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RESEARCH PAPER

Ambulatory infusion suite: pre- and post-occupancy evaluation

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An evaluation is presented of the experience of patients, families and staff in two infusion suites. One infusion suite was a facility occupied until 2009 and the other suite was the replacement for that facility. The primary design objectives of the new facility were to support social interaction, provide opportunities for privacy and provide visual access to nature. The effectiveness of the new facility relative to the old facility with regard to these three design objectives served as the source of hypotheses for the study. Using a Likert-style survey and open-ended questions, the findings suggest that the new facility was successful at addressing these design goals. Subjects were also queried regarding whether these design objectives were important in an infusion suite. The vast majority of the respondents in the new facility indicated that social interaction, privacy and access nature were important in this setting.

Keywords: cancer facility, facility evaluation, healthcare, infusion suite, post-occupancy, privacy, social interaction

Il est présenté une évaluation de l'expérience vécue par les patients, les familles et les employés dans deux centres de perfusion. L'un des centres de perfusion était un établissement occupé jusqu'en 2009 et l'autre centre était celui qui a remplacé cet établissement. Les principaux objectifs de conception du nouvel établissement étaient de favoriser l'interaction sociale, de fournir des possibilités de vie privée et d'assurer un accès visuel à la nature. L'efficacité du nouvel établissement par rapport à l'ancien du point de vue de ces trois objectifs de conception a servi d'hypothèse pour l'étude. Obtenus en utilisant une enquête basée sur l'échelle de Likert et des questions ouvertes, les résultats suggèrent que le nouvel établissement a réussi à satisfaire à ces objectifs de conception. Il a également été demandé aux sujets de l'étude si ces objectifs de conception avaient de l'importance dans un centre de perfusion. La grande majorité des personnes interrogées dans le nouvel établissement ont indiqué que l'interaction sociale, la vie privée et l'accès à la nature étaient des éléments importants dans ce contexte.

Mots clés: établissement de lutte contre le cancer, évaluation d'établissement, soins de santé, centre de perfusion, occupation, vie privée, interaction sociale

Introduction

This study focuses on an evaluation of infusion suites and the perceptions of staff, patients and families with regard to the importance of specific environmental qualities of these settings. Infusion suites are of particular interest to environmental psychologists as the patients receiving infusion treatments may be highly stressed and therefore particularly sensitive to the environment; a diagnosis of cancer is emotionally challenging to patients as well as for their families

(University of New South Wales, 2009). Additionally, infusion patients may spend up to six hours in treatment (Cancer Treatment Centers of America, 2011) surrounded by and looking out on a specific environment.

According to the Environmental Press Theory (Lawton and Nahemow, 1973), in order to achieve a balanced state the physical environment must increase its supportiveness in correspondence to the needs of people

who are experiencing physical and emotional challenges. Designers who have embraced this theory promote environments with strong way-finding amenities, *i.e.* views outside and landmarks (*e.g.* Calkins, 1987) and positive distraction components, *i.e.* nature, art, music and social interaction (*e.g.* Shepley, 2006), to support building users whose coping skills are depleted by their difficult health status.

The opportunity to study the impact of the infusion environment on the patient experience presented itself in 2009 when an architecture firm specializing in evidence-based healthcare design was asked to design a replacement cancer facility. Three main design objectives were documented and promoted in the new facility and served as the focus of the study. The objectives were to provide design configurations and amenities that would increase: opportunities for social interaction between patients and families and between patients; opportunities for privacy; and access to nature and daylight for staff and patients. Existing research and theory suggested the reasonableness of these three design objectives:

- *Social interaction*

Increasing opportunities for social interaction is a means of providing positive distraction and emotional support for individuals who are stressed (Ulrich, 1991/1995). Research on patient preferences indicates a strong desire for the presence of family members in outpatient healthcare settings (Martinez Moreno *et al.*, 2012; Penn, 1992), and the presence of families during medical procedures has been associated with improved patient experience (Bordeaux *et al.*, 2002; Shapira, 1996).

- *Privacy*

Choice and control are two of the major tenets of environmental psychology. Privacy has been defined as the ability to control access to oneself and information about oneself (Moore, 1998). Research indicates that privacy is a factor that should be considered in patient-centred care in cancer facilities (McCormack *et al.*, 2011). Because infusion is a primary means of treating cancer, options for privacy should be addressed in infusion procedure settings.

- *Access to nature and daylight*

The biophilia hypothesis posits that evolution has predisposed humans towards an interaction with nature (Wilson, 1984). A potential benefit of this genetic predisposition in healthcare settings is the potential for nature to have an effect on pain control through distraction. This is an extension of Melzack and Wall's (1965) gate control theory, which proposes that pain can be reduced by the simultaneous conflicting stimulation generated by touch. Multiple studies provide evidence

that access to nature is desirable and beneficial to patients, family and staff (*e.g.* Diette *et al.*, 2003; Kline, 2009; Park *et al.*, 2004; Raanaas *et al.*, 2011; Rodiek and Fried, 2004). Researchers have observed that viewing nature settings for as little as 20 seconds results in psychological and physiological restoration (Kellert *et al.*, 2008). Windows with views of walls or barren rooftops have a less positive effect or even negative effects (Ulrich, 1999). Regardless of the view, full-spectrum light from fenestrations will positively affect circadian rhythms, mood and vitamin D metabolism (Joseph, 2006). The evidence is summed up by Clancy (2008):

although there is much to learn in this area, it is clear that patients are well served by windows for gaining access to natural light and by the ability to control glare and temperature, and that providers are well served by sufficient illumination when performing complex visual tasks.

(p. 67)

The architects for the new infusion suite recognized the importance of evaluating the effectiveness of the new design relative to these three principles, and embarked on the implementation of a practitioner-focused facility evaluation (PFE) (Shepley, 2010). Little research has been conducted on the design of cancer facilities and, more particularly, infusion suites. Only one study was found on this topic. Wessels *et al.* (2010) noted that the combination of three oncology units into one unit, which provided more options for privacy, positively influenced patient satisfaction.

The quality of a PFE is enhanced by being able to make either (1) pre- and post-occupancy comparisons, or (2) concurrent comparisons of contrasting components of an existing facility. In this field study, the conditions suggested a pre- and post-occupancy evaluation methodology. Also critical to the success of a PFE is an objective determination of the aspects of the facility that should be evaluated. If the subject of the evaluation is not established by previously determined design objectives, then it has the potential to be prejudiced by hypotheses that reflect the current awareness of successes (Shepley, 2010). Based on objectives determined during programming, the following hypotheses were tested:

Hypothesis 1: Patients, families and staff will perceive the opportunities for social interaction for patients to be higher in the new facility than in the old facility.

Hypothesis 1a: Patients and families will perceive the opportunities for social interaction for patients to be higher in the new facility than in the old facility.

Hypothesis 1b: Staff will perceive the opportunities for social interaction for patients to be higher in the new facility than in the old facility.

Hypothesis 2: Patients, families and staff will perceive patient privacy levels to be higher in the new facility than in the old facility.

Hypothesis 2a: Patients and families will perceive patient privacy levels to be higher in the new facility than in the old facility.

Hypothesis 2b: Staff will perceive patient privacy levels to be higher in the new facility than in the old facility.

Hypothesis 3: Patients, families and staff will perceive the access to nature for patients to be higher in the new facility than in the old facility.

Hypothesis 3a: Patients and families will perceive the access to nature for patients to be higher in the new facility than in the old facility.

Hypothesis 3b: Staff will perceive the access to nature for patients to be higher in the new facility than in the old facility.

Hypothesis 4: Staff will perceive the access to nature for staff to be higher in the new facility than in the old facility.

Methods

Settings

The infusion unit at the original North Shore Cancer Center (NSCC), which served as the baseline for the study, was 3350 ft² (311 m²). The suite was divided into two separate spaces: one internal, the other located along the exterior wall. The internal unit consisted of four open bays, oriented linearly and separated only by curtains (Figure 1). Although the curtains did not provide a great degree of privacy for patients, they did allow patients to interact with one another. The unit located along the exterior wall consisted of two sets of open areas separated by support spaces; one area consisted of six bays and the second area consisted of four bays. Similar to the internal unit, the bays were oriented linearly and separated by curtains. The smaller group of patients did not have immediate access to the exterior windows due to the built spaces between them and the larger group, which had five windows spread over the six bays. Each window was approximately 30 × 90 inches (76 × 228 cm); the view was facing east and looked out on the medical oncology patient parking lot. This facility had limited views of nature (Figure 2).

The infusion unit at the new cancer centre differs greatly from the original unit. This 6470 ft² (601 m²) building replaced the previously existing facility and accommodates 24 infusion bays for chemotherapy, three linear accelerators, 13 examination rooms, a blood laboratory and a pharmacy (Mass General Hospital, 2009). Patients have various choices of treatment spaces: there are five internal private rooms with no natural lighting, one private room along the building exterior with natural lighting, one open two-person bay and four open four-person bays with natural lighting (Figure 3). In the open areas, visual privacy is achieved via curtains. The infusion area is large enough to allow for views, even when the adjacent cubicle is closed. Social interaction is encouraged by orienting the four recliners in a cluster, rather than linearly. Patients can choose to face one another or orient their chairs toward the healing garden, which faces south.

The windows in the typical four-person treatment area are a continuous 6-ft-high strip of windows running the entire length of the bays (approximately 27 ft/8.2 m) (Figure 4). The treatment spaces with access to natural lighting have views either to the landscaped path to the healing garden (Figure 5) or to the healing garden itself (Figure 6).

Procedure

This study was a before and after comparison involving two environments, which differed in environmental features that supported patient interaction, privacy and visual access to nature. The respondents in this study had experience in both environments. One year after relocation to the new space, patients, family and staff were asked to fill out two questionnaires, one addressing the environmental experience in the old infusion suite, the other addressing the environment in the new infusion suite. The two surveys were filled out at the same time.

The pencil-and-paper survey was distributed by nursing administrators to staff, and by nursing staff to patients and family members, while they were in the unit. Subjects were given approximately three weeks to respond, so some filled them out on-site and others took them home.

Tools

The instrument used was a boilerplate PFE tool that allows for customization based on the design goals of each project. The purpose of the PFE is to allow the design firm to make content substitutions for each project, while working within the same survey structure. The PFE form eliminates the need to produce a completely new survey document for each project. This protocol allows a design firm to conduct PFEs on every project.

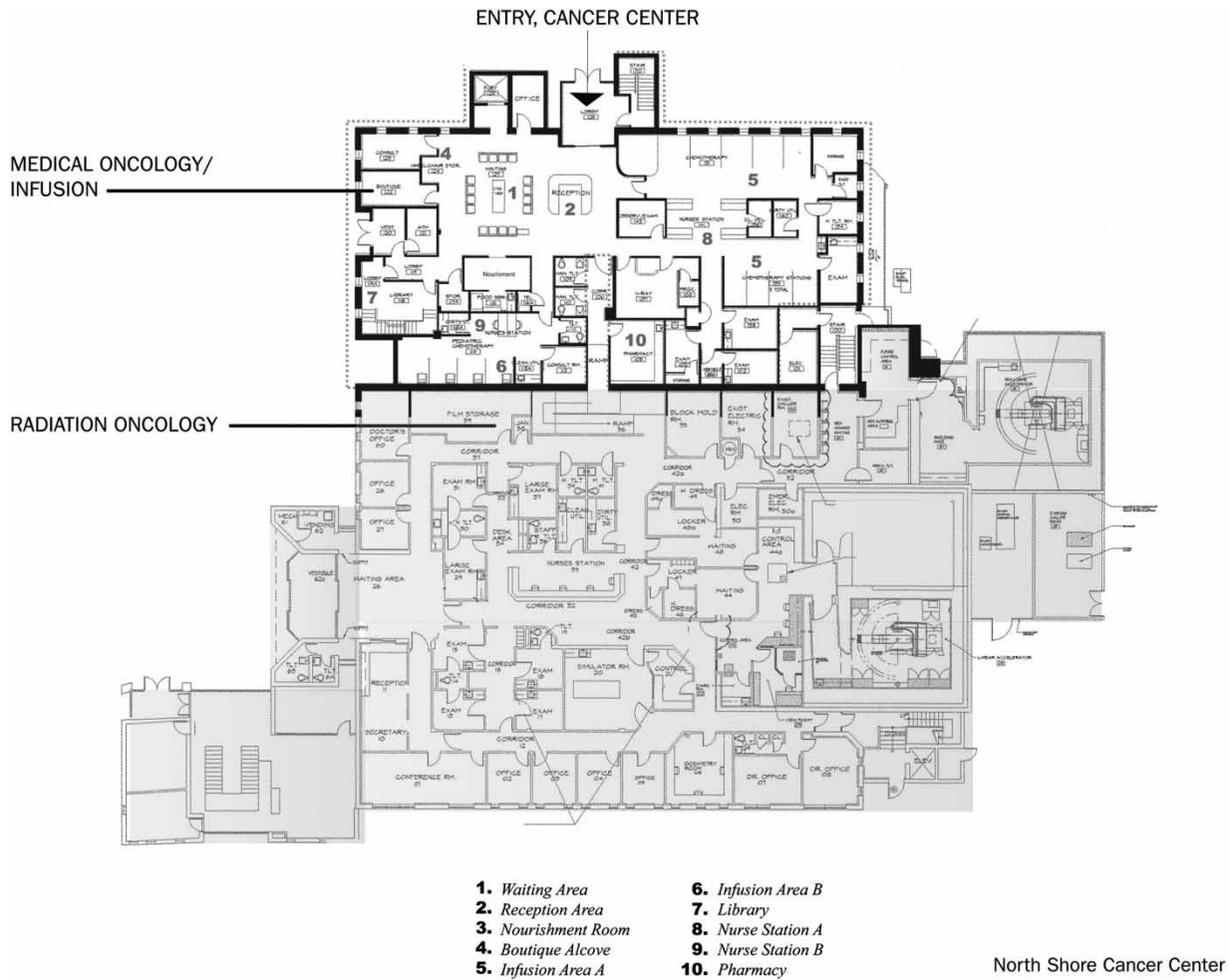


Figure 1 Floor plan of the old infusion suite

The survey contained 20 questions including basic demographic information, Likert-scale questions that addressed the presence and importance of the variables of interest, and open-ended questions. Patients and families replied ‘strongly disagree’, ‘disagree’, ‘neither

agree nor disagree’, ‘somewhat agree’ and ‘strongly agree’ to each of the following Likert-scale statements:

Support of social interaction, privacy and light/nature needs

- the Center provides space for patients to interact with family members and other patients
- the Center provides space that supports patient privacy
- the Center provides natural light and views of nature that support the needs of patients and families

Importance of social integration, privacy and light/nature needs

- it is important to provide space for patients to interact with family members and other patients



Figure 2 Elevation of the old infusion building. The infusion suite is in the wing on the right

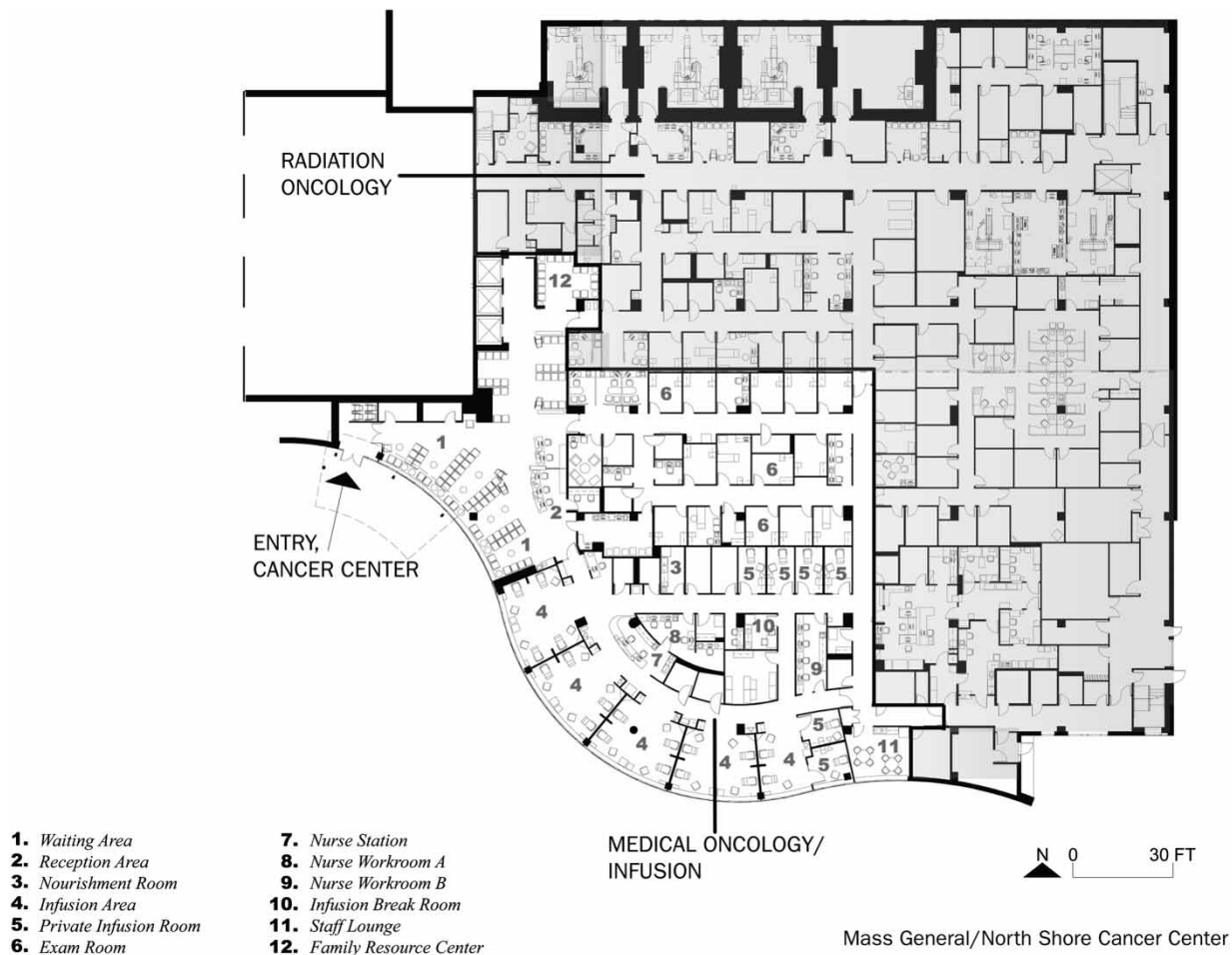


Figure 3 Floor plan of the new infusion suite

- it is important to provide spaces that are designed to support patient privacy
- it is important to provide natural light and views of nature that support patients, family and staff

Additionally they were asked about the effectiveness of specific rooms regarding social interaction, privacy and nature/light. Those rooms included: the waiting area, the reception area, the shared and private infusion rooms, and the overall infusion suite. The open-ended questions addressed the most effective and least effective features of the infusions suite, and an opportunity of any additional comments.

Staff questions included all of the above together with questions about the quality of the environment for staff.

Twelve patients/family members responded regarding the new unit, nine of whom also had experience of the old unit and filled out questionnaires about that facility as well. Ten staff members responded regarding the

new unit, eight of whom also had experience in the old unit and filled out questionnaires about that unit too. There were 22 respondents in all, 17 of whom experienced both units.

This research was granted Institutional Review Board approval for use with human subjects, under the exempt category, by the university of one of the researchers.

Data analysis

There is disagreement among researchers as to whether to process Likert data as ordinal or interval data (Jamieson, 2004). Ordinal data reflect rank order (Jamieson, 2004), while interval data suggest that the distance between each point can be specifically calibrated. The former are non-parametric data, while the latter are parametric data. Given the symmetrical format of the questionnaire, where survey response ratings of 1 and 5 represent extremes and 3 represents a neutral response, the authors felt justified in treating the data



Figure 4 Infusion bay in the new suite



Figure 5 View of the path to the healing garden



Figure 6 Healing garden

as parametric. Even when data are parametric, they must be examined to confirm certain characteristics to allow for particular tests (Smith, 2006) The data were analysed by Q-Q plot and passed for normality.

The research team compared overall ratings for interaction, privacy, and nature for the previous and new facilities and subjected the responses to hypothesis testing using SPSS, via paired samples *t*-tests (two-tailed). The threshold for statistical significance was assumed as $\alpha = 0.05$.

Results

The average age for a staff respondent was 46.1 years; the average age of a patient/family respondent was 63.4 years. Seventy per cent of staff were female, 90% of whom were Caucasian. Fifty per cent of patients/families were male, 91% of whom were Caucasian (one undeclared). The average staff member had worked for approximately 50 months in the old unit and for 20 months in the new unit.

Hypotheses 1, 2 and 3: Combined responses regarding patient experience

Regarding Hypotheses 1–3, the combined populations of patients, families and staff perceived the quality of

the environment for patients to be higher in the new facility relative to the support of social interaction (d.f. = 12; $p = 0.002$), access to nature (d.f. = 12; $p = 0.000$) and the provision of privacy (d.f. = 12; $p = 0.000$).

Hypotheses 1a, 2a and 3a: Patient and family responses regarding patient experience

When reviewing patient and family data independent of staff data, patients and families also perceived the quality of the environment relative to patients to be higher in the new facility with regard to the support of social interaction (d.f. = 4; $p = 0.033$), access to nature (d.f. = 4; $p = 0.019$), and the provision of privacy (d.f. = 4; $p = 0.021$) for patients to be higher in the new facility (Figure 7).

The overall average of the evaluations of specific rooms in the old and new units by patients reflected the same trends as staff (largest difference in perceptions of nature, followed by privacy and interaction); however, the differences were lower. Nature was 3.0 in the old unit and 4.4 in the new unit. Privacy was 3.4 in the old unit and 4.6 in the new unit. Social interaction was rated as 3.8 in the old unit and 4.6 in the new unit (Figure 8).

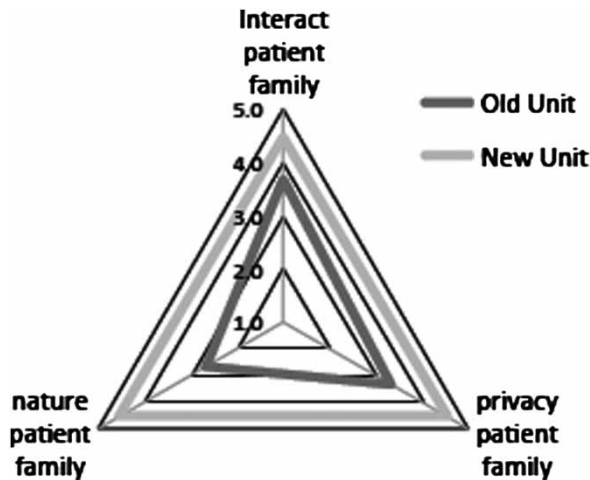


Figure 7 Patient perception of the relative quality of the old versus the new interaction, nature and privacy (nine old unit responses, 12 new unit responses)

Hypotheses 1b, 2b and 3b: Staff responses regarding patient experience

When reviewing staff data independent of patients and families, the results were also found to be statistically significant in favour of the new unit for interaction (d.f. = 7; $p = 0.026$), for nature (d.f. = 7; $p = 0.000$), and for privacy (d.f. = 8; $p = 0.000$) (Figure 9).

The greatest difference in the average of the specific room evaluations of the old and new units by staff was with regard to nature (1.4 versus 4.6). A smaller difference was expressed between the old and new unit regarding privacy (1.5 versus 4.1). A trend toward increased social interaction in the new unit was also found (3.9 versus 4.7) (Figure 10).

In the old unit, staff and patients had comparable evaluations of the quality of social interaction. Staff evaluated the old unit as 3.9 and patients evaluated the old unit as 3.8. There were more dramatic differences in their perspectives on privacy (staff = 1.5,

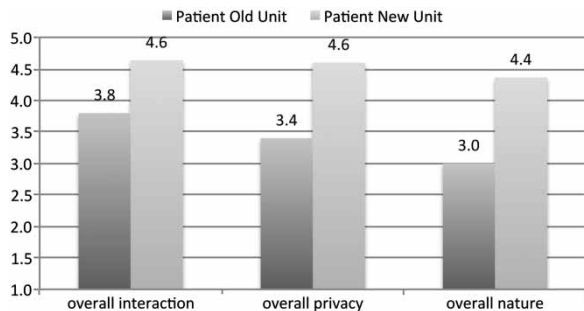


Figure 8 Patient perception of the quality of the old versus the new interaction, privacy, nature (nine old unit responses, 12 new unit responses)

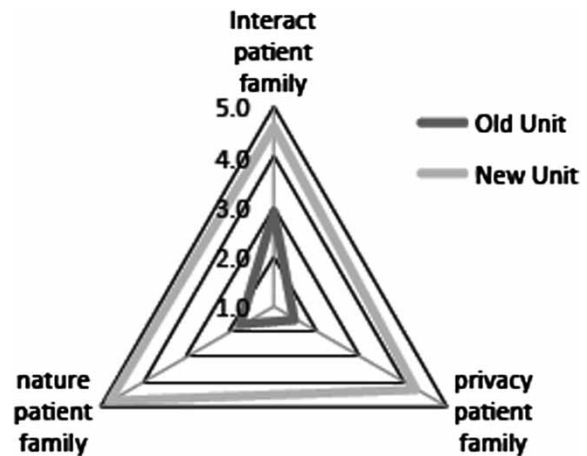


Figure 9 Staff perception of the relative quality of interaction, nature and privacy (eight old unit responses, ten new unit responses)

patients = 3.4), and access to nature (staff = 1.4, patients = 3.0) (Figure 11).

In the new unit, their responses were more similar with regard to interaction, privacy and nature (staff = 4.7, patient = 4.6; staff = 4.1, patient = 4.6; and staff = 4.6, patient = 4.4, respectively) (Figure 12).

Hypothesis 4: Staff responses regarding staff access to nature

Regarding Hypothesis 4, staff were asked to evaluate the experience of staff relative to the perception of the quality of nature. Social interaction between patients and visitors/families, and patient privacy were unrelated to staff needs, so questions on these topics were not included in the survey. Overall, staff perceived access to nature to be significantly higher in the new unit (d.f. = 7 $p = 0.029$). The perception of the equality of access to nature in the old unit was considerably less (2.0) in the old unit than in the new unit (4.5).

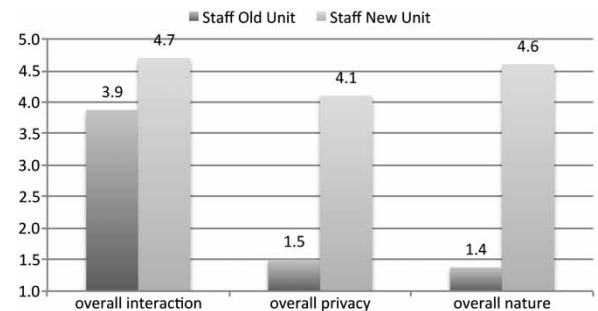


Figure 10 Staff perception of the quality of the old versus the new interaction, privacy, nature (eight old unit responses, ten new unit responses)

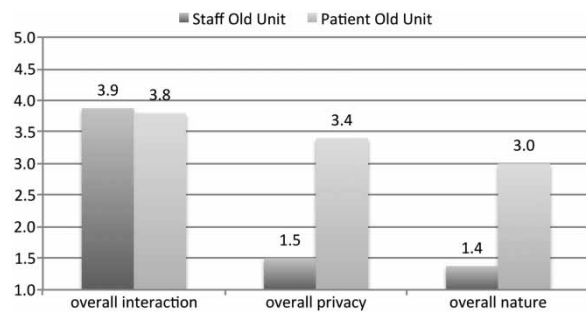


Figure 11 Old unit perception of interaction, privacy and nature; comparison of staff and patients (eight staff responses, nine patient responses)



Figure 12 New unit perception of interaction, privacy and nature; comparison of staff and patients (ten staff responses, 12 patient responses)

Means of evaluations by specific space

In addition to questions about the effectiveness of the environment overall with regard to social interaction, privacy and access to nature, questions were asked about the effectiveness of individual spaces with regard to these three aspects of the design:

- *Social interaction*

For staff in the old unit, the lowest rated space for interaction was the main infusion area (3.2). In the new unit the lowest rated space for interaction was the nourishment area (3.2). The highest rated spaces in the old unit for interaction were the waiting (4.1) and reception areas (4.1). In the new unit, waiting (4.6) and the main infusion area (4.6) were the highest rated. For patients in the old unit, the lowest rated space for interaction were the nourishment area (3.4) and main infusion area (3.4). In the new unit the lowest rated space for interaction is the nourishment area (4.1). Regarding interaction, the highest rated spaces in the old unit were the waiting (4.0) and reception and family resource areas (3.8). In the new unit, private infusion (4.6) and the main infusion, waiting, and reception areas (4.5) were the most highly rated.

- *Privacy*

In the old unit, staff perceived all the spaces, except the family resource room (3.8) as having poor

privacy. The scores ranged from 1.5 to 2.0. In the new unit, privacy was lowest in the waiting (2.7) and nourishment areas (2.7). Privacy was highest in the examination room (5.0) and the private infusion room (5.0). Overall, patients evaluated the privacy levels in the old unit as higher than staff. The highest in the old unit was the private infusion room (4.0); the other spaces ranged from 3.2 to 3.6. Regarding the new unit, the highest privacy was provided in the private infusion room (4.8), and the other rooms ranged from 4.0 to 4.6.

- *Nature*

Staff perceived access to nature as minimal in the old unit. Evaluations ranged from 1.4 to 1.6. Staff perceived some spaces to be very high with their access to nature, including the waiting area (4.5), the reception area (4.5) and the infusion area (4.7). The nourishment area received the lowest rating (1.5). Patient perception of access to nature was higher in the old unit with averages ranging from 2.6 to 3.0. In the new unit, the waiting area (4.5), the reception area (4.5) and the infusion area (4.6) had the highest ratings, while nourishment (3.6), examination (3.6) and family resource (3.7) had the lowest. Staff perception of access to nature for staff was also measured. In the old unit, ratings were very low, ranging from 0.0 (break room and lounge) to 1.6. In the new unit the lowest ratings were for the staff break room (2.1) and the staff workroom b (1.8). The highest ratings were for the nurse station (3.1), greeter station (3.2) and the nurse lounge (4.6).

Importance of social interaction, privacy and nature

While it was demonstrated that the three design goals were achieved in the new unit, this information would not have been useful in the design of infusion suites unless the subjects agreed that these were important objectives. The survey, therefore, asked respondents to evaluate the importance of interaction, privacy and nature.

Related to Hypotheses 1–3, patients, families and staff perceived social interaction, nature and privacy to be important for patients in an infusion suite. There were eight staff and nine patient responses in the old unit, and ten staff and 12 patient responses in the new unit. In response to the Likert scale statement ‘It is important to provide space for patients to interact ...’, in the old unit 93% agreed or agreed strongly. Regarding a similar statement about privacy 93%, agreed or agreed strongly. An identical result was obtained regarding access to nature. When asked about whether these items were important in the new unit 95% thought opportunities for social interaction were important, 95% thought privacy was important,

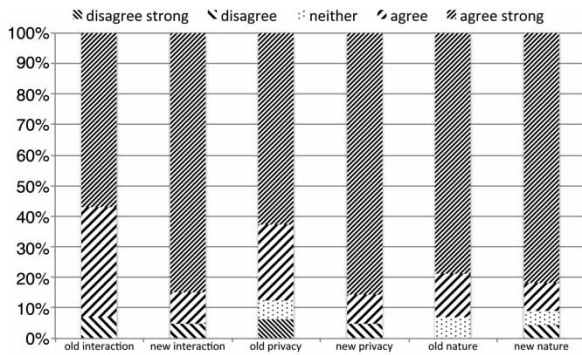


Figure 13 Combined responses of staff and patients regarding the importance of interaction, nature and privacy in the old and the new units (18 staff responses, 21 patient responses)

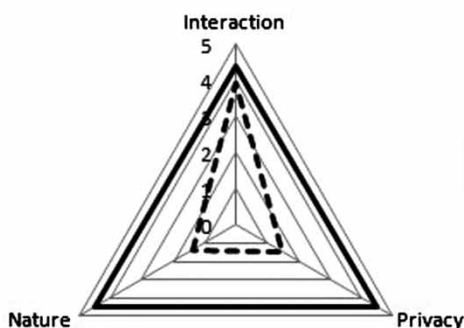
and 91% thought access to nature was important. Related to Hypothesis 4, staff perceived access to nature to be important for staff in the old unit (88%), as well as in the new unit (100%). Figure 13 provides a summary of the combined responses of staff and patients regarding importance of interaction, nature, and privacy in the old and new units.

Relationship between perceived quality and importance

The results also indicated that for staff in the old unit there was a misalignment between what was considered to be important to patients and families, and the quality of what was considered to have been provided. Alignment between importance and perceived quality was less dramatic for the patient population. In the new unit these differences resolved themselves (Figures 14 and 15).

	Quality	Importance
Interaction	3.9	4.4
Privacy	1.5	4.5
Nature	1.4	4.5

Old Unit



	Quality	Importance
Interaction	4.7	4.9
Privacy	4.1	5
Nature	4.6	4.7

New Unit

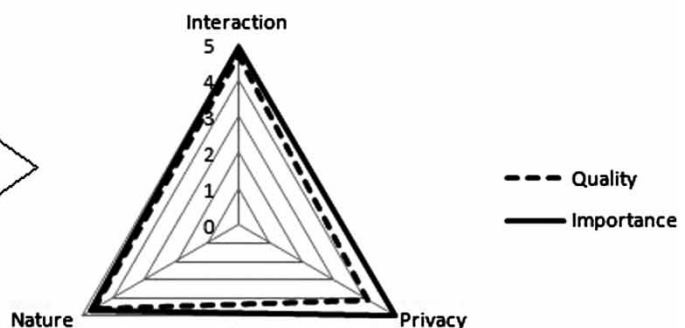


Figure 14 Relationship between perceived quality and importance as perceived by staff

Open-ended comments

The survey also included open-ended questions asking respondents to comment on what they liked best and least about the new and old infusion suites. Subjects were given the opportunity to address any other issues that came to mind, although they consistently used that question to share additional thoughts about the benefits and shortcomings of the two facilities.

Regarding what was liked most about the old unit, patients and families were limited in their responses. Apart from the fish tank in the lobby, their supportive comments focused on the high quality of the staff rather than the physical environment. Staff mentioned the waiting area, the café, the visibility from the nurses’ station (twice), the nearness of the pharmacy, and the homey/cosiness of the facility (four times).

Concerning the negative aspects of the old unit, patients and families mentioned that the suite was old, not cheery, and that the rooms were dark and crowded. They commented on the lack of privacy and the institutional way in which patients lined up in a long row for infusions. Staff commented negatively on the cramped/crowded (mentioned three times) poor work environment that lacked space for families. They noted the absence of privacy for both staff and patients, the overall old and dirty appearance, and the high traffic level.

Regarding what was most appreciated in the physical environment of the new unit, patients and families mentioned the availability of privacy (mentioned three times), the beautiful grounds and other distractions. Brightness and windows/views were commented

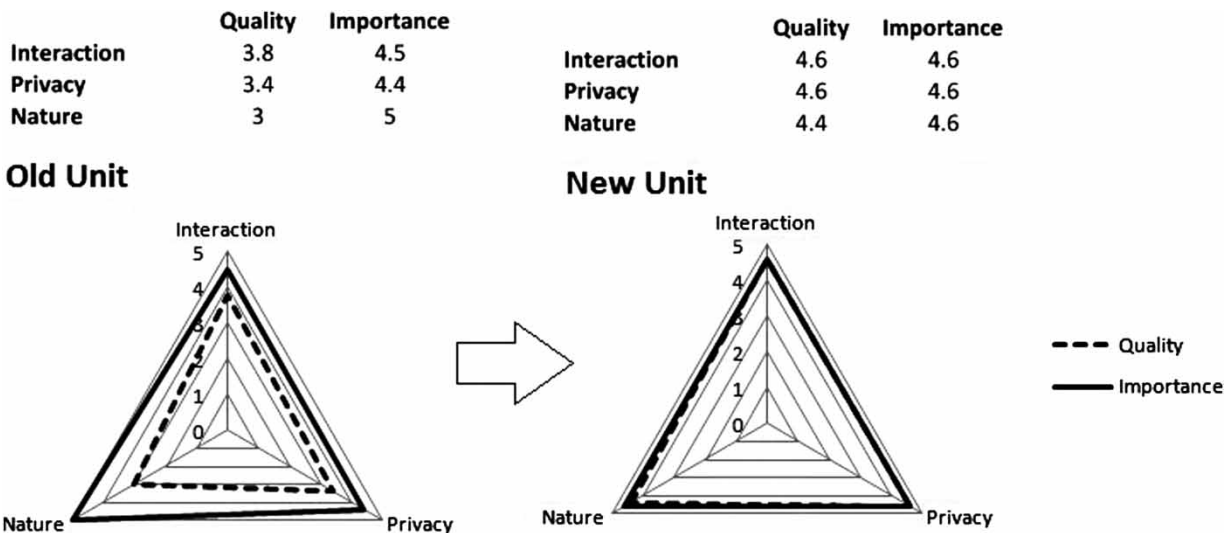


Figure 15 Relationship between perceived quality and importance as perceived by patients

on four times. Other positive adjectives included large, open, pleasant, clean, general quality, warm, organized, and pleasant atmosphere. As in the old unit, even though respondents were asked to comment on the physical environment, excellent staff and friendly atmosphere were mentioned four times. Staff commented on brightness and windows/view (mentioned 11 times). Open/spacious was commented upon six times and cleanliness three times. Also appreciated were the flow, the newness, the curved hall, the shape of the bays and the television.

Regarding elements patients and families disliked about the infusion suite, they mentioned the tight parking spaces (outside the scope of the study), poor acoustical control provided by curtains, and a negative impression of the infusion area. Shortcomings identified by staff included lack of warmth/home-like characteristics (mentioned twice), limited privacy in the lobby, and limited private spaces to meet with large families or groups. Some spaces were perceived as too small (nutrition, break room, kitchen and some private infusion rooms). Also noted was the absence of lockers in the break room, inconveniently located outlets, poor temperature control, distant from co-workers, incorrect labelling of the chairs and lack of a place to hang coats.

Discussion and conclusions

This PFE addressed the effectiveness of a new infusion suite relative to its predecessor in the context of support of social interaction, provision of privacy and access to nature. Support was provided for all ten of the hypotheses, indicating that the new facility was more effective with regard to these dimensions. The study supported the theories and findings of previous researchers with regard to the importance of

social interaction (Clark, 1993), privacy (Bäck and Wikblad, 1998), and nature (Cooper Marcus and Barnes, 1995) in healthcare settings and extended these conclusions to infusion suite settings.

This study also provided support for the concept that patients, families and staff consider opportunities for social interaction, privacy and visual access to nature to be important in infusion suites. Although patients could not officially reserve space in the infusion suite (with the exception of a medical necessity), patients sometimes requested a location – and the staff did try to honour the request, depending on the schedule for the day. Many patients preferred to sit by the window. Friends and family accompanied more than 50% of patients.

An interesting finding was the lack of complete alignment between staff evaluation as opposed to patient evaluation of the importance and perceived quality of interaction, privacy and access to nature in the old unit. In general, the patients perceived the old environment to be of higher quality. This is likely a result of (1) the longer periods of time that staff spend in the space and (2) the tendency of patients to be more influenced by the contributions of the caregivers than the physical environment itself.

Additionally, the open-ended comments corroborated the findings of the Likert-scale questions. One exception was with regard to support of privacy. Three staff members listed privacy as a shortcoming in the new facility, although their responses to the Likert questions indicated that privacy for patients was present. It is likely that they were referring to lack of staff privacy rather than patient privacy. Even though respondents were encouraged to identify shortcomings of the new facility, none were offered.

Perhaps the most noteworthy additional information generated from the open-ended comments, apart from the topics of interaction, privacy and nature, was the higher level of ‘homeyness’ associated with the old unit. Other pre-/post-evaluation studies have found similar responses when comparing new and old facilities (e.g. Shepley *et al.* 2010). New facilities tend to incorporate more materials that are readily cleaned to support infection control, which results in a more sterile-appearing environment. Additionally, patients may feel less comfortable in a new environment if they are concerned about degrading the new furnishings and furniture through use.

Regarding the limitations of the study, the circumstance that the subject population was small (22) might have limited the generation of significant findings. However, a paired samples *t*-test overcame this shortcoming because: (1) the analysis method was the more conservative two-tailed *t*-test (as opposed to a one-tailed *t*-test); (2) a paired samples *t*-test was used, meaning the same individuals completed surveys for both the old and the new units, making the interpretation of results more reliable than standard probability distribution testing; (3) the large *t*-values that resulted lessened the need for large sample testing; and (4) all outcomes were in the same direction (in favour of the new facility), implying intentionality of results (the sign test for binomial distributions suggests leanings should be observed equally in either direction if results are simply due to chance).

In addition to a larger subject population, the strength of this study would have been enhanced by the incorporation of comparisons of multiple infusion suites that address similar design objectives. Future studies are needed in infusion suite settings that focus in more detail on each of three design objectives.

Information regarding patient outcomes would be a useful adjunct to this research. Such data might include the assessment of patient stress or pain in infusion environments with differing degrees of interaction, privacy and views of nature. Additionally, there are important issues relating to staff that were not considered in this study, but which must be considered in all facilities. Those design intentions include providing environments that facilitate medical practitioner job satisfaction, effectiveness and the reduction of medical errors.

Several design features were incorporated into the new facility to support opportunities for interaction, privacy and access to nature. With regard to social interaction, more space was provided adjacent to infusion chairs to permit the presence of families. In order to support privacy, optional private infusion rooms were provided as well as curtains to separate individual

infusion stations. Regarding views of nature, the new infusion suite had wall-to-wall windows (Figure 5) that looked out over a healing garden (Figure 6). The results suggest that features similar to those described above be considered in the development

Apart from making design recommendations, the primary goals of the researchers were (1) that designers would be accountable for the outcomes of their projects and (2) other design/research teams would see this as an example of an approach that could be used with their projects. The study intended to demonstrate the type of design research that can be undertaken under the auspices of an architectural firm with the assistance of a design research consultant. By generating research hypotheses based on design goals and using this information to inform the design of future projects, the knowledge base of the firm grows. By publishing the results in a peer-reviewed journal, the knowledge is further disseminated.

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