Macrocognition in the Health Care Built Environment (m-HCBE)

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Macrocognition in the Health Care Built Environment (m-HCBE): A Focused Ethnographic Study of 'Neighborhoods' in a Pediatric Intensive Care Unit
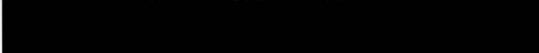
A Dissertation Presented

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DEDICATION

With Love and in memory and honor of my husband Mark Sullivan

With Love and my heartfelt appreciation to my Parents Helen and Paul O'Hara

And my Family, and Friends for prayers, postcards, practice, edits and support

ACKNOWLEDGEMENTS

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Abstract

Objectives: The objectives of this research were to describe the interactions (formal and informal) in which macrocognitive functions occur and their location on a pediatric intensive care unit (PICU); describe challenges and facilitators of macrocognition using three constructs of space syntax (openness, connectivity, and visibility); and analyze the health care built environment (HCBE) using those constructs to explicate influences on macrocognition.

Background: In high reliability, complex industries, macrocognition is an approach to develop new knowledge among interprofessional team members. Although macrocognitive functions have been analyzed in multiple health care settings, the effect of the HCBE on those functions has not been directly studied. The theoretical framework, "Macrocognition in the Health Care Built Environment" (m-HCBE) addresses this relationship.

Methods: A focused ethnographic study was conducted, including observation and focus groups. Architectural drawing files used to create distance matrices and isovist field view analyses were compared to panoramic photographs and ethnographic data.

Results: Neighborhoods comprised of corner configurations with maximized visibility enhanced team interactions as well as observation of patients, offering the greatest opportunity for informal situated macrocognitive interactions (SMIs).

Conclusions: Results from this study support the intricate link between macrocognitive interactions and space syntax constructs within the HCBE. These findings help to advance the m-

HCBE theory for improving physical space by designing new spaces or refining existing spaces, or for adapting IPT practices to maximize formal and informal SMI opportunities; this lays the groundwork for future research to improve safety and quality for patient and family care.

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Introduction and Specific Aims

Efforts to improve patient safety have been at the forefront of the national health care agenda since the release of the Institute of Medicine (IOM) report in 2000 linking medical errors to excessive patient deaths (Kohn, Corrigan, & Donaldson, 2000). Recent data suggests that the number of premature deaths due to preventable adverse events range from approximately 200,000 to 400,000 per year (James, 2013). Subsequent IOM reports established the importance of improving the healthcare delivery environment and interprofessional team work to reduce error and improve safety (Cuff & Institute of Medicine (U. S.), 2013; (Reid, Compton, Grossman, & Fanjiang, 2005). Despite singular efforts, it is the systems view which may help radically improve patient quality and safety; one that goes beyond individual performance knowledge and psychomotor skills and abilities to include adaptive interprofessional team cognitive performance within the complexity of the health care built environment.

Defined as "the adaptation of cognition to complexity" (Klein et al., 2003, pp. 81-85), macrocognition provides a broader cognitive approach to improving patient quality and safety. The theory of macrocognition is comprised of five interrelated functions: sensemaking, re-planning, detecting problems, deciding, and coordinating (Patterson & Hoffman, 2012). Macrocognition research has been situated in all industry settings but the influence of these settings on macrocognition has not been studied.

The goal of this research is to provide preliminary data about the influence of the health care built environment (HCBE) on macrocognition with the long-term goal of improvement in the design of the HCBE and ultimately, patient quality and safety. This research will advance a novel cognitional model, macrocognition in the HCBE (m-HCBE) by answering the question: "What are the influences of the HCBE on macrocognition." The m-HCBE Model is grounded in

the nursing metaparadigm (person, health, nurse, and environment) (Fawcett, 1984; Nightingale, 1860), and two theories: Macrocognition theory (Patterson & Hoffman, 2012) and space syntax theory (Haq & Luo, 2012; Hillier, 2008).

To accomplish the proposed goal, I will conduct the following specific aims:

1. Describe the interactions (formal and informal) in which macrocognitive functions occur and their location on a pediatric intensive care unit in an academic medical center.

2. Describe the challenges and facilitators of macrocognition within the physical environment of a pediatric intensive care unit using the space syntax constructs (openness, connectivity, and visibility).

3. Analyze the HCBE of the pediatric intensive care unit using the space syntax constructs to explicate influences on macrocognition.

Background and Significance

A search strategy to identify existing research using the terms 'macrocognition' AND 'health' AND 'care' AND 'environment' in PubMed and Google Scholar returned 880 documents while a second phase review was conducted to fine tune the search for health care inpatient environments using Google Scholar, PubMed, Psych Info, Scopus, and CINAHL searching terms "macrocognition and/or macrocognitive" AND 'hospital' (substituting for 'health' AND 'care' AND 'environment') returning 81 documents.

In the literature it was noted that early influences on macrocognition came from cognitive systems engineering professionals (Rasmussen, 1983) and the work of Hutchins (1995) who coined the term 'cognition in the wild,' after witnessing how crew members all working in different capacities came together in a severe storm crisis to reorient the navigational system of their ship (Hutchins, 1995). Macrocognition is situated in the 'natural decision making'

philosophy which views the concept in the real world (Hutchins, 1995). It is an approach for cognitively solving problems in complex environments where teams are working (Cacciabue & Hollnagel, 1995; Holden, 2011; Letsky & Warner, 2008; Schraagen, Klein, & Hoffman, 2008).

Macrocognition concepts are found in three sentinel papers describing how the lack of visibility between team members or between workers and their computer screens negatively impacted communication (Bentley et al., 1992; Mumaw, Roth, Vicente, & Burns, 2000; Patterson, Watts-Perotti, & Woods, 1999). In the health care industry, macrocognitive functions have been analyzed in settings from the global community to the local outpatient and inpatient health care setting. Applying the macrocognitive framework to resolving Haiti disaster relief efforts and emergency rescue teams responses helped improve ways to organize teams and resources and develop ways to prepare for future disasters (Beas & Lysne, 2011; Hutchins, 2012; Hutchins, Kendall, & Bordetsky, 2008; Militello, Sushereba, Branlat, Bean, & Finomore, 2015).

In the outpatient non-emergent health care setting, macrocognitive functions were used to evaluate self-care of type 2 diabetic and elderly cardiac patients. These studies concluded that attention to macrocognitive functions offered a more structured approach to patient decision making and self-care with some improvements in glucose regulation and potential for better adherence to medication planning (Dhukaram & Baber, 2015; Klein & Lippa, 2008).

Macrocognition in the inpatient health care built environment has been studied by examining formal team cognitive interactions such as intensive care unit rounds and handovers. Improving these interactions resulted in medical error reduction and better individual and team judgment (Hill, 2010; Patel, Shine, & Almoosa, 2014; Patterson, 2008). An examination of macrocognition has been found useful in identifying cognitive functions in various and multiple

prehospital (emergency response) and other healthcare settings and practices (Perry, Wears, & Patterson, 2008).

Safe health care environment design.

Different macrocognitive functions are described *in* the HCBE, but the effect of the HCBE *on* those functions is not directly addressed. While hospital environments vary across these studies and cannot be directly compared, several studies suggest that macrocognitive functions are influenced by these work environments.

Several design changes in the health care environment have been introduced on inpatient units, in specialty areas, and within individual patient rooms (Reiling, Hughes, & Murphy, 2008). While much of the research has been qualitative, only recently have these changes been quantified with the effect on economic gain. (Zadeh, Sadatsafavi, & Xue, 2015).

Patient visibility has long been a factor in patient safety and quality. The creation and use of decentralized nurses stations was proposed as one way to decrease errors and injuries (Bayramzadeh & Alkazemi, 2014; Pati, Harvey, Redden, Summers, & Pati, 2015; Zborowsky, Bunker-Hellmich, Morelli, & O'Neill, 2010; Zborowsky & Kreitzer, 2009). The results have been conflicting. In an exploratory study, Zborowsky (2010) found no difference in patient visibility between centralized and decentralized nurses' stations, while a quasi-experimental study of decentralized work stations found improved work quality and better patient satisfaction but increased walking distance and reduced collaboration (Pati et al., 2015). Using a case study methodology, Keller (2010) described the value of physicians working together in complex environments using their team knowledge to diagnose chest pain, explaining how experience *and* visually seeing coworkers seem to have more value than heuristic algorithms (Keller, Cokely, Katsikopoulos, & Wegwarth, 2010).

Although studies have not specifically looked at the links between macrocognition and the HCBE some do suggest that the linkage exists. A study focused on re-planning, one of the five macrocognitive functions (Patterson, Ebright, & Saleem, 2011), was undertaken in the inpatient setting to learn how novice and experienced nurses prioritize their bedside care activities. This study uncovered that if nurses are visibly able to see their coworkers, have less distance to travel to request help to team up on tasks, and receive coverage for breaks then prioritizing tasks can occur more easily. When both novice and experienced emergency department physicians work in a location such as an 'interprofessional team center' where they see each other, they are more likely to seek advice from which emergent phenomena occur, raising the overall unit expertise (Schubert, Denmark, Crandall, Grome, & Pappas, 2013).

Safe health care built environment design in the ICU.

Intensive care unit design has undergone significant change to improve patient quality and safety. Chindhy (2014) performed a retrospective chart review study of a cardio-thoracic unit before and after the implementation of the 'acuity adaptable room.' They reported ICU length of stay was shortened by half (49 to 26 hours) and hospital length of stay by one day (6 to 5 days) while post-operative cardiac surgical complications were reduced by 15 per cent (Chindhy et al., 2014). In a quantitative study of a medical intensive care unit (MICU) Leaf (2010) compared clinical outcomes with patient visibility from the central nurses station and found higher mortality rates in patients assigned to rooms less visible to the nurses (Leaf, Homel, & Factor, 2010). Lu (2014) reinvestigated this research to confirm the relationship between visibility and mortality in the intensive care unit, reporting a "… 33.5 % variance of mortality when field of view was obstructed" (Lu, Ossmann, Leaf, & Factor, 2014, p. 92). These studies have

demonstrated health care design changes which have improved patient care and quality by reducing patient transfers through acuity adaptable rooms and improving visibility.

While the literature suggests macrocognition and the built environment influence patient quality and safety, there is scant research that has specifically looked at the influence of the HCBE on macrocognition. This study will extend current research in the field of macrocognition and the design of the health care built environment.

Theoretical Framework

Introduction

I developed the macrocognition-Health Care Built Environment theoretical framework as an approach to conduct research to assess the impact of the HCBE with a larger goal of improving patient outcomes and inpatient design. Grounded in both the IOM aims (Kohn et al., 2000) and my clinical and professional experience, I have operationally defined the health care built environment (HCBE) as a physical space or group of spaces (campus), incorporating clinical, architectural (physical space), and operational science, and interprofessional teams in order to provide adaptive, optimal, quality, safe, cultural, and cost-efficient patient and family care. No one component is more important than another. It encompasses a 'door to door' series of interactions: patients leave home and then either return to home or leave the hospital to the next 'door' whether skilled nursing facility or other locations.

The framework, depicted in Figure 1, the healthcare built environment (HCBE) patient experience, shows how interprofessional teams are categorized: ancillary, operational, and clinical. Each interprofessional team's 'stream of knowledge' has a specific and singular approach to improving patient and family care. Although each expert offers support and care from within their own professional guidelines, they work together to provide an interprofessional

team approach to patient care. As noted in this image, once patients enter the HCBE, the IPT works to provide care in this complex environment in which through joint activity, emergent phenomena are uncovered. Situated macrocognitive functions are found in the space and time continuum and expressed through formal and informal interactions of macrocognition. It is hypothesized the HCBE influences this care, thus effecting safety and quality outcomes for patient and family care.

Nursing metaparadigm and theories informing the m-HCBE model

This emergent theory 'm-HCBE' is grounded in nursing (the metaparadigm), human factors engineering (macrocognition theory) and architecture (space syntax theory). These will be described below.

Nursing.

All nursing research questions are centered on one or more of the four components of the nursing metaparadigm: nursing, health, client, and environment (Fawcett, 1984). The nursing metaparadigm is influenced by the work of Florence Nightingale who defined nursing as "the act of utilizing the environment of the patient to assist him in his recovery" (Nightingale, 1861). In her book "Notes on Nursing: What it is and what it is not"(Nightingale, 1860), Nightingale discussed the external elements affecting both the healthy and sick person. She pushed for sanitary measures and environmental factors such as light, fresh air, warmth, diet, cleanliness and even protection from upsetting news (Nightingale, 1860; Selanders, 1993). Nightingale discussed how communication between team members and patient and family occurs but not how new knowledge emerges.

Florence Nightingale defined the environment of care as a physical space which should be designed and managed to improve patient outcomes and decrease length of stay. She

investigated and observed behavior within this space, similar to the urban-sociological view of the space, buildings and cities as explained by the space syntax theory. While all four components of the nursing metaparadigm have a role, the focus of this research is the environment.

Human factors engineering: Macrocognition.

Macrocognition is an evolving term with multiple definitions. For this study, I will use the definition: "Joint activity distributed over time and space; coordinated to meet complex dynamic needs in uncertain event driven environments with conflicting goals and high consequences for failure made possible by effective expertise in roles; shaped by organizational constraints that produces emergent phenomena" (Patterson & Miller, 2010, pp. xxxi, 307). Macrocognition is important in the health care setting because it encompasses emergent phenomena and new knowledge as teams adapt to complex and evolving situations such as those encountered in patient care.

The macrocognition visualization framework (Figure 2) was created by Hoffman and Patterson (2012) to define and describe the interrelatedness of the functions of macrocognition sensemaking, re-planning, deciding, detecting problems, and coordinating. *Sensemaking* is "collecting, collaborating, and integrating information and assessing how this information maps onto potential scenarios and *Re-planning* is '…adaptively responding to changes in objectives from sources'" (Patterson, Bernal, & Stephens, 2012). (Patterson & Miller, 2010, pp. xxiii-xxvii). *Deciding,* also called decision making (Alison et al., 2015), is the 'act of committing to some course of action in order to reach certain fixed goals' (Patterson et al., 2012; Patterson & Hoffman, 2012). *Detecting problems* describes how persons use sensory and perceptual

processes to focus on important changes in the environment; it is also known simply as noticing (Chang et al., 2014; Patterson et al., 2012; Whaley et al., 2012).

In the visualization framework, Patterson and Hoffman created a ring around all the other functions to depict how *coordinating* "... manages the interdependencies of all the phases" (Patterson & Hoffman, 2012, pp. 221-227). Team coordination is the macrocognitive function that focuses on how people interact with each other to coordinate individuals working on a task. Coordination fails when errors occur in communication, leadership or supervision (Parush, Kramer, Foster-Hunt, McMullan, & Momtahan, 2012; Whaley et al., 2012).

Macrocognition connects how people work together in a temporal and contextual way: it is the intersection of cognition and actions in time and space with the goal of improving patient care. Moreover, it is important to note that macrocognitive functions occur in the physical space of the HCBE but to date scant research has been conducted that examines this relationship.

Architecture: Space syntax theory.

Space Syntax Theory is founded on the principles of form and function: the shape or configuration of a space is created to accommodate planned functions while the functions are influenced and changed by the form or shape of the space (Hillier, 2014). It qualitatively examines cognition, behavior and interactions within the space. The application of this theory to design can be accomplished with quantitative methods to measure the space syntax theory constructs including: openness (lack of boundaries or partitions), connectivity (adjacencies to other spaces), and visibility (line of sight) (Haq & Luo, 2012; Trzpuc & Martin, 2010; Zeisel, 2006). These particular constructs are selected as they are most relevant to understand the effect of the HCBE on macrocognition.

Although space syntax theory was originally conceived in the late 20th century, much of the health care application has been in the 21st century. Recent health care research has focused on nurse movements in health care spaces concluding that visibility, communication, and assignment locations affect patient care (Cai & Zimring, 2012; Hendrich et al., 2009; Hillier, 2008; Sailer & Penn, 2009; Trzpuc & Martin, 2010).

Theory Description.

Using the Meleis approach for theory description (Meleis, 2011), I will describe the structural components (assumptions, concepts and propositions) and functional components (Meleis, 2011, pp. 185-194) of the m-HCBE theory.

Structural components.

Assumptions (reflecting implicit values, beliefs and truths (Meleis, 2011, p. 25) which are identified in this theory.

1. "Nursing is the act of utilizing the environment of the patient to improve his care" (Nightingale, 1861).
2. "Form ever follows function" (Louis Sullivan, architect, 1896) meaning the way a space is designed should follow the function or purpose of the users or occupants. It is the architectural response to operations which is critical in the healthcare field.
3. The healthcare built environment is a complex setting in which care is adaptive.
4. Interprofessional team members must cognitively work together to provide optimal patient care.

Concepts.

The macrocognition in the Health Care Built Environment (m-HCBE) theory has four central concepts: Macrocognition, HCBE, interprofessional health care teams, and situated macrocognitive interactions. The first three of these concepts have been described. Interactions have not been previously described and are explained next.

An interaction has been defined as " a reciprocal action or influence" (Allen, Fowler, & Fowler, 1990, p. 617) and further elaborated to include "…reciprocal events that require at least two objects and two actions; they occur when these objects and events mutually influence one another" (Wagner, 1994). Interactions are socially situated episodes or communications within organizations, work places, or academic settings between colleagues, scientific researchers or students and instructors (Chaboki, Wahab, & Ansari, 2013; Ipe, 2003; Isaacs, Whittaker, Frohlich, & O'Conaill, 1997; Kraut, Egido, & Galegher, 1988; Kraut, Fish, Root, & Chalfonte, 1990; Wagner, 1994) for the purpose of exchanging knowledge or information. Interactions occur between humans or between humans and technology, whether virtually or situated in the environment, and are classified as formal or informal.

A formal interaction is a routine or scheduled activity or meeting lasting more than a few minutes and often with planned participants and agendas (Isaacs et al., 1997; Kraut et al., 1990). In the health care setting formal interactions might include activities such as team rounds, shift change handover reports, huddles, or unit staff meetings. Informal interactions are unplanned, spontaneous events often occurring due to proximity to another individual in a space or visual prompts (Kraut et al., 1988; Kraut et al., 1990; Whittaker, Frohlich, & Daly-Jones, 1994). These interactions can include overhearing or impromptu activities.

Overhearing another conversation and learning from it or joining it may be the antecedent of one or more macrocognitive functions (Vuckovic, Lavelle, & Gorman, 2004) while antecedents for impromptu interactions occur as a result of seeing another IPT member. Both formal and informal interactions consist of one or more of the five macrocognitive functions: Sense-making, re-planning, deciding, detecting problems, and coordinating. Given these

interactions are situated in the environment they will be called 'situated macrocognitive interactions' (SMIs).

Proposition.

The theory is in the early stages of development and thus I will focus on only one proposition: Macrocognition is influenced by the HCBE. The purpose of my research is to examine the HCBE influences on macrocognition. I intend to observe and understand how the environment affects cognitive work between IPT members in the pediatric intensive care unit.

Functional Components.

The m-HCBE theory is comprised of two functional components: the metaparadigm and the environment. I am concerned with all the components of the nursing metaparadigm but I believe the environment is vital to the cohesion of the components. The ultimate purpose of the research is to improve the quality of health care by advancing knowledge of how the built environment enhances macrocognitive functions.

Preliminary Empirical Work.

My research is founded in the clinical nursing work and subsequent design consulting I perform as a nurse and as founder of a consultancy for health care architects and nurse leaders. An approved process improvement project was conducted at MD Anderson Cancer Center in Orlando Florida. No IRB was required as the facility considered this a process improvement opportunity (Penoyer, 2015). We compared centralized and decentralized nurses' station and the effect on interdisciplinary patient and family care. Nurses (n=5) and non-nurses (n=5) were interviewed using a post-occupancy survey (Vischer, 2001; Zimring, 2002; Zimring & Reizenstein, 1980) to determine which layout was more effective.

On the unit with the centralized nurses' station, the ancillary IPT members identified less time searching for the nurses to get a 'real-time' report to determine the status of the patient. On the unit with decentralized nurses stations, the IPT members identified a theme of decreasing efficiency and ability to perform assessments and care due to the need to 'find the primary nurse' before entering their mutually assigned patients' rooms. Thus, this preliminary project suggested an influence of the HCBE on facilitating situated macrocognitive interactions.

Methods

Design

A focused ethnographic study will be conducted in the pediatric intensive care unit (PICU) of the Johns Hopkins Hospital (JHH) within the Johns Hopkins University School of Medicine in Baltimore, MD. This method is appropriate for understanding one aspect of a culture in a short engagement as outlined by Fetterman (2010) and described by others (Cruz & Higginbottom, 2013; Hammersley & Atkinson, 2007; Knoblauch, 2005; LeCompte & Schensul, 2010; Schensul & LeCompte, 1999). In particular, this study will focus on interactions amongst the interprofessional team members within the context of the PICU culture. Observation and focus groups will be used to describe macrocognitive functions of sensemaking (SM), re-planning (RP), deciding (D), detecting problems (DP), and coordinating (C) (Patterson & Hoffman, 2012) among interprofessional team (IPT) members and the space syntax constructs in this unit. As the investigator, I am a non-participant observer as defined by Spradley (1980) and cited in Whitehead (2005). I will not be engaged in the everyday work of the PICU and will not be delivering patient care.

Sample

I will use maximum variation sampling for shadowing ancillary, clinical, and operational IPT members working in the PICU on the days I am observing and for the focus groups (Creswell, 2007). I will recruit members of the IPT who are working in the PICU on the days I am on-site observing. The sample pool will include ancillary team members (i.e. speech and respiratory therapists, nutritionists, rehabilitation services, radiologists), clinical team members (i.e. nurses, nurse practitioners, residents, and physicians), and operational team members (i.e. nurse managers, charge nurses, unit supervisors) who are involved directly or indirectly in meeting the needs of patients to provide direct patient care or care management and consulting. I anticipate observing one to two rounding events per day through the week and shadowing two to four individuals per day.

Inclusion and exclusion criteria for observation and focus groups.

Inclusion criteria: An IPT member working in this PICU; age 18 or older; English speaking; provides direct care or care management or consultation on this PICU.

Additional inclusion criteria for focus groups only: have worked in PICU for 6 months or longer

Exclusion criteria: Non-PICU IPT members; non-English speaking; do not provide direct care or care management on this PICU; decline to provide consent.

Additional exclusion criteria for focus groups only: have worked in PICU less than 6 months

Protection of human subjects

Institutional Review Board (IRB) approval will be obtained from the Johns Hopkins University School of Medicine (JHUSOM) and an interagency agreement between JHUSOM and University of Massachusetts, Worcester will be completed. Consent for observation in the PICU is twofold: from parents and from interprofessional team (IPT) members. Shadowing

formal and informal SMI's in a patient's room requires written consent from parents. Participant IPT members must provide oral consent to be observed. In accordance with JHH policies, consent for focus group participation will be written as these meetings will be recorded with a hand-held digital audio recording device. Consent procedures are outlined in Table 1. Written informed consent to digitally record focus group discussion will be obtained for each IPT member.

All data will be de-identified for analysis. The UMW dissertation committee members will have access to de-identified data for purposes of dissertation advisement. The JHH co-PI's will be provided with de-identified aggregate data only so that staff confidentiality is maintained.

Ethical concerns relate to the dual role of nurse / researcher. As a nurse, if I witness a critical event, I will immediately notify the charge nurse or call for help (Houghton, Casey, Shaw, & Murphy, 2010).

Setting

This research will be conducted in the 40 bed Pediatric Intensive Care Unit within the Johns Hopkins University School of Medicine academic medical center located in Baltimore, Maryland. The PICU is a new unit, in operation just three years and was built according to architectural and public regulatory codes. All rooms are single occupancy. The rationale for conducting research in this PICU is the unit offers the opportunity for the greatest complexity and the potential for emergent phenomena to occur and be described. I plan to observe interprofessional team members working in the PICU in their natural setting or the emic perspective. Analysis of these observations is from my etic or outsider perspective (Fetterman, 2010, pp. 20-22).

Pre-Visit

As the PI, I will conduct a pre-visit prior to data collection accompanied by a committee member of the research team well versed in ethnographic field work, if available. This visit is for relationship building and to visually observe the actual unit layout. I will introduce myself to the JHH co-principle investigators and meet with the PICU charge nurse(s) to learn about the staff population. We will tour the unit and by doing this site visit and walk-through, I will be able to improve my understanding of the spatial constructs from the two-dimensional view of the floor plan. This will provide insight for the best locations for the observations and shadowing.

Procedures

I will observe formal (F) and informal (IF) situated macrocognitive interactions (SMIs) in the PICU. This will be accomplished by observing the space (general unit observation) as well as the IPT members (shadowing of individuals and team rounds).

Additionally, I will conduct focus groups, using a semi-structured interview guide at the end of the observation period. This is to triangulate my observation field notes with information elicited from the IPT members attending the focus groups about SMIs and the places they occur in the PICU. Triangulation and other techniques described further below will be utilized to maintain trustworthiness, as outlined in Lincoln & Guba (1985) (Lincoln & Guba, 1985, pp. 289-331).

General unit observations will occur in one of three types of functional spaces: patient room (P/R), staff and support space (S/S), and circulation space such as corridors (C/S) (Rashid, 2014). Shadowing IPT members who agree to participate allows me to observe where and when informal SMIs occur. An example of this would be if during the formal SMI, there is an 'aside' conversation (informal SMI) where two IPT members talk while the original formal SMI is

occurring. Shadowing will allow me to observe consequences of the original SMI such as IPT members 'hanging back' to further discuss a patient's care.

Antecedents to these situated macrocognitive interactions could include IPT members 'getting ready' for the interaction. An example of this would be if before the interaction, there is a preparatory conversation where a nurse and the respiratory therapist meet to review the care plan, see patient together, or collect and update data. Handwritten field notes will be documented on two types of data collection worksheets: the observation worksheet and the floor plan worksheet as seen in Table 3. and Figure 4.

Recruitment.

Access to interprofessional team members and clinical oversight will be accomplished with assistance from the two JHH co-PIs: James Fackler, MD, Associate Professor, Anesthesiology and Critical Care Medicine Director, Safety-Quality-Logistics, PICU and Judy Ascenzi, DNP, PICU Clinical Nurse Specialist (CNS). Dr. Fackler will facilitate meetings and access to the interprofessional team members while Judy Ascenzi will provide access to the PICU clinical team members. A previous ethnographic study on this unit by an outside researcher was favorably received which supports the feasibility of the setting for this study (personal communication, J. Ascenzi). An introductory phone meeting took place on August 14, 2015. During this meeting permission for the study was granted (pending official IRB approval) including a pre-research site visit to tour the unit and meet the unit leadership.

Once IRB approval is obtained, the research study will be introduced to PICU IPT members via posters, emails notices, and during any introductory meetings as deemed appropriate by the study site co-PIs. The study site co-PIs will direct me on how to distribute notifications of the study to the ancillary and operational team members as well as where to post

the IRB approved fact sheets (such as in elevator lobby, on bulletin boards in nurses station or in the break and conference room).

During the day of orientation, in a staff meeting scheduled by Judy Ascenzi, I will explain to the IPT members that the purpose of the research is to understand how the PICU interprofessional team (IPT) members use the PICU space and that I will be observing how people are working in the PICU. I will explain that my role is to observe the use of the space and not study IPT member's efficiency or how protocols are being followed. I will not use the word 'macrocognition' in the explanation in order to minimize bias of participants and changes in behavior trying to show me how they cognitively perform. The posters and notices about the research will convey this information. By posting these notices, along with my email and mobile phone number, I anticipate IPT members will decide to participate and can notify me by email or text of their commitment and acceptance for being shadowed and to participate in the focus group when I arrive on the first day of observation.

These groups will be conducted on the last day of data collection to minimize any bias of behavior throughout the observations in this research study. Invitations will be on posters and in email correspondence to all IPT members.

Retention.

Retention of subjects will be facilitated by detailed explanation so interprofessional team members can understand the process and commitment in advance of the research study. Retention will be further assisted by the fact that the observation period is only one week. Also, the IPT members will only be shadowed for two to four hours and may only be shadowed once in the week.

Data Collection.

Data collection will take place during an 11 day period but may not require all these days. It includes nine days for orientation, observation and focus groups. Two flexible days are added to allow for additional observation if saturation is not met and/or the focus group cannot be held on the scheduled day (if it conflicts with a critical event on the unit) (Table 2). This is a focused ethnography and saturation is intended to be met within the structure of the research schedule and to meet the aims of the research.

Data will include artifacts, unit observation field notes, focus group notes and demographics of IPT members who participate in shadowing and/or focus groups and digital audio recordings of focus groups. These data will be collected through: (a) written and verbal requests for artifacts; (b) unit observation; (c) shadowing individual team members; and (d) focus groups. Procedures for data collection are described below.

Artifacts.

Ancillary, clinical, operational, macrocognitive, and spatial artifacts (floor plans of the unit and photographs (without people) of the layout from different locations with a 360-degree perspective) will be collected prior to, and during engagement including organizational charts, protocols and samples of visual posted reminders for team meetings. The data request will be sent by email to the JHH co-PIs. Because often the printed floor plan of a unit is 24" x 36" and would be too large to use for field notes. The architectural consultant will convert PICU floor plans (containing no human subject's data) from architectural file formats ('dxf' or 'rvt') to pdf formatted files for ease of use for field notes.

Unit Observation.

Demographic data will be collected from all individually shadowed participants. It will include gender, professional credentials, years in professional role, and years worked in the PICU.

Formal situated macrocognitive interactions.

Formal SMIs will be observed by shadowing scheduled IPT rounds or huddles. During each shift, I anticipate observing one rounding activity comprised of more than one type of IPT member. For example, interprofessional medical rounds would be included while rounds with only nurses or only physicians would not. I anticipate each rounding activity will take 45 to 90 minutes. At the end of the one week observation period, I will shadow a minimum of three to five different formal SMIs. For example, a one week observation could include the following formal SMIs: general surgery rounds, medical rounds, radiology rounds, and a huddle.

On the floor plan documents, I will mark the observational variables such as the location, route, duration at each stop, type of SMIs occurring and the signal that the interaction has ended. Antecedents of formal interactions may be unit protocols or posted schedules. Consequences could be IPT members performing one of the macrocognitive functions or participating in additional informal interactions which may ensue.

Informal situated macrocognitive interactions.

Informal SMIs will be observed through (a) general unit observation (space-based) and (b) shadowing an individual over time (as in following an IPT member during a few hours of their shift) in the context of the IPT members' work environment.

General unit observation will occur in two to three different spaces per shift for approximately 2 hours per space. During each shift, I will observe SMIs for a total of

approximately 4 to 6 hours. At the end of the observation week I anticipate observing a total of 14 to 21 staff and support spaces or circulation spaces. After three days of general unit observation I will debrief with peers in the architectural and human factors engineering professions about the space syntax constructs and the nature of the macrocognitive functions I am observing. Interprofessional team member observation will include going into patient rooms while rounds will not require entrance into patient rooms as this is not part of the Johns Hopkins proposals.

I will shadow an individual IPT member for approximately 2 hours per shift. If they leave the unit, or they take a break, I will go with them to observe any additional informal SMIs. In the field notes I will document the IPT members' situated macrocognitive interactions by type, location, and macrocognitive function as well as the start and end times for which they occurred. Shadowing an IPT member includes documentation of mood and general behavior during the shadowing period (McDonald, 2005). I will shadow at least 3 to 5 IPT members representing different ancillary, operational, or clinical groups during the one week observation period. I will conduct member checks at the end of each interaction, using probing questions as needed to clarify what I heard or observed during the interaction, as well as the antecedents and consequences of the interactions.

Observation worksheet.

Field notes will be documented onto the observation worksheet (Table 3). Each situated macrocognitive interaction will be assigned an interaction identification number (SMI ID#) as seen in column A to help with data analysis, allowing for comparison to other field note documents. The date and start and end times are noted in columns B, C, and D. In columns E, F,

G the situated macrocognition interaction type, location and macrocognitive function will be noted.

Floor plan observation worksheet.

Each observed interaction will also be documented on the floor plan. Multiple copies of blank PICU floor plans will be brought to the PICU to aid in keeping track of location, duration, and IPT members in attendance (Figure 4). I will bring the floor plans to daily observations to use as part of my fields notes for marking locations, routes, duration and types of interactions.

Focus groups.

Two focus groups comprised of IPT members who may or may not have been shadowed will be conducted to discern any information regarding use of the space and the macrocognitive functions I may have missed, and to validate my observations on the unit. Focus groups offer the opportunity to "…better understand the research site and participants, build on previously collected data, and generate new hypotheses" (Schensul & LeCompte, 2012, p. 196). Demographic data will be collected from all focus group participants including gender, professional credentials, years in professional role, and years worked in the PICU. An identification number will be assigned to each participant and placed in front of the chair or otherwise in a visible place.

I will conduct semi-structured interviews in the focus groups, with questions guided by macrocognitive functions and space syntax theory according to the research study aims (Table 5). As part of the discussion, each participant will be provided with a blank floor plan and asked to mark up on the floor plan where they recall performing formal and informal situated macrocognitive interactions. Each blank floor plan will have an identification number on it to match up to the participant. These floor plan mark-ups, along with the focus group responses,

will aid in triangulation of my aggregated observation data. I will not be looking for associations between the shadowed participants and the focus group participants at the individual level.

A trained research assistant will be recruited to observe the interactions within the focus group. Two focus groups comprised of 5 to 10 IPT members each will be held using a maximum variation sampling procedure to ensure a mixed or diverse population (Creswell, 2007, pp. 126-127). This population will be representative of the ancillary, operational, and clinical interprofessional teams. Maximum variation will be used for interprofessional team member selection. Additional team members would add to the thickness of the data collected. If I am unable to conduct a focus group of at least 5 members, I will stay an additional day in order to do so.

They will be held in a designated conference room during meal time breaks each lasting about 30-45 minutes. The meals will be provided for reciprocity.

Data Management.

All journal documentation and all handwritten field notes and floor plan mark-ups will be scanned using a hand-held scanner (which I will bring) into my personal encrypted computer then uploaded directly to my secure University of Massachusetts, Worcester (UMW) drive at the end of each shift, in a space provided by the PICU. A naming convention will be employed for filenames such as Day1_FieldNotes. The hand-written notes and my floor plan mark-ups along with the IPT members' floor plan mark-ups will be shredded or disposed into a designated secure receptacle (per hospital policy) prior to leaving the PICU. The focus group digital audio recordings (in an MP3 file format) will be uploaded from a hand-held recording devise to a secure UMW drive after each focus group. A naming convention will be employed for filenames such as FG1_Audiodata.These files will be made available to a UMW approved transcriptionist

who will no longer have access to the data files upon completion of the transcription, and the PI will delete the files five years data collection.

Data Analysis

Quantitative Data Analysis.

Demographic data analysis of descriptive statistics, medians, ranges and standard deviations will be analyzed using Microsoft Office Excel or SPSS software. Field notes of observations (interactions) will be manually documented for input into NVIVO software (Beekhuyzen, Nielsen, & von Hellens, 2010). Because field notes and floor plan locations are necessary, it is important to use a software program that allows for disparate data. Also, because I am using directed content analysis with theoretical themes, NVIVO provides the opportunities to enter and analyze themes. If I find new themes which I am uncertain if they match the domains of interest, then I will conduct peer debriefing to validate interpretation of data.

The architectural consultant will create distance matrices to measure path distances as exemplified in Figure 3. The distances are measured in feet. The blue letters represent the types of functional spaces: Patient Room (P/R), Staff and Support space (S/S) and Circulation Space (C/S). The space syntax constructs will be analyzed using this distance matrix as well as the field notes. The floor plan mark-ups will be compared in an aggregated way. Individual floor plan mark-up obtained in the focus groups will not be compared with those documenting the locations of the individual IPT members I have observed. In this ethnographic study, space syntax analysis will be accomplished through coding analysis at this time.

Coding.

Directed content analysis as described by Hsieh (2009) will be used for both observation and focus group data. This approach is well suited to research that has a theoretical foundation

with specific categories (Hsieh & Shannon, 2005, pp. 1281-1283). I will use categories based on the formal or informal situated macrocognitive interactions which can yield one or more of the five macrocognitive functions (sensemaking, re-planning, deciding, detecting problems, and coordinating) and the three space syntax theory constructs (openness, connectivity, and visibility). The space syntax constructs of the physical environment derived from focus groups semi-structured interview guides or through shadowing will be described thematically. For example, the observation can include noting if IPT members cannot hear each other, or find an outlet to use for personal computer, or find a privacy zone to discuss their patient. In addition, analysis will remain open to new themes that may reflect the interface between macrocognition and the HCBE.

Trustworthiness.

The techniques to improve each of the four criteria of trustworthiness (credibility, transferability, dependability, and confirmability) as described by Lincoln and Guba (1985), have either been mentioned earlier or will be briefly discussed next. Credibility is maintained through member checks and peer debriefing as well as triangulating observation data with existing published research and by comparing observation to focus group information. Prolonged engagement will occur through an in-depth field observation and extending the scope of general unit and shadowing observations by a day, if needed. Persistent observation will be accomplished by differentiating between all the variables in the PICU to focus on those most significant to the research study (Lincoln & Guba, 1985, p. 304).

Transferability will be accomplished through thick description. Thick description occurs by taking detailed ethnographic notes which explain not just the frequency or location of the

situated macrocognitive interactions, but the context. These notes are then consistently compared to journal entries and field notes so that the findings are grounded in these data.

Dependability is managed by auditing field notes and reflexive journaling. Daily journaling will include information and personal notes about the process, times, and places where macrocognitive functions occur. Reflection is dependent on daily observational data found in the field notes. Confirmability is managed by use of a confirmability audit trail. First described by Edward S. Halpern and explained in Lincoln and Guba (1985) as demonstrated in Table 6. In this table, column B is for audit items, column C is the checklist, and column D is specific to this research study.

Potential Challenges

Due to the complexity of care in the PICU, I anticipate challenges to include permission, day to day changes in operations or IPT member behavior, generalizability, and finally, space syntax analysis. Interprofessional team members are very busy and may not have time to be interviewed.

Receiving permission in a timely manner to enter the patient's room during rounds will be obtained 24 hours before each observation day. The challenge of variation in day to day operations by IPT members and subsequent changes in nurse to patient ratios on different days of the week can be mitigated by observing during one full week, including the weekend and observing on sequential days to minimize this limitation. Changes in behavior of the IPT members may occur if they know they are being shadowed but this should be minimized after one to two days of observation. The PICU is a single unit in an academic medical center. Generalizability of the findings from this study will be limited to similar settings.

Using the theoretical space syntax constructs may be less informative without applying the quantitative methods of the theory to the observations and the PICU physical environment. However, by understanding the movement patterns and IPT member interactions and locations on the unit in which they occur, the distances traveled, and other artifacts such as 360-degree visibility demonstrated in the photographs may minimize this theoretical adaptation.

My perspective is based on clinical nursing experience in critical care units, pediatric and adult cardio-thoracic intensive care units, and in a pediatric emergency department. It is also based on my professional experience observing how interprofessional team members work in their current HCBE for the purpose of planning facility renovations or new design for the purpose of which will improving patient and staff satisfaction safety, and quality. I am the owner of a health care design consultancy company. However, this research is being conducted under the auspices of the student role at the UMW and is not funded by the company. Measures to address any potential conflict of interest will be undertaken including: clear delineation of goals as research not consultation; acknowledgement of disclosure in all research applications /approvals; reflexivity to be aware of potential biases.

Summary

A focused ethnographic study incorporating observation and focus groups will be used to explore the influences of the HCBE on macrocognition. The proposed study will add to our understanding of how health care space may be improved to better support macrocognitive functions. Results will advance a novel cognitional model, m-HCBE. Future research studies can use this approach to examine the design of health care environments in metropolitan and rural acute care hospitals and outpatient settings.
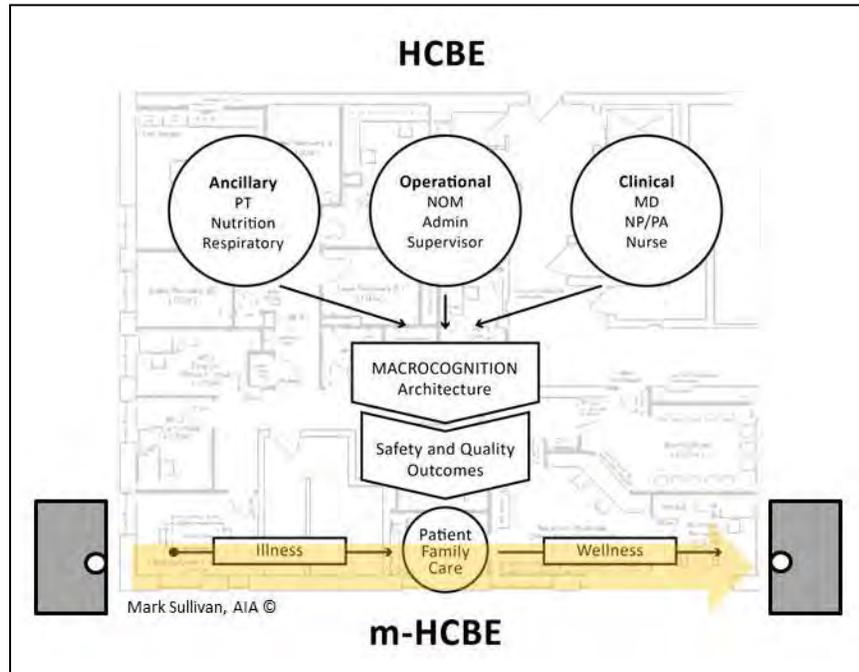
Appendices

Figure 1. Health care built environment patient experience*
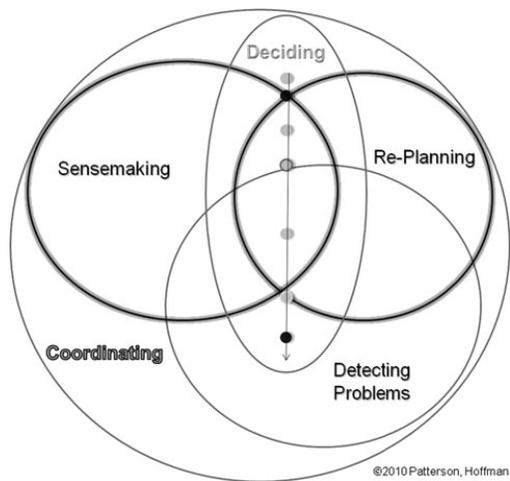
 *floor plan cited with permission

Figure 2. Macrocognition visualization framework*

*cited with permission

Table 1. Consent forms table

A	B	C	D	E	F
Procedures	**Situated Macrocognition Interaction**	**Recorded**	**Consent type? Form name?**	**Consent from?**	**When? (to be determined by Co-PIs**
Observation: • Unit (space-based) • Shadowing (IPT member based	Formal (ethnographic)	no	Oral	Members of rounding teams	In advance of the rounding or scheduled meeting?
			Written	Parents or children	By PI and CO-PIs
	Informal (ethnographic)	no	Waived	Members of rounding teams	One day prior or the same day
			Written	Parents or children	
Focus Group		Audio	Written	IPT participants	One day prior or the same day

Table 2. Research agenda schedule

* with committee member if available to attend

Day#	Research activity name	Tentative dates listed	Day of week	Hours on unit	Researcher activities	Total hours per activity/ shift	Research team
0	Pre-visit	12/18	Fri	4	Meet JHH research team and tour unit.	4	PI*
1	Orientation	02/01	Mon	6	Full unit tour, hang signs, hourly 'walking rounds'; check floor plan against actual space; locate outlets; meet team members	6	PI
2-8	Observation: General unit and Shadowing IPT member	02/02-02/08	Tues to end of Mon	8-12	Formal: Observe 1IPT round activity or meeting per shift (45-90 minutes per)	.75 to 1.5	PI
					Informal: Observe 2 to 3 spaces per shift (2 hours per space)	4 to 6	
					Informal: Shadow 1 IPT members per shift (2 hours per IPT member)	2	
9	Flexible: observation and/or preparation	02/09	Tues	8	If saturation not reached: a). observe 2 to 4 spaces for 2 hours per space: b). shadow 1-2 nurses per shift for 2 to 4 hours per nurse	4 to 12	PI
					Review focus group questions in interview guides and add new questions informed by data	4 to 8	
10	Focus Groups	02/10	Wed	8	2-3 'meal time' focus groups (30-45 min each)	1 to 2.25	PI/ Research Assistant
11	Flexible: focus group	02/11	Thu		If focus group not conducted on previous day		
12	Report to JHH	June – July 2016			1 hour presentation to staff (pending PI completion academic requirements)	1	PI/Co-PIs

Figure 3. Example of the distance matrix*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	FROM:	TO	P/R	P/R	S/S	S/S	S/S	S/S	S/S	S/S	S/S	S/S	S/S	S/S	S/S
2	Patient Rooms		9A4	9A6	Clean Utility	Med room	Soiled utility	Nourish-ment	Equip-ment storage	Emerg-ency storage	Business center	Nurse Station (NS) 1	NS2	NS3	Dict-ation
3	Room 9A04		X	27	110	127	120	102	39	67	125	70	59	137	84
4	Room 9A06		27	X	90	107	100	81	26	45	105	57	37	116	74
5	Room 9A08		32	5	85	102	95	76	31	40	100	62	32	111	69

*Used with permission, Steve Langston, RLF Architects

Table 3. Sample observation worksheet of situated macrocognitive interactions (SMIs)

A	B	C	D	E	F	G
SMI ID#	Date	Time Start	Time End	SMI Type	SMI Locations	Macrocognitive Functions
1				F	C/S	RP, DP
2				IF	P/R	SM
2.1					S/S: Nurse station	C
2.2					S/S: Clean utility	
3				IM	C/S	D
3.1				IF	P/R	DP

Figure 4. Sample observation worksheet of PICU floor plan with legend
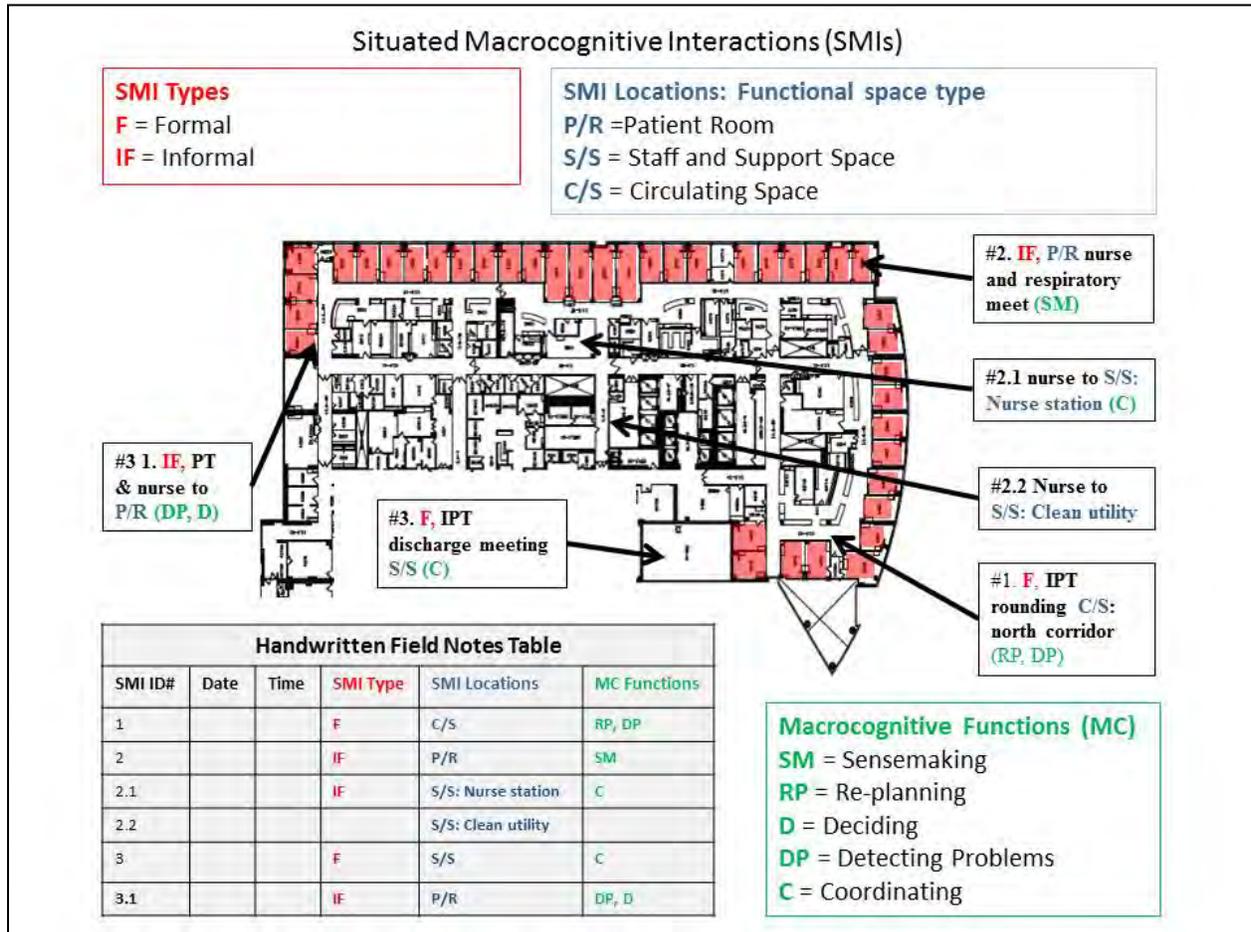
Table 4. Observation Guide

AIM Number	Description	Observation
1.0	Describe the types of situated macrocognitive interactions (formal and informal) in which macrocognitive functions occur and their location on a pediatric intensive care unit in an academic medical center.	
	Formal interactions	Rounding and huddles
	Informal interactions	Overhearing and impromptu
2.0	Describe the challenges and facilitators of macrocognition within the physical environment of a pediatric intensive care unit using the space syntax constructs (openness, connectivity, and visibility) in the physical environment.	
	Openness *Connectivity* *Visibility*	Rooms: what is the size of the rooms and how many seats available and how many people standing because no chair available? What are the names of rooms and where are they located on the unit?
		Nurses' station: What is this space called? Is it centralized, decentralized or a hybrid? What times does clustering of people occur?
		Meeting Rooms: what are the names of the meeting rooms? Do certain types of interactions occur in certain types of rooms?
		Meeting Rooms: Is the room scheduled or randomly used? Are people searching for a meeting room? Do they need to leave the unit to find a space and if yes where do they go?
		Meeting Rooms: Are rooms used for purposes not originally designed (e.g. a break room becomes a place for SMI?
3.0	Analyze the HCBE of the pediatric intensive care unit using the physical environment conditions and space syntax constructs to explicate influences on macrocognition.	
	Which areas create more opportunities for macrocognition?	
	Does the routine meeting occur only in the hallway? If no, where does it occur?	
	Is the nurses' station the primary location for informal SMIs?	
	Which macrocognitive functions are predominately occurring during formal or informal meetings	
	Which ambient features (noise, lighting) are identified as a problem?	
	How does the layout of the corridors (width and depth) affect each type of meeting (can the IPT members see each other or go looking for them)?	

Table 5. Semi-Structured Interview Guide

Aim Number	Description	Questions posed and additional questions based on observation
1.0	Describe the types of interactions (formal and informal) in which macrocognitive functions occur and their location on a pediatric intensive care unit.	
1.1	Sensemaking	Where do you meet with IPT members?
1.2	Re-planning	What different locations do you go to find information/objects to facilitate your interactions with other IPT members? Probe: How do you go about recommending or coordination a change to a treatment plan?
1.3	Deciding	How do you get different team members together to reach a decision about the plan of care when it is necessary?
1.4	Detecting Problems	When a patient has a new problem how do you communicate to the team? Probe: How effective is the process/or the devices you use?
1.5	Coordinating	How/where do you post your notes for other IPT members about patient coordination to see or act on? Probe: Is there a difference in whether the interaction is formal or informal?
2.0	Describe the challenges and facilitators of macrocognition within the physical environment of a pediatric intensive care unit using the space syntax constructs (openness, connectivity, and visibility) in the physical environment.	
	Openness	What types of space do you find it easier to interact? Probe: Is it easier to interact in an enclosed space or in an alcove?
	Connectivity	Where are the spaces you interact with IPT members? Probe: Is it easier to interact with IPT members in functional spaces which are adjacent to each other adjacent spaces?
	Visibility	Do you interact with IPT members because you can see into the spaces where they are located? Probe: Are you more likely to interact with an IPT member when you see them in certain areas of the unit?
3.0	Analyze the HCBE of the pediatric intensive care unit using the physical environment conditions and space syntax constructs to explicate influences on macrocognition.	
Additional (General)	For those of you who worked on the previous unit what sorts of differences do you see in the way that the new unit layout impacts your interactions with other team members as compared with the old unit?	

Table 6. Confirmability Audit Checklist*

A	B	C	D
#	Audit items	Checklist	This research study
1	Raw data	Written field notes, photographs, audio recordings	Journaling, field notes, digital audio recordings
2	Data reduction and analysis products	Write-ups of field notes, working hypotheses	Done during analysis
3	Data reconstruction and synthesis products	Structure of categories (themes, definitions, relationships	• Themes: macrocognitive functions, functional space types and situated macrocognitive interactions; space syntax constructs • Grouping of different macrocognitive functions (e.g. detecting problems and re-planning; or deciding and re-planning and coordinating)
4	Process notes	Trustworthiness notes relating to credibility, dependability, and confirmability	Found in procedures
5	Materials 1. Intentions and dispositions 2. Expectations	1. Proposal and personal notes 2. Predictions and intentions	Found in AIMS, research question
6	Documentation	Preliminary schedules, observation formats	Research agenda schedule, observation worksheet, floor plan worksheet

*Adapted from Lincoln & Guba (1985) (Lincoln & Guba, 1985, pp. 319-320)

References

Alison, L., Power, N., van den Heuvel, C., Humann, M., Palasinksi, M., & Crego, J. (2015). Decision inertia: Deciding between least worst outcomes in emergency responses to disasters. *Journal of Occupational and Organizational Psychology, 88*, 295-321. doi: 10.1111/joop.12108

Allen, R. E., Fowler, H. W., & Fowler, F. G. (1990). *The Concise Oxford dictionary of current English* (8th ed.). New York, NY: Oxford University Press.

Bayramzadeh, S., & Alkazemi, M. F. (2014). Centralized vs. decentralized nursing Stations: An Evaluation of the Implications of Communication Technologies in Healthcare. *Health Environments Research and Design Journal - HERD, 7*, 62-80. Retrieved from http://her.sagepub.com/

Beas, C. C., & Lysne, B. K. (2011). *Using a model of team collaboration to investigate inter-organizational collaboration during the relief effort of the January 2010 Haiti earthquake* (Masters thesis). Retrieved from http://hdl.handle.net/10945/5641

Beekhuyzen, J., Nielsen, S., & von Hellens, L. (2010). *The Nvivo looking glass: Seeing the data through the analysis.* Paper presented at the 5th Conference on Qualitative Research in IT, Brisbane, Australia.

Bentley, R., Hughes, J. A., Randall, D., Rodden, T., Sawyer, P., Shapiro, D., & Sommerville, I. (1992, November). *Ethnographically-informed systems design for air traffic control.* Paper presented at the 1992 ACM Conference on Computer-Supported Cooperative Work.

Cacciabue, P. C., & Hollnagel, E. (1995). Simulation of cognition: Applications. In J. M. Hoc, P. C. Cacciabue & E. Hollnagel (Eds.), *Expertise and technology: Cognition and human-computer cooperation* (pp. 55-73). Hillsdale, NJ: Lawrence Erlbaum.

Cai, H., & Zimring, C. (2012). *Out of Sight, Out of Reach: Correlating spatial metrics of nurse station typology with nurses' communication and co-awareness in an intensive care unit.* Paper presented at the Proceedings of the 8th International Space Syntax Symposium, Santiago, Chile.

Chaboki, H. M., Wahab, A. F. A., & Ansari, M. (2013). *Workplace Visibility and the Impacts on Informal Interaction.* Paper presented at the 4th International Graduate Conference on Engineering, Science and Humanities.

Chang, Y. J., Bley, D., Criscione, L., Kirwan, B., Mosleh, A., Madary, T., . . . Sieben, S. (2014). The SACADA database for human reliability and human performance. *Reliability Engineering & System Safety, 125*, 117-133. Retrieved from http://www.journals.elsevier.com/reliability-engineering-and-system-safety/

Chindhy, S. A., Edwards, N. M., Rajamanickam, V., Lushaj, E. B., Lozonschi, L., De Oliveira, N. C., . . . Osaki, S. (2014). Acuity adaptable patient care unit system shortens length of stay and improves outcomes in adult cardiac surgery: University of Wisconsin experience. *European Journal of Cardio-Thoracic Surgery*, ezt582. Retrieved from http://ejcts.oxfordjournals.org/

Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Cruz, E. V., & Higginbottom, G. (2013). The use of focused ethnography in nursing research. *Nurse Researcher, 20*, 36-43. Retrieved from http://journals.rcni.com/journal/nr

Dhukaram, A. V., & Baber, C. (2015). Modelling elderly cardiac patients decision making using Cognitive Work Analysis: Identifying requirements for patient decision aids. *International Journal of Medical Informatics, 84*, 430-443. Retrieved from http://www.ijmijournal.com/

Fawcett, J. (1984). The metaparadigm of nursing: present status and future refinements. *Image - the Journal of Nursing Scholarship, 16*, 84-89. doi: 10.1111/j.1547-5069.1984.tb01393.x

Fetterman, D. M. (2010). *Ethnography: Step-by-step* (3rd ed.). Los Angeles, CA: Sage.

Hammersley, M., & Atkinson, P. (2007). *Ethnography : principles in practice* (3rd ed.). London ; New York: Routledge.

Haq, S., & Luo, Y. (2012). Space syntax in healthcare facilities research: a review. *Health Environments Research and Design Journal - HERD, 5*, 98-117. doi: 10.1177/193758671200500409 HERD July 2012 vol. 5 no. 4 98-117

Hendrich, A., Chow, M. P., Bafna, S., Choudhary, R., Heo, Y., & Skierczynski, B. A. (2009). Unit-related factors that affect nursing time with patients: spatial analysis of the time and motion study. *Health Environments Research and Design Journal - HERD, 2*, 5-20. doi: 10.1177/193758670900200202

Hill, W. (2010). Human Factors in Clinical Shift Handover Communication: Review of reliability and resilience principles applied to Change of Shift Report. *Canadian Journal of Respiratory Therapy, 46*, 44. Retrieved from http://www.pulsus.com/journals/journalHome.jsp?jnlKy=14&HCtype=Consumer

Hillier, B. (2008). Space and spatiality: what the built environment needs from social theory. *Building Research & Information, 36*, 216-230. doi: 10.1080/09613210801928073

Hillier, B. (2014). *Space syntax as a theory, as well as a method*. Paper presented at the The 21st International Seminar on Urban Form - ISUF2014, Porto, Portugal. http://isuf2014.fe.up.pt/Hillier.pdf/view

Holden, R. J. (2011). Cognitive performance-altering effects of electronic medical records: An application of the human factors paradigm for patient safety. *Cognition, Technology & Work, 13*, 11-29. doi: 10.1007/s10111-010-0141-8

Houghton, C. E., Casey, D., Shaw, D., & Murphy, K. (2010). Ethical challenges in qualitative research: examples from practice. *Nurse Researcher, 18*, 15-25. doi: 10.7748/nr2010.10.18.1.15.c8044

Hsieh, H.-F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 15*, 1277-1288. doi: 10.1177/1049732305276687

Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA: MIT Press.

Hutchins, S. G. (2012). *Analysis of communications during the Haiti relief effort to understand cognitve processes used during team collaboration.* Paper presented at the 8th International Topical Meeting on Nuclear Plant Instrumentation, Control, and Human-Machine Interface Technologies 2012: Enabling the Future of Nuclear Energy, NPIC and HMIT 2012, San Diego, CA.

Hutchins, S. G., Kendall, A., & Bordetsky, A. (2008). *Understanding patterns of team collaboration employed to solve unique problems*. Retrieved from http://handle.dtic.mil/100.2/ADA486786

Ipe, M. (2003). Knowledge sharing in organizations: A conceptual framework. *Human Resource Development Review, 2*, 337-359. Retrieved from

Isaacs, E., Whittaker, S., Frohlich, D., & O'Conaill, B. (1997). Informal communication re-examined: New functions for video in supporting opportunistic encounters. In S. Finn, & WIlbur, S.B. (Ed.), *Video-mediated communication* (Vol. 997, pp. 459-485). New Jersey: Laurence Erlbaum.

James, J. T. (2013). A new, evidence-based estimate of patient harms associated with hospital care. *Journal of patient safety, 9*, 122-128. doi: 10.1097/PTS.0b013e3182948a69

Keller, N., Cokely, E. T., Katsikopoulos, K. V., & Wegwarth, O. (2010). Naturalistic heuristics for decision making. *Journal of Cognitive Engineering and Decision Making, 4*, 256-274. doi: 10.1518/155534310x12844000801168

Klein, G., Ross, K. G., Moon, B. M., Klein, D. E., Hoffman, R. R., & Hollnagel, E. (2003). Macrocognition. *Intelligent Systems, IEEE, 18*, 81-85. doi: 10.1109/MIS.2003.1200735

Klein, H. A., & Lippa, K. D. (2008). Type 2 diabetes self-management: Controlling a dynamic system. *Journal of Cognitive Engineering and Decision Making, 2*, 48-62. doi: 10.1518/155534308x284363

Knoblauch, H. (2005). *Focused ethnography.* Paper presented at the Forum Qualitative Sozialforschung/Forum: Qualitative Social Research.

Kohn, L. T., Corrigan, J., & Donaldson, M. S. (2000). *To err is human : building a safer health system*. Washington, D.C.: National Academy Press.

Kraut, R., Egido, C., & Galegher, J. (1988). *Patterns of contact and communication in scientific research collaboration.* Paper presented at the Proceedings of the 1988 ACM conference on Computer-supported cooperative work.

Kraut, R. E., Fish, R. S., Root, R. W., & Chalfonte, B. L. (1990). *Informal communication in organizations: Form, function, and technology.* Paper presented at the Human reactions to technology: Claremont symposium on applied social psychology.

Leaf, D. E., Homel, P., & Factor, P. H. (2010). Relationship between ICU design and mortality. *Chest, 137*, 1022-1027. doi: 10.1378/chest.09-1458

LeCompte, M. D., & Schensul, J. J. (2010). *Designing & conducting ethnographic research: an introduction* (2nd ed.). Lanham, Md.: AltaMira Press.

Letsky, M., & Warner, N. W. (2008). Macrocognition in teams *Macrocognition in Teams: Theories and Methodologies* (pp. 1-13): Ashgate Publishing Ltd.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry* (Vol. 75): Sage.

Lu, Y., Ossmann, M. M., Leaf, D. E., & Factor, P. H. (2014). Patient visibility and ICU mortality: A conceptual replication. *HERD: Health Environments Research & Design Journal, 7*, 92-103. doi: 10.1177/193758671400700206

McDonald, S. (2005). Studying actions in context: a qualitative shadowing method for organizational research. *Qualitative research, 5*, 455-473. Retrieved from qrj.sagepub.com

Meleis, A. I. (2011). *Theoretical nursing: Development and progress* (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Militello, L. G., Sushereba, C. E., Branlat, M., Bean, R., & Finomore, V. (2015). Designing for military pararescue: Naturalistic decision-making perspective, methods, and frameworks. *Journal of Occupational and Organizational Psychology, 88*, 251-272. doi: http://dx.doi.org/10.1111/joop.12114

Mumaw, R. J., Roth, E. M., Vicente, K. J., & Burns, C. M. (2000). There is more to monitoring a nuclear power plant than meets the eye. *Human Factors, 42*, 36-55. doi: 10.1518/001872000779656651

Nightingale, F. (1860). *Notes on nursing: what it is, and what it is not*. New York, NY: D. Appleton and Company.

Nightingale, F. (1861). *Notes on nursing: What it is, and what it is not: With some account of her life*. New York, NY: D. Appleton.

Parush, A., Kramer, C., Foster-Hunt, T., McMullan, A., & Momtahan, K. (2012). Exploring similarities and differences in teamwork across diverse healthcare contexts using communication analysis. *Cognition, Technology & Work*, 1-11. doi: 10.1007/s10111-12-0242-7

Patel, V. L., Shine, A. L., & Almoosa, K. F. (2014). Error recovery in the wilderness of ICU. In V. L. Patel, D. R. Kaufman & T. Cohen (Eds.), *Cognitive Informatics in Health and Biomedicine: Case studies on Critical Care, Complexity and Errors* (pp. 91-112). London: Springer.

Pati, D., Harvey, T. E., Redden, P., Summers, B., & Pati, S. (2015). An empirical examination of the impacts of decentralized nursing unit design. *HERD: Health Environments Research & Design Journal, 8*, 56-70. doi: 10.1177/1937586715568986

Patterson, E. S. (2008). Structuring flexibility: the potential good, bad and ugly in standardisation of handovers. *Quality and Safety in Health Care, 17*, 4-5. doi: 10.1136/qshc.2007.022772

Patterson, E. S., Bernal, F., & Stephens, R. (2012). Differences in macrocognition strategies with face to face and distributed teams. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 56*, 282-286. doi: 10.1177/1071181312561066

Patterson, E. S., Ebright, P. R., & Saleem, J. J. (2011). Investigating stacking: How do registered nurses prioritize their activities in real-time? *International Journal of Industrial Ergonomics, 41*, 389-393. doi: 10.1016/j.ergon.2011.01.012

Patterson, E. S., & Hoffman, R. R. (2012). Visualization framework of macrocognition functions. *Cognition, Technology & Work, 14*, 221-227. doi: 10.1007/s10111-011-0208-1

Patterson, E. S., & Miller, J. E. (2010). *Macrocognition metrics and scenarios: Design and evaluation for real-world teams*. Burlington, VT: Ashgate.

Patterson, E. S., Watts-Perotti, J., & Woods, D. D. (1999). Voice loops as coordination aids in space shuttle mission control. *Computer Supported Cooperative Work, 8*, 353-371. doi: 10.1023/A:1008722214282

Penoyer, D. (2015, July 21, 2015). [for dissertation proposal -requesting letter or email correspondence regarding RLF postoccupancy project as QIP].

Perry, S. J., Wears, R. L., & Patterson, E. S. (2008). High-hanging fruit: Improving transitions in health care. *Advances in patient safety: new directions and alternative approaches, 3 - Performance and Tools*. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK43656/

Rashid, M. (2014). Space Allocation in the Award-Winning Adult ICUs of the Last Two Decades (1993–2012): An Exploratory Study. *HERD: Health Environments Research & Design Journal, 7*, 29-56. doi: 10.1177/193758671400700203

Rasmussen, J. (1983). Skills, rules, and knowledge; signals, signs, and symbols, and other distinctions in human performance models. *IEEE Transactions on Systems, Man and Cybernetics,*, 257-266. doi: 10.1109/TSMC.1983.6313160

Reid, P. P., Compton, W. D., Grossman, J. H., & Fanjiang, G. (2005). *Building a better delivery system: A new engineering/health care partnership*. Washington, DC: National Academies Press.

Reiling, J., Hughes, R. G., & Murphy, M. R. (2008). The Impact of Facility Design on Patient Safety. In R. G. Hughes (Ed.), *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Rockville, MD.

Sailer, K., & Penn, A. (2009). Spatiality and transpatiality in workplace environments. Retrieved from

Schensul, J. J., & LeCompte, M. (1999). *Ethnographer's toolkit: All the tools needed to begin doing ethnographic research in one package*. Walnut Creek, CA: Altamira Press.

Schensul, J. J., & LeCompte, M. D. (2012). *Essential ethnographic methods: A mixed methods approach* (Vol. 3). Lanham, MD: Altamira Press.

Schraagen, J. M., Klein, G., & Hoffman, R. R. (2008). The macrocognition framework of naturalistic decision making. In J. M. Schraagen, L. Militello, T. Ormerod & R. Lipshitz (Eds.), *Naturalistic decision making and macrocognition* (pp. 3-25). Burlington, VT: Ashgate.

Schubert, C. C., Denmark, T. K., Crandall, B., Grome, A., & Pappas, J. (2013). Characterizing novice-expert differences in macrocognition: an exploratory study of cognitive work in the emergency department. *Annals of Emergency Medicine, 61*, 96-109. doi: 10.1016/j.annemergmed.2012.08.034

Selanders, L. C. (1993). *Florence Nightingale: An environmental adaptation theory*. Newbury Park: Sage.

Trzpuc, S. J., & Martin, C. S. (2010). Application of space syntax theory in the study of medical-surgical nursing units in urban hospitals. *Health Environments Research and Design Journal - HERD, 4*, 34-55. doi: 10.1177/193758671000400104

Vischer, J. (2001). Post-occupancy evaluation: A multifaceted tool for building improvement. In Federal Facilities Council, Board on Infrastructure and the Constructed Environment & National Research Council (Eds.), *Learning from our buildings: A state-of-the-practice summary of post-occupancy evaluation* (pp. 23-34). Washington, DC: National Academies Press. Retrieved from http://books.google.com/books?isbn=0309076110

Vuckovic, N. H., Lavelle, M., & Gorman, P. (2004). Eavesdropping as normative behavior in a Cardiac Intensive Care Unit. *JHQ Online*, 1-6. Retrieved from http://www.nahq.org/uploads/EavesdroppingNormative.pdf

Wagner, E. D. (1994). In support of a functional definition of interaction. *American Journal of Distance Education, 8*, 6-29. Retrieved from

Whaley, A. M., Xing, J., Boring, R. L., Hendrickson, S. M. L., Joe, J. C., LeBlanc, K. L., & E.Lois. (2012). *Building a Psychological Foundation for Human Reliability Analysis. NUREG-2114. Office of Nuclear Regulatory Research*. Washington, D.C.: Retrieved from http://pbadupws.nrc.gov/docs/ML1131/ML113180490.pdf.

Whittaker, S., Frohlich, D., & Daly-Jones, O. (1994). *Informal workplace communication: What is it like and how might we support it?* Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems.

Zadeh, R., Sadatsafavi, H., & Xue, R. (2015). Evidence-Based and Value-Based Decision Making About Healthcare Design An Economic Evaluation of the Safety and Quality Outcomes. *HERD: Health Environments Research & Design Journal, 8*, 58-76. Retrieved from

Zborowsky, T., Bunker-Hellmich, L., Morelli, A., & O'Neill, M. (2010). Centralized vs. decentralized nursing stations: Effects on nurses' functional use of space and work environment. *Health Environments Research and Design Journal - HERD, 3*, 19-42. doi: 10.1177/193758671000300404

Zborowsky, T., & Kreitzer, M. J. (2009). People, place, and process: The role of place in creating optimal healing environments. *Creative Nursing, 15*, 186-190. doi: 10.1891/1078-4535.15.4.186

Zeisel, J. (2006). *Inquiry by design: Environment/behavior/neuroscience in architecture, interiors, landscape, and planning*: WW Norton & Co.

Zimring, C. (2002). Postoccupancy evaluation: Issues and implementation. In R. B. Bechtel & A. Ts'erts'man (Eds.), *Handbook of environmental psychology* (pp. 306-321). New York, NY: Wiley. Retrieved from http://books.google.com/books?isbn=0471188476

Zimring, C. M., & Reizenstein, J. E. (1980). Post-occupancy evaluation: An overview. *Environment and Behavior, 12*, 429-450. doi: 10.1177/0013916580124002

Executive Summary

The study, "Macrocognition in the HCBE (m-HCBE): A Focused Ethnographic Study of 'Neighborhoods' in a Pediatric Intensive Care Unit" was conducted as planned with two minor modifications which are as follows.

The first change was in the number of participants in the fourth focus group. Two members (both clinical interprofessoinal team members) arrived late and wanted to participate. The second modification was to only observe on the day shift and not on the night shift.

The IRB was notified and neither modification required revision of the IRB protocol.

Macrocognition in the Health Care Built Environment (m-HCBE): A Focused Ethnographic Study of 'Neighborhoods' in a Pediatric Intensive Care Unit

Dissertation Defense

December 16, 2016

Susan O'Hara Sullivan, MPH, RN

Introduction

- Reduce error and improve safety has been established in a series of reports by the Institute of Medicine

- Systems approach has the potential to radically improve health care quality and safety

- Beyond individual caregiver knowledge
  - Adaptive interprofessional team cognitive performance
  - Within the complex environment in which health care teams function.

Background / Literature Review

- Macrocognition
- Safe Health Care Built Environment (HCBE)

Macrocognition

- Macrocognition is the "adaptation of c
  (Patterson & Hoffman, 2012)
- Macrocognitive Functions
  - Sensemaking
  - Re-planning
  - Detecting Problems
  - Deciding
  - Coordinating
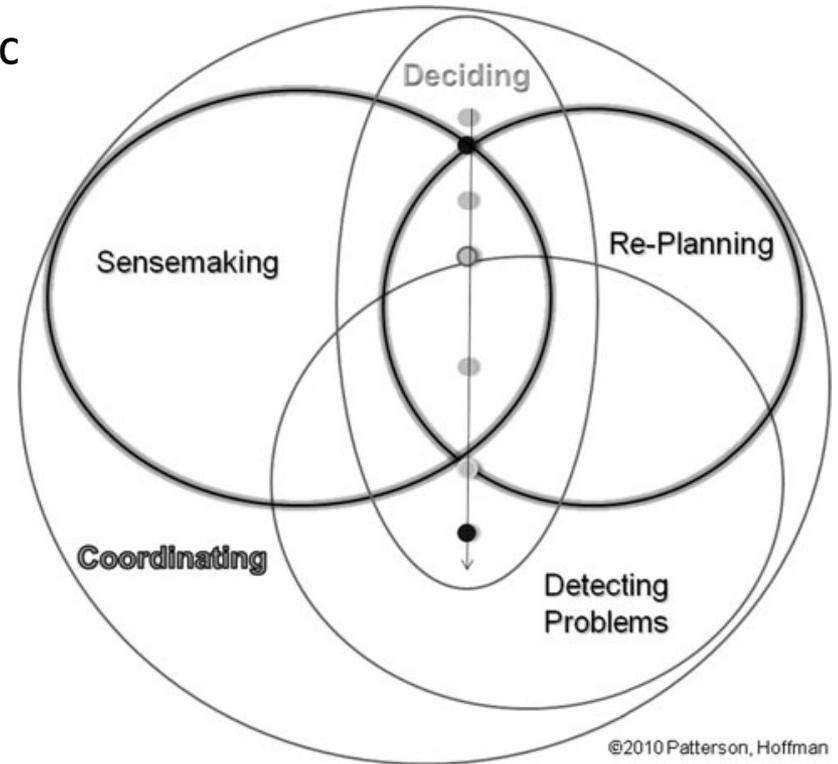
Macrocognition visualization framework*
*cited with permission 48

Macrocognition in Health Care

- Outpatient: Improvement in Self-care and medication and glucose adherence
  - Cardiology Setting
  - Diabetes Setting
- Inpatient: Fewer medical errors and better individual and team judgment
  - Formal team cognitive interactions (Patient Care rounds and unit handovers)
  - Promoting learning environment

Literature Review: HCBE-systems view

- Safe HCBE design: Visibility
  - Patient
  - Interprofessional Team (IPT members)
- Visibility and morbidity, mortality

Studies suggest macrocognitive functions influenced by work environment design – a systems view

- Multiple Industries
  - Aviation, nuclear, aerospace, disaster planning, military
- Health Care Industry through visibility
  - Between coworker
    - Improved relationships between novices and experienced team members
    - Improved task prioritization and increasing new knowledge to raise overall patient care unit expertise
  - Between interprofessional team members and patients
    - In ICU decreased mortality rates and length of stay
    - Within unit with decentralized nurses stations decreases team collaboration
- Macrocognitive functions have been described in the HCBE but effect of HCBE on those functions has not been directly addressed

Aims to Address the Gap in the Literature

- Describe the interactions (formal and informal) in which macrocognitive functions occur and their location

- Describe the challenges and facilitators of macrocognition within the physical environment of a pediatric intensive care unit using the space syntax constructs (openness, connectivity, and visibility)

- Analyze the HCBE of the pediatric intensive care unit using the space syntax constructs to explicate influences on macrocognition

Theoretical framework: m-HCBE

- The Environment of Care: The environment of care improves patient outcomes (introduced and prioritized by Florence Nightingale (1860))
  - Nursing metaparadigm: Patient (Person), Health, Nurse, Environment

- **Macrocognition Theory:** Macrocognition, is the "adaptation of cognition to complexity" (Patterson & Hoffman, 2012)
  - Sensemaking, re-planning, deciding, detecting problems and coordinating

- **Space Syntax Theory:** Shape or configuration of a space is created to accommodate planned functions, while the functions are influenced and changed by the form or shape of the space (Hillier 2008, 2014)
  - Openness, Connectivity, Visibility

Key Concept: Situated Macrocognitive Interactions (SMIs)

- Formal
  - Planned

- Informal
  - Visual
  - Auditory

Methods

- Design and Sample
- Setting and Procedures
- Data Collection
- Data Analysis
- Trustworthiness

Design

- Focused Ethnographic Study
  - Observation: Unit and IPT members (shadowing)
  - Focus groups
  - PICU artifacts
- Components of Architectural Evaluation
- IRB approval

Setting

- 40 beds
- 3 yrs. 21,000
- M/S
- Patient rooms
- Support Spaces
- Circulation Space

Sample

- Maximum variation sampling for IPT
  - Three Stakeholder groups of IPT members
    - Clinical
    - Operational
    - Therapeutic
  - Geographically based teams by room locations: Blue rooms #1-21, green (#22-41), red (ad hoc)
- Notification and recruitment

Procedures

- Pre-visit two members of team
- Architectural drawing files obtained and converted to floor plans for worksheets and analysis
- Observation (unit and IPT members) and Focus Groups

Data Collection

- 1st day: IPT members informed (Informed consent and voluntary participations obtained and ensured)

- 11 day period, 7am to 5pm weekdays; 1 weekend day
  - Observation
    - Unit: Patient rooms (exterior), Support Spaces including Nurses' Stations, Circulation spaces (corridors)
    - Individuals (14)" All three IPT stakeholder groups 30 – 240 minutes
  - Focus groups (4) semi-structured interview guide (2-7 participants/group);
  - Architectural drawing files, panoramic photographs, PICU specific artifacts

Data Analysis

- Architectural: Path distances and isovist field views completed

- Focus group audio recordings transcribed verbatim

- Directed content analysis (pre-existing categories)
  - Formal and informal SMIs, space syntax constructs, additionally new themes
  - Multistage (NVIVO, MS Excel)

- Results of multistage analysis then compared to architectural findings, panoramic photographs

Trustworthiness Criteria and Techniques

- Credibility
  - Peer Debriefing
  - Triangulation
- Transferability
  - Thick description
- Dependability
  - Audit trail
- Confirmability
  - Audit trail
- Reflexive journaling

Results Aim 1: Describe Formal SMIs

- Enclosed Space
  - Morning Huddles
  - Meetings
    - IPT
    - Family

- Open Space
  - Whiteboard huddle
  - Patient Care Rounds

Patient Care Rounds

Results Aim 1: Describe Informal SMIs

- Visual (bumping into)
- Observed therapeutic IPT in room for procedure and asked why she said

- Auditory (overhearing)
- Therapeutic IPT

Informal SMI: Spontaneous Search: NEW

- Urgent
  - Observed clinical IPT see a nurse returning to patient room
- Non-urgent
  - Clinical IPT

Results Aim 2: Describe space syntax constructs (challenges and facilitators)

- Constructs
  - Openness (lack of partitions or boundaries)
  - Connectivity (adjacency to other spaces)
  - Visibility (line of sight)
- Challenges to macrocognition: Limitations
- Facilitators of macrocognition: Supports

Results Aim 2: Openness

Challenges to Macrocognition

- SMIs requiring privacy
- Crossing thresholds of closed rooms (unspoken rule, bad or sad)

Facilitators of Macrocognition

- Interacting with team members
- Sharing new knowledge in real time

Therapeutic IPT

Results Aim 2: Connectivity

Challenges to Macrocognition

- Therapeutic IPT members' offices off unit, or single discipline

- Single patient rooms affecting assignments

Facilitators of Macrocognition

- IPT members' assignments sharing work and coverage

- Corner assignments in neighborhood

Where IPT members congregate

Results Aim 2: Visibility 'corners' and 'islands'

Challenges to Macrocognition

- Islands – NS 2, 4, 6, 7, 8

Facilitators to Macrocognition

- Corners at intersection of corridors "good, great, lovely"

When discussing with one clinical IPT member the comparison between NS 7 to previous employment in another PICU facility

Corners and Islands

Results Aim 3: Influence of HCBE space syntax constructs on macrocognition

- Neighborhood
  - Conceptual
  - Cultural adaptation
    - Alternate use, meaning of space
    - Re-purposing space
- Sub-themes
  - Corners and islands
  - Neighbors and buddies
  - Eyes on the patient

Neighbors and Buddies

- Nurses with near or adjacent patient assignments
- Visible to each other, and on the same team.
- 'Neighborhood report' or 'mini-huddle'

Eyes on the Patient

- A clinical IPT member described the difficulty of having eyes on the patient due to the island configurations

Summary of Key Findings

- Ideal neighborhoods of the PICU are those in which all three of the space syntax constructs (openness, connectivity, visibility) are present, facilitating both formal and informal SMIs
  - Ethnographic and Architectural
- If neighborhood lacks macrocognitive capabilities, or all the space syntax constructs, it is considered an island

Discussion

- Neighborhoods are not only a physical location but a place that includes the key functions of a group of residents

- Circulation spaces (corridors) act as streets: The importance of having "streets" that allow for IPT member interactions and visibility

- This is reminiscent of Jane Jacobs', (social and urban theorist and planner), view of neighborhoods

Successful Clinical Neighborhoods

- A successful clinical "neighborhood" will incorporate design that allows for eyes on the patient
  - As noted by one clinical IPT member, the smaller size of the old unit led to many IPT members' eyes on the patient.
- Deeper architectural analysis
  - Distance matrix
  - Isovist field view

Distance Matrix

Panoramic Photographs

Isovist View between NS/Patient's Rooms

Putting It All Together: Island (NS 8) and Corner (NS 9B, C)

m-HCBE

Limitations and Strengths

- Limitations
  - One pediatric ICU
  - Over a period of 11 days (on day shift) in the late spring season
- Strengths
  - Interdisciplinary approach to understand the intersection of nursing, human factors engineering and architecture
  - Deeper understanding between the intended use of space and the adaptation and meaning of space

Implications and Recommendations

- Implications for Theory: Better understanding of 'where' SMI's occur
- Design:
  - Macrocognition enhanced by certain features in the HCBE particularly those dimensions of a "good corner"
  - Nurses' stations with visibility within, and between, other nurses' stations or nurse alcoves
  - Short and straight corridors without columns or walls blocking views (or design layout to increase number of corners and maximize views)
- Recommendations from this study include designing and testing new or reconfigured HCBE spaces that maximize these features
  - Space Syntax and computer simulation modeling software to find balance between design and IPT members use and meaning of space
- IPT practice
  - Virtual Rounding
  - Multidisciplinary Neighborhoods and repurposed IPT 'Stations'
- Education
  - Teach IPT members about the relationship between disciplines

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- In memory and in honor of my husband Mark Sullivan

Thank you: Discussion and Questions

"Nursing is the act of utilizing the environment of the patient to improve his care" (Nightingale, 1861)

"Form ever follows function" (Louis Sullivan, architect, 1896)

Dissemination Plan

The primary description of this dissertation work was submitted as a manuscript

on ____1/17/17_____ to __Health Environments Research & Design (HERD)_ for review and

consideration for publication.