

ICU Patient Family Stress Recovery During Breaks in a Hospital Garden and Indoor Environments

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Abstract

Objectives: Measure the immediate change in intensive care unit (ICU) family members' state stress levels from the beginning to the end of a person's visit to a hospital garden and compare the changes produced by the garden with those associated with spending time in indoor hospital environments intended for respite and relaxation. **Background:** No previous research has compared the efficacy of different physical environments as interventions to foster stress reduction in family members of ICU patients, a group of hospital visitors known to experience high levels of distress. **Method:** A convenience sample of 42 ICU patient family (from 42 different families) completed the Present Functioning Visual Analogue Scales (PFVAS) before and after each visit (128 total visits) to a garden, an atrium/café, or ICU waiting room. **Results:** Stress scores significantly declined (i.e., improved) from the start to the end of a break on all PFVAS subscales ($p < .0001$) in both the garden and indoors locations. However, it is noteworthy that garden breaks resulted in significantly greater improvement in the "sadness" scale than breaks in indoor locations ($p = .03$), and changes in all five other PFVAS scores showed somewhat more reduction of stress for breaks spent in the garden than indoors, although these differences were not statistically significant. **Conclusion:** Creating an unlocked garden with abundant nature located close to an ICU can be an effective intervention for significantly

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mitigating state stress in family members of ICU patients and can be somewhat more effective than indoor areas expressly designed for family respite and relaxation.

Keywords

ICU patient family, stress recovery, hospital garden, nature, waiting room

Stress in Healthcare Facilities

The great majority of hospitalized patients experience stress (Koenig, George, & Stangi, 1995; Van Der Ploeg, 1988), and some groups suffer severe stress (Nelson et al., 2001). Stress is also a widespread problem among nurses and other healthcare staff (Mealer, Burnham, Goode, Rothbaum, & Moss, 2009; Poghosyan, Clarke, Finlayson, & Aiken, 2010) and can be a major burden for families of hospitalized patients, especially those with loved ones in high-acuity units (Day, Haj-Bakri, Lubchansky, & Mehta, 2013; McAdam, Dracup, White, Fontaine, & Puntillo, 2010). The evidence-grounded theory of supportive design (Ulrich, 1991, 1999) holds that one important way healthcare design can improve outcomes is by fostering stress reduction and coping (Andrade & Devlin, 2015; Andrade, Devlin, Pereira, & Lima, 2017; Devlin, Andrade, & Carvalho, 2016).

Alleviating stress experienced by these groups is an important goal because stress is a negative outcome itself and has a wide variety of detrimental psychological, physiological, and behavioral effects that worsen other clinical outcomes and markers of safety and quality (Gatchel, Baum, & Krantz, 1989; Mealer et al., 2009). Considerable research has identified hospital design features that can reduce patient stress (e.g., Andrade & Devlin, 2015; Andrade et al., 2017; Devlin et al., 2016; Hagerman et al., 2005; Ulrich, Borgen, Gardiner, & Lundin, 2018). A more limited but growing body of evidence has demonstrated that certain healthcare design interventions (such as noise reduction or a nearby garden) can decrease staff stress and burnout (Applebaum, Fowler, Fiedler, Osinubi, & Robson, 2010; Blomkvist, Eriksen, Theorell, Ulrich, & Rasmann, 2005; Cordoza et al., 2018). However, there is a paucity of scientific research that has

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The article addresses the shortage of research on families by describing a study that may be the first to examine stress-reducing influences of the physical environment on a group of hospital visitors known to be particularly burdened by stress—family members of patients in intensive care units (ICUs). The study also breaks new empirical ground by comparing stress recovery of ICU patient family members during breaks in a hospital garden and breaks in indoor settings explicitly designed for family respite, relaxation, and/or positive distraction (an atrium/café, ICU waiting rooms).

Stress in Family of Patients in ICUs

Investigations have consistently found that family members of patients in ICUs experience high levels of psychological distress including anxiety, depression, sadness, and fatigue. A multicenter study of 836 family members of ICU patients revealed that 69.1% reported anxiety and 35.4% had symptoms of depression (Pochard et al., 2001). Pochard and colleagues (2005) also conducted a study of ICU patient family members on the day of discharge or death and found that 73.4% of family experienced anxiety and 35.3% were depressed. McAdam, Dracup, White, Fontaine, and Puntillo (2010) evaluated family of ICU patients with a high risk of dying and reported that 80% of family had symptoms of

anxiety, 70% of depression/sadness, and more than 80% experienced other distressing symptoms such as fatigue. A survey of 94 family and friends of ICU patients found that 20.7% reported moderate to severe anxiety, and 57.6% suffered from fatigue during their loved one's hospitalization (Day et al., 2013). Most family of ICU patients also experienced moderate to severe sleep disturbance as a symptom of stress (Day et al., 2013).

The significance of stress as an unhealthful burden for family members of ICU patients is underscored by the finding that more than 30% evidence symptoms of post-traumatic stress following their loved one's ICU stay (Azoulay et al., 2005; McAdam et al., 2010). The phenomenon of persistent psychological distress and post-traumatic stress after a loved one's stay has been termed post-intensive care syndrome-family (PICS-F) by a taskforce of the Society of Critical Care Medicine (Davidson, Jones, & Bienvenu, 2012; Needham et al., 2012). PICS-F includes both short-term acute and chronic psychological effects of family members of patients with critical illness (Davidson et al., 2012; Rawal, Yadav, & Kumar, 2017). Intervention studies to date aimed at mitigating symptoms of family psychological distress and post-traumatic stress have centered on improving communication between family members and healthcare providers (Black et al., 2013; Davidson et al., 2012). Although findings suggest that communication interventions increase family perception of staff quality, an elaborate and costly multicomponent communication intervention did not prove effective in reducing ICU family psychological distress or post-traumatic stress symptoms either during or after a loved one's hospitalization (White et al., 2018).

Evolutionary Theory: Why Nature and Gardens Should Foster Recovery From Stress

Theory and research suggest that a garden with abundant nature holds promise as a respite environment that could foster reduction of stress symptoms in family of ICU patients. Wilson's (1984) biophilia hypothesis contends that humans have a partly genetic proneness to

affiliate with and otherwise respond positively to nature. Stress recovery theory (SRT) extended biophilia theory by proposing that a capability for rapid recovery from stressful episodes was so advantageous for the survival of early humans that it favored the selection of individuals with a partly genetic proneness for acquiring stress-reducing responses to many nature settings (Joye & Dewitte, 2018; Ulrich, 1993, 2008; Ulrich et al., 1991). This theoretical argument contends that modern humans, as a genetic remnant of evolution, have a predisposition to derive stress reduction benefits from certain nature content and settings (such as vegetation, flowers, water) but have no such proneness toward most built or artifact-dominated settings and materials (such as concrete, metal, glass; Ulrich, 1993; Ulrich et al., 1991). A practical design implication of stress recovery theory is that designing healthcare facilities with prominent nature may harness therapeutic influences that are carryovers from evolution, resulting in more stress-reducing and healing settings (Ulrich, 2008).

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Consistent with SRT predictions, several controlled studies of patient and nonpatient groups have found that viewing trees, plants, flowers, or other nature—but not most built environments lacking nature—can produce rapid and substantial psychological and physiological recovery from stress (Brown, Barton, & Gladwell, 2013; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998; Ulrich et al., 1991; Zijlstra, Hagedoorn, Krijnen, Van der Schans, & Moberg, 2017). Physiological restoration from stress is evident, for example, in reduced blood pressure and sympathetic nervous system activity. These and other beneficial physiological changes are accompanied by reduced levels of psychological

stress symptoms such as anxiety, sadness, and anger and increased positive emotions (Ulrich et al., 1991). Research also suggests that exposure to nature can buffer or “immunize” a person’s psychophysiological reaction to a subsequent stressor (Parsons et al., 1998).

Research on Gardens

Family, patients, and staff who use well-designed gardens in hospitals report reduced stress and enhanced emotional well-being (Cordoza et al., 2018; Marcus & Barnes, 1999; Rodiek, 2002; Sherman, Varni, Ulrich, & Malcarne, 2005; Whitehouse et al., 2001). Although a window view of nature can lessen stress, physical access to a garden appears more effective in fostering restoration (Largo-Wight, Chen, Dodd, & Weiler, 2011; Lottrup, Grahn, & Stigsdotter, 2013). Gardens in hospitals not only provide stress-reducing and pleasant nature views, but if properly designed can also alleviate family stress through other established mechanisms (Marcus & Sachs, 2014; Ulrich, 1999). For example, unlocked gardens that are accessible to family promote restoration by providing opportunities for positive escape (and sense of control) with respect to stressful interior clinical spaces (Marcus & Barnes, 1999; Marcus & Sachs, 2014). Gardens also provide family, patients, and staff with pleasant spaces for seeking privacy or deriving stress reduction via social support (Ulrich, 1999).

Despite the growing research on healthcare gardens and nature, knowledge gaps remain, and most studies have shortcomings. The majority has exposed participants to simulations such as videos, not real gardens or nature. Most of the limited number of studies done in real gardens have methodological weaknesses, for example, the lack of a control user group or comparison environment. Some investigations have not used established or validated measures of stress symptoms or other health-related influences. The present research addressed these shortcomings by using an established and credible stress symptom questionnaire to measure and compare the effects on ICU family of spending time in a real garden in contrast to real indoor hospital settings intended for restoration or relaxation.

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Objectives and Hypotheses

The research had two main aims. (1) Measuring the immediate change in ICU family members’ state (in the moment) stress levels from the beginning to the end of a person’s visit to a hospital garden deliberately designed to reduce stress. We hypothesized that a visit to the garden would foster rapid and significant reduction of state stress symptoms in family members of ICU patients. (2) Comparing the immediate change in state stress symptoms produced by the garden with those associated with spending time in indoor hospital environments intended for respite or relaxation. We hypothesized that the garden would be at least as effective in reducing state stress as a large atrium/café having nature features (plants, fountain), abundant daylight, and distractions (presumed to be positive) such as shops and food and that the garden would be more effective in diminishing state stress symptoms than indoor ICU waiting rooms with little nature.

Method

The study was performed at a 442-bed hospital in Portland, OR, that is a Level 1 trauma center with multiple critical care units. To capture favorable weather for outdoor breaks, data were collected from ICU family members during warmer months, April through October (mean 2.5 rainy days and 4.6 cm rain per month), having fewer rainy days than winter months (November through March, mean 17.6 rainy days and 11.9 cm rain per month).

Study Design

Initial consideration was given to carrying out a randomized controlled study. However, the hospital institutional review board (IRB) deemed random assignment ethically problematic in this instance because it would require up to 50% of the presumably stressed family members of ICU

patients to avoid a garden purposely designed to reduce stress. Another hindrance was that participants in a randomized trial should be unaware of different interventions or conditions assigned to other participants. It could be expected in this study that all family would have knowledge of at least one ICU waiting room, and most would also be aware of the garden because they could see it from hallways leading to the ICUs. The IRB approved an observational, repeated measures study based on a convenience sample of family members visiting patients in adult ICUs. The design ensured that family would have freedom of choice with respect to visiting break or respite environments available in the hospital.

Participants

Family members or close loved ones of ICU patients were enrolled in the study by an investigator at a table in a hallway near the garden and the entrance to the Cardiovascular ICU (CVICU). Signs inviting family to participate in a study were also placed in the CVICU waiting room and Neurotrauma ICU (NTICU) waiting room. The investigator asked family if they would be interested in participating in a study about the garden and other environments available to them during their hospital visits. If they expressed willingness, the study methods were described, informed consent was obtained, a set of questionnaires was provided (see section below), and they were given instructions for filling out the questionnaires and where to drop them off when completed. The investigator did not approach or contact family if they appeared acutely distressed (crying, holding onto others, too preoccupied to give informed consent or understand instructions). The enrollment excluded individuals younger than 18 years of age and non-English speaking persons. The investigator estimated that 65% of the family members approached consented to participate. The enrollment process and inclusion/exclusion criteria imply that most family who consented to participate had stress levels that fell within the lower half of the distribution of stress scores for all family visiting ICU patients at the study hospital.

Measures

To measure the immediate psychological impact of a break in the garden or an indoor environment, ICU family were instructed to complete the Peds QL™ module of Present Functioning Visual Analogue Scales (PFVAS; Sherman, Eisen, Burwinkle, & Varni, 2006) before and after each visit to the garden, an atrium/café, or ICU waiting room. The PFVAS is a self-report instrument that measures state stress and functioning for six symptoms: fear/scared, sadness, anger, worry, fatigue, and pain (Sherman et al., 2006). Total Symptom Score is the mean score for all symptoms. The PFVAS displays a 100 mm line for each symptom anchored with a happy face (labeled, e.g., “not afraid, not scared,” “not worried,” “not sad, not blue”) and distressed face (e.g., labeled “very afraid, very scared,” “very worried,” “very sad, very blue”). Respondents were instructed to “put a mark on each line that best shows how you are feeling at that time for each of the six feelings described below.”

The PFVAS has been used previously to assess the immediate effects of exposure to gardens and indoor settings on stressed adults (Cordoza et al., 2018; Sherman et al., 2005). The reliability and validity of the scales have been demonstrated for adult parents of pediatric patients and patients aged 5–18 years (Sherman et al., 2006), although the validity of the PFVAS has not been formally established for ICU family members such as those in this study. The PFVAS provides a broad assessment of in-the-moment symptoms yet takes little time to fill out (approximately 20 s) and thus is well suited to repeated measurements of symptoms during breaks or visits in environments.

Each family member who consented to participate was provided several sets of three-page questionnaires. Participants were instructed to use the first page of a questionnaire to provide ratings of their symptoms as they entered a break environment and indicate the time. At the end of each break or visit, participants turned to the second page that instructed them to provide symptom ratings “as you leave.” The third page of the questionnaire asked them to indicate the ending time of the break or visit to an environment and identify the location or environment chosen for

the break by checking one of the following: garden, CVIC waiting room, NTICU waiting room, atrium/café, or other.

Respite Environments

Garden

The garden was designed using an evidence-based collaborative process (Hazen, 2013) with the goal of effectively reducing stress in different hospital populations including family of ICU patients, nurses working in high-acuity units, and other groups (Cordoza et al., 2018). Research indicates that a hospital garden should be located close to targeted groups (Nejati, Shepley, Rodiek, Lee, & Varni, 2016) and unlocked (Pasha, 2013) for it to be frequently used and effective in reducing stress. Proximity and being unlocked also are recommended in best practice design guidelines for healthcare gardens authored by qualified professionals (Marcus & Sachs, 2013; Sachs, 2017). A second-floor terrace location was chosen because it enabled short walking times (<1 min 20 s maximum) from the CVICU, NTICU, and a maternity unit and is unlocked, accessible, and safe 24/7.

The garden is located on the same floor as the CVICU. The walk from patient rooms in the CVICU to the garden requires moving through the unit waiting area and takes 20 s. As CVICU patient family members exit the doors to the department, they see the garden through large windows directly across the hallway. The NTICU is located one floor above the garden; the walk from patient rooms to the garden takes 1 min 20 s. Two elevators located a short distance from the NTICU are available for the walk; as family exit the elevator on the floor below, they see a wide view of the garden through hallway windows to the right.

Previous research has shown that gardens designed in informal natural styles with prominent nature/vegetation are more effective in reducing stress than formal or geometric spaces with little nature and predominant hardscape such as concrete (Shukor, 2012; Twedt, Rainey, & Proffitt, 2016). Thus, the garden was planted with abundant vegetation and colorful flowers in a

nonformal style for four seasons of nature views (Figures 1 and 2). The site overlooks a verdant children's garden with trees (Figure 3). The planting, seating, and layout of the garden were designed to provide scenes containing on average more than 60% vegetation in the two-dimensional (side view) visual plane.

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The garden has other design features that researchers have linked to stress reduction and user satisfaction: visual connections from the building interior (windows) to attract users to the garden (Figure 4); access to privacy (Figure 2); options of comfortable movable seating to promote socializing; shade access (Figures 2 and 3); accessible paths for users with crutches, walkers, or wheelchairs (Figure 3); and a play area for children (Marcus & Sachs, 2014; Rodiek, Nejati, Bardenhagen, Lee, & Senes, 2016; Sachs, 2017; Sherman et al., 2005; Ulrich, 1999). Finally, the design reflects attention to environmental sustainability. The garden area is 2,200 ft² (204 m²). Earthquake and building codes limited planting on an additional 800 ft² (74 m²) of the rooftop to potted plants placed at structural strong points. In hot weather, there is continuous background noise in the garden from air-conditioning equipment on nearby buildings at 52–55 dB(A); however, these levels do not interfere with normal conversation at 64–65 dB(A). The garden has free Wi-Fi.

Atrium/Café

The atrium/café is located on the same floor as the CVICU. The walk between the areas, which requires moving from the patient area through the CVICU waiting room, takes 1 min 10 s. The NTICU is located one floor above the atrium/café; the walk takes 1 min 20 s. Two elevators located a short distance from the NTICU are available for the walk; family members see the atrium/café across a hallway as they exit the elevator on the floor below.



Figure 1. The garden has abundant vegetation, colorful flowers, and choices of comfortable seating.



Figure 2. The garden has abundant nature and provides access to privacy and shade.

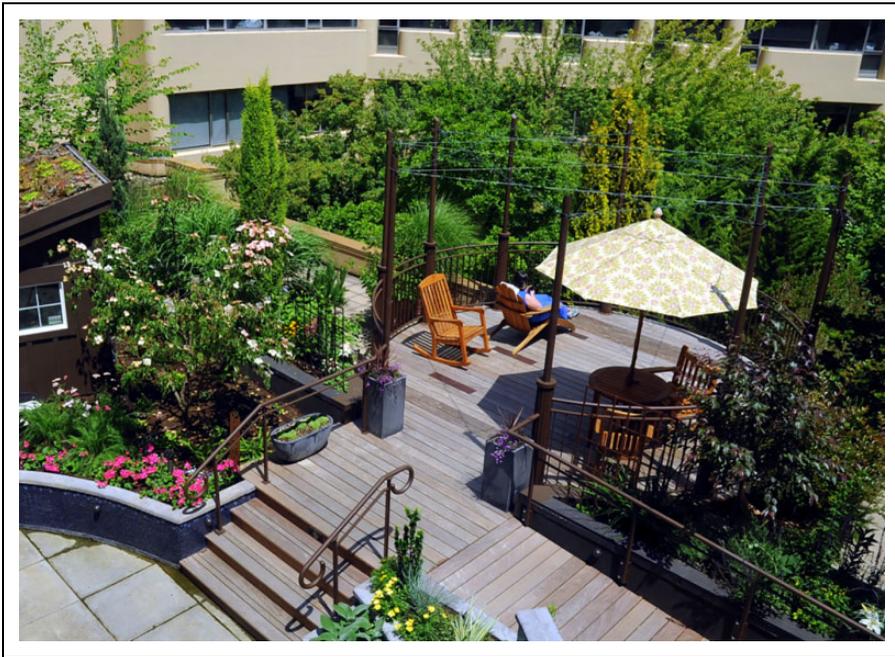


Figure 3. Part of the garden overlooks a verdant children’s garden with trees. There are accessible paths for users with walkers or wheelchairs.



Figure 4. Hallway windows provide visual connections to the garden, facilitate wayfinding, and enable “off-site” users seated or walking in the hallway to have nature views during inclement weather. The main entrance door (right) is unlocked at all times.

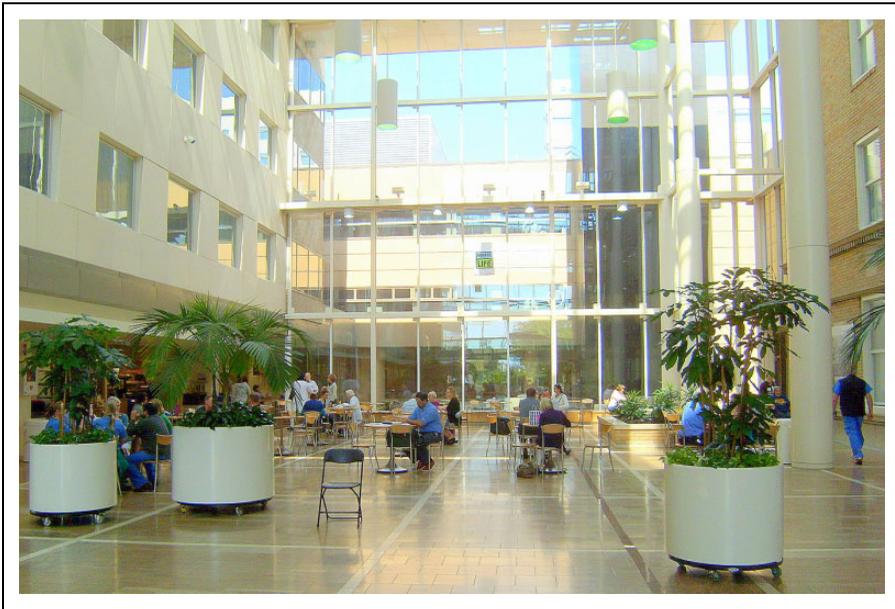


Figure 5. Atrium with plentiful daylight, several large plants, and a fountain (right distance) with plants. The space contains tables and movable chairs for relaxing, socializing, or eating.

The atrium/café is an expansive indoor area consisting of two main parts: a glassed four-story atrium with numerous tables and movable chairs for eating, socializing, and/or relaxing (Figure 5) and an adjacent one-story area with café, coffee stand, retail shops, and a pharmacy (Figure 6). The area was created with the explicit objectives of providing access to food, shopping, pleasant distraction, and relaxation for hospital visitors, patients, and staff.¹ The atrium contains several large potted plants (real not artificial), a water fountain encircled with green plants, abundant daylight even on cloudy days, and free Wi-Fi. Theory and research relating to biophilia and SRT suggest that the nature features in the atrium/café help foster stress reduction.

The atrium and café are both open 24/7. The size of the four-story atrium is 6,984 ft² (649 m²). The adjacent café and shopping spaces comprise another 4,403 ft² (409 m²), giving a total size of 11,387 ft² (1,058 m²) for the atrium/café area. Continuous background daytime noise levels at the center of the atrium range from 52 to 71 dB(A), depending on time of day and number of users.

ICU Waiting Rooms

The NTICU waiting area is located next to the unit entrance and is available 24/7. The walk from patient rooms to the waiting area takes a few seconds. The space consists of multiple seating areas subdivided by wall partitions (Figures 7 and 8). The subareas contain different types of comfortable seating, mostly movable or semi-movable, some fixed (Figure 8). One subarea has television that is controllable by users. Several windows provide daylight, and all overlook gardens or other nature. There are a few wall-mounted artworks (Figure 8) and some potted plants. Acoustic ceiling tile and carpet throughout the waiting area lessen noise. Coffee, tea, water, and Wi-Fi are free in the waiting area. The total size of the NTICU waiting area is 2,004 ft² (186 m²).

The CVICU waiting area is located next to the unit entrance and is available 24/7. As family exit the patient area, they immediately enter the waiting space; the walk from patient rooms takes only seconds. The area consists of one room 651 ft² (60.5 m²) in size with groupings of movable and semi-movable seating. One corner has a wall-mounted television that can be controlled by users



Figure 6. Portion of atrium showing café and retail shops (in distance) adjacent to seating area. The fountain is just to the left out of the picture.

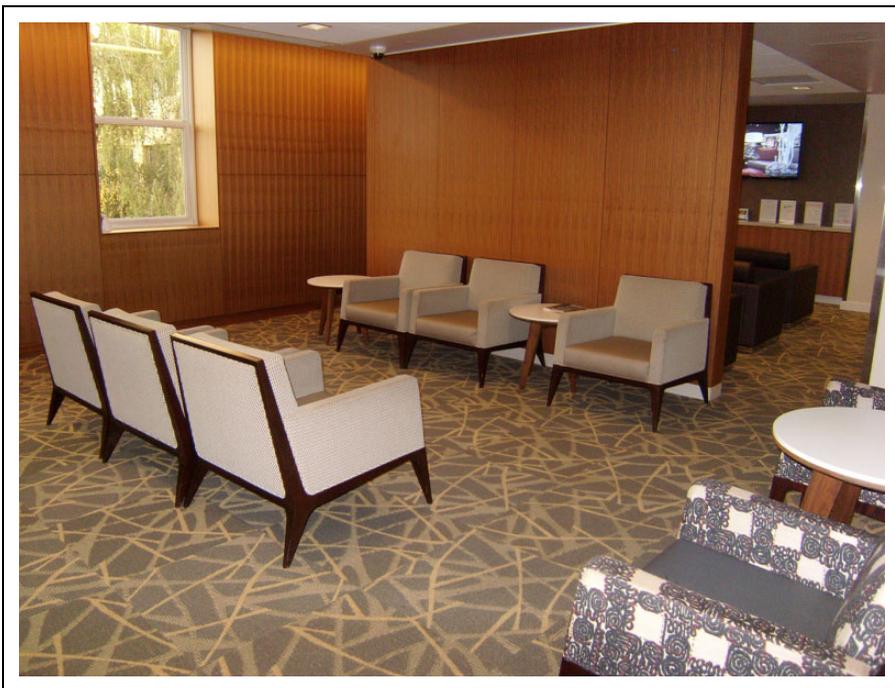


Figure 7. Portion of Neuro Trauma Intensive Care Unit waiting with movable and semi-movable seating, window views of nature, daylight, and subarea with controllable television.

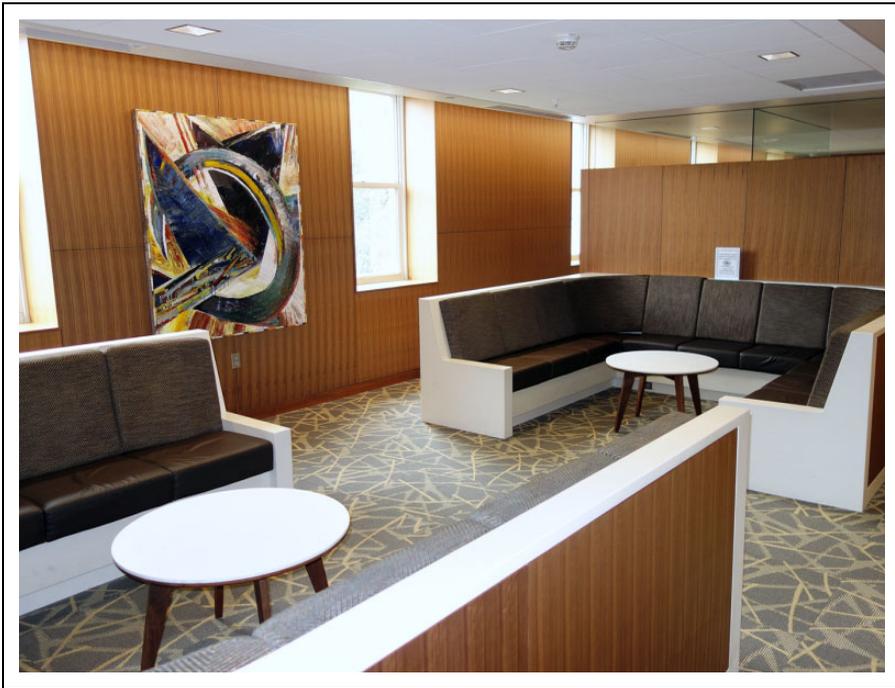


Figure 8. Portion of Neuro Trauma Intensive Care Unit waiting with fixed U-shaped seating intended to foster social support for acutely distressed family. There is daylight, original artwork, and window views of nature.

(Figure 9). The space is windowless and has no natural light. The walls display a few abstract art prints. Acoustic ceiling tile and carpet throughout the waiting area lessen noise. Coffee, tea, water, and Wi-Fi are free in the waiting room.

Results

Analysis

It will be recalled that family members were asked to complete the PFVAS upon entering and leaving the various break areas available to them. The break settings were categorized as “Garden,” “Atrium/Café,” or “Waiting Rooms.” As mentioned, the PFVAS measures six state stress symptoms or subscales: Afraid/Scared, Sad/Blue, Angry, Worry, Tired, and Pain/Hurt. All Visual Analog Scale scores were transformed onto a percentage scale for analysis. The differences between the scores at the start and end of the break were calculated, and a boxplot generated, for each of the six subscales and each of the three break locations. Additionally, differences were

calculated for the six subscales for two break locations: “Garden” and “Indoors” (combining the Atrium/Café and Waiting Room categories). All analyses were performed using R statistical software version 3.5.0 (R Core Team, 2016).

The score at the end of the break was formally compared against a null hypothesis of zero change from the score at the start of the break, for each subscale and location. The analyses used a generalized estimating equations model to account for the availability of data from multiple breaks for some of the family members, an offset term for the score at the start of each break, and a logistic transform due to the bounded nature of the outcome variable (Lesaffre, Rizopoulos, & Tsonaka, 2007). Subsequent analyses were performed using the same methodology in order to determine whether break location was a significant predictor of this change in score. Additionally, odds ratios were calculated to compare the likelihood of family members choosing the Garden, Atrium/Café, or Waiting Rooms for their breaks.



Figure 9. Portion of Cardiovascular Intensive Care Unit waiting with movable and semi-movable seating and wall-mounted controllable television. The space is windowless.

Family Members' Choice of Break Locations

A total of 42 ICU patient family participated (one person per family) and provided questionnaire data for a total of 128 breaks in the three locations. Of these families, 39 spent at least one break in the Garden (82 total garden breaks), 21 in the Atrium/Café (35 total breaks), and only 8 (11 total breaks) in the Waiting Rooms. The average time spent on breaks was 34 min in the Garden, 39 min in the Atrium/Café (excluding one outlier whose recorded duration was 7 hr), and 16 min in the Waiting Rooms.

The families' likelihood of choosing the Garden for breaks was significantly higher than for the Atrium/Café (odds ratio for Atrium/Café compared to Garden = .427, $p < .001$) and far higher than for the Waiting Rooms (odds ratio for Waiting Rooms = .134, $p < .0001$). That is, family members were approximately half as likely to choose to spend their break in the Atrium/Café as in the Garden and approximately 15% as likely to choose the Waiting Rooms. These findings regarding the Atrium/Café should be interpreted with some caution because participants were

recruited near the garden and CVICU waiting room but not in the Atrium/Café. However, it is reasonable to assume that most family members were aware of the Atrium/Café because it was listed as a break location on the questionnaire, and many presumably went to the Atrium/Café for food and to shop. It can also be assumed that all participants were aware of at least one Waiting Room as well as the Garden because they had to pass through a waiting room to enter the patient areas in the CVICU and NTICU. On balance, the odds ratio results indicate that family members strongly favored the Garden over the Waiting Rooms for breaks during the warm months when data were obtained (April through October).

A multivariate analysis was also conducted to assess whether the probability of choosing a break environment (Garden vs. Atrium/Café vs. Waiting Rooms) was associated with possible variation in participants' "pre" (initial) stress scores for each of the six PFVAS subscales. The stress scores did not significantly alter the odds ratios, which suggests that a participant's stress state at the beginning of a break was not strongly linked with their choice of respite setting.

Table 1. Present Functioning Visual Analogue Scale (PFVAS) scores for each break location.

Stress Symptom	Garden, N = 82 Breaks				Indoors, N = 46 Breaks				Comparison <i>p</i> Value
	Mean at Start	Mean at End	Mean Change	<i>p</i> Value	Mean at Start	Mean at End	Mean Change	<i>p</i> Value	
Afraid/scared	26.9	15.0	-11.9	<.0001	21.5	15.7	-5.9	<.0001	.6540
Sad/blue	31.0	13.3	-17.7	<.0001	25.2	19.9	-5.2	<.0001	.0321
Angry	17.3	8.4	-8.9	<.0001	8.7	6.4	-2.3	<.0001	.4722
Worry	24.1	12.7	-11.1	<.0001	20.1	14.2	-5.9	<.0001	.5168
Tired	41.4	20.5	-20.9	<.0001	38.3	26.4	-11.9	<.0001	.1354
Pain/hurt	18.1	8.5	-9.6	<.0001	14.3	10.4	-3.9	<.0001	.3722
Total Symptom Score	26.4	13.0	-13.4	<.0001	21.3	15.5	-5.8	<.0001	.1910

Results: Stress Recovery During Breaks in the Garden and Indoor Environments

Only eight family members took breaks in the Waiting Rooms (11 breaks in total), which reduced statistical power for comparing the effects on stress of breaks in the Waiting Rooms with those in the Garden or Atrium/Café. Therefore, the PFVAS data for the Waiting Rooms were combined with the Atrium/Café data to create an “Indoors” environment category.

A summary of the PFVAS data is shown in Table 1. Columns show the mean score at the start and end of the break, the mean change in score, the *p* value showing whether this change was statistically significant compared with a null hypothesis of zero change, and the *p* value showing whether there was a significant difference between Garden and Indoors. As seen in Table 1, stress scores significantly declined (i.e., improved) from the start to the end of the break on all subscales ($p < .0001$), at both locations (Garden and Indoors). Breaks spent in the Garden resulted in a significantly greater decrease (improvement) in the score for “sadness” than breaks spent in the Indoor locations ($p = .0321$). It is notable that changes in all five other subscale scores (Fear/Scared, Anger, Worry, Fatigue, and Pain) tended to be better (more reduction of stress) for breaks spent in the Garden than Indoors, but these differences were not statistically significant. The mean changes in PFVAS stress scores for the two locations are shown in Figure 10. Figure 11 displays the score changes in boxplots that show the median values,

the interquartile range of values, and the distribution of outlier data points.

Breaks spent in the Garden resulted in a significantly greater decrease (improvement) in the score for “sadness” than breaks spent in the Indoor locations ($p = .0321$). It is notable that changes in all five other subscale scores (Fear/Scared, Anger, Worry, Fatigue, and Pain) tended to be better (more reduction of stress) for breaks spent in the Garden than Indoors, but these differences were not statistically significant.

Summary and Discussion

There is a shortage of studies that have evaluated and compared the possible effectiveness of hospital physical environments in alleviating stress in visiting family members. The research described here examines the efficacy of physical environments as interventions to foster stress reduction in family members of ICU patients, a category of hospital visitors known to experience high levels of distress.

The garden was sited to enable short walking times (1 min 20 s maximum) from the CVICU, NTICU, and a maternity unit. ICU family members chose the Garden for breaks significantly more often than the Atrium/Café ($p < .001$) and far more frequently than the Waiting Rooms ($p < .0001$) during the warmer months when data

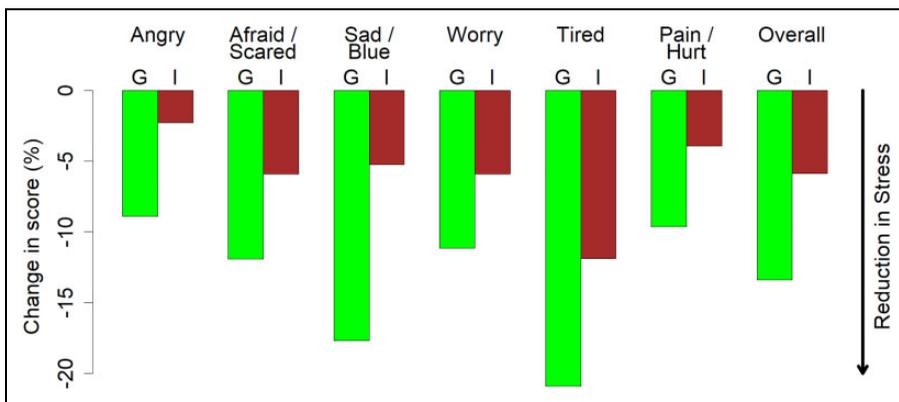


Figure 10. Barplot showing the mean change in score from the start to the end of the break, for each of the six PFVAS stress symptom subscales and for the Total Symptom Score (mean of the six subscales, labeled “Overall”), when the break was spent in the Garden (labeled “G”) or Indoors (labeled “I”).

were obtained (April through October). These findings are not explained by the limited differences in walking times from patient areas within the NTICU and CVICU to the various respite settings (maximum walking time difference = 1 min 12 s). If proximity had influenced choice frequency, the Waiting Rooms would have been chosen for most breaks because the walks from patient areas took only seconds.

During winter months, ICU family members may choose the Garden for breaks less often relative to the Indoors settings. However, the Garden was designed for all seasons, with color and variation through the winter months, and large windows enable persons walking or seated in an adjacent hallway to view the garden on rainy or cold days (Figure 4). Preliminary findings from a four-season behavior mapping study of the same garden indicate that on-site usage declines during rainy or cold weather, but the observed frequency of persons stopping to view the garden through the hallway windows increases in inclement weather (Antick et al., 2017).

Because few family members selected the Waiting Rooms for breaks, the PFVAS data for the Waiting Rooms were combined with the larger amount for Atrium/Café to create an “Indoors” category of respite or relaxation environments. Findings showed that family stress scores significantly declined (i.e., improved) from the start to the end of breaks at both

locations (Garden and Indoors) on all six PFVAS subscales (Fear/Scared, Sadness, Anger, Worry, Fatigue, and Pain). All reductions in the stress subscales were robustly significant ($p < .0001$) for both the Garden and Indoors (Table 1). However, it is notable that the Garden was significantly more effective than the Indoors settings in reducing state sadness experienced by ICU patient family members ($p < .05$). As shown in Table 1, levels of sadness declined an average of 18% during Garden visits but only by 5% in Indoors environments. It is also noteworthy that changes in all five other PFVAS subscales were in the direction of more stress recovery for breaks spent in the Garden than Indoors, although these differences were not statistically significant (Figures 10 and 11).

The findings are somewhat similar to those from a preliminary study by Sherman, Varni, Ulrich, and Malcarne (2005) that used the PFVAS to compare the effects of sitting in gardens versus indoor rooms in a pediatric hospital on small mixed groups of adult visitors and staff. (The indoor rooms were not described.) Although there were too few participants to permit statistical tests, the mean differences for all six PFVAS subscales pointed in the direction of lower stress in the gardens than indoors.

The results support the broader conclusion that both gardens and certain indoor hospital environments can be designed with characteristics that

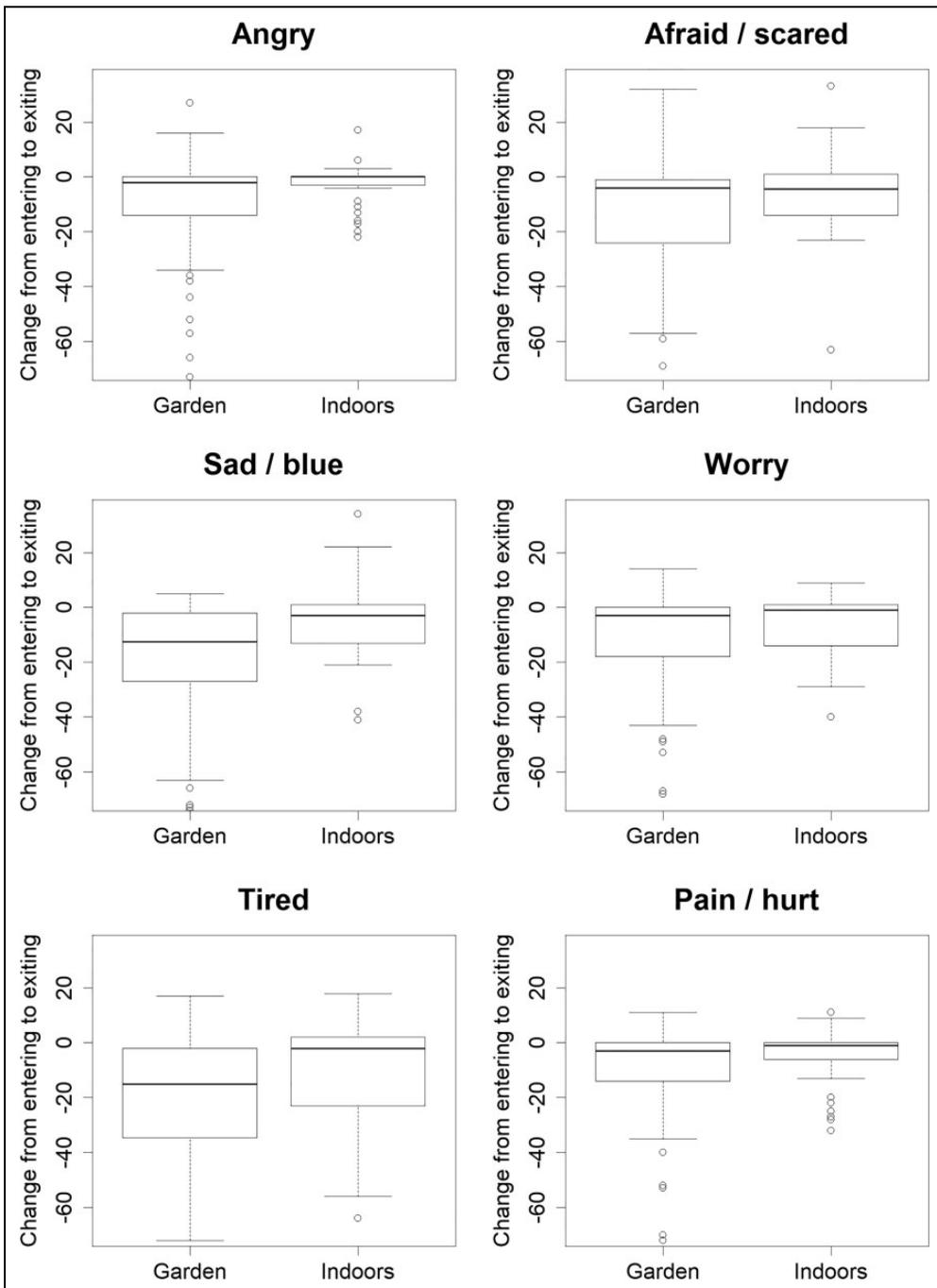


Figure 11. Boxplots showing the mean change in score from the start to the end of the break, for each of the six PFVAS stress symptom subscales, when the break was spent in the Garden or Indoors. In each case, the box shows the interquartile range of values, that is, it extends from the 25th to the 75th percentiles of the data distribution. The solid line in the middle shows the median value. Outliers are shown individually, conventionally defined as any data points that are greater than 1.5 times the interquartile range away from the box.

are effective in fostering rapid and significant recovery from state stress symptoms experienced by visiting family. According to stress recovery theory, the abundance of nature features in the Garden (vegetation, flowers, daylight) accounts for the finding that the Garden somewhat outperformed the Indoors settings in reducing family stress (Ulrich, 1993; Ulrich et al., 1991). Additionally, Biophilia and SRT both propose that settings with prominent nature/vegetation should be more liked and motivate more approach behavior and use/occupancy, than built environments lacking nature (Ulrich, 1993; Ulrich et al., 1991; Wilson, 1984). This conceptual prediction is broadly consistent with the findings showing that participants chose the Garden for breaks significantly more often than the Atrium/Café and far more often than the Waiting Rooms.

Regarding breaks in the Indoors settings, family members chose the Atrium/Café rather than the Waiting Rooms for the vast majority (76%). According to evolutionary theory, the presence of nature features in the Atrium/Café (fountain, plants, daylight) likely fostered stress reduction and may have elicited preference responses that played a role in motivating family to take breaks in the Atrium/Café more often than in the Waiting Rooms. Other motivators for visits to the Atrium/Café presumably included access to food and retail shops.

A limitation of the study is the reliance on a self-report stress measure, although the reliability and validity of the PVAS scales have been previously established. It would be desirable in future research to supplement self-report data with evidence from nonobtrusive physiological stress markers such as skin conductance (Ulrich et al., 1991) and/or a biological marker of stress such as salivary cortisol (Van den Berg & Custers, 2011). The findings also point to the need for future research, wherein family participants would be randomly assigned, for example, to take multiple breaks of comparable durations either in a garden or indoor break environment during their loved one's ICU stay, and follow-up data on distress and post-traumatic stress would be obtained a few weeks after the experience. As noted in an earlier section (*Study Design*), practical difficulties and ethical considerations impeded random

assignment of ICU family in the present study, necessitating an observational design.

Family members of patients in ICUs experience high levels of psychological distress, and upward of one third evidence symptoms of post-traumatic stress following their loved one's ICU stay (e.g., Azoulay et al., 2005). Previous studies focused on reduction of family distress have focused on improving communication between healthcare providers and family (Black et al., 2013; Davidson et al., 2012; White et al., 2018). However, even elaborate communication interventions have failed to reduce ICU family psychological distress or post-traumatic stress symptoms during or after a loved one's hospitalization (White et al., 2018).

Creating a garden with abundant nature located close to an ICU can be an effective environmental intervention for rapidly and significantly mitigating state stress in patient families. Taking breaks in a garden could be part of multimodal intervention, along with staff communication and emotional support, that potentially could prove more effective than approaches based on communication alone for helping family of ICU patients cope with psychological distress.

Implications for Practice

- Stress can be a major burden for families of hospitalized patients, especially those with loved ones in high-acuity units. Healthcare facility clients and designers should give serious consideration to providing such families with outdoor and indoor respite settings having stress-reducing positive distractions such as abundant nature. The findings suggest that a hospital outdoor garden can be an effective environmental intervention for rapidly and substantially reducing state stress if it is designed in an informal style with abundant vegetation/flowers, located close to targeted user groups, unlocked, has visual connections from the building interior (windows) to attract users, provides options of comfortable seating, access to privacy and shade, and has accessible paths for users with walkers or wheelchairs. There is no credible basis, however, for contending that

a garden can be effective as a stress-reducing intervention if it has little vegetation or nature, lacks visual connections to the building interior, and is locked and inaccessible.

- In addition to an outdoor garden, the findings show that an interior space can be measurably effective in mitigating state stress if it has prominent nature elements such as plants and daylight, provide choices of comfortable seating to enable persons to seek privacy or socialize, and offer access to other pleasant distractions such as food and retail shops.
- In appropriate climatic zones design health-care gardens for four seasons of use, and four seasons of vegetation change and color, to achieve greater year-round benefit in terms of pleasant distraction and stress reduction. Provide expansive visual connections to the garden (large windows) from interior spaces such as hallways or waiting areas so that off-site users can sit comfortably and look out onto the garden in all seasons and during inclement weather.
- The study implies that allocating spending to provide several modestly sized, relatively low-cost gardens in a large medical facility, each located close to targeted populations and unlocked, may have greater overall positive impact in reducing stress than providing one or two large and costly gardens located far from stressed populations.

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Note

1. Sources regarding design objectives of the atrium/café were communications from the hospital property manager and ZGF Architects.

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