EVALUATION OF A PEDIATRIC ROOFTOP GARDEN USING THE HEALTHCARE GARDEN EVALUATION TOOLKIT

A Thesis

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Master of Science

by

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May 2020

ABSTRACT

The evaluation of gardens in healthcare facilities through post-occupancy evaluations (POE) is essential for research and evidence-based design. Access to green spaces in healthcare facilities has been shown to improve physical, emotional, and mental outcomes for patients, visitors, and staff, and can be considered part of a holistic approach to health. By applying systematic, valid methods to assess these spaces, we can standardize research into the design of gardens and other natural spaces in healthcare facilities. Results from this, and similar garden evaluations can also be used as guides for future design and research into the policy, programming, and design to optimize user health and well-being outcomes. This study adapted the Healthcare Garden Evaluation Toolkit (H-GET) for pediatric use in order to evaluate a rooftop garden at a pediatric healthcare facility. The H-GET is a mixed methods toolkit consisting of a garden audit tool (GATE), behavior mapping observation, staff survey, and stakeholder interviews, and allows for the collection and analysis of both quantitative and qualitative data. Results of this evaluation suggested that high garden quality, as measured by the GATE audit and staff surveys, is related to high garden usage, and staff believe that the garden was good for mental and physical health. Barriers to use included visibility, accessibility, and insufficient shading and seating. Recommendations for design, policy, and programming in the gardens highlight opportunities for improvements in this and future gardens at healthcare facilities to increase usage and proliferate the multitude of benefits that access to nature can provide.

Keywords: Therapeutic Gardens, Post-Occupancy Evaluations, Mixed Methods Design

BIOGRAPHICAL SKETCH

Julia Jaffe is originally from Connecticut. She attended Wellesley College for her undergraduate education, where she double-majored in Biology and Psychology. After her undergraduate studies, she lived in Boston, Massachusetts where she worked at The Walker School (a home for children with emotional and behavioral issues) and at Temkin Group (a customer experience research and consulting firm). It was at Temkin Group that Julia was able to rediscover her passion for research. She then pursued a graduate education at Cornell University's Department of Design & Environmental Analysis for their interdisciplinary faculty and research opportunities. Julia will enter the Ph.D program in Design & Environmental Analysis in the Fall, during which she will finally get a dog.

DEDICATION

To all the healthcare workers who put their hearts and lives on the line every day to keep us safe.

ACKNOWLEDGMENTS

To everyone who has offered, attempted, and even managed to read this thesis – thank you.

I would especially like to thank my committee – Dr. Mardelle Shepley, Dr. Don Rakow, and Dr. Naomi Sachs. The guidance, support, and feedback I received from them during this entire process was invaluable, both to the project and to me personally. I would also like to thank the Healthcare Facility and architecture firms that allowed me to complete this evaluation, and to the members of their staff and administration who helped organize and participate in the project so willingly and openly – truly embodying the ideals of cross-disciplinary design, research, and practice.

This would not have been possible without Gary Evans, who helped to make the GATE more child-focused, Rachel Wein, who helped me to collect the GATE and behavior mapping data, and Stephen Parry, who got me through the statistical analysis involved in this project.

Finally, I would like to thank my family for being my constant cheerleaders and support system both throughout this thesis and generally in life. Love y’all.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter I

Introduction & Literature Review

1.1 Purpose of Study and The Healthcare Garden Evaluation Toolkit

The field of environmental psychology allows us to explore the impact of design on human health and well-being, social interactions, and community. As we as a society spend more of our time indoors, the restoration provided by the natural environment becomes increasingly important. The increasing disconnect between humans and our natural surroundings has spotlighted the questions of how and why one benefits from a connection with nature, and how to translate those benefits into the design and management of the built environment. In the past 40 years, research into the psychological, physical, and cognitive benefits of interacting with nature has grown, and those within the field of environmental psychology are in a unique position to help translate these findings to create healthier environments. One such environment that necessitates incorporating these benefits is healthcare. Being hospitalized can generate anxiety and fear, and, especially in the case of hospitalized children, extreme stress for the child, parents, and family members (Broadbent, et al., 2003; Dijkstra et al., 2008).

Gardens in healthcare facilities provide physical, psychological, and emotional restoration; facilitate healing; and improve the experience of employees, patients, and visitors alike. The purpose of this study is to complete a post-occupancy evaluation (POE) of a new rooftop garden at a pediatric hospital to understand the

programmatic and physical factors that influence garden use and user satisfaction. The results of the evaluation will help to generate design upgrades for the existing garden to better meet its users' needs and inform the design of future healthcare gardens. A version of the Healthcare Garden Evaluation Toolkit (H-GET) (Sachs, 2017), a set of four standardized instruments adapted for pediatric healthcare facilities will help standardize evaluation of these gardens and serve as valuable design tools for future projects. This research aims to contribute to a more holistic approach to healthcare by using the H-GET to assess the success, design, and programmatic features of a pediatric rooftop garden.

1.2 Literature Review

This literature review will cover theoretical perspectives on nature preference, followed by theories on the impact of nature on health. Next, it will explore the specific impacts on children in terms of the implications of the activities and time spent in nature for personality development, as well as the development of psychological, cognitive, and affective systems. The literature review will then cover contemporary frameworks on designing for health, then historical access to nature in healthcare settings. This will be followed by a review of previous garden evaluations and give support for the use of POEs as research and design tools. The end of the review will include the research significance and conceptual framework for the study.

1.2.1 Theoretical Perspectives on Environmental Preference

Our surroundings have the ability to influence our development and create a foundation for how we perceive the world around us. Throughout human history, we learned how to survive by using the environment around us, and beyond that, how to benefit and prosper. In the past 40 years, researchers have been trying to explain exactly how and why we benefit from nature, specifically why we consider natural environments to be healing. Many of these early theories center on our evolution within the natural world, using the environment as the context within which we developed our physical, emotional, and cognitive abilities. The underlying conceptual frameworks of these theories are rooted in a Darwinian perspective of landscape preference.

Biophilia. The questions around our attraction to nature and the natural world are rooted in many disciplines – spanning biology to psychology to design. The term *biophilia*, first used by psychoanalyst Erich Fromm to describe, “the passionate love of life and of all that is alive” (1973), was later adopted by the biologist E.O. Wilson in his1984 work *Biophilia*. From an evolutionary perspective, humans have a psychological orientation to nature and to other living organisms with which we originally adapted and thrived (Wilson, 1984). As Kellert described in 2008, “our emotional, problem-solving, critical thinking, and constructive abilities continue to reflect skills and aptitudes learned in close association with natural systems,” including many crucial processes in maturation and health (p. 4).

Psychological Mechanisms. Many evolutionary theories are based on a set of psychological mechanisms that were closely tied to order, security, closure and curiosity, challenge, and stimulation (Kaplan, 1975). The theory of prospect-refuge

(Appleton, 1975) reflects on the specific benefits of the environments in which our senses and perceptions developed. The presence of an unimpeded view (prospect) from a secure and protected setting (refuge) would have been comforting and preferred. Orians (1980) continued to expand on this idea that factors or elements that support well-being, reproduction, and survival may have affected environment selection, and thus affected our development as a species. The savanna hypothesis states that human preferences for open, savanna-like landscapes facilitated the survival of early humans through elements that offered perspective, enabled better mobility, and provided potential hiding places.

Kaplan and Kaplan's information processing hypothesis (1989), additionally suggests that landscape and habitat preference depends on multiple domains of variables, such as mystery, openness, smoothness, and coverage. However, developing human affect may also have played a role. Ulrich's affectivity hypothesis (1983) proposes that people respond subconsciously to natural environments due to gradients of positive attractions, such as environments with water. These theories have implications for information gathering, perceiving danger, and finding resources in the context of new spaces, and are compelling foundations for our understanding of the evolution of preference.

Visual processing. Based on this idea of perception and processing as a driving force behind these innate preferences for natural environments, researchers began to explore the link between natural elements and their visual cues. In 1970, Wohlwill suggested that reactions to both natural and man-made environments are based on the visual complexity of the environments. Kaplan and Wendt (1972)

hypothesized that while complexity may certainly play a role in visual preference, it is neither the only nor most important variable at play. Kaplan and Wendt went on to propose that preference was based on the *legibility* of the scene, the *predicted information* afforded from the scene, and the *primary landscape qualities*, such as water or shrubs as discussed above.

Kaplan and Kaplan (1983) expanded upon this idea by initially creating a *familiarity matrix* (see Table 1) to identify what increases the likelihood of a person spending time in an environment. Their *preference matrix* (see Table 1) is based on the idea that an individual will prefer an environment if they can make sense of it and if they can be involved in it through learning or exploration. These four factors are coherence, which provides a sense of security and a sense of place; complexity, which affords opportunities for sensory engagement; mystery, which satisfies our "human need for curiosity" by including settings that can be explored and discovered; and legibility, which denotes a memorable component of the setting so that it is easy to remember and navigate through the space (Kaplan et al., 1998).

Table 1

Familiarity & Preference Matrix

	Familiarity Matrix	
	Low Preference	High Preference
Low Familiarity	Strange	Fascinating
High Familiarity	Boring	Comfortable
	Preference Matrix	
	Makes Sense (Understanding)	Cognitive Involvement (Exploration)
Present (Immediate)	Coherence	Complexity
Future (predictable)	Legibility	Mystery

*Adapted from Kaplan & Kaplan (1983)

The ability to understand visual information afforded humans with a sense of comprehension that they could use to structure patterns of texture and light into manageable “chunks”, which are hierarchical organizations of information that group together common objects (Kaplan, 1975; McNamara et al., 1989). Involvement in the environment also had an impact on long-term survival potential, as this would have led our ancestors to inhabit environments that afforded materials, opportunities, and processes to be challenged cognitively, as humans have an innate need to be stimulated and to learn (Kaplan, 1975).

Implications for Behavior. Other theories about resource availability, wayfinding, safety, and vital survival skills, aim to connect our adaptive-evolutionary perspective with how we react to environments today, as the contemporary human response is to the symbolic meaning of these cues (Sachs, 2017). The environmental press model (Murray,1938; Lawton & Nahemow, 1973) depicts individual adaptation to an environment. The model explores the agreement between the demands and opportunities within an environment and an individuals’ capacities. Optimal fit occurs when a persons’ capacities and abilities match the demands in their environment. But if the demands of the environment exceed the individual’s capabilities, the resulting person-environment misfit can cause undue stress and a decrease in functioning ability.

The idea that the relationship between the qualities of an environment or object and how an individual behaves is also described in Gibson’s theory of

affordances (1979). An affordance implies the complementary nature of animal and environment such that the animal (human) and environment are well-matched in terms of ability, intention, and capability. An environmental affordance consists of what the environment can offer or provide the individual, implying that the “value” of elements within the environment can be perceived (consciously or unconsciously) and thus manipulated.

Since “an organism must prefer those environments in which it is likely to thrive” (Kaplan & Kaplan, 1982, p. 147), a preference for natural environments is an expression of human needs and capabilities which likely afforded survival (Wells & Evans, 2003). Overall, preference can be seen as an important evolutionary function that attracts us to settings in which we can function and thrive. The work on preference is inextricably linked with purpose and perception – making the case for aesthetics to have at least some degree (conveying the functional appropriateness of features) within a setting (Kaplan, 1975).

1.2.2 The Impact of Nature on Health

Exposure to nature has a positive relationship to health outcomes, including improved mental wellbeing, decreased stress, cognitive development, social health, attention restoration, memory, and self-discipline (Barton & Pretty, 2010; Pretty et al., 2005; Wells & Evans, 2003; McCormick, 2017).

Attention Restoration. There is substantial support for the link between natural environments and restoration, as well as the preference for nature as a restorative environment (Hartig, 2004; Hartig & Evans, 1993; Hartig et al., 1997;

Heerwagen & Orian, 1986; Kaplan, 2001; Korpela, Kytta, & Hartig, 2002). Kaplan and Kaplan's theory of attention restoration (ART) builds on evolutionary principles that natural environments restore the attention that is reduced by functioning in contemporary environments (Hartig, Korpela, & Gärling, 1997; Kaplan & Kaplan, 1989). Based on William James' (1890) idea that attention can be divided into involuntary attention, which is captured by fascinating or intriguing stimuli, and direct attention, which is directed by cognitive processes and requires more mental effort, the Kaplans' proposed that exposure to nature helps improve our focus and ability to concentrate by restoring the direct attentional capacity.

ART defines the four factors that can make environments restorative as *being away*, *extent*, *soft fascination*, and *compatibility*. Being away includes privacy, escape, or withdrawal from the environment that is the source of fatigue or stress (Sachs, 2017; Daniel, 2014). Extent refers to the quality of the restorative environment that allows someone to feel as though they are completely immersed and in a different place (Kaplan, 1995). Soft fascination is the idea that attention is held by aesthetically pleasing stimuli that do not necessarily require focus or mental effort. It is thought to be the most conducive to restoration. Compatibility refers to the match between a person's goals and needs and the demands made on that person by the environment. A compatible match encourages reflection and contemplation, which can contribute to lasting restorative outcomes (Hartig, Korpela, & Gärling, 1997).

A study by Kaplan and Berman (2010) later examined directed attention as a resource (a term that implies a finite quantity) that is shared between self-regulation

and executive-functioning tasks; heavy demands in either of the two domains reduced performance and effectiveness in the other. Directed attention fatigue can induce negative emotions, such as irritability, decrease sensitivity to interpersonal cues, and can hinder performance on tasks, leading to increased accidents (Hartig, Korpela, & Gärling, 1997). However, a natural environment intervention led to improvements in both domains, suggesting that the natural environment can be attentionally restorative.

Research has suggested that those individuals who are attentionally fatigued, sick, or mentally ill, are poised to receive the highest benefits from experiences in nature – in other words, the degree to which someone can experience restoration is linked to their level of mental fatigue (Bringslimark et al., 2009; Chawla, 2015; Kaplan & Berman, 2010). It has also highlighted the benefit of micro-restoration, which describes settings that include the elements necessary for attention recovery but which can be experienced for very brief instances (Kaplan, 2001).

Stress Reduction. Psychological stress is defined as resulting from a perceived discrepancy between the social, physiological, and biological resources of the individual and the demands of their physical or social environment (Evans & Cohen, 1987). Ulrich (1983) and Ulrich et al. (1991) stress reduction theory (SRT), which is based on the belief that viewing or experiencing natural environments promotes emotional and physiological recovery, provides support for nature as an overall restorative environment for emotional, physical, and cognitive stress and fatigue.

This theory concerns humans' affective response to visual stimuli, particularly environmental scenes with qualities such as complexity and depth, and natural contents (vegetation, water). This visual exposure to nature mediates the negative effects of stress: restricting negative thoughts, evoking positive emotions, and reducing cognitive overload and psychological arousal while positively affecting arousal and cognitive overload and enhancing positive emotions (Berto, 2014; Bringslimark et al., 2009; Cohen, 1978; Wohlwill, 1974).

Human Connection with Nature. Studies have shown that a connection with the natural world can facilitate faster and more complete physical and psychological healing (Korpela et al., 2001; Lohr et al., 1996; Ulrich, 1984, 1999; Van den Berg et al., 2007). Nature promotes psychological relief by allowing an escape of human-centered built environments and engendering a sense of comfort and sense of place (Berto, 2014; Bingley & Milligan, 2004; Frumkin, 2001). This sense of place, which is associated with the physical and spatial experience of a place, has been linked to an enhanced sense of attachment and belonging, social functioning, quality of life, and the frequency of activities related to well-being and self-care (Berto, 2014; Kellert & Wilson, 1993; Naderi & Shin, 2008).

Burnout. Stress-Triggered Fatigue Reactions (STFR), fatigue depression, and burnout syndrome are considered "burnout diseases" in which individuals experience general feelings of being rushed and stressed, coupled with fatigue, irritability, and an inability to concentrate (Stigsdotter & Grahn, 2003b; Uvnäs-Moberg, 1997). Individuals suffering from burnout diseases have difficulty tolerating others, and are hyper-susceptible to stress. Burnout diseases are more likely to

affect those who are highly engaged in other peoples' lives and fates; women, especially those in "caring" professions such as nurses and teachers; and those between 25 and 45 years old (Stigsdotter & Grahn, 2003b). Gardens and therapeutic horticulture treatment programs have shown promise in ameliorating the symptoms of burnout diseases, decreasing stress and enabling individuals to increase self-confidence through successes in carrying out tasks (Pariola, 2001).

1.2.3 The Impact of Nature on Children

Health outcomes for children. This significance of this research is further supported by investigations into the mechanisms through which nature provides affective, cognitive, mental, and physical benefits for children. Due to their plasticity and vulnerability, children stand to reap more profound benefits from their experiences with nature (Wells & Evans, 2003).

Nature provides opportunities for engagement that are central to recovery from psycho-physiological stress, which in turn creates positive changes in emotional states and contributes to physical, cognitive, psychological, and social development (Adams & Savahl, 2017; Berman et al., 2008; Berto, 2014; Faber Taylor & Kuo, 2006; Kellert, 2005). For example, the perceived stress associated with hospital visits and stays can trigger a state of mental fatigue and "cognitive chaos" due to the increased number of stressors, complexity, and unfamiliarity within the environment (Kaplan & Kaplan, 1989). This has been linked to negative child health outcomes, including increasing emotional distress and physical pain, while stress recovery in pediatric hospitals has been associated with faster wound healing, reduced pain,

and enhanced immune functioning in patients (Parsons, 1991; Sherman et al., 2005; Ulrich 1983, 1991, 1993; Varni & Katz,1997).

Mental Health of Children. In the US, children have increasingly been experiencing physical, mental, and cognitive health disorders, including increased depression, cognitive disabilities, obesity, diabetes, and attention disorders, which may be directly tied to the decline in physical activity and exposure to nature (Center for Health, Environment, and Justice, 2001; Centers for Disease Control, 2007; Faber Taylor & Kuo, 2006; Frumkin & Louv, 2007; Kellert, 2005; Louv, 2008; Pretty et al., 2005). In fact, there is a strong positive correlation between children, age 0-18, spending more time indoors and pediatric mental and behavioral health problems (McCormick, 2017). Based on diagnostic interview data from National Comorbidity Survey Adolescent Supplement (NCS-A), 49.5% of adolescents had at least one mental disorder, an estimated 22% showed severe impairment, and an estimated 3.2 million adolescents (aged 12-17) in the U.S. had at least one major depressive episode (according to the DSM-IV criteria), accounting for roughly 13.3% of the 12-17-year-olds in the U.S. Additionally, an estimated 31.9% of adolescents had an anxiety disorder, 8.3% of whom showed severe impairment (Harvard Medical School, 2007; Kressler et al., 2005; Merikangas et al., 2010).

Much of the research on mental health, nature experiences, and children have focused on the benefits of greening schoolyards and urban spaces, and the subsequent effects on attention-deficit-hyperactive-disorder (ADHD) and social interactions. The research examining ADHD and green space has suggested a beneficial association between experiences in nature and reduction of symptom

severity (Faber Taylor et al., 2001; van den Berg & van den Berg, 2011; Vanaken & Danckaerts, 2018). Children and adolescents with ADHD were shown to have better concentration, less hyperactivity, and fewer behavioral problems after activities in nature (Faber Taylor et al., 2001; Faber Taylor, et al., 2002; Markevych, 2014). Greening schoolyard studies in Austria, Scotland, Australia, and the U.S. have shown significant increases in children and adolescents' psychological well-being, concentration and classroom engagement, relief from stress, positive behavior, happiness, perception of school environments, and health-related quality of life (Bagot et al., 2015; Chawla, 2015; Kelz et al., 2015; Kuo et al., 2018; Roe & Aspinall, 2011). However, the question remains as to what extent the social dimension and natural environment interact to explain the efficacy of nature-based interventions (Bloomfield, 2017).

Contact with nature has been shown to have wide-reaching impacts on mental well-being, social connectedness, and cognitive development of children (McCormick, 2017). A lack of exposure to nature can result in anxiety, anger, sadness, and frustration (Ulrich, 1993), while interaction with nature has been shown to reduce depression and anxiety (Berman et al., 2008; van den Berg & Clusters, 2011), enhance a sense of attachment, belonging, and quality of life (Berto, 2014), develop creativity (Crain, 2001), improve affect & cognition (Bratman et al., 2015), mood (van den Berg et al., 2003), attention, anger, fatigue, and sadness (Bowler et al., 2010; Thompson Coon et al., 2011).

Green spaces have also been shown to foster social interaction, improve social skills, give children greater confidence in social settings, decrease peer

problems, and promote social trust and perceptions of community safety (Amoly et al., 2014; Kuo et al.,1998; Bloomfield, 2017). Other benefits include improvements in memory, productivity, performance, competence, self-discipline, self-identity, and self-efficacy. Green spaces can also help buffer the impact of stress, empower children to develop a sense of independence, and improve symptoms and behaviors of various other psychological disorders (Chawla, 2015; Chawla et al., 2014; Cheng & Monroe, 2012; Dravigne et al., 2008; Gill, 2014; Grinde & Patil, 2009; Hamman, 2013; Heerwagen & Orians, 1986; Kahn et al., 2008; McCormick, 2017; Ming Kuo, 2013; Norwood et al., 2019; Sobel, 1990; Wells & Evans, 2003).

Although there is a broad definition of “psychological benefits”, good mental health is generally seen as a balance between capability, independence, coping with stress and adversity, and cognitive, emotional, and physiological changes that enhance adaptive capacity and effectiveness (Bird, 2007; Bringslimark et al., 2009).

For a more comprehensive exploration into the psychological, cognitive, and social benefits of the natural environment for children, see the systematic reviews by McCormick (2017), Adams and Savahl (2017), Norwood et al. (2019), and articles by Bratman et al., (2012) and Mauss et al. (2011).

Physical Health of Children. Richard Louv, the author of *Last Child in the Woods*, coined the term “nature-deficit disorder” to describe the shift from children spending their leisure time active and outdoors to a more sedentary lifestyle dominated by time indoors spent interacting with media (Arundell et al., 2016; McCurdy et al., 2010). In light of this, many studies have focused specifically on the physical health benefits of nature for children. Exposure to nature can provide pain

relief, accelerate healing, and improve immune function by enhancing human natural killer cell and cytokine activity (Kellert & Calabrese, 2015; Mao et al., 2012; Rakow & Eells, 2019). Contact with nature in children has also been shown to reduce blood pressure and cortisol levels, as well as regulate circadian rhythms to produce more high-quality and longer sleep at night (Kelz et al., 2015; Soderstrom et al. 2013; Ward Thompson et al., 2012).

Rook's (2013) biodiversity hypothesis proposes that the microbial diversity found in nature must be recognized as an essential service afforded by the environment as the diversity plays an immense role in developing and maintaining a healthy immune system. This hypothesis supplements Ulrich's psychoevolutionary theory of SRT in that humans have immediate positive responses to natural settings, which include a diverse range of microbiomes (Chawla, 2015). This hypothesis may help to explain the long-term health benefits of living in close proximity to biodiverse, natural environments.

Furthermore, studies have linked children's declining mental and physical health to environmental toxins and pollutants, as children's physiology and exposure patterns (such as lack of access to clean air and green environments) cause children to be more vulnerable to the negative effects of these toxins (Crom, 1994; Faber Taylor et al., 2001; Pretty et al., 2005; Wells, 2000). Results such as these have made it clear that children are disproportionally suffering long-term developmental consequences of limited interaction with green environments (Kellert, 2005).

For more information on the health and wellbeing benefits of nature, see the systematic reviews from Bowler et al. (2010) and Ohly et al. (2016), and the meta-analysis from Kuo (2015) and McMahan and Estes (2014).

Interacting with Nature. Research into the specific therapeutic effects of nature has largely categorized three types of beneficial human-nature interactions: visual or multi-sensory contact with nature (through a window, nature-themed art, augmented reality); nearby nature (in the presence of interior or exterior natural elements such as plants); and active (involvement/participation) (physical or green exercise, horticulture therapy) (Heerwagen, 2009; Jiang, 2015; Pretty, 2004; Ward Thompson, 2011).

Visual Contact. A visual connection to nature, characterized as viewing living systems and natural processes, has been shown to reduce stress, increase concentration and positive emotional functioning, and improve recovery rates (Ryan et al., 2014). The research on the stress-reducing capabilities of visual contact with nature is connected to the cognitive and physiological changes that occur when sensory stimuli (auditory, haptic, visual, olfactory, or gustatory) are triggered in reference to nature (Ryan et al., 2014). These benefits have also been linked to improvements in mood and self-esteem (Barton & Pretty, 2010; Biederman & Vessel, 2006; Bloomer, 2008; Grahn & Stigsdotter, 2010; Grinde & Patil, 2009; Hartig et al., 2003; Kahn et al., 2008; van den Berg et al., 2003).

Visual contact with nature has also been examined through the psychological benefits of views out of a window. Along with Ulrich's (1984) seminal research on window views and recovery experiences in hospitals, several studies have shown

that these views of nature have been linked with superior memory, impulse inhibition, and attention (Berman et al., 2012; Faber Taylor et al., 2002); psychological benefits such as increased mood (Hartig et al., 2003; Hartig et al., 2014) and greater subjective well-being (Kaplan, 2001); fewer sick days and increased job and overall life satisfaction (Kaplan, 1993); and buffer negative impacts of job stress on the intention to quit (Leather et al., 1998).

These kinds of views result in brief respites by drawing indirect attention and providing micro-restorative opportunities through soft fascination that lead to higher subjective tranquility and effectiveness and increased satisfaction with immediate surroundings (Kaplan, 2001). Since these interludes are short-lived, the restorative effects of window views are thought to derive from the accumulation of these momentary pauses that provide visual access to natural content including smooth ground textures, trees, and a sense of enclosure that holds the promise of more information just outside the boundaries of the view (Kaplan, 2001; Kaplan et al., 1998; Kaplan et al., 1972; Tennessen & Cimprich, 1995). Windows also enable access to the sky to check the weather, watch clouds, and see the sunsets and sunrises – activities that affect individuals' sense of effectiveness and satisfaction (Kaplan, 2001).

A theoretical examination of aesthetic values in nature, such as complexity, choice of colors, balance, and perspective, suggests nature itself contains a variety of powerful aesthetic stimuli (Grinde, 1996). Beauty, a pleasing visual input for the mind, implies that aesthetics is an inherent positive experience (Grinde & Patil, 2009). Kellert (1996) described aesthetics as one of the nine basic values of the

natural world that encompass the physical attraction and overall appeal of nature. Several studies that have looked at the value of plants in restoration and as visual features of an environment have postulated that these aesthetic experiences are what triggers the restorative effects associated with plants (e.g. Park et al., 2004).

Nearby Nature. The benefits of proximity to nature include a positive correlation between good perceived health and proximity to nearest green space, and increased life satisfaction and happiness over a longitudinal study, indicating long-term effects of nearby natural environments (Alcock et al., 2014; Stigsdotter et al., 2010). Better access to green spaces is hypothesized to increase both the frequency and level of physical activity by decreasing the perceived effort to complete these activities and increasing overall motivation (Gladwell et al., 2013). Passive interaction with nature has been shown to increase positive affection, reduce pain perception, increase creativity, improve task performance through renewed concentration and attention, and reduce psychological arousal (Bringslimark et al., 2009; Dunnett & Qasim, 2000; Lewis, 1973).

Studies on the effects of indoor plants have reported increased pain tolerance and management for patients in healthcare facilities (HCF) (Grinde & Patil, 2009; Lohr & Pearson-Mims, 2000; Park & Mattson, 2009; Spring, 2016), decreased perceived job stress, increase job satisfaction (Kaplan & Kaplan, 1989), increased reaction time, attentiveness, and confidence (Lohr et al., 1996; Shibata & Suzuki, 2004), decreased fatigue and overall discomfort (Fjeld et al., 1998), and have even increased longevity and improved reported physical health (Spring, 2016; Takano et al., 2002).

Some research suggests that the psychological benefits of indoor plants are contingent upon the context of the environment and the characteristics of the individuals encountering them (Liu et al., 2003; Lohr & Pearson-Mims, 2000; Kim & Mattson, 2002; Shibata & Suzuki, 2004). Because the human response to an environment is thought to vary as a function of their attitudes, values, and beliefs, this has led researchers to examine plants and nature within the context of a given culture, social conditioning, or personal experience (Altman & Chemers, 1980; Tuan, 1974). Plants are also thought to symbolize nature, and, particularly in high volumes, the recreation of outdoor nature indoors (Bringslimark et al., 2009; Park et al. 2004). The visual stimulation can evoke aesthetic experiences of nature and hold indirect attention, supporting overall psychological restoration (Bringslimark et al., 2009). Flowering plants especially have been thought to hold symbolic and cultural meaning (Adachi et al., 2000; Kim & Mattson, 2002; Park et al., 2004).

Active Involvement. Active involvement of nature includes exercising in nature, participating in horticulture therapy, and spending time in healing gardens (Cooper Marcus & Barnes, 1995; Stigsdotter & Grahn, 2003a). These interventions have been linked to recovery from stress; enhanced dexterity and mobility; increases in self-efficacy and self-esteem; improvements in mood and social interaction, and a more positive view of self (Cooper Marcus & Barnes, 1995; Rappe 2005; Spring, 2016; Stigsdotter & Grahn, 2003a; Ulrich, 2002).

Much of the work on cognitive benefits of experiences with nature have come from school studies that have showed the benefits of outdoor education for children, such as greater attention capacities, higher measures of knowledge gain and

transfer, and improved motor coordination (Basile, 2000; Liberman & Hoody, 1998; Ratanapojnard, 2001). These health effects have been attributed to direct experiences of nature, including garden design and content, and the activities it affords (Stigsdotter & Grahn, 2003a).

Social and therapeutic horticulture practices involve nature-based interventions with vulnerable groups, especially those with mental health needs (Sempik et al., 2003). While the focus is on improving the well-being of participants based on ART and SRT, gardening offers opportunities to improve social skills and self-confidence, develop responsibilities in the care of living things, and provides visual, mental, and auditory stimulation (Burgess, 1990; Sempik & Bragg, 2016; Sempik et al., 2014). These activities can also be adapted to the abilities and needs of individual participants, allowing everyone to benefit from the same activities at different levels of capability (Catlin et al., 1992; Riordan & Williams, 1988).

Interviews from Cooper Marcus and Barnes' 1995 evaluation of four gardens in California revealed that over 75% of individuals felt calmer and more relaxed after spending time in the garden in their facilities. The data also indicated two mood shifts – a "pleasing drop in energy level" and a "spiritual uplift" – and found that visitors to the gardens were more likely to experience a pleasing drop in energy, characterized by lower stress and increased relaxation, while patients were more likely to report feeling the spiritual uplift (Cooper Marcus & Barnes, 1995).

Engaging in physical activity in these nature-settings, also known as "green exercise", has long been linked to positive short and long-term health outcomes, including improved self-esteem and mood (Barton & Pretty, 2010). Green exercise

has been shown to be an effective mental health regulation strategy and engaging in regular green space experiences leads to both longevity and the decreased risk of developing mental health issues (Takano et al., 2002). Some benefits of green exercise include increased positive engagement and feelings of revitalization compared to indoor physical activity, and an improved sense of effective functioning and productivity (Health and Safety Executive, 2008; Kaplan, 2001; Markevych et al., 2014).

Effect on Development. In 1996, Kellert defined nine basic values of the natural world that impact evaluative development, which stresses the creation of beliefs, values, and general moral perspectives. The values include aesthetic, dominionistic, humanistic, moralistic, naturalistic, negativistic, scientific, symbolic, and utilitarian. These values are proposed to develop over three stages: between three and six years old; from six to 12 years old; and from 13 to 17 years old

The first stage primarily emphasizes satisfying material and physical needs, achieving feelings of control, comfort, and safety, and avoiding threat and danger. During the second stage of development, children are more cognizant of the “other-ness” of the natural world, develop feelings of responsibility to care for nature, and are more likely to explore unfamiliar natural settings which aid in expanding their knowledge, competence, and ability to cope with situations independent of adult supervision (Shepard, 1996; Kahn & Kellert, 2002). The third and final stage is a transitional stage from childhood to adolescence, and is characterized by the rapid maturation of a conceptual and ethical reasoning about nature and the environment. During this stage, most individuals begin engaging in challenging, expansive, and

risky activities, which both test the limits of the natural world as well as nurture self-esteem, self-confidence, and an increased sense of identity. For a more complete review of the nine values, and stages of development, see Kahn & Kellert, 2002.

Many theorists have attempted to organize nature's effects on child development. Nussbaum's (2011) proposed 10 "central capabilities" define ways in which access to nature enables healthy development. This framework is consistent when other quality-of-life frameworks in Ward Thompson and Aspinall's 2011 review on the benefits of access to nature for adults. The 10 capabilities include bodily health (better motor coordination, balance, and healthy weight); bodily integrity (free exploration and manipulation of the environment); senses, imagination, and thought (concentration, imagination, resourcefulness); emotions (development of place attachments, emotional ranges, restoration, experiences of emotional competence); and play (Nussbaum, 2011, p. 33-34). It is important to note, however, that a central challenge in the research on the effects of nature exposure on development and health factors is separating the results from other confounding factors that may affect results (Vanaken & Danckaerts, 2018).

Contact with and experiencing nature can greatly impact the cognitive, affective, and evaluative (value-related) development that occurs during middle childhood up through early adolescence (Kahn & Kellert, 2002). Early exposure to nature has been linked with improvements in children's cognitive development via improvements in awareness, observational skills, and reasoning, as well as with the development of imagination and a sense of wonder (Dadvand et al., 2015; Pyle, 2002). Wonder has been postulated as an important motivator for lifelong learning

(Cobb, 1977; Louv, 1991; Wilson, 1997). The cognitive biophilia hypothesis (Lawrence, 1993) proposes that symbols and images of nature, such as those found in children's books, are used to facilitate intellectual development. Learning about, naming, and identifying nature, even in crude and broad terms, can greatly facilitate the development of the capacity to retain and sort ideas and information (Kellert, 1996; Shepard, 1978). The rapid cognitive and intellectual growth characteristic of Kahn and Kellert's second stage of development is greatly enhanced by direct contact with nature and supplements critical thinking and problem-solving skills through these forays into the nonhuman environment.

Ongoing contact with nature, especially during middle childhood, is a crucial factor in personality development (Sobel, 1993). At this age, the self is "under construction" and children use nature in order to achieve an identity separate from their parents and other individuals in their lives (Searles, 1959; Sobel, 1993). Children use nature as environments in which to experiment, fail, and succeed, forming their self-definition in the process of discovery and expression of their emerging identities (Clayton, 2003; Louv, 2008; Kleiber, 1999). Children's subjective accounts of their lives show that becoming familiar with nearby natural environments help to construct their socio-spatial identities through the discovery of opportunities to generate feelings of self-sufficiency, independence, and autonomy (Jones, 1999; Kahn & Kellert, 2002).

Children in mid-childhood demonstrate competence establishing a self separate from the continuous care and control of adults (Erikson, 1968). Cobb has remarked that during these years, "what a child wanted to do most of all was to

make a world in which to find a place to discover a self" (1959, p. 540). Construction and building, which instill a sense of competence, is one way that children physically and symbolically prepare themselves to transition to adolescence; a time when self-identity is often called into question (Sobel, 1993). Chawla (2015) has also found that a sense of relationship between children and the natural world serves as a source of later creativity.

Other research has also highlighted the importance of contact with outdoor environments during middle childhood and early adolescence, when developing a sense of independence and autonomy and a sense of place within the broader environment may aid in the transition from childhood, through adolescence, into adulthood (Altman & Wohlwill, 1978; Arnett, 2006, 2007; Kahn, 1999; Ratanapojnard, 2001). Sebba (1991, p. 147) suggests, "The natural environment is characterized by a continual change of stimuli (over time or across area)," with this continuous change in nature presenting unpredictable challenges that engender a range of adaptive, problem-solving responses. This instability and constant shift of sensory, spatial, and temporal stimuli requires alertness and attention and helps the child's awareness and recognition (Kahn & Kellert, 2002).

Affective maturation refers to the emergence of emotional and feeling capacities during middle childhood. It has been hypothesized that in most, if not all, learning situations, affect precedes intellect and concrete thought as a basis for development and maturation (Kahn & Kellert, 2002). The natural world provides an "unfailing source of stimulation" (Sebba, 1991, p. 415) that elicit a range of emotions, including wonder, joy, satisfaction, challenge, pleasure, and enthusiasm, but also

fear, anxiety, danger, and a sense of uncertainty (Kahn & Kellert, 2002). Joy and wonder are especially enhanced by the emotional salience of natural environments, and an enthusiasm or passion for life, which greatly benefits from immersion and interaction with nature, has been found to be essential to personality formation and learning (Carson, 1998; Kahn & Kellert, 2002).

Favorite Places. Direct physical contact with nature not only plays a formative role in childhood development, but also serves as the basis for the formation of favorite places (Kahn & Kellert, 2002). Many studies have investigated the characteristics of children's favorite places, which have been associated with feeling relaxed and comfortable but also important retreats from distressing situations (Chawla, 2015; Korpela, 2002). When interviewed about their favorite places, children often identify natural settings or else describe these places with a long list of natural features (Hart, 1979, Korpela, 2002). Observational studies have shown that younger children spend large amounts of time in these places constructing things out of loose parts such as earth, branches, water, stones, and grass, but by the age of 12, their interest in transforming the landscape waned as their social worlds became more important (Hart, 1979; Nicholson, 1971).

When Korpela, Kyatta, and Hartig (2002) examined 55, 8-14-year-old Finnish children's favorite places, they found that 75% of the children who identified a favorite place stated that they went to these places to clear their mind or reflect on personal matters, forgetting troubles, or to be free and relaxed. A study with aboriginal children in rural Australia showed that this pull of the natural environment on children is a universal experience (Kreutz, 2015). These children repeatedly used

natural areas as retreats for reflection, privacy, and peace, for restorative experiences, and to watch their community from a distance. Kreutz also observed that the children gave their individual sites names, signifying developing place attachments, and the, “multi-functionality, flexibility, and responsiveness of natural features and properties ensured that children of all ages and abilities experienced a degree of environmental congruence” (Kreutz, 2015, p. 210).

Research into children’s favorite places suggests that these environments induce changes in emotional and cognitive states, which affects the characteristics of restoration (Korpela, 1989; Korpela & Hartig, 1996). When Hartig et al. (1997) examined conscious preferences for the four components of attention restoration theory, they found that they correlate very closely with aspects of the environment in independently reported “favorite places.” In 2002, Korpela, Kytta, and Hartig conducted a study on favorite places, restorative experiences, and self-regulation and found that over half of the children in their study reported using their favorite places for cognitive restoration and one-third reported using their favorite places for emotion-regulation. They also found that children were using different types of places for different emotion regulation strategies, indicating that children need an array of spaces with varying attributes (for privacy, play, etc.).

Environmental strategies of affect regulation are the utilizations of an socio-physical setting (natural or urban) to regulate sadness, stress, or affect (Korpela, 1992; Naragon-Gainey et al., 2017; Skinner et al., 2003; Korpela et al., 2018). When children are asked to grapple with problems beyond their cognitive abilities, control, and understanding, they can become anxious, withdrawn, and even develop a

phobia to the issues presented (White, 2004). Favorite places, whether described as a natural setting or not, often carry themes of affect regulation and their use is described as a restorative, stress-alleviating experience (Johnsen, 2013; Korpela et al., 2001; Mason et al., 2010; Korpela et al., 2018).

Experimental evidence supports the idea that seeing or visiting natural areas is an effective strategy in regulating affect and alleviating mental fatigue and stress (Parsons et al., 1998; Hartig et al., 2003; Berman et al., 2008). Emotion-focused strategies, such as withdrawing to a favorite place, have been postulated as useful when individuals do not have the ability to change or fully escape a negative situation (Bonanno et al., 1995). The perceived frequency of use and efficacy of these emotion-focused environmental strategies have been positively correlated with perceived health and support the idea of mostly natural spaces as restorative environments that benefit well-being (Bowler et al., 2010; Hartig et al., 2014; Kondo et al., 2018; Korpela et al., 2018).

Play. According to the American Academy of Pediatricians (AAP), unstructured play afforded by natural environments affects the amount of physical activity that children engage in, while also allowing them to develop their imagination and creativity and build physical strength and dexterity (McCurdy et al., 2010). Historically, the importance of play to children has been underestimated; it is widely considered optional rather than essential to development (Shell, 1994). While regular play results in immediate health benefits and possibly instills long-term healthy behaviors, the loss of creative play has been recognized as coinciding with

increases in the prevalence of childhood psychiatric disorder and with declines in creativity (Rosin, 2014; Ward Thompson et al., 2008).

R.C. Moore described play with natural materials as forming, “the basis upon which the child can acquire creative intelligence by interacting with the inherited world” (1986, p 9). Similar to what Lynch (1977) and Hart (1979) described, Moore found that these places allowed children to explore, test their capabilities, develop a sense of competence, and learn new things – all supportive of healthy human development. Much of the manipulation of the environment (creating forts, playhouses) that Hart observed in 1979 involved both dramatic play and negotiation, and signaled that the children were not only practicing adult roles, but also acting out real-life situations and finding cooperative solutions (Hart, 1979). By symbolizing these phenomena, children were creating what Erikson (1963) referred to as “microspheres”, which are imagined worlds that allow children to create a foundation for play by creating self-paced challenges before moving into the more complicated, social world in which children have little to no control.

Play in nature affects healthy brain development by encouraging exploration and object building, which in turn strengthens wayfinding, orientation, group decision making, problem solving, and the ability to respond to changing contexts (McCurdy et al., 2010; Heerwagen, 2009; Kahn & Kellert, 2002). Play, use of the senses, thought, and imagination are all included in Nussbaum’s 10 central capabilities, and when children engage in creative play together, they are able to exercise all of these capabilities at once (Chawla, 2015). Imaginative play, often stimulated by props like stones, sticks, and flowers, has been found to be more diverse, with more

imaginative and creative play that fosters social, collaborative, and communication skills and is considered to be a cornerstone of cognitive, emotional, and social development (Bingley & Milligan, 2004; Faber Taylor & Kuo, 2006; Fjortoft, 2001; Fjortoft & Sageie, 2000; Heerwagen, 2009; McCurdy et al., 2010; Moore & Wong, 1997; Pyle, 2002; Soga & Gaston, 2016). These more natural areas have been found to provide longer, more socially cooperative, imaginative, and sensory play than asphalt, built play structures, or lawns (Cloward Drown & Christensen, 2014; Grahn et al., 1997; Herrington & Studtmann, 1998; Luchs & Fikus, 2013; Stanley, 2011).

Children who play in natural environments compared to a standard playground have been found to have better motor fitness, including coordination, balance, agility, and motor skills, signifying that play affordances in nature impact motor fitness and skill development (Adams & Savahl, 2017; Fjortoft, 2001). This type of play has even been found to reduce and sometimes fully eliminate bullying and violent behavior among youth (Coffey, 2001; Malone & Tranter, 2003; Moore & Cosco, 2000). Herrington and Studtmann (1998) found that on built play structures, children use physical prowess to establish social hierarchies, but in “vegetative rooms” created through the naturalization of school grounds, there is more fantasy play in which the social hierarchy is based on, “a child’s command of language and their creativity and inventiveness in imagining what the space might be” (p. 203).

1.2.4 Designing for Health

Psychologically supportive healthcare environments focus on architectural choices, features, and attributes of buildings that are linked to wellbeing needs and experiences (Dijkstra et al., 2008; Ryan et al., 2014; Ulrich et al., 2004). The "healing environments" within the healthcare facility (HCF) suggest that the physical environment can affect the experience within the HCF, including how quickly patients recover from illness, how they perceive the quality of care, and their satisfaction and willingness to recommend the facility (Stichler, 2001; Whitehouse et al., 2001). A healing environment, as described by the Healing Environment Steering Committee at Children's Hospital and Health Center, San Diego, is:

> "a term used to describe a physical and cultural atmosphere created to support families through hospitalizations, medical visits, healing, and bereavement….a philosophy of caring; that is, the desire to develop a space that engenders feelings of peace, hope, upliftment, joy, reflection, and solace and one which provides opportunities for relaxation, enrichment, spiritual connection, humor, and play…these factors play a considerable role in the physical, emotional, and spiritual healing process. The goal of the Healing Environment is to transform the hospital setting into a place that addresses the human spirit and supports families to positively cope with and transcend illness" (Whitehouse et al., 2001, p. 303-304).

Healthcare environments that are psychologically supportive are at the center of a socio-ecological approach to health (Maller et al., 2005). This approach recognizes that health is holistic and requires a multidisciplinary approach to manage and promote all-around health successfully (Maller et al., 2005). A recently adopted health-related quality of life (HRQOL) metric, which relates the impacts of physical, mental, emotional, and social functioning, represents the broader view of care that not only focused on physical conditions but also strives to improve satisfaction and overall quality of life (Sherman et al., 2005; Sullivan, 2003). HRQOL

assesses the subjective perceptions of health status and expectations of the individual (Sullivan, 2003).

In recent years, there have been many approaches to designing spaces that reflect the relationship between humans and the natural world. Along with a branch of architecture called Design and Health, the following approaches generate functional efficiency but also improve the health processes within the built environment (Dilani, 2001).

Salutogenic Design. Salutogenic design aims to proactively promote health rather than focusing on reactionary healing (Antonovsky, 1979; Dilani, 2001). It utilizes the health-promoting effects of nature through a biopsychological model that connects the body and the mind (Sachs, 2017). It is based on Antonovsky's salutogenic theory, which proposes that a built environment that is "comprehensive, manageable, and meaningful" will support health through a coherent environment.

Supportive Design. Ulrich's theory of supportive design was developed on the premise that people in healthcare settings, especially patients, staff, and visitors, are under inordinate amounts of stress (Ulrich, 1991, 1999). However, HCF should be designed to attenuate and even help people cope with the physical, emotional, and mental stress associated with being, living, or working in a HCF by exposing them to physical features and social situations that have stress-reducing attributes. The focus on stress as a dependent variable is practical, as it can be measured through biochemical, physiological, behavioral, and cognitive outcomes intended to either alter the stressful event itself or accommodate its effects (Taylor, 2012). Stress can increase heart rates, blood pressure, and cortisol levels, slow wound

healing, disrupt sleep patterns, and indirectly lead to chronic health problems such as heart disease, digestive disorders, and depression (Gouin & Kiecolt-Glaser, 2012). The theory of supportive design proposes three factors that are essential in reducing stress through design (Ulrich, 1991, 1999). These include a sense of control in the physical and social surroundings, access to social support, and access to positive nature distractions, defined as “an environmental feature or element that elicits positive feelings, holds attention and interest without taxing or stressing the individual, and therefore may block or reduce worrisome thoughts” (Ulrich, 1991). Following from his theory of supportive design was Ulrich’s theory of Supportive Gardens, which further focuses on how to reduce stress by adding a fourth element: physical movement and exercise (Ulrich, 1999).

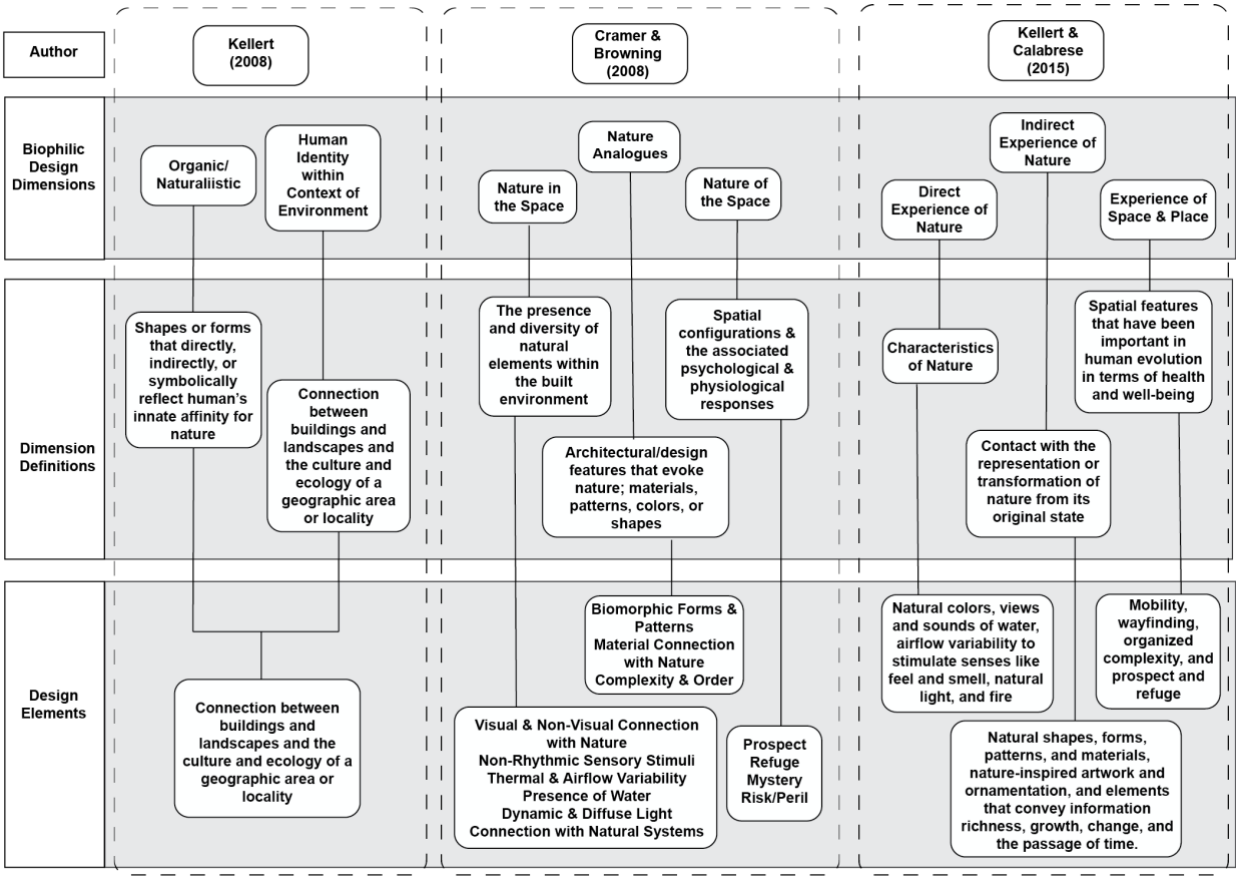
Biophilic Design. Biophilic design is described as, “the deliberate attempt to translate an understanding of the inherent human affinity to affiliate with natural systems and processes – known as biophilia” (Wilson, 1984; Kellert & Wilson, 1993). One of the most important aspects of biophilic design is continuing the innate connection between humans and nature into the built environment (Gillis & Gatersleben, 2015). The incorporation of nature and natural materials instills a sense of a positive relationship to nature into the built environment, and helps to increase a person’s overall connection to nature (Kellert et al., 2011). This can help to create stronger bonds to the culture or ecology of the place, encourage people to engage more in the natural environment, and encourage stewardship to motivate eco-minded and sustainable behaviors over time (Kellert, 2008; Kellert & Calabrese, 2015; Tang et al., 2015). Therefore, it is essential that biophilic designs consider the

occupants, location, and function of the building in order to create a coherent, ecologically sound, and productive environment that offers emotional, intellectual, and spiritual benefits (Gillis & Gatersleben, 2015; Kellert & Calabrese, 2015).

There have been a number of conceptual frameworks for biophilic design meant to help describe the building and its characteristics (see Figure 1). Kellert (2008) defined two dimensions of biophilic design. The first is an organic or naturalistic dimension and the second establishes human identity within the context of the landscape, culture, and spirit of place. Cramer and Browning's (2008) conceptual framework established three categories to define what a biophilic building should portray – nature in the space, natural analogues, and nature of the space – as well as a list of biophilic conditions. To elaborate on the biophilic design frameworks, Kellert and Calabrese (2015) proposed three categories for the experience of these biophilic design elements: *direct experience of nature*; *indirect experiences of nature*; and *experience of space and place* (see Figure 1). Within their indirect experience of nature category, Kellert and Calabrese highlight contact with the representation or transformation of nature from its original state, and elements that convey growth, change, and the passage of time. Research has shown that the process of aging and weathering of materials – elements of indirect experiences – evoke a sense of familiarity and satisfaction that provides an intuitive understanding and benefits of the passage of time (Kellert & Calabrese, 2015). These dynamic features reflect an adaptive response to stresses and challenges of survival over time and help to overcome attenuation and sustain positive health impacts (Kellert & Calabrese, 2015; Ryan et al., 2014).

Figure 1

Description of Biophilic Elements and Frameworks



Successful biophilic design has a number of positive mental and physical impacts through both visual and non-visual connections with nature (Hunter et al., 2010). The presence of natural features (curvilinear forms, gradations, colors, textures) and elements can benefit human emotional well-being, cognitive efficiency, and the healing process (Berto, 2014). Studies have also shown enhancements in productivity, performance, attention and motivation; enhanced physical fitness and health; increased comfort and satisfaction; increased positive emotions and a reduction in stress and negative emotions; improved problem solving and creativity;

better coping and mastery skills; and improved social interaction (Hartig et al., 1991; Kellert & Calabrese, 2015; Park et al., 2009; Steg, 2007). For a more complete review of these categories, characteristics, and impacts, see Ryan et al., 2014 and Tyrväïnen et al., 2014.

1.2.5 Access to Nature in Healthcare Settings

As part of a psychosocio-ecological approach to healthcare, passive and active nature contact must be incorporated as an essential component of the physical environment (Cooper Marcus & Sachs, 2014; Taylor, 2010). For hospitalized children, this connection to nature is particularly important as it can strengthen their sense of connectedness and individuality by allowing them to explore and gain perspective on their place within the natural world (Arnett, 2006, 2007; Wyles et al., 2019). This affiliation can enhance children's emotional and cognitive states as well as allow them to derive more restorative benefits and improved overall life satisfaction (Coombes & Jones, 2010; Mayer et al. 2009; Tam, 2013; Wyles et al., 2019). These environments also provide opportunities for experiences, discoveries, play, socialization, and the expression of self-identities within the confines of the hospital by allowing children to test, fail, and succeed in their environments (Adams & Savahl, 2017; Louv, 2008; Kleiber, 1999).

In pediatric HCF, gardens provide this access to the restorative benefits of the natural environment, and can have positive implications for patients, visitors, and staff. Hospitalization can be extremely stressful for both the child and family members, both of which can benefit from the presence of gardens within the hospital

environment (Carpman et al., 1993; Strain & Grossman, 1975). Being hospitalized has been generally associated with fear, anxiety, and uncertainty, which may affect the healing process for patients (Broadbent et al., 2003; Dijkstra et al., 2008; Mason et al., 1965). For children, one of the most important factors is that the garden allows them to get away from the hospital and be in a physically and psychologically different place. The change of location helped them to gain perspective on their own lives, as well as help them maintain a sense of self and a more positive outlook (Davis, 2011). Child-scale features increased this feeling of separateness and helped them feel more secure, while adolescent patients within the pediatric system found that elements that afforded privacy were most comforting (Whitehouse et al., 2001).

Generally, studies on access to nature in healthcare environments have measured practical outcomes, such as recovery times, reduced pain perception, affect, health and discomfort symptoms, social behavior, and spatial evaluations (Bringslimark et al., 2009; Moore, 1981; Ulrich, 1984; Verderber, 1986; West, 1986). There has been support for positive emotional states and distractions as the mechanisms through which nature provides the aforementioned benefits, such as those in Ulrich's 1984 view through a window study and studies on the effects of indoor and flowering plants (Lohr & Pearson-Mims, 2000; Park & Mattson, 2008, 2009; Park et al., 2004). The main idea is that the pleasant and attention holding power of plants can distract an individual from focusing on pain, resulting in better pain tolerance, lower ratings of pain intensity, and lower ratings of pain distress (Park et al., 2004). However, it should be noted that restoration needs vary with

individuals over time and plants may have greater effects in settings in which people have a need for restoration, such as HCF.

Access to nature in mental health facilities has also been shown to increase the opportunities for enhanced social inclusion and constructive interpersonal relationships that help to destigmatize mental illnesses (Chalquist, 2009; Parr, 2007). Specifically, active participation in gardens or natural environments has been shown to increase positive emotions, improve physical activity, and enhance relationships with peers and staff, as well as to help develop self-efficacy, self-confidence, and increase the perception of being a part of the community (Parr, 2007; Söderback et al., 2004). These longer-term care facilities have also seen benefits from engagement in the growing, maintenance, harvesting and cooking of garden produce (Husock & Gorman, 2018; Knezevic et al., 2016)

Therapeutic or healing gardens, a specific type of garden found within hospital settings, emphasize passive interactions with nature to promote relaxation through instorative experiences (Spring, 2016). Instorative experiences and the resulting benefits are derived from activities which take place within the garden, especially those which engender feelings of belonging and identity (Stigsdotter & Grahn, 2003a). In 2003, Stigsdotter and Grahn defined eight design characteristics that qualify a space as a healing garden. These characteristics are: *serene* (peaceful, silent, caring area); *wild* (facilitating fascination with nature); *rich in species*; *space* (facilitating a restful feeling of entering another world, a coherent whole); *the common* (green open place allowing vistas and visits); *pleasure garden* (enclosed, safe, and secluded); *festive* (meeting place for festivity and pleasure); and

culture/history (historical place facilitating fascination with the course of time) (Stigsdotter & Grahn, 2003b). Spring (2016) noted that the “serene”, “space”, “rich in species”, and “culture” characteristics appealed most to the most vulnerable and ill patients, observing that these were the patients striving to find balance and understanding.

There are many important physical features of healing gardens. They should give the feeling of physical enclosure, safe and away from the hospital environment, and include features that pull visitors in and invite them to stay, such as plants, greenery, wildlife, shade fixtures, benches, and other furnishings on which people can rest (Cooper Marcus & Sachs, 2014; Sachs, 2019). To achieve an optimal amount of green within the garden, Cooper Marcus and Sachs (2014) suggested a 7:3 ratio of “softscapes” (plants, natural materials) to “hardscapes” (paved surfaces, steps, walls).

The healing process is not only dictated by a connection with nature, but also a connection with experiencing the cyclical quality of nature (Naderi & Shin, 2008). Therefore, healing gardens should be built primarily of living materials that engage all the senses and convey the organic, constantly changing quality of nature (Stigsdotter & Grahn, 2003a; Cooper Marcus & Sachs, 2014). Seasonal aspects, such as growth and changes in lighting conditions, temperature, and colors, have been identified as independent attributes contributing to environmental preference ratings and have been claimed as the basis for aesthetic appreciation (Humphrey, 1980; Jackson et al., 1978). These qualities are characteristic of natural elements and materials (wood, stone, wool, cotton) that reveal the organic processes of aging

and weathering, along with a sense of the passage of time (Heerwagen, 2009; Kaplan, 2008; Kellert & Calabrese, 2015). The cyclical and dynamic processes of nature, including cycles of birth, death, and regeneration, evoke a sense of familiarity and satisfaction and reflect nature's capacity to adaptively respond to the stresses of survival (Heerwagen, 2009; Kaplan, 2008; Maller et al., 2005; Kellert & Calabrese, 2015). The complexity and variability of growth and development of these materials have been found to provoke pleasure and enhance well-being, and suggests an almost life-like quality of the built environment (Gullone, 2000; Kaplan, 2008; Schweitzer et al., 2004). An understanding of these kinds of changes has been linked to the ability to quell attenuation and maintain a positive outlook on health and life (Ryan et al., 2014).

The design of the garden must afford opportunities for visitors to interact with the elements of the garden, regardless of age and functional demands, as well as create different levels of demand for the entire population. This means that the designer must recognize the differences in groups of people for which the garden is intended and understand their degrees of mental and physical abilities (Stigsdotter & Grahn, 2003a; Spring, 2016). Other functional elements include shade, a variety of seating options in the sun and shade, wayfinding, privacy, features that afford exploration and play, utilities and amenities, features and furniture that can be manipulated or moved to accommodate different groups or activities, destination points to draw people in to the garden, and elements to engage actively with the garden, like plant information labels or other educational materials (Cooper Marcus & Sachs, 2014). The key challenge in healing gardens is finding a balance between

an aesthetically pleasing, information-rich environment that is interesting and complex without being overwhelming or stressful (Ryan et al., 2014).

With vulnerable populations especially, choosing the right plants can make a considerable difference in air quality (Sachs, 2019). A relatively new tool called “i-tree” enables the selection of site-specific plantings that will be robust and beneficial for air quality and storm water management, and will indicate the specific monetary value for each selection (Sachs, 2018). Plants, especially trees, absorb CO2, produce oxygen, and reduce particulate matter that contributes to air pollution (Akbari, 2002; Dadvand et al., 2012; Dela Cruz et al., 2014). Previous research on outdoor spaces within HCF have shown “fresh air” as one of the most important aspects of being able to get outdoors (Cooper Marcus & Barnes, 1995; Rodiek, 2009; Sachs, 2017). In her 2017 study, Sachs found that getting “fresh air” was the number one reason that people visited the garden (selected by 70.53% of patients and visitors and 69.85% of staff). In the figurative sense, getting “fresh air” may symbolize escape or change, particularly from the sickness and diseases found within and equated with hospital settings (Sachs, 2019).

Gardens in healthcare environments can also utilize a more active approach to the human-nature interaction. Gardening has been used to engage patients and staff in sensory and creative processes, which can help strengthen staff-patient relationships and produce tangible end-products that add to the quality of life (Spring, 2016). Horticulture therapy can encourage participation and socialization, present levels of cognitive challenges, and promote physical movement and therapy.

These gardens can contribute to nutrition or cooking-based activities, as well as provide materials for arts and crafts projects (Spring, 2016).

Active and passive interactions with gardens can provide psychological, emotional, and social benefits, and many healthcare providers have begun to incorporate these lifestyle interventions into anticipatory care and prescribe nature exposure for children who have emotional or behavioral difficulties or experience challenging personal and social circumstances (Adams & Savahl, 2017; Heerwagen, 2009; Norwood, et al., 2019). The recently launched Park Prescriptions program involves doctors or nurses prescribing time in a park or other nearby green space as part of their patient's health regimen (Parks RX America, 2018; Razani et al, 2018). The Children and Nature Network works with pediatric HCF to encourage more time in nature for children and their families by connecting them with parks and other nearby, natural environments that are easily accessible for a diverse population (McCurdy et al., 2010).

1.2.6 The Impact of Access to Nature on Healthcare Staff

The health and well-being of staff in HCF is as important as the patients (Cooper Marcus & Barnes, 1995). The physical environment of a HCF can contain elements that increase health-related complaints and induce stress among staff (Naderi & Shin, 2008; Verderber, 1986; Whitehouse et al., 2001). And from the experience of the staff, the noise, long hours, and lack of contact with the outdoors may cause exhaustion and fatigue (Pati et al., 2008). An environment with natural elements works to contrast those types of stressful environment and can contribute

to a restorative break (Naderi & Shin, 2008). In fact, green spaces at HCF have been found to act as positive distractions for staff, which leads to lower stress and fatigue, as well as afford opportunities for exercise during their shifts (Cooper Marcus & Sachs, 2014).

There is also indirect evidence that access to green spaces at HCF increases staff job satisfaction, loyalty, and their perception of the overall healthcare experience (Cooper Marcus & Barnes, 1995; Cooper Marcus & Sachs, 2014; Paine & Francis, 1990; Zadeh et al., 2014). These types of benefits can contribute to a productive and efficient work force, as well as increase the level of satisfaction for the total HCF community (Cooper Marcus & Barnes, 1995).

Benefits of Light. The benefits of exposure to daylight during the work day have been demonstrated across manufacturing, corporate office, and healthcare settings. Access to daylight not only reduces stress and improves job satisfaction and perceived quality of the work environment, it also helps staff stay alert and productive (Zadeh et al., 2014). Lighting has been shown to be the most important ambient stimulus for alertness and sleepiness in humans (Postolache & Oren, 2005; Cajochen, 2007). In terms of behavioral and psychological benefits, access to daylight can improve performance, concentration, social interactions, and mood through neuro-hormonal changes (Scott, 2000; Zadeh et al., 2014). Studies on the psychological and behavioral benefits to lighting in the workplace have found significant improvements in interpersonal interactions, as measured by level and amount of communication, and positive social interaction, measured by communication followed by laughter (Zadeh et al., 2014). Encouraging exposure to

daylight throughout the workday has been proposed as a low-cost way to increase the health and performance of healthcare staff, which has been linked to both patient satisfaction and patient and family perception of care (Rossberg et al., 2004; Zadeh et al., 2014).

Economic Impact. The economic impact of losing one employee due to dissatisfaction, stress, or poor perception of work environment can cost an organization tens of thousands of dollars on average (Loftness, 2008; Terrapin Bright Green, 2012). Successful health care systems are those whose built environments are design with a focus on quality life as well as quality of care. In 2008, Naderi and Shin reported that the cost of training a new emergency room nurse was $60,000. A prospective study, Fable Hospital 2.0, estimated that reducing nursing turnover could save a HCF almost $500,000 by improving the work environment and staff respite areas (Sadler et al., 2011).

1.2.7 Healthcare Garden Evaluations

The benefits of integrating nature and healthcare is not a modern idea. The relationship of gardens and health harkens back to the Middle Ages, with the writings of St. Bernard nearly 1000 years ago on the healing effects of nature (Cooper Marcus & Barnes, 1999). In fact, many cultures over hundreds of years have utilized nature and gardens in healthcare, showing that contact with nature is not only a universal concept, but also a basic human need (Heerwagen, 2009). This palliative approach emphasized care and experience over cure, and buildings were designed to reflect the home environment (Cooper Marcus & Sachs, 2014).

However, in the 19th century, Louis Pasteur and Claude Bernard developed the germ theory of diseases, changing the approach to healthcare from one that centered on patient comfort to one that focused on the treatment of diseases. These advances, paired with engineering advances in the late 19th century that made steel skeleton, high-rise buildings possible, shifted the design of hospitals so that layouts were now determined for efficiency and infection-control and not for the human spirit (Cooper Marcus & Sachs, 2014; Whitehouse et al., 2001).

In 1978, Planetree evaluated the hospital experience from the patient perspective to gauge the emotional, social, organizational, and physical changes that would produce a more effective healing environment (Cooper Marcus & Sachs, 2014). In the 1990s and early 2000s, research into healthcare settings, gardens, and their impacts on various user groups was studied through post-occupancy evaluations (POE) in order to create evidence-based guidelines for the design of future hospital gardens (Cooper Marcus & Barnes, 1995; Tyson, 1998). A POE is defined as a set of methods for examining the effectiveness of human-occupied environments that enable researchers to functionally uncover discrepancies between the original design intentions and the actual use of the environment (Heath, 2004; Zimring & Reizenstein, 1980). It is a user-oriented assessment that focuses on functionality rather than only aesthetic features and can enforce management's commitment to improving the HRQOL for patients, staff, and visitors (Gifford, 1997, 2002; Heath, 2004). POEs can test whether design goals were met, offer guidelines for future developments, and help determine whether the money was well spent and where the facility might still be improved through design (Heath & Gifford, 2001).

For a POE to be effective, it must employ multiple methods to reinforce and coalesce the results, which increases the validity of these predominantly qualitative studies (Bechtel, 1997; Shepley, 2011). Common techniques include systematic observational behavior mapping, surveys, and interviews, which are employed throughout the design and construction cycle, as well as six months to a year after completion (Cooper Marcus & Barnes, 1995; Davis, 2011; Shepley, 2011).

Previous HCF garden evaluations have been useful in determining the reasons for which people use a particular outdoor space, how that space influences both users' emotional and physical health as well as their satisfaction with the facility and level of care they receive. These evaluations can be used to answer specific design or use questions, inform design guidelines, and provide evidence for the effectiveness of nature-based interventions in HCF (Cooper Marcus & Francis, 1998; Cooper Marcus & Barnes, 1999; Cooper Marcus & Sachs, 2014). Most of the evaluation research of outdoor spaces in HCF has used a mixed methods approach, including site analysis, behavioral observation or behavioral mapping of patients, visitors, and/or staff, and a survey, questionnaire, and/or interviews with key stakeholders and users (Sachs, 2017).

Although many of the methods and instruments used are qualitative, researchers are increasingly incorporating quantitative components, along with testing and adapting previously validated research tools and procedures. Many studies, including Sherman et al. (2005) and Whitehouse et al. (2001), used behavioral observation techniques based on the protocol described by Cooper Marcus and Francis (1990), and surveys and semi-structured interviews of patients,

visitors, and staff based on Cooper Marcus and Barnes (1995). Most healthcare-related research instruments were developed, tested, and published for specific types of care, such as pediatric (Pasha, 2011; Sherman et al., 2005; Toone, 2008; Whitehouse et al., 2001), senior living facilities (Heath & Gifford, 2001; Rodiek & Lee, 2009), and rehabilitation centers (Davis, 2011).

Results from these POEs coupled with qualitative research with users has shown many positive effects of gardens in HCF. In 1995, Cooper Marcus and Barnes found that spending time in the garden of the HCF led to visitors more likely experiencing a “pleasing drop in energy” while patients were more likely to experience a “spiritual uplift”. Ulrich’s now famous 1984 study on the health outcomes of nature views for patients concluded that nature views led to shorter hospital stays, fewer post-surgical complications, fewer negative comments from nurses about patients, and a decreased need for pain medicine. These results and others have been replicated many times, with the frequently documented benefits of reduced anxiety, stress, and depression, and increased mood, self-efficacy, pain tolerance, satisfaction, and cognitive functioning (Sachs, 2017; Sherman et al., 2005; Whitehouse et al., 2001). It may be that cognitive benefits are most beneficial to staff in the healthcare environment, as it has been shown to lead to increased focus, concentration, performance, and productivity, and decreased medical errors (Gray, 2011; Pati et al., 2008; Sachs, 2017).

Users. Garden users within healthcare settings can be separated into patients, visitors, and staff. Research from Whitehouse et al. (2001) and Sherman et al. (2005) revealed that these three groups can use the same space in significantly

differing ways. Children, who were most often healthy siblings of patients, used the space most for activities, while parents and staff engaged mostly in sedentary activities and socialization (Sherman et al., 2005; Whitehouse et al., 2001). Actual patients tended to have the least interaction with the gardens (only 4% of garden users in Whitehouse's study were patients), as many were too ill to be taken to the garden. Different populations within these groups also may have different needs requiring various features and levels of demand.

Whitehouse et al. (2001) interviewed garden visitors and found that the parents expressed a variety of personal reasons to explain why the garden was meaningful to them. Sharing quality time with children away from their hospital rooms and coping with bereavement and loss were popular themes in these interviews. One parent explained, "this is a better place to wait than the waiting room, we couldn't stand being in there, wondering if she'd make it. This is quiet and peaceful, the greenery, the colorful flowers, the sound of water" (Whitehouse et al., 2001, p. 306).

Evidence on staff perceptions and use of gardens in HCF has demonstrated that garden use reduces stress, increases job satisfaction, and may help retain qualified personnel (Cooper Marcus & Barnes, 1995; Sherman et al., 2005). Nurses and staff in HCF are at high risk for burnout, which is associated with high rates of medical errors, turnover, and post-traumatic stress disorder (Cordoza et al., 2018; Poghosyan et al., 2010; Shoorideh et al., 2015). Burnout symptoms include components of emotional exhaustion, stress, fatigue, depersonalization, and reduced feelings of accomplishment (Maslach, Jackson, et al., 1997; Maslach,

Schaufeli, et al., 2001; Moss et al., 2016). In 2018, Cordoza and colleagues evaluated differences in burnout rates for nurses in HCF who either took breaks in a garden or breaks indoors with a view to the outside. They found that compared with the nurses who took indoor breaks, those who took their breaks outdoors had significant improvement in emotional functioning visual analogue scales, and concluded that daily work breaks outdoors may be a successful strategy to mitigate burnout in nurses, especially when paired with other mindfulness-based stress reduction and resiliency training (Gauthier et al., 2015; Goodman & Schorling, 2012; Mealer et al., 2014; Skovholt & Trotter-Mathison, 2014). Exposure to nature can aid staff in processing stressful work situations, enhance morale and performance, and lead to fewer conflicts between staff and patients (Annerstedt & Währborg, 2011; Beck & Katcher, 1986; Bowler et al., 2010; Cama, 2009; Friedmann, 1983, Kellert & Heerwagen, 2007; Kuo, 2010; Louv, 2012; Cooper Marcus & Sachs, 2014; Townsend & Weerasuriya, 2010; Ulrich, 1993, 2008; Wells & Rollings, 2012; Whitehouse et al., 2001).

Satisfaction. Improved satisfaction – both by staff and consumers – has helped to create a critical foundation for the argument for gardens and green spaces within HCF. The importance of the physical environment has been shown to increase patients' perceptions of care along with both patient and staff satisfaction with the HCF as both a healing and working environment (Becker et al., 2008; Irvine, 2004; Rodiek et al., 2013). Hospitals environments that are comfortable, safe, and pleasing are likely to be rated more highly by patients, which potentially influences hospital choice, market share, and bottom line results (Sadler et al., 2011). In 2001,

Whitehouse and colleagues conducted a POE of the Leichtag Family Healing Garden at San Diego Children's Hospital. Their survey included the question, "Does the healing garden increase your overall satisfaction with this Children's Hospital?" to which 80% of survey participants answer "yes" (Whitehouse et al., 2001). Overall, they found that the garden was perceived as restorative and healing, and its use was characterized by increased consumer satisfaction.

These healing environments may influence perceptions of a healthcare provider, measured by willingness to recommend, quality assessments, loyalty, and healthcare satisfaction (Cooper Marcus & Sachs, 2014; Hutton & Richardson, 1995). An example of this comes from Whitehouse's 2001 POE, in which an interviewee in the garden remarked, "If the hospital takes this care, at this level, then it makes me think there would be an emphasis, you know, on preventative medicine at all levels, which is a very good thing" (p. 307). A wealth of studies have published findings of biophilic elements, such as access to daylight and nature views, as the primary driver of faster recovery rates, reduced staff and family stress, lower staff turnover rates, and enhanced emotional wellness (Berry et al., 2004; Terrapin Bright Green, 2012). Results such as improved patient healing has led to shorter stays, less pain medication, and decreased staff and time costs (Cooper Marcus & Sachs, 2014; Rodiek et al., 2013).

Specifically, staff members in HCF have reported higher job satisfaction, feeling more alert, being better able to perform their job requirements and tasks, and recovering faster from stress from to both high responsibility and low control in their work environments due to exposure to nature views, sunlight, and access to the

outdoors (Berry et al., 2004; Terrapin Bright Green, 2012). When organizations take measures to retain employees and improve the work environment, they can avoid the cost of termination ($1,000), replacement ($9,000), and loss of productivity ($15,800) on top of the costs of hiring and onboarding new employees (Loftness, 2008; Terrapin Bright Green, 2012).

This research and evaluation of outdoor spaces in HCF can aid in the financial programming and planning of current and future projects. Advances in our understanding of the subtle neurological, psychological, and social functions associated with contact with nature in HCF have allowed researchers to identify strategies to improve productivity, increase economic gains, and strengthen communities (Terrapin Bright Green, 2012). HCFs are currently able to draw conclusions about the benefits and return on investment of gardens in healthcare settings, although the development of industry-wide standards would increase the measurable quality of these projects (Shepley & Pasha, 2013).

(Social) Return on Investment. As gardens within HCF can put economic pressures on hospital administration, it becomes even more pertinent that researchers include aspects that can show return on investment (ROI) through user satisfaction and likelihood to recommend the HCF to others (Forman, 1996; Whitehouse et al., 2001). ROI is an index of quality that evaluates the efficacy of an investment. This metric has been extremely important in making the case for financial considerations of gardens in HCF to those who believe financial resources are better spent on direct patient care (Whitehouse et al., 2001).

Nevertheless, translating this evidence to tangible outcomes has been a challenge for researchers in this and many related fields. The value of healthcare clearly includes “soft” profits of better overall health, which have historically been difficult to quantify in financial terms, which is the most common type of measured value (Laing & Moules, 2017; Wolf, 2016). Although there is no official metric for relating health benefits from gardens to ROI, many design researchers are turning to a concept of “social value” as the key to developing standardized metrics to evaluate the impact on building users (Mulgan, 2010; Watson et al., 2016a).

The pressure to improve the cost-effectiveness ratio of medical care has increased interest in more subjective health and quality of life measurements, which includes the perspectives of staff, patients, and visitors as well as other, not-easily-quantifiable outcomes (Sullivan, 2003; Terrapin Bright Green, 2012). Social value has emerged as a concept that measures human outcomes that are not immediately quantifiable (Watson et al., 2016b). It mediates the interaction between users and design, and is identified as a combination of social and environmental factors, culture and management, and institutional norms, or “building user group dynamics”, according to Watson et al. (2016b). As a concept, social value has been increasingly understood as something actionable that is about, “maximizing the impact of public expenditure” (National Association for Voluntary and Community Action, 2012). First developed by the Roberts Enterprise Development Fund (REDF) in 1996, with ongoing revisions to the original methodology, Social Return on Investment (SROI) is a process for measuring, understanding, and reporting on the wider socio-economic outcomes and environmental impact created by an intervention (Emerson

& Cabaj, 2000; Norman & MacDonald, 2004; Tuan, 2008). This social impact valuation tool is a mixed methods approach that allows “intangible”, “soft” or “indirect” outcomes – which do not have direct economic value but that are often critical to health and well-being – to be incorporated into impact analyses to estimate the monetary value of benefits to nature (Arvidson et al., 2010, 2013; Diener and Chan, 2011; Maier et al., 2015; Watson & Whitley, 2017; Wood & Leighton, 2010).

The SROI method involves multiple stakeholders coming together to identify outcomes, select indicators, and assign financial proxies to the outcomes based on valuation standards from environmental and health economy fields (Banke-Thomas et al., 2015; Leck et al., 2016; Watson & Whitley, 2017). SROI is then expressed as a ratio of the social value (discounted value of benefits) to the total investment. However, the single monetary value is not intended to be considered in isolation and rather should be applied within a larger context with assessments that are more qualitative in nature (Arvidson et al., 2010, 2013; Hutchinson et al., 2018; Lyon et al., 2010; Nicholls et al., 2012). The overall intent is to put a value on personal, social, and community outcomes, as part of a more holistic approach to the health and well-being impacts of an intervention (Hutchinson et al., 2018). For SROI measures to be effective, it requires ongoing monitoring of the social impact of an intervention (Watson et al., 2016a).

SROI has been shown to be an effective communication tool between organizations and investors, and has been used to raise importance of the social value of interventions among stakeholders, improve resource allocation, and increase social impact (Maier et al., 2015; SROI Network, 2016).

Barriers. Unfortunately, there are still many design and programmatic barriers that keep gardens in HCF from optimal utilization. Research into barriers to garden use provide critical insights into the reasons why these spaces are not reaching their full potential, which can then be translated into more robust design recommendations. Barriers can either be organizational or programmatic factors, or they can be related to the physical garden itself, namely its design and location within the HCF.

Lack of awareness and access. Lack of awareness, inability to access the garden both visually and physically, and lack of signage and information about the garden can greatly hinder utilization of the garden (Pasha, 2011; Sachs, 2017). Whitehouse et al. (2001) found that of those surveyed, 80% of San Diego Children's Hospital patients, 48% of families, and 10% of staff were not aware that the hospital had a healing garden. Cooper Marcus and Barnes' (1995) 24-hospital healing garden study revealed a number of gardens that were simply inaccessible due to locked doors, and Heath (2004) found the lack of automatic doors at a multi-level senior care facility was one of the greatest barriers to garden use. A multi-regional study of assisted living facilities found that people were significantly more likely to spend time outdoors if their facility had automatic doors leading to the garden (Rodiek & Lee, 2009). Whitehouse et al. (2001) also found that distance to a garden, even one as small as 500 yards, from either the building or specific parts of the HCF (cafeteria, giftshop), caused the number of garden visitors to drop significantly. Views into the garden are also an important factor in garden use. Along with the stress reduction from views of nature through a window (Ulrich et al., 1991), window

views allow staff to supervise and assist garden visitors as needed, as well as allow parents to feel more comfortable letting their healthy children play outside while staying indoors with their sick child (Cooper Marcus and Barnes, 1995; Davis, 2002).

Privacy. Privacy is a main concern throughout the healthcare system, but is especially important in gardens. Many adolescents who are treated in pediatric hospitals feel uncomfortable and self-conscious going out into the garden, where they may be seen by others or otherwise unable to “escape” the younger patients (Whitehouse et al., 2001). Private spaces within the garden allow for quiet conversations without fear of being interrupted and enhance the ability to “get away” from the hospital environment (Cooper Marcus, 2005). This is important for patients and staff alike, as staff on break tend to seek refuge and separation from patients and visitors (Pasha, 2013; Sherman et al., 2005).

Weather and Insufficient cover. Much of the research on barriers to use in healthcare garden has found that weather (temperature, rain, snow) is a significant barrier to use. Pasha (2013) found that weather was a barrier for 15% of patients and visitors and 24% of staff, while Naderi and Shin (2008) found that 54% of survey respondents reported rain as the most significant limiting factor to garden use. Related to weather, one of the most noted barriers to use is insufficient cover for both rain and sun. Shade (21%) and rain cover (15%) were the two most frequently requested additions to the gardens in Heath and Gifford’s 2001 POE of eight multi-level senior care facilities. Many researchers, including Ulrich (1999), Cooper Marcus and Francis (1998), Cooper Marcus and Barnes (2005), and Sachs (1999)

have all reported that shade and shaded areas are particularly important for vulnerable populations of patients as well as for HCF in hot climates.

Seating. Often coupled with lack of shade, insufficient and uncomfortable seating are some of the most highly cited barriers to garden use in HCF (Pasha, 2013; Sachs, 2017). Cooper Marcus and Barnes recommended chairs with backs or cushions that can be rearranged to offer social interaction or seclusion, or that can be moved into shaded areas throughout the day to increase garden use (2005). Pasha (2013), also found a significant negative correlation between staff garden use and dissatisfaction with the quality and quantity of seating and shade.

Desire for separate areas for staff and patients/visitors. Previous POEs on gardens within HCF have revealed the desire for staff to have a separate space. In a 2013 study on garden visitation barriers, Pasha found that responses to open-ended questions revealed the tendency of staff to seek refuge during their breaks from the hospital environment, patients, and visitors. This corroborates earlier findings from Sherman et al. (2005) and Whitehouse et al. (2001). Survey results from Whitehouse et al. (2001) illustrated that 11% of staff went to the gardens to seek privacy and refuge from their work, while 15% believed the garden was only to be used by families and not staff. Sherman et al. (2005) found that even though staff had access to three different gardens within their facility, they overwhelmingly chose the garden with no direct access to patient or play rooms, which effectively blocks visitors from using that garden. Sherman commented, “If staff members go to the garden for their breaks, it is logical that they actively seek the garden most spatially isolated from patients, where they are least likely to be interrupted by patients, or

reminded of the concerns of their work" (p. 180). Both Pasha (2013) and Sherman et al. (2005) proposed designing private spaces for staff so that they can fully benefit from the gardens.

Scheduling and Programming. One of the biggest barriers to use of gardens by staff is scheduling. In Davis' (2011) POE of rooftop hospital gardens for physical therapy, staff members explained that their job prevented them from using the garden, specifically that they did not have enough time on breaks to visit the garden. Sixty percent of staff responded "no" to a question which asked if they typically choose the garden over other indoor break areas, and said that they "either did not have a break or that they used their breaks to do paperwork. Garden conditions and location were noted to be unfavorable to doing paperwork" (p. 26). In two studies by Pasha (2011, 2013), she found that between 42% and 47% of staff did not visit the garden because they were "too busy".

1.3 Research Significance

The literature review above emphasizes the range and magnitude of benefits that are linked to increasing contact with nature across a variety of locations and age groups. Supplementing a healing environment with nature and access to the outdoors has shown to increase the quality of life for our most vulnerable populations. The physical environment does much more than supply a venue in which human interactions take place; it has the power to improve physical, emotional, and mental health, and ultimately, improve the lives and experiences of those individuals who work and live within these spaces.

The H-GET (Healthcare Garden Evaluation Toolkit), developed by Naomi Sachs (2017), was originally developed to be used across a spectrum of general acute care hospitals with varying facility sizes, populations, geographic locations, and garden locations within the facility. The toolkit was also developed to be used "by a range of practitioners (e.g., architects, landscape architects, interior designers, and engineers), healthcare providers (such as nurses, therapists, doctors, and administrators), and researchers from multiple disciplines, including academic faculty and students at both graduate and undergraduate levels" (Sachs, 2017, p. 33). Integrating the multi-method H-GET into facility evaluation will help to standardize data collection and produce research that is exhaustive yet simple, easing the translation of the research into practice.

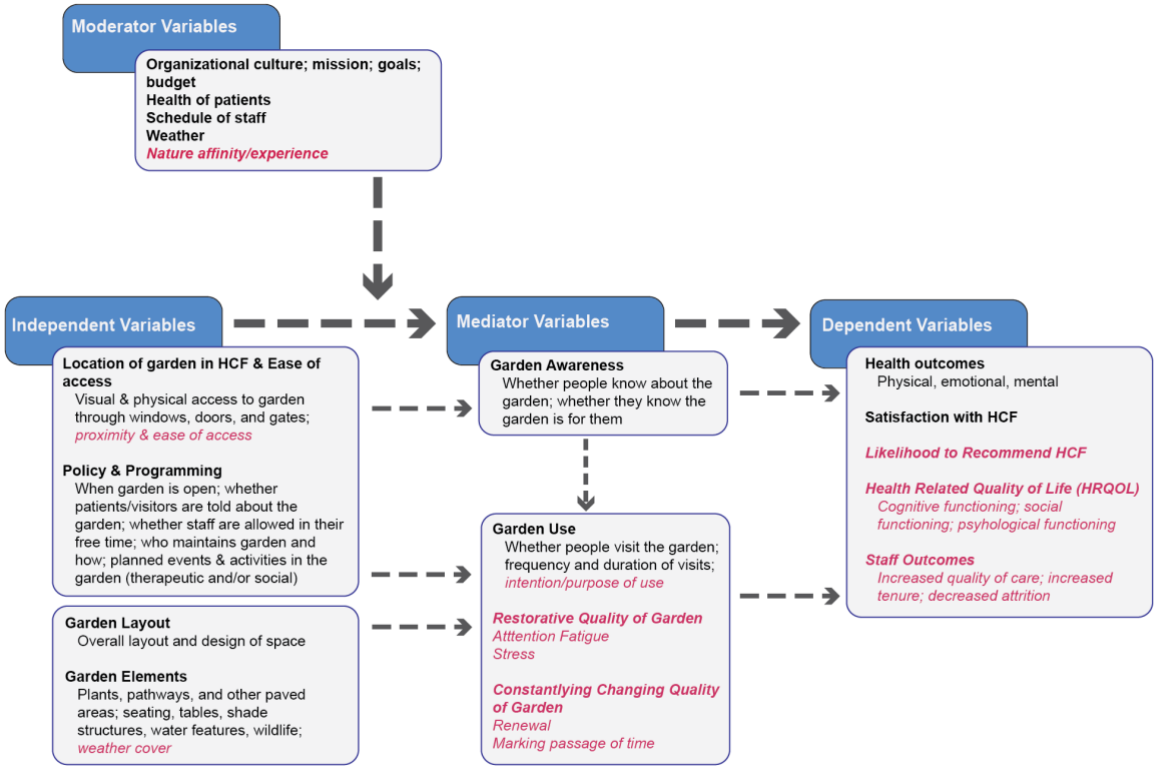
The purpose of this study is to complete a post-occupancy evaluation of the new Rooftop Garden at a pediatric healthcare facility to understand how it is being used and to provide design guidelines and suggestions to both improve the existing garden to better meet its users' needs and to inform the design of future gardens at the healthcare facility. I collected data using the methods described in the H-GET developed by Dr. Naomi Sachs (2017), which includes a Garden Assessment Tool for Evaluators (GATE), Behavior Mapping tool, Stakeholder Interviews, and Staff Surveys. In the process, I assisted Dr. Sachs in adapting these tools to better evaluate pediatric healthcare gardens.

1.4 Conceptual Diagram

The conceptual model for this study is based off of the one that appears in Sachs (2017). Additions to the original diagram (denoted by the black text) are marked in red. The changes include the addition of variables (Nature affinity/experience; Restorative Quality of Garden; Staff Outcomes, etc.) and additions to variables that appeared in the original conceptual framework (proximity & ease of access; weather cover).

Figure 2

Conceptual Framework of this Study



Chapter II

METHODS & PROCEDURE

2.1 Introduction

This chapter describes the four Healthcare Garden Evaluation Toolkit (H-GET) instruments that were used to address the research questions, along with the overall methods used for each of the tools.

2.1.1 Study goals

The primary goal of this study was to evaluate a rooftop garden at a pediatric hospital, and to modify the H-GET for use in a pediatric health care facility. The H-GET was originally developed to be used across a spectrum of general acute care hospitals with varying facility sizes, populations, geographic locations, and garden locations within the facility.

2.1.2 Site Description and Context

The rooftop garden is an 8,000 SF garden located on the 11th level of the main hospital building. It is the first of several planned exterior and interior gardens and green spaces as part of a larger expansion and renewal project across the hospital and its campuses. The garden is part of a healthcare facility in the New England region. This study was conducted in July 2019.

2.1.3 Participants

Active participants in this study included staff members who completed the Staff Survey and the staff, administration, and architectural and landscape consultants who were interviewed. For the Staff Survey, an anonymous link was sent out via the staff intranet, and a drawing for two $25 gift cards was offered as an incentive for participation. Participants were invited to provide their email as entry to the gift card drawing. This information was kept separate from the rest of the survey data, and was removed before data analysis. Interview participants were recruited via email through the researcher's primary liaison, or requested through email as with the landscape architect. These participants received an IRB-approved Recruitment Letter and Consent Form (see Appendix 1 and Appendix 2), which they were asked to look over and sign before beginning each interview. Interviewees were not compensated in any way. Individuals who were observed in the garden through behavior mapping ranged in age from infant to adult, and included patients, visitors, and staff. Demographic information, including ethnicity, race, or other personal characteristics, was not recorded. The researcher did not interact with any garden user unless first approached, and was prepared to leave the garden if any user seemed uncomfortable with the researcher's presence.

2.2 Tools

2.2.1 The Healthcare Garden Evaluation Toolkit (H-GET)

The H-GET is comprised of four instruments, or "tools," designed to quantitatively and qualitatively evaluate gardens in general acute care hospitals. The four instruments are the (1) Garden Assessment Tool for Evaluators (GATE); (2)

Staff Survey; (3) Behavior Mapping; and (4) Stakeholder interviews. The author worked in collaboration with Dr. Sachs to discuss changes to the H-GET from its original intent. Therefore, the following instruments have been slightly modified for this study in order to accommodate data collection in a pediatric hospital. The resulting toolkit has been designated PEDS-H-GET. The modifications are described in detail in subsequent sections of this chapter.

2.2.2 Development of H-GET Method (H-GEM)

In order to create the H-GET, Sachs (2017) conducted an extensive literature review of existing tools used in healthcare evaluation, supplemented with conversations with experts. Although the H-GET is a collection of evaluation tools, the methodological process (known as the H-GEM), also designed by Sachs (2017), includes the design and protocol of the evaluation study, data collection, data analysis, and results. In her review of previous healthcare garden evaluations, Sachs concluded that most methods and instruments were qualitative with some quantitative components, and all studies included an observation and/or survey of a combination of patients, staff, and/or visitors. Many of the studies used the behavior mapping protocol described by Cooper Marcus and Francis (1990). The H-GET was designed as a mixed-methods approach to the evaluation and research of gardens in acute care hospitals, and was designed with two primary goals: the first is to be applicable in as many different sites (climates, geographical locations) as possible, and the second is to be utilized by individuals from a diverse collection of disciplines.

2.2.3 Validity and Reliability

Validity in a research tool is described as an instrument that successfully measures what it is supposed to measure (Loewenthal, 2001). Nunnally (1978) states that one, “validates the use to which a measuring instrument is put rather than the instrument itself” (p. 84), and is an established property of a tool. It is easier to establish validity with an objective measure rather than subjective measures like preference and aesthetic qualities. Support for an instrument’s validity can be shown through many different aspects of the instrument itself. Three robust types of validity are content validity, face validity, and convergent validity. Content validity represents the extent to which a research instrument accurately measures all facets of its intended construct and can be derived from similar instruments, expert opinions, and results of instrument testing (Anastasi, 1982; Leedy & Ormrod, 2013). Face validity represents how well an instrument appears to measure a given construct “at face value” (Anastasi, 1982; DeVellis, 2003). Face validity is inherently subjective and thus difficult to measure. Convergent validity is based on the idea of a researcher’s variables correlating the way they were intended. It has been described as, “the extent to which an instrument measures a characteristic that cannot be directly observed but is assumed to exist based on patterns of people’s behaviors (Leedy & Ormrod, 2013, p 90). The primary emphases for the H-GET are content and convergent validity.

2.2.4 Description of Instruments

The following section describes the individual H-GET tools and changes made to adapt both the tools and protocols to the PEDS-H-GET.

2.2.5 Garden Assessment Tool for Evaluators (GATE).

The GATE is an environmental audit tool used to assess the policy, programmatic, and physical features related to healthcare gardens. Specifically, the GATE focuses on the standardized, systematic evaluation of elements with the potential to be modified through policy-related or physical interventions. It can be used by individuals across industries – from research to design to healthcare administration – and in a range of climates, geographic regions, and garden typologies. The GATE is the most objective of the four H-GET instruments. Items are worded to “minimize subjectivity and bias in the evaluator” and individual items, domains, and the overall garden are scored on Likert-type scales. The adapted version of the GATE used in this study is a seven-page, 103-item audit tool for evaluating the specific physical elements of gardens in pediatric healthcare facilities (see Appendix 3 and Appendix 4 for the full GATE, in color and grayscale, respectively).

This scale included Strongly Agree = 5, Somewhat Agree = 4, Neutral = 3, Somewhat Disagree =2, Strongly Disagree = 1 as options. This “Not Sure or N/A” (not applicable) option was included because although the wording of items was designed to be easily understood by a wide variety of people with diverse backgrounds and expertise, testing revealed that some evaluators felt they were unqualified to respond in some areas, especially those regarding plant material. The

N/A option was included with the “Not Sure” option to reduce the number of options in order to not overwhelm the evaluators. Evaluators were instructed to check the “Not Sure or N/A” if they were unsure of any answers rather than making a guess.

The items in the GATE are divided into “domains”, with each domain containing at least two subdomains. These domains are: Access & Visibility; Sense of “Being Away”; Nature Engagement; Walking & Activities; and Places to Rest. These domains were chosen based on similar audit tools, literature review, and garden-related design guidelines. Each domain is organized into affordances – or the extent to which an environment and human are well-matched in intention, ability, and capability. The domains of Nature Engagement, Walking & Activities, and Places to Rest were derived from Ulrich’s Theory of Supportive Garden Design (1999), which described “positive natural distractions”, “access to social support”, and “physical movement and exercise” (p 49). The Access & Visibility domain was determined based on a literature review and similar tools such as the Cooper Marcus and Barnes (CMB) Audit (2012) and the Seniors’ Outdoor Survey (SOS) Tool (Rodiek et al., 2016), while the Sense of “Being Away” domain was derived from the Attention Restoration Theory (Kaplan & Kaplan, 1989; Kaplan, 1995). The sub-domains are meant to reduce respondent burden by splitting up the larger lists (domains) into clearer, more digestible sections (Dillman, et al., 2014). Refer to Appendix 5 for the specific domains, subdomains, and the number of items contained within each.

Validity for the GATE. The following information reflects the validity for the GATE tool as originally designed by Sachs (2017). The GATE has been shown to

have established high validity, as tested through a Pearson correlation score ($r=0.79$, $p<0.01$ for GATE Cumulative Item Score) (Jiang et al., 2018). During instrument development, the items in the GATE received support for validity in part from an extensive literature review. Content validity was strengthened by virtue of the instrument being modeled on two previously developed instruments by experts in healthcare garden design and access to nature in residential healthcare (Sachs, 2017). Feedback during testing from various experts including those in the fields of architecture, landscape architecture, horticulture and occupational therapy, clinical and non-clinical healthcare staff, and healthcare design research, also strengthens the support for GATE content validity. Support for convergent validity was derived from Principal Component Analysis and the strong-to-moderate correlation of the "Overall Restorativeness" and "Cumulative Item" GATE scores. Further support for GATE convergent validity was determined by the correlation of similar scoring techniques in the H-GET Staff Survey. Face validity was accessed during instrument development by the aforementioned experts, research assistants, and professional colleagues (see Sachs, 2017, for an extensive review of the support for GATE validity).

Changes in the PEDS-GATE. The primary rating scale of the GATE was changed from a 4-point Likert scale to a 5-point Likert scale; adding a "neutral" option. This change was explored in the original study post-hoc and enacted in order to avoid over-use of the Not Sure or N/A option and the subsequent data analysis issues. Other changes to the GATE involved individual items (see Appendix 6), including changing of the order of items. In order to establish a version of the GATE

that was appropriate for a pediatric HCF, the researcher consulted experts in the field of child and environmental psychology. Six changes or additions were made based on those conversations in combination with an extensive literature review. The first change (Access & Visibility, item 12) was aimed at giving children autonomy and the chance at mastery – especially in a place meant to cater to their abilities. The next two changes (Nature Engagement, item 18; Walking & Activities, item 17) were based on the importance of play. The presence of features or objects that could be manipulated or played with along with having places for different types of play examined the capacity of the garden to help children develop gross motor skills, and encourage exploration and discovery. The final three changes were all within the Places to Rest domain (items 6, 10, & 22). Items 6 and 22 both measured the scaling of elements such as seating (6) and tables (22) and if it would be appropriate for users of all sizes, accommodating everyone from toddlers to adults. The final change (PR, 10) was based on having a variety of places that would afford privacy or social interaction – an especially important feature for adolescents.

2.2.6 Staff Surveys.

Staff Surveys are designed to both qualitatively and quantitatively assess staff use and perceptions of the garden and how they feel it affects the health and experience of staff, visitors, and patients, and how it affects their satisfaction with the healthcare facility (HCF). The survey was conducted online via an anonymous link, and optimized for mobile. A mix of quantitative and qualitative questions ask staff about their awareness of the garden; how often they visit and for how long; what

aspects of the garden they like most and least; barriers to garden visitation and use; whether/how the garden and their use of it affects their feelings about the HCF overall; and how they feel about sharing the space with patients and visitors (see Appendix 7). Participants were also asked demographic questions and questions about their attitudes and utilization of nature in their lives away from the HCF. The questions of the survey were divided into general questions about job role and tenure; garden awareness and access; garden visits; garden quality; garden rating; staff use of the garden; and demographics. Quantitative data was collected through a combination of categorical (yes/no), multiple-choice, and Likert-type scales. The majority of questions were quantitative in order to try to limit response burden. Some of the multiple-choice questions included write-in options where participants could elaborate on their answers and provide additional details. Qualitative data was collected through open-ended questions about what they liked most and least, and general comments they had about the garden.

Validity for Staff Surveys. Content, face, and convergent validity were examined during the original development and testing of the survey. Face validity, which was examined as part of the content validation process, is how well an instrument, at face value, measure what it is intended to measure. This was evaluated mostly through the *look* of the survey –professional, legitimate, and appears to make sense. The content validity was established through a literature review; review of similar instruments and the use of them as models; opinions and feedback from a range of experts and lay people; and the original survey testing.

Convergent validity was examined through correlating two types of scoring methods, as well as comparisons with the GATE scoring.

Changes in the PEDS-Staff Survey. Many of the changes made to the Staff Survey were due to the fact that the current study was conducted at only one facility, the survey was distributed online only, and the nature of the location of the rooftop garden. This led to the removal of seven questions along with general wording changes to use the specific hospital and garden name in this study. To eliminate response burden and improve clarity, eight more questions were removed (see Appendix 8). Only one question – Do you spend any of your FREE TIME in the garden – was added to allow for skip logic and improve clarity. Write-in response options were also added to five questions to allow for survey participants to elaborate on their answers. Overall, this version of the staff survey included 47 questions over seven sections, compared to the original version, which included 61 questions over six sections.

Staff Survey Protocol. The survey link was sent out to all staff within the HCF's network via the intranet. This linked to an online version of the survey on Qualtrics, where answers were anonymously recorded. The survey remained open for two weeks after it was initially sent out.

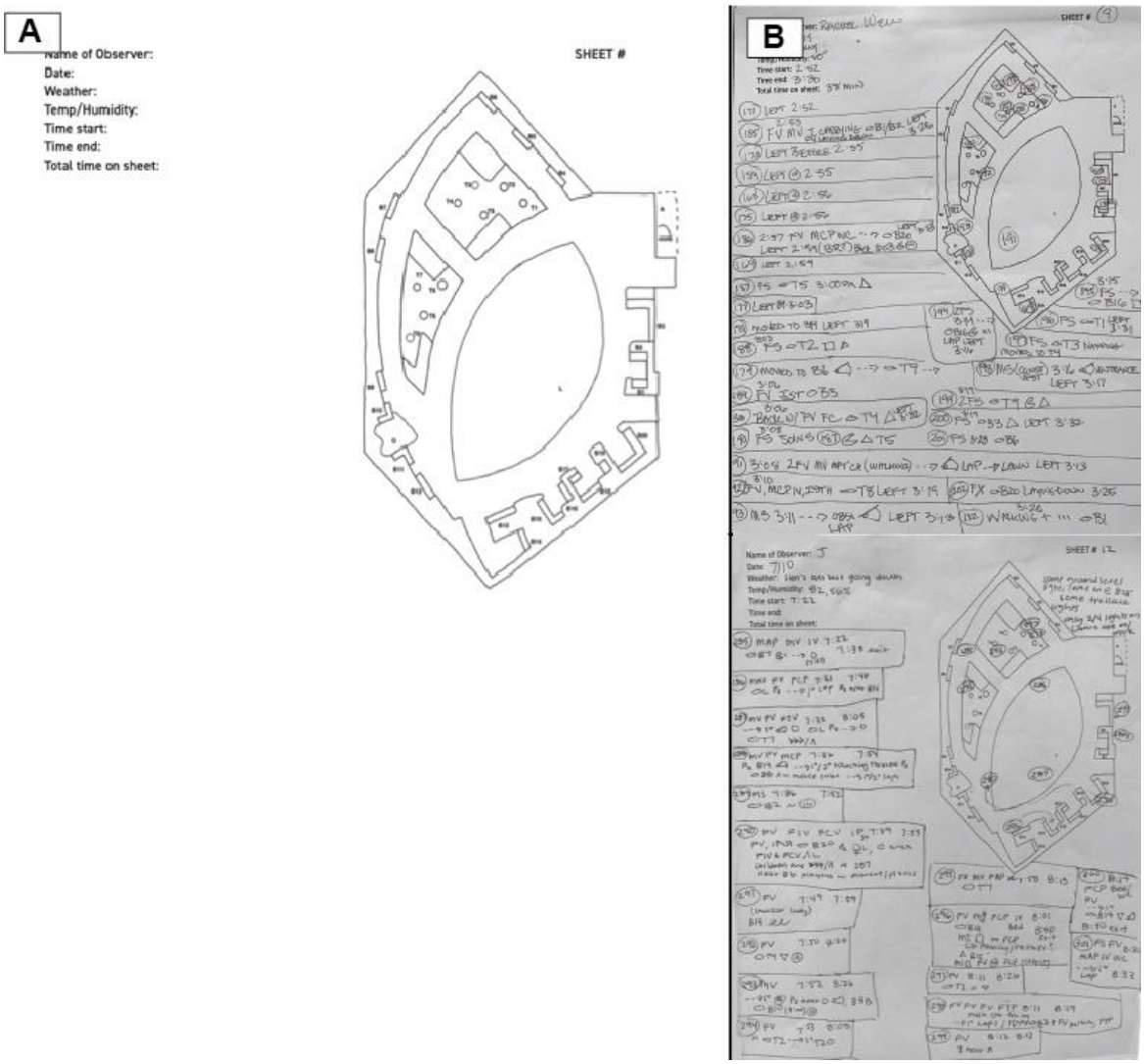
2.2.7 Behavior Mapping.

Behavior mapping (BM) is a systematic observation of who (user types) is doing what (activities) where (specific locations in a space) and when (time of day/month/year) (Proshansky et al., 1970). This tool enables the recording of

specific features and events in real time and helps identify confounding factors that affect behavior. It has also been effective in triangulating evidence from other research instruments, especially in mixed-methods research (Cutler, 2000). This systematic observation method allows for direct collection of objective data where the evaluators note exactly what they are observing – giving this method the potential for strong internal validity (McKenzie & van der Mars, 2015). BM can be used in specific physical settings with little to no burden on the people being observed. The disadvantages related to this type of observation are the possibility of reactivity, in which the people being observed act differently in the presence of observers (e.g., the Hawthorne effect), and observer bias, which can (unintentionally) influence observation and analysis. BM as part of the H-GET involves a minimum of two trained observers making place-based, time-stamped notes about garden users, activities, and usage on pre-printed 8.5x11” plans of the garden (see Figure 3). Evaluators were also instructed to make notes on their plan when possible to give context or record observations about users or the environment.

Figure 3

Blank Behavior Mapping Sheet



Note. (A) Blank Behavior Mapping Sheet (B) Filled in Behavior Mapping Sheets.

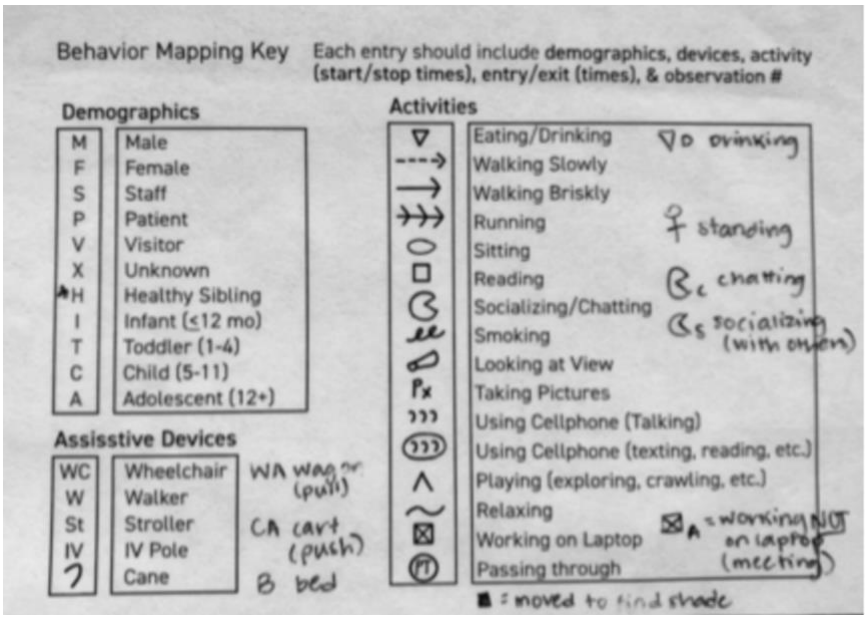
Demographic Variables. In the H-GET BM training, evaluators were trained to identify patients by cues such as ID wristbands, hospital gowns, and aides such as IV poles. Staff could be identified with clothing cues such as scrubs or facility-related uniforms along with ID badges. While visitors were also given ID badges

(required to access the rooftop garden), they were marked with different colors and often temporary vs. the laminated staff ID badges (which also had pictures of the individual). Users that did not display any of these cues were marked “X” since they could not be identified as staff or visitors. Along with demographics, “assistive devices” were also recorded (see Figure 4). Codes that were later added to “assistive devices” were denoted by different number codes: Bed (75); Wagon (pulled) (76); Cart (pushed) (77); Tricycle (78); Oxygen tank (79).

Activities. During behavior mapping sessions, each evaluator was given a laminated “key” with the demographics, activities, and symbols to keep with them at all times (see Figure 4).

Figure 4

Behavior Mapping Key



Changes in the PEDS-Behavior Mapping Tool. Both the BM tool and the protocol were modified for the current study. Some of these changes were made so that the BM tool could be used in a pediatric setting. All changes were made with input from Dr. Sachs. This includes some of the demographics described above, mainly in the addition of the age group variables. In order to fully capture the effect of the garden on the patients and visitors, the age group categories (infant, toddler, child, and adolescent) were added in order to more finely explore the dynamics between patients, visitors, and the garden itself. As described above, five aide variables were added during the study (bed, wagon, cart, tricycle, and oxygen tank). These were linked both to the garden's location in the hospital and the fact that it was located within a pediatric hospital. The garden's location on the 11th floor of the main building meant that it was easily accessible via elevator to the wards in that building (NICU, heart center). This meant that many of the young patients were transported to the garden using wagons and carts – the hospital's version of "child-friendly" wheelchairs, along with the more standard wheelchair, strollers, and walkers.

Changes in the activities included the removal of "using garden as a pass-through" and "HT – doing therapy". The first was removed since the garden is a terminal location, meaning it cannot be used as a "pass-through" to any other location. The second was removed because the garden was not designed for therapy and therefore did not have the necessary features. Note that this was also reflected in changes to the GATE. Eleven activities were added to the activity list – including "socializing/chatting", which Dr. Sachs identified as a necessary addition in

her 2017 paper. The activities “running” and “playing” were added in order to address behaviors that children – patient or healthy siblings – would partake in. The garden’s rooftop location inspired the addition of “looking at view” and “taking pictures”, as the view from the garden encompassed a metropolitan area. The design of the garden, with plantings around the perimeter, a sweeping view, and the number of seating options indicated that “standing” would be an appropriate activity to add to the list. Although seating and having places to rest is extremely important, the fact that this garden was one of the only green spaces in the HCF meant that all types of users would be using the garden, some of whom would be looking for an outdoor area to stand or walk around in. This also led to the addition of “laps” and “lap before leaving”. The perimeter of the garden provided a walking path which was used by all types of users. Some users came to the garden simply to walk around the path, but many who had been engaged in various other activities would stand and walk a lap around the garden before heading back inside. We thought it would be interesting to capture this data along with the other activities to fully show the patterns of use in the garden. The addition of outlets in the garden meant that it was possible for users to bring their laptops to work, spurring the addition of the “working on laptop” activity. We postulated that some staff members may use the garden as a break from their regular meeting spots, or as a quiet place to write-up notes, which prompted the addition of the “working not on laptop” activity. Finally, “relaxing” was added as we felt that as a restorative space with a grassy area, the garden would be able to afford a relaxing environment.

The physical materials were also altered. The base map was reduced to be ¼ the size of the paper (8.5x11”), and all tables and benches, along with major areas such as “observation” or “lawn” were added to the base map. This meant that the majority of the paper could be used for note taking and observations, which would keep the map from becoming too crowded and unreadable (see Figure 3).

One of the biggest changes in the adapted version of the BM tool was the change in observation protocol. In her original study, Sachs described the values of conducting research as a “secret outsider” as described by Zeisel (1981, p. 196), where subjects are not aware of the observer (2017, p. 180). This type of observation is ideal because the observer is not making the garden users uncomfortable, many of whom may be in the garden to find privacy. If users are aware of the observer, their behavior may change (e.g. Hawthorne Effect), or they may not receive the same enjoyment or restorative benefits out of their garden visit due to anxiety or general awareness of the observer. This observation method is also preferred for smaller gardens, as an observer within the garden is likely to occupy seats or benches that are meant to be used by garden visitors. However, since the garden is located on the roof and not visible from any public indoor area, evaluators had to be in the garden at all times. Due to this, we adopted the role of “recognized outsider”, who does not attempt to hide their presence but also does not directly interact with the users being observed. This caused the evaluators to stand and try to be out of the way of garden users as much as possible, walking through the garden every five minutes to be able to observe the entire garden. Evaluators were prepared to leave the garden if any users expressed discomfort. An

unexpected positive of this change meant that garden users approached evaluators to talk about the evaluation and give informal feedback on their perceptions and use of the garden.

The final change altered the observation periods. On the first day of data collection, evaluators began by following the protocol described by Sachs, which denoted approximately 20-minute observation periods followed by a 10-minute break. At the beginning of these intervals, evaluators were instructed to take “snapshots”, as originally described by Cooper Marcus and Barnes (2008) as data collected at specific times about the activities happening in the garden at that moment. However, the volume and turnover of garden visitors was so consistently high, that this method hindered the data collection. The H-GET BM was designed to have observations overlap so that the garden is always being observed by at least one evaluator. Therefore, the protocol was changed to a continuous data collection where evaluators could take breaks to prevent attention fatigue and reduce the risk of any data collection errors, as long as they confirmed the break with the other evaluators. This change was necessary, but it made making the entry and exit times, as well as demographics, especially important. Evaluators were asked to take notes on users or activities to make it easier to match up during data analysis.

Behavior Mapping Protocol. Behavior mapping requires at least eight hours of observation per day for a total of 24 total hours of observation. BM is conducted for two consecutive weekdays and again approximately one week later, weather permitting, by the same observers using the same protocol. Ideally, BM takes place when the weather is especially conducive to outdoor use and when the garden is at

its best and in bloom. To ensure reliability, at least two evaluators must be present for each observation session. Each observation is a “unit” – if observation takes place in a specific location, the corresponding observation number is marked on the map (see Figure 3). If multiple users are together, they are recorded as one observation but the demographics and activities of each person are still noted. Entry and exit times are also recorded. Observation periods were continuous throughout the day, with evaluators taking breaks as needed after checking in with other evaluators. Since the observations are overlapping, the garden is always being observed by at least one person.

Behavior mapping took place over three days for a total of 30 hours. It was conducted for two consecutive weekdays and again approximately one week later, weather permitting, by the same observers using the same protocol. For this study, behavior mapping was completed on a Tuesday-Wednesday and again on the following Monday. Although Sachs (2017) suggested scheduling observation days when the weather is most conducive to outdoor use, data collection was conducted mid-July due to timing and availability of evaluators. Temperature and humidity were recorded throughout each data collection day (see Table 2).

Table 2

Weather for Behavior Mapping Observations

	Day 1	**Day 2**	**Day 3**
Morning	84 ºF humidity 39% Sunny	81 ºF humidity 49% Partly cloudy, sunny	75 ºF humidity 53% Sunny, some clouds
Afternoon	87 ºF humidity 34%	89 ºF humidity 36%	80 ºF humidity 43%

	Sunny, breezy	Mostly sunny	Sunny, some clouds
Evening	87 ºF humidity 35% Sunny, breezy	84 ºF humidity 51% Mostly sunny	83 ºF humidity 44% Sunny, breezy

For demographic information, “infant” was recorded for patients and healthy siblings aged 0-1 years old (Center for Disease Control [CDC], *Infants*). In data analysis, “infants” were not counted as users, as they do not have agency to perform activities separate from their caregivers. Instead, garden visitors were marked as either having an infant with them or not, and any aides that the infant was using were added to their caretaker’s record. Toddlers, aged 1-3 years old (CDC, *Toddlers*) were counted as individual users in data analysis, as they have agency and are able to act on their own accord.

Locations. Locations of users were tracked throughout their visits. The garden included 23 chairs at 9 tables, and 20 benches, designated as shown in Figure 3. Larger areas (Lawn, Observation Station) or benches (B20) in which garden visitors could congregate were most popular throughout the day and across all three days. Heat maps were also created through spatial data mapping to show the density of users at each location across the days (see Figure 5), the most and least popular locations during the day (see Figure 6), and the staff, visitor.

Figure 5

Heat Maps of User Locations.

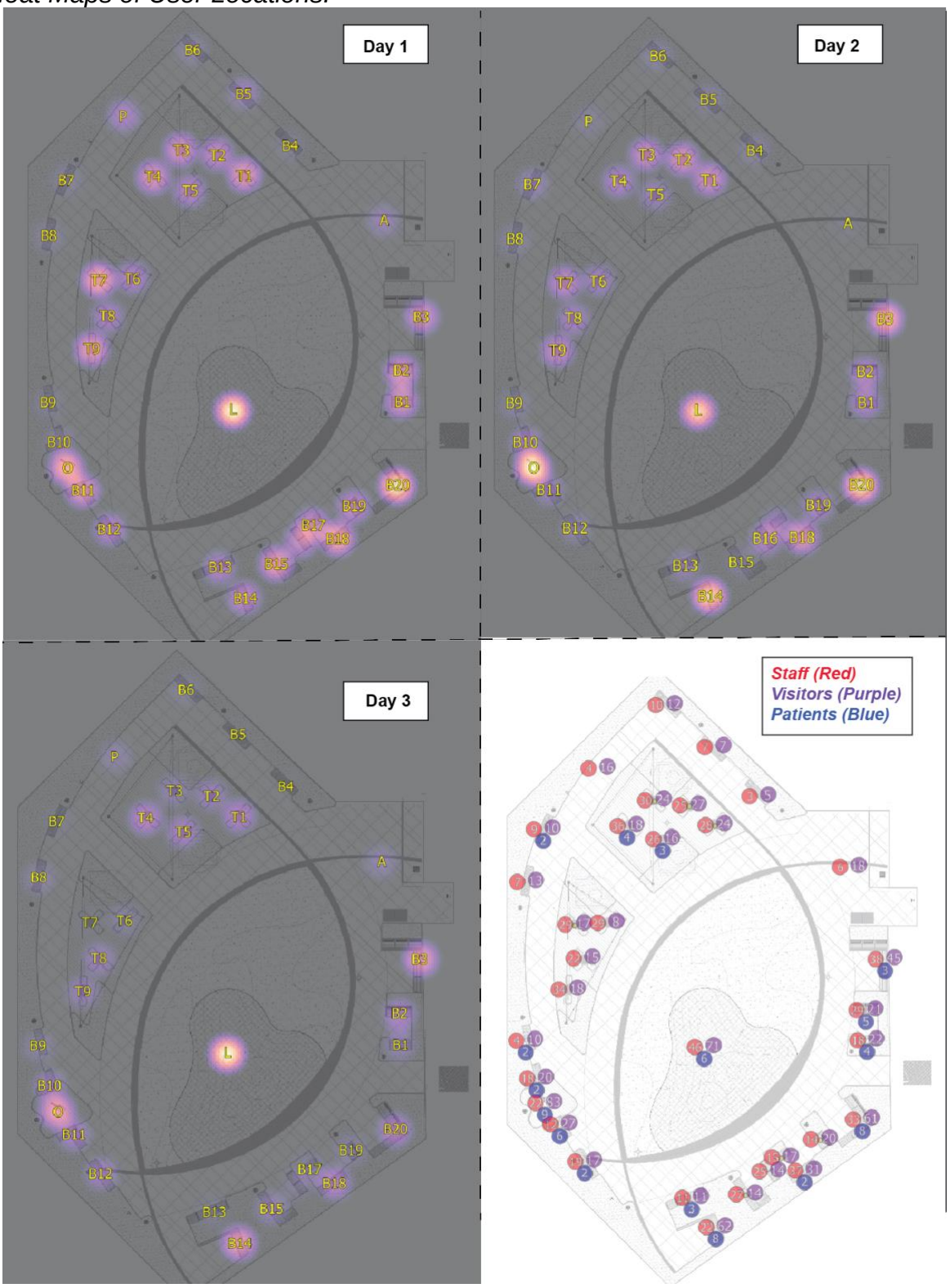


Figure 6

Most and Least Popular Locations based on time of day

2.2.8 Stakeholder Interviews.

Stakeholders are individuals or organizations that have an integral interest in the project or activities. Stakeholder interviews (SI) are structured interviews with individuals who were involved with the garden's design, construction, maintenance, programming, as well as those involved with disseminating information to raise awareness and encourage use of the garden. Structured interviews are used as a

tool to triangulate and corroborate other research instruments and data collected, while generating qualitative information regarding common issues and themes with the garden. Structured interviews, also known as focused interviews, are dictated by a pre-defined script (questions) in order to target the study's hypotheses or research questions, and are also less time-consuming for both data collection and analysis than other forms of interviews (semi-structured, unstructured) (Shepley, 2011; Zeisel, 2006).

H-GET Stakeholder interviews were designed for the HCF's (a) lead designer and landscape architect; (b) staff members and administrators involved in the original design team; (c) HCF's current facilities manager; (d) behavioral health staff. These individuals would be most likely to give the most comprehensive overview of the garden; the lead designer can speak to the design process, program, and goals; the facilities manager understands the daily use, technical issues, and other elements of the garden; and staff and administrators would serve as the connection between the designer and facilities manager, as well as insights as to how the garden was being used and perceived. Interviewees from behavioral health would be able to speak to the considerations of behavioral health on the design and use of the garden. The primary goals for the SI were to learn about:

- Programming goals for the garden and whether or how they were met;
- The design process, including any type of research conducted to inform the design;
- Challenges during design and construction phases;
- Greatest successes and challenges of the design and the garden;
- Use of the garden;

- Lessons learned from the process, including things that might have been done differently, and how those lessons will be translated into future projects.

Changes in the PEDS-Stakeholder Interviews. Changes involved adding two questions to the Staff/Administrator interview script:

- Is there a schedule of who uses the garden, when, and for what? (Patients, groups of patients, therapists only at certain times, more families)?
- Is there any policy and/or schedule for what activities can happen for the garden (programming)?

All other questions in the interview scripts for the designer, facilities manager, and staff/administrator were unchanged from the original H-GET materials.

Stakeholder Interview Protocols. The stakeholders identified above were recruited through email. The researcher's primary liaison at the HCF suggested and introduced the researcher to the staff, administrators, and facility manager via email. Following this initial contact and agreement, the interviewees were sent the IRB-approved H-GET Recruitment Letter (see Appendix 1) to explain the study, and the H-GET Stakeholder Interview Consent (see Appendix 2) before the phone or skype interviews or at the beginning of the in-person interviews.

To keep the SI data collection as standardized as possible, the same base script and data collection protocol were used for each specific interviewee (for the three full SI scripts, please see Appendices 9, 10, & 11). The following questions were asked of all interviewees:

1. *Tell me about the design process for this garden.*

    - *Who brought you in and why*
    - *Who were the major stakeholders (designer/s, CEO, President, staff, etc.)*

- *Who was on the design team (list everyone, not names but roles, including therapy staff, patients, community members, chaplain, etc.). Note: this may be the same as above, but not necessarily.*
- *Who was the primary "driver" of the design – the landscape architect/designer, the architect, the client…?*

2. What was the program / goal(s) for the garden?

3. Do you think those were met? How so, or how not?

4. Did the designer use any research to inform the design?

- *Journals, books, etc.*
- *Interviews or surveys with staff, patients, etc.*
- *Behavior mapping, site observation, etc.*

5. What were the biggest challenges during design and construction?

6. What are the biggest challenges now? Who deals with them, and how?

7. What did NOT happen according to the initial design plan, and why?

8. Have you gotten feedback about the garden since it opened, either formally or informally? If so, discuss who, how, and what.

9. What do you feel the (design / construction) team got really RIGHT with the garden?

10. What do you wish could have been done differently? Or, if you had to do it all over again, what would you have someone do differently?

SIs took approximately 45-minutes, and were conducted either over the phone, zoom (video calling), or in-person. All interviews except for three were recorded using Rev: a voice recording, dictation, and transcription application. Of these three interviews, two were not recorded due to technical difficulties, and one interviewee declined to have the interview recorded, although they consented to the interview in general. The researcher also took pen and paper notes during each interview.

2.3 Methodology for Garden Evaluation

2.3.1 Recruitment and Training of Research Assistant Evaluators

A research assistant was recruited and trained to conduct the PEDS-H-GET for the rooftop garden. Training took place for two half-days, one week before deploying the H-GET. The researcher met the RA at a nearby garden. On the first day, the research and RA conducted one GATE evaluation of the nearby garden and discussed results and questions, and came to an understanding on the meaning of each item. The RA was encouraged to provide feedback on the instruments – reporting if anything was unclear or if they had any ideas as to how a particular item could be improved. The GATE was conducted at least one more time in the nearby garden. On the second day, the researcher explained the Behavior Mapping protocol. The researcher and RA conducted behavior mapping at the same nearby garden. This training was followed by discussion and questions to ensure there was understanding of the symbols for the key and on what each behavior involved. Again, the RA was encouraged to give feedback on the mapping protocol and symbols. A second round of GATE practice was conducted on the second day.

2.3.2 Institutional Review Board

This project involved collecting survey and interview data from human participants, and thus required approval from the Cornell Institutional Review Board for Human Participants. Evaluations that gather staff responses, as opposed to patient or patient-proxy responses, are more likely to receive an exempt status as

staff are not considered a vulnerable population. Other evaluations that keep the identities of subjects confidential or anonymous are also more likely to be given an exempt status. Because the protocol only involved human subjects in surveys and interviews, which were only conducted with staff members, and the “information obtained is recorded in such a manner that human subjects cannot be identified, directly or through identifiers linked to the subjects”, the project was granted exemption from IRB review according to Cornell IRB policy (*Department of Health and Human Services Code of Federal Regulations, 45CFR 46.104(d))* (1905008826). This exemption was granted on May 30, 2019, prior to data collection. As procedures and tools were finalized, amendments were submitted to the original IRB application. Final approval for this project was granted on September 26, 2019 (see Appendix 12).

Practitioner-focused facility evaluations are sometimes considered to be exempt from IRB requirements but are still subject to evaluations through independent hospital IRB offices (Shepley, 2011). Although this study involved the evaluation of a healthcare facility, the project was considered a quality improvement initiative that would support the continued improvement of the garden and inform the design of future gardens. Therefore, no in-house IRB review was required at the healthcare facility. The author obtained a letter of support from the institution official of the healthcare facility’s IRB board stating that they had been informed of the intention and methodology involved in this study and had approved the study (see Appendix 13).

2.4 Data Analysis Methodology

2.4.1 Garden Assessment Tool for Evaluators

Five total audits were conducted during this study: one before data collection, and one by each of the two evaluators on the first and last days of data collection. Averages between evaluators and across days were calculated for the domains and subdomains, as shown in Table 3. In order to calculate the mean scores, two major adjustments were made to the “Yes/No” items and the “Not Sure/NA” (NS/NA) answer option. An answer of NS/NA was coded as 0 – effectively removing the answer from the Likert-type scale. Yes/No responses were automatically coded in Qualtrics as 1=Yes and 0=No. One Yes/No item (in *Access & Visibility*) was linked to a subsequent Yes/No item and open answer item. These and the other two Yes/No items on the audit were:

- Access & Visibility
  - 10A: Garden is open 24 hours a day, 7 days a week
  - 10B: Garden is open all 4 seasons
  - 10C: If garden is NOT open 24/7, what seasons, hours, and days is it open?
- Nature Engagement
  - 12A: Garden has at least one water feature. If NO, skip to question 18
- Places to Rest
  - 17: Garden has at least one table. If NO, skip to the final page.

Table 3

GATE Domain and Subdomain scores

GATE Domain	GATE Sub-Domain	Average
Access & Visibility	Visual Access to the Garden	7.2
	Physical Access to the Garden	6.3

Domain 1 GATE Score		6.8
Sense of “Being Away”	Sense of “Being Away”	7.7
	Aesthetics & Maintenance	9.1
Domain 2 GATE Score		8.4
Nature Engagement	Plantings	7.9
	Other Natural Features	6.1
Domain 3 GATE Score		7.0
Walking & Activities	Primary Walkway	9.9
	All Paved Areas	9.7
	Lighting, Wayfinding, & Amenities	6.6
	Variety & Activities	7.7
Domain 4 GATE Score		8.5
Places to Rest	Seating Availability & Type	6.8
	Private or Social	9.9
	Aesthetics & Sun	8.2
	Tables	7.8
Domain 5 GATE Score		8.2

In order to convert these scores to match the Likert-type scoring of the majority of the GATE, items that received a “no” response were converted to a score of one – the lowest score on the Likert scale. “Yes” responses were converted based on the write-in responses by evaluators for the question, “Garden is open 24

hours a day, 7 days a week": 5 = Open all the time (24/7); 4 = Open approximately 7A-9P every day of the week; 3 = Open approximately 7A-9P Monday through Friday; 2 = Open occasionally throughout the day and week; 1 = Never open (doors are locked and/or garden is otherwise inaccessible).

Correlation of "Cumulative Item" vs. "Overall Restorativeness" GATE scores

The "Overall Restorativeness" GATE score was calculated from the question on the first page of the GATE, "On a scale of 1-10, how would you rate the **overall restorativeness** of this garden? 'Restorative' = Able to restore a person's strength, health, or well-being" as shown in Figure 7. This question allowed evaluators to give a more intuitive response to the garden before evaluators started the more cognitive item-by-item scoring task. This Overall Restorative score was then compared to the Cumulative Item score: the mean of the remainder of the more systematic and objective questions on the GATE (see Table 4). In theory, these two scores would be strongly correlated with one another as the GATE has been shown to have high convergent validity between the individual items and the overall sense of quality and restorativeness of the garden.

Figure 7

Overall Restorativeness Rating on GATE first page

HEALTHCARE GARDEN EVALUATION TOOLKIT

GARDEN ASSESSMENT TOOL FOR EVALUATORS

INSTRUCTIONS — PLEASE READ BEFORE YOU BEGIN

STEP 1: ESTABLISH CONSENSUS
There should always be at least two evaluators. Evaluators must agree on the 1) Garden boundaries 2) Main doorway 3) Primary pathway.

STEP 2: WALK THROUGH THE GARDEN BEFORE YOU START
Think of the garden from the point of view of a frail patient. Walk through the entire garden, test the furniture, look at the area from different positions – including wheelchair and child height. Ask yourself, "How well does this garden support the needs of patients, visitors, and staff?"

STEP 3: EVALUATE THE GARDEN
For each statement on the next five pages, check the box that best represents your level of agreement. If you are unsure or if the statement is not applicable (N/A), check the last box. Note: It is better to check "Not sure or N/A" than to make a guess! A tape measure will be useful for some of the items.

STEP 4: RETURN THE FORMS
Return by mail to Julia Jaffe, College of Human Ecology, Martha Van Rensselaer Hall, Ithaca, NY, 14850, or scan and email to jgj57@cornell.edu.
Questions or concerns? Email jgj57@cornell.edu or call (203) 247-8762.

GENERAL QUESTIONS

01	Your name:										
02	Your role/profession (landscape architect, nurse, etc.):										
03	Date:	Time:						AM or PM (circle one)			
04	Weather (sunny, cloudy, windy):			Temp & Humidity (°F, warm, cool, etc.):							
05	On a scale of 1-10, how physically comfortable are you?	1	2	3	4	5	6	7	8	9	10
06	Name of facility and location (city, state):										
07	Name of garden (if it is named):										
08	Type of facility or patients served:										
09	Location and type of garden (e.g., front entry, central coutyard, rooftop, etc.):										
10	Are there other gardens and/or outdoor sitting areas at the facility?	YES					NO				
	If YES, please list:										

OVERALL RATING

NOT RESTORATIVE AT ALL → COMPLETELY RESTORATIVE

* On a scale of 1-10, how would you rate the **overall restorativeness** of this garden? *"Restorative"= Able to restore a person's strength, health, or well-being.*	1	2	3	4	5	6	7	8	9	10

Table 4

GATE Cumulative, Overall Impression, and Overall Restorativeness Ratings

	GATE Score out of 10
Cumulative Score	7.89
Overall Restorativeness Score (R01)	7.25
Overall Impression Rating (R02)	8.1

Domain and Subdomain Scores. Although the GATE domain and subdomain scores were calculated based on the average of each item, the GATE is meant to be interpreted as a range. While the item scores highlight specific elements in the garden, factors such as a garden's location, access, or design may result in a "low" score in one domain, while the garden maintains a "high" score in another. Therefore, the totality of the score is less important than the score for individual items. For example, within the *Walking & Activities* domain, the subdomain *Primary Walkway* averaged a 9.9, while *Lighting, Wayfinding, & Amenities* averaged a 6.6. Despite having one of the lowest scoring subdomains, *Walking & Activities* received the highest overall score, at 8.5 (see Table 5).

Table 5

GATE Domains ranked

Rank	**Domain**	**Overall Score**
1	Walking & Activities (D4)	8.5
2	Sense of Being Away (D2)	8.4

3	Places to Rest (D5)	8.2
4	Nature Engagement (D3)	7.0
5	Access & Visibility (D1)	6.8

For analysis, all item scores were converted from a 5-point scale to a 10-point scale. Domain and subdomain scores were calculated by averaging the items within each category (see Table 3).

2.4.2 Staff Surveys

Staff Surveys were sent out via an anonymous link in a hospital-wide monthly newsletter. Surveys that were less than 92% complete were considered invalid and were not included in statistical analysis. For clarity, survey questions reported in this section have been bolded and italicized. In reporting, M = mean, Md = Median, and SD = standard deviation.

A total of 375 surveys were returned, with 359 of those being counted as “valid” surveys. Of those 359, 69 (19.2%) surveys were redirected to the end after selecting “no” for question 11 (“Have you ever visited the rooftop garden?”). These participants were asked to select from a list of boundaries to visitation, which included write-in options for “there are things about the garden I don’t like (please specify);” “Weather (please specify);” “Other (please specify).” The results of these “piped-to-end” surveys are reported alongside the completed surveys for all questions that were answered in that iteration with the designation “piped”. All valid

surveys were entered into R for data analysis. A total of 290 surveys (80.8%) were counted as “completed”.

Demographic Results

This section covered questions on age, identity (sex), race, and primary language. The demographic questions were placed at the end of the survey to avoid feelings of intrusiveness and premature termination of the survey. To encourage participants to answer the demographic questions, this section began with the statement, “*A person’s background can sometimes influence how they experience the surrounding environment. You are* ***NOT*** *required to answer these demographic questions, but your answers will help us understand any potential relationships that we find. Thank you*!”

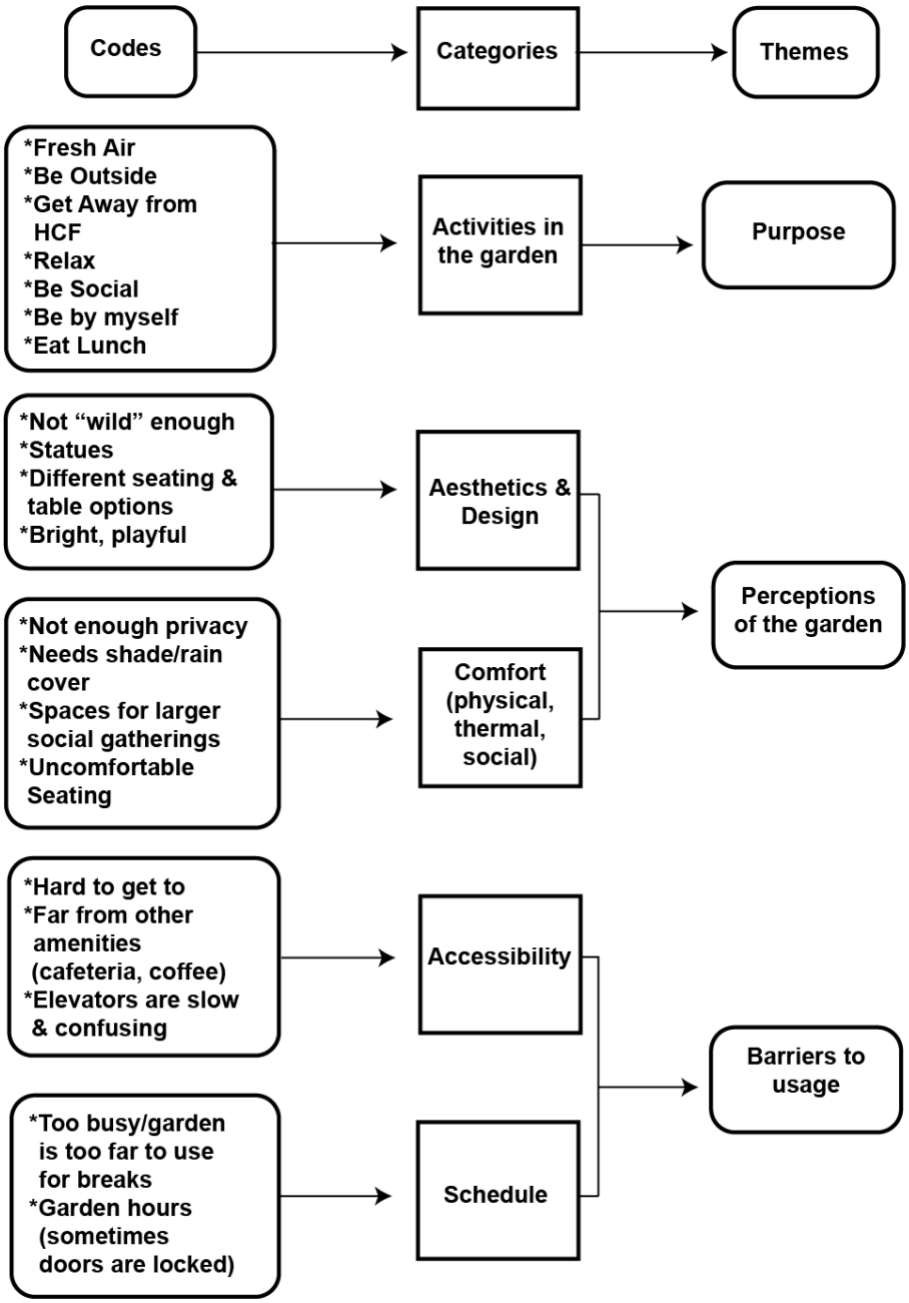
For demographic information and results relating to the questions of age, identity, race and primary language, see Appendix 14.

Open-ended Questions

Respondents were asked four open-ended questions: three pertaining to the rooftop garden and one asking if and why respondents use other outdoor spaces at the HCF. The three questions asked: what do you like most about the rooftop garden; what do you like least about the rooftop garden; please share any other comments about the rooftop garden. These responses were coded and processed in Atlas.ti to identify sub-themes and candidate themes as described by Braun and Clarke (2006) (see Figure 8). Analysis for the open-ended question regarding the use of other gardens was completed separately from the questions asking what respondents liked most and least about the garden.

Figure 8

Code to Theme map for Survey Open Ended Questions



GATE-Like Rating (GLR) Items

The staff survey included 13 questions about the quality of the garden that asked participants to rate differing elements on a 4-point Likert scale (Strongly Disagree (1) to Strongly Agree (4)). A “Not Sure or N/A” option was also included but did not receive a numeric score (see Table 6). These questions were similar to questions on the GATE audit, and represented garden quality. The constructs in the staff survey were worded more generally to reduce respondent burden and to relate the objective measures (GATE) to the more general, subjective measures (survey responses).

Table 6

Survey GATE-Like Rating Items scored via 4-point Likert Scale

Question	**Mean Rating (± SD) (out of 4)**	**Median Score**	**Number of NS/NA**
(Q22) Entrance is easy to find	2.93 (± 0.88)	3.0	2
(Q23) I feel safe in the garden	3.80 (± 0.50)	4.0	4
(Q24) When I’m in the garden, I have a sense of “Being Away”	2.91 (± 0.89)	3.0	11
(Q25) I can find privacy in at least part of the garden	2.57 (± 0.94)	3.0	15
(Q26) Overall, the garden looks well-maintained	3.69 (± 0.52)	4.0	4
(Q27) Garden feels lush and full of life	3.08 (± 0.90)	3.0	7
(Q28) Main pathway is safe and comfortable to walk on or use a wheelchair, stroller, or IV pole	3.64 (± 0.82)	4.0	48
(Q29) There are opportunities for walking	2.85 (± 0.82)	3.0	5
(Q30) There are opportunities for children to play	2.85 (± 0.75)	3.0	16
(Q31) There are many places to sit	2.90 (± 0.88)	3.0	7
(Q32) There is a choice of seating in the sun or shade during most of the day	2.60 (± 1.02)	3.0	15

(Q33) The seating in the garden is comfortable	2.89 (± 0.79)	3.0	17
(Q34) There are places where people can socialize, talk, play, hangout together, etc.	3.29 (± 0.65)	3.0	6

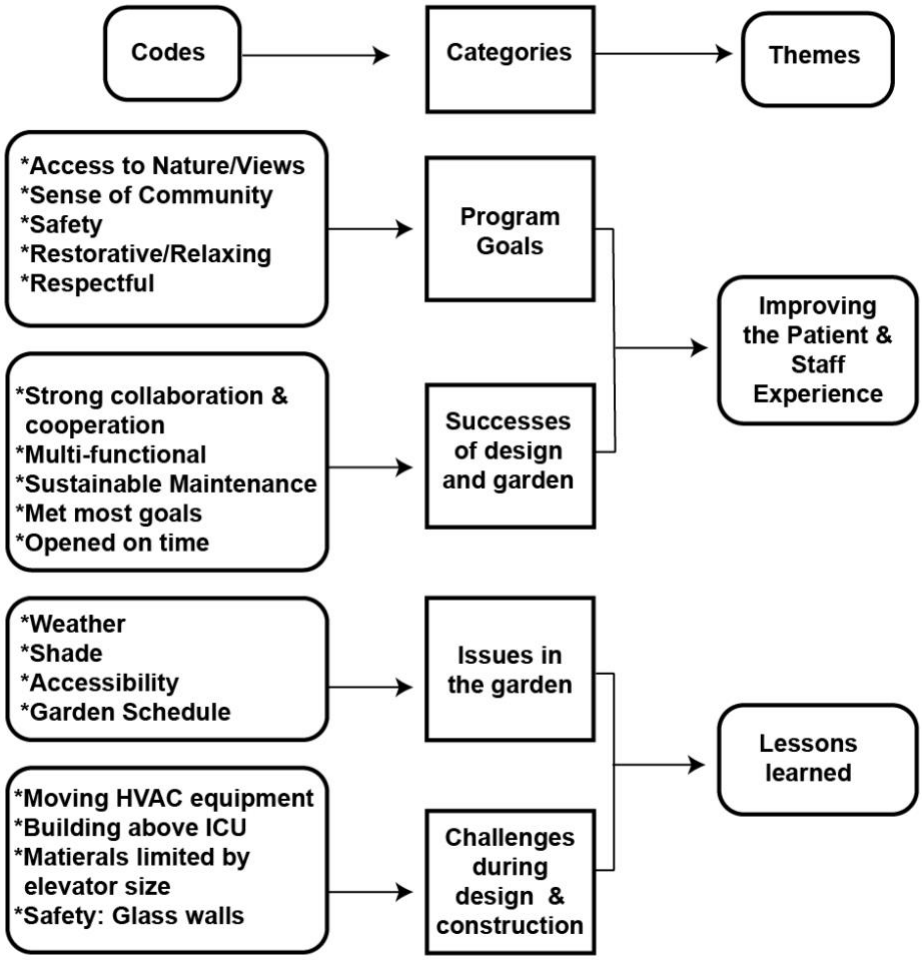
Thematic analysis of open ended and “please specify” options was completed in Atlas.ti (see Figure 8). Thematic analysis is a method of qualitative data analysis for identifying and reporting patterns or “themes” within and across the data (Braun & Clarke, 2006).

2.4.3 Stakeholder Interviews

Stakeholder interviews were transcribed, and analyzed and coded in Atlas.ti. Analysis of these interviews identified facts, themes, commonalities, and outliers across the interviews, as well as aided in the triangulation of results. After applying the thematic analysis outlined by Braun and Clarke (2006), candidate and sub-themes were identified and refined, and a thematic map was created (see Figure 9).

Figure 9

Code to Theme map for Stakeholder Interviews



2.5 Hypotheses

Hypotheses are as follows:

i. GATE Scores and Garden Usage: A high score on the GATE will be positively correlated with higher garden use (as measured by number of people, the average duration of stay in the garden, and the use of the garden throughout the day)

ii. Garden Access and Awareness: Garden access and awareness will be strongly related to garden use

iii. Garden Quality and Ratings: A high score in garden quality (measured through GATE and “garden quality” section of staff survey) will be positively correlated with garden ratings and usage.

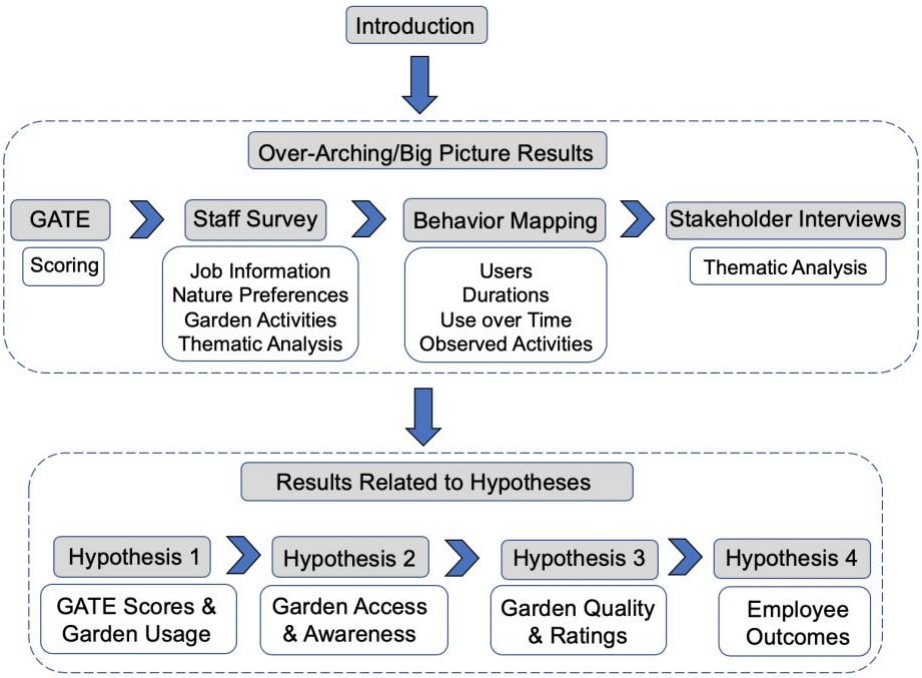
iv. Employee Outcomes: A high score on the GATE-like items will be positively correlated with staff outcomes such as self-reported feelings after visiting the garden, employee satisfaction, and likelihood to recommend the HCF.

Chapter III

RESULTS

3.1 Introduction

The PEDS-Healthcare Garden Evaluation Toolkit (PED-H-GET) is a multi-method approach that measures the degree to which gardens in general acute care hospitals provide a healing environment. The four instruments in this validated toolkit are used to gather both quantitative and qualitative data, and to triangulate and verify results. The data analysis methods used were as follows: most quantitative data analysis was completed in R (version 1.2.1335), including descriptive and inferential statistical analysis. Qualtrics data analysis tools were also used to generate preliminary findings for the staff survey, which was hosted on the Qualtrics platform. Qualitative data analysis was completed in Atlas.ti (version 8.1). Finally, qGIS (3.12) was used to visualize and create heat maps of the behavior mapping data.



3.2 General Results

3.2.1 Garden Assessment Tool for Evaluators

Correlation of "Cumulative Item" vs. "Overall Restorativeness" GATE scores. In order to compare these two scores, the mean scores from all evaluators from every GATE audit were calculated, including the domain, subdomain, and total garden scores (see Table 3 and Table 4). Because the Overall Restorativeness and Cumulative Item scores were evaluated on different scales (1-10 and 1-5, respectively), the Cumulative Item scores were converted to a 10-point scale. After these calculations were completed, the Cumulative Item GATE average score was 7.89, and the Overall Restorativeness score was 7.25. A Pearson's correlation test was run, and although these two scores were highly correlated, the test was not significant ($r=0.74$, $p=0.15$) due to the low n of this study (GATE $n=5$).

Domain and Subdomain Scores. The lowest scoring subdomain was *Other Natural Features* (6.1) within the *Nature Engagement* (7.0) domain (see Table 5). Other low scoring subdomains were *Physical Access to the Garden* (6.3; *Access & Visibility (6.8)*), *Lighting, Wayfinding, & Amenities* (6.6; *Walking & Activities (8.5)*); and *Seating Availability & Type* (6.8; *Places to Rest (8.2)*). The highest scoring subdomains were *Primary Walkway* (9.9; *Walking & Activities*) and *Private or Social* (9.9; *Places to Rest*).

3.2.2 Staff Survey

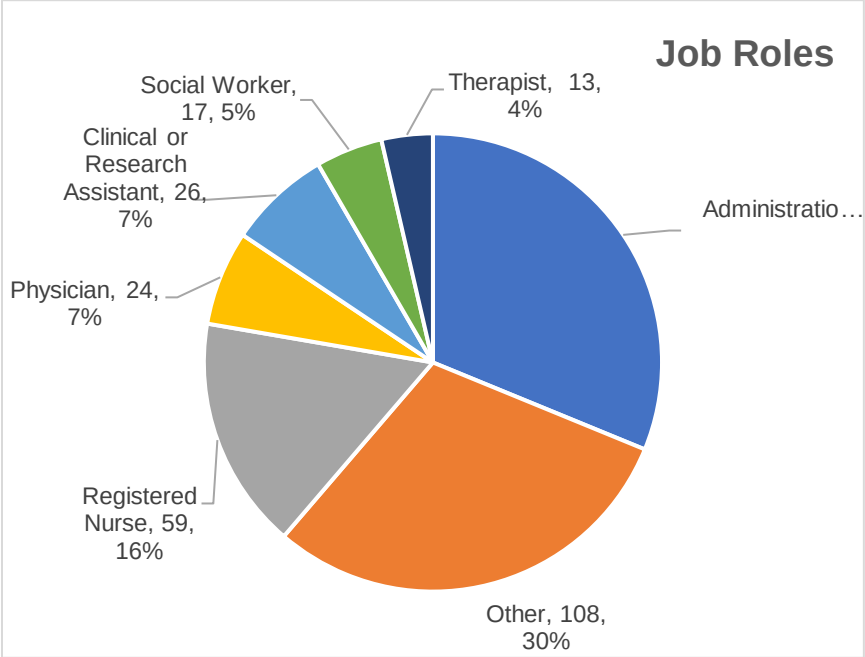
For the complete results from the Staff Survey, see Appendix 14.

Job Role. This question on job role offered 14 selected choices, with “Therapist”, “Facility Maintenance”, “Volunteer”, and “Other” write-in options. To simplify analysis, these job titles were combined into seven categories (see Figure 10).

Job Tenure and Work Schedule. Eighty percent of respondents who completed the survey (233) and almost 70% (48) of those piped out of the survey worked at the HCF for more than one year (Completed: M= 9.35, SD= 10.00, Md=5; Range=1-51 years; Piped: M= 12.39, SD= 10.99, Md=11.5; Range=1-39 years). Two hundred and forty-five (84.4%) of the completed respondents and 64 (92.8%) of piped respondents work day shifts (see Appendix 14).

Figure 10

Job Roles of Staff Survey Participants



Nature Preferences. Respondents were asked to rate how often they spend time outside in nature in their everyday life away from the HCF (see Appendix 14). Ninety-one percent of respondents said they spend time in nature at least a couple times a week, and of those, 46% spent time in nature almost every day.

Nature Importance. Respondents were also asked to rate the importance of being outside in nature when they are not at the HCF on a scale of 1-10 (Not at all important – Extremely important). For completed respondents, the average rating was 8.26 ($\pm$ 1.74), and for piped respondents, the average rating was 8.12 ($\pm$ 1.88). Both groups median rating was 8.0. The difference in ratings between these two groups is not significantly different ($t= 0.56$, $p= 0.58$, effect size= 0.14), showing that it's not a predisposition for preferring nature that separates those who have or have not visited the garden.

Activities in the Garden. Those who reported that they had been to the garden were asked why they visit the garden and the activities in which they partake when in the garden. Respondents were given 22 options with two write-in options (“Attend specific events”; “Other”) (see Table 7). The most frequently selected option was “Get Fresh Air” (230, 79.2%) and the least frequently selected options were, “Walk briskly for exercise” (2, 0.6%). The most frequently selected combinations were “Get Fresh Air” x “Relax” (141, 48.6%), and “Get Fresh Air” x “Have lunch or a cup of coffee/tea” (137, 47.2%) (see Table 8).

Table 7

Survey: Activities in the Garden

Activity	Total
Get fresh air	230
Have lunch or a cup of coffee/tea	152
Relax	150
Just sit down for a while	100
Get Away from facility	93
Look at plants, birds, or other natural features	86
Talk/be with someone else I know	71
Be by myself	70
Read or do work (on paper or mobile devices)	39
Walk slowly, stroll	36
Have Privacy	35
Be amongst other people	26
Text, watch shows or YouTube, etc. on a mobile device	24
Talk on the phone	23
Meditate or pray	22
Other	18
Attend a staff or work meeting	14
Attend specific event	13

Talk with a patient or family member/friend of the patient	13
Work with patient(s) doing therapy (PT, OT, HT, etc.)	8
Express emotions I can't express indoors (cry, laugh, etc.)	5
Write, journal, or draw (on paper or mobile devices)	5
Walk briskly for exercise	2

Table 8

Survey: Co-Occurring Activities

	Get fresh air	**Have lunch or a cup of coffee/tea**	**Relax**	**Just sit down for a while**	**Get Away**
Get fresh air		137	141	95	83
Have lunch or a cup of coffee/tea	137		94	70	59
Relax	141	94		71	56
Just sit down for a while	95	70	71		43
Get Away	83	59	56	43	

Respondents were also asked about the activities of other staff members that they see in the garden (see Table 9).

Table 9

Survey: Activities of other staff members seen in the garden

Activity	**Total**
Eating Lunch	217
Talking/Meeting with Colleague(s)	132
Resting/Relaxing	123
Working with a patient	96

Talking on the phone	81
Talking with a family member or friend of the patient	48
Doing Paperwork	15
Other	11

Thematic Analysis. This section will report on the thematic analysis and the four open-ended questions included in the survey (see Figure 7). Word clouds were generated for the four questions below in Atlas.ti based on the most frequently used words and phrases (see Appendix 14).

What do you like MOST about the rooftop garden? Thirty-five codes were used for analysis (see Table 10). When responses to “What do you like MOST about the rooftop garden” were analyzed, the most frequently coded response was “Fresh Air/Be Outside” (141) followed by “View” (96). This question yielded 543 total responses involving 15/35 codes. When the content of these responses was analyzed, two major themes emerged: 1) getting away or “escaping” the hospital environment and 2) creating a space for patients and their families. Although “Get Away” was a code used throughout the survey, respondents explicitly highlighted their ability to “escape” from the hospital. One respondent wrote, “Really love that an outdoor space is accessible while still being on campus; I feel as though I can get away and take a break while still easily being able to return to emergencies or issues.”

Many answers to this question included patients and families’ own ability to be outdoors away from the bedside. One respondent commented that, “The ability for patients to access the outdoors and enjoy a sense of calmness from away from everything else that may be occurring in their stay” was what they liked most about

the rooftop garden. Another simply stated, “The opportunity to make the patients feel relaxed and happy”, which speaks to the level of importance the staff places on the patients’ well-being and experience.

Table 10

Survey: Code frequencies to Open Ended Questions

Code	Q27	Q30	Q35	Q36	Q41	Total
Too busy	13	0	0	2	0	15
Weather	78	0	0	21	2	101
Seating (Quantity)	10	0	4	30	4	49
Signage	0	0	0	2	2	5
Crowded	8	0	0	19	1	28
Hard to get to	9	0	0	24	3	37
Previous garden	11	0	0	13	6	57
Design	18	0	65	35	8	126
Elevators	6	0	0	7	0	13
Too Small	14	1	0	59	4	78
Garden for patients and visitors	2	1	0	1	0	4
Work Off Site	0	0	0	5	0	10
Ambient Issues	4	0	0	6	0	11
There are things I don’t like	4	2	0	32	5	43
No Shade	56	0	1	84	11	152
No Privacy	6	1	0	14	5	26
Negative Perception	9	0	0	15	3	27
Uncomfortable Seating	3	0	0	13	2	18
Bees	1	0	1	5	3	10
Garden Schedule	5	0	0	11	5	21
Hospital Policy	5	0	0	2	1	8
Locked Doors	2	0	0	2	0	4

Statues	0	0	6	0	1	7
Nature	1	0	90	8	3	102
Get Away	0	0	52	0	3	55
Fresh Air/Be Outside	0	1	141	0	2	144
Lunch	0	2	3	1	2	8
Community	0	0	10	0	0	10
View	0	1	96	0	2	99
Relax	0	1	17	0	6	24
Quiet	0	0	9	0	0	9
Exists	0	0	43	0	3	46
Accessible	0	0	5	0	1	6
Event	0	12	0	0	0	15
Far	2	0	0	20	2	24

Note. Q27: What has kept you from visiting as often or for as long as you would like
Q30: Why do you visit and what do you do while you're there?
Q35: What do you like MOST
Q36: What do you like LEAST
Q41: Please say briefly why you use the other gardens/green spaces

What do you like LEAST about the rooftop garden?

For the question, "What do you like LEAST about the rooftop garden", the most frequently coded responses was "No Shade" (84) followed by "Too small" (59). This question yielded 431 total responses involving 25/35 codes. The content of these responses was analyzed to reveal that, additionally, staff also had issues around accessibility (how easy it was to find and get to the garden), access (being able to utilize the garden during its open hours), seating, privacy, and amount/variety of greenery.

One respondent wrote, "Way too sunny and hot. Too small to comfortably sit and have talk on phone or have conversations with others without feet like others are listening. Elevators too slow. Why is roof garden locked at times?" Other

respondents had a variety of complaints, stating that the garden was, “cramped, too hot and sunny even in spring (avoided in summer), very crowed, no conversational areas, no blockage for rain or weather. Where are the trees and shrubs?”

Answers regarding access and accessibility indicated difficulties with wayfinding: “I’ve been once but I definitely took the wrong elevator and really don’t think I could find it again" and patient access:

> “It is not easily accessible for our patients on 11S [there are no ramps and we need to take patients in the elevators it prohibits pts from going to the garden]. It should also be open in the winter time. Staff and patients would sit outside in their coats to get some fresh air.”

Please share any other comments about the rooftop garden

One hundred and seven respondents answered this question. Apart from reiterating the perceived lack of privacy, shade, and seating options, many staff members emphasized their wish that the garden could be open later in the day or later into the season. One respondent wrote that they, “wish it could be open longer and later so night shift staff can also enjoy the garden. [I] wish there could be some times for patients on enhanced precautions to have protected time in the garden”, while another commented that the garden,

> “needs to be open weather dependent, not closed for season. We had beautiful weather in early Spring before the garden was open and patients who had been cooped up all winter were eager to get outside but there are no areas for them to do so.”

A few respondents took this opportunity to suggest additional programming and activities in the garden. One response stated, “Really enjoy having this space. It might be really nice to add some games or something for patients and families or employees to play (e.g., checkers, giant Jenga)”.

Please say briefly why you also use the other outdoor space(s)

When asked why they use other gardens or green spaces within the HCF, the most frequently coded answer was “More Easily Accessible” (46). This question yielded 93 total responses. Analysis of this content revealed two main reasons for using other outdoor spaces at the HCF: they were more convenient and/or employee-only. More convenient spaces were generally those that were easy to access and in close proximity to food or beverage options. One respondent comment that they use other outdoor spaces because they are, “much easier to get to — I often find myself waiting for the elevators for a non-insignificant portion of my lunch break” while another stated, “the other outdoor space near the cafeteria is more private, shaded, there are more circle tables outside for seating. It is also more quiet besides the construction.”

A number of staff members brought up needing space from families or feeling that the rooftop garden was a space for patients and families. In response to why they use the other outdoor spaces, one staff member commented that the other spaces were, “Definitely easier to get to, more social and feels less invasive of patient space (tends to be staff only), but not nearly as pretty.” Another said,

> “I need to reflect and decompress. I appreciate that families need the garden space, but it would be very helpful for staff to have a place as well. It is increasing busy and the acuity higher. A private space where we can reflect is important to our mental health.”

For all survey results, see Appendix 14.

3.2.3 Behavior Mapping

Users. Over the 30 hours of observation, a total of 1489 users were observed in the garden. Fifty-six infants were observed in the garden, but were not included in data analysis. Staff (602, 40.4% of total) was the most frequent garden user overall, followed by Visitors (587, 39.4% of total). However, Visitors were the most frequent users of the garden on two of the three days (see Table 11).

Table 11

Behavior Mapping: Status totals of garden users

Status	Day 1	Day 2	Day 3	TOTALS
Staff	169	227	206	602
Visitor	113	244	230	587
X (Adult)	36	12	11	59
Adolescent Patient	11	18	24	53
Adolescent Sibling	4	5	16	25
Adolescent X	0	5	1	6
Child Patient	5	29	34	68
Child Sibling	3	17	23	43
Child X	0	4	2	6
Toddler Patient	5	10	12	27
Toddler Sibling	3	0	3	6
Toddler X	1	4	0	5
Patient	0	1	1	2
TOTALS	350	576	563	39

Duration. Duration of stay was collected for most garden users. Staff was most likely to spend between 16-30 minutes in the garden (192, 31.9% of staff) followed by 0-15 minutes in the garden (137, 22.8% of staff) (see Table 12). Visitors were most likely to spend 0-15 minutes in the garden (218, 37.1% of visitors), followed by 16-30 minutes (134, 22.8% of visitors). Patients of all ages were most

likely to spend between 0-15 minutes in the garden. The average duration across the three days was just under 22 minutes (21.92), and the longest recorded stays for each day were 98 minutes (Day 1) 119 minutes (Day 2), and 130 minutes (Day 3) (see Table 13).

Table 12

Behavior Mapping: Durations for status types

Duration (min)	Staff	Visitor	X (Adult)	Adolescent Patient	Child Patient	Toddler Patient
0-15	137	218	17	20	33	8
16-30	192	134	6	17	10	7
31-45	91	51	5	4	7	4
46-60	21	28		3	5	
61-75	2	6			1	
76-90	3	7				
91-105		6		1		1
106-120		4				
121-130		2				

Table 13

Behavior Mapping: Average, longest, and shortest durations (in minutes) for each observation day

	Day 1	Day 2	Day 3	Overall
Average (± SD) Stay	20.64 (± 16.70)	17.42 (± 18.40)	21.09 (± 18.32)	21.92 (± 18.21)
Longest Stay	98	119	130	
Shortest Stay	1	1	1	

Note. SD stands for “Standard Deviation”

Time of Day. To examine if time of day had an effect on visit duration, duration and time of day data was entered into the statistical software R. Time of day was categorized as either Morning (7AM-12PM), Afternoon (12PM-4PM), or Evening (5PM+). A chi-square test was run (X-squared = 379.69, df = 146, p-value < 2.2e-16), and results were returned with a warning message: Chi-square approximation may be incorrect. Due to this message and the amount of data in the table, a Fisher test was run with a simulated p-value, based on 2000 replicates (p-value = 0.0004998). For more results related to durations of visits to the garden, see Appendix 15.

Observed Activities. Evaluators were asked to track all activities of garden users and were given a laminated key containing symbols for 19 activities (see Figure 4). Apart from “Sitting” (1117 observed cases), “Socializing/Chatting” (685 observed cases) was the most frequently observed activity (see Table 14). The least frequently observed activities were “Walking Briskly” (6 observed cases) and “Smoking” (8 observed cases).

Table 14

Behavior Mapping: Activity counts

Activity	Number of recorded activity
Sitting	1117
Socializing/Chatting	685
Eating	498
LOV	440
Walking	270
Laps	256
Using cell (not talking)	216
Lap before leaving	197

Picture	161
Relaxing	137
Playing	124
Talking on cell	120
Standing	98
Reading	43
Running	36
Working on Computer	16
Working not on Computer	12
Smoking	8
Walking Briskly	6

3.2.4 Stakeholder Interviews

Thematic Analysis. Interview transcripts and audio files were analyzed in Atlas.ti to identify facts, themes, commonalities, and outliers across the interviews. Results from this analysis grouped themes that approximately followed the structure of the interview questions (see Figure 9).

Program Goals. The primary design goals for the rooftop garden were that it was child-friendly but also accessible and comfortable for staff and visitors; that it provided a restorative atmosphere with access to sunlight, greenery, etc.; it preserved the legacy of the previous hospital garden; and that it was safe. The construction in and around the healthcare facility made the existing green spaces unavailable, and many comments highlighted the need the rooftop garden would fill as, “a place for staff and family to be able to sort of sit down and eat lunch and have access to the sun, air, and the outdoors.” Another key goal was honoring and keeping direct ties to the previous garden. One administrator remarked, “We were trying to honor and preserve the memory of the [previous garden] up here on the main roof garden because people felt such a loss.” Many interviewees expressed

their commitment to having the previous garden live on in the new gardens. One interviewee said, “I don't think there's anything that isn't coming back from the original garden, as far as the statuary, and every new garden will have soil and whatnot from the old garden.”

Challenges during Design and Construction. Many of the challenges identified through these interviews were directly related to the location of the garden on the roof of one of the main buildings. The HVAC equipment had to be re-located, along with the elevator mechanical equipment. The project required that the construction team, “jump the elevators to create an 11th floor, which is really a half a floor above 10 so, and in order to get the material up here, everything had to be craned from the front entrance.” This caused disruption in the building as two of the elevators had to be temporarily shut down while the 11th floor was being created, but also highlighted another critical challenge: getting materials up to the roof to build a garden. One interviewee explained,

> “we were limited to anything that could fit in the elevator is what we could put up on the roof. We could only make [the trees and plants] as long, as tall as we could in terms of the height or the depth or the width of an elevator cap.”

Other construction challenges included having to, “build a raised roof in order to accommodate water flow and maintenance to be able to get underneath this space.” This was necessary given the team had,

> “talked to other facilities that have nightmares chasing leaks. A lot of [rooftop gardens], when they’re done, when the buildings are built, it leaves the building very susceptible to weather and then if you have a leak in the roof garden, due to trees getting bigger, roots, this and that. You can have all kind of problems.”

This new roof and subsequent garden was created on top of the existing ICU, which introduced challenges such as excess noise, vibrations, and other disrupters that required intense coordination with ICU nursing staff.

Safety was another important goal and challenge for the design process and the garden itself. The entire garden design had to be looked at through both a behavioral health and weather safety lens. In terms of behavioral health, there could be, “no sharp edges, no sharp corners, no handholds, no way to climb the poles of the trellis. The walls had to be high enough to make sure there was no way to climb or otherwise get over them.” The weather issue centered around being able to withstand a hurricane or hurricane force winds. This directly affected the choice of tables, chairs, and any other furniture that was in the original design. An administrator noted, “You don't want anything leaving this roof and going through a window because obviously there's people on the other side of those windows. All of the seating and tables, they all have to be bolted down.” The glass walls were also directly affected by weather considerations. The facility manager explained,

> “The glass was originally designed with three-quarters of an inch-thick glass. When we went and sat down with our insurance company, they brought up the fact that we would barely meet a Category 2 hurricane which was for glass, which was per code. That's fine. They suggested we bump it up a little more to make sure we were absolutely safe. So, I went back to the designers, the glass manufacturer, we came up with a one-inch thick glass that can handle up to a Category 3 hurricane without a problem at all. Then we went back to the structural engineer. He had the VPs up. This was all during the design. And looking at it design-wise, it was literally $40,000 more. So for 40 grand, we got a much, much more, more margin of safety for storms.”

Current Issues. The most frequent issue mentioned by all interviewees was the amount of shade in the garden. This was a common theme in the staff survey, and lack of shade was observed during behavior mapping to be a factor in if or how long users spent in the garden. The nature of the location of the garden meant that, “There aren’t any shadows from buildings, so the sun is directly on you all day. In other gardens, we didn’t have to pay as much attention to the issue.” This was an issue that administrators tried to address by adding more sun shades to the garden, but the layout and orientation of the garden towards the south east meant almost full southern exposure. Administration proposed umbrellas or automatic retractable awnings, but the primary goal of safety meant many proposed solutions could not be implemented. One member of the design team said,

> “People asked why they placed orientation of wood structure where they did because it was not customarily where they would put it in terms of exposure, but we were unable to put a permanent structure right up on southern exposure side because that’s the side where the glass wall is.”

Another issue that was identified both through these interviews and the staff survey was the seasonality of the garden. Again, the main issue was around safety. An administrator remarked, “it’s a roof and if it gets snow and ice it’s not, you know, it’s not simple to go up there and just shovel a path. There’s just no place to put the snow.”

Successes. When asked what the most successful aspects of the design were, many interviewees stated that the design allowed for a mix of activities and purposes, including meeting the primary design goals. One interviewee noted,

“some people are taking breaks, parents can work, people can have meetings…the kids play for hours on the mound just rolling down and running up. If that didn’t speak to ‘did we meet the design goals’, nothing would.” When asked about the most successful part of the process, a facilities manager explained,

> “8,000 square feet? How do you make the most out of that amount of footage and create different spaces? It's almost like we have different living rooms, different play rooms, different dining rooms. And I think the way, particularly [the landscape architect] us[ed] the plant material and the beds was able to break up that space, I think we nailed it.”

Another common success was the process of working with the nursing staff in the ICU. The facility manager said, “We had some fume issues, they didn't panic. They talked to the parents. … it was such a team effort. They were fabulous to work with, which is not shocking. But it just made it way easier on us.”

Codes. Co-occurrence tables of 13 sub-codes were created to show the frequency and meaningfulness of certain combinations across the interviews (see Table 15). The most frequently co-occurring codes were Design/Safety (50), Design/Goals (46), and Construction/Challenges (41).

Table 15

Interview: Co-Occurring Codes

	Construction (81)	**Design (20)**	**Feedback (47)**	**Lessons learned (39)**	**Safety (70)**	**Weather (58)**
Challenges (130)	41	37	14	17	13	17
Construction (81)	0	27	2	1	5	19
Feedback (47)	2	25	0	10	0	4

Future (34)	6	14	6	15	1	3
Goals (71)	1	46	2	1	0	4
Lessons learned (39)	1	16	10	0	3	1
Positives (88)	5	44	5	3	6	9
Safety (70)	19	50	4	1	4	0
Weather (58)	17	35	2	8	7	27

Note. All co-occurrences totaling 10 or higher are highlighted in gold.

3.3 Results Related to Hypotheses

3.3.1. GATE Scores and Garden Usage: A high score on the GATE will be positively correlated with higher garden use

The rooftop garden received a total mean Cumulative Item GATE score of 7.89 out of 10 and Overall Restorativeness score of 7.25. The Overall Impression Rating question on the final page of the GATE, worded exactly as the Overall Restorativeness Rating on the first page of the GATE, allowed evaluators to give a response as to the garden's Restorativeness after spending time in the garden completing the audit. This Overall Impression Rating was 8.1 out of 10. For a breakdown of GATE scoring, please refer to Appendix 5.

Garden use was measured through behavior mapping, by the number of people and duration of stay in the garden, and through questions on the survey pertaining to garden use, frequency, and duration. Over the course of the behavior mapping observations, a total of 1489 users visited the garden with an overall average stay of 21.92 ($\pm$ 18.21) minutes (see Table 13). From survey of reported durations and frequency of use, 64.1% (n=186) reported spending time in the

garden in their free time and 11.7% (n=34) reported spending time in the garden for work.

Staff reported spending an average of 62.6 minutes in the garden for work, with four staff reporting that they spend around two hours in the garden when they working with patients. When asked about use in their free time, six staff reported daily use of the garden (3.2%) while 32.1% (60) reported using the garden a through times throughout the year (see Appendix 14). Over one-third of staff who visit in their free time usually spend between 16-30 minutes (66, 35.5%) in the garden and 26.8% (50) spend between 0-15 minutes in the garden (see Table 12). Only one participant reported using the garden in their free time for more than one hour each visit. All staff reported answers of average duration of time spent in the garden correspond with behavior mapping data (see Table 16). When asked on a scale of 1-5 (“Definitely Not” to “Definitely Yes”) if they would spend more free time in the garden if they could, 217 (74.8%) participants responded either “probably yes” (90; 31.0%) or “definitely yes” (127; 43.8%).

The high cumulative item score, Overall Restorativeness rating, and Overall Impression ratings of the GATE, along with the high number of garden users throughout the observation periods suggestion confirmation of the hypothesis. Correlations between the GATE, BM, and survey data were run, but due to the low *n* of the GATE, correlations were not significant. All scores from the GATE, BM, and survey suggest a trend towards a positive correlation.

Table 16

Staff Durations as reported in the Survey and observed during Behavior Mapping

	Reported percentage from Survey	Observed percentage from Behavior Mapping	Rank
0-15 minutes	26.88%	22.76%	2
16-30 minutes	35.48%	31.89%	1
31-45 minutes	23.12%	15.12%	3
46-60 minutes	6.99%	3.49%	4
Walk through once or twice	6.99%	-	
More than 1 hour	0.54%	0.83%	5

3.3.2 Garden Access and Awareness: Garden access and awareness will be strongly related to garden use

To explore how garden access and awareness is related to garden use, staff were asked whether they knew about the garden before taking the survey, and if so, how the originally found out about the garden. They were also asked their opinions about staff use of the garden. Out of participants who had not visited the garden, 93% (64) indicated that they were aware of the garden before the survey, and over half of these individuals (36; 52.2%) had read about the garden before the opening (see Appendix 14). Respondents who had not visited the garden were asked what were the major barriers that kept them from visiting the garden. The two most common barriers were that staff was “Too busy” (“lunch break is too short”; “I only have limited time and the elevators are extremely slow”) (23; 33.3%) and that the garden was “Too far away/too hard to get to” (22; 31.9%) (see Table 17).

Of participants who had visited the garden, and equal number had found out about the garden by reading about it through hospital communications (103, 35.5%) and from someone telling them about it (103, 35.5%). When asked what keeps them

from visiting the rooftop garden as often or for as long as they would like, the staff who had visited the garden also reported they were “Too busy” (165, 25.7% of responses), the garden was “Too far away/too hard to get to” (133, 20.7%), “Weather” (70, 10.9%), “No shade” (59, 9.2%), and “The garden is only for patients and visitors” (39, 6.1%).

The *Access & Visibility*” domain received the lowest score (6.8) of the five GATE domains, including one of the lowest subdomain scores for *Physical Access* (see Table 5). As the GATE audit tool is meant to systematically evaluate policy, programmatic, and physical features related to healthcare gardens, some of the items in this study received low scores due to the fact that the garden was on the roof of the main building, accessible via two elevator banks. However, the themes of accessibility and ease of access to the garden were identified as issues in both the barriers to visitation sections and open-ended, qualitative sections of the staff survey (see Table 17 and Figure 8). In fact, lack of accessibility of the garden was one of the most frequent responses when asked what participants liked least about the garden and why they use other gardens or green spaces at the HCF.

To gauge staff opinions about garden use, we asked how often they see their fellow colleagues in the rooftop garden. Most participants indicated they saw other staff in the garden either very often (99, 35.5%) or sometimes (92, 33.0%). The most common activities that participants witnessed their colleagues partaking in in the rooftop garden were “Eating Lunch” (217), “Talking/meeting with colleagues” (132), and “Resting/Relaxing” (123). For complete survey results, see Appendix 14.

Garden use was quantified as in hypothesis 1.

Correlation calculations were not possible given the low number of sites, however, trends suggest that the above data supports this hypothesis.

Table 17

Staff Survey: Reported Barriers

Barriers	Completed	Piped
Too Busy	165	23
Too far away/too hard to get to	133	23
Weather	70	-
There are things I Don't Like	60	1
No Shade	59	-
Garden is only for patients and visitors	39	4
Other	32	9
Design	24	-
Locked doors	15	2
Crowded	15	-
Prouty	9	2
Hospital Policy (Staff not supposed to use garden)	8	2
I already spend as much time there as I'd like	7	-
Seating (Quantity)	6	1
Forgot about it	1	2

Note. Piped "Other" includes "Didn't know about it": 4

3.3.3 Garden Quality and Ratings: A high score in garden quality (measured through the GATE and "garden quality" section of staff survey) will be positively correlated with garden ratings and usage.

To compare garden quality through these 13 GATE-like survey questions (GLR), the survey garden rating, and overall GATE scores, the scores from the GATE-like survey questions were converted to a 10-point scale (see Table 18). The cumulative GLR score was 7.28 $\pm$ 1.75. Although the GATE was only completed 5

times, whereas the survey had 290 responses, a correlation was run between the cumulative and overall garden ratings. When a Pearson's correlation was run between this and the GATE cumulative score, there was not a significant correlation (p=0.4, r=-0.4). When a Pearson's correlation was run between the Garden Rating from the staff survey (7.33 ± 1.73) and the GATE Garden Rating (7.25 ± 0.45), there was not a significant correlation (p=0.7, r=0.02). A Pearson's correlation between the Staff GLR and Staff Garden Rating also showed a non-significant result (p=0.2, r=0.08). Although these results are not statistically significant, the Staff GLR (7.28) and Garden Rating (7.33) are both relatively high scores on a 1-10 scale.

Table 18

Survey GATE-Like Rating Items converted to a 10-point Likert Scale

Item	Score (out of 10)
(Q22) Entrance is easy to find	7.33
(Q23) I feel safe in the garden	9.50
(Q24) When I'm in the garden, I have a sense of "Being Away"	7.28
(Q25) I can find privacy in at least part of the garden	6.43
(Q26) Overall, the garden looks well-maintained	9.23
(Q27) Garden feels lush and full of life	7.70
(Q28) Main pathway is safe and comfortable to walk on or use a wheelchair, stroller, or IV pole	9.10
(Q29) There are opportunities for walking	7.13
(Q30) There are opportunities for children to play	7.13
(Q31) There are many places to sit	7.25
(Q32) There is a choice of seating in the sun or shade during most of the day	6.50
(Q33) The seating in the garden is comfortable	7.23
(Q34) There are places where people can socialize, talk, play, hangout together, etc.	8.23
Survey Cumulative Average	7.70

(Q35) On a scale of 1-10 (Very Bad to Excellent), how would you rate the rooftop garden overall?	7.34
GATE Cumulative Item	7.89
GATE Overall Restorativeness	7.25
GATE Overall Impression	8.10

3.3.4 Employee Outcomes: A high score on the GATE-like items will be positively correlated with staff outcomes such as self-reported feelings after visiting the garden, employee satisfaction, and likelihood to recommend the HCF.

Five questions were asked to gauge staff's feelings and opinions about the rooftop garden at their HCF (4) and feelings and opinions on HCF having gardens in general (1) (see Table 19). These questions were used as "indicator outcomes" or potential measures of the garden's success.

The more successful a garden, as rated by the GLR and Survey Garden Rating, the more likely survey participants would be to respond positively to the "outcome" questions. Pearson correlations were run to identify any significant relationships between the "outcome" questions and GLR (see Table 20). The strongest association was found with "Encourage" ($r=0.48, p< 2.2e-16$), followed by "Satisfaction" ($r=0.47, p < 2.2e-16$). The "outcome" questions were rated on a 5-point Likert scale. The first four questions ("Encourage Visits", "Good for Health", "Satisfaction", and "Recommend") appeared in this order on the survey in the "Garden Access & Awareness" section. The last question, "Feel After" appeared in

the “Garden Visits” section of the survey. All questions are written out in their respective sections.

Table 19

Survey: Staff Outcome Questions

Question	Mean (± SD)	Min	Max	Median
Encourage Visit	4.65 ± 0.69	2	5	5
Good for Health	4.67 ± 0.65	2	5	5
Satisfaction	3.8 ± 1.16	1	5	4
Recommend	3.13 ± 1.23	1	5	3
	I feel **Better**	I feel **Worse**	I feel the **Same**	
Feel After	221	6	60	

Encourage Visits

The question, “Would you encourage other people (patients, visitors, or staff) to visit the rooftop garden?” yielded a mean of 4.65 ± 0.69. There was a significant positive correlation ($p<0.001$, $r=0.49$) between the GLR and if a participant would encourage others to visit. The higher the garden quality, the more likely a participant would be to encourage others to visit the garden.

Good for Health

The question, “In your opinion, is spending time in this garden good for people's health (physical and/or mental)?” yielded a mean of 4.67 ± 0.65. There was a significant positive correlation ($p<0.001$, $r=0.31$) between the GLR and the question “Good for Health”. The higher the garden quality, the more likely a participant would be to report that spending time in the garden was good for mental and/or physical health.

Satisfaction

The question, “Does the rooftop garden improve your satisfaction with this HCF?” yielded a mean of 3.8 ± 1.16. There was a significant positive correlation ($p<0.001$, $r=0.47$) between the GLR and the question on satisfaction. The higher the garden quality, the more likely a participant would be to report that it improved their satisfaction overall with the HCF.

Likelihood to Recommend

The question, “Does the rooftop garden increase the likelihood that you would recommend this HCF?” yielded a mean of 3.13 ± 1.23. There was a significant positive correlation ($p<0.001$, $r=0.44$) between the GLR and the likelihood to recommend. Participants would be more likely to recommend the HCF with a higher quality garden.

Feel After

The question, “How do you usually feel after you spend time in the rooftop garden?” was rated as 3 = I feel better, 2 = I don’t feel any different, 1 = I feel worse. Out of participants who answered this question (n=287), 77% (n=221) said they would feel better after visiting the garden, 20.9% said they would not feel any different, and 2.1% (n=6) said they would feel worse. There was a significant correlation ($p<0.001$, $r=-0.40$) between GLR and “Feel Better”. The higher the garden quality, the more likely participants were to feel better after spending time in the garden.

Table 20

Survey: Correlations between GLR and “Outcome” Variables

Question	Correlation coefficient (r)	P value
GLR v. Encourage	0.498	< 2.2e-16**
GLR v. Good for Health	0.303	1.444e-07**
GLR v. Satisfaction	0.474	< 2.2e-16**
GLR v. Recommend	0.443	2.347e-15**
GLR v. Feel After	-0.405	1.002e-12**

** *p < 0.01*

Chapter IV

DISCUSSION

4.1 Summary

The PEDS-H-GET (Pediatric Healthcare Garden Evaluation Toolkit) is an adapted version of the H-GET developed by Dr. Sachs (2017). The H-GET was intended to facilitate the evaluations of gardens in HCF, to be used as a design tool to incorporate best practices for use by patients, visitors, and staff, and to be used as a research tool to test interventions or specific garden features. The toolkit consists of four validated tools: Garden Assessment Tool for Evaluators (GATE), Staff Survey, Behavior Mapping, and Stakeholder Interviews.

This study was conducted as part of a post-occupancy evaluation (POE). POEs are especially useful for large expenditures on physical facilities such as the rooftop garden, as they can determine if the original design goals were met as well as offer guidelines for future or similar developments.

This section will discuss garden quality and usage; accessibility, knowledge, and perceptions of the garden; and barriers and constraints to use.

4.1.1 Garden Quality

A high-quality garden in a HCF can have many implications for patients, staff, and visitors. Gardens in HCFs can reduce stress by affording opportunities for exercise, social support, and positive distractions, or by instilling a sense of control and access to privacy (Sachs, 2017; Ulrich, 1999). This sense of control allows

patients and family members to mentally and physically escape the stressful hospital environment or situation, if only temporarily, and has been shown to help individuals cope with stress (Evans & Cohen, 1987; Sachs, 2017; Ulrich & Addoms, 1981). Stress has been associated with slower healing, and reducing stress has resulted in lower levels of emotional burnout, lower turnover, fewer medical errors, and increased alertness and quality of care (Cooper Marcus & Sachs, 2014; Gouin & Kiecolt-Glaser, 2012).

The GATE, which measures the degree to which a garden in a HCF is considered “a healing environment”, showed high scores for the cumulative item score (7.89/10), Overall Restorativeness score (7.25/10), and Overall Impression rating (8.1/10). Since the GATE is meant to be used in a wide range of settings with different types of gardens, the domains represent over-arching constructs that do not necessarily apply to all gardens. Therefore, a low score in one specific domain is not fully indicative of the quality of the garden. The GATE audit scores for individual items, which identify specific success or issues, may be more meaningful than the overall domain scores. By its nature, the rooftop garden scored the lowest in the Access & Visibility domain (6.8), but scored above an 8.0 in three other domains (Walking & Activities: 8.5; Sense of Being Away: 8.4; Places to Rest: 8.2).

The survey enabled the researcher and institution to gather feedback about the garden and its use from staff across the HCF. Staff rated the quality of the garden through GATE-like questions as 7.28/10, and gave an overall rating of 7.25/10. These questions were similar to questions on the GATE audit, and included

on the survey so as to related the objective garden quality measures (GATE) to the more subjective quality measures (survey responses).

4.1.2 Garden Usage

Surveys and behavioral observation can be used to quantify garden usage patterns, subjective perceptions of the garden and staff outcomes (Whitehouse et al., 2001). In terms of usage, respondents indicated that they spend their free time in the garden on average between 16-30 minutes, and almost three-fourths indicated they would spend more of their free time in the garden if they could. These findings differ from previous research that reported user durations of less than 5 minutes on average (Whitehouse et al., 2001). However, these gardens, unlike the rooftop garden, allowed for users to “walk through” on their way to another part of the hospital. Subjects in a study by Heath and Gifford (2001) stayed less than 30 minutes.

Regarding time of visit, Heath and Gifford (2001) found that the largest percentage of participants utilized the study garden in the afternoon. In the Whitehouse et al. (2001) study, they also reported that the garden was most utilized mid-day, with empty periods in the morning and late afternoon. Although this study also saw a rise in garden users around mid-day, there were no periods of time when the garden was empty. This mid-day increase in garden usage can be attributed to lunch breaks, although staff could be seen eating in the garden throughout the day. The continuous utilization of the garden throughout the day may be partly caused by

the fact that this green space is one of the only currently available to staff at the main hospital building as construction on the future green spaces is ongoing.

Staff reported that they use the garden most to be outside, get fresh air, take in the view, relax, and enjoy their breaks. These results are in concordance with previous healthcare garden evaluations (Narderi & Shin, 2008). This passive use of the garden has been shown to have therapeutic benefits (Largo-Wight, 2011; Pasha & Shepley, 2013). These findings are consistent with previous studies that have found sitting, other sedentary activities, and dining were often identified as the most popular garden activities (Jiang et al., 2018; Heath & Gifford, 2001; Naderi & Shin, 2008; Sherman et al., 2005). These studies also found walking to be a popular activity in the garden, which was the 5th ranked most popular activity in this study.

Staff indicated a variety of reasons for which they utilize the rooftop garden, including being social (see Table 8) and being by themselves, as well as cope with stressful work situations. One respondent to the staff survey wrote, “It's been an incredible space for me to get away and process all of the trauma and emotions that my patients and families are sharing with me”. These findings are similar to Whitehouse et al. (2001) and Naderi and Shin (2008) which reported that staff use gardens for processing and coping, but also for both social interactions and to be alone.

Staff also reported that they would encourage people to visit the garden (rated 4.65/5) and thought visiting the garden was good for physical and mental health (4.67/5). In keeping with this finding was that 77% indicated that they feel better after visiting the garden. These findings are consistent with previous studies in which staff

indicated they thought it was important for HCFs to have gardens and that garden use was associated with improvements in mood and emotional and spiritual outlooks (Davis, 2011; Davis, 2002; Naderi & Shin, 2008; Whitehouse et al., 2001).

The survey data echoed the observational data from behavior mapping, which indicated that the garden was very highly utilized. Almost 1,500 users were observed in the garden during the 30-hour observation, and were spending on average almost 22 minutes in the garden during each visit. It appeared that staff used the garden on their breaks, but, as in previous studies, visitors were, on average, the most frequent garden users (Heath, 2004; Heath & Gifford, 2001; Whitehouse et al., 2001). This may be because visitors have more time to themselves when at the HCF, while staff can only utilize the garden during breaks or for work, or if they are accompanying a patient.

4.1.3 Knowledge and Accessibility of the Rooftop Garden

The rooftop garden ranked lowest in the Access & Visibility domain on the GATE. Studies have shown that the location of the garden and its spatial relationship to the hospital building or other amenities impacts the overall usage of the garden (Jiang et al., 2018; Pasha, 2011; Sachs, 2017). In fact, visibility of and direct access to the garden have been cited as major factors contributing to garden use or non-use, as well as optimization of the benefits of nature in terms of positive experiences, stress reduction, and restoration (Jiang et al., 2018).

Numerous garden evaluations have also identified lack of visual access to the garden as a hindrance to garden use. Gardens that are walled or spatially isolated

limit potential views from windows and decreases the ability of patients who otherwise would not be able to go to the garden to interact or utilize the garden in any way. Studies of successful gardens have reported that at least 90% of patients comment about what they can see of the garden from their rooms, and that they experience comfort and peace when they are able to sit and enjoy the outdoors from their hospital rooms (Jiang et al., 2018).

4.1.4 Perceptions about the Rooftop Garden

The high quality of the garden also translated to improved satisfaction with the HCF and increased likelihood to recommend the HCF to others. These results echo previous studies that have examined these more consumer-focused outcomes, and that the high quality of the garden influenced users to perceive the HCF as providing a higher quality of care (Whitehouse et al., 2001).

However, these findings in this children's hospital study did not translate to completely positive perceptions about the rooftop garden. Content analysis of open-ended survey questions revealed that some respondents felt the garden was not inviting, not peaceful, or not "natural" enough. These sub-codes were grouped under "negative perception," and more than half of the coding incidents were related to what respondents liked least about the garden. Although a survey of patients or visitors was not within the scope of this study, researchers have found that staff tended to be more critical in their evaluations of therapeutic gardens (Heath, 2004; Heath & Gifford, 2001; Sachs, 2017).

An interesting finding that emerged during content analysis was the idea that the garden was only for patients and visitors. Many staff reported feeling that the small size of the space meant that they should not utilize the garden or they would risk taking space away from patients and visitors. Others felt that the garden did not provide space to “get away and reflect during a busy/stressful day” and that there was “no privacy from patients.” The passionate support and opposition in the community around the HCF expansion project may have influenced staff members’ perception of the new garden, but, as there is no way to measure this, it is difficult to know the extent of this confounding variable.

4.1.5 Barriers and Constraints to Use

As important as the individual and collective features of the garden are, the physical design of the garden is not the only factor in how well-used it will be. It would be impossible to fully understand the importance that underlies the human connection to the natural world without incorporating humans into the process. While healing gardens are spaces that have been intentionally designed as healing environments that address emotional, social, organizational and spiritual needs, individual, policy, and programmatic features can all act as barriers to garden use (Cooper Marcus & Sachs, 2014).

Access & Awareness. Lack of awareness of the garden and ease of access were significant barriers to garden usage – in line with the findings from previous HCF garden evaluations (Cooper Marcus & Barnes, 1995; Davis, 2011; Heath, 2004; Naderi & Shin, 2008; Pasha, 2011: Sherman et al., 2005; Whitehouse et al.,

2001). The location of the garden is challenging both in terms of proximity to other amenities (main entrance, cafeteria, coffee shop) or features of the hospital and actual ease of access. Many difficulties revolved around wayfinding and elevator access. The rooftop garden can only be accessed by two of the eight elevators in the main lobby. These elevators are marked with butterfly motifs that say, “Follow the butterfly…take these elevators to the rooftop garden,” but there is no other indication of the rooftop garden nor that the other elevators *won’t* go to the garden. The efficiency of the elevators was also a major barrier to access. Many survey respondents indicated that the elevators are either “too slow” or that, “service during lunch hours take such a long time that it’s not worth it” to go to the garden.

Other issues around access were related to garden schedule and seasonality. The garden is officially open from 7AM-9PM, which caused some tension among night-shift workers, who felt they were not getting the chance to experience the garden. The stakeholders did not indicate a specific closing or opening date, but said that the garden closes at first snow fall, as there is no way to safely remove the snow, and reopens in the Spring. One staff member wrote, “Needs to be open weather dependent, not closed for season. We had beautiful weather in early Spring before the garden was open and patients who had been cooped up all winter were eager to get outside but there are no areas for them to do so.”

Staff Schedules. One of the most prevalent barriers to garden usage was lack of time during the day to get to and utilize the garden. This barrier has also been identified in previous literature in which nurses said that they either did not have a break, had a break but had to use it for paperwork, or otherwise thought the

location of the garden was inconvenient for them to use (Davis, 2011; Pasha, 2011). This rings particularly true for the rooftop garden, and being “too busy” was the most cited barrier to use for staff in this study, followed by “too far away/too hard to get to”. Many staff members remarked that, “just getting to and from the garden would consume most of my 30-minute lunch break”.

Weather and Shade. Lack of shade and adverse weather conditions can significantly reduce the frequency and duration of garden visits for staff and visitors (Pasha & Shepley, 2013). As highlighted in the stakeholder interview analysis, the lack of shade was and has been a major issue in this garden. The relative lack of seating in the shade throughout the day can keep users from staying in the garden for longer periods of time, and can even be dangerous for patients who are sensitive to the sun. The issues of weather and shade were the third and fourth most frequently identified barriers in the staff survey. Weather has been cited as the most significant barrier to green space use in healthcare facilities in previous evaluations (Naderi & Shin, 2008). Many staff expressed their wish that the garden had some sort of rain or weather cover so that they could still enjoy the garden if it was raining. It must be noted that this study was conducted in mid-July, when the sun is arguably at its hottest, and although the garden was highly utilized, the insufficient cover could have affected the frequency, duration, or decision to visit the garden.

Seating. A frequently mentioned barrier to garden usage was the amount and general lack of comfort of the seating types. The nature of the garden required chairs and tables to be bolted down so they would not fly off the roof, but this meant that the arrangement of the seating and tables could not be modified. This absence

of movable furniture has been reported to prevent families and groups from gathering and personalizing their experiences within the gardens, as well as creating more social or more private areas (Davis, 2011). The available seating in the garden consisted of chairs, planter-edge seating, and other backless bench-like options. A few of the benches did allow for the user to lean back against the wall, but only those against the building proper. This type of seating, especially without backs or armrests, is generally considered uncomfortable (Davis, 2011).

The perceived insufficient amount of seating also affected how staff utilized the garden. Many said they could not meet in larger groups as each table had only 2-3 chairs attached. Others said there was no real place to sit alone, since the seating could neither be separated from the tables nor moved, and the benches implied a more communal area. Perceptions of insufficient seating and lack of private seating have been reported to severely limit green space use in HCF (Naderi & Shin, 2008).

Privacy. Another barrier that was identified through content analysis was the perceived lack of privacy in the garden or other private area for staff. One staff member remarked, “I used the garden as a way to recharge, but there is no place to get away from patients and families. There is no privacy to talk on phone or have conversations with others without feet like others are listening.” Pasha and Shepley (2013) found that staff garden use did not co-vary with visitor garden use, and that the staff did not feel as though they could “get away” from the hospital in gardens shared with visitors. Davis (2011) and Pasha (2011) both identified staff members’ desire for private spaces, and Sherman et al. (2005) found privacy to be a major

predictor of garden use. This desire for separate or private areas was also a common factor for why staff use other green spaces at the HCF. In fact, Sherman et al. (2005) reported that in their study, staff actively sought out the garden that was the most spatially isolated from patients, and overwhelmingly used gardens to which patients had no direct access.

4.2 Design Recommendations

The design of gardens in HCF have important implications in terms of use and success, as well as outcomes such as restoration and access to the outdoors. A “garden-as-escape” model, which focuses on a sense of being away from the hospital, needs to present a spatial experience that contrasts with the indoor environment of the HCF (Naderi & Shin, 2008).

4.2.1 Design, Policy, and Activity Recommendations for Rooftop Garden

Previous HCF garden evaluations (Cooper Marcus & Barnes, 1995; Cooper Marcus & Sachs, 2014; Davis, 2002; Paine & Francis, 1990; Whitehouse et al., 2001) have published design recommendations for therapeutic gardens within healthcare settings. The following design recommendations are specific to this garden (4.2.1) and the future green spaces that are part of the larger expansion and renewal project across the HCF and its campuses (4.2.2) (see Figure 11).

Policy Interventions

- Increased education for staff around the existence and purpose of the garden, who it’s for, and how to incorporate its use into patient care.

- Encouraging staff to utilize garden for therapy work with patients or to plan events.
- Ongoing communication about how staff and families are benefitting from garden.

Activity Programming Interventions

- Scheduling, including: more coordinated activities to increase involvement and awareness.
- Include children-specific activities such as gardening or arts and crafts to create signage for the garden.
- Include staff-specific activities such as social gatherings or work-related meetings to increase degree of comfort for staff utilizing garden as well as giving staff the opportunity to add variation into their workday.

Design Recommendations (see Figure 11)

Eight design recommendations for the rooftop garden were suggested by this study. They are:

(A) Include signage to inform garden users about the type of grass and its connection to local culture

(B) Introduce elements and signage to actively engage with garden (plant names and information labels, educational materials)

(C) Install posters about the garden and how to best access it in elevators or other high-traffic areas. Include times or distances to set expectations

Photo source: https://landscapearchitect.com/

(D) Add a weather cover over the trellis to allow for garden use even when it's raining

(E) Add a clock so garden users can keep track of time

Photo source: https://www.allmodern.com/--Snediker-9-School-Wall-Clock

(F) Install vending machines or other food and drink options in garden lobby so that garden users don't have to leave the garden to get a quick snack or drink

Photo source: https://www.ebay.com/itm/Two-Seaga-HY900-Healthy-You-Combo-Vending-Machines

(G) Introduce multisensory features or objects that offer exploration and play (elements activated by sun or wind)

Photo source: https://www.pinterest.co.kr/pin/501799583475705816/

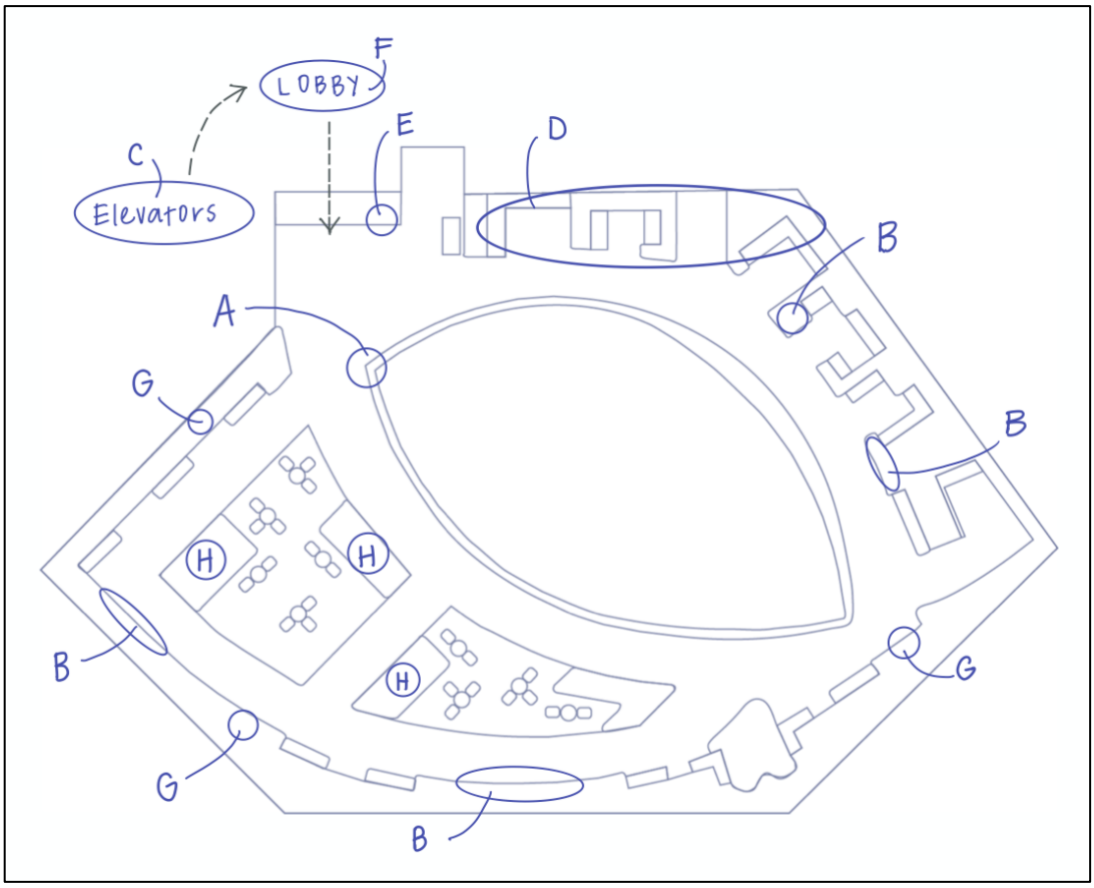
(H) Incorporate plants that attract more birds and butterflies and fewer bees

Photo source: http://www.birdsandblooms.com/

Figure 11

Recommendations specific to the Rooftop Garden

A	Include signage to inform garden users about the type of grass and its connection to local culture.
B	Introduce elements and signage to actively engage with garden (plant names and information labels, educational materials)
C	Install posters about the garden and how to best access it in elevators or other high-traffic areas. Include times or distances to set expectations.
D	Add weather cover over trellis to allow garden use even when it's raining
E	Add a clock so garden users can keep track of time
F	Install vending machines or other food and drink options in garden lobby so that garden users don't have to leave the garden to get a quick snack or drink
G	Introduce multisensory features that offer exploration and play (elements activated by sun or wind
H	Incorporate plants that attract more birds and butterflies and fewer bees



4.2.2 Design Recommendations for Future Gardens

The following recommendations are meant for the future gardens at this HCF, but can be applied to healthcare gardens in general. They are recommendations based on the qualitative and quantitative data presented in this study, but are not suitable recommendations for the current rooftop garden.

Furniture

- More choices of seating type (backrest, armrests, hard and soft seating) and location - (movable, choice of sitting in the sun or shade)
- More tables and chairs of different sizes for eating lunch in larger groups or in seclusion

Weather

- Greenhouse for year-round use
- Designs that ameliorate negative weather conditions (sun, rain, etc.)

Design Features

- Subspaces with different qualities/features to accommodate different purpose of use or degree of demand on the user.
    - Creating opportunities for both privacy and socialization
    - Passive healing spaces (for therapy)
- Organize private nooks along the walking paths to allow observation of passersby while ensuring privacy of individuals
    - Staff only spaces to ensure full escape from work environment and increased privacy.
- Structural features that allow children to interact with adults or other children
- Multisensory features that offer exploration and play such as elements activated by the sun or weather; water features.
- Plants that can be used as screens for privacy or to create more private areas; plants that attract wildlife (birds, butterflies, etc.).

Location

- Proximity of future gardens to amenities such as cafeteria, coffee shop, or entrances.

4.3 Limitations

There limitations in this study were largely out of the researcher's control. As previously mentioned, the socio-political atmosphere was a confounding factor that could not be accounted for, and may well have greatly influenced whether individuals visited the garden or how they perceived it. The researcher did see the influence of this outside factor in the qualitative data in the survey, as well as in informal conversations in passing with garden users. It is possible that some survey questions, especially those related to satisfaction, may have introduced demand characteristics, which can influence participants to respond a certain way to either support or disrupt the hypothesis.

The nature of this evaluation (no pre-evaluation, no control or intervention groups) helped to avoid many threats to internal validity. Although the survey was sent out to the entire staff across all HCF campuses, only those who had visited the garden completed the full survey. This could have introduced selection bias into the study. Another limitation with the survey was that demographic information was not collected for those who had not visited the garden (piped out early) due to researcher error – those respondents were routed to the end of the survey instead of to the demographic question block. Another measurement limitation occurred in the behavior mapping observation. It was difficult to assign demographic information to some garden users (staff or visitor, correct age groups for patients to healthy siblings) as well as to decide to what extent a garden user was "engaged" in an activity. In order to manage this, the researchers discussed and came to an understanding on any ambiguous behaviors or what constituted a specific activity, such as relaxing, and then kept consistent across the observations.

Other limitations include the weather and season in which this study was completed. Mid-July is not the optimal time to conduct a garden evaluation, but was chosen due to timing and scheduling constraints. Although this both lowers the generalizability of the study and introduces conditions that would not be considered "controlled," the high activity in the garden during the study allowed for a large amount of data to be collected and analyzed.

Because of the sensitivity and potential IRB issues with talking to children and patients, this study was not able to include the perspectives of children – either healthy siblings or patients. This study also did not include patient-proxies, such as parents or other family members or visitors, for similar reasons.

4.4 Implications for Practice and Future Research

By analyzing the user processes in the garden, both intended and unintended, we can measure the effectiveness and appropriateness of the design – identifying successes and issues to be addressed in either this or future projects. It is important to evaluate these gardens in order to better understand the impact of nature exposure on a wide range of individuals, and possibly uncover mechanisms to enhance the therapeutic effects of the garden. By examining healing gardens, we can create support for the gardens in general as well as the well-being of staff, patients, and families, and justification for the cost of creating the garden. The research findings of this study serve to statistically support design guidelines suggested by previous researchers with the ultimate goal of helping to develop a more holistic approach to health care.

Future research could be completed on this garden in different seasons, or with access to different populations. Research with patients and healthy siblings could investigate the specific needs and preferences of hospitalized children, and gain the perspective of the garden from a non-adult visitor. Involving patients in this type of research could provide further support for specific elements or activities in the garden, and could be achieved through patients drawing ideal gardens at the HCF.

Future research could also look at ways to more quantitatively measure benefits, such as examining biomarkers or stress or developing measures to operationalize concepts such as well-being, satisfaction, and restoration. The operationalization of these concepts may help answer the question regarding whether time spent in gardens can assist in both preventing illnesses stemming from psychological processes (stress) and alleviating stress-related symptoms (depression, burnout). It would also be interesting to examine the dose-response relationship between time spent in gardens in HCFs and health benefits, as well as the present functioning within the garden. Such research could begin to identify possible individual differences acting as moderators.

In light of the upcoming garden projects in this HCF, future research could incorporate pre-occupancy evaluations to collect data to measure against in the post-occupancy phase. This type of research could start to help identify which particular aspects of gardens may have impacts on cognitive functioning, mental health, and physical health, and identify the causal pathways for these effects.

Other potential future research specifically related to this garden include increased marketing and communication between staff and administration. Along with this, they could implement trainings for facility or department managers to educate them about the garden. Following this, they could complete a post-survey to see if putting this project in the context of the HCF larger plan and increased communication changed perceptions and/or if staff appreciated the communication and transparency.

4.5 Closing Thoughts

As we look to the future, research into how we can strengthen our connection with the natural world is more important than ever. Many healthcare professionals have already begun to show their support for the incorporation of nature and natural features into the healthcare experience, as evidenced by the increasing number of HCFs with accessible green spaces. It is essential that designers, researchers, and healthcare professionals continue to learn and work together to realize the potential impacts of green spaces in healthcare environments to support holistic care and everyday life and functioning. This research represents a call to action across disciplines to focus on our most vulnerable populations. It aims to give those interdisciplinary groups the best possible chance of improving the quality of life and the quality of the experience for everyone involved – from patients to staff to visitors.

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Appendix

Appendix 1: IRB-Appro ved Recruitment Letter

Request for Stakeholder Interview, to be sent via email

Subject Heading: Invitation for Interview

As a M.S. Candidate in Design & Environmental Analysis at Cornell University, I am conducting research about gardens at pediatric healthcare facilities, specifically, the rooftop garden at Boston Children's Hospital. I am interviewing the lead designer (landscape architect/designer or architect); a staff member who was on the original design team; and the Facility Manager. I was given your name because you were or are involved with the garden[s] at Boston Children's Hospital.

The interviews will last approximately 45 minutes, and most will take place over the phone. A few will take place in person when I am conducting on-site research. I will audio-record the interview and then the recording will be transcribed by a professional transcription service.

The questions are about the program/design for the garden, including challenges and successes, and about how the garden is used now. You are not expected to "know everything," just share what you do know.

Would you be willing to participate in an interview? Please let me know so I can contact you to schedule a time that is convenient to you.

Best,

Julia Jaffe
M.S. Candidate
Cornell University
Department of Design & Environmental Analysis
Phone: (203)-247-8762
Email: jgj57@cornell.edu

Appendix 2: Interview Consent Forms

Cornell University Human Subjects Protection
Informed Consent form for
Healthcare Garden Evaluation Toolkit Stakeholder Interviews

Introduction
You are invited to participate in a study being conducted by Julia Jaffe, a M.S. Candidate at Cornell University. The purpose of this research is to develop a Healthcare Garden Evaluation Toolkit (HGET), which will be used to study gardens in pediatric care hospitals. You are being asked to take part in this study because you have experience with the planning, design, construction, programming, and/or maintenance of a healthcare garden.

Procedures
After you agree to the interview, the researcher (Julia Jaffe) will schedule a time for a phone or in-person interview. The interview will last approximately 45 minutes, and will be audio recorded with a smartphone. The recording will be sent to a professional transcription service, and the researcher will use the transcript and her notes to identify themes and topics of importance. During the interview, the researcher will ask you questions about the program/design for the garden, including challenges and successes, and about how the garden is used now. You are not expected to "know everything," just share what you do know. You are not required to answer any questions that you do not wish to answer, and you are free to terminate the interview at any time.

Cost and Compensation
Aside from your time, there are no costs for taking part in the study. You will not be paid for the interview, but your participation is a valuable part of the research process and development of the HGET.

Participation
Participation in this interview is completely voluntary, and there is no penalty for not participating. You may decide to not participate, or to stop it at any time. By completing the survey, you are giving permission for the researcher (Julia Jaffe) to use your information for research purposes, where your responses will be combined with those of other participants.

Confidentiality
Information about you will be kept confidential to the extent permitted or required by law. People who have access to your information include the Principal Investigator and research study personnel. Representatives of regulatory agencies such as the Cornell University Office of Research Integrity and Assurance may access your records to make sure the study is being run correctly and that information is collected properly.

Questions about the Research
You may contact the Principal Investigator, Julia Jaffe, to report a concern or complaint about this research at (203) 247-8762 or jgj57@cornell.edu. You may also contact the Research Chair, Mardelle Shepley, at (607) 255-3165 or mms449@cornell.edu.

Questions about your Rights as a Research Participant
For questions about your rights as a research participant, or if you have questions, complaints, or concerns about the research and cannot reach the Principal Investigator or want to talk to someone other than the Investigator, you may call the Cornell University Office of Research Integrity and Assurance office. Phone number: (607) 255-5138.

Thank you very much!

Julia Jaffe
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Cornell University
Department of Design & Environmental Analysis
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Ithaca, NY, 14853
Phone: (203)-247-8762
Email: jgj57@cornell.edu

STATEMENT OF CONSENT

I agree to be in this study and know that I am not giving up any legal rights by signing this form. The procedures, risks, and benefits have been explained to me, and my questions have been answered. I know that new information about this research study will be provided to me as it becomes available and that the researcher will tell me if I must be removed from the study. I can ask more questions if I want. A copy of this entire consent form will be given to me.

_____ _____

Participant's Signature Date

_____ _____

Printed Name Date

INVESTIGATOR'S AFFIDAVIT:

Either I have or my agent has carefully explained to the participant the nature of the above project. I hereby certify that to the best of my knowledge the person who signed this consent form was informed of the nature, demands, benefits, and risks involved in his/her participation.

_____ _____

Signature of Presenter Date

_____ _____

Printed Name Date

Appendix 3: Garden Assessment Tool for Evaluators (GATE) in Color

HEALTHCARE GARDEN EVALUATION TOOLKIT

GARDEN ASSESSMENT TOOL FOR EVALUATORS

INSTRUCTIONS — PLEASE READ BEFORE YOU BEGIN

STEP 1: ESTABLISH CONSENSUS
There should always be at least two evaluators. Evaluators must agree on the 1) Garden boundaries 2) Main doorway 3) Primary pathway.

STEP 2: WALK THROUGH THE GARDEN BEFORE YOU START
Think of the garden from the point of view of a frail patient. Walk through the entire garden, test the furniture, look at the area from different positions – including wheelchair and child height. Ask yourself, "How well does this garden support the needs of patients, visitors, and staff?"

STEP 3: EVALUATE THE GARDEN
For each statement on the next five pages, check the box that best represents your level of agreement. If you are unsure or if the statement is not applicable (N/A), check the last box. Note: It is better to check "Not sure or N/A" than to make a guess! A tape measure will be useful for some of the items.

STEP 4: RETURN THE FORMS
Return by mail to Julia Jaffe, College of Human Ecology, Martha Van Rensselaer Hall, Ithaca, NY, 14850, or scan and email to jgj57@cornell.edu.
Questions or concerns? Email jgj57@cornell.edu or call (203) 247-8762.

GENERAL QUESTIONS

01	Your name:										
02	Your role/profession (landscape architect, nurse, etc.):										
03	Date:	Time:						AM or PM (circle one)			
04	Weather (sunny, cloudy, windy):	Temp & Humidity (°F, warm, cool, etc.):									
05	On a scale of 1-10, how physically comfortable are you?	1	2	3	4	5	6	7	8	9	10
06	Name of facility and location (city, state):										
07	Name of garden (if it is named):										
08	Type of facility or patients served:										
09	Location and type of garden (e.g., front entry, central coutyard, rooftop, etc.):										
10	Are there other gardens and/or outdoor sitting areas at the facility?	YES						NO			
	If YES, please list:										

OVERALL RATING

NOT RESTORATIVE AT ALL → COMPLETELY RESTORATIVE

*	On a scale of 1-10, how would you rate the **overall restorativeness** of this garden? *"Restorative"= Able to restore a person's strength, health, or well-being.*	1	2	3	4	5	6	7	8	9	10

GARDEN ASSESSMENT TOOL FOR EVALUATORS

For each item, check the box that best represents your level of agreement. If you are unsure or if the statement is not applicable (N/A), check the last box.

ACCESS & VISIBILITY 1

VISUAL ACCESS TO THE GARDEN		STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01	Garden is visible from main public indoor areas (entry lobby, major hallway, etc.).						
02	Garden is visible from indoor areas that involve waiting (waiting rooms, labs, pharmacy, etc.).						
03	Garden is visible from floors above (from offices, patient rooms, etc. on upper floors).						
04	There is signage TO the garden from indoors (in lobby, waiting areas, elevator, etc.).						
05	There is signage for the garden ON OR NEXT TO garden doors.						
06	Entrance to the garden is easy to find.						
07	Doors to the garden are glass or have a window in or next to them.						
08	Garden looks appealing/inviting from indoors.						
09	Information about the garden is available (through pamphlets, signage, website, etc.).						

PHYSICAL ACCESS TO THE GARDEN		STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
10A	Garden is open 24 hours a day, 7 days a week.	YES				NO	
10B	Garden is open all four seasons	YES				NO	
10C	If garden is NOT open 24/7, what seasons, hours, and days is it open?						
11	Doors to the garden from at least one entry are automatic and easy to use.						
12	Any non-automatic doors are easily operated, even by children (not too heavy, don't close too quickly).						
13	Doorway thresholds are flat and smooth (for a wheelchair or an IV pole to cross easily).						
14	The space just outside the main doorway* is covered/roofed (provides protection from rain, sun, etc.).						
15	The space just outside the main doorway has seating for at least two people and space for at least one wheelchair.						
16	A "destination" feature draws people into the garden (seating area, water feature, special tree, etc.).						
17	A restroom in the facility is near a garden entry (about 50 feet).						
18	Garden has an emergency phone that connects with the hospital front desk or security.						

** Remember to make sure all evaluators agree on what is the "main doorway."*

SENSE OF "BEING AWAY" 2

SENSE OF "BEING AWAY"	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 People can find a **desirable sense of enclosure** in the garden.						
02 People can find **privacy in at least one part** of the garden.						
03 People in the garden **cannot look into adjacent private indoor areas** (patient, treatment, and consultation rooms).						
04 Garden has at least one **fully covered (roofed) area** (porch, gazebo, etc.).						
05 At least one **seating area is protected from climatic/ weather extremes** (wind shields, patio heaters, overhead fans, etc.).						
AESTHETICS & MAINTENANCE	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
06 Garden has features that provide a **rich, multi-sensory experience** (things to do, look at, touch, smell, hear, etc.).						
07 Garden is **free from unpleasant sounds** (air conditioners, traffic, loading docks, etc.).						
08 Garden is **free from bad odors** (trash, vehicle exhaust, cooking smells, etc.).						
09 Plants or features **hide or soften unsightly views** (of fences, walls, equipment, etc.).						
10 Garden is **free from trash** (paper, cigarette butts, cans, etc.).						
11 Garden has at least one **trash can.**						
12 There is a **shed or other place to store tools** in the garden.						
13 **Outlets** are provided in the garden (for charging medical equipment, phones, etc.)						

NATURE ENGAGEMENT 3

PLANTINGS	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 **More than half of the garden surface areas are planted** (not paved).						
02 Garden has a **rich variety of plants** (combination of trees, shrubs, perennials; variety of species).						
03 Garden has **plants at multiple heights** (on the ground, raised beds, hedges, vines, trees, etc.).						
04 Garden has **plants that stimulate the senses** (sight, smell, touch, sound, taste).						
05 Some plants are **intriguing, provide "fascination"** (intricate flowers, unusual growth pattern, movement, etc.).						
06 Planting provides **year-round interest** (always something to see, such as flowers, leaves, berries, bark, evergreens, etc.).						
07 Some plants provide **bright colors** in at least one time of year/season (with flowers, leaves, berries, bark, etc.).						
08 **Planting BEDS look well-maintained** (well-weeded, no large "bare spots," etc.).						
09 **PLANTS look well-maintained and healthy** (vibrant, well-pruned, etc.).						
10 **Plants are sturdy** enough to tolerate extreme weather, people picking flowers and leaves, etc.						

OTHER NATURAL FEATURES	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
11 **Plants provide food and/or habitat** for birds, butterflies, and other desirable wildlife.						
12A Garden has at least one **water feature**. If NO, skip to question 18.	YES				NO	
12B If YES, describe water feature briefly:						
13 Water feature looks **clean and well-maintained**.						
14 Water feature design and location **minimizes slipping hazards.**						
15 Water feature has **minimal splash** (spray from splashing can carry harmful bacteria).						
16 **Sound** from water feature is **pleasant and soothing.**						
17 Some **seating is available near** the water feature (within 15 feet).						
18 Garden has **features or objects that children can play with or manipulate**.						

WALKING & ACTIVITIES 4

PRIMARY WALKWAY (PATH OR PAVED THOROUGHFARE)	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 Primary walkway is **relatively flat** (not too steep).						
02 Primary walkway **does not have steps or steep ramps.**						
03 Primary walkway is **smooth but non-skid, even when wet.**						
04 Primary walkway is **at least six feet wide** or, if narrower, has frequent passing areas.						
05 Primary walkway has a **curb or raised edges** (to keep wheelchairs, strollers, walkers, canes, etc. on walkway).						
06 Primary walkway has **seating approximately every 30 feet.**						
07 **Gaps or cracks in paving** (walkways and patios) **are narrow** enough for a wheelchair, stroller, or IV pole to cross smoothly.						
ALL PAVED AREAS (WALKWAYS AND PATIOS)	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
08 Paving **does not create glare** (is tinted concrete, colored stone, brick, etc.).						
09 Paved areas are **clear of debris and other obstacles** (twigs, leaves, hoses, etc.).						
10 **Trees/plants along walkways** and other paved areas **do not drop** a lot of leaves, twigs, seeds, or fruits.						
LIGHTING, WAYFINDING, & AMENITIES	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
11 There are **landmarks and/or signage in the garden to help people navigate their way through** (and back to the entrance).						
12 **A drinking fountain** is in or near the garden (about 50 feet).						
13 Garden has **lighting for night usage**.						
VARIETY & ACTIVITIES	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
14 Garden has **more than one walkway**, with a variety of routes, lengths, and destinations.						
15 At least one **secondary walkway offers increasing levels of difficulty** (with paving material, steepness, steps, etc.).						
16 Garden is **safe for children** (e.g. physically enclosed; easily viewed from nearby seating areas; plantings and other features are not harmful).						
17 Garden has **places for structured or unstructured play.**						

PLACES TO REST 5

SEATING AVAILABILITY & TYPE	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 The garden offers **many places to sit**.						
02 People can choose a **variety of types** of seating (benches, chairs, etc.).						
03 **Movable seating** is available (light enough to move but sturdy enough to prevent tipping).						
04 At least **50% of the seating in the garden has backs and arms** (so that people can easily get up and down).						
05 There is a **place where someone could lie down** for a rest (chaise lounge, bench, lawn).						
06 The garden offers **seating at different or adjustable heights** to accommodate all potential garden users.						
PRIVATE OR SOCIAL	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
07 Garden has **separate areas for activities and socializing**, compared with **contemplation/quiet conversation.**						
08 Garden provides a place where **3 or more people can sit together.**						
09 Some seating areas **allow people to interact with passers-by.**						
10 Garden provides **seating that is somewhat private** (to have a difficult conversation, make a sensitive call, etc.).						
11 Some seating makes it **possible to watch others from a distance**						
AESTHETICS & SUN	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
12 There is a **choice of seating in the sun or shade** throughout most of the day.						
13 Seating **does not produce glare** (is not metal, white, etc.).						
14 Seating material **does not get too hot or too cold.**						
15 Seating, tables, and other furniture look **well-maintained.**						
16 Some seating has **attractive or interesting views.**						
TABLES	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
17 **Garden has at least one table.** If NO, skip to the final page.	YES				NO	
18 Some **seats have tables next to them.**						
19 There is at least one table **large enough for four or more people.**						
20 There is at least one **table that can accommodate people in wheelchairs or scooters.**						
21 **Tables do not tip** (for example, when people use as leverage to sit down and get up).						
22 The garden offers **tables at different or adjustable heights** to accommodate all potential garden users.						

HEALTHCARE GARDEN EVALUATION TOOLKIT

GARDEN ASSESSMENT TOOL FOR EVALUATORS

OVERALL IMPRESSION RATING	NOT RESTORATIVE AT ALL → COMPLETELY RESTORATIVE									
* Without looking back at your original rating, on a scale of 1-10, how would you rate the overall restorativeness of this garden? *"Restorative"= Able to restore a person's strength, health, or well-being.*	1	2	3	4	5	6	7	8	9	10

FINAL INSTRUCTIONS

Please make sure you have completed all pages and have not skipped any items. Thank you!

Appendix 4: Garden Assessment Tool for Evaluators (GATE) in Black & White

HEALTHCARE GARDEN EVALUATION TOOLKIT

GARDEN ASSESSMENT TOOL FOR EVALUATORS

INSTRUCTIONS —PLEASE READ BEFORE YOU BEGIN

STEP 1: ESTABLISH CONSENSUS
There should always be at least two evaluators. Evaluators must agree on the 1) Garden boundaries 2) Main doorway 3) Primary pathway.

STEP 2: WALK THROUGH THE GARDEN BEFORE YOU START
Think of the garden from the point of view of a frail patient. Walk through the entire garden, test the furniture, look at the area from different positions – including wheelchair and child height. Ask yourself, "How well does this garden support the needs of patients, visitors, and staff?"

STEP 3: EVALUATE THE GARDEN
For each statement on the next five pages, check the box that best represents your level of agreement. If you are unsure or if the statement is not applicable (N/A), check the last box. Note: It is better to check "Not sure or N/A" than to make a guess! A tape measure will be useful for some of the items.

STEP 4: RETURN THE FORMS
Return by mail to Julia Jaffe, College of Human Ecology, Martha Van Rensselaer Hall, Ithaca, NY, 14850, or scan and email to jgj57@cornell.edu.
Questions or concerns? Email jgj57@cornell.edu or call (203) 247-8762.

GENERAL QUESTIONS

01	Your name:										
02	Your role/profession (landscape architect, nurse, etc.):										
03	Date:	Time:					AM or PM (circle one)				
04	Weather (sunny, cloudy, windy):	Temp & Humidity (°F, warm, cool, etc.):									
05	On a scale of 1-10, how physically comfortable are you?	1	2	3	4	5	6	7	8	9	10
06	Name of facility and location (city, state):										
07	Name of garden (if it is named):										
08	Type of facility or patients served:										
09	Location and type of garden (e.g., front entry, central coutyard, rooftop, etc.):										
10	Are there other gardens and/or outdoor sitting areas at the facility?	YES					NO				
	If YES, please list:										

OVERALL RATING

NOT RESTORATIVE AT ALL → COMPLETELY RESTORATIVE

* On a scale of 1-10, how would you rate the overall restorativeness of this garden? *"Restorative"= Able to restore a person's strength, health, or well-being.*	1	2	3	4	5	6	7	8	9	10

GARDEN ASSESSMENT TOOL FOR EVALUATORS

For each item, check the box that best represents your level of agreement. If you are unsure or if the statement is not applicable (N/A), check the last box.

ACCESS & VISIBILITY 1

VISUAL ACCESS TO THE GARDEN		STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01	Garden is visible from main public indoor areas (entry lobby, major hallway, etc.).						
02	Garden is visible from indoor areas that involve waiting (waiting rooms, labs, pharmacy, etc.).						
03	Garden is visible from floors above (from offices, patient rooms, etc. on upper floors).						
04	There is signage TO the garden from indoors (in lobby, waiting areas, elevator, etc.).						
05	There is signage for the garden ON OR NEXT TO garden doors.						
06	Entrance to the garden is easy to find.						
07	Doors to the garden are glass or have a window in or next to them.						
08	Garden looks appealing/inviting from indoors.						
09	Information about the garden is available (through pamphlets, signage, website, etc.).						

PHYSICAL ACCESS TO THE GARDEN		STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
10A	Garden is open 24 hours a day, 7 days a week.	YES				NO	
10B	Garden is open all four seasons	YES				NO	
10C	If garden is NOT open 24/7, what seasons, hours, and days is it open?						
11	Doors to the garden from at least one entry are automatic and easy to use.						
12	Any non-automatic doors are easily operated, even by children (not too heavy, don't close too quickly).						
13	Doorway thresholds are flat and smooth (for a wheelchair or an IV pole to cross easily).						
14	The space just outside the main doorway* is covered/roofed (provides protection from rain, sun, etc.).						
15	The space just outside the main doorway has seating for at least two people and space for at least one wheelchair.						
16	A "destination" feature draws people into the garden (seating area, water feature, special tree, etc.).						
17	A restroom in the facility is near a garden entry (about 50 feet).						
18	Garden has an emergency phone that connects with the hospital front desk or security.						

** Remember to make sure all evaluators agree on what is the "main doorway."*

SENSE OF "BEING AWAY" 2

SENSE OF "BEING AWAY"		STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01	People can find a **desirable sense of enclosure** in the garden.						
02	People can find **privacy in at least one part** of the garden.						
03	People in the garden **cannot look into adjacent private indoor areas** (patient, treatment, and consultation rooms).						
04	Garden has at least one **fully covered (roofed) area** (porch, gazebo, etc.).						
05	At least one **seating area is protected from climatic/ weather extremes** (wind shields, patio heaters, overhead fans, etc.).						
AESTHETICS & MAINTENANCE		**STRONGLY AGREE**	**SOMEWHAT AGREE**	**NEUTRAL**	**SOMEWHAT DISAGREE**	**STRONGLY DISAGREE**	**NOT SURE OR N/A**
06	Garden has features that provide a **rich, multi-sensory experience** (things to do, look at, touch, smell, hear, etc.).						
07	Garden is **free from unpleasant sounds** (air conditioners, traffic, loading docks, etc.).						
08	Garden is **free from bad odors** (trash, vehicle exhaust, cooking smells, etc.).						
09	Plants or features **hide or soften unsightly views** (of fences, walls, equipment, etc.).						
10	Garden is **free from trash** (paper, cigarette butts, cans, etc.).						
11	Garden has at least one **trash can.**						
12	There is a **shed or other place to store tools** in the garden.						
13	**Outlets** are provided in the garden (for charging medical equipment, phones, etc.)						

NATURE ENGAGEMENT 3

PLANTINGS	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 **More than half of the garden surface areas are planted** (not paved).						
02 Garden has a **rich variety of plants** (combination of trees, shrubs, perennials; variety of species).						
03 Garden has **plants at multiple heights** (on the ground, raised beds, hedges, vines, trees, etc.).						
04 Garden has **plants that stimulate the senses** (sight, smell, touch, sound, taste).						
05 Some plants are **intriguing, provide "fascination"** (intricate flowers, unusual growth pattern, movement, etc.).						
06 Planting provides **year-round interest** (always something to see, such as flowers, leaves, berries, bark, evergreens, etc.).						
07 Some plants provide **bright colors** in at least one time of year/season (with flowers, leaves, berries, bark, etc.).						
08 **Planting BEDS look well-maintained** (well-weeded, no large "bare spots," etc.).						
09 **PLANTS look well-maintained and healthy** (vibrant, well-pruned, etc.).						
10 **Plants are sturdy** enough to tolerate extreme weather, people picking flowers and leaves, etc.						

OTHER NATURAL FEATURES	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
11 **Plants provide food and/or habitat** for birds, butterflies, and other desirable wildlife.						
12A Garden has at least one **water feature**. If NO, skip to question 18.	YES				NO	
12B If YES, describe water feature briefly:						
13 Water feature looks **clean and well-maintained**.						
14 Water feature design and location **minimizes slipping hazards.**						
15 Water feature has **minimal splash** (spray from splashing can carry harmful bacteria).						
16 **Sound** from water feature is **pleasant and soothing.**						
17 Some **seating is available near** the water feature (within 15 feet).						
18 Garden has **features or objects that children can play with or manipulate**.						

WALKING & ACTIVITIES 4

PRIMARY WALKWAY (PATH OR PAVED THOROUGHFARE)	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 Primary walkway is **relatively flat** (not too steep).						
02 Primary walkway **does not have steps or steep ramps.**						
03 Primary walkway is **smooth but non-skid, even when wet.**						
04 Primary walkway is **at least six feet wide** or, if narrower, has frequent passing areas.						
05 Primary walkway has a **curb or raised edges** (to keep wheelchairs, strollers, walkers, canes, etc. on walkway).						
06 Primary walkway has **seating approximately every 30 feet.**						
07 **Gaps or cracks in paving** (walkways and patios) **are narrow** enough for a wheelchair, stroller, or IV pole to cross smoothly.						
ALL PAVED AREAS (WALKWAYS AND PATIOS)	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
08 Paving **does not create glare** (is tinted concrete, colored stone, brick, etc.).						
09 Paved areas are **clear of debris and other obstacles** (twigs, leaves, hoses, etc.).						
10 **Trees/plants along walkways** and other paved areas **do not drop** a lot of leaves, twigs, seeds, or fruits.						
LIGHTING, WAYFINDING, & AMENITIES	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
11 There are **landmarks and/or signage in the garden to help people navigate their way through** (and back to the entrance).						
12 **A drinking fountain** is in or near the garden (about 50 feet).						
13 Garden has **lighting for night usage**.						
VARIETY & ACTIVITIES	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
14 Garden has **more than one walkway**, with a variety of routes, lengths, and destinations.						
15 At least one **secondary walkway offers increasing levels of difficulty** (with paving material, steepness, steps, etc.).						
16 Garden is **safe for children** (e.g. physically enclosed; easily viewed from nearby seating areas; plantings and other features are not harmful).						
17 Garden has **places for structured or unstructured play.**						

PLACES TO REST 5

SEATING AVAILABILITY & TYPE	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 The garden offers **many places to sit**.						
02 People can choose a **variety of types** of seating (benches, chairs, etc.).						
03 **Movable seating** is available (light enough to move but sturdy enough to prevent tipping).						
04 At least **50% of the seating in the garden has backs and arms** (so that people can easily get up and down).						
05 There is a **place where someone could lie down** for a rest (chaise lounge, bench, lawn).						
06 The garden offers **seating at different or adjustable heights** to accommodate all potential garden users.						
PRIVATE OR SOCIAL	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
07 Garden has **separate areas for activities and socializing**, compared with **contemplation/quiet conversation.**						
08 Garden provides a place where **3 or more people can sit together.**						
09 Some seating areas **allow people to interact with passers-by.**						
10 Garden provides **seating that is somewhat private** (to have a difficult conversation, make a sensitive call, etc.).						
11 Some seating makes it **possible to watch others from a distance**						
AESTHETICS & SUN	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
12 There is a **choice of seating in the sun or shade** throughout most of the day.						
13 Seating **does not produce glare** (is not metal, white, etc.).						
14 Seating material **does not get too hot or too cold.**						
15 Seating, tables, and other furniture look **well-maintained.**						
16 Some seating has **attractive or interesting views.**						
TABLES	STRONGLY AGREE	SOMEWHAT AGREE	NEUTRAL	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
17 **Garden has at least one table.** If NO, skip to the final page.	YES				NO	
18 Some **seats have tables next to them.**						
19 There is at least one table **large enough for four or more people.**						
20 There is at least one **table that can accommodate people in wheelchairs or scooters.**						
21 **Tables do not tip** (for example, when people use as leverage to sit down and get up).						
22 The garden offers **tables at different or adjustable heights** to accommodate all potential garden users.						

HEALTHCARE
GARDEN
EVALUATION
TOOLKIT

GARDEN ASSESSMENT TOOL FOR EVALUATORS

OVERALL IMPRESSION RATING	NOT RESTORATIVE AT ALL → COMPLETELY RESTORATIVE									
* Without looking back at your original rating, on a scale of 1-10, how would you rate the overall restorativeness of this garden? *"Restorative"= Able to restore a person's strength, health, or well-being.*	1	2	3	4	5	6	7	8	9	10

FINAL INSTRUCTIONS

Please make sure you have completed all pages and have not skipped any items. Thank you!

Appendix 5: GATE Scoring

Domain 1: Access & Visibility		
Visual Access to the garden	(1) Garden is visible from main public indoor areas	1.0
	(2) Garden is visible from indoor areas that involve waiting	5.0
	(3) Garden is visible from floors above	0.5
	(4) There is signage TO the garden from indoors	4.5
	(5) There is signage for the garden ON OR NEXT TO garden doors	5.0
	(6) Entrance to garden is easy to find	4.5
	7) Doors to the garden are glass or have a window in or next to them	5.0
	(8) Garden looks appealing/inviting from indoors	5.0
	(9) Information about the garden is available	2.0
Physical Access to the garden	(10A) Garden is open 24 hours a day, 7 days a week	No
	(10B) Garden is open all 4 seasons	No
	(10C) If garden is NOT open 24/7, what season, hours, and days is it open?	7AM-9PM, not open in the winter
	(11) Doors to the garden from at least one entry are automatic and easy to use	5.0
	(12) Any non-automatic doors are easily operated, even by children	N/A
	(13) Doorway thresholds are flat and smooth	5.0
	(14) The space just outside the main doorway is covered/roofed	3.8
	(15) The space just outside the main doorway has seating for at least two people and space for at least one wheelchair	2.8
	(16) A “destination” feature draws people into the garden	4.3
	(17) A restroom in the facility is near a garden entry	5.0
	(18) Garden has an emergency phone that connects with the hospital front desk or security	5.0
Domain 2: Sense of “Being Away”		
Sense of “Being Away”	(1) People can find a desirable sense of enclosure in the garden	4.5

	(2) People can find privacy in at least one part of the garden	5.0
	(3) People in the garden cannot look into adjacent private indoor areas	5.0
	(4) Garden has at least one fully covered (roofed) area	3.8
	(5) At least one seating area is protected from climatic/weather extremes	1.0
Aesthetics & Maintenance	(6) Garden has features that provide a rich, multi-sensory experience	5.0
	(7) Garden is free from unpleasant sounds	3.5
	(8) Garden is free from bad odors	5.0
	(9) Plants or features hide or soften unsightly views	5.0
	(10) Garden is free from trash	5.0
	(11) Garden has at least one trash can	5.0
	(12) There is a shed or other place to store tools in the garden	3.3
	(13) Outlets are provided in the garden	5.0
Domain 3: Nature Engagement		
Plantings	(1) More than half of the garden surface areas are planted	4.8
	(2) Garden has a rich variety of plants	5.0
	(3) Garden has plants at multiple heights	3.0
	(4) Garden has plants that stimulate the senses	4.8
	(5) Some plants are intriguing, provide “fascination”	5.0
	(6) Planting provides year-round interest	1.0
	(7) Some plants provide bright colors in at least one time of year/season	5.0
	(8) Planting BEDS look well-maintained	4.5
	(9) PLANTS look well-maintained and healthy	4.3
	(10) Plants are sturdy enough to tolerate extreme weather, people picking flowers and leaves, etc.	2.5
Other Natural Features	(11) Plants provide food and/or habitat for birds, butterflies, and other desirable wildlife	5.0
	(12) Garden has at least one water feature. If NO, skip to question 18	No
	(18) Garden has features or objects that children can play with or manipulate	4.0
Domain 4: Walking & Activities		

Primary Walkway (Path or Pave Thorough-Fare)	(1) Primary walkway is relatively flat	5.0
	(2) Primary walkway does not have steps or steep ramps	5.0
	(3) Primary walkway is smooth but non-skid, even when wet	5.0
	(4) Primary walkway is at least six feet wide or, if narrower, has frequent passing areas	5.0
	(5) Primary walkway has a curb or raised edges	5.0
	(6) Primary walkway has seating approximately every 30 feet	5.0
	(7) Gaps or cracks in paving (walkways and patios) are narrow enough for a wheelchair, stroller, or IV pole to cross smoothly	4.8
All Paved Areas (Walkways and Patios)	(8) Paving does not create glare	5.0
	(9) Paved areas are clear of debris and other obstacles	5.0
	(10) Trees/plants along walkways and other paved areas do not drop a lot of leaves, twigs, seeds, or fruit	4.8
Lighting, Wayfinding, & Amenities	(11) There are landmarks and/or signage in the garden to help people navigate their way through	N/A
	(12) A drinking fountain is in or near the garden	5.0
	(13) Garden has lighting for night usage	4.8
Variety & Activities	(14) Garden has more than one walkway, with a variety of routes, lengths, and destinations	4.3
	(15) At least one walkway offers increasing levels of difficulty	1.3
	(16) Garden is safe for children	5.0
	(17) Garden has places for structured or unstructured play	5.0
Domain 5: Places to Rest		
Seating Availability or Type	(1) The garden offers many places to sit	5.0
	(2) People can choose a variety of types of seating	4.5
	(3) Movable seating is available	0.3
	(4) At least 50% of the seating in the garden has backs and arms	3.8
	(5) There is a place where someone could lie down for a rest	5.0

	(6) The garden offers seating at different or adjustable heights to accommodate all potential garden users	2.0
Private or Social	(7) Garden has separate areas for activities and socializing, compared with contemplation/quiet conversations	5.0
	(8) Garden provides a place where 3 or more people can sit together	5.0
	(9) Some seating areas allow people to interact with passers-by	5.0
	(10) Garden provides seating that is somewhat private	4.8
	(11) Some seating makes it possible to watch others from a distance	5.0
Aesthetics & Sun	(12) There is a choice of seating in the sun or shade throughout most of the day	3.8
	(13) Seating does not produce glare	3.8
	(14) Seating material does not get too hot or too cold	3.3
	(15) Seating, tables, and other furniture look well-maintained	4.8
	(16) Some seating has attractive or interesting views	5.0
Tables	(17) Garden has at least one table	Yes
	(18) Some seats have tables next to them	5.0
	(19) There is at least one table large enough for four or more people	2.5
	(20) There is at least one table that can accommodate people in wheelchairs or scooters	5.0
	(21) Tables do not tip	5.0
	(22) The garden offers tables at different or adjustable heights to accommodate all potential garden users	1.0
Ratings Questions		
Overall Restorativeness Rating	On a scale of 1-10, how would you rate the overall restorativeness of this garden? **"Restorative" = Able to restore a person's strength, health, or well-being*	7.25
Overall Impression Rating	Without looking back at your original rating, on a scale of 1-10, how would you rate the overall restorativeness of this garden? **"Restorative" = Able to restore a person's strength, health, or well-being*	8.10

Appendix 6: Changes to the GATE

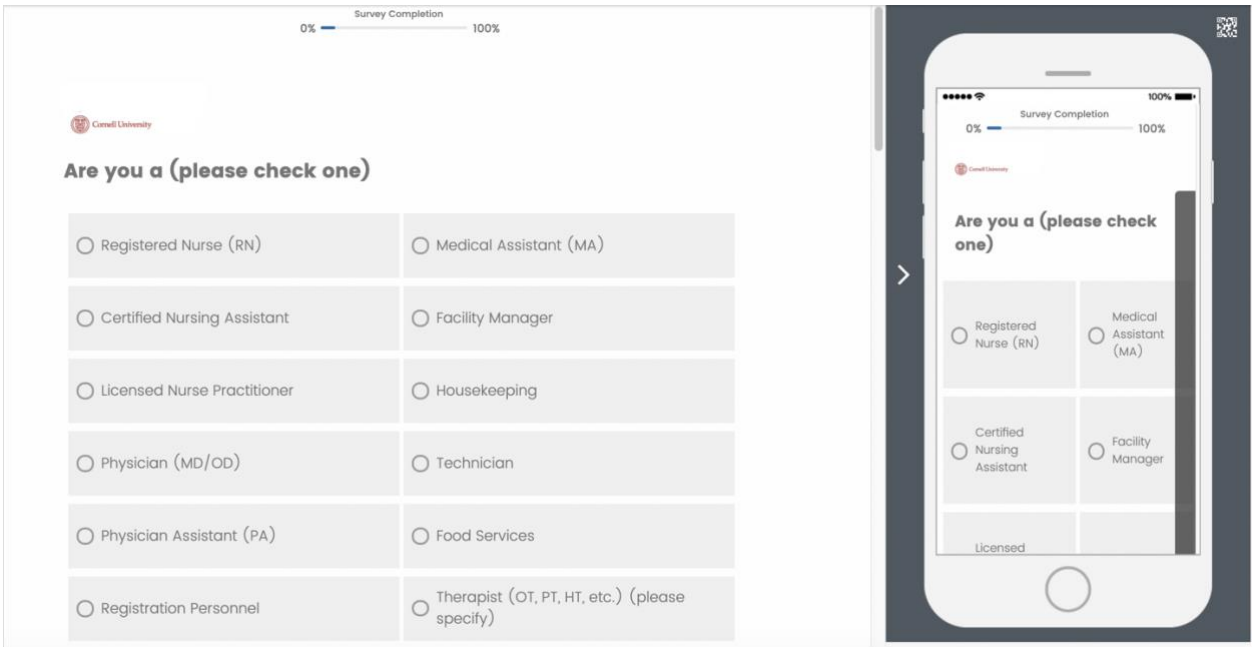
Other changes to the GATE involved individual items including changing of the order of items in order to establish a version of the GATE that was appropriate for a pediatric HCF

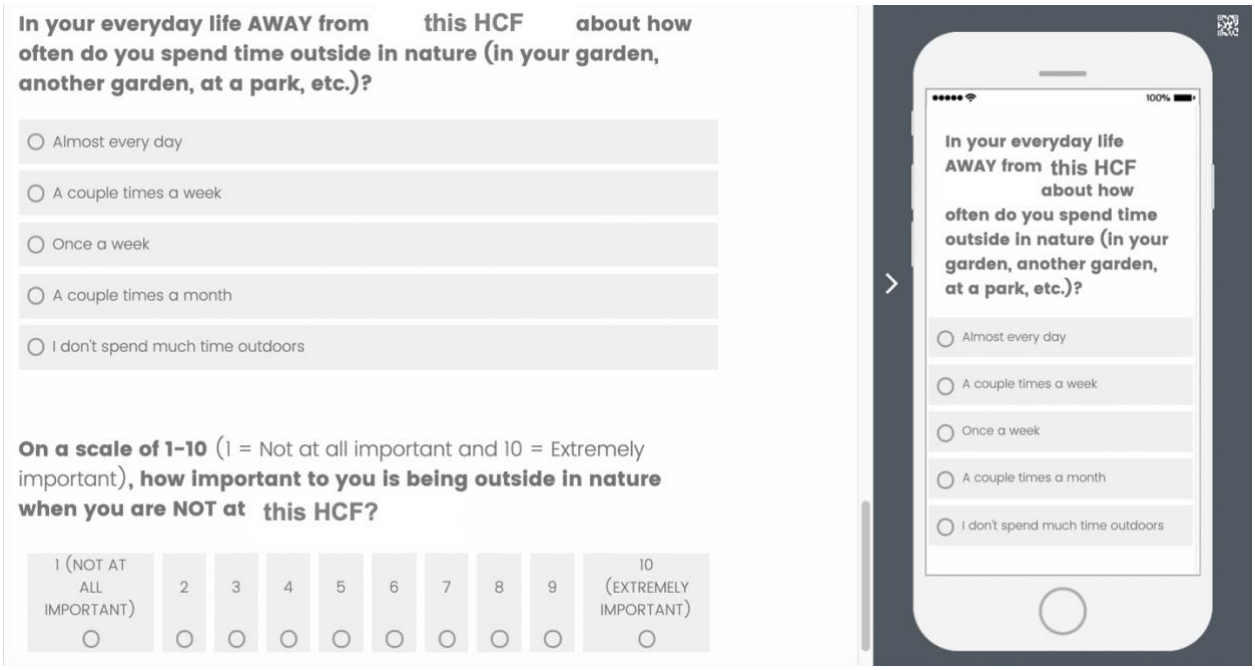
Section	Change	Original GATE item	Adapted GATE item
General Questions	Changed item to include humidity	04: Temp	04: Temp *& Humidity*
	Added item on personal comfort		05: On a scale of 1-10, how physically comfortable are you?
Access & Visibility	Changed order for continuity		04: There is signage TO the garden from indoors
	Changed order for continuity		05: There is signage for the garden ON OR NEXT TO garden doors
	Added item		10B: Garden is open all four seasons
	Added qualifier “even by children”	12: Any non-automatic doors are easy to operate	12: Any non-automatic doors are easily operated, *even by children* **
Sense of Being Away	Added “or features”	09: Plants hide or soften unsightly views	09: Plants *or features* hide or soften unsightly views
	Added item		13: Outlets are provided in the garden
Nature Engagement	Changed for clarity	12A: Garden has at least one water feature. *If NO, skip the next five questions*	12A: Garden has at least one water feature. If NO, *skip to question 18*
	Added item		18: Garden has features or objects that children can play with or manipulate **

	Changed sub-domain for clarity		07: Gaps or cracks in paving are narrow enough for a wheelchair, stroller, or IV pole to cross smoothly
	Added qualifier “about 50 feet”	12: A drinking fountain is in or near the garden	12: A drinking fountain is in or near the garden *(about 50 feet)*
	Deleted “if NO, skip the next two questions”; Changed scoring to Likert scale	13: Garden has lighting for night usage. *If NO, skip the next two questions.*	13: Garden has lighting for night usage
Walking & Activities	Deleted item	If garden has lighting, walkways are evenly lit	
	Deleted item	If garden has lighting: Lighting does not shine into patient rooms	
	Deleted item	Garden has spaces/features for therapists (PT, OT, HT) to work with patients	
	Added item		17: Garden has places for structured or unstructured play **
	Added item		06: The garden offers seating at different or adjustable heights to accommodate all potential garden users **
Places to Rest	Changed order for continuity; changed wording for clarity	10: Some seating makes it possible to watch others from a distance	10: Garden provides *seating that is somewhat private (to have a difficult conversation, make a sensitive call, etc.)*

	Changed for clarity	16: Garden has at least one table. *If NO, skip the next four questions*	17: Garden has at least one table. *If NO, skip to the final page*
	Added item		22: The garden offers tables at different or adjustable heights to accommodate all potential garden users **
Final page	Added item		Overall Impression Rating
	Added item		Final Instructions

Appendix 7: Staff Survey Optimized for Mobile





Appendix 8: Changes to Staff Survey

Section	Change	Original Survey Item	Adapted Survey Item
01: Please tell us about yourself	Deleted item	In which healthcare facility do you work?	
	Deleted item	Where are you filling out this survey?	
02: Garden Awareness and Access	Deleted Item	Please indicate which garden you are taking this survey from	
	Deleted item	Are there places inside this HCF where you can look out and see the garden?	
	Deleted item	If you can see the garden from inside the building, do you enjoy looking at it?	
	Added item (moved from "Garden Visits")		In your opinion, is spending time in this garden good for people's health (physical and/or mental)?
	Added write-in option: There are things about the garden I don't like (please specify)	If No, what has kept you from visiting the garden?	What has kept you from visiting the rooftop garden? (Display logic: Shown if answer to "Have you ever visited…" is "No")
	Re-ordered item for continuity	Would you encourage other people to visit the garden?	Would you encourage other people to visit the rooftop garden?
	Deleted item	In your opinion, is it important for healthcare facilities to have gardens?	
03: Garden Visits	Added item		Do you spend any of your FREE TIME in the rooftop garden? DISPLAY LOGIC > [NO] skip to if you COULD spend more of your free time …

	Deleted item (moved to “Garden Awareness and Access”)	In your opinion, is spending time in this garden good for people’s health (physical and/or mental)?	
	Deleted response option: “I never visit the garden”	Over the course of a year, about how often do you visit the garden at this healthcare facility in your FREE TIME?	Over the course of a year, about how often do you visit the rooftop garden in your FREE TIME?
	Added write-in option: There are things about the garden I don’t like (please specify)	What keeps you from visiting the garden as often or for as long as you would like?	What keeps you from visiting the rooftop garden as often or for as long as you would like?
	Added response option: I already spend as much time in the garden as I would like	What keeps you from visiting the garden as often or for as long as you would like?	What keeps you from visiting the rooftop garden as often or for as long as you would like?
04: Garden Quality	Deleted item	The garden looks appealing and inviting from indoors	
	Deleted item	The garden has some features that provide a rich, multi-sensory experience	
	Deleted item	The garden has other pleasing natural features (water, wildlife, etc.)	
	Changed wording	The garden provides opportunities for walking	There are opportunities for walking

	Changed wording	The garden provides opportunities for other activities	There are opportunities for children to play
	Changed wording	The garden offers many places to sit	There are many places to sit
	Switched order of items (do I need this?)	The seating in the garden is comfortable; There is a choice of seating in the sun or shade during most of the day	There is a choice of seating in the sun or shade during most of the day; The seating in the garden is comfortable
06: Staff Use of Garden	Deleted item	Does the healthcare facility have a policy about staff using the garden in their free time?	
	Deleted item	Do you think staff should be allowed to use the garden in their free time?	
	Deleted item	Does this healthcare facility have a separate garden(s) for staff?	
	Deleted item	This facility had a separate garden for staff, would you use it?	
	Deleted item	Do you think that healthcare staff should have their own garden, separate from patients and visitors?	
07: A Few More Questions About You	Changed wording; Added response options	What is your gender? (Male/Female)	What do you identify as? (Male/Female/*Other (can specify)/Prefer Not to Answer*)
	Changed wording	What year were you born?	What is your age?
	Deleted item	Are you Hispanic or Latino?	
	Added response options	Which one or more of the following best describes your race?	Which one or more of the following best describes your race? (White/Black

		(White/Black or African American/Asian/Native Hawaiian or Other Pacific Islander/American Indian or Alaska Native/Other (please specify))	or African American/*Hispanic or Latinx*/American Indian or Alaska Native/Asian/Native Hawaiian or Other Pacific Islander/Other (please specify))

Appendix 9: PEDS-H-GET Stakeholder Interview Script – Designer

HGET Stakeholder Structured Interview Protocol - Designer

Date and time of interview:
Where and how is this interview being conducted? (on site, phone, etc.):
Name of interviewee:
Name of firm:
Name of HCF:
Date of beginning of design and date of garden ribbon-cutting:

1. Tell me about the design process for this garden.

- Who brought you in and why
- Who were the major stakeholders (CEO, President, staff, etc.)
- Who was on the design team (list everyone, not names but roles, including therapy staff, patients, community members, chaplain, etc.). *Note: this may be the same as above, but not necessarily.*
- Who was the primary "driver" of the design – the landscape architect/designer, the architect, the client…?

2. What was the program / goal(s) for the garden?
3. Do you think those were met? How so, or how not?
4. Did you use any research to inform the design?

- Journals, books, etc.
- Interviews or surveys with staff, patients, etc.
- Behavior mapping, site observation, etc.

5. What were the biggest challenges during design and construction, and how did you deal with those?
6. What are the biggest challenges now? Who deals with them, and how?
7. What did NOT happen according to the initial design plan, and why?
8. Have you gotten feedback about the garden since it opened, either formally or informally, from anyone? If so, discuss who, how, and what.
9. What do you feel the (design / construction) team got really RIGHT with the garden?
10. What do you wish could have been done differently? Or, if you had to do it all over again, what would you do differently?
11. Would you be willing to share materials such as plans, drawings, sketches, etc. for use with the on-site research?
12. Anything else to share?

Appendix 10: PEDS-H-GET Stakeholder Interview Script – Facility Manager

HGET BCH Stakeholder Structured Interview Questions – Facility Manager

Date and time of interview:
Where and how is this interview being conducted (on site, phone, etc.):
Name of interviewee:
Role in HCF:
Date of beginning of design and date of garden ribbon-cutting:

1. Were you involved in the design of this garden? If so, let's discuss the following. Even if you weren't involved on the team, you may know about the design process, goals for the garden, etc.
2. Tell me about the design process for this garden.

- Who brought you in and why
- Who were the major stakeholders (designer/s, CEO, President, staff, etc.)
- Who was on the design team (list everyone, not names but roles, including therapy staff, patients, community members, chaplain, etc.). *Note: this may be the same as above, but not necessarily.*
- Who was the primary "driver" of the design – the landscape architect/designer, the architect, the client…?

3. What was the program / goal(s) for the garden?
4. Do you think those were met? How so, or how not?
5. Did the designer use any research to inform the design?

- Journals, books, etc.
- Interviews or surveys with staff, patients, etc.
- Behavior mapping, site observation, etc.

6. What were the biggest challenges during design and construction?
7. What are the biggest challenges now? Who deals with them, and how?
8. What did NOT happen according to the initial design plan, and why?
9. Have you gotten feedback about the garden since it opened, either formally or informally? If so, discuss who, how, and what.
10. How do people (patients, visitors, staff) use the garden?
11. What do you feel the (design / construction) team got really RIGHT with the garden?
12. What do you wish could have been done differently? Or, if you had to do it all over again, what would you have someone do differently?
13. Anything else to share?

Appendix 11: PEDS-H-GET Stakeholder Interview Script – Staff/Administrator

HGET BCH Stakeholder Structured Interview Questions – Staff/Admin

Date and time of interview:
Where and how is this interview being conducted (on site, phone, Skype, etc.):
Name of interviewee:
Role in HCF:
Date of beginning of design and date of garden ribbon-cutting:

1. Were you involved in the design of this garden? If so, let's discuss the following. Even if you weren't involved on the team, you may know about the design process, goals for the garden, etc.
2. Tell me about the design process for this garden.

- Who brought you in and why
- Who were the major stakeholders (designer/s, CEO, President, staff, etc.)
- Who was on the design team (list everyone, not names but roles, including therapy staff, patients, community members, chaplain, etc.). Note: this may be the same as above, but not necessarily.
- Who was the primary "driver" of the design – the landscape architect/designer, the architect, the client…?

3. What was the program / goal(s) for the garden?
4. Do you think those were met? How so, or how not?
5. Did the designer use any research to inform the design?

- Journals, books, etc.
- Interviews or surveys with staff, patients, etc.
- Behavior mapping, site observation, etc.

6. What were the biggest challenges during design and construction?
7. What are the biggest challenges now? Who deals with them, and how?
8. What did NOT happen according to the initial design plan, and why?
9. Have you gotten feedback about the garden since it opened, either formally or informally? If so, discuss who, how, and what.
10. How do people (patients, visitors, staff) use the garden?
11. Is there a schedule of who uses the garden, when, and for what? (Patients, groups of patients, therapists only at certain times, more families)?
12. Is there any policy and/or schedule for what activities can happen for the garden (programming)?
13. What do you feel the (design / construction) team got really RIGHT with the garden?
14. What do you wish could have been done differently? Or, if you had to do it all over again, what would you have someone do differently?
15. Anything else to share?

Appendix 12: Institutional Review Board (IRB) Approval

Cornell University
Office of
Research Integrity and Assurance

East Hill Office Building, Suite 320
395 Pine Tree Road
Ithaca, NY 14850
p. 607-254-5162
f. 607-255-0758
www.irb.cornell.edu

Institutional Review Board for Human Participants

Notice of Exemption

To:	Julia Jaffe
From:	Guilaine D. Senecal, Assistant Director, ORIA
Protocol ID#:	1905008826
Protocol Title:	Rooftop Garden Evaluation [redacted]
Approval Date:	May 30, 2019
Expiration Date:	None

Your protocol has been granted exemption from IRB review according to Cornell IRB policy and under paragraph(s) 2 of the Department of Health and Human Services Code of Federal Regulations 45CFR 46.104(d).

• Paragraph 2 allows to be exempted from IRB review research activities in which the only involvement of human subjects will be in the following category: Surveys/Interviews/Standardized Educational Tests/Observation of Public BehaviorResearch involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior if:i) information obtained is recorded in such a manner that human subjects cannot be identified, directly or through identifiers linked to the subjects; orii) any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability or reputation.

Please note the following:

- Investigators are responsible for ensuring that the welfare of research subjects is protected and that methods used and information provided to gain participant consent are appropriate to the activity. Please familiarize yourself with and conduct the research in accordance with the ethical standards of the Belmont Report (https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/index.html).
- Investigators are responsible for notifying the IRB office of change or amendments to the protocol and acquiring approval or concurrence **BEFORE** their implementation.
- Progress reports, requests for personnel or other administrative changes, or requests for continuation of approval are not required for the study. However, upon conclusion of the study, please submit a Project Closure form: http://www.irb.cornell.edu/forms.

For questions related to this application or for IRB review procedures, please contact the IRB office at irbhp@cornell.edu or 607-254-5162. Visit the IRB website at www.irb.cornell.edu for policies, procedures, FAQs, forms, and other helpful information about Cornell's Human Participant Research Program. Please download the latest forms from the IRB website www.irb.cornell.edu/forms/ for each submission.

Cc: Mardelle Shepley

Appendix 13: Healthcare Facility Consent Letter

[redacted]

[redacted]

Date: May 13, 2019

RE: IRB Participation

To Whom It May Concern,

I am pleased to write this Letter of Commitment for Julia Jaffe to use the [redacted] Rooftop Healing Garden at [redacted] Hospital as a site for her dissertation project. All collaboration will continue to be supervised by [redacted] Chief Administrative Officer at [redacted] and by Professor Mardelle Shepley at Cornell University.

Julia has explained the intention and methodology of her proposed project including whether and how staff and visitors might be involved. She has expressed full commitment to going through proper IRB channels for Cornell University, in accordance with their policies for student dissertation activities. [redacted] considers her efforts as a quality improvement initiative to receive feedback for continued improvement to the garden, and to help inform future projects, No IRB review is required at [redacted] Hospital.

Please contact me with any further questions.

Sincerely,

[redacted]

[redacted]

Vice President, Research Administration

Institutional Official, [redacted] Institutional Review Board (IRB)

[redacted]

Appendix 14: Staff Survey Results

Staff Survey Results

General Information About This Survey
This Healthcare Garden Staff Survey is being conducted by an M.S. Candidate at Cornell University about gardens in healthcare facilities. It will take approximately 5-10 minutes to complete.
Even if you didn't know about the rooftop garden until now, your feedback is still important!

If you would like to be entered into a drawing to win one of two $25.00 Amazon gift cards, please enter your email address below. Your email addressed will not be connected to your survey in any way, and will only be used in this gift card drawing before being discarded. <Text Entry for Email>

Your Rights As A Research Participant
Aside from your time, there are no costs for taking this survey. You will not be paid, but your participation is valuable for the research. Your participation is completely voluntary. You may decide to not participate or to stop at any time. This survey is completely anonymous and we will not collect any identifiable information. By completing this survey, you are giving permission for the researcher to use your responses, combined with those of other participants, for research purposes. There are no known risks for taking part in this survey. Information will be kept confidential to the extent permitted or required by law. People who have access to these records include the Principal Investigator and the research study personnel. Representatives of regulatory agencies such as the Office of Human Research Protections (OHRP) and entities such as the Cornell University Human Research Protection Program may access these records to make sure the study is being run correctly and that information is collected properly.

Questions About The Research
You may contact the Principal Investigator, Julia Jaffe, to report a concern or complaint about this research at jgj57@cornell.edu or at (203) 247-8762. You may also contact the Research Advisor, Mardelle Shepley, at mms449@cornell.edu or at (607) 255-3165. For questions about your rights as a research participant, or if you have questions, complaints, or concerns about the research and cannot reach the Principal Investigator or want to talk to someone other than the Investigator, you may contact the Institutional Review Board (IRB) for Human Participants at (607) 255-6182 or access their website at http://www.irb.cornell.edu

1. Are you a (please check one):

Registered Nurse (RN):	Medical Assistant (MA)
Certified Nursing Assistant	Facility Manager
Licensed Nurse Practitioner	Housekeeping
Physician (MD/OD)	Technician

Physician Assistant (PA):	Food Services
Registration Personnel	Therapist (OT, PT, HT, etc.) (please specify)
Security Personnel	Facility Maintenance Personnel (please specify)
Chaplain	Volunteer (please specify)
Administration	Other

Note. Job categories were collapsed into the following:

Administration	112
Other	108
Registered Nurse	59
Clinical or Research Assistant	26
Physician	24
Social Worker	17
Therapist	13

2. How long have you work (or volunteered) at this HCF?

More than 1 year	281
Less than 1 year	78
Min	1 year
Max	51 years
Mean	9.93 ± 10 years

3. About how many hours per week do you usually work at this HCF?

40 hours	204
More than 40 hours	74
21-39 hours	64
6-19 hours	8
20 hours	7
1-5 hours	2

4. When do you usually work at this HCF? (Please check one)

Day	309
Both	37
Night	13

5. In your everyday life AWAY from this HCF, about how often do you spend time outside in nature (in your garden, another garden, at a park, etc.)?

Almost every day	151
A couple times a week	134
Once a week	43
A couple times a month	20
I don't spend much time outdoors	11

6. On a scale of 1-10 (1 = Not at all important and 10 = Extremely important)**, how important to you is being outside in nature when you are NOT at this HCF?**

Mean: 8.23 ± 1.78

Please fill in these questions about the ***Rooftop Garden:***
7. Before taking this survey, did you know that this HCF had a rooftop garden?

Yes	355
No	4

8. How did you FIRST find out about the rooftop garden?

Read about it	127
Someone told me about it	121
Other (please specify)	65
Saw a sign in the hospital	38
Walked by it	3
From this survey	3
Saw it from the window	2

Note. Other includes orientation, event in the garden, & news

9. Would you encourage other people (patients, visitors, or staff) to visit the rooftop garden?

Definitely yes	257
Probably yes	65
Maybe	27
Probably not	8
Definitely not	2

Mean (out of 5)	4.58

10. In your opinion, is spending time in this garden good for people's health (physical and/or mental)?

Definitely yes	266
Probably yes	65
Maybe	20
Probably not	6
Definitely not	2
Mean (out of 5)	4.64

11. Have you ever visited the rooftop garden?

Yes	290
No	69

<<DISPLAY LOGIC: If NO>>
11 [NO]. What has kept you from visiting the rooftop garden?

Too busy	23
Too far away/hard to get to	23
Other (please specify)	9
Didn't know about it	4
I feel like the garden is only for patients and visitors	4
Staff are not supposed to use the garden (hospital policy)	2
Forgot about it	2
Doors are locked	2
There are things about the garden I don't like (please specify)	1
Not enough seats	1

<< All answers skip to **End of Survey**>>
Note. This question was only seen by those who answered “no” to question 11 (Have you ever visited the rooftop garden).

12. Does the rooftop garden improve your satisfaction with this HCF?

Definitely yes	101
Probably yes	88
Maybe	55
Probably not	34
Definitely not	12
Mean (out of 5)	3.8

13. Does the rooftop garden increase the likelihood that you would recommend this HCF to others?

Probably Not	85
Maybe	67
Probably Yes	64
Definitely Yes	52
Definitely Not	22
Mean (out of 5)	3.13

14. Do you spend any time in the rooftop garden for work (e.g. working with patients)**?**

No	256
Yes	34

15. Do you spend any of your FREE TIME in the rooftop garden?

Yes	187
No	103

<<SKIP LOGIC: If NO>> Skip To: **Q18**

16. Over the course of a year, about how often do you visit the rooftop garden at this HCF in your FREE TIME (on breaks, before or after work, etc.)**?**

A few times a year	60
A couple times a month	53
About once a month	29
About once a week	20
A few times a week	18

About once a day	6

Note. 104 respondents left this question blank

17. When you visit the rooftop garden in your free time, approximately how much time do you usually spend there?

0-15 minutes	78
16-30 minutes	66
31-45 minutes	43
46-60 minutes	13
I walk through it once or twice before returning to the hospital	13
More than an hour	1

Note. 76 respondents left this question blank

18. If you COULD spend more of your free time in the rooftop garden, would you?

Definitely yes	127
Probably yes	91
Maybe	39
Probably not	30
Definitely not	3
Mean (out of 5)	4.1

19. What keeps you from visiting the rooftop garden as often or for as long as you would like? Check all that apply:

Too busy	165
Too far away/hard to get to	133
Weather [unspecified]	70
There are things about the garden I don't like	60
Weather: No shade	59
I feel like the garden is only for patients and visitors	39
Other [unspecified]	32
Other: Design	24
Other: Crowded	15
Doors are locked	15
Other: Previous garden	9

Staff are not supposed to use the garden (hospital policy)	8
I already spend as much time in the garden as I would like	7
Other: Not enough seating	6
Forgot about it	1

20. How do you usually feel after you spend time in the rooftop garden?

I feel better	221
I don't feel any different	6
I feel worse	0

21. Why do you visit this rooftop garden, and what do you do when you're there? Check all that apply:

Get fresh air	230
Have lunch or a cup of coffee/tea	152
Relax	150
Just sit down for a while	100
Get Away from facility	93
Look at plants, birds, or other natural features	86
Talk/be with someone else I know	71
Be by myself	70
Read or do work (on paper or mobile devices)	39
Walk slowly, stroll	36
Have Privacy	35
Be amongst other people	26
Text, watch shows or YouTube, etc. on a mobile device	24
Talk on the phone	23
Meditate or pray	22
Other	18
Attend a staff or work meeting	14
Attend specific event	13
Talk with a patient or family member/friend of the patient	13
Work with patient(s) doing therapy (PT, OT, HT, etc.)	8

Express emotions I can't express indoors (cry, laugh, etc.)	5
Write, journal, or draw (on paper or mobile devices)	5
Walk briskly for exercise	2

22. Please note your level of agreement with the following statements:
Note. These questions were scored based on a 4-point Likert scale: Strongly Agree =4; Somewhat Agree =3; Somewhat Disagree =2; Strongly Disagree =1; NA/NS answers were removed before analysis
Note. The question and answer format for the following 13 questions is shown below:

	Strongly Agree	Somewhat Agree	Somewhat Disagree	Strongly Disagree	Not Sure or N/A
Question					

Note. For clarity, only the mean, standard deviation, and median will be reported below.

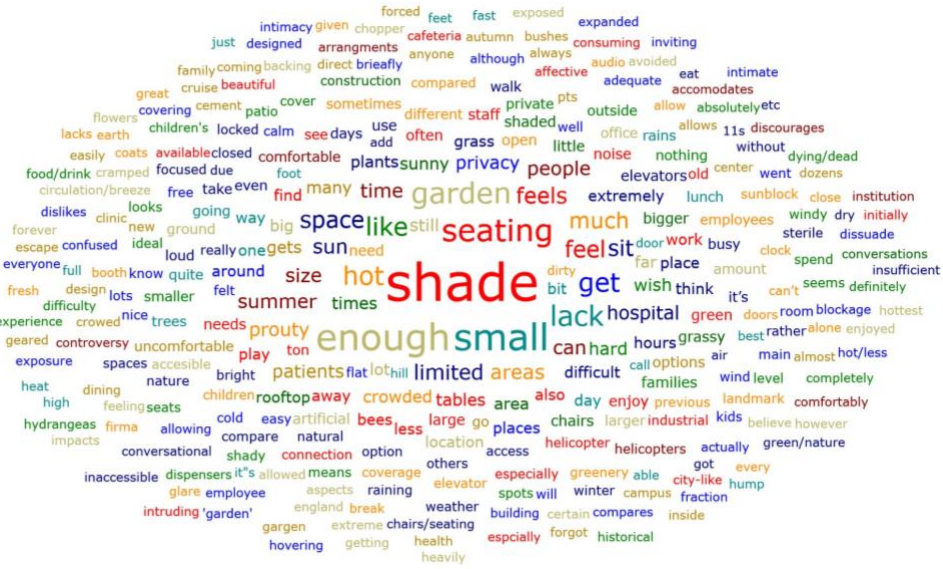
Question	Mean Rating (± SD) (out of 4)	Median Score
The entrance to the rooftop garden is easy to find	2.93 (± 0.88)	3.0
I feel safe in the rooftop garden	3.80 (± 0.50)	4.0
When I'm in the rooftop garden, I have a sense of "being away" from the hospital	2.91 (± 0.89)	3.0
I can find privacy in at least part of the rooftop garden.	2.57 (± 0.94)	3.0
Overall, the rooftop garden looks well-maintained.	3.69 (± 0.52)	4.0
The rooftop garden feels lush and full of life.	3.08 (± 0.90)	3.0
The main pathway is safe and comfortable to walk or use a walker, wheelchair, stroller, or IV pole.	3.64 (± 0.82)	4.0
The rooftop garden provides opportunities for walking.	2.85 (± 0.82)	3.0
The rooftop garden provides opportunities for children to play.	2.85 (± 0.75)	3.0
The rooftop garden offers many places to sit.	2.90 (± 0.88)	3.0
There is a choice of seating in the sun or shade during most of the day.	2.60 (± 1.02)	3.0
The seating in the rooftop garden is comfortable.	2.89 (± 0.79)	3.0
There are places in the rooftop garden where people can socialize (talk, meet, play, hang out together, etc.).	3.29 (± 0.65)	3.0

24. On a scale of 1-10 (where 1 = Very Bad and 10 = Excellent)**, how would you rate the rooftop garden overall?**

Mean: 7.33 ± 1.73

25. What do you like MOST about the rooftop garden?
<Text Entry>
Note. Answers to the text entry questions will be reported here as word clouds. For more information on specific codes used in each of the text answer questions, see Table 10.

26. What do you like LEAST about the rooftop garden?
<Text Entry>



27. Do you ever see other HCF staff in the rooftop garden?

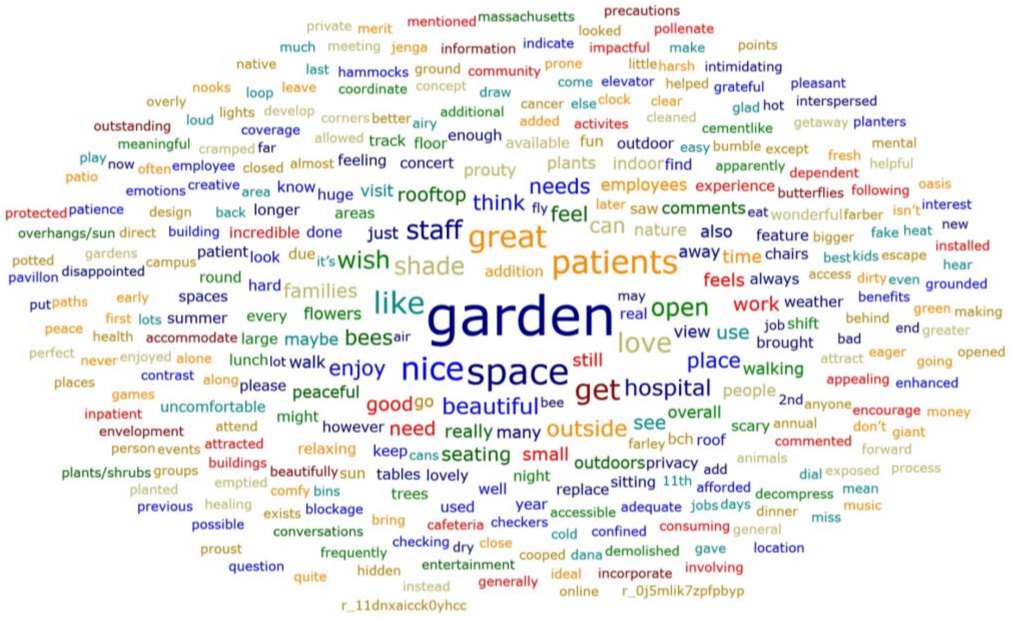
Very Often	99
Sometimes	92
Always	69
Rarely	14
Never	5

Note. 11 respondents left this question blank

28. What are they usually doing? Check all that apply:

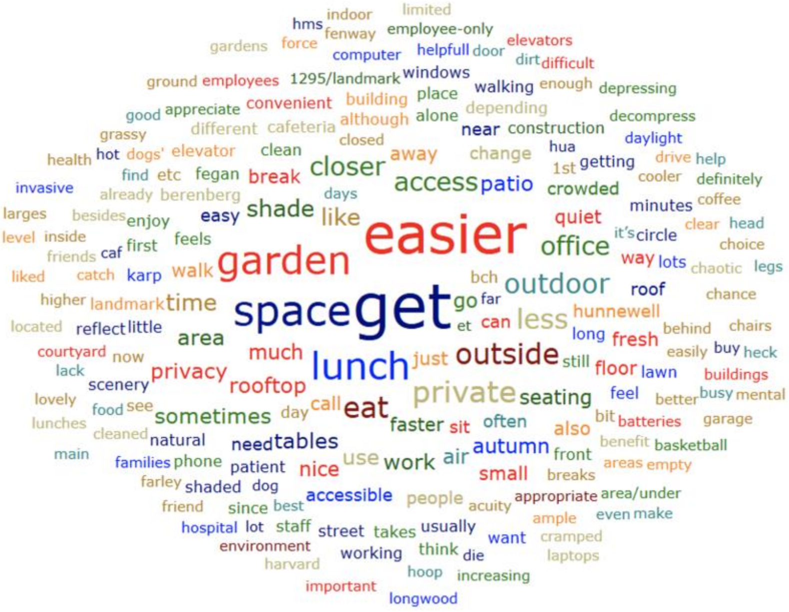
Eating Lunch	217
Talking/Meeting with Colleague(s)	132
Resting/Relaxing	123
Working with a patient	96
Talking on the phone	81
Talking with a family member or friend of the patient	48
Doing Paperwork	15
Other	11

29. Please share any other comments about the rooftop garden:
<Text Entry>



30. Are there any other outdoor spaces at this HCF where you spend time (cafeteria patio, front entrance, etc.)**?**
Yes: 96
No: 194

<<DISPLAY LOGIC: If YES>>
30 [YES]: Please say briefly why you also use the other outdoor space(s) (easier to get to, more private, more social - there is no right or wrong answer, we would just like to know how other outdoor spaces compare to the rooftop garden).
<Text Entry>



A person's background can sometimes influence how they experience the surrounding environment. You are **NOT** required to answer these demographic questions, but your answers will help us understand any potential relationships that we find. Thank you!

31. What do you identify as?
Female: 81.4% (236)
Male: 12.4% (36)
Other (can specify)
Prefer not to answer: 2.4% (7)
[Left question blank: 3.7% (11)

32. What is your age?
Average: 35 years old
Range: 21 years old – 68 years old

33. Which one or more of the following best describes your race
White/Caucasian: 72.1% (209)
Asian: 7.2% (21)
Black or African American: 5.2% (15)
Hispanic/Latinx: 3.1% (9)
Other (please specify): 1.7% (5)
- French Canadian: 0.3% (1)
- Haitian: 0.3% (1)

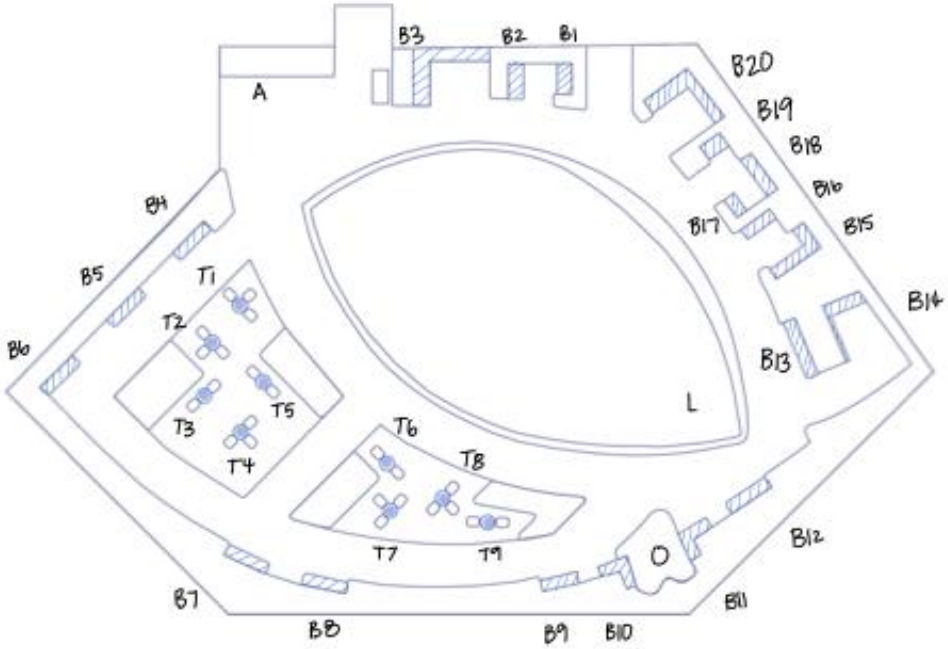
[Left question blank: 10.7% (31)]

34. What is your primary language?
English: 90.0% (261)
Spanish: 1.7% (5)
Other (please specify): 1.7% (5)
- Cape Verdean Creole: 0.3% (1)
- Chinese: 0.3% (1)
- Italian: 0.3% (1)

[Left question blank: 19 (6.6%)]

<<END OF SURVEY>>

Appendix 15: Behavior Mapping Garden Durations and Garden Map



Location	Day 1	Day 2	Day 3
A	7	3	15
B1	17	19	16
B2	18	21	27
B3	16	42	50
B4	3	8	2
B5	8	7	2
B6	5	8	9
B7	4	12	5
B8	4	8	13
B9	3	8	12
B10	5	17	22
B11	19	13	25
B12	12	10	23
B13	11	12	7
B14	14	51	53
B15	21	7	19
B16	14	19	8
B17	15	14	12
B18	23	32	31
B19	14	18	13

B20	33	55	32
T1	20	29	30
T2	14	30	20
T3	17	27	16
T4	18	20	33
T5	12	14	26
T6	11	16	12
T7	24	25	4
T8	10	17	20
T9	20	25	19
L	34	50	87
O	24	59	55
P	10	6	13