While the phones are intended to allow patients or doctors prompt contact with the nurse, particularly in the case of an emergency, the phones often ring at undesirable times. For example, since a nurse keeps a phone with her at all times she

may receive calls while dispensing medications or performing other serious procedures. Ideally, the nurses would be more comfortable working in these situations with no noise disruptions.

Next, the relationship between *thermal quality* and the nurses' comfort is seen through the dialogue between Carol and the facilities maintenance worker. The staff on the unit is provided with a thermostat to adjust the temperature of the work areas with ease. However, as illustrated in the scene, the thermostat has not been working correctly, and the staff consistently complains of being hot. This shows that the thermal qualities are a source of discomfort for the nurses while working.

The next theme explored by the narrative is the *spatial factors* of the nurse work areas. This subject is depicted in the incidence of Carol and Amber having to sit in the corridors to chart due to the insufficient number of workstations in the nurse station. Amber brought her own stool from home, and Carol was obligated to use a bedside table as a chair because of the inadequate number of seats. This produces uncomfortable working conditions for the nurses.

The narrative also illustrates that the employees are inconvenienced with the number of staff toilets. When Amber was leaving for the day she stopped by the restroom only to find it occupied. This is a common occurrence for the staff in the North Tower because the units contain one toilet for all the employees to share. For some the annoyance may cause a need to find another staff restroom throughout the building while others may wait outside the door, or come back later; this suggests that the work area is not supportive of basic needs.

The final theme in the narrative based on the model of environmental comfort is the condition of *privacy*. The North Tower's condition of privacy is closely correlated to the spatial factors and noise level. As a scene of the narrative describes, when the nurses are sitting in the corridors completing their computer tasks they are frequently approached by patients, visitors, and other staff members. This shows that the spatial factors do not provide the nurses the ability to control their exclusivity. This theme is also explored when Amber is retrieving medication. She is interrupted twice because of the medication dispensing area's lack of enclosure. The Omnicells in the North Tower are located at the rear of the nurses' station. Although the medication supplies are held in a secure and locked cabinet, the location of the medication area is too accessible, even allowing patients to walk right up if they see their nurse. The privacy conditions of the unit are a constant source of irritation for the nurses.

Orientation to Narrative

The second narrative, entitled "All in a Day's Work: South Tower" is based on two employees' accounts of their experiences working at Shands Cancer Hospital at the University of Florida. The story follows two registered nurses in a medical-surgical unit, Becky and Mark, as they work a typical 8-hour shift. The story illustrates how the work environment supports or inhibits their productivity, as well as how this influences their comfort. Becky is an experienced RN in her early fifties and has worked in the Cancer hospital since it opened three years ago. On the other hand, Mark is in his mid-twenties who joined the Shands hospital system a few months earlier.

All in a Day's Work: South Tower

Becky quickly closed the break room door behind her. It was 12:43 PM and this is the first chance she's had to take a breather since she got to work. It was no surprise that she was so busy. This is a typical shift for the nurses in

the South Tower. Becky was just happy to finally be done with her morning medication rounds.

The unit is a full house today, proven by the amount of nurses lined up in the med room this morning. Luckily Becky got there early. She was able to get her meds and grab a spot on the counter to crush the pills without waiting in line for her turn. Mark, the newbie, wasn't as fortunate. When Mark got to the med room the line was already three deep, and as he swung open the door he bopped a nurse who was standing at the computer station. "Watch it!" the senior nurse snapped at him. That wasn't really Mark's fault though; every time someone stands at that computer they know the risk. It really is in a bad spot. Not to mention how uncomfortable that computer is to use. Nurses stand hunched over the keyboard, and leave rubbing their sore necks.

Mark glanced at his watch. He knew he didn't have time to waste so he apologizes again for the collision and hurries off to the supply room.

As Mark knelt down and tied his shoe, he realized how tense his body feels. As odd as it sounds, the action of kneeling and taking the pressure off of his feet was actually a relief. Recognizing that he needed to rest for a second he headed to his decentralized nurse station just outside his patients' rooms and plopped into his chair. Coincidentally just as he was sitting he glanced through the observation window and saw Mr. Robbins, a high fall-risk patient, climbing out of bed. Mark hopped up to assist him.

"Hey there Mr. Robbins, are you having a good afternoon? Yes sir, I will be happy to bring you some juice. Let's get you over to that chair. Hold on to my upper arm so that I can help you brace. There you go. Okay Mr. Robbins, I'll be right back."

Mark arrives at the nurse station to grab a boxed juice for his patient. As he reaches over Becky's head attempting to unlock the upper cabinet he realizes that he just interrupted a private conversation. Mark quickly grabs the juice to get out of the way allowing Becky to continue talking on the phone about a change in treatment.

As Mark leaves he begins to wonder, "Becky wasn't talking about herself, was she? Surely she's not leaving; it must have been about a patient. I mean, there really is no point in trying to have a personal conversation up here, unless you want the whole unit to hear." After Mark convinces himself, "Yeah, she couldn't have been talking about herself," he continues on his way.

Mr. Robbins reluctantly accepts the juice after making a grumpy remark about the difficult straw, and Mark returns to his decentralized nurse station

outside Mr. Robbins' room in hopes of finishing some charting. He quickly switches on the task lamp, adjusts the arm rests of his chair, and gets down to business.

Becky gazes out the window at the end of the hall and takes a deep breath as she is walking toward the supply room. It's good to see the rain has cleared up. Becky's expression becomes visibly less tense as she takes in the view outdoors. She types in the key code, steps inside the supply room, and the surrounding noises disappear. Grabbing what she needs, she feels she has just entered a walk-in freezer. 'Why on earth is it so cold in here?' She adjusts the thermostat and walks out the heavy door which slams securely behind her.

She passes room after room until she finally reaches her assigned patients at the end of the hall. Changing a patient's bandages can either be very difficult or very simple, depending on what type of patient you have. Fortunately Mrs. Johnson is as laid back as they come. Mrs. Johnson smiles, grateful for the new dressings and Becky reminds her to try to monitor keep them dry before she closes the door behind her.

Glancing down at her watch she couldn't believe the time. Was it really 3:30PM already? Unlocking the cabinet of her decentralized nurse station she pulls out her notepad. Becky makes a note to herself, and quickly begins the work for Mrs. Johnson's discharge on her computer.

The ringing of Mark's mobile phone fills the typically silent medication room. "Hello, this is Mark. Yes Mrs. Trainor, I will be there in just one moment. I need to run down to the supply room first, okay?"

The phone is the biggest distraction in this place. The nurses each carry one, and it seems to ring at the most inopportune times. Well, more accurately they seem to ring all the time.

Mark peeks out the door of the med room to try to find another nurse to do waste with him. Easy enough, Becky happens to be walking by. They finish the waste procedure and as they're both about to leave, Mark's phone rings again. "Hello, this is Mark. Yes, Mrs. Trainor, I'll bring you a cup of ice, too. See you soon."

Becky can hear the nurse station teeming with people from inside Mrs. Johnson's room- that's a sure sign that it's almost time for shift change.

Mrs. Johnson walks out of the restroom dressed in a flowy Hawaiian print dress ready for discharge.

“Wow, Mrs. Johnson, you look beautiful! I’ve only seen you in our hospital gowns, which unfortunately don’t bring out the blue in your eyes the way that dress does!”

The patient transporter arrives to the room to help Mrs. Johnson find her way downstairs to leave. Becky felt exhausted, but happy to help Mrs. Johnson get ready for discharge. Now she’s off to the nurse station to wrap up for the day.

Interpretation

The narrative “All in a Day’s Work: South Tower” illustrates the built environment at Shands Cancer Hospital by following two employees as they perform their daily tasks necessary to care for their patients. The two main characters in the story are Becky, an older more experienced RN and Mark, a young nurse who is new to the unit. Through these characters’ experiences one can see the role of interior design in promoting, or in some cases hindering, workplace comfort.

Congruent with the first narrative, this story can be divided into five major themes based on the model of environmental comfort. These themes are the key environmental conditions of the theory: (1) lighting, (2) noise level, (3) thermal qualities, (4) spatial factors, and (5) privacy.

When examining the relationship between the *lighting* of the nurse work areas and the nurses’ perceptions of their environmental comfort, it is important to acknowledge the unit’s natural light. During one scene Mark looks out the window at the end of the hall while walking to the supply room. He takes a deep breath, and while these ideas are not directly stated, he appears to be in a moment of respite. The nurses hold high value on the visual access to the outdoors.

When further exploring lighting in the narrative, it is noted that Becky sat down at her decentralized nurse station, adjusted the arm rests of her chair, and switched on her task light. This suggests that along with sufficient natural light, the nurses' tasks are supported by the ability to manipulate the lighting such as the desk lamps and under cabinet lights in their workplace.

The next concept explored in the narrative is *noise level*. The narrative illustrates that the unit is the noisiest during shift change, particularly at the nurse station. In the scene where Becky heard the nurse station teaming with staff from inside her patient's room, she realized that the end of her shift was approaching. The nurse station is the main hub of activity on the unit, and its open environment and hard surfaces only exasperate the noise level.

The narrative provides another example regarding a source of noise on the unit: the ringing from the nurses' mobile phones. Mark is in the medication room when he receives two phone calls. Since the nurses carry a phone with them at all times, they have the potential to be disturbed even while performing duties that require concentration such as dispensing doses of medication. However, the medication dispensing machines are located in an enclosed room that can only be accessed with a security code, so other than the potential for the phone to ring, the room stays relatively distraction free. Yet open environments facilitate slight line access and hard surfaces are typically easier to clean.

Next, the relationship between *thermal quality* and the nurses' comfort is observed in the narrative when Becky is in the supply room and quickly adjusts the thermostat. The employees in the South Tower are provided with thermostats to

adjust the temperatures of each work area. Becky and the other staff members are generally comfortable with the temperatures on the unit; however, if necessary the temperature can be easily adjusted. The nurses have a sense of control over the thermal qualities of their work areas, which supports the nurses while working.

The next theme explored by the narrative is the *spatial factors* of the nurse work areas. This subject surfaces various times throughout the work day. Becky and Mark are both observed sitting outside the patients' rooms at their decentralized nurse stations. During the narrative it is illustrated that these decentralized nurse stations provide the nurses with an individual place to sit and chart on their computers, along with personal lockable storage. The decentralized nurse stations also offer a view into the patient rooms vis-a-vis observation windows. The nurses' performance is supported through the size, location, and features of the decentralized nurse stations.

On the other hand, the narrative also illustrates inefficiencies in the case of the medication room. At the beginning of the narrative it is established that the location of the medication room computer station is problematic when Mark opens the door and hits the nurse who is standing at the computer. Also, the computer station is uncomfortable considering that the users cannot adjust the screen's height or angle. In addition, the scene reveals that the amount of counter space is insufficient, and the nurses often have to wait for one another to finish and waste valuable time. These situations are all common occurrences for the staff in the South Tower because the medication rooms are not large enough to support the tasks of more than 1-2 nurses simultaneously, particularly during the morning rounds of medication.

The final theme in the narrative based on the model of environmental comfort is the condition of *privacy*. In one scene in particular Mark overhears a portion of Becky's personal conversation, exposing the nurses' concern. The nature of an inpatient hospital unit entails easy accessibility to various spaces and people; however, designing the interior environment to suit this approach reduces the exclusivity of staff areas. This leads to the nurses desiring more visual and conversational privacy. Although, this narrative reveals that access to the supply and medication rooms are restricted, which provides much needed privacy and security in these areas.

Another facet of privacy, which is closely related to spatial factors, involves the nurses' personal territory. The decentralized nurse stations offer an individual place to work, and lockable storage for their belongings. This provides the nurses with a sense of personal territory, and increases their perception of privacy.

Utilizing the Findings from the Environmental Comfort Method

The environmental comfort of a workspace has been shown to impact perceived employee performance. An uncomfortable environment drains energy out of the user by creating "work-arounds" in the workspace. A supportive and effective workspace allows and even encourages occupants to apply all their energy and attention to performing their duties. For example, a worker who expends energy propping books under her computer screen to lessen the glare from a window, and then fights to concentrate over the noise outside her office is expending time and energy on adjusting to the environment. This slows down employee output and ultimately decreases productivity. In that sense the environment becomes a barrier to productivity. An employee would be more effective if she could concentrate that wasted energy on work rather than on

struggling against features of her workspace. Research on the workplace underscores this type of experience:

“The difference between a supportive and an unsupportive workspace is the degree to which occupants can conserve their attention and energy for their tasks, as opposed to expending it to cope with adverse environmental conditions before they can get to performing the task. The best workspaces are those that minimize the expenditure of energy by users, allowing them to apply all their energy to work activities. The best workspaces reduce the elements that people have to struggle against to get their work done, and increase the environmental elements that support task performance (Vischer, 2005; p. 108).”

The comfort of workspace features can enhance job performance in numerous ways, and conversely, there are many environmental design factors that slow people down. Designers and facility managers need to determine the value of these workspace features, and the measurement system of the DiConFon questionnaire is one way of approaching these matters in an objective and quantifiable way. This environmental comfort approach allows designers to assess the value of environmental features that affect users.

The habitability pyramid in Figure 1-1 indicates how to calculate the likely impact of investing in the comfort of environmental conditions; to judge the value of an investment in a workspace each environmental feature – such as lighting – needs to be located on the continuum. This allows designers to evaluate what modifications are necessary for the environmental feature to slide up the scale from the physical comfort category to become a condition of functional comfort or even part of the psychological pinnacle of the pyramid. The greater the investment in the quality of the interior environment for workers, the more upward pressure is exerted towards improved environmental comfort. This increased understanding of how people experience their

environment will help avoid investments in things that are less significant to employees' environmental comfort.

The data generated from measuring the nurses' perceptions of their work environment is applied to the categories of the habitability pyramid for the sake of determining which workspace conditions would be most beneficial to improve. The value of each fundamental environmental condition: (1) lighting, (2) noise level, (3) thermal qualities, (4) spatial factors, and (5) privacy, is assessed by categorizing it as physical, functional, or psychological comfort; this approach identifies the positive and negative effects and suggests follow-up action by the facilities managers of the Shands Hospitals to cultivate environmental improvement.

Unit A- Synthesis and Application

From the amalgamation of the low survey ratings of the environmental conditions and the feedback in the focus group discussion, it was found that the registered nurses in Unit A are more comfortable with the lighting (functional comfort level) and thermal quality (functional comfort level) than with the noise level (physical comfort level) and privacy conditions (physical comfort level). The nurses find themselves distracted and interrupted continually throughout the day due to the noise and lack of privacy.

However, the conditions causing the most discomfort in this unit were related to spatial factors (discomfort level). The nurses on Unit A do not have an adequate number of chairs or work surfaces, and they are often displaced into the corridors to chart. This puts the occupants' safety in question.

Dissecting these results and applying them to the environmental comfort model shows that occupants of Unit A do not have to expend a large extent of their energy on adjusting to problematic lighting and thermal conditions in the unit. Both the lighting and

thermal qualities are rated in the functional comfort category. The nurses indicated that the lighting could have been better if there was natural light in the staff area, and the thermal quality did not meet the top tier of the continuum, psychological comfort, because the nurses experienced difficulties in regulating the temperature of the staff areas due to the old air conditioning system. Investments in the amount of windows and repairing the air conditioning system would increase the environmental comfort of the nurses. Although, this is not the greatest need of the unit.

The noise level and privacy conditions, both categorized in the physical comfort level, require occupants to expend energy overcoming the negative effects of these uncomfortable workspace conditions- this is wasted energy that could otherwise be directed towards work. The medical equipment and the voices of other staff members are the noise sources which aggravate and distract the nurses, resulting in the nurses experiencing noise fatigue at the end of the day. The nurses' lack of privacy is also taxing; on the psychological level, the nurses are lacking control over their environment and their exclusivity, and on the functional level the nurses' distractions inhibit their concentration, particularly when the nurses are at the Omnicell, the medication dispensing machines. Because the Omnicell is located at the back of the nurse station, just across the hall from patient rooms, the nurses are constantly interrupted by patients, and even other staff members. The nurses would benefit from the Omnicell being moved to an enclosed area; this would greatly reduce the surrounding noises and remove the patients' ability to approach the nurses while they are dispensing medications.

The spatial condition of the nurse work areas is categorized in the discomfort level of the continuum and is causing the nurses the most expense of energy. The nurse station is not furnished suitably; therefore the nurses are lacking the basic convenience of being able to sit whenever they need to rest. This leads to the nurses putting their tasks on hold while they walk the unit in search of an available chair. The nurses also expressed the need for more work surfaces. To improve the spatial factors in the unit decentralized nurse stations should be added outside of the patient rooms. This addition would provide a work surface and chair for each nurse, minimizing their wasted energy related to spatial factors.

The largest negative indicator- spatial factors- has a more adverse effect on nurses' environmental comfort than those conditions that are less negative (noise and privacy) or semi-supportive (lighting and thermal qualities), because the spatial factors are causing users to expend energy struggling against features of the workplace. Therefore, to increase the nurses' level of environmental comfort in Unit A the most valuable investment in workspace improvement would be to improve the spatial factors, followed by solving noise and privacy problems.

Unit B- Synthesis and Application

When combining the survey results with the feedback in the focus group discussion, it was established that the nurses on Unit B are more comfortable with the noise level (functional comfort level) and privacy (functional comfort level) than with the lighting (physical comfort level) and the thermal qualities (physical comfort level). The canned lights above the medication dispensing area produce an uncomfortable amount of heat when standing under them, and the lights in the east corridor of the unit must remain on all the time because there is no switch to control them. The thermostat does

not function properly and the nurses are continually hot. However, the conditions causing the most discomfort in this unit were related to spatial factors (discomfort level). Similar to Unit A, the nurses do not have an adequate amount of task chairs, computers stations, or work surfaces, and they are lacking an efficient amount of staff toilets on the unit.

Applying these results to the environmental comfort model conveys that occupants of Unit B do not expend as much of their energy on dealing with noise and privacy as they do with lighting and thermal qualities of the unit. Both the lighting and thermal qualities are rated in the physical comfort category. The nurses indicated that the lighting could be better if they had more control over the fixtures, if the lights didn't produce as much heat, and if they had more access to daylight. The thermal quality of the unit is a major concern for the nurses because the unit's thermostat is not working properly. The nurses unanimously rated the unit as too warm. Unit B is lacking the element of thermal control, which is negatively impacting the nurses' psychological comfort, and functionally the nurses are uncomfortable complaining of "walking around and breaking a sweat." Investments in the lighting quality, such as installing indirect lighting fixtures to diffuse the light and assist in creating a natural effect (Lowers, 1999), would increase the environmental comfort of the nurses. Further, repairing the air conditioning system would allow the nurses to work more comfortably. The lighting and thermal qualities currently require occupants to expend energy overcoming the negative effects of these uncomfortable workspace conditions- this is wasted energy that could otherwise be directed towards work.

The spatial condition of the nurse work areas is categorized in the discomfort level of the continuum and is causing the nurses the most expense of energy. The nurse station is not furnished suitably; therefore the nurses are lacking the basic convenience of being able to sit whenever they need to rest. This leads to the nurses putting their tasks on hold while they walk the unit in search of an available chair. The nurses also expressed the need for more computer stations (COWs) and work surfaces. Unit B would benefit from the same suggestion made for Unit A: decentralized nurse stations should be added outside of the patient rooms therefore improving the spatial factors of the unit. This addition would provide a work surface and chair for each nurse, minimizing their wasted energy related to spatial factors. The other facet of spatial factors that the nurses have an issue with is the inefficient amount of staff toilets. All the staff members on the unit share one toilet which is very inconvenient to the nurses because if the restroom is occupied they must leave the unit in search of another staff toilet, or they must return at another time. The nurses expressed that the space of the unit is not being used in an efficient manner. The shower room at the back of the unit is very large, but was a neglected area that no one used. Eventually the room became an unofficial storage area; however, this room could easily be turned into a staff restroom due to the existing plumbing.

The largest negative indicator- spatial factors- has a more adverse effect on nurses' comfort than those conditions that are less negative (lighting and thermal qualities) or semi-supportive (noise and privacy), because it is causing users to expend energy struggling against features of the workplace, and therefore lowering their environmental comfort level. The most valuable investment in workspace improvement,

then, is improving the spatial factors by adding decentralized nurse stations and another staff toilet, followed by solving the unit's lighting and thermal issues.

Unit C- Synthesis and Application

When combining the survey results with the feedback from the focus group discussion, it was established that the nurses on Unit C are more comfortable with the lighting (psychological comfort level) and thermal qualities (psychological comfort level) than with the noise level (functional comfort level) and the privacy (functional comfort level). The noise on the unit is distracting to the nurses and they frequently hear one another's personal conversations. However, the conditions causing the most adverse effect on the user's comfort were related to spatial factors (functional comfort level), particularly in regards to the medication room.

Taking these results and applying them to the environmental comfort model shows that occupants of Unit C do not have to expend energy on dealing with lighting and thermal quality in the nurse work areas. In fact, they are supported by these conditions. The nurses experience psychological comfort in relation to lighting and thermal qualities because they benefit from having control over the lighting in their work areas through the use of task lamps and under cabinet lights, as well as natural light that can be controlled through the electronic window shades. The thermostats are also easy for the nurses to adjust, and the unit's temperature is generally set at a comfortable level for the nurses.

The noise level and privacy conditions, both categorized in the functional comfort level, are providing nurses with slightly less comfort than the lighting and thermal qualities. This means that the noise and privacy conditions are not in full support of the nurses' tasks; in some situations they are slowing down tasks, but certainly not always.

For instance, when a nurse is sitting at her decentralized nurse station and she is interrupted by a staff member or patient, this causes the nurse to stop what she is doing and turn her focus towards that person. This distraction can ultimately affect the productivity of the nurse; however, the nurse may go in to the medication room and close the door, minimizing many of those distractions.

Similar to the noise and privacy of the unit, the spatial factors of the nurse work areas are also categorized in the functional level of the continuum; however, these conditions are supporting the nurses' tasks to differing degrees (slightly more support by noise and privacy and slightly less by spatial factors). The negative spatial factors are causing the nurses the most expense of energy that they could be applying towards working. The spatial factors of the medication room in particular cause the greatest source of strain for the nurses. The medication room does not have enough counter space to service all the nurses, especially during the morning medication rounds when multiple nurses utilize the room simultaneously. The medication room becomes crowded, especially around the northern door. The refrigerator and computer station are located in this area, and nurses often get hit with the swinging door when working in this space. However, the general layout of the unit works well, with the exception of the location of the supplies. Moving the supplies to a more central location on the unit would reduce the amount of back-and-forth walking the nurses currently encounter.

The largest negative indicator- spatial factors- has a more adverse effect on nurses' comfort than those conditions that are semi-supportive (noise and privacy) or supportive (lighting and thermal qualities), because it is causing users to expend energy against features of the workplace. Therefore in order to raise the environmental comfort

level of the nurses on Unit C, the most valuable investment in workspace improvement entails the spatial factors, particularly in the medication room, followed by solving the noise and privacy problems in the nurse station.

Unit D- Synthesis and Application

The results from the questionnaires and focus groups show that the perceived environmental comfort in Unit C and Unit D are similar. Reminiscent of Unit C, the nurses on Unit D are more comfortable with the lighting (psychological comfort level) and thermal qualities (psychological comfort level) than with the noise level (functional comfort level) and the privacy (functional comfort level). The noise on the unit is distracting to the nurses and they often lack the ability to have a private conversation. However, the conditions causing the most adverse effect on the user's comfort were related to spatial factors (functional comfort level), again, particularly in regards to the medication room.

Taking these results and applying them to the environmental comfort model shows that the work activities of registered nurses on Unit D are supported by the conditions of lighting and thermal quality in the nurse work areas. The nurses benefit from having task lamps, under cabinet lights, and natural light in their work areas, all of which the nurses can personally control. The staff thermostats are readily accessible for the nurses to adjust, however the nurses expressed general satisfaction with the unit's temperature and they rarely feel the need to adjust the thermostat. This aspect of control results in the nurses experiencing psychological comfort in relation to lighting and thermal qualities.

The noise level and privacy conditions, both categorized in the functional comfort level, are perceived by the nurses as less comfortable than the conditions of lighting

and thermal qualities. This means that the noise and privacy conditions are not in full support of the nurses' tasks; in the nurse station the high noise levels and lack of privacy slows down nursing tasks because the nurses must divert their energy to combat features of their work environment. However, the medication dispensing room and the supply room are both areas that the nurses perceive as private and quiet. The level of environmental comfort the nurses perceive can be increased by improving the noise quality and privacy in the nurse station. This could be achieved through the addition of sound attenuating materials.

Similar to the noise and privacy of the unit, the spatial factors of the nurse work areas are also categorized in the functional level of the continuum. The unsupportive spatial factors in the medication room are causing the nurses to expense energy that they could be applying towards working. The layout of the medication rooms in Unit C and Unit D are nearly identical, and the nurses are experiencing the same issues in both units. The medication room does not have enough counter space to service all the nurses, especially when multiple nurses are using the room at once in the mornings. The biggest problem area is in the vicinity of the refrigerator and computer station because the northern facing door swings directly in to this space, consequently hitting anyone standing in its path. The other spatial factor that decreases the nurses' comfort level involves the general layout of the unit. The supplies are not centrally located on the unit. Moving the supplies to a more central location on the unit would reduce the amount of back-and-forth walking the nurses currently encounter.

The largest negative indicator- spatial factors- has a more adverse effect on nurses' comfort than the other conditions that are semi-supportive (noise and privacy) or

supportive (lighting and thermal qualities), because it is causing users to expend energy struggling against features of the workplace. Therefore in order to raise the environmental comfort level of the nurses on Unit D, the most valuable investment in workspace improvement involves the spatial factors, particularly in the medication room, followed by solving the noise and privacy problems in the nurse station.

Design Trade-offs

This study has confirmed that trade-offs play an important role when designing a healthcare environment. A trade-off is defined as a choice that involves losing one quality in return for gaining another quality. It is important for design professionals to make design choices with full comprehension of both the upside and downside of a particular decision. For example, in healthcare settings hard non-porous work surfaces that are poor acoustic attenuators are often used to gain other desirable properties, such as durability and ease of sanitation. Therefore, noise levels are frequently identified as problematic in healthcare environments, and it became apparent that the noise level and desire for more privacy were concerns for the nurses in the four units under study.

Further examples of trade-offs in healthcare design may include light levels, patient sleep patterns, staff error rates, centralized vs. decentralized nurse stations, mobile communication methods, and hospital security. Consider the following examples specific to the hospitals settings under study:

1. The nurse stations in the South Tower are located towards the front of the unit. This allows direct visual access from the entry of the unit so that a visitor can immediately recognize where to find help. This reassures wayfinding (Alana Schrader, personal communication, November 16, 2011). However, the trade-off is that nurses' travel distances increase when supplies and work areas are not centrally located (Hendrich & Lee, 2005).

2. The limited amount of workspace in the medication dispensing rooms in the South Tower can accommodate 1-2 nurses preparing medications. Therefore, nurses are often spending valuable time waiting to use the computer and counter space. However, given that space is a valuable commodity in a hospital environment, the designers determined the trade-off of square footage was best utilized through the implementation of decentralized nurse stations outside the patient rooms rather than increasing the size of the medication dispensing room (Alana Schrader, personal communication, November 16, 2011).

Design Recommendations

The following are specific as well as general design recommendations that can be adopted to improve the design of the healthcare workplace:

1. *Design new work efficiencies for underutilized spaces.* It is recommended that consideration be given to renovate Unit A and Unit B. The renovation is suggested to involve converting the existing shower rooms that are currently being used as a storage space into exclusive staff restrooms. In addition, there should be dedicated space for decentralized nurse stations, preferably located outside the patient rooms with an observation window to offer the nurses visual access to their patients. However, since the renovation of the facility is unpredictable in the near future, it is recommended that additional task chairs be added to the unit, and the broken task chairs be replaced with functional ergonomic seating options immediately. In Unit C and Unit D, the medication dispensing room is suggested to be reconfigured. The computer station and refrigerator should be relocated further from the entry.
2. *Implement noise-reducing acoustic solutions that are appropriate for a healthcare setting.* It is recommended that the nurse station and unit corridors have better acoustical conditions to avoid the problem of noise migration throughout the unit. This can be achieved by the addition of high quality acoustical ceiling tiles, and sound reduction paint on the existing walls. Additionally, it is recommended to install a white noise machine to rectify the problem of background noise in the corridors.
3. *Regulate and maintain the air temperatures in the staff areas.* To provide thermal comfort to the staff members the HVAC systems should be maintained and regulated to ensure that it is working properly. The HVAC system in the North Tower needs to be repaired to allow the staff to operate the existing (malfunctioning) thermostats in order to maintain temperature control.

Recommendations for Future Research

This study hopes to serve as a springboard for future research in the field of healthcare environments and how they influence the registered nursing staff's

perceptions of environmental comfort. Therefore, replication of this study is warranted with different sample strategies to confirm or reshape findings. Moreover, since no demographic information was collected, a future study may be beneficial to explore if gender plays a role in the research findings. Finally, since this study concludes with design recommendations to improve the environmental comfort of the research settings, future research with the implementation of the design recommendations is needed to find out if these environmental conditions impact the perceived comfort of nursing staff.

Conclusion of Discussion

This study assesses hospital workplace conditions through the theoretical lens of the environmental comfort model proposed by Jacqueline Vischer (2007). The model ranks workplace environments in a rising continuum of physical, functional, and psychological comfort. Lighting, thermal quality, spatial factors, noise level, and privacy all appear to be related to the nurses' perceived environmental comfort level indicating that the environmental comfort framework is applicable in a healthcare workplace. Combining the nurses' experiences regarding the five environmental conditions created the narratives "All in a Day's Work" which provides true life accounts of registered nurses' working on a medical-surgical unit. In particular, the story reflects on the role of interior design in promoting, or in some cases hindering, nurse productivity.

In sum, medical-surgical units provide an excellent setting for researching environmental comfort and how it relates to healthcare design. Yet, given the lack of empirical research that applies the environmental comfort theory to the healthcare workplace, additional research is needed to gain a better understanding. Nevertheless, the study findings clearly substantiated the premise that the constituents of the physical environment have an impact on the productivity of registered nurses. Knowledge

generated by this multi-site field study formulated general and specific recommendations for improvements to nurse work areas, and the results can be useful to design professionals and healthcare employees in the future.

APPENDIX A
INSTITUTIONAL REVIEW BOARD PERMISSION

UF Institutional Review Board
UNIVERSITY of FLORIDA

Health Center Institutional Review Board

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Tel: (352) 273-9600
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MEMORANDUM

DATE: July 9, 2012

TO: Margaret Portillo, Ph.D.
Box 115705

FROM: R. Peter Iafrate, Pharm.D.
Chairman, IRB - 01 

SUBJECT: EXPEDITED IRB #294-2012 EXPIRES: Wednesday, June 26, 2013

TITLE: EXPEDITED: NURSES' ASSESSMENT OF ENVIRONMENTAL COMFORT IN THEIR PHYSICAL WORK ENVIRONMENT

You have received IRB approval to conduct the above-listed research study. Approval of this study was granted on June 26, 2012. You have also been approved for a waiver of documentation of Informed Consent in accordance with 45 CFR § 46.117(c). This study is approved as expedited as it poses minimal risk and is approved under the following expedited category/categories:

Expedited #7: Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. Note: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR § 46.101(b) (2) and (b)(3). This listing refers only to research that is not exempt.

You are responsible for applying for RENEWAL of this study prior to the expiration date. Re-approval of this project must be granted before the expiration date, or the study will be automatically suspended. If suspended, you may not do any of the following: (1) Enroll or screen any new subjects, (2) perform any study interventions, unless the IRB finds that it is in the best interest of individual subjects to continue participating in research interventions or interactions, (3) collect, use, or report any data, and/or (4) receive any study funding.

The IRB has approved exactly what was submitted. Any change in the research, no matter how minor, may not be initiated without IRB review and approval, except where necessary to eliminate hazards to human subjects. If a change is required due to a potential hazard, that change must be promptly reported to the IRB.

Any (a) serious and unanticipated adverse events and (b) unanticipated problems involving risk to subjects or others, must be reported to the IRB, in writing, within 5 working days.

Upon completion of the study, you are REQUIRED to submit a summary of the study and a Study Closure report to the IRB office.

RESEARCH RECORDS must be retained after completion of the research. Researchers must comply with the longest applicable standard according to current institutional policies. UF Shands researchers must retain research records for a minimum of three years or longer depending if any of the following are involved: HIPAA, medical treatment, patents, or contractual language with a sponsor. For research involving the VA records must be retained indefinitely until VA regulations establish a shorter retention period. Lastly, research data is the property of the institution and you must comply with all institutional requirements before destroying, copying, or transferring any research data. Additional information is available at: <http://irb.ufl.edu/irb01/data.html> (item number 4).

If VAMC patients will be included in this project, or if the project is to be conducted in part on VA premises or performed by a VA employee during VA-compensated time, you must obtain approval from the VA Research and Development Committee before initiating the research.

An Equal Opportunity Institution

APPENDIX B
LETTER TO NURSE MANAGERS REQUESTING PARTICIPATION

Hi [NURSE MANAGER],

I'm a Shands employee and a master's student at UF currently working on a research study which examines the design efficacy of nurse work areas in Shands Cancer Hospital and Shands at UF. I'm particularly interested in how registered nurses perceive the work areas on your unit (nurse station, supply room, and medication dispensing spaces) to identify ways to improve the design of healthcare work areas.

Per the request of the IRB, I am reaching out to each of the Nurse Managers whose units I am hoping to conduct the research on. The commitment of the unit would simply include allowing me to conduct two 20 minute observations of the nurse work areas (which will require no time from the unit's staff), and allowing the registered nursing staff to participate in a survey and focus group (which will require 20-25 minutes from the participating RN's). Also, the study will be anonymous, so I am requesting that each Nurse Manager forward a letter of invitation, which I will supply, to each of the registered nurses working on the unit.

If you are able to agree to allowing your unit to participate in this study, please print out the attached letter of support, read, and sign. Once this is complete, please let me know, and I will be happy to pick up the letter myself. If there are changes you feel are necessary to make to the letter, please let me know before printing it out and signing it. If you have any questions or concerns, please do not hesitate to let me know.

Thank you,

Paige Walker

APPENDIX C
NURSES' LETTER OF INVITATION

Hello,

I am a master's student at the University of Florida, and I am writing to request that you participate in a research study because you are a Shands registered nurse working on unit _____. After working as an interior design intern in the Shands Facilities Development Department for the past three years I have seen many positive changes take place throughout our facilities, however, there is always room to grow. Therefore my thesis study examines the design efficacy of nurse work areas. I am particularly interested in how you perceive the work areas on your unit (nurse station, etc.) to identify ways to improve the design of healthcare work areas. I hope you decide to take part in the following study.

Study Title:

Nurses' Assessment of Environmental Comfort in their Physical Work Environment

Purpose of the research study:

The research investigates the nurse station, medication dispensing areas, and supply rooms in four Shands units; two in the north tower and two in the south tower. The ultimate purpose of the research is to improve the design and functionality of nurse work areas.

What you will be asked to do in the study:

If you participate, you will be asked to take a 5 minute questionnaire and then participate in a 20 minute small group discussion centered on perceptions of the nursing work areas. _____, the nurse manager of unit _____, has given me approval to hold the session in room _____ on _____, 2012 at ____pm. Light refreshments will be provided during the session.

Total time required:

25-30 minutes

Confidentiality:

The information you provide will be kept completely anonymous. The questionnaire will not have your name on it, and there will be no coding that could link your answers to your identity. With your permission, a confidential audio recording will be made during the discussion for future analysis. Your name or personal information will not be identified on the audio recordings, and confidentiality will be strictly maintained.

Voluntary participation:

Participation is totally voluntary and participants will not be obligated to participate or penalized for not participating.

Right to withdraw from the study:

Participants will be able to withdraw from the study at any time without consequence.

Whom to contact if you have questions about the study:

Paige Walker

University of Florida, Gainesville, Florida

Phone:

Email: prebor@ufl.edu

Margaret Portillo, PhD

Professor and Chair, Interior Design Department, University of Florida

Phone:

Email:mportill@ufl.edu

Whom to contact about your rights as a research participant in the study:

IRB-01 Office, Box 100173, Gainesville, FL 32610-1073; Phone: (352) 273-9600

Thank you very much for considering this request! I hope to see you on [DATE].

Sincerely,

Paige Walker

APPENDIX D
OBSERVATION SCHEDULE

	July 2nd	July 5th
Unit A	8:30 – 10:00 am	3:30 – 5:00 pm
Unit B	10:00 – 11:30 am	2:00 – 3:30 pm
Unit C	3:30 – 5:00 pm	8:30 – 10:00 am
Unit D	2:00 – 3:30 pm	10:00 – 11:20 pm

APPENDIX E ORIGINAL DICONFON SURVEY

1

Hello:

This survey is designed and administered by the Groupe de recherche sur les environnements de travail/New Work Environments Research Group (GRET) at the University of Montreal. The survey is designed to assess how you experience the physical spaces in which you work.

This questionnaire is being administered to all personnel. The aim is to understand your perceptions and experience of the physical environment in which you now work. The results will be used to help us identify key areas for improvement and innovation in workspace design. Your responses also indicate successful features of your workspace that can be applied to future designs.

Below you will find a series of questions about the quality of the physical environment in which you work. Each question is in the form of a scale from one (1) to five (5), where 1 means uncomfortable and 5 means comfortable and 3 is a neutral point in-between. Please select one response to each question that best corresponds to your overall experience of working in the building where you are currently located.

Before starting the questionnaire, please read and sign the release form that we are required to administer as per the University of Montreal's guidelines for ethical research. The questionnaire can be completed in about 15 minutes.

If you have any questions or concerns, please contact the survey administrators:

The identification numbers on each survey are to aid in data analysis. Please note that all individual responses are anonymous and will remain confidential. We are very grateful for your time. Thank-you for participating!

1. Access (or User) Code :

User Name (or email address) :

2. Date you complete this questionnaire : _____
month / year

3. Building where you work (address): _____

4. Floor _____

5. Type of office or workstation (check one) :

- Private closed office
- Shared closed office
- Open plan workstation (with partitions)
- Open plan workstation (without partitions)
- Other (describe) _____

6. Approximate distance from your workstation to nearest windows (check one) :

- Next to windows
- 1.5m to 3m (5-10 feet) from windows
- 3m to 6m (10-20 feet) from windows
- 6m to 12m (20-40 feet) from windows
- No windows

Based on your overall experience of working in your current workspace, please check or circle ONE response to each of the following questions about your physical environment:

- | | | | | | |
|--------------------------|---------------|---|---|---|----------------------|
| 7. Temperature comfort: | 1 | 2 | 3 | 4 | 5 |
| | UNCOMFORTABLE | | | | COMFORTABLE |
| 8. How cold it gets: | 1 | 2 | 3 | 4 | 5 |
| | TOO COLD | | | | COMFORTABLE |
| 9. How warm it gets: | 1 | 2 | 3 | 4 | 5 |
| | TOO WARM | | | | COMFORTABLE |
| 10. Temperature shifts: | 1 | 2 | 3 | 4 | 5 |
| | TOO FREQUENT | | | | CONSTANT TEMPERATURE |
| 11. Drafts: | 1 | 2 | 3 | 4 | 5 |
| | TOO COLD | | | | COMFORTABLE |
| 12. Ventilation comfort: | 1 | 2 | 3 | 4 | 5 |
| | UNCOMFORTABLE | | | | COMFORTABLE |
| 13. Air freshness: | 1 | 2 | 3 | 4 | 5 |
| | STALE AIR | | | | FRESH AIR |
| 14. Air movement: | 1 | 2 | 3 | 4 | 5 |
| | UNCOMFORTABLE | | | | GOOD CIRCULATION |
| 15. Odours : | 1 | 2 | 3 | 4 | 5 |
| | UNPLEASANT | | | | NO ODOURS |

16. Dry air :	1 TOO DRY	2	3	4	5 COMFORTABLE
17. Furniture layout of your office/workstation :	1 UNCOMFORTABLE	2	3	4	5 COMFORTABLE
18. Size of your office/workstation:	1 UNCOMFORTABLE	2	3	4	5 COMFORTABLE
19. Work-surfaces:	1 INADEQUATE	2	3	4	5 ADEQUATE
20. Work storage space:	1 INADEQUATE	2	3	4	5 ADEQUATE
21. Storage for personal effects:	1 INADEQUATE	2	3	4	5 ADEQUATE
22. Meeting-space and conference rooms:	1 INADEQUATE	2	3	4	5 ADEQUATE
23. Access to equipment or facilities you need located outside your office/workstation:	1 INCONVENIENT	2	3	4	5 CONVENIENT
24. Chair comfort:	1 UNCOMFORTABLE	2	3	4	5 COMFORTABLE
25. Computer configuration (<i>keyboard, screens, mouse etc.</i>):	1 UNCOMFORTABLE	2	3	4	5 COMFORTABLE
26. Noise distractions:	1 TOO DISTRACTING	2	3	4	5 COMFORTABLE

27. Background noise levels:	1	2	3	4	5
	TOO MUCH NOISE				COMFORTABLE
28. Specific noises from voices, equipment:	1	2	3	4	5
	TOO NOISY				COMFORTABLE
29. Noise from ventilation system:	1	2	3	4	5
	TOO NOISY				COMFORTABLE
30. Noise from outside the building:	1	2	3	4	5
	TOO NOISY				COMFORTABLE
31. Access to/availability of building amenities (e.g. food & coffee, washrooms, fitness):	1	2	3	4	5
	INADEQUATE				ADEQUATE
32. Visual privacy in your office/workstation:	1	2	3	4	5
	UNCOMFORTABLE				COMFORTABLE
33. Conversation privacy:	1	2	3	4	5
	UNCOMFORTABLE				COMFORTABLE
34. Telephone privacy:	1	2	3	4	5
	UNCOMFORTABLE				COMFORTABLE
35. Overall lighting comfort:	1	2	3	4	5
	UNCOMFORTABLE				COMFORTABLE
36. How bright it gets:	1	2	3	4	5
	TOO BRIGHT				COMFORTABLE
37. Glare from lights:	1	2	3	4	5
	UNCOMFORTABLE				NO GLARE

38. Interior colours:	1	2	3	4	5
	UNATTRACTIVE				ATTRACTIVE
39. Light reflections on surfaces or screens:	1	2	3	4	5
	UNCOMFORTABLE				NO GLARE
40. Low light levels:	1	2	3	4	5
	UNCOMFORTABLE				NOT A PROBLEM
41. Flickering lights:	1	2	3	4	5
	UNCOMFORTABLE				NOT A PROBLEM
42. Access to daylight:	1	2	3	4	5
	INADEQUATE				ADEQUATE
43. View out of windows:	1	2	3	4	5
	INADEQUATE				ADEQUATE
44. Glare from windows:	1	2	3	4	5
	UNCOMFORTABLE				NO GLARE
45. Security of the building:	1	2	3	4	5
	INADEQUATE				ADEQUATE
46. Employee safety at at all times:	1	2	3	4	5
	INADEQUATE				ADEQUATE
47. Cleanliness and hygiene in the building:	1	2	3	4	5
	INADEQUATE				ADEQUATE
48. Building maintenance and repair:	1	2	3	4	5
	INADEQUATE				ADEQUATE
49. Overall appearance:	1	2	3	4	5
	UNATTRACTIVE				ATTRACTIVE

APPENDIX F MODIFIED DICONFON SURVEY

ID Num: 1
NT75-1, NT65-1; ST6E-1, or ST5E-1

Work Environments Questionnaire

This survey is being administered to Shands registered nurses and is designed to assess your perceptions and experience of the physical environment in which you now work. Although this study may not benefit you directly, the information gained from it will help to improve nurse work area designs in the future.

Below you will find a series of questions about the quality of the physical environment in which you work. Each question is in the form of a scale from one (1) to five (5), where 1 means uncomfortable and 5 means comfortable and 3 is a neutral point in-between. Please select ONE response to each question that best corresponds to your overall experience of working in the building and unit where you are currently located. There are no right or wrong answers. The questionnaire can be completed in about 5 minutes.

If you have any questions or concerns, please contact the survey administrator:
Paige Walker; prebop@shands.ufl.edu

Please note that all individual responses are anonymous and will remain confidential. This questionnaire will not have your name on it, and there will be no coding that could link your answers to your identity. Thank you for participating!

Based on your overall experience of working in your current workspace, please circle ONE response to each of the following questions about your physical environment:

1. Security of the building:	INADEQUATE	1	2	3	4	ADEQUATE	5
2. Cleanliness of the building:	INADEQUATE	1	2	3	4	ADEQUATE	5
3. Building repair and maintenance:	INADEQUATE	1	2	3	4	ADEQUATE	5
4. Overall appearance:	UNATTRACTIVE	1	2	3	4	ATTRACTIVE	5
5. Interior colors:	UNATTRACTIVE	1	2	3	4	ATTRACTIVE	5

6. Temperature comfort:	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5
7. General temperature:	TOO COLD 1	2	3	4	TOO WARM 5
8. Temperature shifts:	TOO FREQUENT 1	2	3	4	CONSTANT TEMPERATURE 5
9. Ventilation comfort:	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5
10. Air freshness:	STALE AIR 1	2	3	4	FRESH AIR 5
11. Odors:	UNPLEASANT 1	2	3	4	NO ODORS 5
12. Furniture layout of nurse station:	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5
13. Size of your nurse station:	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5
14. Nurse station work surfaces:	INADEQUATE 1	2	3	4	ADEQUATE 5
15. Computer configuration: (keyboard, screen, mouse, etc.)	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5
16. Work storage space:	INADEQUATE 1	2	3	4	ADEQUATE 5

17. Work chair most often used:	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5
18. Break room:	INADEQUATE 1	2	3	4	ADEQUATE 5
19. Storage for personal effects:	INADEQUATE 1	2	3	4	ADEQUATE 5
20. Location of supply room:	INCONVENIENT 1	2	3	4	CONVENIENT 5
21. General noise distractions:	TOO DISTRACTING 1	2	3	4	COMFORTABLE 5
22. Specific noises from voices:	TOO NOISY 1	2	3	4	COMFORTABLE 5
23. Specific noises from equipment:	TOO NOISY 1	2	3	4	COMFORTABLE 5
24. Visual privacy in your nurse station:	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5
25. Conversation privacy:	UNCOMFORTABLE 1 2	3	4	5	COMFORTABLE
26. Telephone privacy:	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5
27. Overall lighting:	UNCOMFORTABLE 1	2	3	4	COMFORTABLE 5

28. High light levels:	UNCOMFORTABLE				NOT A PROBLEM
	1	2	3	4	5

29. Low light levels:	UNCOMFORTABLE				NOT A PROBLEM
	1	2	3	4	5

30. Light reflections on surfaces or screens:	UNCOMFORTABLE				NO GLARE
	1	2	3	4	5

31. Access to daylight:	INADEQUATE				ADEQUATE
	1	2	3	4	5

32. View out of windows:	INADEQUATE				ADEQUATE
	1	2	3	4	5

33. Overall, would you say that your current workspace helps you get your work done or makes it difficult to get your work done?

	MAKES WORK MORE DIFFICULT				MAKES WORK EASIER
	1	2	3	4	5

34. Overall, how satisfied are you with the physical environment in which you work?

	DISSATISFIED				SATISFIED
	1	2	3	4	5

If you would like to make any comments or suggestions regarding the functionality and comfort of your work space please write them in the space below. I would love to hear from you.

Thank you very much for responding to this questionnaire. I appreciate your time and cooperation!

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BIOGRAPHICAL SKETCH

Paige Walker received her bachelor's degree in family, youth, and community sciences, with a minor in education from the University of Florida in 2008. She began pursuing a master's degree in interior design in 2009. While completing her graduate studies she worked as an interior design intern at Shands at the University of Florida for over three years. She assisted in the design of large additions, new construction builds, and small renovations in the Shands building complex. During this time her interest and knowledge in healthcare design intensified, leading to the topic of her thesis research. After graduation she plans to work for an architecture firm specializing in healthcare design.