Chapter 15

Hospital Outdoor Landscape Design

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Additional information is available at the end of the chapter

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1. Introduction

Among public institutions, the large buildings and complicated intervening and surrounding areas of hospitals usually tend to be seen by the public as removed from the urban context, as spaces to be feared, which one only accesses in emergencies or out of necessity. However, this psychological perception of their distance and separation can be decreased by today's more hospitable approaches to their content and design [1].

With a growing understanding of the importance of the physical environment for the quality of hospital care and the health and safety of patients and staff, the outdoor spaces of hospitals are beginning to be considered, particularly in scenic and more green areas, as a productive complement to the interior areas which are reserved for patient treatment and have traditionally been prioritized.

As a result of this new, holistic approach to medicine which entails alleviating the fears and disorientation of patients that may hinder medical treatment, the hospital has come to be seen today as a necessarily comforting and stress-free environment, created with a broader, patient-oriented sense that encompasses both master planning and landscaping [2].

This means that the outdoor as well as the indoor spaces of hospitals are understood as crucial to patients' physical, psychological and social recuperation and wellness [1, 3, 4, 5, 6]: appropriately designed active and passive hospital landscapes enhance patients' interaction with nature and so reduce stress, facilitating interaction with others in ways compatible with and complementary to those found in the urban environment [7, 4].

1.1. Benefits of natural environments within hospitals

Physical benefits

Research shows that rehabilitative structures and procedures enhance both the physical endurance and the physical well-being of patients. Interaction with a natural environment

has a positive effect on patients' feeling of well-being, which in turn has a salutary effect on their physical health. In addition to anecdotal evidence, there are theoretical and practical studies illustrating the positive effects of interaction with nature on blood pressure, cholesterol levels and stress-reduction [8, 9, 10, 11, 12]: a study by Robert Ulrich concluded that patients recovering from operations were discharged earlier, took fewer analgesics and were evaluated less negatively by nurses when they had windows in their rooms overlooking nature, compared to patients in similar rooms facing brick walls [7, 13]; and a study of the home environment similarly found that a living context with windows overlooking a natural scene produced "micro-restorative experiences" that enhanced a sense of well-being, as against a context with views of built elements [9].

Psychological benefits

Being able to choose between having privacy and interacting socially may assist in the process of recovery of patients, for most of whom the rigid regulation of time and activity in the hospital can have negative psychological effects, such as loss of self-esteem or the feeling of control, and a resulting increase in stress.

Research shows that high blood pressure and heart activity caused by stress can be decreased if patients are exposed to natural scenes, because such scenes engage them, draw their focus away from themselves and disturbing thoughts, and so contribute to their recovery [5, 14, 8]. Research conducted in London by the Bow Centre has used flower and cutting gardens for horticultural therapy; patients are overwhelmingly in favor of well-designed hospital landscapes, because of their positive psychological effects and the chance to pass time there [15].

Social benefits

Everyone, regardless of age or ailment, needs recreation and social support; participation in social activities may also be the only means of family and community interaction and integration, and of sharing similar experiences, for the physically disabled. Studies have shown that patients with strong social support networks typically experience less stress and better health, as well as better recovery and survival rates for various conditions, than those who are isolated [8]. Social support improves immune functions and moods, and results in better compliance with treatment [16].

Natural environments in health care facilities contribute to social integration by providing spaces for social interaction and support; evidence indicates that they significantly help increase access to social support for patients, families, and staff [3].

2. Outdoor hospital spaces

2.1. Typology of outdoor spaces in hospitals

2.1.1. Landscaped grounds

Green areas between buildings, primarily used for waiting and eating in, link the architecture with walking paths; however, they may be expensive to maintain.

2.1.2. Landscaped setbacks

These are usually planted areas in front of the main entrance, which are visually pleasant and serve to separate the hospital building from the street.

2.1.3. Front porches

These may include overhangs or porch roofs, an area where vehicles can pick up or drop off passengers, sitting areas, signs with directions, a mailbox, telephone booth, bus stop, etc.

2.1.4. Entry gardens

These are visually pleasant green spaces designed like gardens and located near hospital entrances.

2.1.5. Courtyards

Courtyards are the central and most often used spaces in a hospital building complex, because of their proximity to the dining area; they tend to be used more by visitors and patients if they are easily visible, and should be sufficiently large to prevent overcrowding [1]. Courtyard features may include landscaped tree-shaded areas, water features, flowerbeds and moveable seats; for reasons of privacy and security as well as aesthetics, they may be fenced around (especially if designed for care of the mentally ill) up to a height of 4.27m [17].

2.1.6. Plazas

These outdoor areas, which are typically paved and furnished, should allow easy access to wheelchairs, walkers and crutches. They should include shade from flowering trees or spreading evergreens, and at least a quarter of the trees should be above the minimum specified size. A plaza should have shaded seating areas decorated with plants, colored shrubs and ground cover, and perhaps a water feature. Because these areas are largely paved, landscaping and gardening maintenance costs are low.

2.1.7. Roof terraces

A roof terrace is usually a long, narrow balcony occupying one side of the roof of a hospital building. The elements it is comprised of (plants and seating) and the surface finish are designed to minimize observation from from higher buildings overlooking it. Roof terraces are sometimes too exposed to wind, heat or shade, and for this reason care must be taken in selecting their location [3].

2.1.8. Roof gardens

Gardens located on roofs are visually attractive, enabling patients to look out from their rooms and have a comforting view of grass, paving stones, benches and people, rather than

roofing material or medical equipment. Depending on how much planting material is used and to what depth, green roofs generally weigh between 6.82kg and 22.73kg per square foot. They are a practical and sustainable way of regulating the quantity and speed of run-off, as they retain 70-90% of the rainwater that falls on them in the summer, and 35-40% of the precipitation in winter [18]. Roof gardens enable major energy savings that will more than compensate, in time, for the costs of building, structure, waterproofing, and landscape maintenance; and they also minimize the environmental impact of a health care facility.

2.1.9. Healing gardens

Gardens which serve as safe and meditative environments for healing and recuperation date back to the medieval period, and have traditionally been features of hospitals, hospices, rehabilitation centers, and nursing homes [19]. The wide range of activities related to healing gardens may be passive or active: looking at the garden from a window, sitting, eating reading, doing paperwork or taking a nap in the garden, prayer and meditation, walking to a preferred spot, gardening, exercise and sports, and children's play [20]. The gardens are conducive to stress relief, relieving physical symptoms, and enhancing the feeling of well-being of hospital staff and patients.

Successful healing gardens make use of certain fundamental design principles [21]:

Enhance feelings of control: People should be aware that there is a garden and be able to find, enter and use its space. The garden should have private areas which cannot be seen from overlooking windows, and different kinds of spaces so users can feel they are making choices; if users are also consulted in designing the garden, this will also add to their feeling of control. All or some of the five senses can be chosen as focal stimuli in the garden's construction [22].

Have a prevalence of green material and areas: Patients' sense of well-being is enhanced by soft landscapes, so plant material should be dominant and hardscaping reduced to a minimum: trees, shrubs and flowers should make up about 70% of the garden, with 30% in walkways and plazas [23].

Encourage exercise: Designs should provide easy access and independence, as well as stress-reducing structural elements such as walking paths for patients to encourage exercise, and play areas for children [24].

Provide positive distractions: Stress levels among patients have been shown to decrease when they are in the presence of plants, flowers, and water features as well as when they are engaged in gardening. In the Child and Adolescent Mental Health Unit at Great Ormond Street Hospital, growing vegetables has been seen to have therapeutic value for young people with eating disorders; and, as mentioned earlier, flower and cutting gardens are being utilized for horticultural therapy at London's Bow Centre [25].

Minimize intrusions: Gardens should be designed to minimize negative factors like urban noise, smoke, and artificial lighting, in favor of natural lighting and sounds. Gardens that

appeal to the different senses are ideal (although strongly scented flowers and other scents should be avoided for chemotherapy patients) [23].

Minimize ambiguity: Complex or mysterious settings that provide a challenge might be of interest to the healthy, but research shows show that abstract design may be contra-indicated for patients who are ill or undergoing stress. For this reason, the use of abstract art may be unsuitable, and design should focus on clearly identifiable elements.

2.1.10. Meditation gardens

This type of small, enclosed, quiet garden is designed with a central focal point to help patients (often a single patient at any given time, depending on the size) concentrate and relax as part of the healing process. It is a space for quiet contemplation, removed from distractions and private – that is, not visible from other indoor spaces. Meditation gardens are labeled as such and purpose-designed, and their layout is usually simple and minimalist, comprising, for example, a circle representing life, a square symbolizing order, or symbols such as the Celtic knot, which represents travel [3]. They usually have a lawn and/or a comfortable seating area with a focal point, typically a water feature, to encourage meditation. The vegetation should provide cool colors such as violets, blues and greens, rather than bright, warm or contrasting colors [26].

2.1.11. Viewing gardens

Some health care facilities with limited space and budgets feature a small, enclosed garden that can be seen but not entered. Such gardens cost little to maintain, provide some green space, flowers, perhaps a water feature, and they can be seen from sheltered indoor seating areas; however, the elements of nature they provide are removed from the senses, as they cannot be approached smelled, heard or touched.

2.1.12. The viewing/walk-in garden

In this variation on a viewing garden, the green space can actually be entered from a corridor or waiting room: because it has limited space and seating, it remains a quiet area which does not disturb the privacy of any nearby rooms or offices, and also provides a comforting view for people waiting or passing by in the corridor. The main disadvantage is that people using the space may feel a lack of privacy, as they can be watched by others [3].

2.1.13. Edible gardens

A healing garden can be developed to a new dimension if herbs, fruit plants and vegetables are grown together with the usual planted vegetation in an easily accessible space. This "edible garden" should be simple and balanced, but designed in a repeating pattern with wandering paths demarcating public and private spaces [27]. The vegetation would favor annuals over perennials; and the garden could feature a large number and variety of plants, such as, for example, Nasturtium spp., the flowers of which are beautiful and can also be eaten.

2.2. User groups

2.2.1. Patients

The health-care environment should be designed taking into account patients' psychological as well as physical needs, disabilities, and duration of stay [28]; long-term inpatients or outpatients will have more varied requirements than short-term ones, and their holistic treatment will be enhanced by access to gardens, sheltered outdoor plazas, common social areas, and reading resource areas [29]. In addition, patients undergoing different kinds of treatment may use these areas for different purposes: for example, othopedics patients may need to use walking aids in the gardens; facilities for seniors may need handrails and more shaded areas; physical therapy patients may need to tend to plants at different heights; and psychiatric patients may need "memory cues" and planted areas which minimize the risk of injury.

2.2.2. Visitors

A supportive and distractive environment is also essential for people visiting friends or relatives in the health-care facility, because while visiting patients can be salutary, it may also be emotionally draining [30].

2.2.3. Staff

Outdoor spaces are especially important for health-care staff, who spend most of their time in the facility, and need designated and accessible areas removed from their daily activities, where they can wander, collect themselves, and adjust to the stress of their work [31]. While administrative staff tend to have the most free time to use outdoor spaces, as they typically have a one-hour lunch and regular breaks [1], nurses are the staff who have to keep patients constantly in view and help them go outdoors. However, nurses generally do not have time to stay with patients outside, and cannot leave them alone, so their responsibilities, as well as the distances from nursing stations to the outdoor spaces, have a negative effect on the use of these spaces by both patients and nurses.

3. Outdoor design criteria for hospitals

When creating a garden for a health-care facility, the focus should be on location, accessibility, patients' requirements and preferences, and the design elements to be included [32]. The garden should have opportunities for mobility and exercise, present a choice between social and solitary spaces, and facilitate beneficial distraction and direct or indirect interaction with nature [8].

Accessibility

This is an essential requirement, both within the hospital and in its environment. Gardens may be designed and set up attractively, but people need to be aware that they exist, that they are easily accessible through entrances and paths and useable regardless of people's

age or disability, and that they facilitate certain activities. Within the garden, visitors follow internal circulation routes, typically between walls, but occasionally crossing open spaces. Paths help people to find their way in hospitals, and differentiating them can help patients and visitors find their way [33].

Visibility

The more a garden is visible and people are aware of it, the more its activity areas and paths will be preferred. At least one outdoor space should be visible or its location clearly indicated from the main entrance [34]. Patients' rooms should have views of the garden so they can enjoy it even if they are unable to visit it [35].

Feeling of Control

Research shows that a feeling of lack of control can lead to or aggravate depression, passivity, elevated blood pressure, and decreased immune system operation [9]. A sense of control in the garden can be enhanced by getting users involved in its design; and different types of spaces and layouts can enable them to make their own choices – for example, a variety of pathways, of types of nooks where they can sit, of furniture (if some is moveable), or of views, ranging from close to distant [36].

Feeling of Security

Patients often feel both physically and psychologically vulnerable in hospitals, and a feeling of security should be provided. This includes sufficient lighting and public telephones in isolated areas so people can call for help, and other facilities and design elements in the garden that make them feel safe. Broadly speaking, there should be a feeling of enclosure but without the feeling that one is being watched. Features should include handrails and seating at frequent intervals, particularly near the entrance, to assist the elderly, the disabled or mobility-impaired, and an avoidance of paving materials like asphalt that reflect a strong glare [5].

Physiological comfort

As hospital patients are often sensitive to temperature (burn patients, for example, generally have to keep out of direct sunlight), options such as sunny and shady areas should be provided [8], as well as seating shielded from breeze by plants or structures. Various medications require patients taking them to avoid sunlight; some patients might be afraid of catching a chill if they go outdoors. Others patients have trouble getting up on their feet, so the garden should have garden seats with arms and backs, and also benches one can sprawl or lie on.

Quiet

Research on four hospital gardens showed that users were disturbed by sounds of machines like air conditioners and traffic noise; areas to be used as garden spaces should be planned in advance, away from traffic, parking areas, delivery driveways, and helicopter landing pads [20]. A garden designed for therapeutic purposes should be quiet and removed from

sounds inside the hospital, which range from public announcements, to television sets to catering trolleys and gurneys; visitors to the garden should feel calm, and be able to hear reassuring sounds such as birdsong, wind chimes, or flowing water.

Familiarity

Hospitals may cause stress for patients and their families, as they are unfamiliar environments, and they can be made more comforting and familiar if they include aspects of nature [37]. People working in hospitals similarly experience stress, and need to have access to familiar and relaxing garden settings. The aesthetic of the health-care environment should therefore be based on this fundamental need and provide spaces on a human or domestic scale as well as familiar-looking plants and furniture; this is particularly important in facilities for Alzheimer's patients and the terminally ill.

Flexibility

Exterior spaces should attract people, invite them in and engage them; they should be designed based on when (i.e. at what times and in what weather conditions) by whom (i.e. what groups), and how they are currently used (for example, for a lunch break, exercise, or socializing), and also on how their usage may be shaped in the future. To maintain interest and year-round interaction, for instance, they should be studied to see how they are used in different seasons, and then designed with different seasonal blooms and colors and different weather conditions taken into account.

Sustainability

Resources should be allocated intelligently when designing outdoor spaces: every material used does not have to be green, and some hard surfaces like concrete can help prevent storm water run-off. Wild grasses and Sedum spp. create ground cover which reduces domestic grass, decreasing the cost of maintaining lawns. Xeriscaping (designing with low water-use plants) together with native vegetation also helps reduce water use and maintenance. Nature trails enable users to have exercise, education and a natural aesthetic at a minimal cost; and solar-powered lights and water features that recycle rainwater can also be cost-effective and sustainable.

3.1. Hard landscape design

3.1.1. Gateways and entrances

Gateways and entrances welcome people on arrival and provide cues for them to find their way around the site; they can perform this function if a comprehensive network of connecting paths is planned, specified, and followed up to ensure they are properly constructed [25]. The main entrance should be accessed logically by the most direct path, and the entry way to the outdoor space should have no ramps or steps [1]. Landscaping, artwork and detailing can prioritize the main access points and create a sense of place, and benches should be available for people arriving or waiting for rides to sit on [38]. Entrances must be sufficiently wide to accommodate people with special mobility requirements; for

the visually impaired, different kinds of surfacing materials can be helpful, and tactile elements should indicate thresholds [39].

3.1.2. Parking areas

Parking areas should be sufficient to accommodate staff and employees, and parking should ideally be reserved for staff at the back of the hospital so they do not have to deal with heavy traffic when they come to work [40]. Parking for patients, especially those with disabilities should be as close as possible to the entrance [6]. Patients and visitors unfamiliar with the hospital may easily be confused if parking space is difficult to find; this can be solved by using directional signs that can be altered or moved as conditions change [41].

3.1.3. Paths

Large hospital or medical complexes should be organized within a clear circulation hierarchy: main roads, shopping streets, neighborhood streets and service alleys. Each of these, as well as intersections and destinations, should be indicated by a consistent system of spatial cues [33]. This circulation in the health-care facility should be independent of public roadways, and public (nonsecured) and private (secured) zones should be distinct, preferably with patient intake and outdoor recreational areas in the private zone. Traffic circulation should be organized so that individuals and ambulances can directly access emergency facilities [29].

The main circulation routes should be clearly indicated, for example by giving easily understood names to the main corridors like “Hospital Street” or “Blue Corridor” (here the walls and floor should be predominantly blue in color); or having colored lines along the walls or floor to designate main routes; or using lighting along a route [42]. Primary routes should be accessible to everyone; however, some people will prefer to experience the natural environment unmodified and will not expect easy access everywhere [25].

Minor walkways should be at least 1.5m wide, with drainage that will get rid of rainwater quickly. One-way traffic routes should be at least 1.5m wide to allow for the turning circle of a wheelchair; while two-way traffic routes should be at least 2.1m wide. There is a risk of tripping if the edges of a path are raised [26]; and handrails or balustrades and wheelchair barriers will preclude people’s falling where surface levels change, or from entering uneven ground beside paths and paved areas.

In the garden, clear links with different facilities and direct routes are essential. Right-angled corners in paths should be avoided, and slopes designed as follows: a walkway’s slope should not exceed 5% (i.e. 30.48cm of rise for a length of 6.1m); cross slopes should not exceed 2% (30.48cm of rise for a length of 15.24m). Where the slope does exceed 1/20, there should be a support railing to preclude slipping. The surfaces of paths should be firm, smooth and level, and provide traction; they should reflect the context, with “softer” materials used for informal settings. Paving surfaces should be smooth enough to be used by wheelchairs and gurneys [3]; but grooved paving may be unsuitable for them. Different

materials have different pros and cons: concrete is suitable, but costly; asphalt absorbs and radiates heat, and may be too hot in the summer; decomposed granite may be suitable for wheelchairs, but is not for users of crutches. More recently developed rubberized paving materials are firm enough to support wheelchairs, and also absorb the force of a fall.

Outdoor areas should be designed so they can be used throughout the year; snow- or ice-melting devices should be in place for walkways during the winter.

3.1.4. Children's gardens

Children are usually discouraged from moving around in hospital environments lest they disturb the health-care workers or patients; there should be spaces set apart for them where they can move as freely as they need or wish to [43], as they need to engage in imaginative play regardless of the condition of their health. Children need to feel they can create and make changes by interacting with their environment and moving objects and parts; as a result, flexible play areas should be designed to stimulate their imaginations [44] and give them the pleasure and therapeutic benefit of creative activity.

A children's area might, in addition to using primary colors and providing climbing structures, include a path maze, a chalkboard masonry wall, child-sized sculptures, or a miniature bridge traversing a faux rock stream, which can also be crossed on stepping stones. Routes should be stable and made of surfaces like decomposed granite, asphalt, wooden boardwalk, resilient mats, and concrete, to resist slipping. There might be platforms so children in wheelchairs can safely move onto and off play structures; and sand play areas may be made available at different heights, so they can be used on the ground or from a wheelchair [45].

3.1.5. Dining areas

Because the dining area is used by more people than any other hospital area, there are more potential outdoor space users in it; having an outdoor space near the dining area is essential [1]. There should be tables in the space for eating, reading, and writing activities, and to serve as territorial markers, as people rarely intrude on a table that is being used. Shade and semiprivate group spaces can also be provided by umbrella tables with chairs.

3.1.6. Art

Artworks form part of the healing environment, and works of art in health-care facilities featuring images of nature have been linked with stress relief in diverse groups of people. In hospital spaces which can easily be accessed, artworks which create inviting, habitable spaces should be incorporated into the design.

The type of artwork used is also important; it should have what Niedenthal et al. (1994) describe as "emotional congruence", which means that when confronted with a collection of environmental stimuli, the viewer will tend to focus on the parts that correspond to his or

her emotional state. For example, abstract art might be seen as interesting by a relaxed person, but as frightening or threatening by a person in a state of anxiety [8]. As the hospital environment tends to increase stress, artworks, sculptures and other design elements should provide an unambiguously positive message; complex or abstract art is therefore not suitable for this kind of setting.

Appropriate artworks can create an engaging focal point for a hospital space. In terms of genre, Ulrich has shown that postoperative patients preferred representational pictures, which tend to incorporate the subdued colors of nature, as opposed to abstract art, which often features unexpected color combinations; another study found that people in a state of anxiety prefer less saturated colors [46]. The artworks should therefore be selected with these effects in mind.

3.1.7. Water

Hearing water running in a fountain, or seeing fish in a pond or sunlight reflecting on water, can be meaningful for a patient [44]; the sound of running water in particular can mask other noises which negatively affect the therapeutic value of a space. Such sights and sounds create sensory focal points for garden spaces which attract all ages and abilities.

Water should be available, close to the garden site, and in a paved area to prevent muddying. The spigot should be 61-91.5cm above ground, and hand levers (not round spigot handles) and snap connectors should be used. Soaker hoses and mulch can decrease the water requirements of the garden. “Bubble” fountains may be appropriate, as they are tactile and make use of shallow water, raising fewer health and safety issues.

3.1.8. Site furniture

This term refers to free-standing elements such as seating, litter bins, lighting and signs, which should be selected to meet the needs of users. Furniture should be anchored to concrete pads or too heavy to be moved, and in cases where there is a risk of users running away, it should not be placed near fences or walls [32].

3.1.8.1. Seating

Seating should be available where people would actually want to use it, typically enclosed and towards the back, facing an attractive view or focal point, and not obstructing people on the path. Comfortable, movable, and varied seating can increase usage of the garden, especially by hospital staff; there should be benches and chairs for individuals, and more social seating arrangements for groups [38]. Social seating arrangements (right-angled or centripetal benches, or movable chairs) should be conveniently located near the garden entrance, where they are most likely to be used by staff for short breaks [3]. In addition to semiprivate areas there should be some benches arranged in a line rather than in a group, facing a view or circulation area.

Benches are usually situated at rest places or corridors with an exterior view [44]. Space should be left beside a seat to accommodate a wheelchair or electric scooter. Raised features can help wheelchair users and people who cannot easily bend down, and should attract others as well, for example if the edge can serve as an informal seat. The thinnest construction materials should be used as long as they are stable, to increase the area of the garden: seating ledges should be 20-45cm wide, and the sides may range from 45cm high for a child, to 60cm for a visitor sitting by a bed, to 75cm or more for those who cannot bend easily.

Seats can be artworks in themselves. The material used should not retain heat or cold, so concrete, aluminium and steel should not be used: wood or hard plastic are preferable. Moveable chairs can be rearranged depending on the sun or shade, and to adjust the size of the seated group. In general, seats should have arm and back support, but their height and depth, as well as their supporting structure, will affect their usefulness to people with special needs, and this should be taken into consideration [25].

3.1.8.2. Signage

Being able to choose whether or not to follow or avoid a route that might have rough paths is essential; appropriate, approachable and welcoming signs are a must. Site signage should indicate, among other things, directional or one-way traffic, restrictions, parking, deliveries, patient entry points, entrances to facilities, and so on [32]. Tactile signs should be fixed at a height of 150cm (120cm for children) [45]. Other sensory indictors, such as audible water features and wind chimes may also be used to assist wayfinding for the visually impaired in the garden.

3.1.8.3. Lighting

The primary purpose of lighting is to enhance safety and security. Exterior lighting deters thieves or vandals; while lights on stairs, walkways or approach roads both increase safety from attackers and help prevent accidental falls. Parking areas, entrance and service roads, and also isolated or dark areas need to be clearly defined and lit; bollards or bulkheads are usually used for this purpose. Lighting along pedestrian routes should be mounted at a height where faces can be seen and recognized, and any entrances, intersections or hazards such as changes in path level, should be indicated by beacons. An added therapeutical benefit of night-time lighting is that it enables safe use of the space at night, and viewing of the garden from indoors [3].

3.1.8.4. Receptacles

The locations of trash containers should be considered as an essential element of health-care facility planning, as they allow for easy disposal of food and paper products outdoors. The number of receptacles required depends on the population density and the activity level in an area, as well as how often they are emptied; overflowing litter bins indicate a need either for more of them or for more frequent service. There should be litter containers at all transition areas such as doors, building entries, parking access points and social and pedestrian spaces. To provide a less disturbing environment, receptacles should be placed at least 3.6m away from where people tend to socialize [38].

3.2. Planting design

As noted earlier, plants which require little water beyond the establishment period and can tolerate the urban environment and climate changes should take precedence in hospital garden planning. Other types of vegetation with varied densities should be used to connect greenways and wildlife corridors; and native vegetation should be mixed with compatible new plants in such a way as to sustain both. Native trees are particularly useful as they attract local wildlife: plant species that attract butterflies bring an atmosphere of gentleness; while additional features (fountains or birdbaths, a bird feeder, trees appropriate for roosting or nesting) may be used to attract birds, which stimulate the senses with their colors and sounds and raise people's morale.

A dark woodland environment might feel oppressive, so open, sunny glades and generous paths are preferable for the health-care environment: they help wild flowers to grow, and enhance the sensory aspects of nature [25]. Seasonally changing flowering trees, shrubs and perennials bring a comforting awareness of life's rhythms and cycles; and using vegetation that provides contrast and harmony through textures, forms, colors and arrangements draws people's attention and and focus away from themselves [8].

Large canopy trees create shade in summer and provide shelter in winter; they can help modify the local climate and reduce the air temperature. Trees with foliage that moves in the breeze attract the gaze to patterns of colors, shadows, light, and movement, providing a soothing and meditative experience [3]. In mental health facilities with high security, trees can soften and screen off the sight of security fences, and can also be planted in areas that patients can access under supervision. Shrubs should be trimmed to emphasize their natural form, so the space looks well cared for and sends the implied message that patients are also well cared for.

For all users of the garden, including the partially sighted, scented and brightly coloured flowers and leaves provide an attractive sensory experience. The olfactory sense is closely associated with memories and feelings, so scents can suddenly stimulate memories and responses, aiding those with memory loss. Sensory stimulation is particularly important for the visually impaired and for patients with reduced cognitive function, and this can be assisted by plants that are colorful throughout the year, are scented (e.g. Lavandula spp. and Echinacea spp.), and have tactile qualities (e.g. Festuca caesia). Fruit trees can be good for smaller spaces, and offer seasonal attractions.

The edible garden is a useful concept, particularly if the produce can be used in the facility's kitchens. Long-term residents will be able to experience the seasonal development of the garden, and patients in day centers will be able to participate in tending the garden at any time of the year; an activities program might focus on food-growing – for example, eating fruit crumble, or painting berries [25]. Planting an orchard also puts a site which is only available for a short time to good use.

Precautions should be taken in planting to ensure that there are no hazardous or thorny plants, especially in gardens for children or psychiatric patients, and also no plants that

drop slippery fruit or leaves that might constitute a hazard [39]. Low shrubs and dense, dark vegetated "walls" that obscure the view should not be planted near sidewalks; instead, these areas should be planted with year-round screens whose appearance is softened by varied deciduous plants and open spaces.

Elevated gardens can be designed for the use of patients in wheelchairs; here pots and planters should be raised to a height of at least 61cm and should be accessible from all sides if they exceed this depth. This kind of vertical garden can be used easily by both ambulatory and seated patients.

Raised planter boxes can be set up in some areas and looked after by patients in wheelchairs or on motorized scooters; this adds area to the garden at minimal cost. The width of the plant beds should be at most 1.5m if they can be accessed from all sides, or 0.75m if they are used from one side. More area can also be added to the raised bed through the use of structural extensions.

Table planters are shallow, soil-filled trays supported on legs. These raised planters, which are the same width as raised planters, need a height of about 70cm of free space below them (including knee clearance) to allow people to sit on chairs and tend them. The soil containers should be 20-25cm deep, so the total height of the structure is about 87.5-92.5cm, with the top of the planter no higher than the rib cage of the seated person [45].

3.3. Maintenance of hospital landscape areas

The site should be well manitained, for therapeutic as well as physical safety reasons [47]. In comparison with patio structures and spaces, shrubs, trees, and flowers are more difficult to maintain, but they provide the most therapeutic benefits. Suitable fertilizing, selective thinning rather than shearing, and the use of seasonal color are important factors conducive to the characteristics of the garden that users prefer [3]; hand weeding, mulching, companion planting, and the proper spacing of plants will decrease the the use of chemical fertilizers. In short, a poorly maintained environment offends their dignity and has a negative effect on the morale of patients.

4. Conclusion

While gardens had been used in the service of health care for centuries, modern medicine, beginning in the early 20th century, disregarded their therapeutic value [48]. In recent years, however, there has been a resurgence of interest in the contribution to healing provided by outdoor garden environments in healthcare facilities. The hours spent in a hospital can be stressful for patients, staff and visitors, and going out into a garden provides an escape; as one patient commented: "It's a good escape from what they put me through. I come out here between appointments... I feel much calmer, less stressed." [5].

Easy access to a natural environment can contribute to stress management and potentially improve health outcomes**:** physiological studies indicate that 3-5 minutes spent in such

environments reduces anger, anxiety and pain and induces relaxation. Research also shows that "positive distractions" can reduce stress [7, 4, 45, 49], and their visual forms include gardens, scenic views and artwork, which play a critical role in modern hospital design: gardens, fountains, fish tanks, rooftop gardens, and water features provide patients, staff and visitors with restorative experiences of nature. Sensory stimulation through design elements or atmospheric features like labyrinths and reflecting pools, seasonal vegetation that attracts birds, and found objects of art and other elements of surprise and delight, also contribute to positive distraction.

Green areas outside hospitals are today seen as both beneficial and necessary, and specialized gardens have now been designed to meet the needs of particular patient groups such as children, cancer patients, those undergoing rehabilitation, burn patients, the elderly and Alzheimer's patients, among others. In order to afford the greatest therapeutic benefits, the health-care garden should have a broad variety of vegetation, including seasonal flowering species, plants that attract small, safe fauna (birds, squirrels, butterflies), and leaves or grasses that move in the breeze. There should be views open to the sky and clouds, and if possible to the horizon; reflecting pools with fish or water lilies; and moving water features that can be seen and heard.

The benefits of gardens in health-care facilities may be limited by various factors. The first of these is lack of information on a garden's location, accessibility and purpose: hospital staff should be educated as to its purpose and users, and on how to make use of it in patient and family care; and continual feedback to staff from users is essential. To ensure that patients and their visitors are aware of the garden and can access it, colorful brochures with pictures, information, and maps should be distributed, and posters about it put up in frequented areas such as elevators [14]. Other limiting factors may include lack of sensitivity to patients' specific mobility needs; disturbing sensory stimuli (e.g. noise and allergic pollens); lack of facilities for competing user needs (such as the wish to smoke or the desire for fresh air); and ambiguous design elements [32].

It is vital that the garden be easily maintainable, to inspire confidence in patients that they are being well taken care of by the staff. Water-efficient, low-maintenance landscaping should be used, with water conservation achieved by managing storm water runoff in the site. Keeping up and using green spaces around hospitals lowers the costs associated with recovery and also contributes positively to patients' survival chances and quality of life during their stay. Hospitals should landscape and improve their existing green spaces, and then restructure their facilities and patient care practices to provide maximal interaction between patients, visitors, staff and these natural environments.

Today the requirements of some specific patient groups are being taken into account when planning and designing outdoor hospital spaces [36]; there is now a need for gardens to be designed for other patient groups, such as children with autism, cystic fibrosis or cerebral palsy; patients with schizophrenia or Parkinson's disease; and heart surgery patients.

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