Horticulture for Health Activity in U.S. Hospitals: Horticultural Therapy, Nutrition-led Programming, Gardens at Hospitals, and Affiliated Community Gardens

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Public and private hospitals have signaled a growing interest in using horticulture-centric models for public health, programs addressing populations with specific health challenges, as well as initiatives that can impact the broader community's health and wellness. Using the horticulture for health framework (Fleming, 2021) to examine these initiatives reveals four significant areas of activity: horticultural therapy, nutrition-led programming, hospital gardens, and affiliated community gardens. The dynamic hospital environments offer opportunities for health leaders to consider and implement newer models of health services for multiple populations visiting, working, and being treated in hospital settings. Current research and practice across several disciplines provide the foundation for understanding and implementing initiatives where horticulture plays a significant role.

Background

Hospitals provide a range of services, programs and facilities for patients, staff, and their communities. Demands on hospitals to provide services to diverse and numerous populations with medical challenges, their core mandate, is partnered with the responsibility of delivering positive health outcomes, satisfying patients, complying with legislation including the Affordable Care Act, and being fiscally responsible. This has generated strategies and initiatives that are both traditional and non-traditional. This paper addresses the interest in horticulture-related activity in hospitals in the U.S. within this context. Using the overlay of the horticulture for health framework which categorizes different ways horticulture is used for health improvements, a review of existing programs, services and gardens sheds light on models that provide established and innovative approaches where horticulture plays a significant role within the hospital-specific setting.

Hospitals, for the purpose of this paper, are defined as "institutions providing medical and surgical treatment and nursing care for sick or injured people", where inpatient services are delivered at general hospitals, specialized hospitals, short-stay, long-term care hospitals and integrated healthcare facilities (Britannica, 2022). Bedless hospitals (ambulatory, strictly outpatient care or day surgery) are not included in this review.

Using the horticulture for health framework, four significant areas of activity became evident at more than one hundred hospitals. Inclusion criteria was a minimum of two of the four horticulture for health categories. Activity in each of the four areas will be described, where horticulture plays a role in services, programs, or gardens, as well as relevant research identifying current topics of interest and investigation.

Limitations

The research used electronic database literature searches of PubMed and Google Scholar along with review of American Horticultural Therapy Association (AHTA) publications (2010 through 2021). Bibliographies of identified studies were inspected for other relevant studies. Reports from conference proceedings and interviews with health sector professionals and program facilitators were used when information was not published elsewhere.

Horticultural Therapy

Horticultural therapy (HT) is a modality used in hospitals across populations addressing a variety of health challenges from eating disorders to physical rehabilitation (Fleming & Sampson, 2022; Smith, 2022; NYU Langone Health, 2022). HT is defined as "the participation in horticultural activities facilitated by a registered horticultural therapist to achieve specific goals within an established treatment, rehabilitation, or vocational plan. Horticultural therapy is an active process which occurs in the context of an established treatment plan where the process itself is considered the therapeutic activity rather than the end product" (AHTA, 2022a).

The prevalence of HT in U.S. hospitals has not been quantified to date and is not as widely used in these settings to the degree that other therapeutic interventions like occupational (OT), recreational (RT) and physical (PT) therapies are (Table 1). The use of horticulture-focused activities and adaptive tools and gardens, essential for HT, are used by other therapeutic disciplines, though not widely incorporated (Wagenfeld & Atchison, 2014; Stowell et al., 2021). Horticultural therapists have been members of interdisciplinary treatment teams at hospitals though this practice is not widespread.

Research validating health benefits of gardening, foundational for HT and other horticulture-based activity continues to shed light on positive impacts across health domains (Howarth et al., 2020; Soga & Yamaura, 2017; Spano et al., 2020). Studies have validated horticulture-focused therapeutic services in hospital settings, specifically HT with children's neuropsychological improvements (Allah & Kazemi, 2020), cancer patients (Chen & Tu, 2014), hemodialysis patients (Diehl et al., 2019), dementia care (Lu et al., 2020), psychiatric inpatients (Pieters et al., 2018), and cardiac patients (Wichrowski et al., 2005) among others (Fried & Wichrowski, 2008). Empirical studies on treatments related to, or part of HT services in hospitals include: aromatherapy (Beyliklioglu & Arslan, 2019; Boehm et al., 2012); nature interventions for hospitalized cancer patients and military personnel (Blaschke et al., 2017; Cutillo et al., 2015; Ozkaraman et al., 2018; Ameli et al., 2021); biophilic design in hospital rooms and environments (Verzwyvelt et al., 2021; Wichrowski et al., 2021); and hospital healing gardens (Fleming & Figueirdo, 2016; Nakau et al., 2013). The literature reveals a wide breadth of applications where horticulture is used with therapeutic modalities in hospitals.

An examination of horticulture for health activity within hospitals identifies HT services, available in a limited number of hospitals throughout the U.S. (relative to the total number of hospitals in the U.S. and those that have traditional therapeutic services of OT, RT, and PT). Several HT programs are long-standing. Craig Hospital's (CO) program was established in 1982. Legacy Health's (OR) HT programs at multiple locations, delivered to cardiac, burn and pediatric patients, and NYU Langone Health's (NY,NY) HT services for inpatients from multiple departments (rehabilitation, epilepsy and psychiatry) at its multiple hospitals - Rusk Rehabilitation, NYU Langone Orthopedic Hospital, Tisch Hospital and Hassenfeld Children's Hospital (NYU Langone Health, 2022), have been in place for more than 40 years, these hospitals also functioning as internship sites for emerging HT professionals in addition to participation in research investigations (Wichrowski et al., 2005; 2021).

HT is delivered at general hospitals like Memorial Regional Hospital (Hollywood, FL), Inova Mount Vernon Hospital (Alexandria, VA), and University of Vermont Medical Center (Burlington, VT). Specialized hospitals are also providing HT. Pediatric hospitals with HT include Anne & Robert Lurie Children's Hospital (Chicago, IL), St Louis Children's Hospital (MO), and University Hospital Rainbow Babies & Children's Hospital (Cleveland, OH). Physical rehabilitation hospitals including MossRehab, Einstein Healthcare (PA), Craig Hospital specializing in neurorehabilitation and spinal cord treatment (Denver, CO), Shepherd Center (Atlanta, GA), and Bryn Mawr Rehab Hospital (Malvern, PA) use HT in treatment of their patients. The very large veterans administration healthcare system delivers HT at some, not all of its locations including: Salem VA Medical Center (VA), Brook Army Medical Center (San Antonio, TX) (Amelia et al., 2021; Cooper Marcus & Sachs, 2014), Perry Point VA Medical Center (MD), Topeka's (KS) Department of VA Medical Center, and the James J. Peters Veterans Administration Medical Center in the Bronx which partners with NY Botanical Gardens for its Veterans Horticultural Therapy program (THRIVE), with funding support from Institute of Museum and Library Services grant (NYBG, 2019).

HT is available at a few hospitals delivering psychiatric and behavioral health services: Rogers Behavioral

Health's residential eating disorder program in Oconomowoc (WS), Las Encinas Hospital in Pasadena (CA), Silver Hills Hospital (CT), and the University of Florida Psychiatric Hospital, the latter program delivered in partnership with staff from Wilmot Gardens Therapeutic Horticulture Program (Gainesville, FL). Hawaii State Hospital (Kaneohe, HA) offers a gardening program, and Oregon State Hospital has a vocational horticulture program with greenhouse. This data, not a definitive list, highlights the type of hospitals offering HT and the populations who have access to these services in hospital settings.

Relative to other therapeutic modalities like OT, RT, and PT, hospitals do not deliver HT to the same number of patients or at the same number of hospitals. Remuneration for HT treatment is not third party reimbursable, this being a factor limiting its use in all settings including hospitals (Haller et al., 2019). Some hospital programs are delivered as therapeutic horticulture (TH), distinguished from HT by AHTA because clinical charting is not required (& typically less costly), defined as "participation in horticultural activities facilitated by a registered horticultural therapist or other professionals with training in the use of horticulture as a therapeutic modality to support program goals. Therapeutic horticulture is the process through which participants enhance their well-being through active or passive involvement in plant and plant-related activities" (AHTA, 2022a).

HT services are delivered by professionally registered horticultural therapists. Of the approximately 210 HTR or HTM total number in the U.S., 19 self-identified as working in hospitals (AHTA, 2022b). Others delivering horticulture-based programs lack the professional designation. Some have HT training and/or a Certificate in HT, this being the case with Adventist Health Glendale (CA) TH for acute physical rehab unit (AHTA, 2022b). Health professionals trained in OT, RT and PT are delivering services as is the case with Sarasota Memorial Hospital (FL) where OTs deliver services at its Rehabilitation Pavilion's Mobility Garden. The Shepherd Center (Atlanta, GA) program is delivered by a horticultural specialist as TH. Craig Hospital (Denver, CO) and Magee Rehabilitation Hospital (Philadelphia, PA) programs are delivered collaboratively by HTRs, CTRSs, RTs and OTs. Non-professional AHTA members including private contractors may be delivering HT or TH at hospitals, with 4 self-identifying in this category (AHTA, 2022b). The general awareness and acceptance of horticultural therapy is limited compared to other therapeutic interventions, and this appears to be the case for hospitals.

Gardens in Hospitals

Gardens are part of the horticulture for health paradigm, with plant-rich environments positively impacting health in many domains.

Gardens in healthcare facilities fall under a broader multi-disciplinary sector of environmental design and healthcare/hospital design and care. Widely accepted evidence-based research and design supports the philosophy that "physical environments can affect patient medical outcomes and care quality" (Ulrich, 1984; Ulrich, 2000; Berg et al., 2015). Support for gardens in hospital settings relate to patient satisfaction, elements offering less stress for patients and staff, new facility designs (to accommodate newer technologies) as well as research on noise mitigation, sunlight in rooms, hospital rooms with garden views, and access to nature (Lyendo, 2017; Cordoza et al., 2017; Munts, 2007; Verzwyvelt et al., 2021). Supportive design, a term referring to factors facilitating coping and restoration from stress that accompanies illness and hospitalization, (and health worker burnout), not limited to gardens in hospitals, but including them, validates these physical green spaces (Ulrich, 2020; Cooper Marcus & Barnes, 1999; Cooper Marcus & Sachs, 2013; Galanis et al., 2021).

The number of U.S. hospitals with healing or therapeutic gardens continues to increase as evidenced by the 78 identified in this paper (Table 1) and an additional 70 identified by the *Therapeutic Landscapes Network directory* (2022). The Facilities Guidelines Institute, the leading authority in this sector, has established parameters for hospital garden design, construction, and maintenance covering multiple facets: "views of nature should [not shall] be considered in design of physical environment, ideally with direct physical access to outdoors or suitable alternatives", "should provide a garden…[with] consider[ation] for specifically designed therapeutic or restorative gardens for patients and/or caregivers…separate outdoor respite areas for medical and support staff should be provided…opportunities for active as well as passive interaction with nature in outdoor spaces should be provided…[and] signage, access to both sun and shade" (2018). While hospitals are not required to have gardens, most have green

spaces, because of mental and physical benefits for all stakeholders.

Hospital gardens serve multiple purposes from restoration, as a setting for meditation, delivery of therapeutic services, infusion treatment, play space and facility beautification (Hazen, 2022; Davis, 2011). Many are specifically designed to serve the needs of their patient populations – cancer, rehabilitation, veterans, pediatric, dementia, and psychiatric. Benefits for patients' families, visitors and staff (including staff burnout during and post COVID) (Cordoza et al., 2018; Galanis et al., 2021) and green garden spaces used for reprieve and sanctuary, is becoming increasingly more important as evidenced by newer hospital gardens like Stanford Hospital, built in 2019, and its 4 acres of interconnected gardens, vertical garden outside an interfaith chapel, and an 85 tree orchard outside their emergency department.

A review of hospital gardens revealed several trends. Play gardens at pediatric hospitals are popular with 18 identified in this review including Brigham and Women's Hospital (MA), St. Louis Children's Hospital's Olsen Family Garden (MO), Ranken Jordan Pediatric Bridge Hospital (MO), Rady Children's Hospital in San Diego (CA), Dell Children's Medical Center (TX), UNM Children's Hospital Albuquerque (NM), Randall Children's Hospital at Legacy Emanuel Medical Center (OR), Golisano Children's Hospital (FL) and Stanford Childrens' Hospital with its multiple gardens (one designated specifically for staff), interactive animal habitat play area, sea-themed Emerald Garden with amphitheater for special events, and half climate entry for transitioning from outside to indoors (Allahyar & Kazemi, 2021).

Rooftop gardens are evident at hospitals, where these typically underused spaces become green areas. Examples include Schwab Rehabilitation Hospital in Chicago (IL), the Christ Hospital Joint & Spine Center (OH), Monmouth Medical Center (NJ), Mass General's Uflelder Garden, and the University Hospital - Rainbow Babies & Children's Hospital's Angie Fowler Adolescent and Young Adult Rooftop Garden in Cleveland (OH). Another trend is indoor plant-rich garden areas offering connections to nature for patients, visitors, and staff, seen at Children's Medical Center (TX), Moss Rehab's Alice and Herbert Sachs Therapeutic Conservatory (PA) and Boston's Dana-Farber Cancer Institutes' 2 story indoor Morse Conservatory. Outdoor gardens at cancer hospitals have been designed to facilitate physical access or garden views from windows for those undergoing treatment - Illinois Cancer Center, Contra Costa County Regional Medical Center Martinez (CA), and Legacy Good Samaritan Medical Center (OR). University Hospital Seidman Cancer Center's (OH) zen-inspired Geller Terrace inaccessible green roof is a variant on this model. Hospitals for psychiatric and behavioral health populations at Unity Center for Behavioral Health (OR), Hawaii State Hospital (HA), and Silver Hills Hospital (CT) use gardens for treatment and restoration, with the latter incorporating a wildflower garden at their facility (Pieters et al., 2018).

Less common models of hospital gardens, designed for populations not previously mentioned, include Palo Alta (CA) VA Medical Center's polytrauma patients, maternity populations at Legacy Emanuel Medical Center (OR) (Ulrich & Serene Perkins, 2017), families of ICU patient (Ulrich et al., 2020), and Virtua Voorhees Hospital's (NJ) Angel's Garden for bereaved parents. The use of labyrinths, food gardens and therapeutic walking trails at Spaulding Rehabilitation Hospital (MA) and Walter Reed National Military Medical Center's (MD) Green Road at Bethesda Healing Garden continue to broaden the applications of hospital gardens.

Research in this field sheds light on connections between hospital gardens and health. Use of medical and aromatic plants in healthcare gardens, indoors and outdoors (Arslan et al., 2018; Dijkstra etc al., 2008; Lacanna et al., 2018), impact of hospital gardens on nurse burnout (Cordoza et al., 2018), hospital gardens as connections to nature (Helphand, 2019), medicine wheel gardens as healing spaces (Kavasch, 2002), post occupancy evaluations of healthcare landscapes (Jiang et al., 2018), and Artificial Intelligence and brain activity related to green spaces (Tung, 2021) suggest future directions, research and best practices.

Hospital Nutrition-Led Programs

Nutrition-led programs are the third horticulture for health area evident at U.S. hospitals. Horticulture and fresh produce is one element of nutrition. It is the use of, access to, growing and harvesting of fresh produce that justifies its inclusion in this paper. The role that plants play in health and nutrition has been examined by The National Institutes of Health and others for the potential to prevent, manage and treat disease (2016; Ahonen et al., 2019; Veldheer et al., 2020). Nutrition focused interventions are linked to improvements in

chronic disease and disease management, diet quality, food security, hospitalization and health care costs, reductions in impatient admissions, and emergency visits (Downer et al., 2022; Gurvey et al., 2013; Everett et al., 2020). Research covering diverse health conditions and links to nutrition span brain health (Vaziri & Dus, 2021), child and youth development (Knowles et al., 2018), and dietary patterns and cognitive health in older adults for example (Chen et al., 2019). Studies connecting access to healthy food, plant-based diets, and chronic disease prevention (Schulze et al., 2018; Swartz, 2018), chronic kidney disease (Carrero et al., 2020), cardiovascular health (Satija & Hu, 2018; Bhat et al., 2021), diabetes (Bryce et al., 2017; Veldheeer et al., 2021; Evert et al., 2019), primary care (Buyuktuncer et al., 2014), and dyslipidemia (Trautwein & McKay, 2020) substantiate the importance of nutrition interventions.

Several factors are influencing nutrition-led programming occurring at U.S. hospitals. Increasing demand for preventative and educational programming as well as programs addressing diversity, equality and inclusion (DEI) (Everett et al., 2020), greater emphasis on healthy lifestyles (Howarth et al., 2020; National Gardening Association, 2021; Fleming, 2022), support for plant-based diets (Ahonen et al., 2019; Alcorta et al., 2021), the emerging field of nutritional cognitive neuroscience (Zamroziewicz & Barbey, 2016), and personalized nutrition approaches (Kim & Seo, 2021) are the context for initiatives. Calls for changes to nutrition practices (Laur et al., 2017), disruptions and advances of food technologies (Jang, 2020; Kim & Seo, 2021), and legislation holding health care facilities accountable for post-hospitalization outcomes (Everett et al., 2020; Centers for Medicare & Medicaid Programs, 2019) are pushing forward programs and services where nutrition, particularly those involving fresh produce, are being established.

Additionally, the *Affordable Care Act's* federal tax-exempt status for hospitals requiring initiatives deemed *community benefit*, are influencing initiatives, where surplus funds of nonprofit hospitals are used to "prevent illness; ensure adequate nutrition; and address social, behavioral, and environmental factors that influence the community's health or emergency preparedness" (James, 2016; Corrigan et al., 2015; Anon, 2010). This, and commitment to community health are playing a role in expanding nutrition-led programming. Concurrently, a movement called *Food is Medicine*, is playing a dominant role in this sector, "refer[ing] to specific activities that increase access to food that support health" where food and health care intersect (Downer et al., 2022). (A comprehensive bibliography of peer-reviewed research in the U.S. on Food is Medicine has been compiled by *The Center for Health Law and Policy Innovation of Harvard Law School*, providing current data on food-health connections) (2020). This has set the stage for different types of nutrition-led programming at hospitals where fresh produce is central to the initiatives. These take various forms and play several distinct roles in healthcare services, with an expanding scope for hospital nutrition services and community health/community benefit departments (Milliron, 2021). At times hospitals take the leading role in program delivery; in other models hospitals are part of a coalition or community partnership.

Preventative programs where the food is medicine concept has been incorporated into services, includes access to fresh fruits and vegetables as a strategy addressing poor diets, food insecurity, and specific health conditions, and where education can be a component of healthcare services. Initiatives use horticulture and fresh produce for addressing individual and population health including hospitals' nutrition-led programs growing, using, and providing access to fresh fruits and vegetables. Examples illustrate various models. Preventative community education lifestyle medicine/nutrition programs are delivered through hospitals - Adventist Health Castle (HA), Boston Medical Center (MA), Connecticut Mental Health Center, and Cordilleras Mental Health Center (CA).

Non-traditional nutrition focused programs, like CSAs (community supported agriculture food packets) specifically for staff are available at NYU Langone (NY) and Island Hospital (WA). Other models include farmers markets held at hospitals, (George et al., 2013; Bryce et al., 2018; Dellarto-Blackwell & Stewart, 2016), hospital-based food pantries (Gany et al., 2015), nutrition and cooking classes at VA Greater LA Healthcare System's Healthy Teaching Kitchen (CA), hospital food procurement strategies and healthy food programs at hospital cafes including Sidney & Lois Eskenazi Hospital (IN), Fairview Hospital (MA) Brigham and Women's Hospital (MA), St. Joseph Mercy Anne Arbor (MI), and St. Luke's Anderson Campus (PA) (Dellarto-Blackwell & Stewart, 2016). These are emerging in greater numbers.

Main Line Health - Lankenau Medical Center in

Philadelphia (PA) has established comprehensive community nutrition programming with pop-up nutrition classes and pop-up food demonstrations; *Greener Partners* farm to hospital program; *Heart Smart Corner Store* nutrition-led health screenings and medical referrals delivered at neighborhood stores (Main Line Health, 2022). University of Vermont Medical Center's 8-week gardening, nutrition and health program seeks to improve long-term health outcomes on-site at the hospital and off-site (Vermont Biz, 2020). Hospital-produced videos from University of Michigan Rogel Cancer Center provide educational information on nutrition - related topics like plant-based diets and mortality, cancer, and new research (Healthcare Triage, 2019; Michigan Medicine, 2015).

A second type of community health nutrition program, *Produce Prescription Program*, has seen significant expansion in the U.S. in the last five years. Research by Downer et al. identified 30 unique programs (2022; Garfield et al., 2021; Aiyer et al., 2019). Produce prescriptions, defined by the recently formed National Produce Prescription Collaborative of produce prescription stakeholder entities are "a medical treatment or preventative service for patients who are eligible due to diet-related health risk or condition, food insecurity, or other documented challenges in access to nutritious foods, and are referred by a healthcare provider or health insurance plan" (Downer et al., 2022; National Produce Prescription Collaborative, 2022a). *The Food is Medicine Research Action Plan* by *Harvard's Center for Health Law and Policy Innovation* supports this type of programming, identifying produce prescriptions as one of three interventions that are replicable, scalable, and effective (along with medically tailored meals and medically tailored groceries) (Downer et al., 2022). Using "multi-pathway interventions (food plus education) allow for hospitals and others to be part of the process/solution whereby health care systems respond appropriately to nutritional needs, and greater recognition that food can be a health care benefit, with Medicaid benefits" (Downer et al., 2022).

Many of the produce prescription programs where participation by hospitals is occurring, are driven by community-based nonprofits (Swartz, 2018; Bianchini et al., 2017; Cavanagh et al., 201; National Produce Prescription Program, 2022b) supported by dedicated federal funding through *GusNIP Produce Prescription Grant Program* available to hospitals (Downer et al., 2022). Examples include Durham NC. produce prescription program *Eat Well* delivered through Reinvestment Partners RPRx in partnership with Durham Veterans Affairs Health Care System (UNC Gillings School of Global Public Health, n.d.); *Fresh Rx Farm* to Patient program partnered with Jupiter Medical Center (FL) (Fresh Rx, 2022); St. Joseph's Healthcare in Bangor (MA), and Salinas Valley Memorial Hospital (CA) (National Produce Prescription Collaborative, 2022b). Hospital affiliation with community gardens and their horticulture/nutrition/education programming represents another model of horticulture for health interventions seen at U.S. hospitals (discussed in the next section).

Not all U.S. hospitals delivering community nutrition-led programs are identified in Table 1.

Hospital Affiliated Community Gardens

There is a strong correlation between hospitals that have on-site or off-site community gardens and those that deliver community focused nutrition programs. Both are considered part of the horticulture for health parameter.

Hospital affiliated community gardens (the terms garden and farm are often used interchangeably) have existed for a decade, though knowledge of these outside local communities where they exist appears limited (including reference to these in HT literature). No centralized database for hospital affiliated community gardens exists, limiting awareness of the scope of such gardens and relationships. The American Community Garden Association does not gather this data. Research by George et al. (2015) and Dellarto-Blackwell and Stewart's 2016 report *Farms & Health A Guide to Farm & Garden Programs in Healthcare* identified gardens operating in partnership with hospitals. This paper, not a definitive listing, identifies 29 hospital affiliated community gardens (Table 1).

Community gardens are defined as a single piece of land gardened collectively by a group of people (Okvat & Zautra, 2011). They take many forms, and when affiliated with hospitals, are at times located on hospital grounds, or can be off-site as affiliated food production/education sites. *The Affordable Care Act*, previously mentioned, has contributed to the establishment of such gardens as community benefit; some hospitals use them to address "comprehensive patient care … in built and social environments that contribute to chronic disease burden" (James, 2016). Not all hospital

affiliated community gardens were established based on the legislation. Most seek to provide community health strategies as preventative care with the ultimate goal of improving health outcomes, addressing health inequities, and as a way of addressing community need. "The potential [of community gardens affiliated with U.S. healthcare institutions] to contribute to comprehensive patient care" and promote healthier environments is an important raison d'etre for these models (George et al., 2015).

The impetus for community gardens partnering with hospitals is founded on a large body of evidence that demonstrates health benefits from gardening (Howarth et al., 2020; Soga et al., 2017). Research specifically on health benefits of gardening at *community gardens* includes reducing health disparities, increasing physical health, food access for food insecure individuals, populations, and those with at risk medical conditions, and opportunities for public health and wellness education (Alaimo et al., 2016, Egli et al., 2016; Fleming, 2021; Fleming et al., 2020; Gregis et al., 2012).

Limited research has investigated correlations between hospital affiliated community gardens and specific health outcomes. Veldheer et al. studied participation of cardiac patients (2020). Heise et al. investigated community gardening as prevention for overweight and obese high-income and middle-income countries (2017), and Spees et al. examined health behaviors and perceptions of cancer survivors harvesting from an urban garden (2015), these providing some baseline research. Marsh et al. examined community gardens as sites of comprehensive primary healthcare (Australia) (2018), and Milliron et al. evaluated a community garden at an urban outpatient clinic (2017). Further research in this area will support health benefits for specific populations.

Models of hospital affiliated community gardens reveal that they can address and deliver a variety of programs across target populations and are used by all types of hospitals. Some are delivered by hospital professionals under the auspices of community health/community benefit departments, with the hospital functioning as the anchor institution. On-site food gardens are fewer in number than off-site gardens; City of Hope National Medical Center (CA) and Penn State Health's Milton S. Hershey Medical Center (PA) being two examples of the former. On-site rooftop community gardens appear to be more common. Examples include Chicago Weiss Memorial Hospital's (IL) parking structure's rooftop garden with raised beds used by staff and refugee populations, and Hawaii State (psychiatric) Hospital (Kailua, HA). Food grown on rooftop gardens at Sidney and Lois Eskenazi Hospital (IN) and Boston Medical Center (MA) is used in their hospital cafeterias (Dellarto-Blackwell & Stewart, 2016; Boston Medical Center, n.d.). New Milford Hospital (CT) uses rooftop aeroponic towers for food production. Some on-site hospital community gardens offer CSA produce at their locations: Island Hospital (WA), St. Luke's Rodale Institute Organic Farm (PA) and St. Joseph Mercy (Ann Arbor, MI) (Healthcare without Harm, 2018; Dellarto-Blackwell & Stewart, 2016).

Off-site community gardens appear to be a more common model. Cancer Treatment Centers of America (Arizona location) uses a 25-acre working farm integrating nutrition, gardening, physical activity, and emotional support for people in cancer treatment (Cancer Treatment Centers, n.d.). Grow2Heal hospital garden affiliated with Baptist Health in Homestead (FL) uses food production, food access and nutrition education for a variety of populations (South Florida PBS, n.d.) as does Lankenau Medical Center's Greener Partners Deaver Wellness Farm (Main Line Health, Philadelphia). Some hospital systems demonstrate a strong commitment to affiliated community gardens, establishing multiple locations. Western Maryland Health System and UPMC Western Maryland Hospital and Health System (MD) each have 5 community garden sites (Ronan, 2016). Trinity Health (MI) has two farms.

Partnerships with community agencies where off-site community farms are used to address a variety of hospital populations include veterans from Tampa's (FL) James A. Haley Veterans Hospital participating in a 12-week garden program (GROW) at an urban farm/community center, and Baltimore VA Medical Center (MD) partnership with TALMAR social agency. Shepherd Center (GA) rehabilitative hospital partners with Ability Garden with services available to discharged patients. Kaiser Foundation Hospital community garden promotes participation by Latino youth (LA, CA).

Henry Ford Health's 1500 sq. foot greenhouse and education center is a different model, run by a resident hospital farmer, with a focus on wellness and community outreach (Henryford.com, 2022).

Hospital affiliated community gardens are championed by both hospital staff and community garden partners because of multiple health benefits for individuals and communities. With the capacity to deliver therapeutic services, provide access to nutritious food, address food and health disparities, promote health, education and positive social engagement without stigma, this horticulture for health example contributes to social capital and community benefit (Ahonen et al., 2012).

Discussion

Awareness of horticulture for health activity in hospitals

The research revealed that there are at least 100 U.S. hospitals with horticulture for health activities. Much of this activity occurs as a function of a specific department. Few hospitals appear to be delivering all four types of activity identified in this paper. Much of this can be attributed to discipline specific areas of responsibility, the nature of training and expertise, and organizational structure. Horticulture-focused activity relies on expertise such as nutrition, horticultural therapy, or tax knowledge - community benefit. Horticulture for health activity would not be considered a core hospital function, rendering it less prominent for senior administration attention. The possibility of these initiatives fulfilling community benefit requirements has raised their profile and may provide future opportunities for nonprofit hospitals seeking to maintain their tax-exempt status, and for practitioners with the skills to deliver HT, healthcare garden design, and programming at community garden settings.

Aligning horticulture for health initiatives for greater synergy and health improvements

Can there be greater synergy between initiatives and departments within hospitals where horticulture is a component of programs and activities? Though the nature of the health services is quite different, from nutrition-led programs, affiliated community gardens, hospital gardens and horticultural therapy, the foundation for all the areas relies on horticulture playing a role in improving health in this hospital specific setting. Staff who are managing affiliated community farms, delivering horticultural therapy, or developing community wellness/prevention nutrition-based programs have a common interest in how horticulture functions as a mechanism or catalyst for health. Being aware of other programming at their facilities might engender greater cross-department interdisciplinary collaborations, knowledge transfer and patient/stakeholder participation in other initiatives. Models where these collaborations are occurring, like Henry Ford West Bloomfield Hospital (MI), University of Vermont Medical Center (VT), and Rogers Behavioral Health (multiple locations) speak to how aligning horticulture initiatives can expand health programming, and importantly, outcomes for individuals and communities. Gardens in particular may address two other elements within hospital settings – spaces for coping with escalating violence against healthcare workers (Berger, 2021), and places for delivery of spiritual care where supportive or difficult conversations can occur (Nakau et al., 2013).

Further research validating the benefits

Decision-making at hospitals is focused on health outcomes, patient numbers, patient satisfaction, and cost-benefits of services (Mazurenko et al., 2017). Research offering data in these areas will guide policy, funding, and future initiatives. Anecdotal comments from horticultural therapy patients suggest their preference for, and satisfaction with horticulture-based interventions, but it is empirical evidence that will more strongly validate it, and other horticulture-based initiatives. Research where horticulture for health activity can impact outcomes is being explored including: the link between obesity, an important health factor contributing to many health challenges, with nutrition and access to food through strategies like community gardening; models where hospital's role in food is medicine movement contributes to individual and community health; and methodology quantifying financial impact of green spaces in hospitals across populations including benefits for nurse and physician burnout (Murphy, 2022).

Conclusion

The paper has identified models where horticulture for health activity in U.S. hospitals have been established. Using the horticulture for health framework, four significant areas have been identified – horticultural therapy, gardens in hospitals, nutrition-led programs, and affiliated community gardens. Horticulture is and can be a common factor, where activities function independently, and to a lesser degree, where connections between the areas exist. The obvious connections are between nutrition-led programs and affiliated community gardens, and therapeutic gardens used for delivery of HT or horticulture-based therapeutic interventions. One significant factor that emerged, relatively unknown in the HT profession,

is community benefit-tax exempt status that has been used to establish horticulture (and other) programs and services, most often seen as affiliated community gardens. Replicating greater numbers of horticulture for health activities in hospitals will increase the health outcomes for individuals and communities, promote additional community partnerships, impact healthcare design, support green spaces in hospital settings, and use horticulture in new applications for health improvements. The cost benefits of each of these horticulture-centric initiatives will need to be justified given the nature of hospital care, financial burden, and U.S. healthcare at the present time.

Conflicts of interest

The authors declare no conflicts of interest.

Table 1.
Listing of U.S. Hospitals with Horticulture for Health Activities

Name of Hospital	Beds	Type	Location	HT/TH	Therapeutic Garden	Other Garden	Nutrition led programs	Community Gardens	Comments
Adventist Health Castle	160	general	Kailua, HA				x	x	rooftop food garden, community nutrition events
Adventist Health Glendale	515	general	Montrose, CA	x	x	x			TH by OT in acute physical rehab unit
Advocate Hope Children's Hospital-Oak Lawn	409	pediatric	Oak Lawn, IL		x	x			healing garden
Ann & Robert Lurie Children's Hospital of Chicago	312	pediatric	Chicago, IL	x	x	x			Crown Sky Garden
Baltimore VA Medical Center	324	veterans	Baltimore, MD			x		x	partners with TALMAR using affiliated farms
Baltimore Washington Medical Center	285	acute care	Glen Burnie, MD	x	x	x		x	Healing Garden viewed from infusion area
Baptist Health Homestead Hospital	182	general	Homestead, FL				x	x	Grow2Heal affilated hospital garden
Banner Gateway Medical Center	185	general	Phoenix, AZ	x	x	x		x	Women's Garden designed for community healing
Banner- University Medical Center Phoenix	245	general	Phoenix, AZ		x	x			healing garden
Boston Medical Center	487	trauma center	Boston, MA		x		x	x	rooftop farm; food 4 hospital cafeteria & preventative food program
Brigham and Women's Hospital	812	general	Boston, MA		x	x	x	x	rooftop garden; produce used in hospital Café; childrens garden
Brooke Army Medical Center	500	military, trauma	San Antonio, TX	x	x	x		x	Returning Heroes Home Healing Garden, BAMC Garden
Bryn Mawr Rehab Hospital	148	rehabilitation	Malvern, PA	x	x			x	HT -rehab services; enabling, educational,medicine wheel gardens
Cancer Treatment Centers of America Phoenix	38	cancer	Goodyear, AZ				x	x	onsite farm; nutrition programs for patients & community
City of Hope National Medical Center	217	cancer	Duarte, CA		x		x	x	onsite community garden
Children's Medical Center Dallas	601	pediatric	Plano, TX			x			2 indoor gardens
Colmery-O'Neil VA Medical Center	160	veterans	Topeka, KS	x	x		x		small gardens; greenhouse supporting HT
Conneticut Mental Health Center	20	mental health	New Haven, CT				x	x	garden; community focused nutrition programs
Contra Costa County Regional Medical Center	161	short term acute care	Martinez, CA		x	x			view of garden from infusion & other rooms
Cordilleras Mental Health Center	68	mental health	Redwood City, MD	x			x		HT with gardening & pre-vocational focus; vegetable garden
Cornell Health	200	general	Ithica, NY				x	x	Nature Rx program; community garden
Craig Hospital	93	neurorehabilitation	Englewood, CO	x	x			x	HT since 1994; donates plants to local food gardens
Dana-Farber Cancer Institute	30	cancer	Boston, MA		x		x		2 story indoor garden; Morse Conservatory
Dell Children's Medical Center	248	pediatric	Austin, TX	x	x	x	x		Rooster Teeth Healing Garden
Durham Veterans Affairs Medical Center	151	veterans	Durham, NC			x	x		nutrition program partner *Eat Well*
Edward Heart Hospital	294	cardiac	Naperville, IL	x	x	x			exterior waterfall & healing garden
Fairview Hospital	25	general	Great Barrington, MA				x	x	food garden; food to hospital café & patients
Golisano Children's Hospital of SW Florida	134	pediatric	Fort Myers, FL		x			x	Komen Family Garden

Hassenfeld Children's Hospital at NYU Langone	68	pediatric	New York, NY	x	x	x			rooftop terraces; sprawling gardens and abundant outdoor space
Hawaii State Hospital	144	psychiatric	Kaneohe, HA	x		x			patient gardening program
Henry Ford West Bloomfield Hospital	191	general	Detroit, MI	x	x	x	x	x	greenhouse; wellness & community programs; interiorscape garden
Illinois Cancer Center	462	cancer	Peoria, IL		x	x			views from treatment rooms; Illinois Cancercare Fdn tribute gdn
Inova Mount Vernon Hospital	237	general	Alexandria, VA	x	x		x		HT program
Island Hospital	43	general	Anacortes, WA			x	x		CSA; local grower connection; farm stand
James A. Haley Veterans Hospital	499	veterans	Tampa, FL					x	off-site gardening program @ affiliated garden
James J. Peters VA Medical Center	311	veterans, military	Bronx, NY	x	x				THRIVE HT program with NY Botanical Garden
Johns Hopkins Bayview Medical Center	422	trauma center	Baltimore, M		x	x			labyrinth & gardens
Jupiter Medical Center	242	general	Jupiter, FL	x	x	x	x	x	Jacqueline Fiske Healing Garden; Fresh Rx partner; community farm
Kaiser Foundation Hospital	305	general	Los Angeles, CA				x	x	nutrition educ at affiliated community garden for Latino youth
Lankenau Medical Center	370	general	Philadephia, PA				x	x	offsite farm; nutrition programs; nutrition educ for med students
Legacy Emanuel Medical Center	554	general, trauma	Portland, OR	x	x	x			research on Sacred Places; garden for burn patients
Legacy Good Samaritan Medical Center	539	general	Portland, OR	x		x			Stenzel Therapeutic Garden supports burn patients
Legacy Meridian Park Medical Center	150	acute care	Tualatin, OR	x	x	x			3rd floor interior garden/intensive care area
Legacy Mount Hood Medical Center	115	general	Gresham, OR	x	x				Healing Garden
Legacy Silverton Medical Center	48	trauma center	Silverton, OR			x			botanical garden on site
Las Encinas Hospital	155	mental health	Pasadena, CA	x		x			HT in mental health facility
Mad River Community Hospital	78	acute care	Arcata, CA			x		x	food garden affiliate
Magee Hospital	96	rehab	Philadelphia, PA	x	x			x	2 sites for HT; rooftop greenhouse & raised beds
Massachusetts General	1,019	general	Boston, MA	x	x	x		x	mutiple gardens; Ulfelder Garden; rooftop garden
Memorial Hospital	526	acute care	South Bend, Indiana				x	x	affiliated garden with nutrition education
Mercy Hospital South	767	general	St. Louis, MO		x	x			healing gardens designed with nature's colors
Mission Hospital	815	surgical, pediatric	Asheville, NC	x	x				behavioral health beds; gardening & other therapies
Monmouth Medical Center Southern Campus	201	general, cancer	Lakewood, NJ		x			x	rooftop garden views from patients' rooms; Deary Memorial Garden
Moss Rehab	130	physical med, rehab	Elkins Park, PA	x	x				Sachs Therapeutic Conservatory greenhouse
New Milford Hospital	85	general, trauma	New Milford, CT				x	x	aeroponic food garden onsite; plow2plate nutrition program
Northeast Georgia Medical Center Gainesville	500	trauma, acute care	Gainesville, GA	x	x	x		x	Anne's Garden; Water Garden
NYU Langone Orthopedic Hospital-Rusk Rehabilitation	51	rehab, orthopedics	New York, NY	x	x		x		indoor & outdoor therapeutic garden; plant cart
Oregon State Hospital	560	mental health	Salem, OR	x	x				greenhouse vocational program

Overlake Hospital Medical Center	349	general	Bellevue, WA			x		x	food garden
Palo Alta VA Medical Center	800	veterans	Palo Alta, CA		x	x			therapy garden 4 polytrauma rehab; commemorative rose garden
Penn State Health Milton S. Hershey Medical Center	628	general/trauma	Hershey, PA	x	x	x	x	x	rooftop gardens; onsite community garden
Perry Point VA Medical Center	505	veterans	Perry Point, MD	x	x	x			garden & greenhouse
Rady Children's Hospital	524	pediatric	San Diego, CA	x	x	x		x	Leichtag Family Garden; Buggy Garden; private gardens
Ranken Jordan Pediatric Bridge Hospital	60	pediatric	Maryland Heights, MO	x	x	x	x		Outdoor Therapy Playgrd-activity canyon; partner w Miss. Botanic Gd
Randall Children's Hospital at Legacy Emanuel	165	pediatric	Portland, OR	x	x				Children's Garden
Raymond G. Murphy Medical Center	203	military, veterans	Albuquerque, NM	x	x				Veteran's Therapeutic Garden
Rogers Behavioral Health - Oconomowoc	244	mental health	Oconomowoc, WI	x	x	x			gardens & greenhouse
Salem VA Medical Center	242	veterans	Salem, VA	x	x		x		Salem VA greenhouse program
Salinas Valley Memorial Hospital	263	general	Salinas, CA				x	x	produce prescription program; community cooking programs
Sarasota Memorial Hospital - Sarasota Campus	839	acute care, rehab	Sarasota, FL	x	x				multi-terrain outdoor Mobility Garden in Rehab Pavillion
Schwab Rehabilitation Hospital	102	rehab	Chicago, IL		x	x			rooftop garden; childrens garden; meadow
Seattle Children's Hospital	407	pediatric	Seattle, WA			x	x	x	rooftop food garden; nutrition classes; Practice Greenhealth program
Shepherd Center	152	rehab, brain injury	Atlanta, GA	x	x	x		x	comm. benefit program 4 discharged patients w local Ability Garden
Sidney & Lois Eskenazi Hospital	333	trauma	Indianapolis, IN			x	x	x	sustainability/wellness focus; rooftop garden; plots for staff
Silver Hill Hospital	129	psychiatric	New Canaan, CT	x	x	x			TH activities; wildflower garden
Smilow Cancer Hospital	168	cancer	New Haven, CT		x	x			sanctuary healing garden
Spaulding Rehabilitation Hospital	132	rehab	Charlestown, MA		x	x			rooftop garden; therapeutic walking trail
St. Joseph Hospital	112	acute care	Bangor, ME			x	x		prescription produce program
Saint Joseph Hospital - Cancer Centers of Colorado	400	general & cancer	Denver, CO		x			x	healing garden onsite
St. Joseph Health Santa Rosa Memorial Hospital	338	acute care	Santa Rosa, CA		x	x			labyrinth
St. Joseph Mercy Ann Arbor Hospital	537	general	Ann Arbor, MI	x		x	x	x	green therapy; farm; food production for hospiial kitchen
St. Louis Children's Hospital	402	pediatric	St. Louis, MO	x	x				rooftop outdoor Olsen Family Garden
St. Luke's Anderson Campus	167	cancer center	Easton, PA				x	x	organic farm; food to hospital cafeteria; mobile market
Syracuse Veterans Affairs Medical Center	161	veterans	Syracuse, NY	x	x				Clear Path gardening & culinary TH program
Texas Children's Hospital	173	pediatric, women	Houston, TX		x	x		x	children's roof garden; Merle C. Donigan Play Garden
The Christ Hospital Joint & Spine Center	87	orthopedic	Cincinnati, OH		x	x			2 rooftop therapeutic gardens
Tisch Hospital	300	general	New York, NY	x	x		x		multiple therapeutic modalities; CAS for staff
Trinity Health Oakland	443	general	Pontiac, MI				x	x	farm at Oakland location using food is medicine concept

Unity Center for Behavioral Health	102	mental health	Portland, OR	x	x				Behavioral Health Garden
University of Florida Health Psychiatric Hospital	81	psychiatric	Gainesville, FL	x	x				TH program delivered through Wilmot Gardens
University Hospitals Rainbow Babies & Children's Hospital	244	pediatric	Cleveland, OH	x	x				Angie Fowler Adolescent & Young Adult Rooftop garden
University Hospitals Seidman Cancer Center	150	cancer	Cleveland, OH		x	x	x	x	Schneider Healing Garden; rooftop garden
University of Michigan Rogel Cancer Center	550	cancer	Ann Arbor, MI				x		plant-based diet/nutrition videos
UNM Children's Hospital	18	pediatric	Albuquerque, NM		x			x	UVM Medical Center Rooftop Garden
University of Vermont Medical Center	562	general	Burlington, VT	x		x	x	x	rooftop garden; gardening for health videos; nutrition programs
UPMC Western Maryland Hospital & Health System	204	rehabilitation	Cumberland, MD		x		x	x	5 sites for affiliated community gardens; food is medicine approach
VA Greater Los Angeles Healthcare System	832	veterans	Los Angeles, CA	x			x	x	community garden; nutrition programs with Healthy Teaching Kitchen
Virtua Our Lady of Lourdes Hospital	410	general	Camden, NJ	x	x		x	x	meditation garden; CASTLE nutrition activities
Virtua Voorhees Hospital	587	general	Voorhees, NJ		x	x			Angel's Garden outdoor sanctuary for parents who have lost a baby
Walter Reed National Military Medical Center	244	military,veterans	Bethesda, MD		x	x		x	Epidaurus 2 nature space; Green Road; Wild garden
Watertown Regional Medical Center	95	short term acute care	Watertown, WI				x	x	food from garden serves hospital, café; staff involvement
Weiss Memorial Hospital	236	general	Chicago, IL				x	x	community garden on parking garage's rooftop; plots 4 refugee pop
Yakima Valley Memorial Hospital	222	general, trauma	Yakima, CA			x		x	food garden; fresh produce nutrition programs

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