

# Design for Health: A Case for Interdisciplinary Design Collaboration

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**Abstract:** Design for healthcare settings is complex and to address the diverse needs of users and various stakeholders, a more integrated approach to design is needed. This paper will discuss design research into the interdisciplinary design process through a case study of an award winning Patient Room Prototype (PRP). To address the issue of complexity in the design of patient room settings, to enhance the experience of designing for the real world, and to address the problem more holistically from multiple perspectives, an interdisciplinary collaborative approach to research and design using participatory design tactics such as full scale mock-ups and prototyping in addition to participant observation, recorded feedback and interviews were used. Collaboration and input involving graduate and undergraduate students of industrial design and graduate architecture + health students from two universities in two countries, as well as experts from industry, academia and clinical staff resulted in the sharing of ideas, knowledge and feedback through intense work sessions. Insights such as the need for more input from patients and families in the design process, the value of participation and feedback from multiple stakeholders and key lessons learned are discussed.

**Key words:** *Healthcare Design, acute care patient room, interdisciplinary design, collaboration, case study, prototype.*

## 1. Introduction

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 or consumer demand. According to Ulrich et al (2004), these conditions provide a “once-in-a-lifetime” opportunity to improve the quality of the healthcare experience and he argues that “improved physical settings can be an important tool in making hospitals safer, more healing, and better places to work” [17]. One of the most critical issues for design research in healthcare environments today is patient and user satisfaction, expectation and demand [7].

Although more attention than ever is being directed to the design of healthcare facilities, there is still much work to be done to humanize the overall healthcare experience for patients and their families as well as for the people who provide the care. As Malkin (2008) points out, “[patient] areas should receive the most thoroughly researched creative design even at the expense of more ‘public’ areas within hospitals [12]. Patient [user] satisfaction is related to the model of care and to the physical, emotional and social support presented through the design of the physical environment [17,18,11]. The patient room can be considered the most important room in the acute care hospital and there has been a focus more recently on how design can improve the overall experience for patients, family and staff. Some influencing factors affecting the reconsideration of the 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 family in the care process [12,11,18,1,19]. These interrelated factors contribute to the complexity of patient room design and the various stakeholders responsible for the design of healthcare facilities have very different perspectives of

the issues, priorities and user needs, thus warranting a more integrated, user-centred and interdisciplinary design approach.

This paper presents one part of a two part design research thesis that explored the unique needs of patients and their partners in care in an acute care patient room and will focus more specifically on *how* these unique needs can be better integrated into the design of a patient room prototype. The following sections will outline the issues, opportunities and need for interdisciplinary design collaboration in the patient room context based on a unique case study of a patient room prototype project, part of an ongoing iterative design-research process between two universities. Presented as an example of successful interdisciplinary design collaboration, the observed benefits, challenges and lessons learned related to interdisciplinary collaboration and participatory design-research strategies will be discussed.

## **2. Design for Health**

### **2.1 Patient-centred design and design thinking**

Patient-centred design is a fairly recent concept that evolved from the movement toward patient-centred care in healthcare as a response to addressing consumer needs from the patient perspective rather than the medical-centred approach [15]. Similar to the concept of human-centred design, universal design and inclusive design, a common goal of human-centred design is to design for all users to function at their highest capacity. However, function is only one principle that must be addressed in such a complex setting. In a hospital setting, design can have multiple implications for effective functioning for staff, patients and their partners in care where the concept of human-centred design aligns with the need to understand the impact of the designed environment on a person's level of functioning and well-being. While the focus of patient-centred design is on the patient, it also involves many different stakeholders, each with specific and sometimes overlapping and conflicting requirements [1].

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 [4]. It is possible to see healthcare design problems as Buchanan explains based on Rittel's definition, that they are “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” [6]. In the patient room setting, where the health and welfare of the occupants should be paramount, there are a myriad of factors that can impact the health and well-being of the persons who would be part of the overall experience and it is safe to say that many are indirectly or directly related to the design of the physical space or objects within the space.

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 that are needed to address healthcare design problems [4]. Patient-centred design is a complex process where the designer must constantly navigate their focus between the micro and macro issues related to the healthcare setting [15]. Seeing the problem from all points of view and holistically requires taking a broad “systems approach”, being able to frame the problem in a distinctive way and to design from first principles [8]. To “get beneath the surface” of some of the most pressing problems, human-centred activities associated with design thinking can have a big impact. Some of the personality traits critical for “design thinkers” are empathy, integrative thinking, optimism, experimentalism and the ability to collaborate among and across disciplines [4].

### 3. Interdisciplinary Design and Collaboration

#### 3.1 Healthcare and the value of interdisciplinary design collaboration

The need for sharing and collective problem solving is especially salient for healthcare design projects. Verderber (2010) in *Innovations in Hospital Architecture* notes that *interdisciplinism* will promote a necessary attitude of openness and sharing, further suggesting the inevitability of the blurring of current disciplinary boundaries between architecture, interior design, industrial design, landscape architecture, ecology and other allied design disciplines with the medical and social sciences[19]. An interdisciplinary and human-centered approach to design can help various team members synthesize their collective knowledge into a cohesive solution that meets the needs of various stakeholder groups. The word interdisciplinary has different meanings across different sectors and in different contexts. For this paper, the word *interdisciplinary* will be generally defined as the collaboration between two or more disciplines toward a common goal. The main distinction between interdisciplinary and multidisciplinary in this case being that collaboration on activities is shared between two disciplines [or more] rather than just the sharing of perspectives [14]. Collaboration according to the *Oxford English Dictionary*, is defined as “*working with others in a ‘cooperative or unified’ way*”. Collaboration can happen in many ways and many capacities such as through virtual spaces which adds to the complexity of these formed relationships. Although there is much interest in collaboration for the purpose of innovation or knowledge making, there are both benefits and challenges [10,8]. For example, many challenges of working in teams revolve around methods of communication, roles, relationships and social interactions among team members [8]. Garvey (2009) suggests that successful design between academic and external organizations need to be mediated in order to balance the expectations that arise due to different understandings of the connection between research and practice or more often between the expectations of an educational environment and the world of practice. In terms of the value of interdisciplinary collaborations such as the one discussed in this paper, some of the common values for the student, external organizations and academic institutions include:

Table 1. Value Exchanges in Design Collaboration in Design Education (adapted from Garvey (2009) *Looking for the Real World: Balancing Expectation and Inspiration in Design Collaborations.*)

Participant	Outcomes	Unique Characteristics
Student	<ul style="list-style-type: none"><li>• Experience of working in realistic work scenarios</li><li>• Potential for job opportunities</li><li>• Increase in credibility</li><li>• Better able to express unique ideas</li></ul>	<ul style="list-style-type: none"><li>• Graduates and undergraduates working side by side</li><li>• Overlap of domain knowledge</li><li>• Insight obtained through site tours, focus groups and knowledge exchange sessions</li><li>• Experience of physical and virtual collaboration</li><li>• Access to new experiences, technologies, resources and methods</li><li>• Sharing of financial resources to expand production</li><li>• Sharing of spaces and facilities to fully realize the potential of project ideas</li></ul>
External Organization	<ul style="list-style-type: none"><li>• Access to fresh ideas</li><li>• Exposure to top students</li><li>• Access to research &amp; development without overhead/commitment</li><li>• Graduates with relevant experience</li></ul>	
Academic Institution	<ul style="list-style-type: none"><li>• Opportunities to promote students</li><li>• Gaining industry insight</li><li>• Opportunities for public relations</li><li>• Potential for research agreements to support further collaborations</li></ul>	

## 4. Case Study

### 4.1 Patient Room Prototype Project

The Patient Room Prototype (PRP) project is an ongoing interdisciplinary design collaboration that joins teams from two different universities, different disciplinary and program levels to research, design and test an inpatient room prototype. The end goal is in part to extend the work of the previous PRP iterations in promoting safety, efficiency and satisfaction for all users in the patient room of the future. Four separate cycles of research/design/fabrication/evaluation culminated in prototypes built in 2003, 2006, 2007 and 2009 which informed the 2012 prototype design described in this paper. The project requirements have not changed drastically over each iteration; however the requirements are reframed with each new team based on the current healthcare context and the insights gained from each cycle of design, fabrication, evaluation and redesign, see Figure 1. Patient Room Prototype project iterative cycles.

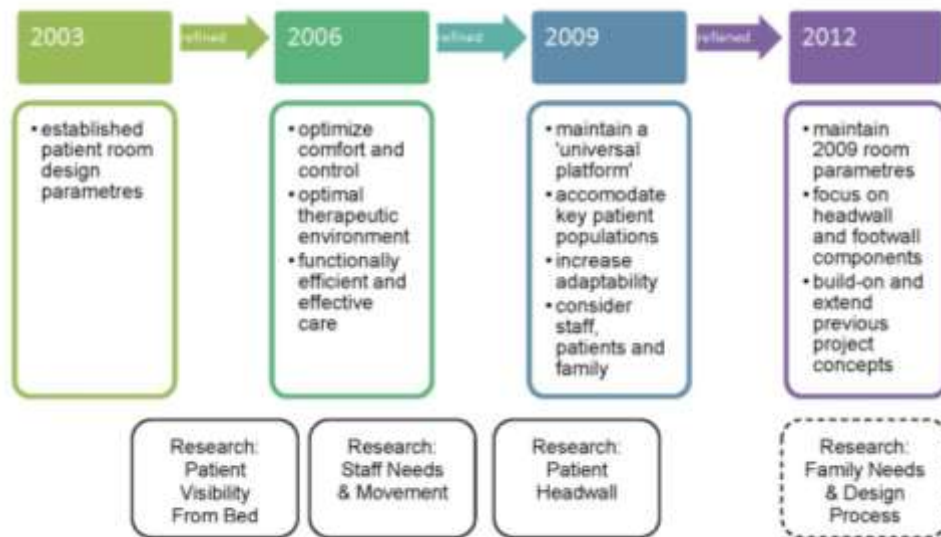


Figure 1. Patient Room Prototype project iterative cycles.

In January 2012, a new cycle of the Patient Room Prototype, PRP (v2012) involving a collaborative team of undergraduate and graduate students from the school of industrial design Carleton University (Canada) and graduates from the architecture and health program at Clemson University (United States) joined up for the first time through virtual communication. The academic team consisted of two 4<sup>th</sup> year undergraduate industrial design students, one master of design student/ interior designer and eight graduate architecture students each headed by a faculty professor/advisor, see Figure .

The goals and objectives of the v2012 cycle were to work within the project site known as the “black box room” in the Clinical Simulation Training Lab (CLRC) in the school of nursing, Clemson University. This location allowed access to nursing faculty, students and a range of inpatient care clinical equipment and the prototype room is used for teaching of nursing students when not undergoing redesign, fabrication or research. The main objective of this project cycle was to work with the basic prototype room footprint developed in earlier cycles and to focus on two key elements/zones of the patient room: the headwall (patient/staff zone) and the footwall (patient/family zone). More specifically, an overarching goal of the project was 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 of the project.

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

- Collaboration across disciplines, institutions and countries
- Re-design and build several new elements of an existing prototype room
- Strive for design solutions that go beyond the boundary of function and convention
- Explore and incorporate best practice and evidence-based design strategies with new alternatives and innovations
- Demonstrate how interdisciplinary design can raise the quality of design in a healthcare context
- Address the concepts of efficiency and effectiveness in a comprehensive way with a focus on improving the quality of experience for patients, their families and caregivers

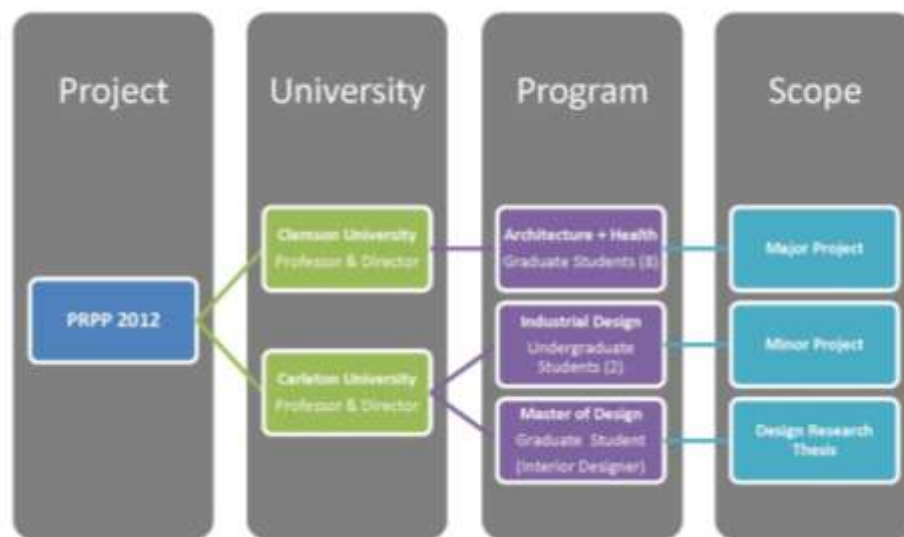


Figure 2. PRP v2012 project team organization

## 4.2 Design research study

This project iteration became the basis for a design research study by the master of design student from Carleton University as a means to explore the interdisciplinary design process in the context of the design of a better patient room. With a particular focus on improving the experience for patients and family within the patient room setting, the author first explored *what* elements of an acute care patient room former patients and family perceived to impact their overall experience. Through the use of an on-line survey questionnaire and focused interviews, these findings were analyzed and put forth as design criteria to further enhance the design of the patient room prototype. The second part of the design research focus was on *how* the findings from the first part of the study might be better incorporated into a patient room setting, shifting the focus on the interdisciplinary design collaboration process. The research design involved four stages that aligned with the time frame and course schedule of the PRP v2012 project during the winter term. The researcher assumed multiple roles through the duration of the project including participant/observer, interviewer and at times consultant. The representative case allowed for the study of a unique ongoing interdisciplinary design collaboration that has led to award winning

design strategies for patient rooms as well as insight into the challenges of implementing such a process across distance and with diverse backgrounds/skill sets. Building a common knowledge set from previous cycles based on shared knowledge and experience is a main goal of the PRP research project. Some of the key measures of success include

- build on knowledge accumulation from previous cycles while incorporating the collective bias, knowledge and experience of new team members
- work with a set of shared values and language forming a common benchmark to build from
- strive for a balance between the larger body of knowledge and experience of real context

### 4.3 Interdisciplinary collaborative design process

Over the course of a semester, the teams worked across interdisciplinary borders, geographical distance and through ongoing collaboration with external experts and stakeholders to develop innovative concepts for the headwall and footwall element of the patient room prototype. Figure 3. Interdisciplinary collaborative design process diagram demonstrates the collaborative and participatory phases of the project as a series of six 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 at each critical stage. In addition to traditional design research and design tactics, the PRPv2012 project involved multiple virtual and participatory sessions which included

- interdisciplinary precedent studies
- collaborative review and feedback sessions
- design charettes at each university campus
- tours of hospitals and previous PRP prototypes
- overnight experiential observations at hospitals
- multi-stakeholder focus group meetings
- collaborative work sessions with industry experts and clinical staff
- hands-on, full-scale mockup and prototyping

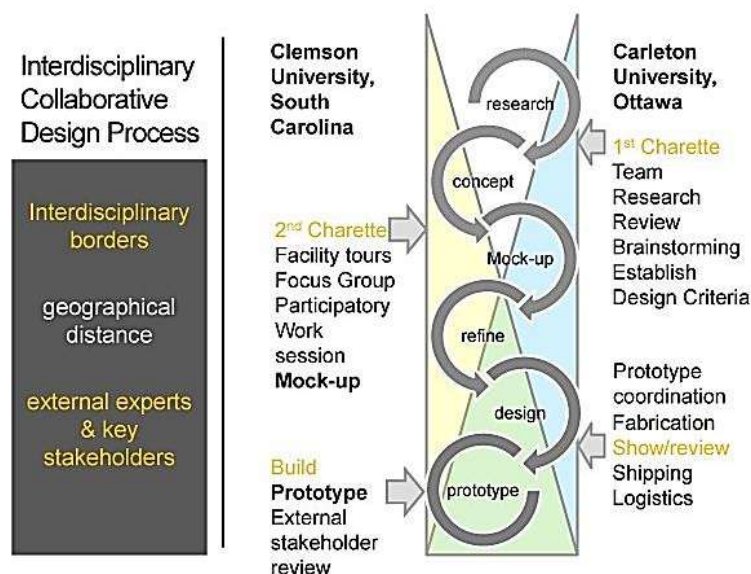


Figure 3. Interdisciplinary collaborative design process diagram

As indicated in the diagram, the six design process stages (research, concept, mock-up, refine, design, prototype) were essentially balanced between virtual meetings and reviews as well as on-site collaboration and participatory sessions hosted by each university. The underlying coloured triangles (yellow on left) and (blue on right) represent the individual project teams or the underlying design collaborative framework. The central triangle (green) demonstrates the coming together of the two sides to form a cohesive vision (represented by mixing blue and yellow resulting in a new colour). In this case, interdisciplinary team generated input, best practices and lessons learned were synthesized into full-scale mock-ups and further refined prototypes of the elements within the patient room prototype. The final outcome represents the collective vision of the teams, vetted by external stakeholders which resulted in a unique hybrid approach to the headwall and footwall elements of a patient room.

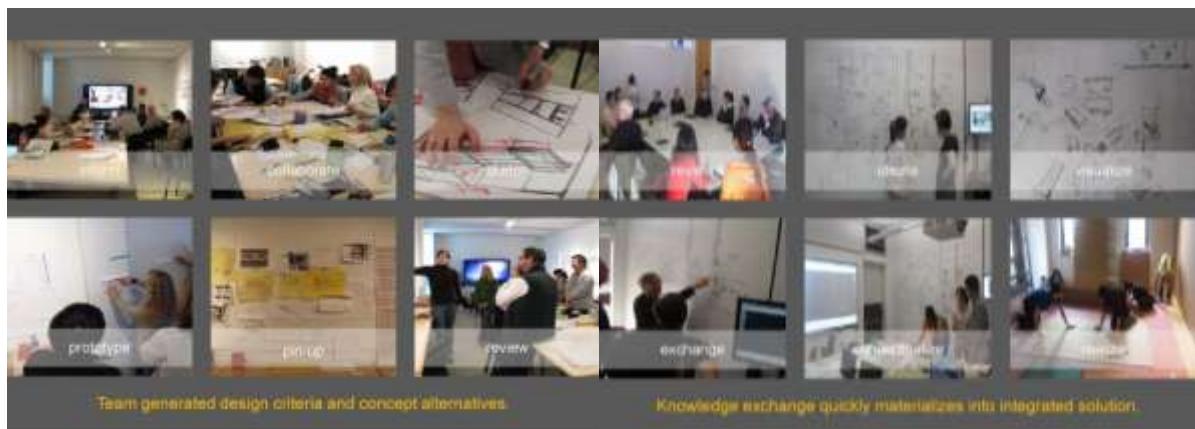


Figure 4. Research and concept development



Figure 5. Focus group, participatory session and full-scale mock up

## 5. Findings and Discussion

The final outcome of the 2012 patient room prototype was positive overall. The final review of the prototype with multiple stakeholders from academia, practice, industry and clinical staff revealed the challenges and success of the final prototype as well as the interdisciplinary design process in general. The following themes emerged:

- Refinement as progress
- Accommodate rather than integrate



- Push to the point of failure
- Value of interdisciplinary design
- Keeping the user at the centre

With each new iteration there has been the generation of “new knowledge” and “lost knowledge” or what Allison refers to as a “dynamic dance”, some steps forward and some steps back. This measure of success is based on the degree to which parts of the prototype get resolved or unresolved [Allison, personal communication, April, 2012]. However, this iteration was noted to be more advanced than others in terms of refinement of the concept. A more “finished” prototype room revealed the interdisciplinary goal of the project to achieve a more integrated solution, not only in terms of aesthetics, but also in the seamless integration of a “kit of parts”. See Figure 6. PRPv2012 final prototype



Figure 6. PRPv2012 final prototype

The PRPv2012 allowed for ideas and innovations to be pushed to the point of failure. While there was success in refinement of some elements, many issues were not resolved or failed to meet the scrutiny of the panel. Some of the challenges for the teams revolved around logistics of “putting it all together”. This included exchange of drawings and critical dimensions to ensure proper integration of components, coordination of components developed and constructed at different sites/locations, knowledge of building materials and construction methods and overall coordination and logistics of transporting components to the final prototype site. Still, these challenges were seen as a positive outcome of the design process as well as the learning process in that these projects are required to further test and realize the possibilities within the constraints given to each new team.

In terms of the overall value of this case for the healthcare industry as a whole, there was a very positive response to the on-going effort to link the disciplines in a form of research and development for interdisciplinary



collaboration. However, there was a concern to further this interdisciplinary aspect to stretch beyond the boundaries of design disciplines to industry for support in sharing of research, resources and funding. Some of limitations that impacted the overall outcome of the design involved earlier innovative concepts being discarded as a result of the availability of actual or appropriate materials or knowledge from outside sources, often of a proprietary nature.

Finally, it was observed that the final outcome reflected the goals of control and comfort for patients and family and that the users were at the heart of the prototype design. This could be contributed in part to the focus on user-centred design research strategies and participatory design methods incorporated throughout the design process. An immersive and hands-on approach to realizing concepts in real-context, full scale gave all involved the “big kinetic picture” [3] allowing each participant to explore and test their ideas and get real time feedback. Human factors in relation to spatial qualities were quickly observed and students felt an overall sense of realization and accomplishment. One key challenge in testing the collaborative concepts involved the professional or clinical staff acting as proxy for patients and family in most cases, leaving questions that might only be resolved by the feedback of actual patients or family during the design process. Another improvement to the process would see the inclusion of all stakeholders participating throughout all of the stages.

## **5.1 Insights and lessons learned**

The patient room prototype project process offers some key lessons that may be applicable to other interdisciplinary design research and development projects. The following is a summary of some of the insights and lessons learned:

The patient room became “real” for the design teams with the development of the first mock-up. Design concepts based on traditional design and research methods offer only part of the picture and to fully appreciate the design problem, a more systematic vision of the full context is required. With the full-scale, 3-dimensional form of the concept realized, much of the discussion between team members and external stakeholders became more focused on the people who would use and experience the space. Mock-ups and prototyping and other participatory design methods help bridge the gap between different perspectives, ways of knowing and doing [1,16,20] of the important values of prototyping methods is that they tend to put the people at the centre of the problem and prevent the tendency to focus on the technology or aesthetic details alone [5]. In addition to providing a more human-centred focus, students benefit from the value of the experience of working on a realistic scenario and the opportunity to express their unique ideas within a collaborative framework [10].

Coming together sessions were extremely important not only in terms of sharing experience and 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, and image collage were used to communicate ideas at various stages of the design process. The sharing of information and decision-making was key to the success of this interdisciplinary collaboration. This finding is supported by others who suggest that various input of information combined with visual communication methods can improve overall opportunities for group discussion and decision making [14].

The synergy of working with an interdisciplinary team in both natural (field) and simulated (lab/studio) settings provided 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 prototype had been developed in previous iterations, each new team brings “new eyes” to the same problem. For example, the folding bed conceived in an earlier iteration of the prototype was found to be too heavy and difficult for staff to use and difficult to see family from the patient bed thus preventing the external stakeholders from seeing it as a feasible option. The new team explored ways to make the bed lighter, adjusted the location and more fully integrated it within 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 the external stakeholders that a feasible solution to accommodate family members overnight within the constraints of a patient room was possible.

Design skill or knowledge alone is not enough to address the unique challenges of design for healthcare settings. Personality and a willingness to learn with an open mind were important factors that contributed to both the challenges and success of this interdisciplinary collaboration. It would seem that healthcare projects in particular require design team members to have empathy for all users. Empathy and user-centred approaches to design allow people to “re-frame” their point of view and to see the world through a “new set of eyes”, fostering a people first approach to design problems [13, 5]. Tactics such as overnight stays in a patient room and observing room use scenarios by clinical staff helped to foster a sense of empathy and the designers were able to see how much their decisions can make a difference in the lives of people they are designing for.

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, the effort seemed counterproductive. It was also observed that there was a fine line between group discussion and group interaction. At times, too much talking and discussion stifled the creative energy of teams. There was a determination by students to “get going” or to “stop talking and start doing” on many occasions. Planned breaks and social opportunities were important for participants to have some “down time. These observations reflect some of the findings on team collaboration in that a balance between activities of intense effort and relaxation as well as reflection are needed to stimulate creativity [8].

It was noted that industrial designers are not usual participants in projects of the built environment and that collaborations between architects and interior designers is more common. Input from industrial design was seen as a valuable asset to this collaboration process and to the success of the prototype. The need for design to be addressed at all scales from the earliest stage of the design process is important for integrated solutions. [2]. It became obvious early in the design process that each interdisciplinary team member looked at the issues and design problems in both similar and unique ways from their disciplinary perspectives, as well as from their different experience and skill levels. It is apparent from these observations that collaborations such as the PRP project can help build relationships between various disciplines and help strengthen the collective value of a design’s potential by binding together ideas to help integrate content-component-context linkages within the built environment [2].

One critical component missing from the PRPv2012 process was the direct input/participation from patient and their family members. Students needed to rely on the views of others or their own experience in a hospital setting to make critical design decisions that would impact the key user group. The context of healthcare settings makes access to patients and families difficult for design research [9] and relying on national patient exit surveys or proxy may not provide sufficient user perspective. It might prove revealing to include actual patients and family members as co-participants in the design/research process for the next iteration of the PRP, and explore various design research methods that would help to better understand their unique needs within the context of the patient room setting.

## 6. Conclusions

This case study explored how the interrelatedness of context and process for the design of health supportive patient rooms can be addressed through interdisciplinary collaboration. The findings demonstrate the important value of interdisciplinary design collaboration for all involved, including academic institutions, students, healthcare providers, industry professionals, manufacturers and ultimately the patients and families who will experience these spaces. The observations and lessons learned from the case study indicate that the future of healthcare design and patient rooms in particular should strive to utilize interdisciplinary and participatory design research that allows for improvement and innovation at all scales of the design solution while putting people as the center. Providing a semi-structured, balanced framework with clear objectives can enhance success of interdisciplinary collaborations. Encouraging the use of visual and hands-on participatory methods can help all participants realize the impact of their ideas in relation to the full context of the problem and put the users at the center of the solution. Future design/research projects exploring design in the healthcare context should expand the interdisciplinary collaboration process beyond the design disciplines to include industry partners and should explore new participatory methods that can better reflect the needs of patients and their partners in care.

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