**Design of Acute Care Patient Rooms for
Improved Patient/Family Experience:
A Case for Interdisciplinary Collaboration**

By

Tamara Phillips

**A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs
in partial fulfillment of the requirements for the degree of**

Master of Design

in

Industrial Design

Carleton University

Ottawa, Ontario

© 2012, Tamara Phillips

Library and Archives
Canada

Published Heritage
Branch

395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque et
Archives Canada

Direction du
Patrimoine de l'édition

395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

ISBN: 978-0-494-93501-9

Our file Notre référence

ISBN: 978-0-494-93501-9

NOTICE:

The author has granted a non-exclusive license allowing Library and Archives Canada to reproduce, publish, archive, preserve, conserve, communicate to the public by telecommunication or on the Internet, loan, distribute and sell theses worldwide, for commercial or non-commercial purposes, in microform, paper, electronic and/or any other formats.

The author retains copyright ownership and moral rights in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

AVIS:

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque et Archives Canada de reproduire, publier, archiver, sauvegarder, conserver, transmettre au public par télécommunication ou par l'Internet, prêter, distribuer et vendre des thèses partout dans le monde, à des fins commerciales ou autres, sur support microforme, papier, électronique et/ou autres formats.

L'auteur conserve la propriété du droit d'auteur et des droits moraux qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

In compliance with the Canadian Privacy Act some supporting forms may have been removed from this thesis.

While these forms may be included in the document page count, their removal does not represent any loss of content from the thesis.

Conformément à la loi canadienne sur la protection de la vie privée, quelques formulaires secondaires ont été enlevés de cette thèse.

Bien que ces formulaires aient inclus dans la pagination, il n'y aura aucun contenu manquant.

Canada

ABSTRACT

There has been much study on patient perspectives and overall satisfaction within healthcare settings (Katherine & Gallant, 2006; Sloan Devlin & Arneill, 2003; Leventhal Stern, et al., 2003) but not as much specifically directed toward the family or ‘partners in care’ and their specific needs within the adult acute care patient room. One assumption of this thesis is that families or partners in care have unique needs, which are not always considered in the design of acute care patient rooms. Another assumption of this thesis is that to meet the diverse needs of patients and families as well as other healthcare stakeholders is complex and a more integrated approach to design is needed. Both of these assumptions puts human health and wellness at the forefront of design intent and this thesis uses a case study as a way of ‘learning how to learn’ about the complexity of design for health care settings.

A survey questionnaire distributed to former patients and families found several interrelated factors that could contribute to a more positive patient room experience. A case study of an interdisciplinary design-research collaboration for a prototype patient room explored how the needs of patients and families could be better integrated into the design of a patient room footwall. The research findings generated design criteria for acute care patient rooms addressing the needs of patients and families, insights into the challenges and success of interdisciplinary design collaboration as well as suggestions for further research.

Keywords: healthcare design, adult acute care, patient and family satisfaction, interdisciplinary collaboration, case study, patient room prototype.

ACKNOWLEDGEMENTS

To my family

Kevin and Olivia
for supporting me through the thick of it all,
and for keeping me grounded.

To my supervisors

Dr. Thomas Garvey and Dr. Federica Goffi
who provided me with an amazing opportunity to learn
coupled with relentless energy and encouragement.

A special thank you to

David Allison
for his generous insight, support and
encouragement.

I could not have completed this document without the many special people that helped and supported me along the way. A warm thank you to Lorenzo Imbesi, Lois Frankel, Won Joon Chung, Valerie Daley, Diane Smyth, Anthony Marini, my fellow grad students at Carleton, my colleagues at Algonquin College and Jessica and Khulood, my PRPP teammates.

I would also like to thank everyone who participated in this research with the hope that they truly believe in the importance of design to improve the healthcare experience.

In Memory

This paper is dedicated to

Nelson and Carol Phillips

Who with their unending love and encouragement,
provided the foundation that supports me in everything I do.

TABLE OF CONTENTS

ABSTRACT	II
ACKNOWLEDGEMENTS.....	III
TABLE OF CONTENTS.....	V
LIST OF FIGURES	IX
1 INTRODUCTION	1
1.1 HEALTHCARE, DESIGN AND PATIENT/FAMILY ACCOMMODATION	3
1.2 RATIONALE AND PURPOSE OF STUDY	4
1.3 CONTRIBUTION TO INTERDISCIPLINARY DESIGN RESEARCH.....	6
1.3.1 PATIENT ROOM PROTOTYPE PROJECT (PRPP)	6
1.4 RESEARCH QUESTION AND OVERVIEW.....	7
2 LITERATURE REVIEW	10
2.1 DESIGN FOR HEALTH	10
2.1.1 HEALTH SUPPORTIVE ENVIRONMENTS AND EVIDENCE-BASED DESIGN (EBD)	16
2.2 PATIENT-AND-FAMILY CENTRED CARE	21
2.2.1 PATIENT AND FAMILY SATISFACTION IN HEALTHCARE ENVIRONMENTS	22
2.2.2 ACCOMMODATING PARTNERS IN CARE	24
2.3 HUMAN-CENTRED DESIGN AND DESIGN THINKING	25
2.3.1 INTERDISCIPLINARY COLLABORATION	27
2.3.2 DESIGN RESEARCH AND PARTICIPATORY DESIGN.....	28
2.4 PATIENT ROOM DESIGN	30

2.4.1 TRENDS AND INNOVATIONS IN PATIENT ROOM DESIGN.....	33
2.4.2 FUNCTIONAL ORGANIZATION	34
2.4.3 HEADWALLS AND PATIENT ZONES	37
2.4.4 FOOTWALLS AND FAMILY ZONES.....	38
2.4.5 PATIENT ROOM FURNISHINGS AND FINISHES	40
2.5 SUMMARY OF LITERATURE REVIEW	41
3 METHODS.....	42
3.1 INTRODUCTION.....	42
3.2 APPROACH AND STUDY DESIGN OVERVIEW.....	43
3.2.1 CASE STUDY SELECTION.....	44
3.2.2 EXPERT INTERVIEWS.....	45
3.2.3 FORMER PATIENT AND FAMILY SURVEY QUESTIONNAIRE	47
3.2.4 OBSERVATIONS	48
3.3 QUALITATIVE DATA ANALYSIS	49
3.4 RESEARCH PLAN/SCHEDULE.....	50
3.5 VALIDITY AND RELIABILITY	50
3.6 LIMITATIONS OF THE METHODS.....	51
3.7 ETHICAL CONSIDERATIONS.....	52
4 FINDINGS AND DISCUSSION	53
4.1 INTRODUCTION.....	53
4.2 INSIGHTS FROM PATIENT AND FAMILY SURVEY QUESTIONNAIRE	56
4.2.1. GENERAL FINDINGS	58

4.2.2 PHYSICAL ATTRIBUTES	59
4.2.3 SUMMARY PHYSICAL ATTRIBUTES AND DESIGN IMPLICATIONS	66
4.2.4 EMOTIONAL ATTRIBUTES	67
4.2.5 SUMMARY EMOTIONAL ATTRIBUTES AND DESIGN IMPLICATIONS	68
4.2.6 SOCIAL ATTRIBUTES	70
4.2.7 SUMMARY SOCIAL ATTRIBUTES AND DESIGN IMPLICATIONS	73
4.2.8 IDEAL HEALING SPACE: THE NEXT ACUTE CARE PATIENT ROOM	74
4.2.9 SENSE OF A HEALING SPACE & OVERALL SATISFACTION	77
4.3 KEY DIFFERENCES BETWEEN PATIENTS AND FAMILY	78
4.4 CASE STUDY: PATIENT ROOM PROTOTYPE PROJECT (PRPP)	82
4.4.1 INTRODUCTION/BACKGROUND	82
4.4.2 PATIENT ROOM PROTOTYPE PROJECT (PRPP)	83
4.4.3 THE DESIGN PROCESS	91
4.4.4 HOSPITAL AND PROTOTYPE TOURS, OBSERVATIONS AND EXPERT FEEDBACK	98
4.4.5 CONCEPT DEVELOPMENT (FOOTWALL)	103
4.4.6 INTERIM MOCK-UP FABRICATION AND OBSERVATIONS	104
4.4.7 DESIGN FABRICATION, IMPLEMENTATION AND FINAL PROTOTYPE	106
4.5 SUMMARY PATIENT ROOM PROTOTYPE OUTCOMES	113
5 CONCLUSIONS	117
5.1 INSIGHTS AND LESSONS LEARNED	117
5.2 SUGGESTIONS FOR FURTHER RESEARCH	122
5.3 CONCLUSION	123

REFERENCES.....	125
APPENDICES.....	133

LIST OF FIGURES

Figure 1. Conceptual diagram for literature review.	9
Figure 2. Physical Environment Process Leading to Stress.....	11
Figure 3. Example of high levels of complexity visual stimulation.	12
Figure 4. Example of low stimulation and visual interest.....	14
Figure 5: Health Supportive Design Criteria and Outcomes.	18
Figure 6. Physical Environmental Stimuli Diagram.	20
Figure 7. Benefits of Accommodating Patients and Family.....	25
Figure 8. Patient Room: Factors that impact occupant health and well-being.....	31
Figure 9. Healthcare Users and Stakeholders diagram.	32
Figure 10. Design criteria for patient rooms.	33
Figure 11. Patient Room Activity Zones.....	36
Figure 12. Preliminary Affinity Diagram.....	49
Figure 13. Visual representation of research design.....	50
Figure 14. In-patient Footwall Design and Floor Plan, JGH Pavillion K.	55
Figure 15. Conceptual Mapping of Survey Questions.....	56
Figure 17. Multi-Sensory Content Analysis Patient Room.....	65
Figure 18. Mind Map Sketch (Family).....	72
Figure 19. Mind Map (family).....	72
Figure 20. Overall rating of experience in patient room. Responses to the question 2.14.	78
Figure 21. Patient vs. Family Preferences: control of elements.....	79
Figure 22. Patient vs. Family Preferences: elements for comfort.....	81

Figure 23. Patient Room Prototype Project History.....	84
Figure 24. PRPP 2012 Project Team.....	85
Figure 25. PRPP 2012 Project Schedule.	86
Figure 26. PRPP Universal Plan Layout	88
Figure 27. Acuity Adaptable Room Clearances.....	89
Figure 28. PRPP Interdisciplinary Collaborative Design Process.....	92
Figure 29. Carleton Design Charette	94
Figure 30. Carleton Charette Concept Pin-Up and Review	95
Figure 31. Charette Generated Footwall Concept Sketch Example A	96
Figure 32. Charette Generated Footwall Concept Sketch Example B	97
Figure 33. Clemson Charette Brainstorming.....	98
Figure 34. Information Exchange & Collaboration	103
Figure 35. Full-Scale Mock-up Development.....	105
Figure 36. Fabrication Folding Bed/Bench	107
Figure 37. Footwall Folding Bed Fabrication	108
Figure 38. Prototype Fabrication and Installation.....	110
Figure 39. Photo of Final Footwall Prototype.....	112
Figure 40. Final Footwall –Application of Design Criteria	113
Figure 41. Final PRPP 2012 Patient Room Prototype	116

LIST OF APPENDICES

Appendix A. Expert Interview Consent Form	133
Appendix B. Expert Interview Question Guide	134
Appendix C. Email Recruitment Cover.....	135
Appendix D. Patient and Family Survey Questionnaire	136
Appendix E. Example Content Analysis	146
Appendix F. Example of Interview Coding	147
Appendix G. Example Affinity Diagram Chart	148
Appendix H. Example Field Notes	149
Appendix I. Example Pilot Survey Content Analysis.....	150
Appendix J. Example Field Notes Annotated Floor Plan	151
Appendix K. Example Chi Square Test	152
Appendix L. Example Frequency Table.....	153
Appendix M. Precedent Study	154
Appendix N. Hospital Tours Observation Summary	156

INTRODUCTION

“What patients now crave is more attention to their states of mind and emotions, and to all those things in the environment that sustain them.”

—Esther Sternberg, 2009.

People may have many ideas of what constitutes a healing space, but most people would not refer to the hospital as a healing space. In fact, people will most likely cite a patient room as institutional, cold, impersonal and uncomfortable. What does this really mean in terms of the physical, emotional and social needs of patients and their families? How can designers and healthcare organizations support the healing process through design of the acute care patient room?

Healthcare is an area that is in much need of design consideration. There is a move toward building new hospitals to replace or update old infrastructures, accommodate new technologies and to meet current standards and consumer demand. These pressures increase the demand from healthcare administrators for evidence that supports design decisions, especially as they relate to safety, staff efficiency and improved patient outcomes. According to Ulrich et al (2004), these conditions provide an “once-in-a-lifetime” opportunity to improve the quality of healthcare facilities with a new focus on patient health and the overall quality of the healthcare experience. He argues that “improved physical settings can be an important tool in making hospitals safer, more healing, and better places to work” (Ulrich, 2004, pp.2-3). In a study commissioned by the Centre for Health Design, 15 types of stakeholders identified the most critical issues for research in healthcare environments (Cohen, Allison, & Witte, 2009). One of the key issues in healthcare environments today is patient and user satisfaction, expectation and demand. The study demonstrated that various

stakeholders responsible for the design and operations of healthcare facilities have very different perspectives of the issues and priorities, which indicates the need for an interdisciplinary approach to design for healthcare settings.

Although more attention than ever is being directed toward the design of hospitals, there is still much work to be done in terms of humanizing the healthcare experience for patients and their families, especially in the clinical areas central to the daily care/recovery of patients. As Malkin (2008) states, “[patient] areas should receive the most thoroughly researched creative design even at the expense of other more ‘public’ areas within hospitals such as public lobby, site features, or the types of exterior building materials used” (p. xiii). This statement suggests that creative design considerations, such as innovative design features, attractive room elements and optimum furniture and material selections may not always be the priority (if at all) during the planning and design of patient care settings. A growing body of evidence supports the relationship between the indoor environment and stress in healthcare settings, not only for patients and families, but for staff as well (Chaudhury, Mahmood, & Valente, 2009; Ulrich & Zimring, 2004; Dijkstra, Pieterse, & Pruyn, 2006). Ulrich (1991) in a call to action to the design community over a decade ago stressed how “unsupportive design has effects that work against the process of healing” (p.57). This started a movement toward a better understanding of the ways in which design could be psychologically supportive and in turn improve a person’s overall well-being.

Patient satisfaction is related to the model of care and to the physical, emotional and social support provided through design of the physical environment (Hamilton & McCuskey Shepley, 2010; Ulrich & Zimring, 2008). These interrelated factors contribute to the complexity of patient room design. The patient room could be considered the most important room in the acute care hospital

and more attention recently has focused on how design can improve the overall experience for patients, family and staff. Some influencing factors affecting the reconsideration of patient room design include the increasing costs of healthcare, changing models of care, the aging population, more outpatient treatment, consumer demand for private accommodations, and changing attitudes toward the inclusion of the family in the care process (Malkin, 2008; Hamilton & McCuskey Shepley, 2010; Ulrich & Zimring, 2004; Allison, 2009; Verderber, 2010).

1.1 Healthcare, Design and Patient/Family Accommodation

An aging population, greater consumer awareness, healthcare restructuring and mounting evidence that the physical environment can affect health are some of the reasons why a re-visioning of what hospitals could be in the future is topical. If healthcare facilities are to remain responsive, the needs, values and expectations of all stakeholders, including patients and their families need to be included in the design of all healthcare settings, especially the patient room (Allison, 2009).

To meet the diverse needs of today's patients and their families, patient room design will need to address these new demands. Through an interdisciplinary approach, design strategies that consider the physical, emotional and social needs of users in a way that promotes safety, efficiency and flexibility for change will result in more integrated solutions. A better understanding of the issues facing healthcare, consumer perceptions, expectations and a review of best practices in patient room design will provide a basis for design guidelines that when applied to a new prototype patient room can better accommodate the needs of all stakeholders, including family members.

In *A Visual Reference for Evidence-Based Design*, Malkin (2008) states that accommodating families as partners in care is becoming a common theme in new patient room design, especially now that private rooms are becoming more prevalent. Hamilton & McCuskey Shepley (2010) in

Design for Critical Care, agree that although there seems to be a consensus that patient care should include the involvement of loved ones, in chapter 4, they suggest more design research is needed to look at the role of patient room features that address family caregiver needs, and what specific features significantly contribute to overall family satisfaction in the patient room.

The shift toward accommodating changing and multiple needs within the patient room can be seen in the proliferation of new products geared toward the healthcare industry. Materials and furnishings typically seen in offices or hospitality industries are making their way into the patient room setting in order to address similar demands such as flexibility, comfort, durability and aesthetic choice. Moveable and changeable wall systems with integrated power, lighting, technology and a diverse choice in decorative finishes are providing options to customize and personalize the patient room space. Seating manufacturers are developing small scale, multi-purpose seating/sleeping options to accommodate family members within the small space constraints of the patient room. These elements (wall systems, furniture components, sleeping accommodation) do not always get incorporated into the design of patient rooms in a cohesive way. These developments provide an opportunity to enhance the patient/family experience through a more integrated approach to design of acute care patient rooms.

1.2 Rationale and Purpose of Study

The patient room is where the patient spends the majority of their time, where the caregiver provides most of the care, where families come to support loved ones and impressions are made (Hamilton & McCuskey Shepley, 2010). According to the Canadian Institute for Health Information (CIHI), the average length of stay in 2008-2009 in an acute care hospital has increased to 7.6 days, an increase of 5.6% since 1995-1996. (The Canadian Institute for Health Information,

2010). In the US the average inpatient stay is 4.8 days (CDC-National Center for Health Statistics, 2012). Inpatients are also older and more acute than in the past (Stern, 2012). The common goal of hospital administrators, staff, patients and families is to achieve optimal care and recovery, while at the same time reduce the overall time spent in the hospital.

The literature indicates that there is growing support for the adoption of mostly (if not all) private patient rooms in the construction of new healthcare facilities in the U.S. (Allison, 2009; Chaudhury, Mahmood, & Valente, 2009; Ulrich & Zimring, 2004). A move toward mostly private patient rooms can also be seen in some new hospital developments in Canada (Stern, H., personal communication, January 2012). New approaches to patient room design opens up the design research potential to address issues around patient and family satisfaction in healthcare settings. With the advent of mostly private rooms, increasing restrictions on space to accommodate complex levels of care, safety and infection concerns, and growing expectations for a health supportive environment by patients and families, a more systematic approach to design of patient rooms is necessary. Recent studies of new approaches to private patient room design have focused on the operational aspects or the effects of patient room design on care practices (Battisto & Pak, 2009; Chaudhury, Mahmood, & Valente, 2009; Pati, 2009).

The purpose of this study is to explore what aspects of the physical environment can enhance the patient and family experience through design of acute care patient rooms and to understand the role of interdisciplinary design collaboration as a means to better integrate the diverse needs of all stakeholders in the patient room setting.

1.3 Contribution to Interdisciplinary Design Research

Many new examples of how to accommodate the needs of all patient room stakeholders within the constraints of the modern patient room have emerged (e.g., Malkin, 2008 and Hamilton & McCuskey Shepley, 2010). Although these examples demonstrate innovative design strategies to address the multitude of needs in patient room design, few fully integrate the architectural, interior design, product design, lighting and technology into a more cohesive system. Of particular interest to this study is the way in which the multiple and often conflicting requirements of all stakeholders (especially patients and family), operational issues and healthcare design guidelines can be effectively integrated into the design of a patient room in a safe, efficient, health promoting and elegant solution which can adapt to change of use over time. It is only through an interdisciplinary design lens that the complexity of these criteria can be addressed in an integrated way.

1.3.1 Patient Room Prototype Project (PRPP)

Research for this study extends the previous work on an on-going collaborative project between Carleton University, Ottawa and Clemson University, South Carolina where students from the two institutions work collaboratively on elements of a patient room following an iterative and participatory design process (Battisto & Allison, 2008; Garvey, 2009). This interdisciplinary collaboration commenced in 2003 with subsequent projects every three years. Each new iteration of the project starts with a participatory research approach, leading the teams to specific goals and design criteria that in turn, set the focus for that year's project.

The objective of the project for 2012 is to work within past-established parameters for the patient room and focus more directly on two key components of the patient room: the headwall (patient zone) and footwall (family zone). This project provides an opportunity for empirical research in

which new and established criteria and concepts can be tested in a full-scale mock-up and a final working prototype, further extending the design-research on the PRPP.

1.4 Research Question and Overview

What aspects of the physical environment can enhance the patient and family experience through design of acute care patient rooms?

- a) What elements and features contribute to patient and family perception of a supportive patient room environment?
- b) How can these elements and features be better integrated into acute care patient room design to support patient-and-family centred care?

The overarching goals of this thesis are:

- To analyze recent trends and developments in the design of acute care patient rooms that address patient-and-family centred care approaches.
- To explore what patients and families perceive support their needs during a stay in an acute care setting.
- To investigate an interdisciplinary collaborative approach to research and design for patient rooms
- To identify design criteria that will improve patient and family satisfaction in acute care patient rooms.
- To share the lessons learned and identify opportunities for further research

A review of the current literature on the topic of study through both primary and secondary sources provided an understanding of the current state of the problem. Secondary sources identified key trends, developments and concepts, while the primary material provided insight into the evidence that exists to support the research study. The diagram illustrated in Figure 1 visually demonstrates the conceptual framework of interdisciplinary areas within the literature initially drawn from to form the basis of the research questions for this thesis.

Figure 1. Conceptual diagram for literature review.

LITERATURE REVIEW

“Promoting the health process through design means designers design to reduce stress and strain by understanding the physical, psychological, and social needs.”

—Alan Dilani, 2001.

2.1 Design for Health

In terms of making design decisions involving environments for vulnerable users, designers need to be aware of the interrelated physical, social and psychological implications and whether their solutions support or hinder independence and quality of life (Lawrence, 2002). A concept that is getting much attention in the design of healthcare settings has stimulated research on the psychological effects of design decisions on people’s health and quality of life. In a well known study, Ulrich (1994) demonstrated that a pleasant view through a window could improve the health outcomes of patients. More recently he argues that there is sufficient evidence that demonstrates ways in which design of the environment can help to reduce people’s stress [in response to the environment] and promote restoration (Ulrich R. et al., 2004).

Stress

Healthcare environments in particular are places associated with stress and anxiety. They are usually the last places that people would associate with health, healing or restoration. In one comprehensive review of the empirical literature on the relationship between indoor environment and stress in healthcare and office settings, Rashid and Zimring (2008) provide a conceptual framework that shows how design and the physical environment may contribute to the process leading to stress (Figure 2).

Figure 2. Physical Environment Process Leading to Stress. Adapted from (Rashid & Zimring, 2008).

Evans et al., (1998) provides a preliminary taxonomy of design characteristics that can affect the ability of people to cope and adapt to particular settings. Five dimensions of the designed environment that have the potential to affect human health by altering stress levels are: stimulation, coherence, affordances, control and restoration (p.85). While all five of these dimensions are important in the design of healthcare facilities, this study will focus mostly on design implications relating to stimulation, control and restoration in the patient room setting.

Figure 3. Example of high levels of complexity visual stimulation.

Stimulation is the amount of information a setting or object imposes on a person. Most people function optimally with moderate levels of stimulation but can become over or under stimulated based on a number of factors. Interior design elements that can contribute to the level of stimulation of an occupant include the characteristics of intensity, complexity and novelty (Evans et al, 1998, p.86). Typical hospital environments exhibit many of the characteristics associated with high levels of stimulation, intensity and complexity that may contribute to the feeling of stress. Figure 3 is an image of a hospital room in an acute care cardiac unit (CCU) that demonstrates how a multitude of equipment, visual clutter and diversity of elements can contribute to excessive visual and auditory stimulation not only for patients but for family and staff as well. This visual complexity can be tempered in part by the design of the equipment, the layout of the space as well as consideration for what needs to be exposed, to whom and in what manner.

In response to one of the current trends to conceal medical equipment within the headwall design, one recent study looked at the effects of the visibility of medical equipment on the well-being of patients. Although this was a preliminary study using a simulation experiment with students, the results indicated that concealing the majority of medical equipment or at least minimizing the sight of it may lead to stress reduction in patients (Tanja-Dijksra, 2011). The suggestion is that reducing the visible clutter in the room can produce more pleasant feelings and in turn reduce the feeling of stress (p.43). Although the study focused on the patients' health, one can presume that family and visitors would also appreciate the stress reducing benefits of minimizing the sight of medical equipment. These factors demonstrate how important design of the physical environment and especially patient rooms can be to the overall health of the occupants.

In contrast to the effect of stimulation overload, low stimulation can also lead to feelings of boredom, depression or apathy (Evans & Mitchell McCoy, 1998). These are the feelings usually associated with institutional environments. Figure 4 demonstrates that although a setting may appear clean and bright, too little variety or complexity can result in a lack of visual interest. It is a common complaint of patients, family and visitors that patient rooms often look cold, stark, institutional and drab.

Figure 4. Example of low stimulation and visual interest.

It should also be noted that the level of stimulation is not only due to visual or auditory levels of stimulation but stimulation levels leading to stress can also be contributed to the feeling of crowding or lack of personal space; also common experiences of the patient room setting. The size and layout of space, furniture and objects as well as the use of colour and lighting all play a role in the user's perception of feeling crowded (Dijkstra, Pieterse, & Pruyn, 2006).

Another issue that designers need to consider is that illness affects our sense of place and how we perceive it. We experience spaces through all of our senses; by what we see, feel, smell and hear. (Sternberg, 2009, p.291). One extreme phenomenon known as ICU psychosis or ICU syndrome (Hamilton & McCuskey Shepley, 2010, p.197) is associated with patients experiencing symptoms of delirium, anger, sleep disorders and other negative experiences while in the ICU. There are conflicting views in the research as to how much the physical environment contributes to this condition however, most agree that every effort should be made to minimize stress to patients and

staff. Some organizations such as the Society of Critical Care Medicine (1995) have developed guidelines to address some of the sensory orientation issues of patients which include: natural illumination, window views, clock, calendar, bulletin board, pillow speaker connected to a radio or television and elements of visual interest such as colour, graphics or pictures (Ibid, p.1998).

Control and Choice

Control can be defined as a having a sense of mastery by having the ability to change or alter the setting in which one is in (Kopec, 2011). Key concepts that relate to control in the physical environment include physical constraints, flexibility, responsiveness, privacy, spatial language, defensible space, and symbolic elements (Evans, 1998, p.88). The design of hospitals and patient rooms specifically can be analyzed based on these concepts and how they might contribute to an occupant's feeling of stress. For example, physical constraints such as the inability to adjust the light levels, room temperature or angle of the television could result in feelings of frustration, anger and ultimately stress. According to Evans (1998), the *spacial resources*: the volume and size of space, visual exposure, openness, brightness and extent of view all can contribute to the effects of crowding (Evans, 1998, p.89) which previously mentioned is a common stressor in patient room settings.

Privacy or the ability to regulate visual, acoustic and social interaction can also contribute to a person's sense of control (Evans & Mitchell McCoy, 1998). Concepts of privacy such as solitude/intimacy, public/private and visual/auditory can all be addressed through the various elements of the physical space. Even the arrangement of furniture can affect social interaction, which should be a consideration in the design, flexibility and layout of patient rooms (Ulrich R. S., Effects of Healthcare Environmental Design on Medical Outcomes, 2001). Providing the ability

for all users to have some degree of control or choice over the elements within the patient room may reduce their feelings of stress and encourage social interaction. Designers and administrators of hospitals should be aware of the symbolic associations of control in physical environments. For example, size, sterility, uniformity of materials, furnishings and restrictions on personal items all contribute to the institutional feeling (Evans, 1998, p.89).

2.1.1 Health Supportive Environments and Evidence-Based Design (EBD)

The theory of *supportive design* (psychosocially supportive design) stems from a culmination of evidence from various fields such as environmental psychology, evolutionary biology, psychoneuroimmunology and neuroscience (Ulrich,1991,1997; Malkin,2008; Kellert, Heerwagen, & Mador, 2008; Sternberg, 2009). The term used extensively in the field of healthcare design is often incorporated into concepts such as ‘healing environments’ and ‘therapeutic design’. Evidence based design (EBD) incorporates more than just the elements that would support healing and also includes the effect of the built environment on other important outcomes of the healthcare setting including safety, staff efficiency and other operational concerns (Malkin, 2008, p.2).

The eight EBD goals include:

- Reduce surface contamination linked to healthcare associated infection.
- Reduce patient falls and associated injuries.
- Decrease medication errors
- Improve communication and social support for patients and family members
- Decrease patient, family, and staff stress and fatigue
- Improve staff effectiveness, efficiency, and communication

- Improve environmental safety
- Represent the best investment

The theory of supportive design or health supportive environments proposes broad and flexible design guidelines (psychosocially supportive design criteria) as outlined in

Figure 5 that can be applied to a wide range of health-related fields” (Ulrich R. S., 2000, p.4).

Ulrich explains that the underlying premise of the theory is to reduce stress and support restoration through design strategies which foster:

- Control and access to privacy
- Access to nature and other positive distractions
- Access to social support

Some of the measurable outcomes from applying these criteria in the design of supportive environments include: reduced stress/anxiety, improved sleep, reduced pain, lower infection occurrence ,shorter recovery time and improved patient satisfaction (ibid, pp.6-9). Ulrich et al. (2008) provides a conceptual framework for EBD in healthcare (

Figure 5) that proposes categories in which specific variables can be linked with design of the built environment. Specific to the design of patient rooms, features believed to foster a sense of control include letting patients and family have some degree of control over lighting, temperature, television programming, and internet access. Personalization of the room for example, could be accommodated by allowing occupants to select their own artwork (Ulrich, Berry, Quan, & Turner Parish, 2010).

Design Issues	Design Criteria and Strategies	Evidence-Based Health Supporting Design Outcomes
<i>Foster Control and Privacy</i> an individual's real or perceived ability to influence the situation they are in	Bedside dimmers to control lighting Personal choice of visual and auditory privacy Personal choice of music Noise abatement, choice and control	High probability of reduced stress/anxiety for patients and family Moderate probability of reduced pain High probability of improved sleep Moderate to high probability of lower infection rates
<i>Access to Nature and Positive Distractions</i> environmental-social conditions with the capacity to improve mood and promote restoration	Views of nature (real or simulated) Artwork of nature images or landscapes Minimize negative views/distractions	Very high probability of improved patient satisfaction High probability of improved benefits for staff and families
<i>Foster Social Support</i> emotional support and tangible assistance from others	Comfortable, moveable seating Convenient overnight accommodations	

Figure 5: Health Supportive Design Criteria and Outcomes, adapted from (Ulrich R. S., Effects of Healthcare Environmental Design on Medical Outcomes, 2001).

Healthcare outcomes specifically related to the inclusion of a 'family zone' in patient rooms include: reduced patient falls, reduced patient stress, reduced depression, reduced length of stay, improved patient privacy/confidentiality, improved communication with patients & family

members, improved social support and increased patient satisfaction (Ulrich & Zimring et. al. 2008).

In considering design as a function of therapeutic intervention, Evans refers to the theory of restoration and suggests that restorative elements include retreat, fascination, and exposure to nature. It should be the intent of patient room design to strive to produce restorative environments and to provide the conditions for rest, recovery or contemplation. Fascination can be created through window views of nature, fireplaces or other natural elements or positive distractions (Evans, 1998; Ulrich R. S., 1984; Kaplan, 1995; Heerwagen, 2010). According to Heerwagen (2003), *Bio-Inspired Design: What Can We Learn from Nature?*, through choreographed material and finishes selection, interior spaces can incorporate many of the universal elements found in nature (such as those common to natural landscape scenes) that promote a restorative feeling. These elements include movement (simulating clouds, water, blowing leaves/grasses), organized complexity (balanced composition of elements), colour schemes derived from nature (full-spectrum/layering of tonal values and hues), fractal patterning (emulating natural growth patterns/scales), and the use of organic shapes and horizontal lines (considered universally to be more peaceful).

Figure 6. Physical Environmental Stimuli Diagram. Adapted from *Why Buildings Don't Work: The Role of Architecture in Human Health*. (Evans & Mitchell McCoy, 1998)

Figure 6 organizes the physical environmental stimuli that can facilitate the design of healing environments into categories such as architectural, interior or ambient features and whether patients interact with or passively observe these features (Evans, 1998). According to Dijkstra et al. (2006, p.166), a better understanding of the physical environmental stimuli and their effect can help in the design of healthcare environments with more positive benefits for staff, patients and their families. Stimulus objects can impact the health and well-being of people either directly or indirectly. An example of a direct influence might be that one type of flooring (carpet) could hold

more microorganisms than another (vinyl) which could have a direct *physiological* influence on a patient's health by causing a resulting infection. More indirectly, environmental stimuli (such as plants in a patient room) could through the psychological process of sensory perception give the patient a feeling of pleasure which could impact their anxiety and in turn improve their ability to recover. It is also possible that stimulus objects can have both direct and indirect influence on a patient's health. For example, a carpet can also have indirect impacts such as reduction in noise levels or the appearance of a more homely ambience. (Dijkstra et al., 2006, p.167). It is easy to see then, that the design and selection of elements and objects within patient rooms can have both direct and indirect consequences on a patient's health and well-being. It is also obvious that these factors are not as easily isolated as depicted, but the impact of each variable as a whole within the patient room setting are interrelated and should be considered as a whole.

2.2 Patient-and-Family Centred Care

According to Malkin (2008), "Designing the patient's experience is always a multidisciplinary endeavour that starts with how care will be delivered". There has been a shift away from the 'conveyor-belt' approach to healthcare to more holistic approaches to care that focus on the psychosocial as well as the medical needs of patients and their families (Katherine & Gallant, 2006). Two US organizations are instrumental in the move toward more patient and family focused care, a trend that is starting to affect the design of new patient rooms. Patient-centred care is a model of care that was established by the Planetree Model Hospital project in San Francisco in the 1980's that is based on the idea that all decisions should revolve around the comfort and convenience of the patient (www.planetree.org). This organization supports the concept that family members are 'partners in care' and that their input and needs should be considered at all levels of the healthcare experience.

The Institute for Patient-and Family-Centred Care (1992) is a non-profit organization that extends this philosophy and promotes patient-and family-centred care as:

“an approach to the planning, delivery, and evaluation of health care that is grounded in mutually beneficial partnerships among health care providers, patients, and families...Patient- and family-centered care is an approach to health care that shapes policies, programs, facility design, and staff day-to-day interactions. It leads to better health outcomes and wiser allocation of resources, and greater patient and family satisfaction.”(Institute for Patient-and Family Centred Care, 1992).

The four core concepts of the organization are Respect and Dignity, Information Sharing, Participation and Collaboration. Although this concept has been promoted for some time, accommodating the family in the care of patients is a relatively new concept that is most widely adopted by pediatric, maternity and newborn intensive care (Conway et al. 2006).

2.2.1 Patient and Family Satisfaction in Healthcare Environments

Ulrich et al. (2008) confirm in a comprehensive review of the evidence that satisfaction with the physical environment is a key predictor of overall satisfaction in healthcare settings (p.16). Published data on the specific needs of patients and their family members in response to acute care patient rooms is sparse, especially in Canada. Most hospitals conduct patient ‘exit’ surveys through independent national marketing survey companies (such as Press Ganey Associates) which they take very seriously in terms of quality indicators (Stern, 2012). National standard patient exit surveys, such as the ones used by Press Ganey provide limited insight into the specific qualitative needs of patients and families related to the designed experience. As a result, “architecture often uses staff that work with patients every day as advocates” (Allison, D. personal communication,

April 2012). Although these surveys can provide some valuable information for designers, they may not provide the full picture. Bate and Robert (2007) state that specific questions [such as the quality of the patient room] or the overall experience by patients and families cannot always be expressed or captured in surveys (Bate & Robert, 2007). They argue that many surveys focus on attitudes rather than experience and do not often fill the 'gap' of capturing a person's emotional experience. "Users are simply not asked 'how did it feel?' (pp.163-164)". In an attempt to bridge the quantitative/qualitative gap in standardized hospital surveys, a new form of 'sentiment analysis' has been proposed that captures the written comments of patients based on the standardized question format. These comments are gathered and subjected to a systematic content analysis that links the patient sentiments to specific areas within hospitals, such as the patient room environment (Vance & Berger, March 2012). What this example does indicate is that there is a need for more qualitative information about the hospital experience from the direct users. The focus of most surveys has been on the patient's experience and less so if at all on the experience of the partner in care.

One study that investigated patient and family perspectives on healthcare facilities used small focus groups at three types of healthcare settings at five different facilities. They interviewed patients and families in the first phase and healthcare professionals and patients in a second phase. They found that patients and healthcare providers both identified family accommodations as important features in healthcare environments. They also found that the needs identified by patients sometimes differ greatly from those identified by designers and architects (Leventhal Stern, et al., 2003). As Malkin (2008) points out, most patients dislike the feelings of vulnerability and dependency that are so often associated with a stay at the hospital (p.85). The benefits of good design may not even be realized if the most basic needs of patients and their families are not met.

This highlights the need for more inclusive and user-centred design approaches. It also demonstrates that the design of the physical environment is only one facet (although an important one) of the larger picture in healthcare settings and that many factors need to be taken into account in the context of designing the patient room, starting with the type of care.

2.2.2 Accommodating Partners in Care

Traditionally, accommodation for families in acute care patient rooms has been a visitor chair in addition to the patient chair. Some rooms have reclining patient chairs that allow a person to stay longer or overnight and some facilities bring in a hospital cot for overnight accommodation (Cote, J. personal communication, Januray 2012). Healthcare manufacturers are starting to address this need through the design of various pull-out chairs, sleepers and sofas that can accommodate 1 or 2 people. With the move toward mostly private rooms in many new hospitals, family can be better accommodated within a delineated space that prevents interference with the primary caregiver activities (Allison, 2009). This trend is influencing the way patient rooms are being designed and the types of amenities that can be accommodated within the space. A current space design strategy is to allocate a distinct area within the room referred to as the ‘family zone’. According to Hamilton & McCuskey Shepley (2010) , “A design that respected the role of family members during a crisis would have space allocated to family use that would not intrude on the activity of a code team working around the patient.” Space allocated for family/visitors in new patient room design is usually adjacent to the window or at the end of the bed or ‘footwall’ depending on a number of factors that affect the base room design. A summary of some of the benefits of involving patients and families in the healthcare experience include:

PATIENTS AND FAMILIES	<ul style="list-style-type: none"> • More knowledgeable and competent • Better healthcare experience • Less anxiety and stress • Improved patient outcomes (physiological and functional) • Improved emotional health
STAFF	<ul style="list-style-type: none"> • Increased job satisfaction • Reduces stress, fatigue • Increased quality of work
HOSPITAL ORGANIZATION	<ul style="list-style-type: none"> • Improved quality of care • Safer environment • Decreased complaints • Better health management • Decreased length of stay

Figure 7. Benefits of Accommodating Patients and Family. Adapted from *Putting Patients First: Practices in Patient-Centred Care*, by Frampton, S. & Charmel, P. (2009), a Planetree Publication, Jessey-Bass, John Wiley.

2.3 Human-Centred Design and Design Thinking

In much of the literature about healthcare design, the operational term patient-centred care has a direct relationship with a relatively new concept of patient-centred design (Ryan & LaBat, 2009). According to Buchanan (1995), “The discipline of design, in all its forms, empowers individuals to explore the diverse qualities of personal experience and to shape the common qualities of community experience” (Buchanan R. , 1995, p. 29). Going to the hospital is not often a choice and the experience is not often pleasant. The focus of Western traditional models of care emphasize curing, medicine and technology (Huelat, 2007, p. 3). By putting the patient’s (and other primary user) needs at the centre of the design process, the focus becomes more human-centred rather than medical-centred.

Human-centred design is a term that has evolved from movements in the design fields such as universal design, inclusive design, user-centred design and design-for all (Nussbaumer, 2012).

These concepts align with the need to understand the impact of the environment on a person's level of functioning, independence and well-being. The common goal of these movements is to design for all users to function at their highest capacity. In a hospital setting the impact of the environment can have multiple implications for effective functioning for staff, patients and their partners in care. Being able to see the 'big picture' as well as having the ability to "observe the world in minute detail" with a "people-first approach" are attributes of design thinking needed to address healthcare design problems (Brown, 2008).

Patient-centred design is a complex process where a designer must constantly navigate their focus between the micro and macro issues related to the healthcare setting (Ryan & LaBat, 2009, p.204). The 'user' in the case of a patient room should focus on the patient, but it also involves many different stakeholders, each with specific and sometimes overlapping requirements. The complex nature of healthcare problems requires the input of many people and the collective vision of various stakeholders and is a prime topic for 'design thinking' strategies. Often referred to as 'wicked problems' in the design literature, Buchanan (1992) in an article about design thinking refers to Rittel's definition of design problems as being "ill-formulated, where information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing" (Buchanan R. , 1992, p.15). In reference to how designers think, Cross (2011, p.75) refers to three key design strategies that are characteristic of design thinking that would be critical for addressing design issues in healthcare.

- Taking a broad 'systems approach' to the problem, rather than accepting narrow problem criteria
- 'framing' the problem, in a distinctive and sometimes personal way

- Designing from ‘first principles’

In reference to design thinking, Brown in *Change By Design* (2008), suggests that to “get beneath the surface” of some of societies most pressing problems (such as healthcare), human-centred activities associated with design thinking can make a large impact (Brown, 2008, p.2). He argues that certain experiences or developments can unlock the aptitudes that are common traits of good designers. Some of the key personality traits of design thinker’s according to Brown include:

- *Empathy*: imagining the world from different perspectives and taking a ‘people first’ approach enabling them to imagine solutions that are inherently desirable and meet explicit or latent needs.
- *Integrative thinking*: they use both analytical processes and can see all salient and often contradictory problems, often creating novel solutions improving on existing alternatives.
- *Optimism*: they assume that no matter the extent of constraints on a problem, there must be one possible improved solution.
- *Experimentalism*: posing questions, they explore constraints in creative ways and in new directions.
- *Collaboration*: are able to work among and across other disciplines.

2.3.1 Interdisciplinary Collaboration

An interdisciplinary and human-centred approach to design can help various team members synthesize their collective knowledge into a cohesive solution that meets the needs of the various stakeholder groups. This research explores the interdisciplinary design process in the context of the design of a patient room prototype. The word ‘interdisciplinary’ has different meanings across different sectors and in different contexts. Terms found in the literature include interdisciplinary

care, interdisciplinary teams, interdisciplinary research and interdisciplinary design. The word ‘interdisciplinary’ generally means the collaboration of two or more disciplines toward a common goal. Poggenpohl & Sato (2009), offer a helpful distinction in that activities that fall between two [or more] disciplines would be considered interdisciplinary in contrast to multi-disciplinary activities in which several disciplines only share perspectives (p.138). Collaboration according to the *Oxford English Dictionary*, is defined as ‘working with others’ in a ‘cooperative or unified’ way. Collaboration can happen within an organization, across organizations, cultures, departments, programs and in virtual space adding to the complexity of these formed relationships. Design collaboration in the contemporary sense is still in its infancy (Poggenpohl & Sato, 2009). Although there is much interest in collaboration for the purpose of knowledge making and innovation, there are both benefits and challenges to interdisciplinary design collaborations.

Interdisciplinary teams may consist of allied design professions or more diverse teams including members representing fields outside of design, such as psychology, engineering or medicine. The range of collaboration might include involvement at only certain phases of the project or throughout all phases of the design process. An interdisciplinary collaboration could also include non-designers such as industry representatives, clients, users or advocates of certain user groups and external stakeholders through the use of participatory design methods (Poggenpohl & Sato, 2009).

2.3.2 Design Research and Participatory Design

Design research such as observations, prototyping, co-creation with users and other participatory methods can expand the traditional design process to address the problem more holistically and from multiple perspectives (Brown, 2009). The use of prototyping and mock-ups are design

research tactics that allow designers and researchers to quickly and at various levels visualize and interact with design ideas that replicate the real world (Groat & Wang, 2002; Brown, 2009). The definition of a prototype (also referred to as a model) varies across disciplines but is used to explore, test and refine ideas at different stages within the design process (Brown, 2009, pp. 87-108). These methods have heuristic value. For example, the learning experience of constructing the full-scale mock-up can be an outcome in itself (Groat & Wang, 2002, p. 290). The power of prototyping lies in the value of taking concepts from the abstract to the concrete; in “building to think” and “thinking and making” (Brown, 2009; Pallasmaa, 2009). Seen by some as a circulatory process of drawing and making, the value is in the “constant shifting of viewpoints from the idea to the sketch, the model, a full-scale test, and back again...built and tested as a mental construction in several alternates before the final concept is chosen” (Pallasmaa, 2009, p.67). The recent interest in the design fields to move closer to the user experience has resulted in a resurgence of past participatory movements that evolved from Scandinavian approaches from the early 1970’s to more recent models of varying levels of democratic involvement such as user-centred design, experience design and ‘co-design’ practices (Brown, 2009; Bate & Robert, 2007; Sanders, 2009).

Mock-ups and prototypes are also important simulation techniques that can be used to allow future stakeholders a way to visualize and interact with a concept. The design of patient rooms has been the focus of user-centred design mostly from the perspective of staff safety and efficiency through the use of mock-up and simulation. One study that used a mock-up as an ‘interactive laboratory’ to establish evidence-based (EBD) guidelines for inpatient hospital rooms found that the mock-ups allowed for the evaluation and confirmation of EBD solutions and strategies to establish client standards for new hospital rooms. In addition to the mock-ups, the study used questionnaires, scenarios, on-demand modifications and observations to evaluate EBD solutions. A diverse group

of 71 stakeholders including clinical staff, maintenance staff and patient and staff safety representatives evaluated the mock-ups. They tested the location of beds, position of headwall, nurse spaces and technology, clearances for universal rooms and patient and family amenities. They also suggest that when used as a means for mixed-method research, mock-ups can address many stakeholder concerns as well as contribute to the healthcare design knowledge base (Watkins, Myers, & Villasante, 2008).

2.4 Patient Room Design

Changes affecting the design of patient rooms are the result of many influencing factors including demographic shifts, aging population, technological advances, high cost of healthcare and changing models of care (Ulrich & Zimring, 2004). Growing evidence supports the private patient room in terms of lower infection rates, less patient transfers, less noise, improved communication with staff and overall patient satisfaction (Ulrich, Berry, Quan, & Turner Parish, 2010). “Consumer preference and improved patient and family amenities are driving hospitals to build new private rooms in order to remain competitive in their markets” (Allison, 2009, p.1). This trend can also be seen in Canada where new hospital developments such as the Jewish General Hospital in Montreal is building mostly private rooms for infection prevention measures among other benefits such as patient and family satisfaction (Stern, personal communication, January 2012).

When considering the patient room as a healing space, many contextual factors need to be considered. According to Verderber (2011), there are eight interrelated factors that when viewed together can form a holistic picture of the impact of the designed environment on occupant health and well-being (Verderber, 2010).

Figure 8. Patient Room: Factors that impact occupant health and well-being.

Figure 8. Patient Room: Factors that impact occupant health and well-being is a visual interpretation of these factors as they relate to this thesis and the concept of the patient room as a healing space. Missing and added to this diagram (dotted bubble) is the consideration for amenities and accommodation within the patient room space. Often an afterthought or perhaps not considered at all as a factor that can impact occupant health and wellbeing are the interior design and industrial designed objects and products in which the occupants come in most intimate contact with. This would include the stimulus and interaction objects cited earlier in this paper such as

seating, furniture, fixtures, textiles, accessories equipment etc. It might be that these elements are considered part of the aesthetics or appearance of the room. However, their significance to occupants should be considered in an analysis of the impact of the total environment. Figure 9 demonstrates the complex set of needs (tangible and intangible) of various stakeholders including the hospital administration, clinical staff, patients and their family or personal caregivers to be considered in the design of patient rooms.

Figure 9. Healthcare Users and Stakeholders diagram. (Camarda, Kim, Mehta, 2005).

Allison (2009) identifies four overlapping and often competing design criteria for patient rooms: improving operational efficiency and effectiveness of care, improving health and safety outcomes for patients and staff, improving patient family and staff satisfaction and accommodating changing needs (Figure 10). These criteria need to be considered independently as well as together during

the design process in order to capture the interrelated needs, both intangible and tangible. In the design of a healing environment, each design decision can help or hinder the ability for a positive experience.

Figure 10. Design criteria for patient rooms.

2.4.1 Trends and Innovations in Patient Room Design

One recent trend in acute care as noted earlier is toward the single private patient room. Although the all-private room hospital was in existence as early as 1908, more recently there has been a surge in hospitals adopting an all private or mostly private room model (Verderber, 2010). While the assumption might be that patients and family would given the choice, choose a single private room, some studies suggest otherwise. Douglas (2004); Lawson (2000) and Stevens (1995) found

that some patients prefer to have a roommate for the social interaction, comfort and support it affords. In any case, a number of single, private patient room configurations have emerged due to recent trends that influence the design such as changes in the delivery of care, new technologies, new work practices and organizational changes. As Hamilton (2010) points out, there are too many different unique demands in healthcare for one 'perfect' patient room to exist (Hamilton & McCuskey Shepley, 2010).

In a response to the need of future hospitals to respond to change and efficiency, the *acuity adaptable patient room* and the *universal room* are design concepts that evolved to address these overlapping concerns and to provide more long-term flexibility to accommodate increasing levels of care (Katherine & Gallant, 2006). The premise is that these rooms would allow for the accommodation of increased patient acuity and care within the same room without the need or to reduce the need to transfer the patient. The necessary medical equipment such as medical gases and power would be provided, easily upgraded or brought in via portable means in order to support higher levels of care. (Allison, 2009).

In addition to greater medical equipment considerations, one of the primary design characteristics of private single patient rooms is the spatial organization of the room into three distinct activity zones: the Patient Zone, the Clinical Zone and the Family Zone (ibid, p.327). These zones evolved based on the need to better define the various activities within the confines of the patient room space in order to support efficiency and safety for patients and staff.

2.4.2 Functional Organization

The room size, location, layout and configuration can all impact patient and family satisfaction. The current trend is toward mostly or all private patient rooms. The most cited reason for this shift

is for infection prevention, but benefits to patients and families include more privacy, control of the overall environment and more space for families and guests (Brown & Gallant, 2005; Ulrich & Zimring, 2008). As a result, family zones are becoming a common feature but vary in size, proportion, layout and amenities. The type of hospital and level of care dictates the size and recommended clearances of the room. Issues of space and layout become more pressing as the acuity level increases. With the move toward more acuity-adaptable private rooms, family zones must be designed in accordance with space, safety and operational standards for higher levels of care. Clearances around the bed, access to the patient, and space for more medical equipment set up the space constraints. In addition to space/layout requirements, a handwash sink in the clinical zone is becoming a standard evidence-based room feature. In one study, Pati (2009) uses a multidimensional framework that attempts to address the needs of the three primary stakeholders in patient rooms (caregivers, patients and families) to demonstrate the issues that arise in room configuration and their impact on outcomes just by the location of the bathroom. Using a symposium format with fourteen experts from four institutions, six patient room configurations were assessed according to six domains of assessment (1) patient safety, (2) staff efficiency, (3) circulation, (4) infection control, (5) patient considerations, and (6) family considerations (Pati, 2009). While the author cautions that this exercise is not to identify the best patient room for universal applicability (p.17), it is a useful starting point for benchmarking of patient room attributes and the important considerations that can affect the design of the space.

The family zone typically the space in front of the window or at the end of the patient bed, (see Figure 11) must be planned carefully in order to maintain the space and operational requirements. As a result, there is more attention recently focused on the design of the footwall as a space saving strategy to integrate and accommodate patient and family amenities. Review of various patient

Design strategies that optimize space can help keep a manageable footprint while at the same time meet the needs of all stakeholders. Some of the rooms analyzed appear to be so large that any kind of patient/family/staff intimacy is lost. For example, the focus should be on attending to the patient's needs, not setting up 'shop' for families to 'loungue around' until the patient gets better.

A re-evaluation of the personal space and territorial needs of various users of the patient room can result in a more intimate, yet emotionally and socially satisfying space. Having just enough space for short visits by guests but accommodating one person overnight might provide the right balance.

While an interdisciplinary and patient-centred design approach best addresses the multiple and complex needs of healthcare settings in general, two key components in the patient room in particular can benefit from this approach to design: the headwall and footwall systems. Malkin (2008) suggests that these components of the patient room need not be expensive or elaborate to meet the basic needs of organizing equipment and amenities in order to reduce clutter (p.25). However, reducing the visual clutter is only one dimension of the problem that needs to be addressed through the design of these elements.

2.4.3 Headwalls and Patient Zones

Patient support systems, the point at which all medical services are brought to patient is the single most important consideration in the design of the patient room (Hamilton & McCuskey Shepley, 2010, p. 104). Even still, there is very little research on the design efficacy of this element. Battisto & Pak (2009) conducted a case study with nurses and respiratory therapists, which consisted of a task analysis and interviews to understand their use of and experience with typical headwall patient support systems. Their study revealed that design in fact plays a critical role in staff efficiency and safety, especially in terms of ergonomics and accessibility (Battisto & Pak, 2009). The headwall type of system has been around the longest and is used most often, especially in lower level acuity rooms (Hamilton & McCuskey Shepley, 2010, p. 104). In an attempt to create a more integrated design solution, architects and designers often treat the headwall as a design feature within the

room. A recent trend in headwall design has been to incorporate decorative elements as functional aspects in the concealment of equipment either in a customized or manufactured product solution.

2.4.4 Footwalls and Family Zones

The family zone is a relatively new development in acute care patient room design and is becoming more prevalent with the move toward mostly private patient rooms (Hamilton & McCuskey Shepley, 2010; Malkin, 2008; Allison, 2009). Earlier examples of the incorporation of areas for family within the acute care patient room evolved in response to the need to accommodate families in the care process for children and maternity care units (Malkin, 2008; Leibrock & Harris, 2011). The trend to accommodate family in acute care patient rooms for adults is becoming a standard feature in many American and Canadian hospitals. A review of the literature reveals that accommodating family in the patient room can be as simple as provision of a converter/sleeper chair or as grand as an entire separate ‘family suite’ adjacent to the patient zone.

As stated earlier, benefits of accommodating the family in the patient room such as increased patient satisfaction through emotional, social and physical support, are becoming more accepted. However, adding the needs of family to those of the patient and staff add to the complexity of design for patient rooms. For example, each stakeholder has unique physical, emotional and social needs that require accommodation within the constraints of small spaces. Design elements such as room size, layout, technology, furniture, equipment, finishes and materials all play a role in creating a safe, efficient, and adaptable health-supporting environment. Appropriate family zones according to Ulrich et al. (2008) may encourage family members to stay longer and provide social support for patients (p.26).

One study that used a mock-up as an “interactive laboratory” to establish evidence-based (EBD) guidelines for inpatient hospital rooms found that the need to accommodate family members in the patient room was emphasized, but there was concern that furniture such as a sleeper sofa would interfere with delivery of care. Eight participants from the workshop (it is not known how many were actual patient or family members) felt that a sleeper chair and/or computer access was sufficient for each standard level of care inpatient room to support a family’s needs. In acute care patient rooms it was “assumed that...the room would need to accommodate more visitors and longer visits (overnight stays) resulting in a room layout with a family zone to accommodate a sleeper sofa and patient chair. In addition to the sleeping/seating accommodations, the room would have a built-in wardrobe, additional shelving for display and personal belongings. (Watkins, Myers, & Villasante, 2008).

An emerging trend aimed at integrating more presence of family in the patient room within the constraints of a small space is the design of integrated footwalls. The idea according to Allison (2009) in reference to a patient room prototype project between Clemson University and Carleton University is to see the footwall as a ‘hearth’ for the room. It is the main focal point for patients, and provides the best viewing angles for social interaction and media viewing (p.9). In addition to providing a visual focal point, the footwall element can reduce visual and physical clutter and “minimizes additional furniture in the room that would otherwise need to be moved for routine patient and emergency response” (ibid. p.9). This idea has been expanded upon by others and is evident in a review of best-case examples and recent developments in hospital room furniture design.

2.4.5 Patient Room Furnishings and Finishes

Furniture in healthcare settings requires a higher standard of quality and attention to detail than is needed in office and hotels (Huelat, 2003; Leibrock & Harris, 2011; Malkin, 2008). In these settings especially, the furniture plays an integral role in ensuring user safety, comfort and adaptability (Malone, 2011, p.39). Furniture is one of the ubiquitous yet least critically analyzed components of the design process, even in healthcare settings. According to Malone (2011), a typical new 120-bed inpatient hospital may relocate or purchase over 1600 pieces of furniture. She points out that more attention needs to address the role that furniture may play in achieving desirable patient, staff, and visitor outcomes (p.3). In terms of the role of furniture (including systems and built-in millwork) in realizing patient and staff outcomes, no research was found that looked at the relationship between furniture type/layout that could best support patient social support or communication with family and caregivers in single patient rooms (Malone & Dellinger, 2011, p.20).

The authors developed an evidence-based design (EBD) checklist based on a comprehensive review of current evidence, industry standards and guidelines for furniture in healthcare settings. The *evidence-based design furniture checklist* developed initially as a tool to assist with the specification of furniture for healthcare facilities, may prove useful for comparing current products that exist for healthcare applications such as systems and built-in furniture for patient rooms. The eight item checklist aligns with the current goals of evidence-based design, and uses evidence to link furniture features to healthcare outcomes (Malone, 2011, pp.5-6).

Finishes and materials for healthcare must meet the stringent guidelines for durability, cleanability and flammability for institutional settings (Leibrock & Harris, 2011; Malkin, 2008). Infection

control is one of the most important factors for the performance consideration of every material, finish, installation and detail method that goes into the design of a patient room. To make a patient room less institutional requires careful consideration of the materials and finishes to provide a balance between 'high maintenance' and 'high touch'.

2.5 Summary of Literature Review

This review highlighted a shift toward more therapeutic and consumer centered design in hospitals. It was also observed that a new trend in acute care patient room design is to accommodate the needs of family or 'partners in care' and that in doing so it would benefit both the healthcare organization as well as improve overall patient satisfaction. Very little design research has explored this issue. A growing body of evidence supports the fact that certain design interventions along with the social support of family and friends can reduce stress, provide necessary restoration and accelerate the healing process (Ulrich & Zimring, 2004; Ulrich R. , 1984 Evans & Mitchell McCoy, 1998).

This shift also aligns with human-centred and participatory design approaches that seek to find more inclusive design methods to address complex design issues. Interdisciplinary design collaborations are one way to explore the complex needs of healthcare settings. Design for healing environments involves understanding the operational, functional, emotional and social needs of multiple stakeholders in addition to the unique demands of healthcare such as durability and infection prevention.

METHODS

“If we study people in environments strictly through disciplinary eyes—whether the social sciences, psychology, biology, physiology, or the design disciplines—we will always see only part of the picture. Each provides only partial solutions to environmental problems.”

—John Zeisel, 2006

3.1 Introduction

Subsequent to the literature review, analysis of the design strategies employed to date, interviews with a diverse group of stakeholders including experts in the healthcare design field, nursing staff, as well as patients and families with personal experience in acute care settings were conducted to gain a more holistic view of the problem. Design can enhance the patient and family experience in the patient room setting (Ulrich, Berry, Quan, & Turner Parish, 2010). Design of patient rooms involves addressing a complex set of needs (tangible and intangible) from various stakeholders requiring an interdisciplinary, collaborative approach to research and design. The purpose of this study is to address the following research questions:

What aspects of the physical environment can enhance the patient and family experience through design of acute care patient rooms?

- a) What features and elements contribute to patient and family perceptions of a supportive, healing space?
- b) How can these elements and features be better integrated into the acute care patient room design to support patient-and-family centred care?

Literature suggests that family and ‘partners in care’ are important to the health, safety and well-being of patients (Zimring, et al., 2008; Ulrich & Zimring, 2004; Hamilton & McCuskey Shepley, 2010; Chaudhury, Mahmood, & Valente, 2009). Having someone present during a hospital stay can physically, emotionally and socially support patients’ during the healing process. Integrating the needs of partners in care in the patient room is an important factor in creating supportive healing environments (Ulrich R. S., 2001). Accommodating the needs of family with patients and staff caregivers has an impact on the overall design of patient rooms. Most research focuses on the patient and staff needs within the patient room, less attention has been directed toward the specific needs of families within the adult acute care patient room. Interviews with industry experts were conducted to explore this trend and to understand the ways in which the patient and family needs were currently being addressed.

3.2 Approach and Study Design Overview

A single case study, the Patient Room Prototype Project (PRPP) formed the basis of exploration for the research questions. The selected research strategy is to obtain a deeper understanding of the complexity of the design problem from the various stakeholders and user groups within the context of the patient room setting. Although the main focus is on patient and more specifically family satisfaction in acute care patient rooms, it is hypothesized that user satisfaction is affected by many components of the built environment and that a more holistic approach to design that addresses the physical, social and psychological needs of users is needed. The research design (illustrated in Figure 13) involved four stages that aligned with the time frame and course schedule of an interdisciplinary design project between two universities, in two different cities/countries during the winter term. The researcher assumed multiple roles through the duration of the project including participant/observer, interviewer and at times consultant. It should be noted that the

researcher has a formal professional background in Interior Design with experience in healthcare facility design and that this experience was drawn on during the course of the research project.

Within this research design framework, four stages for data collection were used to address the research questions and fulfill the research goal:

Stage 1: Literature Review/Precedent Studies

Stage 2: Focused and informal interviews

Stage 3: Patient and Family Survey Questionnaire

Stage 4: Observations

3.2.1 Case Study Selection

There are several reasons for the selection of this particular case. The first is that it aligned with the researcher's personal topic of interest. Second, it provided both chronological and current perspective on the development of award winning innovative design strategies for patient rooms in acute care settings. Third, the interdisciplinary design process using distributed collaborative technologies provided a unique perspective of how design could address complex, real problems in healthcare. Finally, the project offered the opportunity for empirical research, as well as to meet and gain valuable insights from a broad range of stakeholders and experts within the healthcare design domain.

According to Groat and Wang (2002), a case study is an empirical inquiry that investigates a phenomenon or setting within its real-life context and in relation to the complex dynamics of that setting (pp. 346-347). Poggenpohl & Sato (2009) add that case studies can be used to investigate

complex subjects that may be difficult to analyze through analytical methods. They further state that the case study can be used to find patterns that could lead to further elaboration of the research problem (p. 39). Investigating the case study method for interdisciplinary design research revealed that although the method is commonly used in other professions such as social science, architecture, law and business, “Design research has not established effective ways of using this method” (Poggenpohl & Sato, 2009, p.39). The value of case studies for the design fields is that they can be used where “real world context tends to make more controlled empirical study difficult” (Francis, 1999, p.13). Further, they are often used to study complex subjects that are not easily investigated using either analytical or quantitative methods alone (Poggenpohl & Sato, 2009; Francis, 1999; Groat & Wang, 2002). “Learning how to learn” is an important part of the case study method (Malecha & Green, 2001, p. 5) and practice, industry and academia can learn from each other through examples such as the Patient Room Prototype Project (PRPP). A framework for case studies developed by the American Institute of Architects (www.aia.org) will be adapted to organize, document and analyze findings from the various data collection methods. By gathering varying perspectives and points of view, design problems such as improving the patient and family experience in acute care hospitals can be realized more fully.

3.2.2 Expert Interviews

An interview guide (Zeisel, p.228) was used for focused, semi-structured interviews with experts in the healthcare and allied industries. The guide, based on key themes and topics emerging from the literature review consisted of nine (9) open-ended questions (see Appendix B). The purpose of these interviews were to explore the issues and challenges facing the healthcare industry generally and more specifically, the design of patient rooms aimed at patient-and-family centered care. The

goals were to understand various attitudes toward this topic and to identify challenges and opportunities for improving the patient/family experience.

Interviews were conducted by phone, email or in person upon receiving informed consent. Each interview began with a brief summary of the scope and purpose of the research study and requested permission to audio record the interviews. The data from the interviews were transcribed, coded and sorted into emerging themes (see Appendix F. Example of Interview Coding). Interview participants were recruited based on names identified through the literature review process or recommendations through informal discussions with people working in the healthcare industry.

Focused, semi-structured interviews were conducted with the following:

- Dr. Hartley Stern, Executive Director, Jewish General Hospital, Montreal, Canada (in person)
- Joanne Cote, Manager Coronary Care & Director of Transition, Jewish General Hospital, Montreal Canada. (in person)
- Jain Malkin, President of Jain Malkin Inc., San Diego, California and Author *A Visual Reference for Evidence-Based Design* (The Centre for Health Design). (through email)
- Gail C. Allen, RN and Clinical Strategist, Herman Miller Inc. (by phone)
- Julie Sless, Vice President Herman Miller Canada, Healthcare Division. (by phone)
- David Allison, Professor, Director of Architecture + Health Program, Clemson University, South Carolina.(in person)

3.2.3 Former Patient and Family Survey Questionnaire

Based on key themes from the literature review, precedent studies and industry expert interviews a survey questionnaire tool was developed (see Appendix D) The goal of the survey questionnaire was to obtain patient and family perspectives toward their previous experience in an acute care patient room and to identify key elements of the room that they perceived would enhance their overall experience. The representative sample was limited to persons 18 years and older and who had experienced a stay in an acute care hospital within the previous 12 months. The survey questionnaire asked participants to answer the questions from either the perspective of a patient or a family caregiver only, not both. After selecting one of these choices, they responded to the questions as either a patient or a family caregiver. This distinction was important to better understand the unique needs of each group within the patient room setting. The survey was structured based on the framework of patient room features, elements and criteria identified through earlier analysis.

The survey was pilot tested with 2nd year undergraduate students prior to distribution in order to ensure clarity of the questions and content. A recruitment cover page containing a link to the survey (Appendix C) was sent out to a convenience sample drawn initially from the researchers' email contact list. The intent was to use a 'snowball' effect in order to generate a broader interest in the study topic. Understanding that the feedback from patients and family members currently experiencing a patient room stay would be ideal, the main objective of this survey was to identify key features and elements of patient rooms that patients and their 'partners in care' would identify as important to their overall experience in a patient room setting.

Qualitative and quantitative data was generated through the use of a survey questionnaire. The questions consisted of 23 multiple choice, five factor Likert scale and open-ended questions allowing participants to expand on their answers (refer to Appendix D) The survey was administered through the Canadian online service Fluid Surveys and all responses were electronically recorded. The questions were organized into two sections: *Demographics* and *Patient Room Environment*. The questions focused on the reflective experience of the participants addressing the general as well as the specific aspects of the patient room setting from a social, emotional, sensory and physical standpoint. For example, questions addressed participants' perceived feelings of the patient room environment, specific aspects concerning the finishing, furniture and amenities within the patient room as well their interactions with others within the patient room space. An overview of the research study was provided along with instructions, a statement of confidentiality and contact information. At the end of the survey, participants were invited to volunteer for a further interview on the topic by phone, email or in person.

3.2.4 Observations

Various modes of observation were used throughout the design research process such as unobtrusive, direct and physical traces. Site visits and walk-throughs of three hospitals provided field notes, drawings, photos and audio taped conversations with staff. Since the researcher was also a participant, observations of the PRPP design process were recorded graphically in sketches, photos and through carefully dated notes for each work session.

3.3 Qualitative Data Analysis

The affinity matrix/diagram method shown in Figure 12. Preliminary Affinity Diagram was used to establish the primary categories and to identify key themes from the literature as well as identify key experts for interviews.

Figure 12. Preliminary Affinity Diagram

Field notes, interviews, and audio recordings were immediately transcribed, coded and organized into emerging categories that related to the research questions and study objectives. This information was further captured in an electronic Microsoft WORD document based on the emerging categories, patterns and quotations. This chart became a tool for continuous refinement. Data was added to the diagram as it became available, resulting in a comprehensive picture of the views of the various stakeholders. (see Appendix G).

3.4 Research Plan/Schedule

The research plan outlined to fulfill the research goals is illustrated in Figure 13.

Figure 13. Visual representation of research design

3.5 Validity and Reliability

A framework for the case study analysis was adapted from the AIA guidelines and development checklist for case studies (Malecha & Green, 2001). Questions for the patient/family survey questionnaire were developed based on emerging themes and patterns from the literature review and expert interviews. Since one of the main objectives of this study was to identify design features of patient rooms that could enhance the patient and family experience, a conceptual framework was developed to organize the survey questions according to three key domains related to user

satisfaction: physical, emotional and social attributes of the built environment. This framework was then used to analyze and summarize the survey findings. Further, the survey questionnaire was pilot tested with 26 undergraduate students in the Interior Design program at Algonquin College. The test identified questions that were unclear, redundancies in questions and length of survey. Further, a statistical analyst from Carleton University reviewed the question format, type and efficacy of anticipated responses. The researcher conducted a pre-test on-line to ensure that the survey was functional and that the process to fill it out and submit was effective. As a result, further refinement was made to the survey questionnaire before it was officially administered on line.

3.6 Limitations of the Methods

The following are some limitations to the research study that were both expected and unexpected.

Former Patient and Family Survey Questionnaire. Due to the nature of healthcare settings, getting direct access to patients and families in the natural environment is difficult. The decision to obtain representative feedback through the use of a survey tool from this group of stakeholders resulted in a less direct approach and the assumption that an experience within the past year would provide valuable insights. Another limitation was the size and nature of the participant sample. The ratio of patient to family participants made it difficult to run any meaningful comparisons on the differences between their perceptions/needs in the patient room setting and only general statements based on the percentage counts could be made. Other potential limitations include the risk of self-selection by participants due to the volunteer nature of the survey and a limited range of respondents (almost all from Ontario) which would make it difficult to generalize the results to other geographical areas or other populations.

Interviews In-person interviews were much easier to extend and build on the responses based on the interpretation of eye contact and body language of the participant. The ability of being able to show images and even draw during the interviews helped clarify ideas and provided valuable insight. These helpful qualities were lost in phone interviews and it was much more difficult to maintain a flow while at the same time record all the pertinent information.

Observations the fact that the researcher was both a participant and observer made it difficult at times to capture the full extent of the situation. All effort was made to consistently and systematically record the events as they unfolded. However, at times it was difficult to maintain the role of the design researcher while at the same time participating in the process, which may have resulted in lost or incomplete information for some phases of the project.

3.7 Ethical Considerations

The Carleton University Ethics Board granted ethics approval for the study in January 2012. Interview participants signed informed consent forms prior to the interview. Interviews by phone or email included a description of the study, confirming that by completing the interview, participants were giving consent. Unless approved by way of consent, participant names were not used in the thesis document. For the survey questionnaire, confidentiality and anonymity of participants was assured through a 'snowball' email process, with the exception of those respondents who provided their contact information for a further personal interview. A Canadian server hosted the survey and therefore the data was not subject to U.S. security policies or federal laws. All documentation, field notes and artifacts were stored in locked file cabinets and password secure electronic files that will be destroyed within one year of completion of this study.

FINDINGS AND DISCUSSION

“Complex webs of elemental interrelationships are critical in creating a quality built environment and require considerable understanding, forethought, and collaborative planning.”

—Tom Bartuska, 2007

4.1 Introduction

The case study approach using mixed methods provided a multi-dimensional framework for the analysis of innovations in acute care patient room design. Both the context and process were explored and observed simultaneously through the lens of an interdisciplinary design-research collaboration for an acute care patient room prototype (PRPP).

One of the specific goals of the PRPP 2012 was to explore the headwall and footwall elements within the acute care patient room more in depth. The footwall feature has become part of the family zone in recent examples of best practice patient rooms in an effort to better integrate the multiple needs of all stakeholders, including families into the modern healthcare environment. A specific focus of this research study is to explore how design can improve the experience for patients and families in acute care patient rooms.

Review of the literature provided the key ideas and concepts used to develop the interview questionnaire. Content analysis of field notes and coded transcripts from the expert interviews revealed the following general themes.

- Foster control and choice
- Promote social support and interaction

- Reduce stress and promote a positive experience
- Address issues of infection prevention
- Accommodate change over time
- Balance function, form and aesthetics
- Include the physical, emotional and social needs of all users

These themes in themselves can be translated into general design criteria for patient rooms. However, to what extent do these general criteria address the needs of family within the patient room environment? What was observed through the interviews is that while family are seen as important in the process of patient care, accommodating the needs of family in the design of patient rooms is often not thought of and the focus is more on staff efficiency or the needs of patients from a clinical perspective. One interview participant said that “many institutions say they provide it [family-centred care], but do they really involve families in a meaningful way and give them power?” This speaks to the importance of including all stakeholders in the design process, especially those who have had the experience of being a ‘partner in care’.

Interviews with nursing staff and hospital administrators support the literature findings that family are important to the healing process. In an interview with Dr. Stern, Executive Director of the Jewish General Hospital he confirms that “families provide many benefits to patients, including safety assistance, support with care activities such as assistance with walking and getting in and out of bed, which help speed up the recovery process.” He adds, “Older patients especially need more assistance, with activities like walking and mobilization...patients are much older and sicker in acute care facilities today and family and partners in care play many important roles”. He admits, “Families are an important source of support to the nursing staff and can help alleviate staff fatigue

and workload” (Stern, D., personal communication, January 16th, 2012). They investigated various daybeds and fold-out chair beds as an alternative to the folding cots that they currently use. Their new in-patient rooms will all feature built-in seating and accommodations for family at the footwall including a bench, storage, and workspace/desk (see Figure 14). These findings reinforce the trend toward a more patient-and-family centred approach to design and planning of modern healthcare facilities.

Figure 14. In-patient Footwall Design and Floor Plan, JGH Pavillion K.

Courtesy of JGH, Montreal.

The following section will look at the emergent themes derived from the author for each of the data collection methods. A discussion of the findings will be augmented with commentary, actual quotations, and recommendations where appropriate. Further discussion of the findings will discuss lessons learned and directions for future research.

4.2 Insights from Patient and Family Survey Questionnaire

Figure 15. Conceptual Mapping of Survey Questions

The conceptual diagram in Figure 15 organizes the survey questions into three main categories for ease of understanding the relationship of the responses to the concept of a healing environment. The main goal of the survey was to explore what elements of the patient room patients and families perceive support their needs and contribute to their overall experience of a *healing space*.

The questions focused on physical, emotional or social aspects of the patient room environment excluding the bathroom space. As indicated in the diagram above, all questions lead to the key

questions at the end of the survey that asked respondents to identify what specific elements affected their overall comfort and overall experience in the patient room they stayed in. These provided probes for the final open ended question: *“if you could be part of a team to design the next acute care patient room, what ONE element would you ensure was incorporated into the design to make it a healing space?”*

To compare differences across the alternatives (i.e., never, rarely, sometimes, often, always) chi-square goodness of fit tests were calculated based on the number of respondents (n=29) which remained the same for all questions. Results that showed significantly different from the expected number of responses across all alternatives, and display a *p* value of less than .05 are included in the summarized results below. Content analysis for frequencies was used for open-ended responses and where appropriate to augment the results, direct quotations from respondents are included. The numbers of patients vs. family responses were too uneven to run t-tests for frequencies, but percentages are used to compare and hi-light any emerging themes or notable similarities or differences.

The results are summarized as follows:

- General findings
- Key differences between patient and family responses

4.2.1. General Findings

Demographics

Demographically, the largest group of participants was in the 51-70 age range and the second highest group was in the 31-50 age range. The majority of respondents were family or close relatives who stayed in a semi-private room. The majority, 58% stayed 1-6 days and 42% stayed 7 or more days. 73% of participants stayed in the medical/surgical department.

Room Types

The majority of respondents stated their preference to have private rooms, expressing their need for more privacy, less disturbance, fewer interruptions, less exposure to other “disagreeable” or “noisily ill” patients and more space to accommodate family and visitors. These sentiments may be reflective of the fact that a majority of the respondents (65%) stayed in a semi-private room and one would expect the noise, privacy and interference from other patients to be a common issue. This finding is consistent with the literature and the trend toward more private rooms for both safety and consumer satisfaction. However, some respondents did express their desire for a semi-private room that could afford them a sense of companionship. Some comments were “semi-private seemed better because there was someone to talk to when there were no visitors” and “it’s good not to be alone”. The theme of companionship and company seemed to offset their concerns for privacy and negative aspects about noise or disruptions in general. These results also indicate that family have a preference for private over any other room type.

Common Themes

Review of the results identified the following features and elements of the patient room environment that did not meet the needs of patients and families. It seems as though these items were things in which they wanted to have some degree of control over, and were important to their overall comfort/experience in the patient room setting.

- Furnishings/Seating
- Personal Space/Storage/Display
- Design/Layout
- Privacy/Noise
- Nature/Materiality/Decor
- Temperature/Lighting/Ambience
- Media/Personal Electronic Devices

Following is a summary of the key themes according to the categories of the survey questionnaire framework in Figure 15:

4.2.2 Physical Attributes

This category addresses the functional and formal elements of the space including space/layout, furniture, finishes, appearance, ambient features and architectural objects. Only significant Chi-square goodness of fit tests for questions relating to the physical attributes are included unless otherwise noted. A summary of specific elements within the patient room follows (quotes are taken directly from the comments in the open-ended questions in response to each item and cross-referenced with coding from observations and interviews):

Furnishings/Seating

Seating overall consistently came up as an issue for patients and families in terms of quantity, quality and flexibility. More than anything, most people were least satisfied with the flexibility (69%), support for posture (68%) and comfort (64%) of seating. A majority were also not satisfied with the adjustability (62%), material (54%) and appearance (50%) of seating in their rooms.

A majority of comments related to the need for more and improved seating for visitors/guests, 2 -3 visitors seemed to be the common preference. Comments such as "chairs seemed to be scarce" and "had to look for a chair for visitor" indicate that family often searches for more seating to meet their needs. A suggestion for flexible and/or folding seating reoccurred hinting at a possible solution to providing additional 'on-demand' seating when the need arises. While quantity of seating was a key issue, the quality of seating was also important.

The literature, expert interviews and the nursing staff all confirm that family and visitors mostly sit in the patient chair or window ledge. This is consistent with comments such as "one big chunky chair—very uncomfortable and if the patient was sitting in it, where else to sit except the window ledge" and "most patients sit and fall asleep in patient chair" or "most people fall asleep in the recliner next to the patient". A number of respondents requested to have more comfortable sleeping accommodations for family, other than a chair or a cot. Comments such as "chair was awful to sleep in" and "a more comfortable pull out bed for spouse to stay in" indicate that a recliner chair is not a sufficient solution for overnight guests. An interview with a former patient revealed that he "would have stayed with my wife overnight the whole time" but he would end up in the hospital himself if he slept in the old, uncomfortable chair that was in the room. Instead, he parked his camper truck in the hospital parking lot so that he did not have to drive back and forth

the hour and half home every day. Similarly, an interview with a former family caregiver indicated that he did not stay overnight because he lived only a few minutes from the hospital, but the man that was caring for the patient next to them came from abroad and could not afford to stay in a hotel. He also wanted to be with his friend as much as possible, so he sat, slept, ate and watched television in the one patient recliner in the room. These comments clearly indicate the need for additional seating for short stay as well as longer stays and provision for inpatient room sleeping for at least one person. In addition to patient room accommodation, access to a shower within the unit and personal storage would allow a family member to stay with their loved ones with a sense of comfort and dignity if they chose to do so.

Personal Space/Storage/Display

There were many comments identifying the need for more personal storage that was lockable and more accessible than was typically offered in a nightstand/bedside table. One participant gave specific requirements, "enough to hold small travel case, hang at least two changes of pj's plus hanger for clothes as you arrive so they don't have to be taken home and brought back". Although patient storage suitable to hang full-length clothing is now a recommended planning guideline or code in new buildings, older facilities may not meet these criteria. Likewise, family needs for storage may not be accounted for in new buildings.

Personal space and storage space comes up a lot in many questions. Having a place to put and safely secure their possessions is important. This sentiment is consistent with expert interviews and was identified in facility observations. It is evident that staff, patients and family members all need "space for stuff". For example, new technology such as a 'nurse tablet' needs to be set down occasionally. As identified by one nurse "I have seen things sometimes [set down] on the overbed

table and even on the patient”. Storage for items such as purses, laptops, coats and boots were identified. A former family caregiver implies the emotional need for lockable storage when they “felt like a nomad...had to drag stuff all around just to go get a tea” for fear of leaving it lying around in the room.

Another example of the need for personal space is the repeating theme of the windowsill. This comment comes up consistently across all data collection. Interestingly, nursing staff see it as ‘normal’ that “they put their ‘stuff’ on the window sill...use it for a nightstand, it is sort of their little space”. Patient and family comments in response to needs for display included “it was on the mantle of the window which is not always appropriate for certain gifts and it was far from the bed” and “always on the windowsill...not always convenient or accessible”. One comment pertaining to the need for seating said that if the patient was in the only chair in the room “there was nowhere else to sit except the window ledge”. If designed in such a way (with intent), a window sill becomes an affordance for sitting, putting food, displaying personal items, keeping things off the floor and a sense of territory for guests. It is clear that a design detail as simple as a window ledge has physical, emotional as well as social implications and that if this affordance is eliminated the need still exists and should be accommodated elsewhere in the space.

In response to working and eating space, most comments focused on the overbed table/tray as being the only surface in the room. The comments indicated that typical overbed table trays were “too narrow” and insufficient for accommodating all activities or personal objects. There was a need for family/guest working and eating surfaces and this was reflected in other questions that revolved around control and comfort of the patient room setting.

The need for shelving to display gifts, cards, flower or other personal items was a reoccurring comment. "shelf at eye level while sitting up in bed" and " a little more display but closer to bed...perhaps a wallboard near bed for tacking up pictures of loved ones" are conflicting statements of where one would want to have visual access to display if they were a patient. The window ledge was cited as the place where these things were often put but as one respondent commented "is not always appropriate for certain gifts and was far from the bed". One respondent suggested enough space for up to 10 cards and one or two vases. Generally there was a need for some display space, perhaps visible from the bed as well as visible/accessible from the bed.

Design/Layout

The layout of the patient room and the placement of elements, features and furniture affect emotional and social needs of patients and families. As noted earlier, the preference for private rooms is high and this trend is confirmed through the literature review and interviews. The case study analysis demonstrated the room layout that best accommodated patients and families was the outboard toilet location which provided an L-shaped family zone in front of the window and at the footwall.(refer to Figure 11). This configuration also allowed the best window views and natural light. The preference for this layout was also identified in focus groups held with patients for the expansion of the Jewish General Hospital in Montreal (Cote, J. personal communication, January 2012) with the argument that it provided patients more privacy and more space for family.

Nature/Materiality/Decor

For question 2.7 *Rate the following items in terms of importance to your overall COMFORT in a patient room setting* the following items showed significant chi square results: a clock in the room, storage for clothing and personal items, adjustability of the television/media, colour, fabric and

natural materials and plants, views to nature, lighting both ambient and natural as well as music, choice of an air freshener, furniture and a small fridge.

When respondents were asked to fill in the blank to question 2.5: “*the patient room I stayed in looked ____*”, the consistent themes of institutional/bland; outdated/dingy; and uninviting/cold emerged. In contrast, when asked to fill in the blank to question 2.6: “*all new patient rooms should look ____*”, the most reoccurring themes were inviting, warm and cheerful as reflected in one respondent’s comment: “designed for healthcare receivers”. These themes repeated in the responses to question 2.8, which asked respondents to reflect and comment on the multi-sensory elements of the patient room experience. Figure 16. Multi-Sensory Content Analysis Patient Room demonstrates the content analysis from these questions illustrating the key themes that were important to patients and families in terms of the multi-sensory experience of the patient room setting.

Patient and Family Perception of Hospital Experience: *Multi-sensory Content Analysis*

Sight	Smell	Sound	Feeling	Activities
other patients medical equipment no visual appeal nurse supplies bland beige, commercial institutional views of rooftops, other buildings, parking lots blank wall lack of colour privacy curtains not enough storage "personal stuff piled in stacks" "mobile equipment annoying" "side table for personal stuff too small" (beside bed) bland no stimulation old aged should look: Warm Cheerful Bright Colourful Natural Homey Clean Uncluttered	body odor cafeteria food anti-bacterial dusty medicine sterile sickness cleaners should smell: clean fresh non-institutional familiar	people walking talking in hallway footsteps beeping nurses talking other patients machines ticking of clocks should sound: quiet nature music controlled non-irritating	prison crowded cold rough dark poor light ugly "didn't want to touch anything" depressing institutional cheap, old stiff "didn't make you feel like you should get better" numb invasion "felt like a holding cell" hard surfaces uncomfortable emotionless "I always feel uncomfortable in these rooms" dull "couldn't move... only the touch of the bed" Cramped should feel: Inviting Restful Relaxing Calm Comfortable	playing cards on bed family sit on bed family stood around bed no seating talking to others in room un-engaging watching others amusing myself reading assisting should allow: overnight accommodation for family/guest "to make themselves at home" Adjustability Connection to outside Ability to use personal electronic devices

Figure 16. Multi-Sensory Content Analysis Patient Room

Temperature/Lighting

The consistent comments on lighting included the need for dimmable, adjustability and control. Comments such as "could be more subdued", "softer" and "not friendly" indicate a need for more attention to the type, location, access and control of both task and ambient lighting for patients and families in the patient room setting.

Media/Personal Electronic Devices

Many comments discussed the need for more complimentary access to television and movies/entertainment. Some would have liked additional entertainment such as access to music or

a radio. Suggestions on the size of the screen, viewing distance and ease of controls were common themes. The location, size and control in terms of content and adjustability are all key themes that reoccur in all data sets.

4.2.3 Summary Physical Attributes and Design Implications

- It is clear that patients and families want more personal storage space that is secure and can accommodate both patient and family possessions and clothing.
- Display space is important and consideration should be given to the ability to see and access items from the bed position.
- Seating and sleeping accommodation for family/guests is currently insufficient or non-existent.
- Lighting is a very important aspect of the patient room setting that appears to be lacking in thought for the accessibility, adjustability and control of ambience for patients and family members.
- Size and viewing of television screens is an issue, presumably due to small, outdated equipment or vision impairment of patients. Elderly patients and family members may require more consideration in terms of the size of screen, the viewing location/angle and ease of use for controls.
- The colour and overall appearance of the room is important to patients and families. Consideration for multi-sensory stimulation, reducing overall visual clutter and providing the ability to control the colour/décor of the room could enhance overall comfort and experience.

4.2.4 Emotional Attributes

This category addresses the emotional elements of the space where respondents expressed their perceptions of how they felt in the patient room setting and solicited feedback on the multi-sensory experience of the space. It included questions about feelings, sense of control, impressions of space and comfort. Only significant Chi-square goodness of fit tests for questions relating to the physical attributes are included unless otherwise noted. A summary of specific elements within the patient room follows (quotes are taken directly from the comments in the open-ended questions in response to each item and cross-referenced with coding from observations and interviews):

In terms of recollection about their feelings about the patient room they stayed in, there were no significant chi squares for any of the identified variables. However, an unequal spread was found in some of the responses and the following general comments can be made concerning design of the patient room environment.

Peaceful and Relaxed

A high number of respondents rarely felt peaceful and none always felt peaceful. The same can be said that the majority sometimes felt relaxed and few never felt relaxed. While the numbers for how peaceful or relaxed respondents felt are not significant, when cross-referenced to questions concerning comfort and quality and how a patient room *should* feel, specific design features such as light, views of nature, colour, furniture, materials and a sense of space and control can be linked to their overall satisfaction and overall experience of the patient room setting.

Adjustability/Control

In response to patients and families desire to adjust/control elements within the patient room the items rated highest in importance were the use of personal electronic device (85%), visibility to outdoors (81%), room lighting/ temperature (80%), windows/curtains (72%) and the angle/location of television (70%).

Sensory Experience

Questions that asked for specific sensory responses to the patient room setting based on what they looked at, heard, smelled or touched/felt resulted in a number of subjective responses. Reoccurring comments from respondents for what they looked at most of the time included walls "blank walls", other people/patients, monitors and "invasive medical equipment", window views, hallway and privacy curtains. In response to smells, cleaning chemicals, food and other people were the main 'odors' that resonated with respondents. In response to the question 2.7 about the importance of an in room scented air freshener, the number of responses that felt it was important was not insignificant (48%) which suggests that the olfactory sense is a powerful component of the patient room experience that should be considered. Sounds that were noted most came from the hallways, equipment, intercom/PA system, nurses and other people talking, television and cleaning crews. Relating to the look and feel of the room, the most common comments included uncomfortable, boring, cold, impersonal, "technological feel", unnatural and "like I was in somebody's workplace".

4.2.5 Summary Emotional Attributes and Design Implications

Not surprisingly and consistent with the literature (Zimring, et al., 2008), noise is a consistent issue in and around the patient room setting. Some of the excessive noise is probably related to the fact

that most respondents stayed in a semi-private room. The olfactory experience of patients and family is notable. Most comments about the feeling of the space were negative and in themselves were 'multi-sensory- responses. For example, cold could was associated with both the feeling and with the look of the space. The feeling of comfort and familiarity also included items from home that patients and family wished they could bring with them. The most noted objects included blankets, pillows, duvets and chairs or beds indicative of the 'creature comforts' of home and the 'high-touch' elements that are often missing in healthcare settings. This reference to the tactile sense can be cross-referenced to question 2.13 where 100% of patients and 87% of families felt that the fabrics/linens within the patient room environment were important or very important to their sense of comfort. In contrast to the 'high-touch' needs, the need for 'high-tech' was also significant. Technology such as laptops, ipad, televisions and internet access were other wished for items and the control of their use, flexibility and content were important to their sense of comfort. Interestingly, but supported by a body of literature on pet therapy (Planetree Concept, Huelat, 2007), pets especially dogs were a wished for item from home to comfort them during their hospital experience.

- Effort should be made to eliminate or reduce noise within and around the patient room. Private rooms will help reduce the impact but the selection and application of finishes and materials should take into account their impact on acoustic control within the patient room setting.
- Sensory stimulation is an important design consideration (Dijkstra, Pieterse, & Pruyn, 2006; Evans & Mitchell McCoy, 1998). Too much stimulation from visual clutter and perceived 'messiness' may impact the ability for patients and family to relax. Design

strategies that reduce clutter while at the same time offer positive stimulation through visual as well as other sensory modes may contribute to the overall comfort for patients and families.

- Providing choice and control of the patient room environmental in terms of the décor, furnishings and ambient features may help patients and families feel more comfortable in acute care patient room settings.

4.2.6 Social Attributes

This category addresses elements and features of the patient room that may contribute to the social needs of patients and families in acute care patient rooms. Questions about interactions with other people, activities and elements of the space that contributed to their ability to interact, communicate or connect with others fell under this category. Only significant Chi-square goodness of fit tests for questions relating to the physical attributes are included unless otherwise noted. A summary of specific elements within the patient room follows (quotes are taken directly from the comments in the open-ended questions in response to each item and cross-referenced with coding from observations and interviews):

Passing Time and Keeping Occupied

Interestingly, most respondents (64%) spent time reading and next to watching television (32%), the use of personal electronic devices was used for working, texting and entertainment. Comments from the open-ended responses included “I had my *ipad*, so was able to listen to music and read as well as play games to keep amused” and “spoke to patient or other visitors”.

Visiting, Socializing and Comforting

The space/layout can impact how patients and family/visitors interact in the patient room setting. For example, as in the previous section, a window ledge (if one exists) is often used as secondary seating for visitors or people whom simply just stand around the bed. This theme came up a number of times in the open ended questions as well as in the pilot phase when students were asked to create mind map sketches Figure 18. Mind Map (family). Without sufficient seating for additional visitors/family, it seems that they just ‘stand around the bed’ presumably uncomfortable for the patient as well as the visitors. This sentiment is reflected in the comment “more than one had to stand. You feel like you are on display”. This can be seen in the following mind-map sketches where family members are shown gathered around the bed in a circular pattern in an effort to have intimate and visual contact with the patient. Although the number of people depicted standing around the bed in Figure 18. Mind Map (family) seems excessive (and probably would not be allowed all at one time in the patient room), both sketches indicate the need for overflow seating allowing close and visual contact with the patient.

Figure 17. Mind Map Sketch (Family)

Figure 18. Mind Map (family)

In response to the open-ended question 2.11 *Did anything about the patient room you stayed in affect your ability to interact with your loved ones?* Seating, space, privacy, and visiting policy were the main themes. Once again, the quantity, quality or flexibility of the seating had an influence on the social interaction between patient and family members. Comments that reflect the impact of design on the social aspects of the patient room include, “access around the bed was difficult so to hold the patient’s hand (the chair was too big and clunky to put beside the bed) I had to sit on the window ledge—very awkward and physically uncomfortable for long periods of time”. Other similar comments include “more width so the chair could be beside the bed more comfortably” and “[there was a] height difference between the chair and bed height”.

4.2.7 Summary Social Attributes and Design Implications

The design of the space, furnishings and technology can have a profound impact on how patient’s and family interact within the patient room setting. The way in which designed elements such as seating, lighting, television and sleeping accommodations are provided for or arranged within the space can affect the user’s overall sense of comfort and control. These comments indicate the need for more holistic design thinking from the perspective of the patient/visitor/family needs for social interaction as well as physical and emotional support within the patient room setting.

- Consider the proximity of family to patients both in terms of visual and physical contact
- The design, scale and type of seating can affect the ability of family to interact with patients
- Sleeping accommodations should be provided for family to stay overnight within the patient room

- The ability of family as well as patients to control aspects of the environment can encourage interaction as well as avoid the negative impact disturbing the patient

4.2.8 Ideal Healing Space: The Next Acute Care Patient Room

The final three ‘capstone’ questions for the patient room survey questionnaire were used to identify the elements and features of acute care patient rooms that former patients and families perceived to contribute the most toward their ‘sense of a healing space’ and ultimately to their overall experience and satisfaction within the patient room setting.

Noise (62%), lighting (41%) and view (31%) were the elements respondents felt most affected their overall comfort in the patient room setting.

Table 1. Attributes that contribute most to the perception of a healing space

The findings for the first three items are consistent with the literature pertaining to environmental factors that impact patient outcomes. These findings could be a result of staying in a semi-private room, the most predominate room type identified. The results for equipment, furniture and room layout were considered almost as significant as a view at 28% but these items are not identified as frequently in the literature as being factors that contribute to a positive patient/family experience.

In reference to the open-ended question 2.15 *If you could be part of a team to design the next acute care patient room, what ONE element would you ensure was incorporated into the design to make it a healing space?* The following themes emerged:

Nature Views and Natural Elements/Materials

Not surprisingly, most of the respondents wanted more views and visibility to nature. This is consistent with previous findings by Ulrich and others that access to natural daylight and views of nature have a healing affect (Ulrich R. S., 1984). In this case, it is probably because most of the respondents stayed in semi-private rooms and may have been denied visual access to a window from the room layout. However, many of the comments went beyond a window view. For example, comments on materiality of the space such as “natural elements: furniture”, “more natural materials and finishes”, as well as “paintings of nature” and the desire for plants all speak to the design elements and features within the physical space that can have a positive impact on patient and family satisfaction/experience.

Personalized and Less Institutional

The idea of a more personalized effort toward the design of patient rooms was a theme that surfaced many times throughout the survey and again in this culminating question. Comments such as “dark chocolates on the pillows”, “personalized choice”, music would be my second choice, but this would be difficult in the ward setting” and “more personalized materials and furnishings (similar to a hotel room)” all speak to ways in which the designed space could provide a more personalized experience for patients and their families. Comments such as “more personal-less institutionalized”, “make-it more home-like” speak to the desire of patients and families to recover/heal in an environment that is more human-centered. Remarks such as “hide the medical equipment, it is invasive and depressing” and “remove the clinical ambiance (equipment)” speak loud and clear about the preferred aesthetic for future patient rooms.

Comfortable and Adaptable Furnishings

Again, this is a common theme that surfaces over and over again in the survey. Features regarding furniture that respondents would want to ensure get included into the next patient room designs include: more comfortable seating and accommodation for patients and guests, flexible space for activities by patient and families, foldable, easy to move seating and ‘more cozier’ bedding and furnishings in general. These comments indicate how the patient room furniture design, materials and layout play a pivotal role in the perceived comfort and control of patients and families and affect their overall experience in the patient room setting.

4.2.9 Sense of a Healing Space & Overall Satisfaction

Two questions that explored how patients and families might equate the designed environment to their perception of a *healing space* combined their impressions of their *overall comfort* (question 2.13) and their idea of an *ideal healing space* (question 2.15). Looking at these responses together, the following elements would be key criteria in the design of the next patient rooms to promote patient and family satisfaction:

- Elimination and Control of Noise
 - Use design strategies that aim to reduce or eliminate in-room noise
- Choice and Control of Lighting
 - Provide more types and choices for lighting
 - Allow for adjustability of lighting to suit various activities
- Actual and Perceived Temperature
 - Explore ways in which design can reduce the perception of feeling cold
- Views of Nature and Natural Elements
 - Consider the way in which design elements within the patient room can enhance sensory contact with nature within the patient room setting
- Personalized and Less Institutional
 - Reduce the visual impact of medical equipment
 - Provide opportunities within the room that can be personalized and easily changed/accessed
- Comfortable and Adaptable Furnishings
 - Improve short and long-term accommodations for family/visitors
 - Provide furnishings that can adapt to various user needs and activities

Overall Satisfaction

Generally, the results indicate that there is room for improvement of patient and family satisfaction strongly linking to the design of the physical environment. Figure 19 shows the results to the final question of the survey questionnaire that asked respondents to rate their overall experience in the patient room they stayed in within the past twelve months. There was a fairly equal split, with only 34% of respondents either satisfied or very satisfied and 40% of respondents either unsatisfied or very unsatisfied.

Figure 19. Overall rating of experience in patient room. Responses to the question 2.14.

4.3 Key Differences Between Patients and Family

- The number of patients responses (n=6) 21% compared to family responses (n=23) 79% were too uneven to run t-tests for frequencies, but percentages are used to compare and hi-

light any emerging themes or notable similarities or differences. Clearly, noise and lighting were the most significant concerns of both patients and family as identified in the previous sections. However, some key differences were found that can give insight into specific needs of each primary user group within the acute care patient room setting.

- 96% of family wanted use and control of personal electronics compared to 68% of patients.
- 57% of families compared to only 17% of patients were concerned about the location of the bed.
- 83% of family compared to only 33% of patients want to have control of the location of chairs within the patient room.

Figure 20. Patient vs. Family Preferences: control of elements

Overall Comfort

50% of patients and only 26% of family members felt that a view most affected their comfort. It is presumed this is a result of the majority of respondent's stay in a semi-private room and did not have visual access to a window due to the room layout or bed position.

As noted earlier, colour and materiality were significant factors for perceived comfort. For example in question 2.7 *Rate the following items in terms of importance to your overall COMFORT in a patient room setting*, 66.7 % of patients and 69.5% of families rated colour to be important or very important. 100% of patients and 87% of families rated fabrics/linens and natural materials (83.4%) to be important or very important.

Furniture was a main concern for family and not a major concern of patients. However, surprisingly, twice as many family members felt that the medical equipment affected their overall comfort. This is interesting because it is often thought that the equipment should be concealed or out of view of patients to relieve their stress and anxiety, but it may have more of an impact on family members than patients in some settings such as adult acute care. Interestingly, 73.9% of family/visitors felt that a clock was important or very important in terms of comfort but only 33% of patients found it important.

Figure 21. Patient vs. Family Preferences: elements for comfort

Room Elements That Met Patient and Family Needs

Both patients and family were unsatisfied or very unsatisfied with seating, space for working, media/entertainment, space for personal items, storage, lighting and room temperature.

83% of former patient's felt that control of the angle or location of the television was very important compared to 69.5% of family but both are significant enough to warrant design implications for this item. For example, this issue raises the question about whether one large flat screen television mounted on the footwall (current trend) meets the needs of the primary and secondary users. Conflicting comments from nursing, design professionals and in the literature as to where the best location for the television is, how large, how flexible and what should be

standard or not seems to be an unresolved issue that can impact the room design as well as the amount of control, choice and comfort of users.

4.4 Case Study: Patient Room Prototype Project (PRPP)

It was hypothesized that to design a patient room that can address the complex needs of healthcare environments, a holistic approach to design is needed. In response to part (b) of the research question *How can the needs of patients and families be better integrated with patient-centred healthcare delivery in the design of acute care patient rooms?*, the following case study illustrates a unique interdisciplinary research and design collaboration for a patient room prototype project (PRPP). The following is an analysis of the PRPP with a focus on the context and process as they relate to the goals of this research study. Since the focus of this research is the patient and family experience, the analysis looked mainly at the family zone/footwall elements of the patient room.

4.4.1 Introduction/Background

The most significant lesson learned from this case study is that insight from multiple stakeholders is needed to better understand the overarching goals and often conflicting criteria in patient room design. The second most important lesson learned is that more holistic and participatory design methods are needed to fully appreciate design problems in healthcare environments. The patient room is an evolving prototype in which design must address diverse and often competing criteria within healthcare settings (Allison, 2009). Healthcare represents one of the most complex services and because it happens within a facility, all stakeholders involved in the design of healthcare space, components and systems must be involved and understand how the design of the built environment can influence the health, safety and welfare of patients, families and caregivers (EDAC study guide).

This case demonstrates the need for patient room design to support a positive healing environment that responds to the multi-level needs of people in healthcare settings. The physical details of the space such as light, colour, materials and layout; attention to the relationship between people and activities; provisions for family members as partners in care; and addressing the need for flexibility of use can all contribute to a positive experience for people in healthcare settings.

To address the complexity of patient room design, an interdisciplinary, collaborative approach to research and design using participatory design tactics such as prototyping and full scale mock-ups in addition to traditional design methods leads to more integrated, holistic solutions that address real-world needs and problems (Garvey, 2009).

An integrated and participatory design process allows for exploration of multiple perspectives of the design problem. Collaboration and input involving students, experts from academia, architecture/design professionals and clinical staff resulted in the sharing of ideas, knowledge and feedback through intense work sessions, real and virtual reviews and full-scale mock-ups and prototyping. Although the final design concepts that resulted are an important part of the solution to enhance the future of patient room settings and the human condition in general, the design process itself and the lessons learned through this project case study are valuable for future healthcare design research, design practice, healthcare practitioners and academic study in various design fields.

4.4.2 Patient Room Prototype Project (PRPP)

The Patient Room Prototype Project (PRPP) is an ongoing interdisciplinary project that joins teams from two different universities and from different program levels to collaboratively research, design and test an inpatient room prototype. The end goal is in part to extend the work of previous

PRPP design teams in promoting safety, efficiency, and satisfaction of all users in the patient room of the future. The first iteration of the design-build collaboration began in 2003 between Architecture + Health students from Clemson University, South Carolina and Industrial Design students from Carleton University, Ottawa. Subsequent iterations of the PRPP were developed and tested in 2006 and 2009 based on previous design and research.

Figure 22. Patient Room Prototype Project History

Schedule and Process

Teams of graduates and undergraduates from the Industrial Design Program at Carleton University, Ottawa and the Architecture + Health program at Clemson University, South Carolina joined for the first time through virtual communication in January. Figure 23 illustrates the interdisciplinary design team organization. Project teams each headed by a faculty professor, consisted of 8

Architecture + Health graduate students from Clemson University and 2 Undergraduate Industrial Design students and 1 graduate Master of Design student from Carleton University.

Figure 23. PRPP 2012 Project Team

Each week the teams met virtually to share and update information. In addition to the virtual meetings, each team travelled to the hosting universities for design charrettes, fabrication and reviews (see Figure 24).

Figure 24. PRPP 2012 Project Schedule.

Challenges , Opportunities and Objectives

The goal for the 2012 project was to build on and extend the past projects by going beyond the physical parameters of the pre-determined standard room layout ‘chassis’, and to focus specifically on the headwall and footwall/family zone components of the room. More specifically, to explore how the needs of patients and their families can be better integrated within the given constraints of the space while also meeting the staff and organizational goals for the project.

The project presented the teams with a number of design challenges and opportunities including:

- Collaboration across disciplines,(Architecture, Interior Design, Industrial Design), institutions (Clemson University and Carleton University) and countries (South Carolina, US and Ottawa, Canada).
- Re-design and build several elements of the existing full-scale patient room mock-up based on the pre-determined prototype ‘platform’ or ‘chassis’.

- Rise above the sometimes only functionally focused design solutions common in healthcare industry and strive for design solutions that go beyond the boundary of convention.
- Explore and incorporate best practice and evidence-based design strategies while at the same time explore new alternatives and innovations for application to the patient room setting.
- Demonstrate how interdisciplinary design can raise the quality of design in healthcare contexts while addressing the complexity of healthcare design, multiple stakeholders and overlapping and conflicting requirements.
- Address the concept of efficiency and effectiveness in a comprehensive way in terms of safety, outcomes, and the quality of healthcare experiences for patients, their family and caregivers.

The main project objectives were to:

- Provide a setting that is therapeutic, environmentally friendly and safe
- Provide a setting that is adaptable and accommodates change over time
- Provide a setting for positive patient, family and staff experiences
- Enable efficient and effective clinical care and health outcomes
- Optimize space while meeting the needs of all users

Design Parameters and Goals

The existing parameters for the project provided some unique constraints that were based on the pre-established adaptable/universal patient room 'chassis' from earlier iterations of the PRPP (see figure Figure 25) providing the following planning assumptions:

- 30' x 30' structural bay
- 15' headwall to foot wall centerline dimension
- 21'-deep room from centerline of exterior column to interior face of corridor wall
- Neutral exterior wall so that the design of internal elements does not affect the exterior façade
- Inboard bathroom location (located along corridor wall)

Figure 25. PRPP Universal Plan Layout

PROJECT FOUNDATION

Previous Prototype Strategy Usage

LEGEND

- A/O/V Supply Location
- Min 5ft Clearance (Critical Care)
- Min 4ft Clearance (Step-Down)
- Min 3ft Clearance (Acute Care)
- Patient Bed

Utility Requirements

Acute Care	Acuity Adaptable
2 O	4 O
2 V	6 V
2 A	2 A

Based on one adaptability model suggested by BR Rottenberg

Strategy 18: Acuity Convertible Rooms

Provide acuity-convertible rooms (ability to convert room through minor modifications among ICU to step-down to acute)

Applicable Code 2.2.2.6
Min. 3' clearance for Med/Surg is met
Applicable Code 2.2.2.7
Min. 4' clearance for Step-Down is met
Applicable Code 2.2.2.6
Min. 5' clearance for Critical is not met
Applicable Code 2.2.2.5.2.2
Infringement Allowance for minor encroachments like columns and handwashing stations
Current headwall accommodates 2 O / 2 V / 2 A

Applicable Code 2.2.2.6
Min. 3' clearance for Med/Surg is met
Applicable Code 2.2.2.7
Min. 4' clearance for Step-Down is met
Applicable Code 2.2.2.6
Min. 5' clearance for Critical is not met
Applicable Code 2.2.2.5.2.2
Infringement Allowance for minor encroachments like columns and handwashing stations
Current headwall accommodates 4 O / 4 V / 2 A

PELHAM PRP

CLRC PRP

Figure 26. Acuity Adaptable Room Clearances

In addition to meeting the overarching project objectives noted above, the main design goal for PRPP 2012 was to design and develop a more integrated headwall and footwall system that could better accommodate all stakeholders and offer some degree of personalization, customization and adaptability over time. Specific design goals and criteria for headwall and footwall components that emerged from the interdisciplinary review process included:

Promote a positive, therapeutic and health-supporting environment

- Integrate and organize elements and features based on modular principles. This concept allows for a visually stimulating focal point for the patient, while at the same time reduces the visual clutter so common in patient rooms.
- Materials and finishes should be healthcare appropriate while at the same time avoid an institutional aesthetic.
- Explore alternatives to the full built-in media screen allowing more flexibility to accommodate technological change and preference in the future.

Accommodate change and adaptation over time

- Materiality and component options including integrated acoustic, magnetic, graphic and backlit 'light box' panels, can be changed, customized or upgraded easily.

Ensure functional efficiency and effectiveness

- Physical and visual elements should define various 'activity' zones in order to provide a sense of space and clear activity zones for staff, patients and users.
- Integrate seating, sleeping accommodation for one guest and storage to reduce the loose, bulky furniture in the room allowing for maximum accessibility to patient.

Address infection prevention and patient and staff safety

- Locate a hand wash sink in the footwall with immediate proximity to the entrance to facilitate hand washing for infection prevention. Physically and visually separate the sink zone from the family zone. Integrate and conceal clinical supplies from family/patient views.
- Integrate night lighting for user safety and to prevent disruption from the need to turn on the room lighting for people moving through the space at different times.
- Materials and finishes should be environmentally friendly as well as appropriate for healthcare settings in terms of durability, cleanability, and flammability and infection prevention.

Optimize space constraints while supporting the needs of all stakeholders

- Employ space saving strategies to minimize the need for loose furniture and maintain an open footprint. The design ensures that critical care zones around the patient bed are easily maintained for step-down or higher acuity in the event of an emergency.

4.4.3 The Design Process

“For the things we have to learn before we can do them, we learn by doing them”

—Aristotle.

Interdisciplinary Collaborative Design Process

Using an interdisciplinary design process in a collaborative and distributed learning environment, teams worked across geographical borders and distance to develop innovative concepts for the headwall and footwall of a patient room prototype. As part of an iterative design-research process outlined earlier, this iteration of the Patient Room Prototype Project (PRPP) looked more specifically at refining the headwall and footwall concepts from earlier design iterations. Figure 27. PRPP Interdisciplinary Collaborative Design Process demonstrates the collaborative and participatory phases of the project as a series of interconnected links. Each link informing the next so that information and knowledge inputs from various sources (internal/external) were shared, discussed, critiqued and incorporated into the design. The prototype resulted in a refined prototype based on the collective vision of the interdisciplinary teams and vetted by external stakeholders.

Figure 27. PRPP Interdisciplinary Collaborative Design Process

In addition to traditional design research and development tactics, the PRPP project involved multiple virtual and participatory phases. These included preliminary research and reviews, design charrettes at each university campus, tours of hospitals and patient room prototypes, observations, focus group sessions with healthcare industry experts and collaborative work sessions. Best practices and lessons learned synthesized into a full-scale mock up of patient room components. A discussion of the main project phases follows.

Research and Review

A key component of this project was an exploration of issues, trends and challenges facing healthcare settings and specifically affecting the design of patient rooms. This iterative research-design process included both practical as well as theoretical knowledge from multi-disciplinary perspectives. A literature review identified current research and thinking on acute care patient room design. A precedent analysis of best practices in acute care patient room design, including built projects, past prototype designs and current market products for healthcare resulted in a summary of design strategies that could be incorporated into new concepts for the headwall and footwall design of the Patient Room Prototype Project (PRPP). Further, direct and lateral exploration into new emerging products, technology, finishes and materials that could apply to healthcare (such as emerging technologies, products and concepts from other market sectors) revealed potential opportunities for integration.

Design Charette: Carleton University, Ottawa

At the beginning of February, the Clemson University team joined up with the Carleton team for the first in-person design charette. Over three days, collective brainstorming together and in smaller teams identified user needs, code requirements, space constraints, aesthetic goals and design direction for further concept development (Figure 28).

DESIGN CHARRETTES | CARLETON

Figure 28. Carleton Design Charette

In addition to the code and functional requirements for the patient room, a review of the collective research resulted in numerous documents, drawings and sketches that were in turn pinned up and reviewed by the teams (Figure 29).

Figure 29. Carleton Charette Concept Pin-Up and Review

Charette Generated Diagrams and Concepts

In addition to the building code and functional requirements, the teams collectively reviewed the research and identified the following themes that translated into design criteria and preliminary concepts. Figure 30 & Figure 31 are two examples of the many concepts generated based on the established criteria.

- **Lighting:** emphasis on natural, soft, indirect/direct lighting; light as colour/mood, function/safety, positive distraction. Goal: enhance control and choice.
- **Form:** clean, streamlined and unified lines, emphasis on integrated look, minimal seams; flexibility for change/upgrade; modularity. Goal: to reduce visual complexity

- Colour: balance of warm/cool colours, neutral backdrop with natural wood elements; clean, fresh, soothing. Goal: to reduce institutional feeling and promote restoration.
- Materiality: smooth yet tactile. 'green', durable, cleanable (minimal pattern and texture on surfaces); easy to replace, update/personalize. Goal: to prevent infection, ease of maintenance, to accommodate change/choice.

Figure 30. Charette Generated Footwall Concept Sketch Example A

Figure 31. Charette Generated Footwall Concept Sketch Example B

Design Charette, Clemson University, South Carolina

At the end of February, the Carleton University team met up with the Clemson University team in South Carolina for further research and design concept development with the assistance of a diverse group of stakeholders including healthcare architects, nursing and clinical staff as well as healthcare furniture and product manufacturers. Hospital tours, observations of past prototype patient room design projects and feedback sessions set the groundwork for further project development.

Figure 32. Clemson Charette Brainstorming

4.4.4 Hospital and Prototype Tours, Observations and Expert Feedback

The groups toured two hospitals that have a focus on patient-and-family centered care principles. Each of the facilities focused on patient and family care practices. One was in a rural setting while the other was in an urban setting. The rural hospital rooms were more spacious, had more of a hospitality feeling both inside and out and gave a lot of attention to the architectural and interior design elements and detailing throughout the facility. In fact, it looked more like a resort than a hospital. Students from Clemson University took turns spending the night in some of the patient rooms here to observe firsthand the patient experience.

The urban hospital was a high-rise and had more of a 'corporate' feeling. This feeling extended from the grand scaled lobby to each of the inpatient floors. Although the philosophy of care was similar, the layout, appearance and accommodations were very different. The tours allowed the students to see firsthand the issues faced by patients, families and staff within the patient room setting. The two facility tours allowed students to explore, observe and informally interview the

clinical staff (one of the primary user groups) in order to better understand the constraints and operational issues faced in typical care situations. Questions raised by the professional stakeholders in the group further enriched the dialogue with clinical staff.

The following is a summary of insights and lessons learned from the hospital facility tours:

General Observations and Insights From Hospital Tours

- Staff in both facilities want to minimize the amount of furniture and storage components in the patient room, however appropriate storage can help reduce the visual and physical clutter within the space.
- Staff at both facilities note that patients/family complain of the visual clutter in room. Clutter is a result of too many and ill-fitting room elements but also the accumulation of garbage and personal items people bring to the space.
- Conflicting views of where the guest bed should be (at window or footwall). There is an assumption that the patient chair/lounger is sufficient for overnight guest accommodation.
- The current bench/flip out bed is uncomfortable and too low (they want better eye contact with the patient).
- Common patient/family complaints involve lighting (brightness, location, accessibility) and temperature (location of air grille, control of) and location of telephone.
- Not enough access around bed is a problem in code situations, efforts should be made to enhance patient accessibility

- Too much space and too much furniture can also be a problem from a cost, maintenance and social perspective.
- The window ledge was a place to sit, eat and display things.
- During an emergency, staff need to move furniture and people out of the way quickly to have full access to patient
- A balance between patient, family and staff needs is essential
- Safety must be considered at all scales including layout, ergonomics, accessibility, finishes & materials, lighting and design/architectural detailing
- Consideration for cleaning, durability and ability for the aesthetic to be easily updated or re-refreshed over time is important

Patient Room Prototype Reviews

Following the hospital tours, the PRPP groups also observed, reviewed and discussed previous prototype projects, current best practices and future innovations. With each new iteration of the project, there has been the generation of new knowledge and lost knowledge. David Allison refers to this as a “dynamic dance” where each project seems to take some steps forward while at the same time taking steps backward. According to Allison, the measures of success for this project are based on what parts of the patient room are resolved or unresolved in each iteration. As part of the learning process, one of the issues has been that with each new team they need to go through the learning process all over again, a sort of “re-inventing the wheel”. (Allison, 2012 personal communication, April, 2012).

- 2003 The first iteration of the prototype project started the collaborative tradition between Clemson University Architecture + Health and Carleton University, Industrial Design. The final prototype resulted in a foam core model and a non-operable bed.
- In 2006 the patient room prototype at NXT/Clemson Lab in Pelham, one of the first patient room prototypes featured a first bench/bed footwall concept, vertical backlit headwall and colour-changing over bed light canopy. These concepts were resolved at a later date during an interim iteration and a version was built in a real hospital setting to be tested.
- In 2009 the collaboration looked at the accommodation of special populations and resulted in a bathroom that was fairly resolved in order to test and the first iteration of the fold-down bench/bed concept which was finished in an extended summer session. The headwall was unresolved and introduced new complexities that needed further refinement. A modified version of the 2009 prototype in the Nursing Simulation Centre (CLRC) on the Clemson Campus, explored the concept of an ‘immersive’ media screen.

External Stakeholder Exchange/Feedback

A debriefing session after the tours allowed for an exchange of information, observations and insights. This session provided a more comprehensive perspective from the various stakeholders on what the key concerns, issues and challenges were that needed to be considered for the next design iteration. It also allowed the students to share their concepts with the group and obtain feedback and direction to guide further development of the footwall and headwall concepts.

The following summarizes some of the key issues, concerns and considerations that emerged:

- Need to think less about integration of technology and more about being able to adapt to change. Look at the potential for projection in the future that might replace wall mounted screens.
- Bench/bed was well received in the prototype but needed to be lighter in weight, easier to use, durable and easy to clean (with chlorine-blend solution) and sized to suit standardized hospital bed linens. No storage of extra linens or pillows would be kept in room due to infection prevention.
- Minimize room clutter; maximize space and access to patient around bed.
- Some display for personal items, a writable surface for daily chart updates, information for patients and family. Nursing staff had a preference for a footwall media screen for future electronic charting, education, positive nature scenery etc.

Participatory Working Session

Participatory working sessions with design students and their supervisors as well as various key experts from architecture, nursing, healthcare furniture manufacturing and product representatives resulted in a hybrid solution incorporating architectural, furniture and lighting elements within an integrated framework of components.

Figure 33. Information Exchange & Collaboration

4.4.5 Concept Development (Footwall)

Rather than re-invent the wheel, and to address the goal of adaptability and change of use over time, the preliminary concept built on the theory of modularity based on an existing healthcare systems furniture product line. This resulted in a hybrid solution that mixed existing manufactured, modular components and structural supports with new custom elements including a bench and flip-down bed combination.

The team explored alternative ways to integrate the various elements in accordance with the established project goals and design criteria. The following lessons emerged:

- limitations of the existing product lines in terms of preferred range of materials and finishes
- limitations of working with manufactured standards and structural elements into a pre-existing space
- challenges of integrating multiple elements from many companies into a cohesive new solution
- challenges of working with multiple perspectives and design constraints to arrive at a single feasible solution within a pre-established time period.

4.4.6 Interim Mock-up Fabrication and Observations

Final concepts for a new footwall design were resolved through team collaboration. Students developed the concepts into a full-scale cardboard mock-up. Constructed on site at the Clemson University campus, this mock-up tested and measured the feasibility of the concept, the physical and spacial qualities, human factors issues and design strategies for further concept refinement. Along with the experiential learning benefits, constructing the mock-up allowed for a sense of realization and accomplishment for all involved. According to the interdisciplinary design firm IDEO (2009), prototyping can be seen as “building to think” or “thinking with your hands” (pp.87-89). Prototyping used as a method to enhance traditional design methods helps to quickly make ideas more tangible for further evaluation and refinement (ibid, p.89).

Figure 34. Full-Scale Mock-up Development

The use of mock-ups is becoming more prevalent, especially in healthcare design as a useful way to test assumptions and design strategies before moving into construction (Bell, 2007). There is real value in the generation of full-scale mock-ups. As Bell (2007) points out, “there is no substitute for the full-scale experience of a room mock-up—the goal is to get the ‘big kinetic picture’” (p.3). In interdisciplinary design collaborations such as this one, there are numerous value exchanges for students, external stakeholders and academic institutions (Garvey, 2009). From a participant-observer perspective, there was a sense of accomplishment in realizing the collective

ideas of the team. The real value was in the real-time feedback from the various participants. The full-scale model allows for more interactive engagement, where people can respond to the physical and multi-sensory aspects of the space. Some of the key challenges building the mock-up were a result of the cramped space, lack of familiarity with tools/materials and overall confidence with full-scale model making. However, the students went quickly from “I have never built anything before” to “ok, let’s start measuring at this point and then we can build up from there” indicating that once they started the process, they quickly were able to apply their knowledge and skills to the design problem in real-scale.

4.4.7 Design Fabrication, Implementation and Final Prototype

Design development continued on the separate headwall, footwall and bed/bench components at each university with the Carleton team travelling to Clemson for the final implementation of the prototype and industry feedback/review.

Figure 35. Fabrication Folding Bed/Bench

Communication, coordination and logistics were the main challenges of this phase of the project. For example, exchange of drawings and confirmation of critical dimensions to ensure proper integration of components once brought together on the final building site posed many challenges and time delays for the teams. Coordinating what components could realistically be built at the Carleton site and then be transported to the Clemson site also posed significant challenges for the teams. The knowledge of various building materials and construction techniques affected the quality of the final solutions and components needed to be re-built multiple times or abandoned altogether. The logistics of getting the final product to Clemson resulted in the final design being driven to some extent by the limitations of methods to transport the final product. For example, the

prototype for the bed/bench was re-designed and re-assembled in the last hours in a way that it could be taken apart and packed as ‘checked baggage’ on an airplane. This resulted in re-thinking some of the sizes of components that were too large to transport adding the additional delay of procuring materials to finalize the fabrication once the team travelled to the actual building site at Clemson. This may seem time consuming and counterproductive, but this exercise demonstrated some key positive characteristics of design thinking such as the ability to improvise and to re-imagine the problem in a new way (Brown, 2008).

Figure 36. Footwall Folding Bed Fabrication

Time issues were systemic for all team members during the final implementation and fabrication of the prototype. Many comments by students and faculty revolved around the time issue. Some participants felt that it was “hard to know what questions to ask [during materials research]” and this wasted a lot of time. Others felt that “too much time was spent on design concept” or on various phases of the project and “too much time was wasted talking [rather than doing]”. Still others felt that delays due to unavailable materials caused additional last minute runs for supplies and bottlenecks in the fabrication/construction.

Lack of knowledge or skills to complete certain construction tasks caused further delays and a domino effect resulted in many sleepless nights and frustrations for all involved. The lack of balance in skill and abilities was a sore point for many students and this caused some noticeable animosity. The organization of work took on an organic flow with students self-organizing based on what they could do. When strong leadership or project management presence was absent, many students found themselves standing around not knowing what to do next. Some students were reliant on others to show them or direct them.

Figure 37. Prototype Fabrication and Installation

The final prototype was the result of an idea presented as close to reality and completion as the students could achieve within the limited time, space and experience. In spite of the noted challenges, the final days and hours saw a ‘coming together’ of all team members to complete whatever tasks they could to reach the common goal. Students who had never held a drill before were installing door hinges. Improvisation was happening intuitively in order to work closer toward the finalization of a unified, finished concept. This final phase showed the value of experiential learning in both understanding the context as well as the multiple facets of the design process as well as the benefits of interdisciplinary knowledge exchange. It brought the students closer to the details and purpose of the project intent by dissolving the disciplinary borders (if only temporarily) through the experiential process of learning through doing.

In terms of the value of the interdisciplinary process, one student felt that it helped with “what questions to ask by providing other perspectives”. For example, knowing what the other disciplines saw as being important to the success of an integrated solution. They acknowledged that working

with other perspectives raised questions that they would not have thought about. The value of interdisciplinary design collaboration for healthcare projects is obvious here. Not all participants look at the same level of detail or approach the problem at the same scale but each of these perspectives must be considered and understood in order to reach an integrated design solution.

At the time, students do not always see the value inherent in this process. A comment from one of the students “I think we went too in depth for what is needed for the profession” giving the construction of cabinets as an example. This comment suggests that the disciplinary boundaries exist in terms of what level of detail or scale/scope they perceive to be ‘part of their domain’. This is a problematic view, especially for working on healthcare projects where every little detail can affect the safety and health of the users. At the same time this same student said, “I think healthcare projects make you more aware of the human element”, further acknowledging the human-centred approach and the important relationship between design of the built environment and people.

The challenges inherent in the collaborative design process are learning experiences in themselves. This is an example of the reality of taking an idea from concept to actualization and working with diverse backgrounds, experience and knowledge of the built environment. Evidence of this is found in comments from the students such as “I am learning so much and it’s frustrating too!” Even in light of these challenges, most of the feedback from student participants was positive in terms of their understanding of the value of the learning experience. This was acknowledged through informal interviews with various students during the process. While better time management, scheduling and a more consistent balance of skill levels were their main suggestions for improvement to overall process, more positively students reported their expanded knowledge

through comments such as “I feel I learned more about project management” and “knowing what I learned is applicable to my future or career”.

Figure 38. Photo of Final Footwall Prototype.

The final review with multiple stakeholders from academia, practice, industry and the clinical fields revealed the following insights concerning the challenges and success of the final prototype (image in Figure 38) and the interdisciplinary design process in general. A discussion of the salient lessons learned and recommendations for further study follows.

Figure 39. Final Footwall –Application of Design Criteria

4.5 Summary Patient Room Prototype Outcomes

Refinement as progress

The outcome of the 2012 prototype was positive overall. It was noted that this iteration of the patient room prototype was more advanced than all other iterations in terms of refinement of the concept. A more ‘polished’ and ‘finished’ prototype room revealed the interdisciplinary goal of the project toward a more unified solution. Not only in terms of aesthetics, but in the seamless

integration of components or ‘kit of parts’ such as seating, bed/bench, acoustic elements, storage and lighting of the footwall element. It was agreed that this integration should be pushed even more to make a more distinct ‘connection’ between the headwall and footwall elements through the ceiling to unify design and technology.

Accommodate rather than integrate

The group as a whole discussed the issue of ‘technology push’ in healthcare settings and the degree to which change impacts how much technology should be integrated into the design of future patient rooms. This prototype project took the approach to accommodate rather than integrate the technology so that change could be easily accommodated.

Push to the point of failure

The discussion around the value of this process to the stakeholders involved and the healthcare industry as a whole was seen to be positive in that the prototype project allowed for ideas and innovations to be ‘pushed’ to the point of failure. While there was success in refinement, many issues were not resolved or failed to meet the scrutiny of the panel. The headwall and ceiling backlit panel could not be completed, as critical materials were not received. The issue of how to bring tubes around to the patient head needs to be better explored. The drop-down bed was much lighter than an earlier iteration but lacked structural support due to the choice of construction materials. The pivot hinge mechanism was not concealed and raised questions about safety and cleaning. Although the thinness of the bed was one of the key goals to have it fully integrated into the footwall, the thickness and comfort of the mattress was in question. Recognizing not all iterations of the prototype project will advance the concepts or fully realize the goals, it was agreed

by the group that these projects are required to test and realize the possibilities within the constraints given to each new team. It was stressed that each team should go beyond the norms and that pushing the prototype to failure was an indication of advancement.

Value of interdisciplinary design research and development

A very positive response to the on-going effort to link the design disciplines in a form of research and development for interdisciplinary collaboration. It was noted that architecture and interior design were common collaborators but there was a definite need for more involvement from industrial design and engineering to further address some of the on-going issues in healthcare environments. The interdisciplinary aspect needed to stretch beyond the design disciplines to industry for support in sharing of research, resources and funding. It was noted that the key to advancing design concepts in healthcare was to link the outcomes to how design can improve healthcare issues such as safety and patient satisfaction.

Keeping the user at the centre.

It was observed by participants that the goals of the project were focused on control and comfort for patients and family and that the users were at the heart of the prototype design. The goal to integrate the needs of multiple occupants including those of family within the confined space was recognized by comments from clinical staff such as “it feels comfortable” and “I love the pull-down bed, my patient’s spouses, especially the older one’s would really like this”.

Figure 40. Final PRPP 2012 Patient Room Prototype

CONCLUSIONS

5.1 Insights and Lessons Learned

The Patient Room Prototype Project (PRPP) process and design concepts offer many lessons for the design of similar projects or for future interdisciplinary design activities. The following is a summary of the insights and lessons learned:

1. The patient room design became ‘real’ with the development of the first mock-up. Design concepts based on traditional design and research methods offer only part of the picture. To fully appreciate the design problem, a more holistic vision of the context is required. With the full-scale 3-dimensional form of the concept, much of the discussion became more focused on the people who would use and experience the space. Prototyping, mock-ups and other participatory design methods help bridge the gap between different perspectives, ways of knowing and doing (Brown, 2009; Sanders, 2009; Watkins, Myers, & Villasante, 2008). One of the important values of prototyping methods is that they tend to put people at the centre of the problem and prevent the tendency to focus only on the technology or aesthetic details (Brown, 2009, p.94).
2. Coming together sessions were extremely important not only in terms of sharing experience and of knowledge, but also in trying to find a common language between the design industry, academia, and the healthcare field. Visual communication methods were the key to bridging the communication gap during group discussions, both in person and virtually. Design thinking tools such as sketching, diagramming, illustration, modeling,

prototyping and image collage were used to communicate ideas at various stages of the project. Working in situ with multi-disciplines at various experience levels allows for a transfer of methods, skills and knowledge that enriches the overall design experience. The sharing of information and decision-making is key to the success of interdisciplinary collaborations. This finding is supported by others who suggest that “The integration of qualitative and quantitative information from multiple sources, together with its visualization and clear manipulation, offers improved opportunities for group consideration and decision” (Poggenpohl & Sato, 2009).

3. The synergy of working with an interdisciplinary team in both natural (field) and simulated (lab/studio) settings provides the necessary insight for realizing feasible solutions to real world problems, even if they do not quite work or they have been done before. Even though components of the patient room had been developed to different levels in previous iterations of the PRPP, each new team and scenario brings new ‘eyes’ to the same problem. For example, the folding bed conceived in an earlier iteration of the prototype was too heavy and difficult for one person to use thus preventing the external stakeholders from seeing it as a feasible solution. The new team explored ways in which to make the bed lighter and to fully integrate it with the new thinner footwall concept. In this case, it was not re-inventing the wheel but incremental change that led to the refinement of the design concept. This iteration of the design was able to demonstrate to external stakeholders, a feasible solution to accommodate the need of family/guests to stay overnight within the constraints of a universal patient room setting.

4. Design skill or knowledge alone is not enough to address the unique challenges of healthcare settings. This research showed that a designer's personality and a willingness to learn with an open mind are important factors in the success of interdisciplinary collaboration. It would seem that healthcare projects especially require design team members to have empathy for all users. Dev Patnaik in *Wired to Care* provides many examples of how empathy and user-centred approaches to design allow people to 're-frame' their point of view. He argues that "when you learn to see the world through a new set of eyes, nothing looks the same again" (Patnaik & Mortensen, 2009, p. 144). Tactics such as an overnight stay in a patient room and observing room use scenarios foster a sense of empathy and can help designers see how much their decisions can make a difference in the lives of people they are designing for. Empathy is also a trait that Brown (2009) identifies as a key characteristic of design thinkers who take a people first approach to design problems.
5. Moving quickly through the design process from observation, user input, inspiration, conceptualization and prototyping encourages collaboration and interdisciplinary input at all phases of the design process. It was observed that the creative energy of the collaborative team participants spiked with the advent of new information and discussion. However, these periods of intense activity only lasted for an hour or two. After that length of time it seemed counterproductive. It was also observed that there was a fine line between group discussion and group interaction. Too much talking and discussion stifled the creative energy within the groups. There was determination to 'get going' and 'stop talking' on many occasions. Planned breaks and 'social' opportunities were important to allow participants to have some 'down time'. These observations are consistent with a

study on team collaboration by Cross (2009) in that “alternating intense effort with relaxation and reflection” are important to stimulate creativity (p.74).

6. This research highlighted the fact that Industrial Design is not usually involved in projects for the built environment while collaboration between Architecture and Interior Design is more common. Input from industrial design was seen as a valuable asset to this collaboration and to the success of the prototype. The need for design to be addressed at all scales from the earliest stages of design are important for integrated solutions (Bartuska, 2007). It became obvious early in the design process that each disciplinary team member looked at the issues and design problems in both similar and unique ways. McClure & Bartuska, (2007) endorse the need for more interdisciplinary collaboration for the design of the built environment and argue that

“designs...that emerge from a limited or channeled discourse tend to be fragmented and isolated from the context. Designers need to establish common ties that bind them, and their ideas, together and help integrate content-component-context linkages within the built environment” (p.7).

It is apparent from these findings that interdisciplinary collaborations such as the PRPP build relationships between various disciplines and help strengthen the collective value of design’s potential to address important problems in society such as those in healthcare design.

7. The patient and family questionnaire in this study also identified the need to consider the design of patient rooms and the needs of users more holistically. For example, it was clear that many of the elements of a patient room that impact patient and family satisfaction are

design issues. It was also evident that the physical, emotional and social attributes most important to patients and family are interrelated and have an impact on their perception of what constitutes a healing space, which ultimately affected their overall experience in the patient room setting. This supports the findings from others (Ulrich R. S., 2001; Evans & Mitchell McCoy, 1998; Dijkstra, Pieterse, & Pruyn, 2006). There is clearly a need for design disciplines to work together along with other disciplines outside of the field who share the common goals of creating more health supportive environments. The observations from the case study indicate that the future of healthcare design and patient room design in particular should strive to utilize interdisciplinary and participatory design research that allows for improvement and innovation at all scales of the design solution. The collaboration for this patient room prototype between architecture, interior design and industrial design revealed that even working in a team environment, each discipline focused on details specific to their discipline.

8. One critical component missing from the PRPP process was the input from actual patients and their families. Students needed to rely on the views of others or their own experiences and observations to make critical design decisions that would have impact on the key user group. The context of healthcare settings makes access to patients and families difficult for design research (Douglas & Douglas, 2005). Insights from this study show that relying only on national patient exit surveys or on staff / industry input from professionals during the design process for issues related to patient and family needs is not sufficient. Some conflicting patterns emerging from the survey questionnaire, observations and analysis

reveal the need for patient and family representation during the design process. There were conflicting views of where the guest bed should be (at window or footwall) and this may have been influenced by other factors in the room such as placement of air vents over the sleeping area and desire to have more direct visual and physical contact with the patient. For example, clinical staff members made assumptions that a patient lounge chair is sufficient for sleeping in by family/visitors. However, comments from the patient and family questionnaire revealed that most chairs that are provided in patient rooms are uncomfortable for sitting, not appropriate for sleeping in and interfere with their ability to support their loved ones. Another conflicting view was of how television/media/technology can enhance the patient/family experience. For example, some clinical staff and professionals favored the full-fixed media wall, others felt that the bedside monitor was the most accommodating solution and comments from the patient/family questionnaire stressed the desire to control and adjust the location/viewing angle of the media screen.

5.2 Suggestions for Further Research

Based on the findings from this research, the following are suggested areas for further study:

- One question that arises from this research is how could patients and families be more involved in the design process for future patient room design and what would be the best methods to use that could help better understand their diverse needs?
- More research is needed to explore the conflicting findings between patient room stakeholders and furniture/fixtures and technology within the patient room such as the

best location, size and type of media/entertainment, the size, type, function and location of furniture for seating/sleeping and other noted activities.

- Lighting is an important issue and more design research could conduct user/task studies that focus on lighting in the patient room from the patient and family perspective.
- Control of room elements is important to patients and family within the patient room setting. Further design research might explore the preference for as well as the location, integration and interface of products/technology with patient room design to better facilitate control of various room settings/elements.

5.3 Conclusion

The research question asked what aspects of the physical environment can enhance the patient and family experience through design of acute care patient rooms. Through this exploration, this study sought to understand a) what specific attributes patients and family perceive contribute to a supportive patient room environment and b) how these findings could be better integrated into the design of acute care patient rooms.

The former patient and family survey questionnaire provided the confirmation that there is room for improvement in design of patient rooms. It showed that the things that were most important to patients and families revolved around issues of control and comfort and that these elements were all related to the design of the physical environment or to the objects within the environment. The findings from observations and interviews highlighted the need for patients and families to have their own voice in the design process and to share their unique perspective of the patient room experience.

The case study explored the second part of the question looking at how the interrelatedness of context and process for the design of health supportive patient rooms can be addressed through interdisciplinary design collaboration. The findings from the case study demonstrate the important value of interdisciplinary design collaborations for all involved, including students, academic institutions, healthcare providers, industry professionals, manufacturers and ultimately for the patients and families who will experience these spaces. It further revealed the unique challenges of designing supportive healthcare environments, the complexity of addressing the views of multiple stakeholders and conflicting criteria.

In response to the shift in thinking toward a more human-centred approach to hospital design, this research demonstrated that the blurring of disciplinary boundaries (even temporarily) can expand the human-environment problems such as those found in healthcare facilities. This research shows that interdisciplinary collaboration and participatory design methods offer a path toward a more holistic approach to the complexities involved in designing healing spaces.

This project offered an opportunity to explore the important role of design for healthcare. It allowed the design researcher to observe as well as participate in the successful application of interdisciplinary design collaboration for a patient room prototype and to share the lessons learned.

REFERENCES

- Allison, D. (2009). Single Bed Hospital Rooms in the US: Design issues and trends. *Journal of Japan Institute of Healthcare Architecture*, 4-7.
- Augustin, S., & Coleman, C. (2012). *The Designer's Guide to Doing Research: Applying Knowledge to Inform Design*. New Jersey: John Wiley & Sons.
- Bartuska, T. J. (2007). Understanding Environment(s): Built and Natural. In W. R. McClure, & T. J. Bartuska (Eds.), *The Built Environment: A Collaborative Inquiry into Design and Planning* (2nd ed., pp. 33-43). New Jersey: John Wiley & Sons.
- Bate, P., & Robert, G. (2007). *Bringing User Experience to Healthcare Improvement: the concepts, methods and practices of experience-based design*. Abington: Radcliffe Publishing Ltd.
- Battisto, D., & Allison, D. (2008, September). A Patient Room Prototype: Bridging Design and Research. *Academy Journal*.
- Battisto, D., & Pak, R. (2009). Using Task Analysis to Describe Nursing Work in Acute Care Patient Environments. *The Journal of Nursing Administration*, 39(12), 537-547.
- Battisto, D., Allison, D., & Pak, R. (2009). Evidence-Based Approach to Creating a Human-Centred Acute Care Patient Headwall. *Healthcare Design 09*, (pp. 1-6). Orlando.
- Bell, K. (2007, May 1). Mock-ups: Giving hospital clients the ultimate reality check. *Healthcare Design*, pp. 1-3.

- Brown, K. K., & Gallant, D. (n.d.). Impacting Patient Outcomes Through Design: Acuity Adaptable Care/Universal Room Design. *Critical Care Nursing Quarterly*, 29(4), pp. 326-341.
- Brown, T. (2008, June). Design Thinking. *Harvard Business Review*, pp. 1-10.
- Brown, T. (2009). *Change By Design*. New York: Harper Collins.
- Buchanan, R. (1992, Spring). Wicked Problems in Design Thinking. *Design Issues*, 8(2), 5-21.
- Buchanan, R. (1995). Rhetoric, Humanism, and Design. In R. Buchanan, & V. Margolin (Eds.), *Discovering Design: Explorations in Design Studies* (pp. 23-66). Chicago: The University of Chicago Press.
- CDC-National Center for Health Statistics. (2012, March 1). *Hospital Utilization: Fast Facts*. Retrieved from CDC Centers for Disease Control and Prevention: <http://www.cdc.gov/nchs/fastats/hospital.htm>
- Chaudhury, H., Mahmood, A., & Valente, M. (2009, November). The Effect of Environmental Design on Reducing Nursing Errors and Increasing Efficiency in Acute Care Settings: A review of the literature. *Environment and Behaviour*, 41(6), 755-786.
- Conway, J., Johnson, B., Edgman-Levitan, S., Schlucter, J., Ford, D., Sodomka, P., et al. (2006). *Partnering with Patients and Families To Design a Patient-and-Family-Centred Health Care System*. Institute for Patient and Family Centred Care, Cambridge, MA.

- Cote, J. (2012, January 16). Director of Transition, Pavilion K- Clinical Project, Jewish General Hospital. (T. Phillips, Interviewer) Montreal, Canada.
- Cross, N. (2011). *Design Thinking*. New York, NY, USA: Berg.
- Cross, N., & Clayburn Cross, A. (1995, April). Observations of teamwork and social processes in design. *Design Studies*, 16(2), 143-170.
- Dijkstra, K., Pieterse, M., & Pruyn, A. (2006). Physical environmental stimuli that turn healthcare facilities into healing environments through psychologically mediated effects: systematic review. *Journal compilation*, 166-181.
- Dilani, A. (2001). Psychosocially Supportive Design-Scandinavian Health Care Design. *World Hospitals and Health Services*, 37(1), 20-24.
- Douglas, C., & Douglas, M. (2005). Patient-friendly hospital environments: exploring the patient's perspective. *Health Expect*, 8(3), 264-276.
- Evans, G. W., & Mitchell McCoy, J. (1998). When Buildings Don't Work: The Role of Architecture in Human Health. *Journal of Environmental Psychology*, 18, 85-94.
- Francis, M. (1999). *A Case Study Method for Landscape Architecture*. Research Project, Landscape Architecture Foundation, Washington, DC.
- Garvey, T. (2009). Looking for the Real World: Balancing Expectations and Inspiration in Design Collaborations. *IASDR09*, (pp. 1-9). Seoul, Korea.

- Goetz, P., Malone, E., Harmsen, C., Reno, K., Delstein, E., Hamilton, K., et al. (n.d.). *An Introduction to Evidence-Based Design, EDAC Study Guide 1. Exploring Healthcare and Design*. The Centre for Healthcare Design.
- Groat, L., & Wang, D. (2002). *Architectural Research Methods*. New York: John Wiley and Sons.
- Hamilton, K., & McCuskey Shepley, M. (2010). *Design for Critical Care: An evidence-based approach*. Burlington, MA, USA: Architectural Press.
- Heerwagen, J. H. (2003, January 15). Bio-Inspired Design: What Can We Learn from Nature? *BioInspire*.
- Heerwagen, J. H. (2010). Interior Design Meets the Adapted Mind. In C. S. Martin, & D. A. Guerin, *The State of the Interior Design Profession* (pp. 72-77). New York: Fairchild.
- Huelat, B. J. (2007). *Healing Environments: What's the Proof?* Alexandria, Virginia, USA.
- Kaplan, S. (1995). The Restorative Benefits of Nature: Toward An Integrative Framework. *Journal of Environmental Psychology*, 15, 169-182.
- Katherine, B. K., & Gallant, D. (2006). Impacting Patient Outcomes Through Design: Acuity Adaptable Care/Universal Room Design. *Critical Care Nursing Quarterly*, 29(4), pp. 326-341.
- Kellert, S. R., Heerwagen, J. H., & Mador, M. L. (2008). *Biophilic Design: the theory, science, and practice of bringing buildings to life*. New Jersey: John Wiley & Sons.

- Kopec, D. (2011). *Environmental Psychology for Design* (2nd ed.). New York: Fairchild Publications.
- Lawrence, R. (2002). Healthy Residential Environments. In R. B. Bechtel, & A. Chrchman (Eds.), *Handbook of Environmental Psychology* (pp. 394-412).
- Leblanc, T. (n.d.). Transdisciplinary Design Approach: An Experimental Model to Project-based Teaching and Creative Problem Solving. *IFIP International Federation for Information Processing*, 289, 106-122.
- Leibrock, C. A., & Harris, D. (2011). *Design Details For Health* (second ed.). New Jersey: John Wiley and Sons Inc.
- Leventhal Stern, A., MacRae, S., Gerteis, M., Harrison, T., Fowler, E., Edgman-Levitan, S., et al. (2003). Understanding the Consumer Perspective to Improve Design Quality. *Journal of Architectural and Planning Research*, 20(1), 16-28.
- Malecha, M. J., & Green, R. (2001). *Case Studies: the Study and Practice of Architecture. Development Checklist and Submission Guidelines*. Case Study Work Group. The American Institute of Architects.
- Malkin, J. (2008). *A Visual Reference for Evidence-Based Design*. Concord: The Centre for Health Design.
- Malone, E. B., & Dellinger, B. A. (2011). *Furniture Design Features and Healthcare Outcomes*. The Centre for Health Design.

- McClure, W. R., & Bartusksa, T. J. (Eds.). (2007). *The Built Environment: A Collaborative Inquiry into Design and Planning*. New Jersey: John Wiley and Sons.
- Nussbaumer, L. L. (2012). *Inclusive Design: A Universal Need*. New York, NY: Fairchild Books.
- Pallasmaa, J. (2009). *The Thinking Hand: Existential and Embodied Wisdom in Architecture*. West Sussex: John Wiley & Sons.
- Pati, D. (2009). A Multidimensional Framework for Assessing Patient Room Configurations. *Health Environments Research and Design*, 2(2), 88-11.
- Patnaik, D., & Mortensen, P. (2009). *Wired to Care*. New Jersey: FT Press.
- Poggenpohl, S., & Sato, K. (2009). *Design Integrations: Research and Collaboration*. Chicago, USA: Intellect, The University of Chicago Press.
- Rashid, M., & Zimring, C. (2008). A Review of the Empirical Literature on the Relationships Between Indoor Environment and Stress in Health Care and Office Settings. *Environment and Behavior*, 40(2), 151-190.
- Ryan, K., & LaBat, K. (2009). Addressing the challenge of patient-centred design. *Australian Medical Journal*, 1(13), 204-210.
- Sanders, L. (2009). *Symposium: Designing for, with and from user experiences*. Retrieved November 28, 2010, from Make Tools: Presentations: <http://www.maketools.com/presentations.html>

- Sloan Devlin, A., & Arneill, A. B. (2003, September). Health Care Environments and Patient Outcomes. *Environment and Behavior*, 35(5), 665-694.
- Stern, H. D. (2012, January 16). Executive Director, Jewish General Hospital. (T. Phillips, Interviewer) Montreal, Canada.
- Sternberg, E. M. (2009). *Healing Spaces: The Science of Place and Well-being*. Cambridge, Massachusetts, USA: The Belknap Press of Harvard University Press.
- Tanja-Dijksra, K. (2011). The Impact of Bedside Technology on Patients' Well-Being. *Health Environments Research & Design Journal*, 5(1), 43-51.
- The Institute for Patient and Family Centred Care. (1992). *What is Patient and Family Centred Health Care?* Retrieved November 26, 2011, from The Institute for Patient and Family Centred Care: <http://www.ipfcc.org/faq.html>
- Ulrich, R. (1984). Effects of Interior Design on Wellness: theory and recent scientific research. *Journal of Health Care Interior Design*, 3, 97-109.
- Ulrich, R. S. (1984). View Through a Window May Influence Recovery from Surgery. *Science*, 224, 420-421.
- Ulrich, R. S. (2001). Effects of Healthcare Environmental Design on Medical Outcomes. *International Conference on Health and Design*, (pp. 49-59).

- Ulrich, R. S., Berry, L. L., Quan, X., & Turner Parish, J. (2010). A Conceptual Framework for the Domain of Evidence-Based Design. *Health Environments Research and Design Journal*, 4(1), 95-114.
- Ulrich, R., & Zimring, C. (2004). *The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity*. The Centre for Health Design.
- Ulrich, R., & Zimring, C. (2008). A Review of the Research Literature on Evidence-Based Healthcare Design (Part II). *Health Environments Research & Design Journal*.
- Vance, G., & Berger, D. (March 2012). *Linking Patient Sentiment Analysis to Patient Room Environment*. white paper.
- Verderber, S. (2010). *Innovations in Hospital Architecture*. New York: Routledge.
- Watkins, N., Myers, D., & Villasante, R. (2008). Mock-Ups as "Interactive Laboratories": Mixed Methods Research Using Inpatient Unit Room Mock-Ups. *HERD*, 2(1), 66-81.
- Zeisel, J. (2006). *Inquiry By Design: Environment/Behavior/Neuroscience in Architecture, Interiors, Landscape, and Planning*. New York: W.W. Norton & Company.
- Zimring, C. M., Ulrich, R. S., Xuemei, Z., Dubose, J. R., Seo, H.-B., Choi, Y.-S., et al. (2008). A Review of the Research Literature on Evidence-Based Healthcare Design. *Health Environments Research and Design Journal*, 1(3).

APPENDICES

Appendix A. Expert Interview Consent Form

Participant Consent Form for Expert Interviews

Research study: Designing the Acute Care Patient Room: Improving the Patient/Family Experience

I, _____, voluntarily agree to participate in a research project conducted by Tamara Phillips for the completion of a Master of Design thesis study, supervised by Prof. Thomas Garvey, School of Industrial Design, Carleton University. Researcher contact: (email: tphill11@connect.carleton.ca Phone: 613-253-7762)

BACKGROUND

This study is being conducted from the perspective of supportive healthcare design to improve patient outcomes. It is based on the premise that a physical, psychological and socially supportive environment can help patients recover and can improve the overall healthcare experience. In order to design a supportive environment for patients and their caregivers, it is important to understand the key elements within the patient room setting that may impact or enhance the healthcare experience.

PURPOSE

The purpose of these interviews is to explore from a domain area expert perspective, the issues and trends concerning the design of patient rooms in acute care settings.

The goal(s) of this study will be

- a) to identify key issues and needs of patients and families in the context of the acute care patient room setting.
- b) to define and prioritize preferred features and elements of a supportive acute care patient room setting.
- c) to apply resultant criteria to the design of a patient room prototype for validation and identification of further required research.

TASKS AND DURATION

Participation will involve an interview by phone, email or in person as per your preference, to discuss topics related to the design of an acute care patient room. Your response to the questions will be used to form a framework for further investigation of the identified topics. The questions will focus on the design elements (such as furnishings) within the space that may hinder or enhance the healing experience. The total duration of the interview will not exceed 1 hour.

I agree to have my interview/discussion recorded...Yes____No____

PARTICIPATION AND RIGHT TO WITHDRAW

Your participation is voluntary. At any time before March 1, 2012 you may withdraw from participation without prejudice. If you decide to withdraw from the project, any information you have provided will be destroyed.

Appendix B. Expert Interview Question Guide

Expert Interview Question Guide

Designing the Acute Care Patient Room: Improving the Patient/Family Experience

Name: _____ Job Title: _____ Date: _____

Company: _____ Location: _____

Research indicates that having family present and involved in a patient's recovery process can have a positive impact on overall patient outcomes. Children's hospitals often endorse these benefits, but the concept is not well advanced in acute care settings for adults. With an aging population and more complex inpatient healthcare needs, what does this mean for healthcare delivery and how will this affect the design of acute care patient rooms in the future?	
How would you define patient-and-family centred care?	
What factors would you say are influencing this trend in healthcare?	
What do you see as the potential benefit(s) of accommodating families in the acute care patient room setting?	
What specific issues related to accommodating family in the acute care patient room do you see?	
What do you feel are the common attitudes and perceptions toward accommodating families in the acute care patient room?	
What specific applications addressing the needs of family in acute care patient rooms have you been involved with?	
What is unique about this particular area of need?	
What do you feel are the biggest issues/concerns of patients/families that are not being addressed in acute care patient room design?	
What do you feel is the single most important consideration for the design of acute care patient rooms that could improve the patient/family experience?	
What other influences do you see affecting the design of acute care patient rooms in the future?	

Appendix C. Email Recruitment Cover

Do you think that patient rooms are healing spaces?

Healthcare is a hot topic today. Many hospitals are being renovated or newly built to accommodate growing demand, an aging population, changes in technology and outdated infrastructure. Some people think this is an 'opportunity of a lifetime' to re-think hospital design.

Do you want to have your say?

TAMARA
SURVEY

DESIGNING THE ACUTE CARE PATIENT ROOM: IMPROVING THE PATIENT/FAMILY EXPERIENCE

We want to hear from you!

***Please take a moment to complete this short survey about
patient room design from the patient and family/visitor perspective.***

Click on this link to take the survey:

<http://app.fluidsurveys.com/surveys/tamara-R/acute->

*your input will help provide a better understanding of the issues, needs and perspectives of patients and their family and friends as they relate to the design of acute care patient rooms.
All answers will be confidential and used for academic research only.

Designing the acute care patient room: improving the patient/family experience

This survey is part of a research project conducted by Tamara Phillips for the completion of a Master of Design thesis, School of Industrial Design, Carleton University, Ottawa, Canada.

Background:

This study is from the perspective of supportive healthcare design to improve patient outcomes. It is based on the premise that a physical, psychological and socially supportive environment can help patients recover and can improve the overall healthcare experience for both the patient and their family/personal caregivers. In order to design healing places, it is important to understand the key elements within the patient room setting that influence a positive healing experience.

For healthcare facilities to remain responsive, the needs, values and expectations of all stakeholders (including the patient and family/personal caregivers) must be considered in the design of all areas of the hospital, especially the patient room.

The purpose of this survey is:

1. to obtain anonymous feedback on the key issues, needs and preferences for the design of patient rooms in acute care settings from the patient and family/ personal caregiver perspectives.

The questions focus on the reflective experience of patients and family/personal caregivers for the patient room only (excluding the bathroom).

All information contained in this survey is completely confidential and will be retained for academic research purposes only. This research has been approved by the Carleton University Ethics Board. Contact Tamara Phillips at tphilli1@connect.carleton.ca with any questions concerning this study.

PLEASE ANSWER EACH QUESTION CAREFULLY AND AS COMPLETELY AS POSSIBLE.

Section 1: Demographic Questions

Question 1.1: In what age group do you belong?

Question 1.2: How would you classify yourself?

Question 1.3: In the past 12 months, how many times have you been either a patient or a visiting family member/caregiver in an acute care patient room?

Acute care for the purpose of this survey will include any inpatient hospital where patients are treated for brief but severe illness, accident, trauma or recovery from surgery.

Participants who volunteer for this survey will have experienced a short-stay in a hospital patient room within the past 12 months as either a patient or a family member/close friend and are 18 years of age or older.

- Patient
- Family/Close Friend

Question 1.4: Please indicate the province or state in which the most recent hospital stay occurred.

Question 1.5: Before proceeding with the survey, please identify yourself as one of the following groups:

you will be basing your responses on your previous experience as either a patient OR a family member/close friend (not both) for the duration of the survey.

- ☐ I am 18 years or older and a relative or close friend who stayed with a patient that was hospitalized in an acute care patient room within the past 12 months, please check the box and proceed with the survey.
- ☐ I am 18 years or older and was a patient who was hospitalized in an acute care patient room within the past 12 months, please check the box and proceed with the survey.

Question 1.6: What type of room did you stay in?

- ☐ Single Private Room
- ☐ Semi-Private Room (2 person per room)
- ☐ Common/Ward (more than 2 people per room)
- ☐ Other, please specify: _____

Question 1.6: What would be your preference for a room type if you had a choice? Why?

- ☐ Single Private Room _____
- ☐ Semi-Private Room (2 person per room) _____
- ☐ Common/Ward (more than 2 people per room) _____
- ☐ Other, please specify: _____

Question 1.7: What was your length of stay

- ☐ 1-3 days
- ☐ 4-6 days
- ☐ 7-9 days
- ☐ more than 10 days

Question 1.8: What acute care department did you spend most of your stay in?

- ☐ Medical/Surgical
- ☐ Elder Care
- ☐ Maternity
- ☐ Other, please specify: _____
- ☐ prefer not to answer

Section 2: Patient Room Environment

Question 2.1: From what you can recall about the patient room you stayed in, rate *what you remember feeling* according to the following terms:

Never Rarely Sometimes Often Always

	Never	Rarely	Sometimes	Often	Always
invaded	☐	☐	☐	☐	☐
crowded	☐	☐	☐	☐	☐
anxious	☐	☐	☐	☐	☐
irritated	☐	☐	☐	☐	☐
peaceful	☐	☐	☐	☐	☐
happy	☐	☐	☐	☐	☐
relaxed	☐	☐	☐	☐	☐
bored	☐	☐	☐	☐	☐
confined	☐	☐	☐	☐	☐
helpless	☐	☐	☐	☐	☐
content	☐	☐	☐	☐	☐
safe	☐	☐	☐	☐	☐
comfortable	☐	☐	☐	☐	☐
cold	☐	☐	☐	☐	☐

Question 2.2: From what you can recall, rate the following room elements according to *how they met your needs*.

	Very Unsatisfied	Unsatisfied	Neutral	Satisfied	Very Satisfied
storage space	☐	☐	☐	☐	☐
seating	☐	☐	☐	☐	☐
display for gifts/cards	☐	☐	☐	☐	☐
sleeping accomodations	☐	☐	☐	☐	☐
lighting	☐	☐	☐	☐	☐

	Very Unsatisfied	Unsatisfied	Neutral	Satisfied	Very Satisfied
television/entertainment	☐	☐	☐	☐	☐
space for eating	☐	☐	☐	☐	☐
space for working	☐	☐	☐	☐	☐
space for personal items	☐	☐	☐	☐	☐
room size or layout	☐	☐	☐	☐	☐

Question 2.3: Based on your responses in the previous question, what would you suggest could improve the following patient room elements?

- storage space
- seating
- display for gifts/cards
- sleeping accommodations
- lighting
- television/entertainment
- space for eating
- space for working
- space for personal items
- room size or layout
- other

Question 2.4: Please rate the following room elements in terms of your desire to *adjust/control* them during your hospital stay:

	Not at all Important	Somewhat Important	Neutral	Important	Very Important
Room lighting	☐	☐	☐	☐	☐
Room temperature	☐	☐	☐	☐	☐
Angle/location of television	☐	☐	☐	☐	☐

	Not at all Important	Somewhat Important	Neutral	Important	Very Important
Use of personal electronic device	☐	☐	☐	☐	☐
location of bed	☐	☐	☐	☐	☐
location of chairs	☐	☐	☐	☐	☐
location of table	☐	☐	☐	☐	☐
window blinds/curtains	☐	☐	☐	☐	☐
making of snacks/beverages	☐	☐	☐	☐	☐
number of visitors	☐	☐	☐	☐	☐
age of visitors	☐	☐	☐	☐	☐
visibility to outdoors	☐	☐	☐	☐	☐
access to outdoors	☐	☐	☐	☐	☐
music selection	☐	☐	☐	☐	☐
entertainment selection	☐	☐	☐	☐	☐
artwork selection	☐	☐	☐	☐	☐
securing of personal possessions	☐	☐	☐	☐	☐
colour/decor	☐	☐	☐	☐	☐

Question 2.5: Fill in the blank to this statement with a word or phrase that best describes your impression: *The patient room I stayed in looked*

Question 2.6: Fill in the blank to this statement with a word or phrase that best describes your thoughts: *All new patient rooms should look*

Question 2.7: Rate the following items in terms of *importance* to your overall COMFORT in a patient room setting.

	Not at all Important	Somewhat Important	Neutral	Important	Very Important
clock (indication of time)	☐	☐	☐	☐	☐
whiteboard (for communication)	☐	☐	☐	☐	☐
calendar	☐	☐	☐	☐	☐
closet for clothing and personal items	☐	☐	☐	☐	☐
adjustable television/media entertainment	☐	☐	☐	☐	☐
concealment of medical equipment	☐	☐	☐	☐	☐
images/artwork of nature scenes	☐	☐	☐	☐	☐
colour	☐	☐	☐	☐	☐
fabrics/linens	☐	☐	☐	☐	☐
natural materials/finishes	☐	☐	☐	☐	☐
plants/flowers	☐	☐	☐	☐	☐
view to a garden or natural vista	☐	☐	☐	☐	☐
adjustable lighting	☐	☐	☐	☐	☐
natural lighting	☐	☐	☐	☐	☐
personal choice of music	☐	☐	☐	☐	☐
personal choice of scented air freshener	☐	☐	☐	☐	☐
adjustable furniture	☐	☐	☐	☐	☐
personal space for things/belongings	☐	☐	☐	☐	☐

	Not at all Important	Somewhat Important	Neutral	Important	Very Important
small fridge to store food/beverages	☐	☐	☐	☐	☐

Question 2.8: Briefly describe what you recall about the following environmental elements:

- What did you look at most of the time?
- What did you smell most of the time?
- What did you hear most of the time?
- What did it feel like most of the time?
- Who did you talk to most of the time?

Question 2.9: What is the one thing from home that you wished you could have brought with you to help COMFORT you during your stay at the hospital? Why?

Question 2.10: What activity did you typically do to pass the time or to keep occupied during your stay in the patient room? Choose all that apply.

- ☐ Watch television
- ☐ Read books, magazines
- ☐ work on laptop/PDA
- ☐ write/draw/doodle
- ☐ play games
- ☐ listen to music
- ☐ talk on the phone
- ☐ Other, please specify:

Question 2.11: Did anything about the patient room you stayed in affect your ability to interact with your loved ones? Briefly explain why.

Question 2.12: How would you rate the seating that was in your room?

	Very Unsatisfied	Unsatisfied	Neutral	Satisfied	Very Satisfied
size	☐	☐	☐	☐	☐
material	☐	☐	☐	☐	☐
adjustability	☐	☐	☐	☐	☐
flexibility	☐	☐	☐	☐	☐
colour	☐	☐	☐	☐	☐
appearance	☐	☐	☐	☐	☐
support for posture	☐	☐	☐	☐	☐
cleanability	☐	☐	☐	☐	☐
comfort	☐	☐	☐	☐	☐

Question 2.13: From your experience, what do you feel are the three (3) items below that most affected your OVERALL COMFORT in the patient room you stayed in?

- ☐ lighting
- ☐ view
- ☐ colours/decor
- ☐ furniture
- ☐ medical equipment
- ☐ noise
- ☐ room layout
- ☐ safety
- ☐ space
- ☐ Other, please specify:

Current number checked: 0 Minimum: 1 | Maximum: 3)

Question 2.14: Based on what you recall, how would you rate your OVERALL experience in the patient room you stayed in?

- ☐ Very Satisfied
- ☐ Satisfied
- ☐ Neutral
- ☐ Unsatisfied
- ☐ Very Unsatisfied
- ☐ N/A

Question 2.15: If you could be part of a team to design the next acute care patient room, what ONE element would you ensure was incorporated into the design to make it a 'healing space'? Please describe and explain why.

Thank you for taking the time to fill out this survey.

If you would be interested in a short interview in person or by phone on this topic, please check your preference below.

Please note: Friends and relatives of the researcher will not be accepted as volunteer participants, however they may recommend willing participants; for this part of the study.

You may also contact the researcher at tphilli1connect.carleton.ca or 613-727-4723 x 5715 to arrange volunteer participation.

- ☐ Yes I would like to volunteer for this interview. Please contact me by the method selected below.
- ☐ Please enter telephone number where you can be reached:
- ☐ Please enter email address where you can be reached:
- ☐ I will contact the researcher using the contact information provided above.
- ☐ no thank you

Appendix E. Example Content Analysis

FAMILY Pre-Survey Questions (Pilot SUMMARY)

Designing the Acute Care Patient Room: Improving the Patient/Family Experience

15 Family/visitors (all female, 2 nd year ID students)		Summary
1. From the following list, check the items/issues that you recall bothered you most about your previous stay in an acute care patient room. (choose up to 3)	<ul style="list-style-type: none"> — lack of privacy — feeling crowded — lack of control over setting — look of the space — feeling of the space — lack of personal space — lack of support for activities — insufficient space/furniture/equipment — other _____ 	<ul style="list-style-type: none"> — 1111111111 — 1111111111 — 1 — 11111111 — 1111111111 — 1111111111 — 111 — 111111 — Sound privacy — Feeling cold
2. From what you recall, which of the following elements/features of the headwall or footwall do you feel could be improved to meet your personal needs (check all that apply):	<ul style="list-style-type: none"> — storage space — seating for guests — display for gifts/personal items — overnight accommodations — task lighting — technology/electronics — communication tools — work surface — other _____ 	<ul style="list-style-type: none"> — 1111111111 — 1111111111111111 — 11111 — 11111111 — 11111111 — 11111 — 11 — 11111111 — other _____
3. In order of importance, how would you rate the following criteria for the design of patient rooms?	<ul style="list-style-type: none"> — thermal comfort — control/adjustability — appearance — personalization 	<ul style="list-style-type: none"> — 22242453235315 — 34334232423246 — 256655364654133 — 655665465662454

Carleton University
Master of Design Program, School of Industrial Design

Appendix F. Example of Interview Coding

DR. Karelly Strel - EXECUTIVE DIRECTOR - JEWISH GENERAL HOSPITAL - MONTREAL, PQ

Meter #	Subject	Information	Value	Comments
36	<u>Topics</u> # INFECTION	- STANDARD PRIVATE ROOMS - NO SPREAD OF INFECTION - NOT JUST CONSTRUCTION BUDGET - OPERATING BUDGETS		- PRIVATE ROOMS REDUCE SPREAD OF INFECTION
123	# MONEY	- STAFFING ISSUES - BECAUSE HAVE PATIENT RATIOS - THAT ARE SAFE		- DESIGN FOR STAFF EFFICIENCY
148	MONITORING ACCESS			
200	STANDARDING - OF ROOM ELEMENTS SAME INTERVIEW VS SAME PALLIATIVE CARE			STANDARDIZED ELEMENTS / EQUIPMENT
	REINTEGRATION DUE CARE			
244	# PATIENT 3 QUALITY	EXPERIENCE		
3:20	PATIENT ROOM	- PATIENT SURVEY MONTHLY		
3:46	POLL	EXIT POLLS PATIENT EXPERIENCES		
4:09	NOISE REDUCTION	SLEEP		MATERIALS

4:12 CLEANLINESS

- MATERIALS
- MIN. SURFACES -
EASY TO GET AT.

Appendix G. Example Affinity Diagram Chart

Patient Room Prototype Project Issue Identification

Healthcare Furniture Mfg Registered Nurse/Clinical Strategist Hospital Executive Director Nurse Mgr./Director of Transition Patients Family Architect/Designer

SPACE	SAFETY	CHANGE	FURNITURE & EQUIPMENT	LIGHTING	FINISHES & MATERIALS	DESIGN	USERS/ STAKEHOLDERS	PSYCHOLOGICAL / SOCIAL
Private Optimize Incorporate amenities Anticipate change Customized Personalized Reduce clutter Maintain clear floor space around patient More space for families Clear demarcation of activity 'zones' Lots of stuff and people in small space	Prevention of Infection Fall Medical Errors	Of use Over time Levels of acuity	Moveable for emergency Minimize visual and equipment clutter Comfortable accommodation for family Removable components Benches for secondary seating only Lockable storage for personal items	Reading Natural Soothing multi-levels control adjustable	Durability Cleanability Changeable Fresh Consider aging customers Minimize surfaces for cleaning Avoid pale, clinical colours Colour important Overall aesthetics, comfort important Not too 'luxurious like a hotel- perception of accountability	Consider ergonomics of all users Consider needs of elderly patients and family members Balance needs of all stakeholders Reduce floor clutter, improve access to patients Lacking in family amenities Family not as much involved in design process or satisfaction surveys	Ideally, nurses want 360 degree access to patient Expect family to be more involved in care Health and safety benefits of family support Patients are older, need more family assistance Need for overnight accommodations for around the clock support from family Many facilities do not involve family in a meaningful way	Minimize stress larger views to outdoors, some privacy from corridor views of nature reduce noise enable choice/ control ability to customize, personalize, make oneself 'at home'
Look at the room or the furniture components like 'empty shells' that can be customized with components as needed In [the patient room] even the	Anti-microbial not there yet, but near future Medication errors- reduce possibility of interruptions from patients/ families	Infrastructure (med gas, wiring, plumbing etc.) critical component in adaptability, future change Need to have a 'forward facing' design that can be adapted to future needs IOA innovative	Should not be built-in-need to move/re-configure by families or in case of emergency Integrate equipment Fully adjustable/ reachable lamp that	Sore spot often inability to read in bed, same for family seating or sleeping area Fully adjustable/ reachable lamp that	Easily cleaned Drop-down surfaces, will they get cleaned? What are the maintenance issues? Disappointed	address ergonomic needs of patients, families and staff 'forward facing' looking at patient while documenting/ Charting to improve communication Disappointed	Older patients and caregivers Baby boomer generation-more demanding More critical patients on general medical floors w/intensive care needs	Minimize stress -noise reduction -adequate lighting for tasks -conceal equipment -accessibility -reduce clutter Balance between safety needs and psychological needs

Appendix H. Example Field Notes

name/nom	project/projet
date/date	JOANNE COPE - PAVILION & DIRECTION OF TRANSITION CLINICAL PROJECT
tasks/tâches	<p>9:00 - 10:30 MGR. of LOCOMOTOR CASE UNIT.</p> <p>Articulation G</p> <p>patients walked TOILET ON CEILING - space for family's - privacy.</p> <p>HIGH UNITS - COMBINE MT. Articulation Arms.</p> <p>Large Windows</p> <p>Articulation Arms / ICU</p> <p>EQUIPMENT IS SMALLER</p> <p>House -</p> <p>Communication of Needs</p> <p>Daily Routine -</p> <p>Columns? - no Hot Line</p> <p>Energy Population</p> <p>Chaper - Noise Reduction</p> <p>HEATED - ELIMINATED CASH.</p> <p>No Articulation Arms</p> <p>HEAVY, Horizontal</p> <p>Slide Bar.</p>
<p>Visited.</p> <p>Rust</p> <p>CHICAGO</p> <p>'Sister Project.'</p>	

Appendix I. Example Pilot Survey Content Analysis

Pilot Survey	Former Patient	Former Family
All female, ages 18-35		
2 nd Year Undergrad		
Students (Interior Design)		
Bothered you most about past experience	1. lack of privacy 2. lack of space 3. lack of personal space	1. lack of privacy 2. lack of personal space 3. feeling of space
Room elements that could improve	1. seating for guests 2. overnight accommodations 3. storage space	1. seating for guests 2. storage space 3. work surface
Importance of room criteria	1. thermal comfort 2. flexibility of use 3. accessibility	1. accessibility 2. flexibility of use 3. thermal comfort
Would most help reduce stress	1. television/media entertainment 2. concealment of medical equipment 3. view to garden/nature	1. view to garden/nature 2. soothing colours 3. television/media entertainment
Recollection of experience remembered most	institutional clinical dated Poor views out of windows: parking lots, roofs, other buildings, depressing	Privacy curtains "nothing uplifting or invigorating" lack of positive distraction "boring, cramped, felt unclear"
Activities to have time	mixed	1. Read books/magazines/ Write /doodle/draw 2. Watch television 3. Work on laptop/pda
One element to include in new patient room design	Space for family and friends	1. Colour, lighting, appearance "clean, fresh, lots of light" 2. Storage 3. Seating/overnight accommodation 4. Display of personal items

1. INFECTION CONTROL
2. EFFICIENCY
3. COMMUNITY
"What do they consider 'breathing'?"

Key issues for Family Zone.

- OVERNIGHT ACCOMMODATION
- COMFORTABLE SEATING FOR LONG PERIODS
- SPACE FOR MORE THAN 1 VISITOR / OVERNIGHT GUEST
- PERSONAL STORAGE
- SURFACE FOR WORKING / EATING

What kind of things?

Appendix J. Example Field Notes Annotated Floor Plan

Appendix K. Example Chi Square Test

5. Artwork Selection – same as above

Category	Observed Frequency	Expected Frequency	Expected Proportion	Residual Deviation	Residual Squared	Sum
A	6	5.8	.20	+1.65%	+0.06	Sums:
B	3	5.8	.20	-6.26%	-1.16	
C	11	5.8	.20	+9.66%	+2.16	Observed Frequencies:
D	5	5.8	.20	-12.75%	-0.33	
E	4	5.8	.20	-11.63%	-0.75	29
F						Expected Frequencies:
G						
H						29
						Expected Proportions:
						1.0

[Note that for $df=1$, the calculated value of chi-square is corrected for continuity.] [For $df=1$, this is the uncorrected value of chi-square.]

chi-square = 6.69
 df = 4
 P = 0.1532 [P is non-directional]

6. Colour / Décor – vast majority thought this was at least somewhat important (20). throughout participants mention wanting to have a more homey feel, vibrant colours, brightness, less clinical, etc. this is one of their most important issues.

Category	Observed Frequency	Expected Frequency	Expected Proportion	Residual Deviation	Residual Squared	Sum
A	4	5.8	.20	-11.63%	-0.75	Sums:
B	1	5.8	.20	-82.76%	-1.99	
C	5	5.8	.20	-12.75%	-0.33	Observed Frequencies:
D	10	5.8	.20	+72.41%	+1.74	
E	9	5.8	.20	+55.17%	+1.33	29
F						Expected Frequencies:
G						
H						29
						Expected Proportions:
						1.0

[Note that for $df=1$, the calculated value of chi-square is corrected for continuity.] [For $df=1$, this is the uncorrected value of chi-square.]

chi-square = 9.43
 df = 4
 P = 0.0508 [P is non-directional]

Significant:

1. Room Lighting – being able to control the lighting one of the most overwhelming issues. only 1 participant was either neutral or didn't care about this issue. control of the lighting and being able to have natural lighting is clearly a huge issue.

Category	Observed Frequency	Expected Frequency	Expected Proportion	Residual Deviation	Residual Squared	Sum
A	0	5.8	.20	-100%	-2.41	Sums:
B	4	5.8	.20	-31.63%	-0.75	
C	1	5.8	.20	-82.76%	-1.99	Observed Frequencies:
D	13	5.8	.20	+124.14%	+2.99	
E	11	5.8	.20	+89.66%	+2.16	29
F						Expected Frequencies:
G						
H						29
						Expected Proportions:
						1.0

[Note that for $df=1$, the calculated value of chi-square is corrected for continuity.] [For $df=1$, this is the uncorrected value of chi-square.]

chi-square = 23.93
 df = 4
 P = <.0001 [P is non-directional]

Appendix L. Example Frequency Table

		NEEDS_DISPLAY			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY UNSATISFIED	2	8.7	8.7	8.7
	UNSATISFIED	5	21.7	21.7	30.4
	NEUTRAL	7	30.4	30.4	60.9
	SATISFIED	9	39.1	39.1	100.0
	Total	23	100.0	100.0	

		NEEDS_SLEEPING			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY UNSATISFIED	2	8.7	8.7	8.7
	UNSATISFIED	2	8.7	8.7	17.4
	NEUTRAL	9	39.1	39.1	56.5
	SATISFIED	9	39.1	39.1	95.7
	VERY SATISFIED	1	4.3	4.3	100.0
Total		23	100.0	100.0	

		NEEDS_LIGHTING			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY UNSATISFIED	3	13.0	13.0	13.0
	UNSATISFIED	6	26.1	26.1	39.1
	NEUTRAL	9	39.1	39.1	78.3
	SATISFIED	4	17.4	17.4	95.7
	VERY SATISFIED	1	4.3	4.3	100.0
Total		23	100.0	100.0	

		NEEDS_TV			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY UNSATISFIED	4	17.4	17.4	17.4
	UNSATISFIED	7	30.4	30.4	47.8
	NEUTRAL	6	26.1	26.1	73.9
	SATISFIED	6	26.1	26.1	100.0
	Total	23	100.0	100.0	

		NEEDS_SEATING_SPACE			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY UNSATISFIED	4	17.4	17.4	17.4
	UNSATISFIED	8	34.8	34.8	52.2
	NEUTRAL	4	17.4	17.4	69.6
	SATISFIED	7	30.4	30.4	100.0
	Total	23	100.0	100.0	

		NEEDS_WORKING_SPACE			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY UNSATISFIED	5	21.7	21.7	21.7
	UNSATISFIED	9	39.1	39.1	60.9
	NEUTRAL	6	26.1	26.1	87.0
	SATISFIED	3	13.0	13.0	100.0
	Total	23	100.0	100.0	

Appendix M. Precedent Study

Patient Room Precedent Study	Precedent A	Precedent B	Precedent C	Precedent D
Floor Plan
Footwall/ Family Zone
Headwall/ Patient Zone
Project	Patient Room Prototype (2009)	Green Patient Lab Prototype (2009)	Rush University Medical Centre, Chicago (2012)	Jewish General Hospital, Montreal (2014)
Architect/ Designer	Clemson + Carleton University Collaboration	Anshen + Allen	Perkins & Will	Jodoin Lamare Prattte Gross Kaplin Gorilensky Marosi Troy
Key Features	Vertical headwall with concealed gases 'Green' materials Retractable wall Fold-down bed/bench	Vertical headwall concealed gases Terrace/Balcony Separate Family Room Control of room elements: lighting, temp, windows	Built-in bench seating and sleeper sofa White board Visual display Control of room elements: lighting, temp, windows Floating millwork	Integrated headwall/ceiling finish Deep window ledge Acoustic wall panels with graphics Pedestal handwash sink Control of room elements: lighting, temp, windows
Trends	Media footwall Built-in seating Light wood finishes	Media footwall Light woods Large windows Demountable, modular	Wall mounted television Modular wall components	No media on footwall (personal monitor at bed) Built-in seating

	Integrated headwall/ceiling finish Large window/natural light/views	walls	Integrated features/elements Light woods	Light wood finishes Integrated headwall/ceiling finish Large window/natural light/views
Advantages	Reduced visual clutter Separation of handwash sink Family has own 'zone' Good built-in storage	More residential ceiling treatment Use of artwork for positive distraction	Visual stimulation/positive distraction for patient Technology not main feature Reading lamps look residential Integrated bench/storage element-removable cushion	Ample storage on footwall/integrated bench/desk surface White board
Disadvantages	Looks cold and corporate Institutional ceiling Feels too open Too many seams in millwork, soffit Dark sink hard to see if clean family can not view screen bed/bench too low for patient/family eye contact	Too large, especially for a 'sustainable' space-family can't interact with patient Footwall lacks material interest-focus on screen Outlets in headwall too low Staff work area looks clinical/facing patient Floor looks more clinical Family zone too far away to be interactive	Floor, ceiling and headwall look institutional Hard edges at bench Minimal closed storage-may look cluttered Shelves hard to reach/clean Handwash sink too open to family area/clinical looking Colours appear unbalanced	Two-tone wall finishes look clinical Dark floor looks harsh Seams in woodwork
Overall Concept	Modern, Integrated and Retractable features	Evidence-Based Design & LEED	Streamlined and integrated, modern aesthetic	Modern, integrated, colour, pattern

Appendix N. Hospital Tours Observation Summary

Greer Memorial Hospital Greer, South Carolina	Village Hospital, Pelham, South Carolina

<ul style="list-style-type: none"> ▪ Rural setting, low-rise, hospitality theme ▪ generous square footage ▪ Patient-and-family focused care ▪ Dedicated space for families within room ▪ Decentralized nursing stations “perching stations” ▪ “when enough space is in rooms for family—other support spaces (lounges) are not used (Dina Batisto) ▪ Cross-over between family/staff areas (especially for supplies and nourishment)—, “feeling of threat” by nurses ▪ “storage constantly an issue” for nursing staff ▪ “visitors use staff kitchen/supplies that are not locked” ▪ “too much furniture in the patient rooms” ▪ “why is the patient chair on the corridor side of room?” ▪ Is a desk or worksurface needed in the rooms? Who 	<ul style="list-style-type: none"> ▪ High rise, urban setting ▪ Acuity-adaptable room ▪ Patient-and-family focused care ▪ Minimal space for families in room at footwall ▪ Village has central open ‘nursing hub’ ▪ Where to put the phone is always an issue ▪ Minimize furniture in room, reduce clutter, keep clear access, “keep storage minimal” ▪ The nurse has a preference for the guest bed at the window, not at the foot of the bed ▪ They put their ‘stuff’ on the window sill...use it for a ‘nightstand’. ▪ Complaints that the light overhead is in patient’s eyes.

<p>uses it, why and how much?</p> <ul style="list-style-type: none"> ▪ Patients like blinds/controlled visibility to nurses/corridor 	
<p>Headwall</p> <ul style="list-style-type: none"> ▪ Traditional horizontal rail headwall ▪ Custom millwork panels, too many grooves and joints collect dust ▪ Design and look consistent with overall room theme ▪ Medical equipment and visual clutter detracts from overall room aesthetic ▪ Equipment looks 'tacked on' rather than integrated	<ul style="list-style-type: none"> ▪ Prototype 'vertical' custom headwall ▪ Footprint reduces space at footwall for bench/bed ▪ Patients and family "love" the look of the headwall panels, "wow, this is nice" ▪ width is fine, bed can be pulled out to access patient in emergency but too much stuff gets in way ▪ Medical equipment is concealed on sides, need for more and accessible outlets ▪ Need to soften or minimize view of light fixture behind translucent panel
<p>Footwall</p> <ul style="list-style-type: none"> ▪ Large, even too generous area for family, it was too far away from patient for any kind of interaction/observation by family or visitors ▪ Too far from bed/patient for interaction/conversation ▪ Pull out sofa not long enough for tall people, uncomfortable seam in middle 	<ul style="list-style-type: none"> ▪ Flip-out bench /bed for visitors and overnight guest... "the intent of the footwall bench is 'overflow seating' not long-term seating." ▪ Family complain it is too low ▪ Most patients sit and fall asleep in patient chair so they can be next to the patient and see the television. ▪ "Pull-out bench seating/sleeping too low...hard to use, gets in the way of the bed"

- Although it is 'homey', it looks dated
- Difficult to clean
- Large, hard to move
- Desk is facing the wall with person's back to patient
- Built-in cabinetry does not allow for easy upgrades to technology or changes to décor
- Good attempt at integrating art, technology into pleasing focal point
- Ample storage space
- Small refrigerator
- White board was added after, is this the best place for it? Can patients actually read it or is it for family?

- Most family sleep in the recliner chair next to patient
- Sharp edges and corners safety concern
- Too many parts and components
- Flip-out has seam down centre, not comfortable
- Overall footwall lacks visual interest, clock and television look 'stuck on wall'
- The patient room window is used for sitting, putting food, personal items and display, "it is their personal space"
- Family put flowers and cards on the same counter where nurses prepare meds and put down supplies

General Observations and Insights

Staff in both facilities want to minimize the amount of furniture and storage components in the patient room, however appropriate storage can help reduce the visual and physical clutter within the space

Staff at both facilities note that patients/family complain of the visual clutter in room. Clutter is a result of too many and ill-fitting room elements but also the accumulation of garbage and personal items people bring to the space

Conflicting views of where the guest bed should be (at window or footwall). There is an assumption that the

patient chair/lounger is sufficient for overnight guest accommodation.

Common patient/family complaints involve lighting (brightness, location, accessibility) and temperature (location of air grille, control of) and location of telephone.

Not enough access around bed is a problem in code situations, efforts should be made to enhance patient accessibility

Too much space and too much furniture can also be a problem from a cost, maintenance and social perspective.

Should a window ledge be considered an appropriate place to sit, eat and display things?

During an emergency, staff need to move furniture and people out of the way quickly to have full access to patient

A balance between patient, family and staff needs is essential

Safety must be considered at all scales including layout, ergonomics, accessibility, finishes & materials, lighting and design/architectural detailing

Consideration for cleaning, durability and ability for the aesthetic to be easily updated or re-refreshed over time is important