

R E V I E W

Green space in hospital built environment. A literature review about therapeutic gardens in acute care healthcare settings before Covid-19

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Abstract. *Background and aim:* Hospital facilities are one of the most stressful environments and there is evidence that during Covid-19 having outdoor and green spaces helped medical staff and nurses to decrease the stress and anxiety level. Nevertheless, knowledge about the type of green space is limited. The aim of the study is to systematize the existing scientific literature on the topic in a specific time period. *Methods:* Scopus, PubMed, and Cochrane library databases have been explored in a systematic way. Following the Prysma diagram and checklist 25 studies have been included. Descriptive statistics and content analysis have been performed to highlight green typologies, users and functional area involved, spatial focus, relationship between users and space and vegetation typology. The different topics have been clustered according to Kellert's biophilic framework. *Results:* Articles reviewed included studies from the 2000 to 2020. The selection led to the analysis of 25 documents mostly focused on patients (73%) and only partially on staff (15%) or family members (12%). Generic users are addressed but specific attention is devoted to pediatric (20%) or psychiatric (11%) patients. Hospital space is analyzed mainly at the environmental unit (39%) or functional area (30%) perspective. Different relationship between users and green spaces have been highlighted such as: indirect (wilderness), direct (healing gardens) or symbolic (representations). *Conclusions:* The present review highlights relevant characteristics of green space in hospital built environment with specific focus on pre-pandemic situation. (www.actabiomedica.it)

Key words: healing garden; hospital building; therapeutic green space; evidence based design

Introduction

Hospital facilities are one of the most stressful environments ever (1,2). Those who inhabit them experience a state of physical and emotional stress, with specific regards to patients, medical doctors and nurses (3–8). Covid-19 pandemic exacerbates this condition and new strategies need to be investigated (9).

Several scientific studies have demonstrated how much it is the physical environment itself that

influences this problem; and how, in this sense, the integrated design of green plays a fundamental role (10–12).

In this perspectives seminal works have been conducted with reference to the biophilic design theory developed by researcher Stephen Kellert with specific reference to interaction between nature, built environment and users in direct, indirect, or symbolic relationship (13,14). Direct experience involves contact with nature that requires prevalent human input to survive,

as in healing gardens and vegetable gardens. Indirect experience refers to relatively unstructured contact with self-sustaining features of the natural environment such as everyday light, plants, animals, natural habitats, and ecosystems. Included in this category is wilderness, gardens and plants, and flowering pots. Finally, symbolic experience does not involve actual contact with real nature, but rather the representation of the natural world through images, photographs, videos, metaphors, and more. In this case, synthetic plants and images. Based on those seminal works, over the years lot of interest on green space in healthcare architecture was reported by researchers, a considerable amount of studies attested how much the natural world has benefits for human well-being (15–20).

Starting from Ulrich's findings that showed that stressed individuals felt significantly better after exposure to nature scenes rather than to American urban scenes lacking nature elements (21), several studies investigated both visual and contact relationship between people and green space, with specific regards to healthcare facilities, a place with fragile users and stressed work environment. Restorative theories was also fundamental in understanding the benefits that natural environment have on users (22) and it has been shown that specific features of the green space (i.e. accessibility, quantity, etc.) have different impact on users wellbeing depending on context and age group (23–28).

Green space in urban settings is commonly recognized as a fundamental element for stress reduction, physical and mental health benefits and several systematic studies have been conducted in this direction with also policies implications both before and during Covid-19 (29–35).

Unfortunately, those aspects are still underexplored in the healthcare facilities research field where more attention is devoted to the functional aspects or the indoor environment.

The history of green healing has roots in ancient time but the awareness of the importance of green for health has faded with the arrival of modern architecture and the vision of a hospital as a machine for healing. Since the 80s, the benefits that can be derived from careful green design in hospitals have started to be highlighted (21). By the end of 1990s and during

the first decades of the 21st century, design has started to be more conscious about the role of outdoor and green spaces, although more systematic studies are needed. Research resumed the attention towards the natural component in the medical field, demonstrating the fundamental role of nature in the different health contexts, until the drafting of first design guidelines for therapeutic greenery (36,37).

Healing gardens is generally recognized as an evolving concept of designing green spaces with a healing intention. It has been defined as a variety of garden features that foster restoration from stress and have positive influences on patient, visitors, and staff or caregivers but also a space to look out at, and a space for passive or quasi passive activities such as observing, listening, strolling, sitting, exploring (17,38). Healing gardens design in healthcare architecture can have a pivotal role, but only if they fulfill the specific need of users. Meaningful is the example of healing gardens for patients with Dementia, this kind of space must follow certain requirements to not be harmful for patients (39–43).

Today, the experience of the Covid-19 pandemic raised even more awareness of the importance of the experience of nature; some studies have been conducted in healthcare settings to assess wellbeing of hospital staff (44–47) or reporting therapeutic garden program implementation and attention to the topic for both healthy, sick and fragile users (48,49). Despite the growing interest there is a lack of structured and systematic synthesis or validated checklists regarding the theme of green integrated in hospital design with specific attention to pre-pandemic era (36,50). Books and manuals are available but there is the need of systematize scientific articles that have been produced in the recent years, with an adequate reflection on the specific type of hospital environments or users.

In addition, what is often underlined in research is a lack of communication and training on the subject (51) confirming a gap between theory and practice: often those who design hospital green spaces are not aware of the implications of healing gardens research (52).

Therefore, the aim of this work is to systematically collect and review the studies that address the issue of green design in the acute care hospital

environments before Covid-19 pandemic period. This review is also intended to set the basis for further studies on the topic.

Materials and methods

Search question and key words identification

Within a PICO framework for literature reviews, the Research Questions that addressed this study were:

*Which setting and type of green has been mostly studied in scientific literature before Covid-19?
Which information does the research offer with respect to hospital therapeutic green design?*

From the research question three main topics were found: hospital design, therapeutic gardens, scientific evidence. From these contexts the key words have been extracted.

The key words defined were based on a three level framework based on the previously mentioned topics, to be adapted and merged according to the research of the different databases:

- i. the general setting to be referred as healthcare facilities: “hospital” OR “healthcare environment” OR “healthcare building” OR “healthcare facility” OR “hospital design”;
- ii. the specific setting to look at such as: “therapeutic garden” OR “healing garden” OR

“green space” OR “nature” OR “garden” OR “horticulture” OR “green”,

- iii. the research approach to be based on evidence or operative guidelines: “evidence based design” OR “Evidence based hospital design” OR “evidence based medicine” OR “guideline”

The search string used within the different databases are reported in Table 1

Additionally, it was only considered the time period from January 2000 were the first definition of Healing Garden was provided by Roger Ulrich and Clare Cooper Marcus, until March 2020, to avoid Covid-19 related topics.

A total of 585 records have been collected resulting in 500 after duplicates removal and first check of consistency.

SCREENING AND ELIGIBILITY

After exporting the results of the first search by keywords, titles, keywords and abstracts have been carefully reviewed one by one by M.D.P. and A.B. in order to discard out-of scope documents that were not excluded by the filter application in the selected databases. A third review was taken by R.R.M. in case of incongruency between the two authors. This first review was mainly practical, it wants to understand which articles were totally off-topic. A second review was conducted on the full text screening; again the three reviewers performed the inclusion and exclusion process in a qualitative way, to identify those

Table 1. Search string in the different databases.

Pubmed:	“Hospital Design and Construction”[Mesh] OR “Architecture/therapeutic use”[Mesh] OR “Health Facilities”[Mesh] OR “hospital”[tw] OR “healthcare environment”[tw] OR “healthcare building”[tw] OR “healthcare facilit”[tw] “therapeutic garden”[tw] OR “healing garden”[tw] OR “green space”[tw] OR “Nature”[Mesh] OR “Gardening”[Mesh] OR “Horticulture”[Mesh] OR “Horticulture/ methods”[Mesh] “evidence based design”[tw] OR “Evidence Based Medicine”[tw] OR “guideline”[tw]
Scopus:	“hospital” OR “healthcare environment” OR “healthcare building” OR “healthcare facilit” OR “hospital design” “therapeutic garden” OR “healing garden” OR “green space” OR “garden” OR “horticulture” “evidence based design” OR “Evidence based hospital design” OR “evidence based medicine” OR “guidelin”
Cochrane library:	“therapeutic garden” OR “healing garden” OR “green space” OR “nature” OR “garden” OR “horticulture” OR “green” Since this is a database that deals with clinical trials, it does not affect the search by entering the keywords for concept 1 and 3.

articles that really could answer the research question giving relevant and quality results. Here the aforementioned exclusion criteria were used: articles out of the timeframe (1st January 2000 – 31st March 2020), not written in English language, or referring to low care health facilities (i.e. nursing home, elderly care centers, community centers) were excluded. Only papers where operative indication for the designer were mentioned have been considered and where a clear relationship between the physical space and health outcomes were present. Articles and Reviews have been considered while conference papers have been excluded. From the full text screening a total of 123 papers were excluded while 25 were included since operative design indications for acute care hospitals were present. The PRISMA diagram and checklist has been used as an added value of this review to guarantee systematic robustness and replicability (53,54); the dedicated figure shows the results of the process of screening and eligibility adopted throughout the search (Figure 1).

Summarizing, the studies taken into consideration consider a period from 2000 to 2020, refer only to the hospital context and reflect on the design of therapeutic green, not only intended as a green space but also as widespread green presence both inside the hospital facility and in its surroundings.

Data analysis

The selected studies have been analyzed through descriptive statistics to understand the general characteristics of the papers, the specific methods used more frequently and the results obtained. In particular, a first analysis regarded origin, affiliation and publication platforms to understand which journals devote more attention to the topic and highlight the research field or laboratories where such studies represent an innovation area. Then the different methods have been clustered to verify if the topic is well established or still in an exploratory phase: literature reviews and empirical studies have been mapped also to understand the study design and methods used by the different authors.

Furthermore, the contents have been analyzed through a detailed mapping to highlight: i) type and forms of green elements; ii) users and functional area involved; iii) Spatial focus; iv) Type of relationship

between users and green space and v) Vegetation typology.

Results

Origin and scientific area

From the literature screening and selection 23 articles and 2 reviews have been included in the study (Table 2). Geographically the research groups are predominately from USA (n=11; 44%), followed by Norway (n=3;12%), Pakistan (n=2; 8%) , Greece (n=2; 8%), Australia (n=2; 8%) and Italy (n=2; 8%). The remaining studies (n=1 each country; 4%) are coming from Iran, China, Turkey, The Netherland, UK, Saudi Arabia. Three international collaboration are present (n=3; 12%).

Regarding journals, the majority of articles are published in multidisciplinary platform confirming the topic positioned at boundaries of established disciplines. In particular a mix of built environment, agriculture and medical scientific publications are present.

The attempt of clustering the different journals in single topics shows that the majority is related to architecture/planning field (n=10; 40%), followed by Agriculture/Forest studies (n=7;28%) and Medicine/Nursing studies (n=6; 24%) while the remaining are related to Environmental Psychology (n=1; 4%) and Quality Management (n=1;4%). The most recurrent journals are SAGE's Health Environments Research & Design (HERD) (n=8; 32%) and Elsevier's Urban Forestry & Urban Greening (n=3; 12%). The authors affiliation reflect this cross-disciplinary composition showing collaboration between social sciences and applied sciences covering several departments such as architecture, design and planning; forest, agriculture, environmental science; mental health, medicine, nursing; engineering, statistics, information management, business.

Type of study design and methods

What emerges from the literature review is the constant reference to an Evidence-Based Design (EBD) approach and the utilization of different data

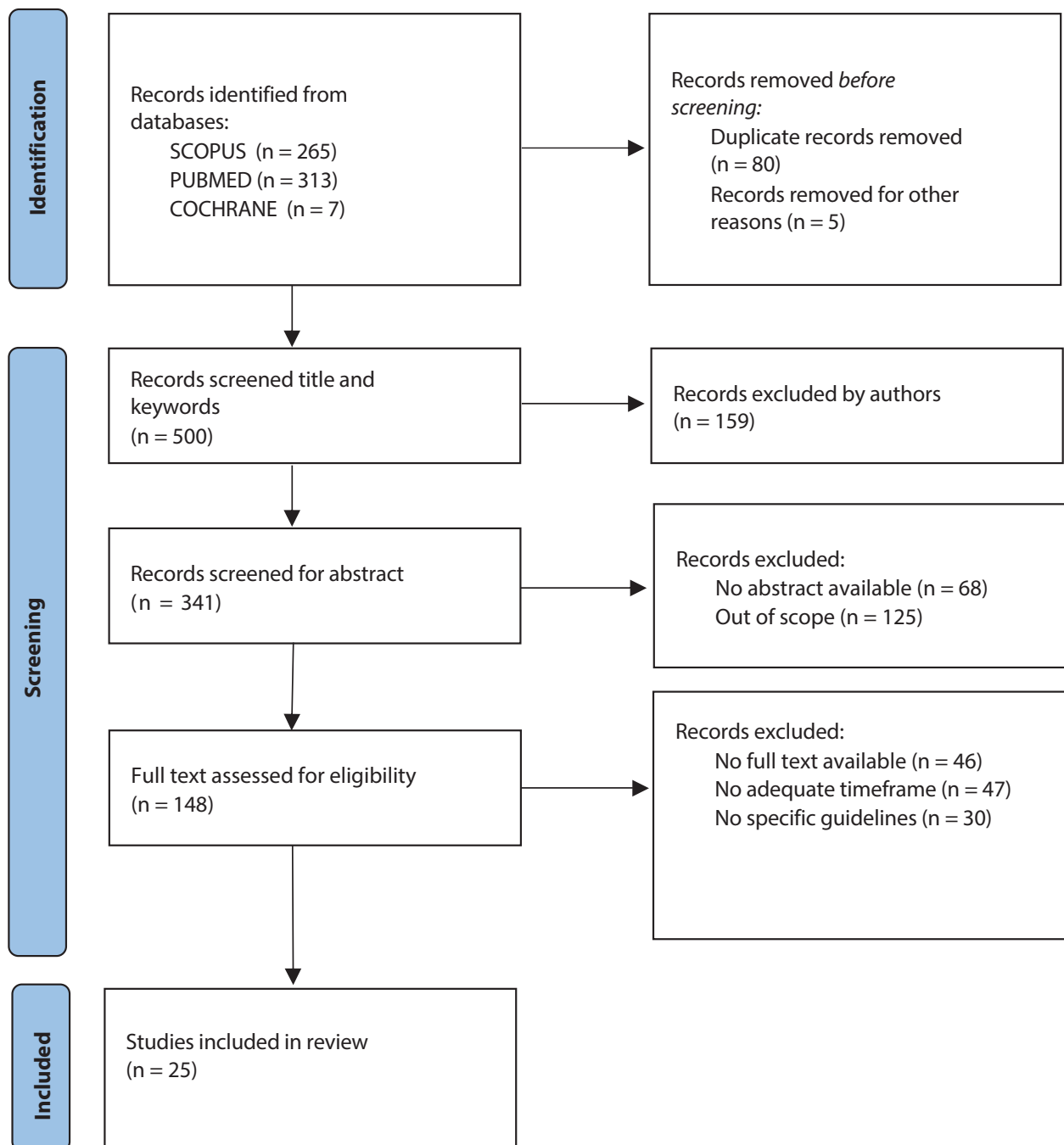


Figure 1. Prisma flowchart diagram of the literature search process.

collection methodologies, in specific sample cases, followed by the analysis of primary or secondary data for the formulation of design strategies or recommendation. However, some common challenges emerge as well such as that each hospital is unique, in terms of

context and users, so it is difficult to find studies that manage to consider all the variables. For this reason rather than on the specific results this review is focusing more on the methodological processes adopted and on the relationship between users and green type.

Table 2. List of papers included in the analysis. The detailed analysis is reported as supplementary material.

n	Year	Authors	Title
1	2000	Lohr & Pearson-Mims	Physical discomfort may be reduced in the presence of interior plants
2	2001	Whitehouse et al	Evaluating a children's hospital garden environment: Utilization and consumer satisfaction
3	2008	Naderi & Shin	Humane Design for Hospital Landscapes: a case study in Landscape Architecture of healing garden for nurses
4	2008	Park & Mattson	Effects of flowering and foliage plants in hospital rooms on patients recovering from abdominal surgery
5	2010	Vincent et al	The effects of nature images on pain in a simulated hospital patient room.
6	2010	Gonzalez et al	Therapeutic horticulture in clinical depression: A prospective study of active components
7	2011	Davis	Rooftop hospital gardens for physical therapy: a post-occupancy evaluation.
8	2011	Gonzalez et al	A prospective study of existential issues in therapeutic horticulture for clinical depression
9	2012	Raanaas et al	Health benefits of a view of nature through the window: a quasi-experimental study of patients in a residential rehabilitation center.
10	2012	Beukeboom et al	Stress-reducing effects of real and artificial nature in a hospital waiting room.
11	2015	Cooper Marcus & Valente	Healing Gardens: design processes and realizations of beneficial environments
12	2016	Trau et al	Nature Contacts: Employee Wellness in Healthcare.
13	2016	Ali Khan et al	Plant Therapy: a Nonpharmacological and Noninvasive Treatment Approach Medically Beneficial to the Wellbeing of Hospital Patients
14	2016	Ali Khan et al	Therapeutic horticulture: Influencing psychological responses of surgical patients and their environmental assessment scale
15	2017	Aburas et al	The Influence of Nature Stimulus in Enhancing the Birth Experience.
16	2017	Reeve et al	Healing gardens in children's hospitals: Reflections on benefits, preferences and design from visitors' books
17	2018	Tinner et al	Perceived Importance of Wellness Features at a Cancer Center: Patient and Staff Perspectives.
18	2018	Blaschke	Cancer Patients' Recommendations for Nature-Based Design and Engagement in Oncology Contexts: Qualitative Research.
19	2018	Paraskevopoulou & Kamperi	Design of hospital healing gardens linked to pre- or post-occupancy research findings
20	2018	Paraskevopoulou et al	The impact of seasonal colour change in planting on patients with psychotic disorders using biosensors
21	2019	Pearson et al	The Physiological Impact of Window Murals on Pediatric Patients.
22	2019	Uwajeh et al	Therapeutic gardens as a design approach for optimising the healing environment of patients with Alzheimer's disease and other dementias: A narrative review.
23	2019	Lu et al	Horticultural Therapy in Patients With Dementia: A Systematic Review and Meta-Analysis
24	2020	Allah Ya & Kazem	The role of dish gardens on the physical and neuropsychological improvement of hospitalized children
25	2020	Guglielmetti & Menicucci	Understanding the benefits of horticultural therapy on paediatric patient's well-being during hospitalisation

The observation of which study methods are used and how they can be combined: from the sample of selected articles highlights that the majority are single empirical studies (n=15; 60%), followed

by Pre and/or Post Occupancy Evaluations (n=6; 24%), Literature Reviews (n=2; 8%) and Case study reviews (n=2; 8%). Empirical studies are generally cross sectional experiment with control cases in the

form of randomized clinical trial (55–57), but some examples of quasi-experiment longitudinal studies are present (58,59). POE are often addressed to understand the effectiveness of the intervention such as site design or usage of the new green space compared to the literature or to the project objectives (60), but sometimes they evaluate the clinical outcome before and after therapeutic intervention that involve nature (61). Study design and data collection are mainly mixed method (n=12; 48%) or only qualitative (n=11; 44%); the remaining two papers are Systematic (n=1; 4%) or Narrative Literature Reviews (n=1; 4%).

Data are mainly collected through interviews and questionnaires based on psychometric or psychiatric validated scales, with some implementation of specific clinical experiment (62,63) or validated surveys like Nature Contact Questionnaire (NCQ) (64) or Quality of Care from Patient Perspective (QPP) (65). Physiological and clinical parameters such as vital signs, blood pressure, analgesic consumption, heart and respiratory rate, are also collected in mixed method experimental studies with control cases (65,66). In general, the presence of both quantitative and qualitative data allows the authors to discuss hypothesis with both numerical clinical-performance findings, such as improvements in recovery time or changes in the amount of analgesic administration, as well as articulated data, concerning individual users, such as emotions/perceptions reported (67,68) or mapped through biosensors (69).

Pre and Post Occupancy Evaluation is recognized as a very effective an environment-behaviour approach to assessing built environments of all sizes and types and has been consistently used for evaluating sustainability and overall performances in healthcare facilities (70–72). The former analysis determines the needs that will have to be solved during the design by including healthcare staff and patients in the design decision-making process; the latter evaluates the real effectiveness of the project and its capability of responding to the initial needs (73). By interviewing, after the implementation and testing of the hospital, patients, doctors and visitors; nevertheless, this process is very time consuming and require long term strategies and stakeholder engagement during time.

Users and functional area

Integrated therapeutic green design proves to be beneficial not only for patients, but also for healthcare staff and visitors (i.e. caregivers, relatives or friends). Although most of the selected studies (73%) focus their interest solely on the patient, the remaining percentages verify positive effects on staff and family members, respectively 15% and 12% of the total papers collected.

In fact, of fundamental importance in the design of therapeutic green spaces is the link between the design and the type of user who will inhabit it. This is because natural space does not always mean therapeutic space; to be so requires an understanding of the target audience and its specific needs. Most studies propose design solutions extremely related to the type of users (73) showing a garden design always tailored to particular types of visitors, including, of course, the specific needs of staff and family members (60,64,68).

Therefore, despite several studies are addressing generic users (27%), many different categories emerge such as:

- pediatric patient (20%);
- psychiatry patient (11%);
- maternity ward patient (8%);
- oncology patient (8%);
- surgery patient (8%);
- physically disabled patient (7%);
- neurorehabilitation patient (4%).

Spatial focus

Although the selected articles are only about the hospital setting not all authors decided to approach the topic in the same way, different spatial focuses emerge:

- i. The entire building (22%). These are all studies that reflect on the relationship between the hospital as a whole and the relationship with the therapeutic green (60,61,64,67,73–75).
- ii. The functional area (30%), refers to the specific departments (pediatrics, oncology, psychiatry, etc...) or specific areas, for example, waiting rooms (55,65,66,68,73,76,77)

- iii. The environmental unit (Patient room) (39%). Most studies focus on the relationship between the patient room and the natural setting, or the effects of incorporating green elements into the room, such as potted plants and flowers (56,57,59,62,63,78,79).
- iv. The outdoor space (9%) Finally, there are only two articles (58,80) that specifically reflect on the topic of horticultural therapy and only study the effect of the activity on the patient, referring only to the context outside the hospital.

Discussion

Type and forms of green elements

From reading the selected articles, several forms of green space in hospital environment emerges with specific regards to Hospital Gardens, Healing or therapeutic activity gardens, Wilderness, Potted plants and flowers or Representations.

These, in different ways, contribute to the improvement of the patient's condition of well-being, as shown by the qualitative and quantitative data emerging from the studies.

Hospital gardens are the most recurrent form, appearing in 33% of the selected articles and referring to all the outdoor spaces specifically designed to promote and improve people's health and well-being. The benefits of such space can be achieved through a passive experience (looking at or being in a garden) (64) and/or through active accessibility in the garden which can eventually result in utilization for rehabilitation activities (59). Access to nature has physical, social, and spiritual benefits (74), and these types of spaces constitute a special component of the healthcare building organism that offers relief not only to patients but also to staff and relatives (75).

While generic hospital gardens consider a mixed participation of the visitor, active or passive, there are other spaces with a higher degree of specialization and designed to host activities within the natural component such as gardening or occupational therapies (58,61). A recurring example reported in several studies is being spaces dedicated to horticultural therapy;

11% of studies address the use of these areas as complementary places to traditional therapy or care which results in improved staff social relationships, physical and cognitive activities (76).

Another form of therapeutic greenery is wilderness, defined as all undesigned green spaces visible within the hospital area or, as well, not accessible designed green areas. This is a component addressed by almost 15% of the studies, considered primarily as a contributing element to the quality of vision from the inpatient window, correlated with a positive influence on the patients or staff state of well-being (59,64,69). Indeed, both seminal and recent scientific studies show that direct viewing nature from the window can be an effective way to support the recovery process (19,81). However, the hospital facility is not always set in a natural context; consequently, in situations where natural settings cannot be exploited, images and interior design should recreate the natural world.

One third of the articles consider interior greenery, understood as potted plants and flowers (56,62). These represent all plants placed in hospital interior environments, such as patient rooms or waiting rooms, that serve decorative purposes or to support small gardening tasks such as watering or pruning (55,57,66,78). Some authors argue that even small potted plants can be considered a surrogate for green spaces in improving the physical and neuropsychological characteristics of hospitalized patients (79).

Only a minority of the articles (11%) refer to representations of greenery in photographic or pictorial format, referred to by the more general term "pictures" (63). This approach appears particularly useful in refurbishment cases where direct views of the natural landscape are not possible or where it is desired to quickly bring the green component into the hospital walls as well with a relative lower cost (65). An example of natural images is the inclusion of murals in the rooms of pediatric patients, these have beneficial effect on the physiological state of children, decreasing the heart rate and, therefore, improving the state of stress (57). Consequently, it is of particular importance the presence of these elements in inpatient rooms (63), as in other hospital areas, for example in delivery rooms (65) in which it has been shown how the view of natural scenarios can improve the experience of childbirth. It is interesting

to note that some authors suggest that it may not be necessary to provide presence of real elements, but that their synthetic representation or reproduction is equally sufficient for therapeutic purposes (55).

Despite the choice of vegetation type can be seen as important, it is not punctually considered in the selected articles. Only in three researches (55,56,69) it is studied how different types of tree species can affect users wellbeing. As a result, seasonal species must always be ensured, thus changing throughout the year; this can have a great symbolic influence in the individual, instilling hope and a sense of time. This can create several limits and contradictions also in terms of maintenance of hospital spaces as well as potential allergies of fragile users (82,83)

Type of relationship between users and green space

Significant attention is reported toward pediatric patients (57,67,76,79,80). The hospital is a place of great stress; for children, the natural environment can become a place of positive distraction.

In addition, it is interesting to note what types of green areas are most appropriate for the specific type of user. For example, in the case of patients suffering from mental disorders, horticultural therapy activities are very effective (61,73). In children, on the other hand, it is essential to provide the healing garden with a space for play, nature in this case has a strong action of distraction and release, but without forgetting the design of areas for rest dedicated to the most fragile children (80). In contrast, in the case of cancer patients the space must be equipped with comfortable seating and places of privacy and the garden becomes a place for contemplation and rest (68,77).

In order to identify specific research outlooks we clustered the studies starting from Stephen Kellert biophilic categories (13). Among the selected articles, we see a greater number focus on indirect relationships, such as just viewing the natural element can be beneficial. In fact, as seen in the previous section, several studies focus on the inpatient room, also because indirect viewing of greenery is the most common way to create a contact with nature. For example, consider hospitalized, bedridden patients after surgery, the only mode of contact with nature is viewing it from the

bedside. Nevertheless, for other types of patients, direct contact with nature is of paramount importance, for example, in the case of psychiatric departments (58) or in rehabilitation wards (59). Access and direct relationship with nature are essential, as long as possible. In these cases, the garden becomes a therapeutic space and medium: on the one hand, it can provide a place for ortho-therapeutic or rehabilitative activities, on the other hand, being a natural component, it binds to the innate human need to relate to the green defined as biophilia (84). In general terms, direct relationship refers to the spaces where man can have a physical and sensory experience: healing gardens, therapeutic gardens, wilderness, or spontaneous vegetation. On the contrary indirect relationship refers to indoor potted plants, meaning also a simple visual relationship; symbolic, however, are the representations of nature, such as images or paintings.

These different types of components turn out to follow specific design approaches, depending on the scope, as shown in Figure 2. Despite each article is narrowly focused on a single topic and a single user category, Kellert framework helped us to unify and extract some design strategies as research outlooks.

The strategies that are coming from the different papers represent a toolkit for designers as a list of acknowledgements to consider (85). Hospital design needs to consider green elements in its different forms and how this should relate with the healthcare environment, whether it is direct, indirect or symbolic relationship. In general terms it is possible to note that, for example, in the case of patients suffering from mental disorders or dementia, gardening activities are very positive.

In children and the elderly, the role of healing gardens is very important, although they take two completely different forms. For children it should be equipped for play and for the elderly more for rest and contemplation (43,86). The review highlights also that oncology, pediatrics, geriatrics, psychiatry and staff areas need access to the garden, so healing gardens must be designed easily accessible for this type of users, or planning the green space with high proximity or including therapy activities in the garden. In particular for oncology patients and elderly patients a greater interest should be given to the type of seats and to resting areas, providing the right amount of shades.

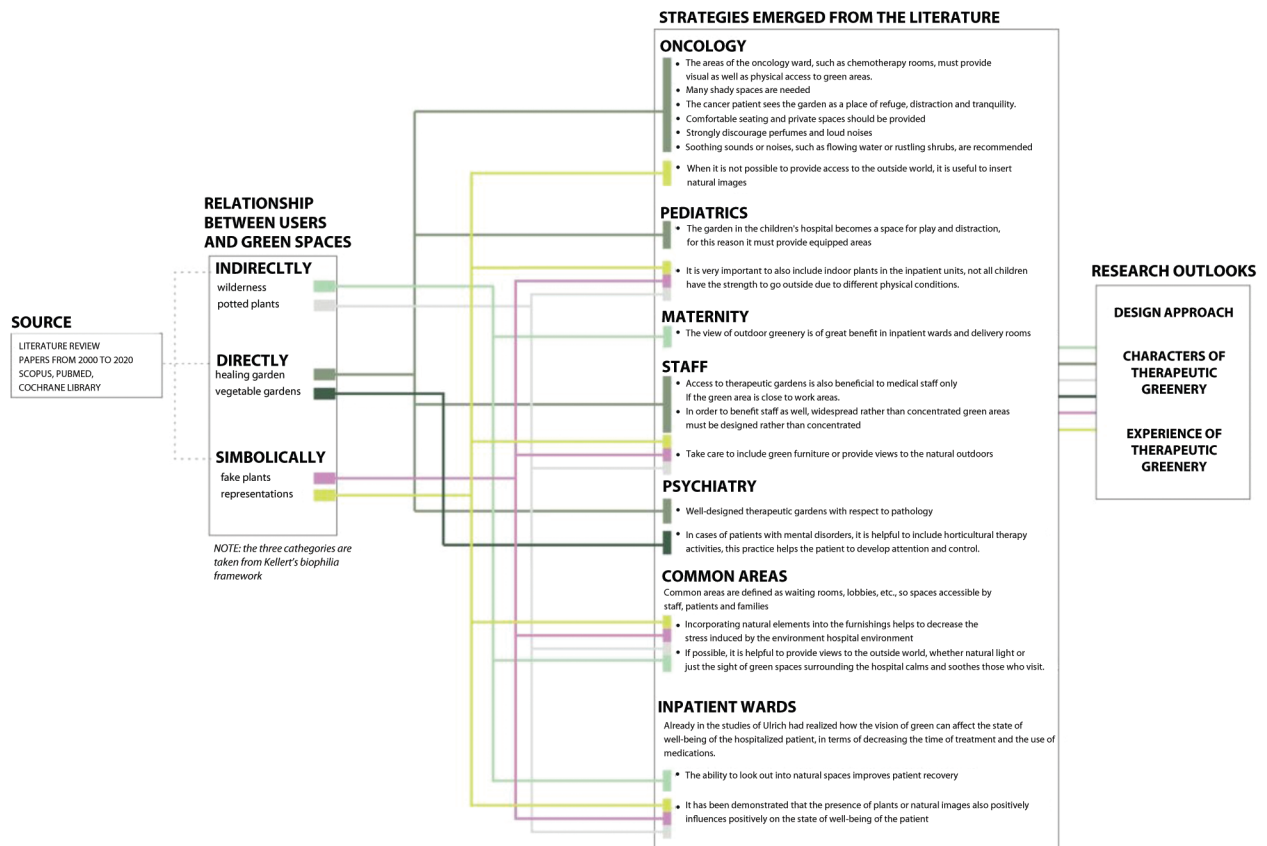


Figure 2. Summary of the findings and strategies emerged from the literature review based on Kellert biophilic framework.

For the wards dedicated to maternity and post-operative stays design need to focus on furniture and windows. A possible way is to insert potted plant, or, if is not allowed, picture or nature paintings. Data show how physiological parameters are better even with the presence of representation of nature.

Finally, the study is coherent with contemporary research confirming that nature not only affects patients but even staff and visitors (44); therefore green planning cannot only relate to gardens dedicated to patients, but even with common areas and staff areas, as well as general users (87). Such strategies can also support the definition of new hospital models based on users wellbeing and supporting spaces (88).

Study limitations

The review has been limited to papers published between January 2000 and March 2020 therefore

considerations raised or exacerbated by Covid-19 have been explicitly excluded. Furthermore no company reports or gray literature has been included in this review therefore more operative and practice-oriented strategies may be present. This is also relevant for articles or documents written in other languages than English; detailed strategies or local perspectives have been excluded from this review. Finally the study focuses only on acute care hospital settings therefore insights from lower care facilities can be beneficial in future studies.

Conclusions

The analysis conducted highlighted that the impact green components have on users within health-care facilities is relevant and multifaced even before the Covid-19 pandemic period (89). Multiple studies

are available, and a variety of typologies, methods and outcome are reported.

Limited number of reviews are present and multiple approaches are adopted showing a lack of comprehensive and shared research directions. The study enables to identify research perspectives in line with the evolution of the scientific discipline and with the general objective to foster synergies between Built Environment and Public Health research with specific regards to the healthcare settings where spaces for users are always more requested and strategic guidelines are needed. In fact, it is important to note that not all green space is therapeutic but appropriate design strategies should be implemented with specific attention to the type of users and needs. Starting from the framework proposed in this review, future studies should focus on the post-Covid-19 pandemic to identify whether new interventions involving green space in hospital setting are capable of incorporating such strategic concepts.

Ethic Committee: not applicable

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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