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Research Article

Urban Green Spaces and Landscape Design in Healthcare Facilities: Enhancing Healing Environments

Ar. Charu Arora Mathur[1*], Dr. Rashmi Ashtt[2]

[1*]Research Scholar, Doctorate of Philosophy, Department of Architecture and Planning, Indira Gandhi Delhi Technical University for Women, Kashmere Gate, Delhi, India.
[2]Professor, Department of Architecture and Planning, Indira Gandhi Delhi Technical University for Women, Kashmere Gate, Delhi, India.

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ABSTRACT

Healthcare facilities are essential for the delivery of medical care, but improving user experience and mental perceptions is necessary given their historical reputation as scary places. Beyond aesthetics, outdoor landscapes have been underutilised and have not met therapeutic needs. Among order to reduce anxiety and tension among patients, visitors, and staff, this research investigates the transformative potential of landscape design in healthcare settings. Healthcare facilities that have outdoor areas provide several advantages, such as enhanced physical, social, and psychological well-being. Studies show that being in nature speeds up healing, decreases blood pressure, and reduces stress. Through the provision of recreational spaces for staff and therapeutic gardens for patients, designers may effectively create a supportive environment that improves overall hospital efficiency and fosters well-being. Design characteristics that are effective in creating outdoor habitats that are both comfortable and accessible include sustainability, safety, and approachability. An environment that is soothing and promotes healing can be created by incorporating components like plants, water features, and suitable lighting. In addition, regulatory guidelines and routine upkeep guarantee that these areas continue to be therapeutic and useful. In order to optimise outdoor areas for holistic healing and improved healthcare outcomes, this study highlights the crucial role that landscape architecture plays in healthcare facility design and advocates for the inclusion of evidence-based design concepts. Future studies should investigate certain hobbies and tastes in order to improve outdoor space utilisation efficiently.

Keywords:- Healthcare facilities, Landscape design, Therapeutic gardens, healing garden, Outdoor spaces.

INTRODUCTION

Long stays in hospitals can be stressful for everyone involved, including staff, patients, and visitors [1-2]. There seems to be a growing recognition of the benefits of nature for health and well-being, and a growing desire to incorporate green spaces into or adjacent to hospitals. As most hospitals are situated in man-made environments, the green space that abuts these buildings is called "designed" rather than "wilderness." The benefits of incorporating green areas into hospital buildings on patients' health and well-being are becoming more and more evident [3–12]. Furthermore, in addition to the general calibre of treatment given, it has been acknowledged that this is a factor that increases patient satisfaction with the healthcare practitioner [26].

In general, a healthcare centre is a location where individuals and community members can get medical care and services. Small clinics, nursing homes, treatment centres for addiction and mental health issues, hospices, rehabilitation centres, and other types of establishments are among these facilities.

According to [16], the general public believes that these healthcare services should only be used in an emergency or other circumstance where it is required. But there's a need to enhance the user experience, create a more entertaining approach, and change people's perceptions of these locations. There's a probability that the interior surroundings of these medical facilities will feel less tense because to the Landscape.

The majority of the time, the exterior design of medical institutions was created with the goal of creating an artificially enhanced environment that would enhance the facility's reputation. Nevertheless, this isn't always

done to meet the therapeutic needs of the personnel or the patients [20]. Understanding the function that landscape plays in the healing process is crucial to supporting the development of outdoor spaces as a resource for alleviating stress.
Using this comprehensive strategy can help patients feel less anxious and confused about the hospital, which will improve physician attention and reaction. It will contribute to making the facility's environment less stressful for all of its users. This will improve the hospital's overall effectiveness [14] and play a critical role in the physical, psychological, and social recovery and well-being of the patients [16, 20].

Advantages of outdoor spaces in Healthcare facilities

[22] Natural elements that promote healing include sunshine, clean air, and vegetation. [14] Several studies have demonstrated the positive effects that daylight, green spaces, and views of the surrounding landscape have on hospital patients' general health. Incorporating external environments can have numerous advantages for a patient's health and welfare, encompassing psychological, social, and physical aspects.
Both theoretical and empirical research indicate that patients' physical well-being and endurance seem to greatly increase when they are exposed to outside environments. Additionally, research indicates that spending time in natural environments can lower stress and may even benefit cholesterol and blood pressure levels [18, 21, 24, 26, 27]. Natural environments can provide advantages and a micro-restorative experience [26]. Negative psychological consequences are more common in those who work in healthcare facilities and are required to spend a lot of time indoors. The healing process can halt as a result of this. Nature is entwined with the body and the mind. A higher sense of wellbeing and a quicker recovery can result from spending time in or taking in natural surroundings [22]. The breath-taking vistas of the surrounding countryside divert the viewer's attention from the topic and their unsettling thoughts. They offer advantages like reducing anxiety and depressive symptoms, aiding in the control of rage and discomfort, and enhancing general wellbeing
[17].
Open spaces in healthcare institutions provide an environment full of natural light, allowing patients to engage socially or spend quiet time in contemplation. They must be created such that the user can choose between social engagement and privacy. Opportunities for social support, recreation, community involvement, social activity participation, sharing comparable experiences, and other related activities are provided by the outdoor amenities. Immunological function and mood have been demonstrated to be enhanced by social support [19]. Research has shown that patients who are with a robust social support network, as opposed to being left on their own, are more likely to survive and make a full recovery. This is because having a network like this improves patients' overall health and lowers their stress levels [21].

Users of healthcare facilities

For healthcare facilities to plan and build their outdoor spaces in a way that enhances the overall healthcare environment, it is imperative to understand the user groups who will be using these areas as well as the needs and expectations that go along with them. Three main categories can be used to categorise the individuals who use these facilities: patients, visitors, and medical professionals. Every individual have distinct requirements and distinct habits of behaviour [28].

The therapeutic needs of patients are taken into consideration when building healthcare facilities. Patients may belong to multiple groups based on how they use, enter, or remain in the hospital. Due to their medical conditions, some patients could need to stay at the facility for a longer period of time, while others would simply need to be there for an OPD (shorter stay) [25]. When developing the outdoor settings, consideration must be given to the patients' physical and psychological demands. For example, those responsible for designing children's healthcare gardens have an obligation to pay special attention to the provision of play and other physical activities that relieve stress [28]. Furthermore, it's possible that people undergoing various forms of therapy would use these spaces for various goals. Orthopaedic patients, for instance, would require walking aid in the gardens, while senior citizen facilities might require railings and more shaded areas [16]. Gazing upon these vast, verdant areas that are occasionally teeming with activity helps deflect the patient's focus from pain or unfavourable thoughts, therefore expediting the healing process. Although some patients may not be well enough to be taken outside, a view like this and some nearby activities can aid in their rehabilitation.

The patient is frequently accompanied to the hospital by a nurse or other carer, or they stay with them there. Sometimes, like when they come during visiting hours or visit the outpatient department (OPD), guests are only kept at the hospital for a brief period of time. Sometimes they have to wait a long period because the patient is undergoing an operation or a diagnostic procedure that requires a lengthy recovery period. These visits may occasionally be overpowering, depending on the condition of the person they are visiting. They can benefit much from the outside areas because they provide a place to relax, engage in fun diversions, and eventually build a supportive environment.

Employees in the healthcare sector are required to spend a significant amount of time in the rigorous environment of the institution. They have incredibly busy work schedules and responsibilities. They are allowed to access the outdoor areas during breaks or in situations where they might be accompanying patients while they participate in outdoor activity activities. Established landscape areas can provide them with a restorative respite from the demanding work and uninspiring surroundings of the medical centre [13].

Stress reducing effects of viewing plants and nature

It has been repeatedly demonstrated in numerous studies involving both non-patient groups (e.g., university students) and patients that the simple act of gazing at scenes dominated by greenery, flowers, or water is significantly more effective than constructed scenes devoid of nature (rooms, buildings, towns) in promoting recovery or restoration from stress. [35] A small amount of study indicates that even among hospital patients who are very stressed, spending a few minutes in environments with plants or other natural stimuli can induce quantifiable restoration.

Three to five minutes in a natural setting has been shown to have beneficial impacts on one's physiology, psychology, and emotional state. This is strong proof. Regarding the initial psychological/emotional element, there are multiple points of view that indicate the presence of vegetation or elements resembling gardens accentuates feelings of enjoyment and calmness while lowering feelings of anger, fear, and grief. Some natural environments have the power to captivate people's interest and attention, which makes them an enjoyable diversion from worrying. Studies on the physiological signs of stress recovery have shown that, in less than five minutes, studying natural environments can significantly improve these signs.

Beneficial alterations in physiological manifestations like heart rate, blood pressure, muscle tension, and brain electrical activity provide as evidence for this. Research carried out in laboratories and clinics corroborates these findings. A battery of physiological responses, for instance, was recorded in one meticulously controlled study involving 120 anxious individuals (non-patients) who were randomly assigned to watch one of six different videotapes depicting either artificial landscapes devoid of natural elements, natural settings with vegetation, or vegetation near water while they recovered. Four physiological variables—blood pressure, heart rate, skin conductance, and muscle tension—were continually observed. The findings consistently showed that people recovered from stress in natural environments more fully and swiftly than in any constructed situation. Within three minutes, all physiological parameters exhibited noteworthy alterations, demonstrating the rapidity of nature-induced healing.

The pattern of physiological data provided more evidence supporting the hypothesis that natural environments are superior to artificial environments in terms of lowering sympathetic nervous system activity. (The stress reaction requires higher sympathetic nervous system activity, which includes arousal or energy-intensive mobilisation.) Furthermore, information gathered from self-reports of emotions showed that recovery from the psychological effects of stress was significantly faster in natural settings. Individuals who were placed in natural settings with plants and other elements of the environment reported having a great deal more good emotions and a lot less anxiety and anger than those who were placed in artificial situations. Additionally, examined healing in non-patient volunteers who were under stress after finishing a demanding test series or operating a vehicle through city traffic using both physiological and psychological measurements [36]. Findings were essentially in line with previous reports; blood pressure measurements and emotional self-reports, in particular, supported the notion that staring at an artificial environment devoid of natural elements helped people recover more quickly than staring at a naturally occurring setting with lots of vegetation. Brain wave activity was recorded in two Japanese investigations (1990, 1992) while unstressed individuals (non-patients) gazed at fake items or plants.

Volunteers watched two different kinds of potted plants (Begonia and Pelargonium); the same pots empty of plants; or a cylinder that resembled the pots in an interesting pilot study while the scientists measured alpha rhythm activity. According to the findings, looking at pots with flowers in them made participants feel the most peacefully awake, while looking at pots devoid of any plants made them feel the least at ease [37]. In the second experiment, participants saw a concrete barrier the size of a hedge, a hedge of greenery, or a mixed condition with both concrete and flora while the electroencephalogram (EEG) was being recorded [38]. The conclusion that the vegetation promoted peace and the concrete produced stressful effects was corroborated by the EEG data.

Benefits of Healthcare Gardens for Staff

The lack of healthcare professionals is a serious issue in most of Europe and North America. It has long been known that positions in the healthcare sector, such as nursing, may be quite demanding due to the high workload, lack of decision-making authority, and stress associated with shift rotation. However, workloads and demands have escalated further as healthcare providers worldwide have been pressured to control or cut costs [39]. These conditions have, in many cases, led to lower job satisfaction, increased absenteeism and

turnover, a scarcity of competent labour, increased provider operating costs, and a deterioration in the quality of patient treatment. These noteworthy staff-related problems imply that the previously expressed conclusion—that many healthcare professionals use gardens as a healthy means of stress relief and decompression—is highly significant. It should be mentioned that evidence is beginning to show that hospital gardens enhance workers' happiness with their workplace and may help hospital administrators attract and retain qualified personnel [40–43].

Types of Outdoor spaces in healthcare facilities

In many cases the outdoor spaces of healthcare facilities are primarily designed for cosmetically enhancing the site, parking, walkways and locating other building services. To design and develop an outdoor space which complements the operations of indoor healthcare facility, it is important to understand the various types of outdoor spaces available in the facility. The different types of outdoor spaces are the-

Set back areas – By definition, setback "is the minimum distance which a building or other structure must be set back from a street or road" [29]. Set back areas are not generally envisioned for active use. Parking and other services are generally provided in these areas. They are intended for a visually pleasing setting at the entrance. Front setback is a transitional zone from city to the healthcare environment. The boundary walls are generally lined with trees, they help in buffering the healthcare services from the surrounding environment. Trees act as visual and sound barriers.

Entrance – It consists of entry greens and the porch area.

The lawn at the entrance is a visually pleasant green space to create pleasing image of the healthcare facility. It is the most visible and easily accessible zone. They also include signages. They evoke a familiar and comforting appearance [21].

The building entrance porch is also located here. It is generally used as pick-up and drop-off zone [16]. The porches define the building entrance and give the visual cue of main entrance into the facility [21]. The porches are generally defined by some overhang or design feature.

Courtyards – By definition, courtyards are "the open areas which are completely or partially enclosed by walls or buildings" [30]. Some healthcare facilities may be designed with courtyard concept. This gives the designer an opportunity to develop it into an interactive zone along with some outdoor private spaces which have good air circulation. Courtyards can be planned for both visual relief and access. It needs to be located in such a manner that either it is directly visible or is apparent on entering the complex.

Courtyards can provide visual and auditory relief using colorful plants, large canopy trees providing shade, water features, stones, bridges, pathways, movable and immovable seating etc. [16, 21]. Courtyards can also turn the spaces between the large built healthcare structures into a more human scale, which give a relief from overwhelming feeling of the surroundings. Water features, orientation and openings in a courtyard can be planned to create a micro-climate which make the space more suitable for use in different types of weather conditions.

Plazas - Plaza spaces in hospitals are outdoor areas designed for practical use and are primarily covered with hard surfaces. While they may feature trees, shrubs, or flowers in planters, they generally present a paved, urban plaza appearance rather than a green space [16, 20].

They provide easy accessibility for people in wheelchairs, walkers, and crutches. They should also have covered seating spaces with pleasing views or surrounded by vegetation or water feature. Due to the predominance of paving, landscaping and gardening maintenance costs are low [16].

Parking areas - Parking areas in healthcare facilities are designed for accommodating patients, visitors, and staff. These spaces must be carefully designed to ensure easy access for individuals with disabilities and clearly marked pedestrian pathways.

Generally, the employees and staff parking is reserved at the back, visitor parking is closer to the entrance and emergency vehicles should have unobstructed access. Effective way finding and signage can help users navigate the parking area efficiently. Vegetation can enhance the appearance and provide shade in parking spaces to protect vehicles from heat.

Healing gardens – Healing garden refers to gardens designed to promote recovery. They are the places for spiritual, psychological and physical healing [27].

Not all gardens have healing effect. They must create an environment that is therapeutic. They provide space for both active and passive activities, like viewing, gardening, walking, meditation, reading etc. design elements of a healing garden include –

- An entrance, which summonses & encirclements visitor into the garden
- Creative use of colour and lighting to elicit emotion, comfort & awe.
- Emphasis on natural features as grounding points such as – use of rocks, wood, natural fences, screens, trellises, wind, sound, etc.
- Element of water for its psychological, spiritual & physical effects.
- Integration of art enhances overall mood and spirit of garden.
- Garden features that attract wild life & provide diverse habitat.

There are numerous types of healing gardens designed to encounter the diverse psychological and physical needs of their users, some of them are –

i. **Horticulture therapy garden –** It utilizes plants & horticultural activities to rally social, educational, psychological and physical adjustment of person, thus refining their body, mind and spirit.

ii. **Therapeutic garden –** it is a space that has been precisely premeditated to meet physical, social psychological and spiritual needs of people. These include –

- Alzheimer's garden: outdoor spaces designed at adult day-care programs and dementia residence.
- Rehabilitation garden
- Restorative gardens (psychiatric hospitals)
- Senior community gardens: assisted living, continuing care retirement communities and other senior living residences.
- Cancer gardens: chemotherapy facilities.
- Enabling gardens: vocational schools, arboretum.
- Meditation garden: religious institutions and other faith based settings. It is an outdoor space created to provide quiet separation. It serves as a retreat space to unwind and practice mindfulness.
- Dementia specific garden: people with dementia often forget where they are coming from or going to. It orients users through visual cues so that they gain a sense of control and in turn self-confidence.

iii. **Viewing/ walk in garden –** with space or budget constraint, a viewing garden can't be entered. Spaces that can be viewed and entered from inside the hospital like waiting areas or the corridors are referred as walk in gardens.

iv. **Edible garden –** herbs, fruits, vegetables are grown together in easily accessible space.

Children's garden – they are the outdoor spaces with flexible play areas which stimulate their imagination, gives pleasure and therapeutic benefit [23]. These areas use primary colours, climbing structures, miniature bridges, sand play areas and slip resistant materials is used so that children can heal and move around without getting hurt. Platforms should be given for children on wheel chair, so that they can safely move onto and off play structures.

Rooftop gardens – they are the areas on top of hospital buildings. They are designed for use or viewing from offices and hospital units. They offer comforting views, capture the space which might have gone unnoticed, make the space visually attractive and enable major energy savings.

Dining areas – the outdoor eating areas of the cafeteria are the communal hub of healthcare facilities. The design features include – use of natural light, providing comfortable seating options, shaded and semi-private group spaces should be provided and tables are for eating, reading, writing and to serve as territorial markers.

Indoor landscape – plants aid in process of recovery. Live plants or living walls reduce stress level in patients. It provides positive distraction during treatment, creates positive change in mood as natural setting creates visual interest. It provides privacy, comfort and even aids in directing visitors through the hospital.

Plants chosen for indoor design should be –

- Safe and healthy addition to the environment.
- Allergy free plants that do not release air borne pollen
- Use of soil-less growing media as it allows plants to thrive in a sterilized, organic free material which could attract pest or mold.

Watering of plants is done through sub-irrigation systems; precise amount of water is to be supplied.

Essential Outdoor Design Criteria for Healthcare facilities

Healthcare facilities have to consider a number of standards, laws, and requirements when designing outdoor areas to make sure they are therapeutic, useful, and promote staff and patient well-being. Planning of outdoor spaces in healthcare facilities has to be done so that it would support, enhance, and foster favourable health

outcomes. The location, ease of access, needs and preferences of the patients are most important design criteria when planning green outdoor spaces in a healthcare facility [15].

Approachability – the outdoor spaces should be easily approachable regardless people's age or disability. The paths have to be smooth and wide enough so that patients on bed can be wheeled or that two wheel chairs can pass.

Visibility – people need to be aware that outdoor landscape spaces exist in the facility. The outdoor space location should be clearly indicated or directly visible from main entrance. These spaces should have views from patients' room, so that they can enjoy/heal even if they are unable to visit.

Safety – one should feel safe and secure in the environment. The space should have sufficient light. There should be feeling of enclosure but without the feeling of being isolated or watched by all. The design elements like handrails, seating a frequent interval should be included and materials with strong glare should be avoided.

Feeling of control – the user of outdoor space should be able to go and move with minimum assistance in landscape space. Choice to sit alone or in a group, where to sit or walk reinforces a sense of autonomy. Use of mobile furniture and different types of spaces with views helps the user to feel more calm, comfortable and in control.

Familiarity – unfamiliar environment causes stress. Design should include elements that are familiar in their culture, like local plants, detailing, furnishing etc. The outdoor spaces should be on human scale and evoke connection with the surrounding environment. Aesthetics should be based on fundamental needs.

Quiet – users should be able to enjoy natural sounds of water, birds and rustling of leaves as they have soothing and calming effect on people. Users should not be disturbed by sounds of machines (Air conditioner, generator, etc.), traffic, public announcements, emergency vehicles, helicopters etc.

Flexibility – the outdoor space design should take into account its users, that is, for whom (user group) it is being designed, what are they being currently used (socialising, exercise, or lunch break) for, and how their use may change over time (duration of the day, season, weather etc.).

Sustainability – sustainable outdoor hard and soft landscaping elements like pavement materials, solar powered lights, native plants or low water use plants can contribute positively to the facility's overall environmental goals. Rainwater harvesting, zero run-off, ground water recharging practices should be considered and integrated in planning of outdoor spaces.

Aesthetics – outdoor spaces should be inviting, attractive and should welcome people on arrival. Design elements should have calming effect on people and should be able distract people positively. Natural colors and materials like rock, wood, plants and water have healing effect.

Maintenance – the outdoor spaces need to be maintained regularly for their safety, functionality, and aesthetic appeal year-round. Maintenance should focus on creating a friendly, comfortable, and welcoming environment rather than achieving flawless perfection.

Landscape Design Elements used in healthcare facilities

The design elements used in landscape of healthcare facilities play a crucial role in fostering mood changes and reducing stress levels. These elements help in creating spaces that provide sensory stimuli, physical and psychological movement and spaces for social interaction or seclusion [27].

Plants – variety of greens, growing and living things, colorful planting stimulate senses and aid in healing. Plants provide visual enhancement, create micro-climate, wind control, create buffer from unwanted sounds, views and dust. They also help in energy conservation.

It is recommended to –

- Mix native vegetation with compatible new plants. This will attract local fauna like birds and butterflies which help in stimulating senses with color and sounds.
- Have open, sunny spaces with generous paths. Dark woodland environment should be avoided in healthcare facilities.
- Texture, form, color and arrangement of vegetation draws people attention and focus away from themselves.
- Large canopy trees provide shade in summer and shelter in winter.
- Scented plants for visually impaired provide attractive sensory experience.
- No hazardous or thorny plants or plants which drop slippery fruits and leaves should be planted there.

Elevated gardens or raised planter boxes or table planters can be designed for people on wheelchair.

Signage – it helps in way finding. The patient or the visitor needs direction from the point of arrival on the healthcare site to the building, to his final destination in the building and back again to exit from the building and site. Some key points for signage in healthcare facility are –

- Appropriate, approachable and welcoming signs.
- Establish a clear system
- A few signs only at each intersection
- Separate external signs for pedestrians and drivers with suitable size and location

- Clear, easy to read lettering
- Night light
- Avoid unofficial signs on free standing boards
- Color coding, if used can relate to other colors in building fabric.
- Consider need for additional signage.

Site signage indicates direction of traffic, restrictions, parking, entry points and entrance to facilities.

Lighting - the primary purpose of lighting is safety and security. Bollards and bulkheads define walkways and roads. Lighting enables viewing of garden from indoors. It also helps in safe use of space at night. Night time illumination must provide appropriate light levels to allow safe navigation. During the daytime, providing appropriate interior lighting in transition areas is important.

Pathways - circulation in the health-care facility needs clarity and hierarchy. Direct emergency access has to be provided for ambulances and individuals.
Walkways should be atleast 1.5m wide or 2.1m if designed for wheel chair. Raising of pathways, steps and right-angled corners should be avoided. Walkway slopes should not exceed 5% and cross slope should not be more than 2%. If slope is more than 1:20 then handrails should be provided.
The surface of pathways should be firm, smooth and non-reflecting. Rubberized paving materials are most suitable for healthcare facilities.

Site furniture – they are free standing elements on the site. It includes – bollards, benches, sunshades, pergolas, tables, chairs, planters, litter and recycling receptacles and outdoor charging stations.
When deciding outdoor furniture, aesthetics, durability, weather conditions and functionality have to be considered. Materials like synthetic resin, teak (lasts upto 50 years), aluminum (light weight and durable), wrought iron (heavy, historical outdoor furnishing material), steel (strong) can be used for outdoor furniture.

Art work – incorporation of works of art are beneficial to patients, visitors and staff. It enhances the physical and social environment. It can assist in establishing "landmarks" around the building in order to assist way finding.
It is preferable to use images of nature or subdued art. Abstract art can cause anxiety. One needs to be very careful when installing art work in psychiatry unit as it should evoke positive association and memories.

Water – the sight and sound of water creates sensory focal point. It attracts people of all ages and abilities. Hearing the sound of falling water, seeing fish in a pond or sunlight reflecting on water has soothing and calming effect and is rejuvenating for all.

Managing Policy and Maintenance in Healthcare Facilities

Outdoor landscape areas should be utilised to their full potential as resources [15]. Because it adds additional variation and support to the entire healthcare institution, landscaping is a crucial component of a therapeutic environment. Maintaining the outdoor area regularly is essential to guaranteeing its physical safety and maximising its therapeutic benefits. Compared to concrete landscape features like signage, paths, pergolas, etc., plants are more healthful and need more frequent upkeep. Properly cared for plant that features organic scents, hues, and textures benefits its users more. The requirement for chemical fertilisers can be reduced by using appropriate fertilisation techniques, companion planting, mulching, manual weeding, selective thinning, and ideal plant spacing.

CASE STUDY

Khoo Teck Puat Hospital (KTPH), Singapore, 2010 (RMJM Architects)

Khoo Teck Puat Hospital (TPH) in Singapore has 10,957 square feet of green space in addition to 590 general beds. In December 2017, this hospital received the Stephen R. Kellert Biophilic Design Award. The hospital's architecture is reminiscent of a tropical jungle, complete with a waterfall that empties into a verdant courtyard in the middle. The outdoor pavilion, flower boxes, and green roof of the hospital contribute to its lush surroundings. Windscreens on the façade aid in wind direction, which is beneficial for the hospital's public areas. It is right in the way of the sun. The hospital uses 33% less energy than comparable conventional hospitals [31].

Figure 1. Khoo Teck Puat Hospital (KTPH). Ref. [32]

The hospital resembles rainforests due to its lush vegetation, which takes up nearly four times the space of the natural world. The hospital's V-shaped design allowed skiers to start their journey on the nearby rainwater pool. The ill family can enjoy some natural surroundings thanks to the center's playground, which is shaped like a forest and has evergreen trees that reach the upper stories of the structure. According to architect Steven Kieran, the hospital serves as an example of the significant influence this strategy could have on enhancing health [33]. The parts that are blue and green make up about 18%. The local climate in this field was 2 °C colder than the areas right outside the hospital, based on post-occupation observations. Khoo Teck Puat is patient-friendly and provides a view of the lovely Yishun Pond Park. Fins encircling the walls direct the building's interior breezes, which come from the northeast. By deploying shade devices, sun-induced hazing can be avoided. The devices can guide light towards the ceiling, increasing brightness and conserving energy. Large fans in the hospital's common room are powered by solar panels mounted on the roof. By extracting cool air from the interior courtyards, the air conditioning system seeks to lower cooling demands [34]. To sum up, this hospital creates a healing atmosphere through the use of sensory-engaging strategies. Taking in views of lush vegetation, hearing the sound of water falling, and inhaling a variety of plant scents are a few examples.

David H. Koch Center at New York Presbyterian Hospital

The David H. Koch Centre at New York Presbyterian Hospital, designed by NBBJ, is a cutting-edge illustration of modern healthcare architecture. This New York City hospital combines state-of-the-art technology with biophilic design principles to create an environment that promotes staff well-being and patient rehabilitation. A few of its architectural features are expansive floor to ceiling windows that flood the space with natural light, rooftop gardens that offer peaceful green spaces, and indoor plant installations that improve air quality and reduce stress. The thoughtful positioning of the structure maximises views of the Hudson River, adding to the tranquil atmosphere. The design has been linked to improved patient outcomes, such as faster recovery periods, and it has also assisted in lowering healthcare workers' stress levels [44].

Benefits to Patients and Staff of KTPH

Therapeutic Environment: The KTPH features a central courtyard with a large waterfall, as well as a lot of greenery, including flower boxes, green roofs, and other biophilic design elements. It has been demonstrated that incorporating natural components generates a soothing and healing atmosphere that lowers tension and anxiety. By creating a more calming and encouraging environment, such a setting can have a noteworthy upshot on the recovery of patients. Additionally, the hospital's architecture has elements that regulate temperature, assisting in reducing the local temperature by 2°C in comparison to the surrounding surroundings. This control over temperature enhances the therapeutic experience by creating a more comfortable atmosphere for staff and patients alike.

Improved Air Quality: Air quality at KTPH is meticulously managed through various design elements, including windshields and shading devices that regulate airflow and sunlight. These features improve indoor air quality by reducing glare and ensuring a more pleasant visual and sensory environment. The extensive vegetation surrounding the hospital also plays a crucial role in filtering pollutants and increasing oxygen levels. This dual approach to air quality enhancement benefits both patients and staff by creating a healthier and more comfortable indoor environment.

Energy Efficiency: The hospital's design emphasizes sustainability, achieving a 33% reduction in energy consumption compared to traditional hospitals. This significant decrease in energy use not only contributes to a more environmentally sustainable operation but also supports cost-effectiveness. Indirectly, these energy savings can benefit patients and staff by ensuring that operational resources are utilized efficiently, potentially lowering costs and improving the overall operational conditions within the hospital.

Enhancing Well-being: The sensory appeal of KTPH's design is notable, with features that engage multiple senses—sight, sound, and smell. The green landscapes, soothing sounds of the waterfall, and the natural fragrance of plants all contribute to enhancing the emotional and psychological well-being of both patients & staff. Such a multi-sensory approach helps create a more pleasant and supportive environment, further contributing to overall well-being.

Patient-Centric Design: The patient-centric approach at KTPH focuses on creating a healing environment that supports recovery. The design incorporates features such as a forest-like playground and scenic views, all contributing to a more pleasant experience for patients and their families. This thoughtful integration of nature and design aims to improve patient satisfaction and support their healing process.

Benefits to Patients and Staff of David H. Koch Center at New York Presbyterian Hospital

Improved Recovery Times: The "David H. Koch Center at New York Presbyterian Hospital" is designed to maximize natural light, with expansive floor-to-ceiling windows that flood the interior with daylight. Natural light is linked to improved patient outcomes, including faster recovery times, as it helps regulate circadian rhythms and enhance mood. This design consideration plays a critical role in optimizing the recovery process for patients.

Enhanced Well-being: Indoor plant installations are a key feature of the Koch Center's design, contributing to improved air quality and reduced stress. The presence of indoor greenery creates a calming atmosphere that benefits both patients and staff. By fostering a more pleasant environment, these plants help to reduce stress levels and promote overall well-being.

Rooftop Gardens: The inclusion of rooftop gardens at the Koch Center provides serene spaces for relaxation and reflection. These green spaces offer patients, staff, and visitors an opportunity to unwind and escape the hospital environment. The tranquil atmosphere of the gardens can help reduce stress and enhance mental well-being, contributing positively to the hospital experience.

Strategic Positioning: The strategic design of the Koch Center includes maximizing scenic views of the Hudson River. These views contribute to the building's calming atmosphere, offering patients and staff a sense of tranquility and improved mood. Scenic vistas play a significant role in creating a more serene and pleasant environment.

Staff Well-being: The biophilic design principles employed at the Koch Center are not only beneficial to patients but also contribute to lower stress levels among healthcare providers. By improving the working environment, these design elements enhance job satisfaction and overall staff well-being, which can lead to better patient care and a more positive workplace atmosphere.

Air Quality and Comfort: The incorporation of indoor plants and strategic design elements at the Koch Center significantly improves air quality. This creates a healthier environment for both patients and staff, promoting comfort and well-being. The focus on air quality aligns with the overall goal of creating a supportive and pleasant environment within the hospital.

Both Khoo Teck Puat Hospital and the David H. Koch Center exemplify how thoughtful design that incorporates biophilic principles and advanced technologies can greatly enhance the well-being and recovery of patients, while also improving the working conditions for healthcare providers.

TABLE 1 Comparative analysis: Compare and contrast of case studies

Aspect	**(KTPH), Singapore**	**David H. Koch Center, New York Presbyterian Hospital, USA**
Design Philosophy	Biophilic design with extensive greenery and tropical jungle theme	Biophilic design integrating advanced technology and natural light
Architect	RMJM Architects	NBBJ
Key Features	- Green roofs - Flower boxes - Central waterfall - V-shaped building - Shading devices - Windshields - Solar panels	- Floor-to-ceiling windows - Rooftop gardens - Indoor plant installations - Scenic views of Hudson River
Energy Efficiency	33% reduction in energy consumption compared to traditional hospitals	Advanced technologies improve energy efficiency (specific percentage not detailed)

Impact on Patient Well-being	- Therapeutic environment - 2°C cooler local temperature - Reduced stress with sensory appeal	- Improved recovery times - Reduced stress from natural light and greenery
Impact on Staff Well-being	- Enhanced comfort - Improved air quality - Supportive working environment	- Lower stress levels - Improved job satisfaction - Enhanced work environment with natural light and green spaces
Innovations and Technologies	- Green roofs - Solar panels - Shading devices - Windshields - Natural cooling from design	- Expansive windows - Rooftop gardens - Indoor plants - Strategic positioning for scenic views
Patient-Centric Features	- Forest-like playground - Scenic views - Multi-sensory appeal	- Serene green spaces - Scenic views of Hudson River - Natural light integration
Lessons Learned	- Effective biophilic design - Significant energy savings - Multi-sensory therapeutic environment	- Natural light and greenery enhance recovery and well-being - Strategic design improves comfort and tranquility
Best Practices	- Integration of nature - Energy efficiency - Multi-sensory environment - Patient-centric design	- Maximizing natural light - Incorporating green spaces - Enhancing air quality - Strategic building positioning

CONCLUSION

Designers of therapeutic spaces that benefit all users can benefit greatly from a thorough grasp of the healing role those outdoor surroundings play in healthcare institutions. Incorporating therapeutic gardens that are specifically designed to meet the requirements of various patient groups, as well as scenic views, water features, and multisensory experiences, all contribute to a more secure and well-rounded experience. In addition to offering patients a healing atmosphere that improves their tolerance for medical treatments, these outdoor areas also assist guests in reducing the stress that comes with visiting the hospital. These areas help workers be more productive and satisfied with their jobs.

In metropolitan contexts, outdoor green spaces are especially important and advantageous for healthcare establishments. By providing a haven from the pressures of the medical setting, they enhance both mental and physical health results. According to the research, these landscape spaces' designs provide more than just aesthetic value; they are essential to the process of holistic healing.

To examine the best activities for outdoor areas, comprehend patient preferences related to gender, and address issues influencing outdoor space utilisation despite their availability, more research is necessary. This research highlights the therapeutic benefits of outdoor green spaces in the planning and design of healthcare facilities, supporting evidence-based design principles that give the creation of healing settings for all user's top priority.

REFERENCES

1. Cooper Marcus, C., 2007. Healing gardens in hospitals. Interdiscip. Des. Res. 1 (1), 1–27.
2. Oyesanya, T. O., & Bowers, B. (2017). Managing visitors during the hospital stay: The experience of family caregivers of patients with traumatic brain injury. Journal of family nursing, 23(2), 273-298.
3. Hartig, T., Cooper Marcus, C., 2006. Essay: healing gardens—places for nature in health care. Lancet 368, S36–S37.
4. Curtis, S., Gesler, W., Fabian, K., Francis, S., Priebe, S., 2007. Therapeutic landscapes in hospital design: a qualitative assessment by staff and service users of the design of a new mental health inpatient unit. Environ. Plan. C: Gov. Policy 25 (4), 591–610.
5. Detweiler, M.B., Warf, C., 2005. Dementia wander garden aids post cerebrovascular stroke restorative therapy: a case study. Altern. Therap. Health Med. 11 (4), 54–58.

6. Long, R., 2001. Healing by design: eight key considerations for building therapeutic environments. Health Facil. Manage. 14 (11), 20–22.
7. Mroczek, J., Mikitarian, G., Vieira, E.K., Rotarius, T., 2005. Hospital design and staff perceptions: an exploratory analysis. Health Care Manag. 24 (3), 233–244.
8. Schweitzer, M., Gilpin, L., Frampton, S., 2004. Healing spaces: elements of environmental design that make an impact on health. Toward optimal healing environments in health care: second American Samueli symposium, January 22–24, 2004. J. Altern. Complemen. Med. 10, S71–S83.
9. Tieman, J., 2001. Healing through nature. Hospitals cultivate medical, financial interest on-site gardens. Mod. Healthc. 31 (2), 34–35.
10. Zhao, Y., Mourshed, M., 2012. Design indicators for better accommodation environments in hospitals: inpatients' perceptions. Intelligent Buildings International 4 (4), 199–215.
11. Cervinka, R., Röderer, K., Hämmerle, I., 2014. Evaluation of hospital gardens and implications for design: benefits from environmental psychology for architecture and landscape planning. J. Archit. Plan. Res. 31 (1), 43–56.
12. Vittori, G., 2011. Greening of healthcare. Location and design of facilities are essential to the mission of health. Mod. Healthc.(Suppl. 42).
13. Ulrich, R., 2002. Health benefits of gardens in hospitals. In: Paper Presented to Plants for People: International Exhibition Floriade. Holland.
14. Dejana Nedučin, Milena Krklješ, Nađa Kurtović-Folić. (2010). Hospital outdoor spaces - therapeutic benefits and design considerations. FACTA UNIVERSITATIS Series: Architecture and Civil Engineering, 8(3), 293-305.
15. Epstein, M. (2006). Hospital gardens help patients heal. Seattle Daily Journal of Health Care Design & Construction, 11.
16. Gökçen Firdevs Yücel. (2013). Hospital outdoor landscape design. In Advances in Landscape Architecture. INTECH.
17. Htin, C., McMahon-Moughtin, K., & Signoretta, P. (2009). Urban Design - Health and the Therapeutic Environment. Architectural Press, Elsevier Ltd.
18. Kaplan, R. (1992). The psychological benefits of nearby nature. In D. Relf (Ed.), Role of Horticulture in Human Well-being and Social Development: A National Symposium. Timber Press.
19. Kaplan, R. (2001). The nature of the view from home: Psychological benefits. Environment and Behavior, 33, 507-542.
20. Marcus, C. C., & Barnes, M. (1995). Gardens in healthcare facilities: Uses, therapeutic benefits, and design recommendations. The Center for Health Design.
21. Marcus, C., & Barnes, M. (1999). Healing Gardens: Therapeutic Benefits and Design Recommendations. John Wiley & Sons.
22. Marcus, Clare Cooper. (2000). Gardens and Health. International Academy for Design and Health (IADH).
23. Moore, R. C., & Marcus, C. C. (2008). Healthy planet, healthy children: Designing nature into the daily spaces of children. Journal of Landscape Architecture, 3(1), 34-41.
24. Parsons, R. (1991). The potential influences of environmental perception on human health. Journal of Environmental Psychology, 11, 1-23.
25. Smith, J. (2007). Health and nature: The influence of nature on design of the environment of care. The Center for Health Design. Retrieved from http://www.healthdesign.org/chd/research/health-and-nature-influence-nature-designenvironment-car
26. Ulrich, R. S. (1991). Effects of interior design on wellness: Theory and recent scientific research. Journal of Healthcare Design, 3, 97-109.
27. Ulrich, R. S. (2000). Evidence based environmental design for improving medical outcomes. In Proceedings of the Healing by Design: Building for Health Care in the 21st Century Conference. Montreal, Quebec, Canada, March 1-10.
28. Ulrich, R. S. (1999). Effects of gardens on health outcomes: Theory and research. In C. Cooper-Marcus & M. Barnes (Eds.), Healing Gardens: Therapeutic Benefits and Design Recommendations (pp. 27-86). John Wiley & Sons.
29. Wikipedia contributors. (n.d.). Setback (land use). In Wikipedia, The Free Encyclopedia. Retrieved from https://en.wikipedia.org/wiki/Setback_(land_use)
30. The Free Dictionary. (n.d.). Courtyard. Retrieved from https://www.thefreedictionary.com/courtyard
31. Neal, G., (2018). A New Remedy: Introducing Biophilic Design into Hospitals. Retrieved from http://hconews.com/2018/01/31/a-new-remedyintroducing-biophilic-design-into-hospitals/
32. Nestor, C., (2017). Ostra Hospital, Psychiatric Facility. Östra Hospital, White Architects, Göteborg, Swedenc, Terrapin Bright Green.
33. Walker, D., (2017). Two New Biophilic Design Case Studies. Retrieved from https://www.terrapinbrightgreen.com/blog/2017/12/two-newbiophilic-design-case-studies/
34. Fromm, E., (1973), the Anatomy of Human Destructiveness, Holt, Rinehart and Winston, New York.

35. Ulrich, R. S. (1981). Natural versus urban scenes: Some psychophysiological effects. Environment and Behavior, 13: 523-556.
36. Hartig, T. (1991). Testing restorative environments theory. Unpublished doctoral dissertation, Program in Social Ecology, University of California, Irvine.
37. Nakamura, R. and E. Fujii (1990). Studies of the characteristics of the electroencephalogram when observing potted plants: Pelargonium hortorum "Sprinter Red" and Begonia evansiana. Technical Bulletin of the Faculty of Horticulture of Chiba University, 43: 177-183. (In Japanese with English summary)
38. Nakamura, R. and E. Fujii (1992). A comparative study of the characteristics of the electroencephalogram when observing a hedge and a concrete block fence. Journal of the Japanese Institute of Landscape Architects, 55: 139-144. (In Japanese with English summary.)
39. Ulrich, R. S. (2002). Communicating with the healthcare community about plant benefits. In C. Shoemaker (Ed.) Proceedings of the Sixth International People Plant Symposium. Chicago: Chicago Botanic Garden.
40. Whitehouse, S., Varni, J. W., Seid, M., Cooper-Marcus, C., Ensberg, M. J., Jacobs, J. J. and R. S. Mehlenbeck (2001). Evaluating a children's hospital garden environment: Utilization and consumer satisfaction. Journal of Environmental Psychology, 21: 301314.
41. Sadler, B. (2001). Design to Compete in Managed Healthcare. Facilities Design & Management (March).
42. Cooper-Marcus, C. and M. Barnes (1995). Gardens in Healthcare Facilities: Uses, Therapeutic Benefits, and Design Recommendations. Martinez, CA: The Center for Health Design.
43. Cooper-Marcus, C. and M. Barnes (1999). Healing Gardens: Therapeutic Benefits and Design Recommendations. New York: John Wiley.
44. NBBJ. (n.d.). David H. Koch Center at New York Presbyterian Hospital.