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Territories of Engagement in the Design of Ecohumanist Healthcare Environments

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Abstract

Background: Increasingly, architectural and allied designers, engineers, and healthcare facility administrators are being challenged to demonstrate success in adroitly identifying and contextualizing ever-shifting and expanding spheres of knowledge with respect to the role of energy conservation and carbon neutrality in healthcare treatment environments and their immediate exterior environs. **Aim:** This calls for making sense of an unprecedented volume of information on building energy usage and interdigitizing complex and at times contradictory goals with the daily requirements of building occupants. **Ecohumanist Design Strategies:** In response, a multidimensional framework is put forth with the aim of advancing theory and practice in the realm of designers', direct caregivers', and administrators' engagement with ecohumanist design strategies in the creation of ecohumanist healthcare environments. **Conclusions:** Ten territories for engagement are presented that both individually and collectively express salient themes and streams of inquiry in theory and practice, within an operative framework placing the patient, the patient's significant others, and the caregiver at the center of the relationship between the built environment and occupant well-being.

Keywords

landscape and nature, environmental sustainability, evidence-based design, territories of engagement, research methods

The concept of "sustainability" in architecture still remains rather poorly defined. Leading architectural theorist Kiel Moe (2007, 2008) has published widely on why architects find the concept of sustainable architecture "unreliable" at best. Moreover, architects have publicly commented that sustainability is not even relevant to architecture per se (Belogolovsky, 2011; Peters, 2010). Moe views integrated design strategies as having the potential to support better, and perhaps more sustainable architectural designs, noting that in integrative design, there is the acknowledgment of the social construction of architecture that has not always been evident in recent periods of architecture (Moe, 2008, p. 8). He argues "that in architecture, all technology is social before it is technical" (Moe, 2008, p. 8). From this, one

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could argue all sustainability matters are social before they can be considered as technical matters. If the barriers to integrative design continue to be largely social and cultural, largely due to communication issues between disciplines and disciplinary silos, then this is where any current efforts to overcome this condition must begin. Interestingly, his book, highlighting 28 ''integrated design'' examples in North America, features not one building designed for healthcare or with human health and well-being uses first and foremost (Moe, 2008).

If ''sustainable architecture'' continues to remain rather poorly conceptualized and measured/measurable by architects, and particularly in the realm of healthcare environments, broader conceptualizations are needed. One key problem attributable to the widespread usage on this term is that it places the preponderance of responsibility on the physical facility side of the equation when in reality the person and the physical environment that one inhabits function transactively, interactively, dynamically, and across time and space in healthcare settings. To address this definitional, and hence, conceptual conundrum, the term *ecohumanism* has been put forth (Verderber, 2010). Ecohumanism is defined as a conceptual framework whereby equal concern is accorded human well-being as well as the ecological well-being of a place and its inhabitants. Reflective, healthcare-focused environmental design practitioners are being called upon by their clients to provide diagnostic and treatment settings that respond to both sets of concerns of priorities simultaneously, more than ever before. The former set of priorities cannot continue to be traded off in favor of the latter. Myriad determinants impact what gets built, and these factors must be treated as functioning in consort—symbiotically—with the goal of attaining equilibrium between the attainment of carbon neutrality together with a highly supportive care setting for patients, patients' significant others, and staff persons. In the coming decade, ecohumanists will be called upon to deploy bionic engineering, new building material palettes, assembly systems, and a host of increasingly carbon neutral design strategies in this regard (Verderber, 2010).

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In architecture, practitioners and theorists generally are guided by the assumption that design shapes the well-being, behaviors, moods, overall experience, and mental health of the individuals who inhabit the environments they design. The Architectural Institute of America (2013) counsels its members that ''as an architect, your everyday decisions, large and small, can affect the mental and physical health of everyone that comes into contact with your work.'' Due to this, it is not surprising that designers and others in the building industry are increasingly concerned with how people respond to their designs. Research has shown that a majority of building owners, architects, and contractors care deeply about the health of occupants in their buildings and that this has a significant impact on their decisions (Bernstein, 2014, p. 24). Further, respondents said that health and well-being concerns of occupant would likely be of greater importance in the next 2 years. Despite the importance of this topic to architects, there are relatively few peer-reviewed studies in the architectural literature compared to other disciplines. For example, researchers in applied psychology (Beute & de Kort, 2014), medicine (Zadeh, Shepley, Williams, & Chung, 2014), and healthcare design (Joseph, 2006) are among a number of researchers in those and related fields to conclude that natural daylight is a positive therapeutic environmental design attribute. Design decisions relating to building layout, building scale, and choice of materials have been shown to have impact. In particular, research has shown that design can improve patient safety, reduce patient stress, and improve the work environment for caregiver staff (Ulrich et al., 2008). Increasingly, designers' work emphasizes the experiential dimensions of buildings and landscapes as constituent parts of a complex interpretation of sustainability. Sustainability is generally relegated to economic, environmental, and social sustainability, with the ''social'' aspect

often poorly defined as a leftover, noneconomic, nonenvironmental component within the equation. Concepts relating to people, their perceptions, how they work, and how they heal are too often generalized within the social, that is, human dimension. Ecohumanism seeks to address this facet of the work of design professionals but, additionally, seeks to consider the role of landscape ecology and the conservation of finite natural resources relative to the success of the completed built project. With this said, the scientific foundation for evidence-based design (EBD) for health as it pertains to a building's energy consumption remains rather insignificant, and what is known remains curiously nonintegral in the designer's early stage decision-making processes. However, recent research by Alvaro, Wilkinson, Gallant, Kostovski, and Gardner (2016) affords a new look at, for example, the postoccupancy evaluation (POE) process and why it has become essential to rethink its limited current focus in this regard. This research explores the POE process in the expansion of psychosocial well-being, seeking a deeper, more design-focused feedback mechanism, including transactions between natural daylight and patterns of socialization.

Meanwhile, debate continues on the role of "evidence" in healthcare design (Hamilton, 2014; Lundin, 2015). Some architects believe their creative intuition and past experience are threatened by empirical evidence generated by others, especially that which emanates from other disciplines and literature realms. For example, architects do not typically seek empirical evidence on whether cluttered or unhygienic environments are perceived as countertherapeutic, or whether spacious, daylight-filled, variegated environments are perceived as therapeutic. The 11 Maggie's Centers built to date have aimed to celebrate the particularities of ecohumanist design for cancer patients including concepts of "kitchenism" and meditative spaces (Jencks, 2015, p. 16), yet these aspects have not been explicitly grounded in EBD approaches. Promising recent work in the architectural research literature, however, is evidenced in the work of Feddersen (Feddersen & Ludtke, 2014), with regard to nursing home designs and in efforts to improve the lives of people with dementia.

Sustainable healthcare architecture has been the focus of recent publications, including the contributions by Guenther and Vittori (2008, 2013) and Cooper Marcus and Sachs (2013), both of which employ multiple case studies, photography, architectural drawings, and interdisciplinary reference sources. Guenther and Vittori identify and define 31 key sustainability indicators, organized into six categories to measure performance, specific to resilient–regenerative *healthy buildings*: site planning, form and facade, water, energy, materials and construction practices, and community. However, a given building's history and potential for future renovation, its architectural connection to surrounding buildings/context, and its aesthetic qualities are not explicitly explored.

The relationship between sustainable design and healthcare environments warrants further consideration, particularly as the majority of postwar health buildings across North America, Europe, and elsewhere are currently facing renovation and rebuilding in the coming decade and beyond. This transactional relationship between sustainability and concepts of occupant well-being, comfort, and health promotion is timely. In response, 10 "territories" that intersect sustainable design considerations, human health needs, and the occupancy of healthcare facilities and their associated landscape environs are presented below. They aim to capture key, in-evidence aspects of this interrelationship within an ecohumanist perspective. The goal is to inform, be informed by, and extend beyond the status quo.

These territories are inspired by a recent influential essay focused on the territories of urban design (Krieger, 2009). Subsequent to this essay, a similar approach identified territories of theory and practice in educational design/build curricula in university-based architectural curricula (Verderber, 2014b). Below, each territory of designers' engagement with ecohumanism in the healthcare milieu is framed as a dynamic, fluid stream of inquiry using examples drawn from healthcare buildings in use. Due to space limitations, this overview remains brief, although each built example cited crosses over into more than one stream of inquiry, with some crossing into virtually all of the territories. Collectively, this compendium aims to represent an interdependent constellation of concerns (Figure 1). Above all,

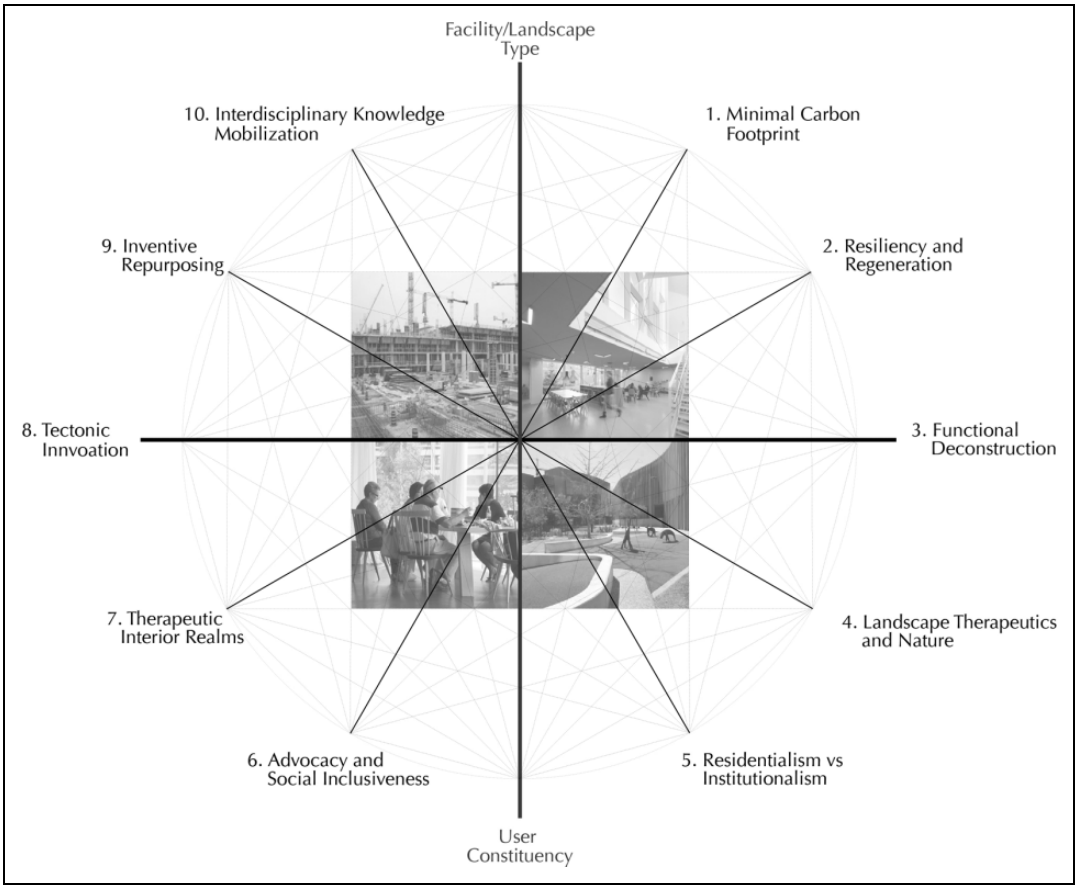

Figure 1. Territories of engagement in evidence-based, ecohumanist healthcare environments.

the intent is for this compendium to serve as a basis for further development and reinterpretation, as conditions evolve across time, space, and cultural contexts. Engagement is attainable by means of the following 10 considerations:

1. Minimization of the Carbon Footprint

In "Minimization of the Carbon Footprint," a healthcare facility and its site environs are designed in a manner that strives to achieve carbon neutrality with regard to its daily operative performance. Hospitals are a particularly energy-intensive building type, because they tend to have specialized equipment and are continually in use. Hospitals have an energy use intensity much higher than all other building types except for grocery stores (U.S. Environmental Protection Agency, 2013). Energy use is tied to harmful emissions that endanger humans and our environment, and a main culprit is building construction and daily operation, which contribute almost half of our harmful emissions (Intergovernmental Panel on Climate Change, 2014). There is a need to design all buildings to meet stricter environmental performance targets. The 2030 Challenge is a voluntary initiative designed to incrementally lower emissions use to reach carbon neutral levels by 2030.

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Relating to quantifiable, measurable sustainability parameters, energy use is an important metric. The Leadership in Energy and Design (LEED) is a certification tool for measuring certain specific aspects of environmental sustainability including energy and resource use in buildings for healthcare and to date 25 have been certified LEED Building, Design and Construction Healthcare in the United States (U.S. Green Building Council, 2016). The LEED certification is not comprehensive from a holistic or architectural standpoint, nor does it claim to be. Due to the complex nature and often-conflicting parameters, all certification systems or definitions of sustainability are culturally reliant, and must be evaluated contextually, and relative to the starting point. For example, LEED only measures certain criteria, and naturally does not measure spatial quality, the occupant's satisfaction with the building, the design's relationship to history, creativity in architectural expression, or a wealth of other criteria that architects find essential to analyze in relation to sustainability and quality of buildings. The 2030 Challenge seeks to lower fossil fuel energy use and harmful emissions (80% less fossil fuel use by 2015 based on 1990s benchmarks). The baselines are regional or country average/median for that building type. It makes no distinction between building size, costs, materials, or design quality. These ways of measuring sustainability are important because they raise awareness and can spur change but are problematic because they are not tied to architectural concepts and vice versa.

It has been proven in many technical studies and initiatives that the barriers to low-energy buildings are not technological, but rather social and cultural. There have been demonstration projects that show, technically, it is possible to design to 2030 metrics. For example, "Targeting 100!" (University of Washington, 2012) is a research project by the Integrated Design Lab at University of Washington in collaboration with a host of industry collaborators. They analyzed six study regions in the United States to find how possible and practical it would be to dramatically reduce energy consumption levels in hospitals. It was found that heating energy was the single largest energy load, and therefore the best target of opportunity for energy savings. They identified performance goals and concluded that by highly integrating a bundle of schematic architectural, building mechanical, and plant system designs, it was possible to achieve more than a 60% reduction in energy, thus meeting the 2030 challenge goal for 2010-–2015. Using a very simple payback calculation, these energy options would pay back, on average, in less than 9 years. Much lower energy-consumptive hospitals are possible, although they are not yet being built in North America and even when they are, the term "low" energy consumption is relative and varies greatly by the building's situational context. This equally applies to transportable buildings for healthcare, as prefabrication of component assemblies and even entire structures can yield numerous advantages in the manufacturing and construction process (Verderber, 2016). There remains a critical disconnect between theory and practice in the sustainable design discourse in this regard with regard to the operative definition of a low-energy building (Peters & Weyer, 2015).

The question arises: How can the profession and discipline of architecture move beyond meeting ever-changing code/regulatory contexts, which can render any "low-energy" calculation obsolete within only a matter of years, while creating a building/landscape design of genuinely sustainable, enduring merit? There is an ever-growing sentiment in architecture, in both education and practice, that world leading architecture is something apart—different from—operative, mainstream definitions of a sustainable architecture. Further, the term *sustainability* itself denotes yet another set of unwieldy constraints imposed upon the designer. New ways of conceptualizing low-energy, truly sustainable design strategies are needed—strategies that are simultaneously restorative/therapeutic and ecologically based through.

2. Resilient and Regenerative Care Settings

In "Resilient and Regenerative Care Settings," the healthcare environment is demonstrably therapeutic and restorative for patients and other building occupants while simultaneously conserving nonrenewable natural resources. Robin Guenther argues for "resilient/regenerative/restorative"

approaches to a sustainable healthcare, rather than viewing it as yet another set of burdensome constraints imposed upon the designer (Guenther, 2009). Similar sentiments occur in the theoretical writings of McDonough and Braungart (2002) in the conceptualization of a cradle-to-cradle philosophy that can extend in the future to entire buildings. Guenther calls for diminishing, reducing, removing the carbon footprint, while concurrently extending and reconsidering the healing environment from a therapeutic perspective. The cradle-to-cradle approach advocated by McDonough and Braungart has become an influential concept, although it remains difficult to implement at the total-building scale. The architecture office 3XN worked with McDonough to produce a design guide (Lyngsgaard & Jørgensen, 2013) and built the Green Solution House (GSH) on the Danish island of Bornholm using these principles. The GSH is a high-performing building; all materials used in the building are either fully recyclable or biodegradable.

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Rather than doing more with less, it is proposed that designers should just do *more*. The recent work of architects Bjarke Ingles Group (BIG) is guided by a "hedonistic sustainability" approach (Ingles, 2010), with the aim of demonstrating how green design can be much more palatable to the designer, of healthcare environments or otherwise. BIG refuses to accept the architectural designers' hardship for the sake of a greater environmental good, but rather creatively seeks to invoke entirely new "briefs" and opportunities for design innovation.

Raymond Cole argues that green building strategies, performance goals, and associated assessment methods currently emphasize the ways and extent that buildings can and should mitigate global and local resource depletion and environmental degradation. By contrast, the emerging notion of "regenerative" design and development emphasizes a coevolutionary, partnered relationship between humans and the natural environment, rather than a managerial one that builds, rather than diminishes, social and natural capitals (Cole, 2012). Ken Yeang (2008), designer of "bioclimatic" skyscrapers and the author of the influential *Ecodesign: A manual for ecological design* (2008), asserts that architects undergo significant academic training and yet receive no coursework or field experience in ecological design itself. Beyond, there is a need to explore such design strategies as:

3. Functional Deconstruction

In "Functional Deconstruction," the scale and complexity of a medical center is ameliorated through the redistribution of its constituent parts to autonomous ambulatory care sites, fostering a more human-scaled, energy conserving design outcome. The massive megahospitals built in the 1960s and 1970s came to symbolize all that was wrong with the late 20th-century high-tech medical machine. The McMaster's Health Sciences Center, which opened in Hamilton, Ontario, in 1972, in many ways represented the apotheosis of the "bigger is better" movement in hospital architecture. The trend up to then had been to centralize as many functions and the largest number of beds, on a single site, premised on the assumption that a single treatment "armature" or apparatus could be built that would be able to be midwifed as needs changed. This would, in theory, render the hospital envelope as never becoming obsolete. This resulted in massive interstitial floors sandwiched between inpatient and related support floors. The overall effect was one of a place that was absolutely overbearing in its scale, where wayfinding was extremely challenging, and where the upfront construction costs were as high as 40% greater than a conventionally built hospital at the time. Interstitial megahospitals were built in Canada, by the Department of Veterans Affairs in the United States, and in a number of other countries, including Japan, Taiwan, the UK, and in Germany (Verderber & Fine, 2000). These institutions were found to consume enormous amounts of energy, although this expenditure was justified on the grounds that

other savings were being achieved. These places tended to look not unlike massive automobile factories and were rather threatening (especially in the eyes of children) in their institutional interior/exterior imagery and formal attributes.

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The movement to reject their massiveness, and oppressive qualities, would result in the demassification of the various constituent parts of these institutions. This process of removing parts and redistributing them as autonomous care settings throughout the surrounding community has been defined as *functional deconstruction* (Verderber & Fine, 2000). Functional deconstruction manifests in two different ways. First, it has been (and continues to be) a process whereby much smaller, freestanding, diagnostic, and treatment centers, that is, kidney dialysis centers, outpatient oncology centers, surgicenters, primary care clinics, shopping mall–based clinics, were built by the thousands, beginning in the mid-1980s. It is a trend that continues to the present. Second, newly built medical centers are being composed as *campuses* with collections of buildings that appear to be freestanding yet are in realty constituent parts of a greater whole, umbilically connected by means of underground passages, car parks, and the like. An early example of this site and architectural design strategy was the Freeport Health Care Village, Kitchener, Ontario, in 1989, by the NORR partnership, with McMurrich and Oxley Architects.

It is far less problematic to inject sustainable design attributes into smaller scaled building envelopes, compared to the prior generation of highly centralized medical center behemoths that appeared to be giant factories or warehouses. The Peter and Paula Fasseas Cancer Clinic at the University Medical Center, in Tucson, AZ, by CO Architects is a freestanding clinic that would have in prior decades been embedded within the "mainframe" of its parent hospital. Here, however, it is sited independently (Jiang & Verderber, 2015). Its exterior facades are transparent, layered, and textured versus the harsh concrete exteriors of mid-to-late 20th-century Brutalist hospitals. This freedom to explore transparency and dematerialization allows varied compositional massing, stepped floor levels, roof terraces, balconies, and courtyards, providing multiple opportunities for:

4. Landscape Therapeutics and Nature

In "Landscape Therapeutics and Nature," the physical landscape and human engagement with nature are considered key therapeutic aspects of design and a building's relationship to its site environs. Much of EBD research on the topic of sustainable healthcare facilities relates to the proxemic availability and access to outdoor areas. Research on the relationship between nature and human health status found a restorative effect of natural views on surgical patients. Further studies found that patients experience less stress and pain if they can view nature and other pleasant surroundings (Ulrich, 1984; Ulrich et al., 2008). Subsequent research conducted at the time identified a condition now known as *psychological windowlessness*, whereby a hospital room, while technically windowed, can yield such a low level of sensory amenity it is rendered dysfunctional in this regard (Verderber, 1986, 1987; Verderber & Reuman 1987). And yet, architects and landscape architects often do not work together from the earliest stages of a project to conceptualize the entire building and its site context from the standpoint of person–nature connectivity (Verderber, 2006, 2010, 2014). Sustainable healthcare architecture per se has continued to be only sporadically discussed as a specific concern, although some notable exceptions to this pattern stand out. The book *Therapeutic Landscapes: An Evidence-Based Approach to Designing Healing Gardens and Restorative Outdoor Spaces* by Cooper Marcus and Sachs (2013) is an important example in EBD for outdoor health environments. However, the architectural examples cited focused on large-scale campus-type buildings, rather than smaller scale, more qualitative interventions relating to

Figure 2. Fiona Stanley Hospital, Brisbane Australia (2014) by Hassell with Silver Thomas Hanley, is a large state government hospital and teaching facility with a four-story rehabilitation hospital. The rehabilitation hospital has an integrated therapeutic landscape where exercise and outdoor activities are central to the recovery process. Designed landscape elements such as kerbs, slopes, varied surfaces, and paving textures helping patients practice and challenge themselves outdoors to aid in their recovery. Photograph by Peter Bennetts.

experience and place. Unfortunately, this further reinforces the stereotype that EBD cannot be experimental, qualitative, or small scale, even though it can be, it just typically is not deployed in that way. From graphic icons depicting the appearance of sustainability strategies to metrics against benchmarks, the architectural role of intuition, experience, and unique site responses is less of a focus.

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The Fiona Stanley Hospital in Brisbane Australia (Figure 2) was completed in 2014 by Hassell, in collaboration with Silver Thomas Hanley. This facility includes a large rehabilitation hospital where patients often have long stays of up to 6 months and the design of the landscape encourages exercise as important experiential and therapeutic design elements. The interior physical therapy rooms are integrated into public spaces to inspire people to exercise and to draw people outdoors. Outside, the architects intentionally designed the environment to allow patients to tackle physical features they will encounter once they leave the hospital, so kerbs, unstable surfaces, slopes, and stairs are designed features. Discrete markers in the pavements allow patients to measure their recovery and set themselves goals for their rehabilitation, extending the treatment area outdoors. The hospital symbolizes a reinvented perspective on the therapeutic benefits of allowing patients to engage in significant physical activity while outdoors, while blurring the lines of demarcation between "hospital" and the "public realm." Such design strategies can be in support of and entirely compatible with:

Figure 3. De Hogeweyk Dementia Village, Weesp Netherlands (2009) by MBVDA Architects, is a care village with 23 apartments and an outpatient care unit as well as a community center, restaurants, shops, and entertainment facilities. It was designed as a multifunctional village within a healthcare environment to give the residents supportive surroundings for independence and dignity. Image courtesy: Vivium.

5. Residentialism Versus Institutionalism

In "Residentialism versus Institutionalism," the building/landscape for healthcare challenges needless institutionality, through experimental or familiar architectural forms and imagery, together with new, mixed-use programmatic combinations thereof. Mixed-use healthcare environments achieved through combining health programs with offices, schools, or other functional purposes—even housing—can be a way of meaningfully interweaving healthcare into the community while also offering more informal, noninstitutional care settings. In the UK, successful contemporary interpretations exist of the "comprehensive health center" (De Syllas, 2015), including the Heart of Hounslow Centre for Health (2007), London, by Penoyre and Prasad. Another example, De Hogeweyk (Figure 3), is a village for aged residents that offers an unusual and pioneering approach to the design of care environments for individuals with dementia. The focus of the care regimen is not on merely "nursing" the elderly with dementia but rather giving them the chance to live with dignity by tailoring individual care services to each resident as needed (Feddersen & Ludtke, 2014, p. 176). Located near Amsterdam in the Netherlands, residents live in 23 apartments within a 15,000 m^2 "town" with a supermarket, doctor's office, hairdresser salon, restaurants, small shops, and a theater, all within the footprint of the healthcare environment.

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A healthcare facility need not in any demonstrable way appear outwardly (or inwardly) "institutional." Nor does its sustainability quotient need to be narrowly defined by its total energy performance apart from concern for its behaviorally or socially based aims. The Skypad is an example of a healthcare facility designed to look and function very differently from the typical cancer treatment unit embedded within a conventional hospital. Orms (2016) designed a 10-bed specialist cancer treatment center for teenagers in 2011 in Wales on the site of the University Hospital of Wales, a noted teaching hospital. This two-level building is raised on stilts and its bright blue "carriage" is cantilevered over two imposing 1960s buildings, so that the Skypad is actually atop the preexisting hospital's main service tunnel. From the outside, this blue form appears more like a boutique hotel or fine arts space than a cancer treatment clinic, offering an alternative for its adolescent patients; it is the first facility of its kind in Wales. Its architecture allows for design excellence in inpatient and outpatient cancer treatment for young people in a noninstitutional environment. The aim was to encourage patients to leave their beds, to socialize with other patients. There are shared rooms where a patient can close one or more set of curtains for privacy, as well as private rooms. This treatment center was funded entirely through donations led by the Teenage Cancer Trust, therefore linking the center to the goal of attaining:

6. Advocacy and Social Inclusiveness

In "Advocacy and Social Inclusiveness," the planning and design of socially responsive architecture enhances the lives of patients and communities alike, providing sociopolitical empowerment to otherwise marginalized building occupants. Within a strong tradition of social inclusion and innovative contemporary design, many important benchmark precursors in design for healthcare, especially in housing and small treatment facilities, can be found in Scandinavia (Peters, 2014). For example, in Denmark, there have been a series of small-scale treatment facilities designed by leading and emerging architects embedded in communities not on large healthcare/medical campuses. This allows for a wider range of creative formal expression, varied user experiences, scales of intervention, and fuller integration of healthcare facilities into their community contexts. The NORD architects' Center for Cancer and Health in Copenhagen (Figure 4) is a metal clad courtyard building with a folded faceted roof designed to look noninstitutional. The building is arranged around interior courtyards, and the interiors are designed for generous daylighting with many open spaces with high ceilings. The building is designed to disrupt the stigma and fear surrounding cancer treatment and to encourage spiritual and emotional rejuvenation.

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Another example is the Solingen Care Facility in Germany by Arbeitsgemeinschaft Monse + Molnar, a small-scale building designed to be socially inclusive and to break down physical barriers (Feddersen & Ludtke, 2014, p. 42). The architects of this 20-bed long-term care facility designed a multigenerational care setting for residents ranging from ages 18 to 60+, designed to improve and enhance their psychoemotional outlook toward life by incorporating interesting patterns, colors, materials, and textures, and diverse room arrangements in support of occupant needs, that is, large dining tables that invoke comparable spaces found in housing for younger persons, and creating a focus on natural daylighting in social areas for listening to music and multimedia engagement. Long-term care facilities are not usually designed with this level of nuance, and this building therefore stands apart as an exemplar in recent architecture for health.

Another noteworthy recent example of socially responsive design for health is the intergenerational nursing home and children's nursery school in Hamburg, Germany, by Feddersen Architekten (Terri Peters visited, March 10,

Figure 4. Centre for Cancer and Health, Copenhagen, Denmark (2012) by NORD architects, was planned and designed to be socially inclusive and to disrupt the stigma of cancer treatment through the design of the building's geometry, material, and spatial arrangement thereby creating a socially inclusive environment. Image courtesy: NORD. Photograph by Adam Mørk.

2016). The Seniors Center in Island Park is a care home with 140 assisted-housing beds. It was designed to offer healthcare for seniors within their neighborhood, providing a mixture of uses to closely approximate a normative neighborhood ambience and its associated social interrelationships among residents, thereby reducing the stigma and feeling of isolation often experienced by these residents. It also doubles as a skills training and lifelong learning center for the aged. A nursery school is also housed in the building, including a day nursery for up to 60 children combined with an on-site residential unit with seven apartments for young mothers and their children. Through creative, occupant-sensitive planning and design strategies, the lives of patients and their community contexts can also be improved by means of:

7. Therapeutic Interior Realms

In "Therapeutic Interior Realms," the experience of the building affords a health-promoting and therapeutic environment on a daily basis, emphasizing the point of view and comfort of patients, their significant others, and caregivers. The network of Maggie's Centers are health-promoting places designed to provide emotional, practical, and social support for people with cancer, their loved ones, and friends (Jencks, 2015). There are 16 built Maggie's Centers, to date, designed by award-winning architects known for landmark architecture and cultural buildings, rather than a primary expertise in healthcare design. This group of firms includes Snohetta, Ted Cullinan, Gehry Partners, Zaha Hadid, and OMA. Built on the grounds of hospitals, they are

designed as a "hybrid building type" more akin to "a house but not a home, a collective hospital that is not an institution, a church which is not religious, and an art gallery that is not a museum" (Jencks, 2015, p. 28). The concept of kitchenism or providing a central kitchen table for collective eating, socialization, and psychoemotional support is a dominant programmatic element, and this functional space is expressed in a unique way in each center. Every center affords diverse spatial variations, such as seating alcoves positioned to engage framed views of nature, and each has intimate spaces set apart from, where people can feel alone yet still feel connected to others. Each center provides a meditation room and an adjacent space for meditation and yoga. These buildings share no prerequisite goal for square footage energy efficiency or low energy usage, yet they offer many experiential and mental health benefits and engage with human health promotion in innovative ways.

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The provision of therapeutic interior spaces is the primary focus of The MGM Grand in Las Vegas which offers their entire 14th floor, 171 rooms, as WELL-certified rooms for guests, and these are designed to make people feel healthier at a US$30 per night premium (MGM Grand, 2016). These rooms focus on experiential design for the senses, including hypoallergenic sheets, "energizing lights," a special air filtration system, aromatherapy, warm white room lighting, "long wave night lighting," and a Vitamin C infused shower. This prototype is based on the WELL standard, a new EBD certification system focused on health and wellness. It assesses seven categories of well-being in the built environment: air, water, nourishment, light, fitness, comfort, and mind (Delos WELL Standard, 2016). This desire to promote wellness and to embed this into the materials, furnishings, and ambient sensory environment of the room is closely related to architectural:

8. Tectonic Innovation

In "Tectonic Innovation," the built project contributes to environmental design discourse with respect to the advancement of inventive spatial and technology-driven design strategies, and thereby garners peer recognition and wide influence within the professional community. The Lady Cilento Children's Hospital in Brisbane, Australia (Figure 5) by Lyons (2016) with Conrad Gargett architects is a visually striking building, with a vibrant, colorful facade and bold geometric forms. The architects aimed to set a benchmark in sensory design for pediatric healthcare; the building was designed around the concept of "a living tree." A grand central atrium vertically connects the floors and organizational areas, and it is accentuated by giant artworks of parrots. Color, pattern, and texture have been used throughout the facility with bravado, injecting novelty, energy, and a sense of playfulness. The building has won several architecture and healthcare awards relating to the project's focus on sustainability, integrated artwork, and its "child-centered" design. Strong landscape connectivity was achieved, incorporating the site's hillside terrain. Outdoors, patients can access a secret garden, adventure garden, climbing wall, basketball court, wheelchair-training ramp, and a habitable green roofscape.

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Another example is the renovated Residence for the Sisters of St. Joseph of Toronto Canada, by Shim-Sutcliffe Architects (Figure 6). It was designed as a health-promoting, contemplative place, integrating various sustainable design criteria while providing innovative architectural design features (Shim-Sutcliffe Architects,

Figure 5. Lady Cilento Children's Hospital (2014), Brisbane Australia, by Lyons Architects with Conrad Gargett Architecture, features a bright color palette and striking materials. It has garnered numerous awards, including the F.D.G Stanley Award for Public Architecture, the Karl Langer Award for Urban Design, and a Salutogenic Design Award from the International Academy of Design and Health. Image courtesy: Lyons Architects. Photograph by Dianna Snape.

2014). The facility offers 58 residential suites offering varying levels of personal care and assistance. Located alongside a ravine, the complex is designed to be naturally day lit and ventilated and to frame views of its natural surroundings. The complex incorporates geothermal heating and cooling systems, solar panels, solar hot water preheating, a green roofscape, rainwater cisterns, and permeable pavers. This partial renovation of a 1850s historic structure and partial reinvention by adding a new structure and landscape design closely relates to the:

9. Inventive Repurposing of Existing Resources

In "Inventive Repurposing of Existing Resources," the built outcome expresses inventive planning and design strategies with respect to retaining and reinventing heritage protection-worthy buildings and landscape resources in the 21st century.

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In 2014, Penoyre Prasad Architects and Arup completed the renovation of St Guy's Tower in London, UK (Figure 7) by recladding and renovating this landmark 1970s hospital. This 143-m building is one of the tallest hospital towers in the world and its Brutalist design remains an imposing urban structure. The retrofit work was primarily intended to remediate various building technology damage, improve energy efficiency, and reduce annual operational costs. Prior, the patient tower had been highly insulated and overcladded. It was retrofitted with anodized aluminum panels and new window facade systems, entirely applied from the outside in order to

Figure 6. Residence for the Sisters of St. Joseph of Toronto by Shim-Sutcliffe Architects (2014) features innovative architectural design strategies, including integration with landscape, connection to the existing structure, and incorporation of multifunctional sustainable and health-promoting features. It has garnered numerous awards, including the Living City Award in 2013 by the Toronto and Region Conservation Authority and the World Architecture News Award for Best Hospital Upgrade Award in 2014. Image courtesy: Shim-Sutcliffe Architects. Photograph by Bob Gundu.

minimize interior space disruptions. The work was carried out while the building remained fully in use, adding innumerable logistical and patient care challenges. As well as recladding the tower structure, which is actually two forms linked by a bridge, the project reconsiders the immediate public realm insofar as redefining the connection of the patient tower to the ground level, improvements in wayfinding, and the enhancement of the visitor's experience.

A more ambitious and explicitly ecological approach in the repurposing of existing resources occurred in the Mackay Base Hospital renovation, in Queensland, Australia, by Woods Bagot. This hospital opened in 2015, and the design was guided by life cycle and "future proofing" as well as principles drawn from EBD. The development of the project and the extension of the hospital were based on changing demographics in the area, including an aging local population base, and the need to mitigate flooding and extreme weather threats. Work began in 2008 with the aim of repurposing existing resources and increasing energy efficiencies, resulting in "a major reform to the existing master plan and a 20% reduction in the original construction program, a greater alignment with the intended model of care/services, and delivery of a significant ecological sustainable building" (Woods Bagot, 2016).

According to the London-based architectural firm Arup, modernist healthcare architecture between 30 and 50 years old within the UK's NHS network remains fundamentally versatile and adaptable to new healthcare-based purposes. The upgrading of facade alone can accrue significant major envelope performance improvements and keep these heritage-quality resources in good repair for adapted future use. Exterior facade

Figure 7. The St. Guy's Tower Retrofit Project (2014), London, UK, by Penoyre Prassad Architects and Arup features new exterior cladding and restoration of a landmark 1970s NHS hospital. Photograph by George Rex.

retrofitting can result in new levels of thermal efficiencies, natural daylight transmission levels to interior spaces, enhanced natural ventilation, heating–cooling capabilities, shading, view amenity, associated human safety issues, and significant energy performance annual cost expenditures (King, 2013).

This desire to achieve far more with fewer nonrenewable resources, and to adopt repurposing strategies to existing resources, extends to multiuse and multifunctional designs. A recent report issued by The Royal Institute of British Architects (2013) highlights how familial interdependency is being fostered in places with increasing numbers of extended families living under one roof to their collective mutual benefit. Efforts are underway to renovate existing housing to be more multigenerational and multiuse, for example, Varberparken Estate in Denmark, which is a social housing estate that has been totally renovated and a mix of uses introduced—where a nursing home is now housed in one of the former housing blocks (C.F. Møller, 2016).

10. Interdisciplinary Knowledge Mobilization

In "Interdisciplinary Knowledge Mobilization," in all stages of the design of a building/landscape, there is acknowledgment of broad-based considerations of sustainability beyond the building itself, and between participants representing diverse areas of expertise and perspectives. The design of healthcare environments is an interdisciplinary proposition, involving multiple areas of expertise and implementation foci. In relation to sustainability in healthcare settings, Guenther (2009) argues for the need for "integrative design":

> design teams must break down traditional silos between architectural designers and medical planners; owners must engage a broader spectrum of building operations specialists in the design process; the process must foster new dialogues between highly specialized consultants. In short, the process must encompass broader considerations. It demands new and unfamiliar tools such as rating systems, carbon calculators, and climate and hydrology analytics. As if that were not enough, sustainable design requires research." (p. 5)

Integrative design is essential to achieving a reflective approach to design education. In this regard, the Laboratory for Integrative Design at the University of Calgary's Faculty of Environmental Design was founded as a center for drawing together researchers from multiple disciplines. There, research teams examine interrelationships between design, engineering, computer science, material science, mathematics, and the biological sciences.

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The term ''knowledge mobilization'' has rapidly acquired currency in many disciplines and can serve as a rallying point for accelerating evidence-based research in healthcare facility planning and design (Lawlor, 2013). It is a call for efforts to make sense of and translate research-generated knowledge for the betterment of society. In the case of evidence-based research and design in healthcare environments, many studies have been published over the past 30 years (Ulrich et al., 2008). Yet one question looms above these contributions to knowledge: what is the fundamental relationship between research and creative design innovation, as pertaining to the design and construction of healthcare environments? Research universities are committed to the generation of new knowledge, and as such are tasked with engaging industry and society to find new outlets for this new knowledge. Advances in the discipline and practice of architecture, unfortunately, often occur randomly, lacking coherent directionality—and seldom in a smooth, linear progression. However, as a building is completed and occupied, it becomes possible to carry out the postoccupancy assessment of its strengths, weaknesses, and opportunities for improvement. This knowledge is then transferrable to other contexts, so future errors and omissions can be avoided. The transfer quotient of this new knowledge, if it remains unreported in peer-reviewed outlets and forums, will remain limited. Unfortunately, genuine knowledge mobilization, and innovation itself for that matter, remains largely discipline centric (Nichols, Phipps, Provencal, & Hewett, 2013). A completed building, however, requires the mobilization of myriad types of information, from the rather mundane to the poetic, and knowledge mobilization should foster and sustain innovation and experimentation whenever possible across a spectrum of concern.

Summary and Discussion

The relationship between sustainable design and healthcare environments warrants further consideration, especially since the majority of postwar health buildings across North America, Europe, and elsewhere are facing renovation and/or total rebuilding in the coming decades. The transactional relationship presented above between sustainable design considerations, patient and staff well-being and comfort, and their health promotion—taken together as an ecohumanist perspective—is most timely. The aforementioned 10 ''territories'' of architecture and landscapes for health seek to articulate the intersection of sustainable design, human health needs, and the occupancy of healthcare facilities and associated landscape environs. Each is premised on it being able to express a key aspect of ecohumanism in environments for health and well-being.

Designers and researchers who engage ecohumanist concepts in the consideration of healthcare environments will be positioned to fuse these concerns into a coherent paradigm for professional practice. These territories illustrate ways to navigate the challenges of the nettlesome performance gap that persists between building energy usage attributes and the health promoting, patient-focused design attributes that evidence-based designers strive to achieve. To more holistically address critically important concepts of environmental sustainability in healthcare environments, conceptual frameworks grounded in ecohumanism bring needed clarity and hence can aid in charting the course of future research. To some, this conceptualization may appear to be random. Why only 10? These territories of engagement are intended to be interpretative rather than prescriptive, and in no ''set order'' nor intentionally presented hierarchically or as being limited in scope or expandability. The essential point is not that a given building/landscape example is applicable to only one given territory—when, in reality, any given building/landscape can apply across all 10 (or more) territories—territories to be articulated as future events unfold. Rather, the intent is for others to elaborate upon and amend this initial conceptualization, as it pertains both to EBD research in healthcare environments and in daily professional practice in architecture and in its allied disciplines. Together, this framework represents but one holistic cosmology of ecohumanist concerns. Further broader or, in turn, more fine-grain, conceptualizations undoubtedly exist.

Future work in this area, regardless, would prudently engage new, patient-focused environmental

control technologies currently becoming commonplace in healthcare environments. The ability to attune, or "tune" these care settings to suit specific comfort levels, can concurrently result in reduced waste of nonrenewable natural resources as well as a higher degree of user satisfaction with one's care setting. For researchers, further work is warranted on the health impacts of passive environmental design together with other key aspects of sustainable architecture for health. For example, in the realm of housing, a promising recent study by a housing association in the UK has found thermal comfort and energy efficiency can be linked to health outcomes (Gentoo Green, 2015). Their "Boilers on Prescription" pilot saw doctors "prescribing" better performing buildings, so that elderly patients are kept warmer and more comfortable, thereby reducing their doctor's visits. In the future, public policies and facility management strategies may result in the retrofitting of aging hospitals with new high-performing facades as a way to reducing occupant stress, discomfort, and to promote faster rates of recovery. There is great potential in the intersecting fields of building energy efficiency and building performance research, as a means to improve human health and conserve nonrenewable environmental resources.

Researchers have identified a range of economic benefits to sustainable healthcare: reduced operating costs, risk avoided through improved occupant health and safety, and tangible community benefits (Houghton, Vittori, & Guenther, 2009). Green infrastructural systems are another significant area of inquiry warranting further research. Much potential exists for extending and reinforcing architectural/landscape sustainability concepts in direct consort with the therapeutic benefits of humans' engagement with nature and landscape (Cooper Marcus & Sachs, 2013; Jiang & Verderber, 2015). Sustainability, from a performance perspective, offers new ways to think about nature and landscape, beyond just having an accessible outdoor area. Cooper Marcus found that positive changes have occurred related to healing gardens

> Leadership in Energy & Environmental Design (LEED) for Healthcare, the Sustainable Sites Initiative, and the Environment of Care Section of the 2014 Guidelines for Design and Construction of Hospitals and Outpatient Facilities all now include a requirement or credit pertaining to access to nature. (2016, p. 172)

However, Cooper Marcus highlights some impediments to truly innovative indoor–outdoor design as a single continuum. She notes that few schools of landscape architecture provide courses on healthcare design. Also, the quantitative nature of guidelines can be an impediment, given that "access to nature" is vague and can be interpreted in a multitude of ways (Cooper Marcus, 2016, p. 173). Few design guidelines and considerations enumerate exactly what access to nature implies, nor if or how they draw on available research to guide the design of a successful healing or restorative garden with ecohumanist benefits at stake as well as potential economic and community benefits. Evidence-based approaches have much to offer, in helping recenter the discussion on people and health, and in generating new knowledge for new and renovated healthcare facilities to benefit human well-being as well as the ecological well-being of a place.

Implications for Practice

- This article offers an ecohumumanist framework for conceptualizing intersections between the often-competing territories of sustainable design, human health needs, patterns of occupation, and integration with landscape.
- This article offers 10 examples of ecohumanist health designs which engage with aspects of sustainable architecture, landscape, and health.
- This article offers an architectural design perspective into the discourse of sustainable healthcare environments.

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