

Advantages of greenery in hospital environment - a literature review

Sedina Kalender – Smajlović¹ and Mateja Dovjak*²

ABSTRACT

Background: Incorporating greenery into hospital environment contributes to the sustainable development goals by mitigating health, environmental and economic problems. Despite the increasing interest in plants, gardens and green roofs in general built environments, the benefits of greenery in hospital environment are still under-researched. The aim of this review was to summarize the relevant literature and describe the benefits of greenery in hospital environment.

Methods: The PubMed, Springer Link and CINAHL databases were searched to identify relevant studies and articles published between 2012 and 2023. The keywords used were hospitals, greenery, green systems, vegetation, and room plants. The language restriction was that articles were published in English.

Results: Following the PRISMA methodology, seven eligible studies were included in the literature review. Evidence shows that the presence of greenery affects patient health outcomes and the well-being of healthcare staff. Moreover, the healing and therapeutic effects greenery in the hospital environment have been identified. Greenery also has a positive psychological effect on healthcare workers and visitors. Humanizing healthcare spaces and connecting them with nature empowers patients, reduces stress and pain, and improves emotional well-being.

Conclusion: The biophilic design concept increases occupant connectivity to the natural environment through vegetation at the location, including implemented green building envelope systems (green walls and roofs) and the introduction of indoor plants. It should be incorporated into the established steps of hospital design. In summary, more research is needed, particularly on the potential impact of plants on hospital-acquired infections.

Keywords: Room plants; Hospitals; Vegetation; Green systems; Greenery; Plants

Literature Review article

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INTRODUCTION

A lot of space is lost in positioning buildings at location areas. »Camouflage architecture« is based on rationalization, where land is draped over the building envelope. Green building systems (i.e. green roofs, green walls and green building envelopes) are passive techniques that can be used to solve the problems of modern cities. Such an approach contributes to the sustainable development of an urban environment [1]. With the Industrial Revolution, urban space expanded much faster and with greater changes than in previous evolutionary periods.

The large areas that modern cities occupy, their structure, materials, and the general lack of vegetation have inevitably altered the climatic characteristics of urban spaces. These changes directly affect the local climate of urban areas, especially the central parts of cities, leading to a significant increase in urban temperature and other changes, known as the urban heat island effect [2].

Greenery contributes to sustainable development with environmental, economic and health benefits.

Greenery contributes to sustainable development with environmental, economic and health benefits. Environmental benefits include i. rainwater allocation and purification [3], ii. improvement of air quality, iii. sound insulation and improved acoustics [4], iii. reduction of the urban heat island effect [5], iv. increasing energy efficiency (on global, regional, and local levels) [6, 7], v. green roofs as a substitute for lost landscape areas [3] and natural habitat for animals and plants [8]. In addition to economic benefits in terms of lower renovation costs [2], lower energy costs [9,10], lower wastewater/meteoric water management costs and space use [3], several benefits of green systems are reflected in all health determinants. These include social, psychological and physical health. An experimental study on the effects of green roofs on the built environment [9] highlights the contribution of green roofs to the reduction of mortality and morbidity as a result of minimizing the harmful effects of excessive heat and air pollution in urban environments. The Green Roof Organisation [11] considers green roofs as elements of healthy cities and states that horticultural therapy leads to better recovery after surgery. Simonič and Dobrilovič [3] argue that recreational spaces improve health and aesthetics, socializing, and positively affect the indoor climate by increasing thermal comfort and occupant productivity as well as reducing sick building syndrome.

Several trial studies have revealed that observing nature or even images of nature scenes have beneficial effects on mood and mental health.

Plants and planted landscapes are known for their therapeutic benefits. Hospitals are increasingly adopting therapeutic landscapes such as healing gardens, horticultural therapy, and memory gardens [12]. In recent decades, human-plant research has increasingly focused on providing empirical evidence of the relationships between plants and health [13]. Several trial studies have revealed that observing nature or even images of nature scenes have beneficial effects on mood and mental health. A Japanese study [14] reports that looking at plants altered EEG recordings and reduced stress, anxiety, anger and sadness, and lowered blood pressure, pulse rate and muscle tension. Another Japanese study [15] found that looking at a green hedge was physiologically more beneficial than looking at a concrete fence.

Despite the increasing interest in green plants, gardens and green roofs, the benefits of greenery in the hospital environment are still under-researched. In the hospital setting, environmental factors and architectural layout should be emphasized as part of infection control measures, in addition to identifying patients at risk for hospital-acquired infections and following standard precautions to reduce transmission [16]. As noted by Gould et al. [17], there are frequent discussions on hygiene and infection risks associated with cut flowers introduced into the hospital environment. It has been reported that this practice is no longer allowed in many wards because the flowers are considered to be hygienically problematic, cause allergies, and harbour bacteria in the water that can cause infections. Based on these findings, this study aimed to summarise the relevant literature and describe the benefits of greenery in the hospital environment.

MATERIALS AND METHODS

The PubMed, Springer Link and CINAHL databases were searched to identify relevant studies and articles published in the last decade (2012-2023). The keywords used were hospitals, greenery, vegetation, green systems, outdoor plants and room plants. The language restriction was that the articles were published in English. Studies and review articles describing greenery were summarised. Literature selection was made as illustrated in Table 1.

RESULTS

The search results are shown in Figure 1. The systematic review included seven articles. An overview of the studies analyzed is shown in Table 2.

Table 1: Inclusion and exclusion criteria

	Inclusion criteria	Exclusion criteria
Language	<ul style="list-style-type: none"> English 	<ul style="list-style-type: none"> All others
Date of publishing	<ul style="list-style-type: none"> 2012 – 2023 	<ul style="list-style-type: none"> Before 2012
Article category	<ul style="list-style-type: none"> Original research Systematic review Review article 	<ul style="list-style-type: none"> Editorials Professional articles Letters
Keywords	<ul style="list-style-type: none"> Room plants and hospitals Vegetation, green systems, greenery, plants 	

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Natural elements in the hospital environment can reduce patients' feelings of stress.

Figure 1: Flow diagram

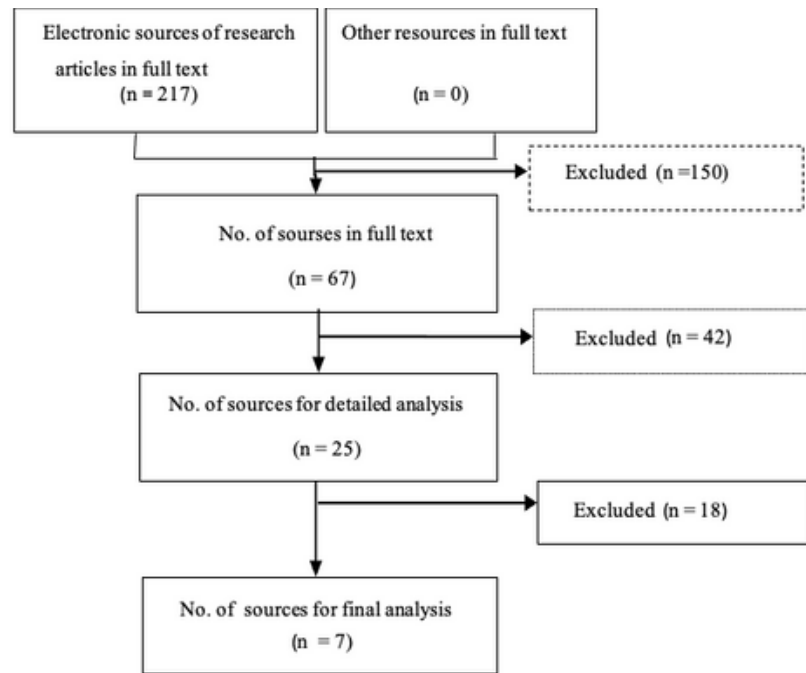


Table 2: Index of articles included in the final analysis

Authors, year	Aim	Type of study	Population	Country	Results
Kim, Ahn [18] (2021)	To investigate the role of green spaces in the immediate surroundings of a hospital on the incidence of asthma.	Cross-sectional study	Patients with asthma	California, United States of America	Findings suggest that creating dense or clustered tree patches and small-scale green spaces could substantially improve air quality and reduce asthma emergency room visits.
Beukeboom, Langeveld, Tanja-Dijkstra [19] (2012)	To investigate the effect of exposure to nature or artificial nature on reducing patients' stress.	Field research	N = 457 patients (60% women and 40% men) in two radiology waiting rooms	Netherland	Natural elements in the hospital environment can reduce patients' feelings of stress. The presence of greenery or posters of plants in waiting rooms creates a pleasant atmosphere that has a positive effect on patients' well-being.
Qi, Yan, Lau, Tao [20] (2021)	To investigate the impact of the hospital environment (paediatric clinic) on patients and relatives.	Case study	N = 195 persons	China	Optimizing the design of the waiting area in pediatric clinics, focusing on functional layout, flow organization, supporting facilities and environmental details, can improve overall satisfaction with pediatric waiting rooms.
Ali Khan, Amin, Khan, Imtiaz, Khan, Imran, Asad, Badshah [21] (2016)	To investigate the therapeutic horticultural impact of indoor plants and floral arrangements on health outcomes in surgical patients.	Case study	N = 270 patients	Pakistan	Plants and floral arrangements have an effect on shorter postoperative length of stay, lower analgesic intake, and lower pain intensity than a ward without greenery.
Raanaas, Patil, Hartig [22] (2012)	To study the effect of looking out of the window on the natural environment by patients in rehabilitation.	Longitudinal quasi-experiment	N = 288 patients	Norway	Looking out of the window at the natural environment helps improve physical and mental health. Differences were found according to gender and a diagnostic group of patients.
Korpela, De Bloom, Kinnunen [23] (2014)	To study the effects of houseplants and looking out of the window on recovery and restoration.	Literature review	N = 63 articles	Finland	In a hospital setting, the view on nature is important. Research reveals the therapeutic effects of natural environments that reduce stress. They focus on the effects of looking at or exercising in nature, the setting and effects of indoor plants and views on nature through windows.
Song, Ikei, Nara, Takayama, Miyazaki [24] (2018)	To examine the effects of viewing bonsai on autonomic nervous system activity, prefrontal cortex activity and subjective ratings of psychological relaxation in elderly patients undergoing rehabilitation.	Cross-sectional study	N = 14 participants	Japan	Viewing bonsai resulted in a significant increase in parasympathetic nervous system activity, a substantial decrease in sympathetic nervous system activity, and a significant increase in the feeling »comfortable and relaxed«.

DISCUSSION

This review has identified the advantages of greenery in a hospital setting. Interestingly, Kim and Ahn [18] used two spatial regression models to show that the associations between greenery (i.e. trees/green spaces) and asthma are highly significant. However, Ali Khan and colleagues [21] found that patients in a ward with greenery had more vigorous psychological moods regarding recovery from surgery and more positive emotions and feelings about their hospital stay. They also felt that atmosphere in the ward as more calming, pleasant and satisfying. In addition, focus group discussions with doctors and nurses in the ward confirmed the questionnaire findings that i) leafy plants and flower arrangements create a nurturing environment in the ward, ii) reduce patients' stress, iii) improve patients' health and mental state and iv) bring a pleasant atmosphere to the hospital environment. These findings confirm the therapeutic value of horticultural activities, especially for surgical patients in a stressful hospital environment. The study by Beukeboom, Langeveld, and Tanja-Dijkstra [19] also confirms that patients exposed to natural plants and those exposed to plant posters reported lower levels of stress compared with patients who had no greenery in the hospital environment. Further analyses showed that these small but significant effects of exposure to nature were partly mediated by the perceived waiting room functionality.

In the study by Qi, Yan, Lau, Tao [20] it was found that the waiting rooms in pediatric clinics currently do not meet the essential needs of patients in areas such as mother and infant rooms, children's play areas and drinking water facilities. There are widespread problems with creating natural environments, such as views on natural scenery out of the window and indoor green plants. Six factors were found to have significant positive impact on overall satisfaction with the waiting area, describing 69.7% of the changes in the respondents' level of satisfaction with the waiting environment. Interestingly, Raanaas, Patil, Hartig [22] also found that a blocked view appeared to negatively affect physical health change in women. In contrast, obstructed vision appeared to negatively affect mental health in men. Pulmonary patients with a panoramic view showed more significant improvement in mental health than coronary patients with such a view. Those who had a panoramic view of nature often chose to stay in their bedroom when they wanted to be alone than those who had an obstructed view. Song et al. [24] also found that viewing bonsai significantly increased parasympathetic neural activity and decreased sympathetic neural activity by physiological measurements. These results are partially consistent with the findings of previous studies on the effects of viewing leafy plants, fresh flowers and bonsai in a hospital setting [25].

Totaforti [26] argues that the global health challenges of the 21st century require a new way of thinking and a change in the organization of health services, with an approach that takes into account human needs in their entirety rather than in a strictly therapeutic sense. Numerous studies show that humanizing healthcare facilities and contact with nature can empower patients and have a positive impact by reducing stress and pain and improving emotional well-being. As healthcare facilities continue to move towards more sustainable business models, with a focus on energy efficiency and environmental care, the popularity of installing vegetative roofs is likely to increase [27].

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These findings confirm the therapeutic value of horticultural activities, especially for surgical patients in a stressful hospital environment.

Patients who viewed the green surface had fewer postoperative complications, required less pain medication and had a hospital stay that was almost 9 % shorter than those who viewed the brick wall.

The therapeutic garden is becoming increasingly popular as a non-pharmacological approach in the modern healthcare system.

Research has shown that while plants in the office seem to improve creative task solving, they interfere with simple tasks, such as proofreading or sorting, which require constant focus on the task at hand.

As has been pointed out in the past, the healing power of green spaces is a significant advantage of installing vegetated roofs in healthcare facilities. In a study [28] the recovery time of surgical patients looking out the window at a brick wall was compared with those looking at green areas. Patients who viewed the green surface had fewer postoperative complications, required less pain medication and had a hospital stay that was almost 9 % shorter than those who viewed the brick wall. As the Association of American Medical Colleges [29] notes, gardens also serve the purpose of expanding the healing environment by providing natural light, fresh air, space to move around and space for patients to exercise.

Howarth, Brett, Hardman, Maden [30] found highly positive effects of gardens and gardening on health, well-being and improved functional biometric outcomes based on a scoping review involving 77 studies. Interventions ranged from garden visits, gardening and therapeutic activities. Findings showed associations between gardens and improved mental well-being, increased physical activity and reduced social isolation. Perez, Alexander and Bailey [31] note that the appearance of plants is beneficial: their leaves remove toxins, dust and microorganisms from the air and produce the negative ions from their leaves. The overall evidence that charged ions affect mood is unconvincing, although their benefits are strongly promoted in advertising.

Thompson [32] notes that there is increasing evidence that exposure to plants and green spaces, particularly horticulture, is beneficial for mental and physical health and could reduce pressure on hospitals. Health professionals should therefore encourage their patients to use green spaces and work in gardens and should put pressure on local authorities to provide more open spaces and more trees, which would also help prevent air pollution and climate change. Therapeutic gardens have been used in hospitals for millennia and were strongly advocated by Florence Nightingale as they help improve the environment for patients, visitors and staff [33]. The therapeutic garden is becoming increasingly popular as a non-pharmacological approach in the modern healthcare system. It is a type of healing garden used primarily as a physical therapy or horticultural therapy programme, which may include both horticultural and non-horticultural activities. These activities are very helpful in treating patients, reducing stress in health care workers and patients, improving hospital outcomes, increasing work efficiency and reducing medical costs [34]. Korpela and colleagues [23] report that evidence shows that looking out the window at nature mitigates the negative effects of workplace stress; the more natural elements present, the lower the negative effects of workplace stress on intention to leave. A laboratory study that recorded brain waves and blood volume pulses found that people were less nervous or anxious when looking out of a window at nature than when looking out of a window at the city or no window. The amount of contact with nature during work breaks is also associated with less perceived stress and better self-rated health. Research has shown that while plants in the office seem to improve creative task solving, they interfere with simple tasks, such as proofreading or sorting, which require constant focus on the task at hand.

Geimer-Flanders [35] notes that complementary and alternative medical practices can be combined with evidence-based conventional medicine to promote an optimal healing environment and overall well-being for patients.

We emphasize the transition from therapeutic gardens as curative to sensory gardens with therapeutic elements that would address all sensory and motor systems according to universal design principles. This ensures health (physiological, social, psychological components), comfort and well-being.

The results of our study provide opportunities to implement biophilic concepts in the current design of the hospital environment [2, 36-38]. Specifically, the design of healthy hospitals should start from site characteristics, where strengths and weaknesses are defined. Advantages such as existing green areas, natural habitats and water (lakes, rivers) should be preserved, optimum insolation of the building should be ensured, and this should be linked to the building design. Disadvantages such as proximity to industry and busy roads with increased noise and pollutant emissions can be avoided by ensuring optimal building and room orientation, setbacks, and by incorporating natural green barriers. Potential excessive solar gain, and thus overheating of the building, can be regulated by selecting trees that block the sun's rays in summer and let them pass through in winter.

Climbing plants and pergolas can already be part of the active living shade on the building, as well as orientation of the building and active spaces towards the views of greenery outside, and incorporating green systems (green roof, green wall) into the envelope. These envelopes have numerous environmental, social, health and economic benefits. They also have a water collection and purification function. Parts of the building envelope functionally connect and extend to the external surfaces and form part of the healing garden. They integrate water and plants into the indoor environment, especially in common and communication areas. From a sanitary technical and hygienic point of view, closed transparent systems and indoor elements with vegetation can also be designed to let in direct light. All this becomes part of the bioclimatic design of buildings [2, 36-39].

CONCLUSION

To ensure the well-being of patients, healthcare staff and visitors in the hospital environment, there has been a growing stream of research addressing the impact of vegetation on patient health outcomes and the well-being of occupants. Based on the evidence-based approach, the healing and therapeutic effects of greenery in the hospital environment have been identified.

The recommend biophilic design concept increases occupant connectivity to the natural environment through: i. the use of on-site vegetation, ii. with implemented green building envelope systems (green walls and roofs), and iii) the introduction of indoor plants. The possible risks of plants should be considered to prevent health-related infections in the hospital environment.

JOURNALISM ETHICS CONSIDERATIONS

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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From a sanitary technical and hygienic point of view, closed transparent systems and indoor elements with vegetation can also be designed to let in direct light.

The possible risks of plants should be considered to prevent health-related infections in the hospital environment.

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CONFLICT OF INTEREST

The authors report no conflicts of interest. The manuscript has not been published and is not under consideration for publication elsewhere.

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