The Garden of the Senses
Principles, Evidence, and Practice for Designing Restorative Outdoor Spaces Based on the Stress Reduction Theory

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Abstract

This document aims to establish essential principles that can serve as a guide for designing restorative outdoor spaces in social and healthcare environments to facilitate patients' recovery.The choice of the topic arises from the evaluation of two fundamental premises. Firstly, the constant and upward growth of general diseases and mental health disorders at a global level is highlighted by the World Health Organization (WHO). The second is based on a historical analysis by Cooper Marcus (2007) in "Healing Gardens in Hospitals", which reveals that, between 1950 and 1990, the therapeutic value of connecting with nature was lost in most hospitals in Western countries, where hospital construction focused exclusively on interior architecture designed for efficiency, negatively impacting patients, families, and staff.Therefore, using Roger Ulrich's Stress Reduction Theory (SRT) and other scientific evidence, this presentation aims to highlight the positive impact that therapeutic gardens may have in these contexts and how they should be designed. To this end, the renovation project of the Benito Menni Complex in Sant Boi de Llobregat, Spain, established in 1854 specifically to treat mental health disorders, will be used as a reference model for a deeper understanding.The project proposes the use of a substantial garden, acting as a central axis, through the arrangement of technically and strategically placed elements that promote a specific therapeutic objective. This space, in addition to allowing a direct commitment to the natural environment and the connection between the different buildings that surround it, emphasizes promoting rehabilitation, education, and stimulation, as well as the physical, psychological, and socio-emotional development of people. Sensory, climatic, and geographical factors, together with elements of human physiology such as sounds and smells, will play a fundamental role in this analysis.

1. Introduction

Throughout history, the treatment of mental health has undergone a slow and uneven evolution, reflected in the physical spaces dedicated to its care. While there were advances during the Middle Ages, the stigma persisted and was exacerbated by religious interpretations. It wasn't until the 20th century, in places like Spain, that significant progress was made in integrating mental health into the general healthcare system (González Duró, 2021).

However, from the perspective of architectural design, there is still much to explore and rethink regarding these environments. The current reality presents a discouraging panorama: the global prevalence of mental disorders has significantly increased, reaching between 26% and 28% during and after the COVID-19 pandemic. In Spain, the National Health System reports that, in the last 5 years, 6.7% of the adult population has reported experiencing anxiety and/or depression.

In response to this concerning reality, Spain's Public Health Strategy (2022) has propelled the need to rethink healthcare from a sustainable perspective. This initiative recognizes that current hospital infrastructures are far from ideal for treatments, as their overwhelming and stressful characteristics, such as their "heavy," distant, monochromatic, and large-scale morphology, have a negative impact on patient's health and perception (Duric et al., 2015; Liczner-ski et al., 2015; Hartig et al., 1996).

This problem is compounded by the lack of connection with nature in most hospitals. The absence of green spaces or their use for purposes unrelated to patient recovery, such as parking lots, vehicular circulation areas, or technical installations, deprives patients of the benefits that nature contact has for mental health. This disconnection from nature originates in the predominant hospital design between 1950 and 1990, an era that prioritised asepsis and efficiency over patient well-being, reflecting a medicalized vision of health that did not consider the environment's impact on recovery (Marcus, C. 2007).

Hence, it´s proposed a paradigm shift in hospital space design, one that focuses on patient well-being and their connection with nature. This new approach aligns with the salutogenic model, proposed by Antonovsky (1993) and continued by Lindström and Eriksson (2005, 2006), which places the patient at the centre of their own healing, recognizing them as the architect of their well-being (Juvinyá et al., 2013).

In this context, the proposed research aims to explore the relationship between physical space and mental health in the context of mental disorders. It will analyse whether outdoor spaces can promote faster recovery, contribute to the healing process, and/or alter moods. It will identify if there are elements that architecture can integrate to function as a therapeutic tool and determine the most influential intervention spaces.

Based on the knowledge generated by this research, a guide will be proposed for the design of new therapeutic outdoor spaces, using the Benito Menni complex in Spain as a reference.

2. Material and method

A review of the scientific literature concerning the effects of open spaces on human health was conducted. The initial phase of the search took place in August 2023 and involved the combination of the terms 'Healing Gardens' and 'Mental Health' in the PubMed database, as well as references from books published in Google Scholar. This initial search provided a comprehensive overview of the topic, facilitating a more rigorous selection process.

In the subsequent phase, which occurred in February 2024, the search was updated using electronic databases such as PubMed and ScienceDirect. Additionally, the Knowledge Repository from The Center for Health Design was utilized. The search was refined using specific terms such as 'Hospitals', 'Restorative Spaces', “Mental Recovery”, “Outdoor Spaces”, “Healing Spaces”, and “Wound”, employing Boolean operators AND, OR, and NOT.

The third phase involved the selection process based on specific inclusion criteria: publications within the past 20 years, focusing on individuals aged 18 years and older in hospitalisation, home care, and/or isolation settings (e.g., COVID-19). Publications needed to be written in English or Spanish and were required to examine the impact of the subject-environment relationship from a cognitive-behavioural perspective. Only open-access publications were considered, while university theses, book reviews, monographs, duplicates, and studies solely focusing on rooftop restorative spaces or evaluating the impact solely on medical staff were excluded. Publications lacking a clear design or methodology were also excluded from the review.

3. Findings

From the initial search, (N=418) potential articles were identified. Subsequently, (N=2) articles were removed due to duplication. After reviewing the titles and abstracts, (N=284) articles were excluded. The remaining (N=132) articles underwent eligibility assessment based on

inclusion and exclusion criteria. Ultimately, (N=11) articles were selected for inclusion in this study (Figure 1).

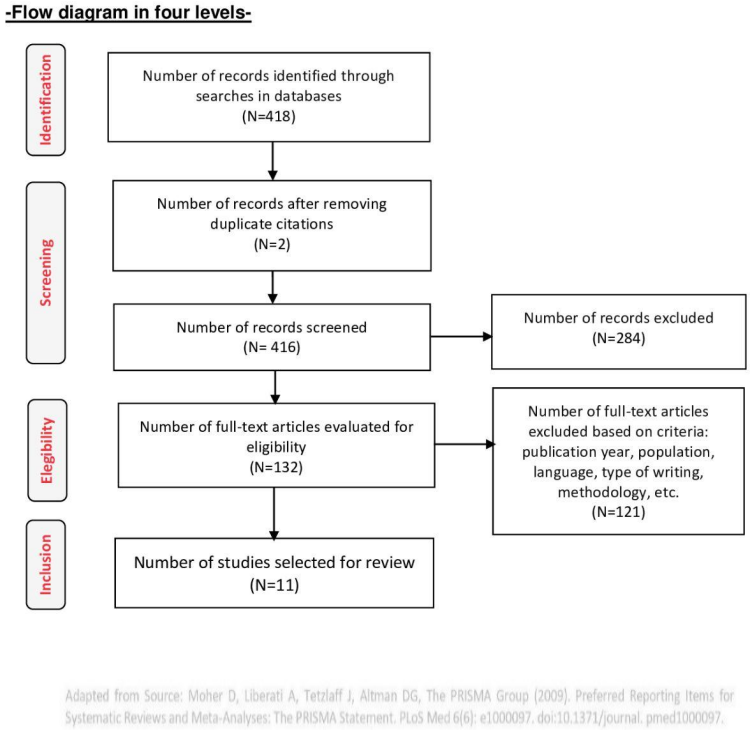

Figure 1. Flow diagram

	Title	Author and year	Aim	Study design	Methods	Results
1	Hospital outdoor spaces: User experience and implications for design	Tseung, V. et al. (2021)	Evaluate the impact of outdoor spaces on patient´s experience.	Observational prospective	Total (N=74) users. (N=39) were patients. Semi structured interview	Outdoor space benefits healing by helping patients focus on life beyond their illness, design of healthcare spaces facilitates patients' access to outdoor space to benefit healing, and programming in the outdoor space promotes healing and recovery.
2	Guidelines for the design of a healing garden for the rehabilitation of psychiatric patients	Erbino, C. et al. (2015)	To make a guideline for a masterplan in a Psychiatric hospital.	Case study	Site analysis and users analysis by focus groups and interviews (N=75) people with schizophrenia and personality disorders.	Although the main result is the design of the master plan of a Healing Garden, the analysis of the users showed that for the studied population it is important to have contact with nature, to feel autonomous, safe and comfortable, to prefer familiar environments and to be able to choose between places and functions.
3	Effects of Restorative Environment and Presence on Anxiety and Depression Based on Interactive Virtual Reality Scenarios	Wang, Z et al. (2022)	Evaluate the impact on mental health using VR restorative environment.	Experimental	(N=20) divided into two gropus. Group 1 (N=12) with high levels of anxiety and depression and group 2 (N=8) with mild anxiety and depression. Measurements: PQ, STAI. RES, TAI and SDS.	The use of VR scenarios rooted in restorative environments and presence demonstrated notable intervention effects on depressive moods among individuals experiencing mild to moderate anxiety and depression. Statistical analysis revealed a significant improvement in depressive states following exposure to open environments.
4	Design guidelines for healing gardens in the general hospital	Wang, Q et al. (2023)	Inspire more hospitals and to integrate healing gardens and offer guidelines for their implementation.	Case study observational prospective	Mixed. Literature review, case studies, users analysis (questionaries) and site analysis.	A masterplan for Zhongnan Hospital is being developed according to guidelines, utilizing questionnaires to assess Kaplan factors related to the environment and Ulrich factors aimed at reducing patient stress.
5	Therapeutic Gardens – A healing environment for optimizing the health care experience of Alzheimer's and dementia patients: A narrative review	Uwajeh, P. et al. (2018)	Include the role of therapeutic gardens in the healing environment as an intervention for bettering the clinical outcomes of Alzheimer's and dementia patients.	Systematic review	(N=36) articles.	Therapeutic gardens boost physical abilities, independence, and life quality. Horticultural therapy programs aid stress, improve physical function, and boost cognitive skills, socialization, and self-esteem. These spaces calm, reduce agitation, isolation, and vulnerability, lower heart rate, and increase confidence and hope. They enhance memory, mood, concentration, planning, problem-solving, and positive outlooks.
6	Impact of a Healing Garden on Self-Consciousness in Patients with Advanced Alzheimer's Disease: An Exploratory Study1	Gueib, C. et al. (2020)	We evaluate the impacts of hospitalization and of a specific healing garden on self-consciousness.	Exploratory study	N=20 pacients with a self consciousness questionaire (SCQ).	The significant improvement observed in the overall SC score is mainly attributed to the restoration of body awareness. The SCQ improves in individuals exposed to gardens, with better body identity, improved disease awareness, enhanced short-term memory, introspection ability, and judgment regarding external factors.
7	Therapeutic landscapes and healing gardens: A review of Chinese literature in relation to the studies in western countries	Jiang, S. (2014)	Evaluate whether there are differences between Western and Eastern therapeutic gardens and the characteristics to take into account.	Systematic review	(N=19) articles.	Both cultures see 'therapeutic landscapes' as green spaces that promote physical, mental, and social well-being through activities that reduce stress, enhance mood, and encourage social interactions. These spaces also stimulate the senses, support introspection and self-care, and foster autonomy. Chinese healing gardens particularly blend horticultural therapy with traditional medicine and spiritual elements, offering a holistic approach to well-being.
8	The impact of seasonal colour change in planting on patients with psychotic disorders using biosensors	Paraskevopouloun, A. et al. (2018)	To investigate the effect of seasonal color change in plantations on the design of healing gardens for patients suffering from psychotic disorders.	Experimental	Mixed (N=25) people. (64% men y 36% women). Measurement: eye tracking, facial expression analysis, and galvanic skin.	Images featuring fall foliage and shrubs received more fixations and viewing time compared to images with bright green leaves. The chosen tree was deciduous with green and yellow colors. The seasonal color change in the treetop evoked positive and intense emotions. It appeared to be more challenging to positively influence the emotions of male participants compared to females.
9	A systematic review of access to green spaces in healthcare facilities	Weerasuriya, R. et al. (2018)	Explore the experiences of users (staff, patients and visitors) who have had passive/quasi passive access to green spaces within an urban healthcare setting.	Systematic review	(N=24) articles.	The experience is assessed based on three main themes: control and autonomy, socialization, and engagement with nature. Theme 3, focused on nature, shows the most significant improvements, including calming effects, relaxation, mental clarity, stress reduction, and sensory stimulation. Nature is symbolic, with trees representing strength and seasonal changes signifying life's phases and vitality. Spiritual stimulation is achieved through nature's association with blessings and introspection.
10	Healing environment: A review of the impact of physical environmental factors on users	Huisman, E. et al. (2012)	Verify if healing environments, make hospitals less stressful and promote faster healing for patients, family and staff.	Systematic review	(N=65) articles.	In patients and families: Visual confort. Also Daylight factors - reduces time of hospitalization and better orientation for them.
11	Evaluation of a horticultural activity programme for persons with psychiatric illness	Kam C, et al. (2010)	Investigate the effect of the application of horticultural activity on stress, work performance and quality of life in people with psychiatric illnesses.	Cases and controls	(N=22) people. Pre and post evaluation. Measurements: DASS21, PWI-C and the evaluation of Work Behavior evaluation + interviews for feedback.	There was a significant difference between the control and experimental groups. Horticultural therapy is effective in reducing levels of anxiety, depression, and stress. (The entire process, planting the seed, studying the terrain, harvesting vegetables, sensory garden, testing harvested herbs).

Figure 2. Selected articles (N=11)

3.1. Self-consciousness, autonomy, and introspection

Six publications have demonstrated that outdoor restorative spaces promote self-awareness, autonomy, and introspection in users [1, 2, 5, 6, 7, 9]. In a case study conducted by Erbino et al. (2015) with 75 individuals diagnosed with schizophrenia and/or personality disorders, it was found that those who participated in therapeutic gardens felt more autonomous, confident, and comfortable. Similarly, Weerasuriya et al. (2018) concluded that patients exposed to outdoor spaces experienced more positive sensations when interacting with nature. They reported a greater sense of control, choice, escape, privacy, autonomy, and mental clarity.

3.2. Contact with nature, health recovery, and stress reduction

Eight publications have demonstrated that being in contact with nature promotes faster recovery and a decrease in stress levels [1, 2, 4, 7, 8, 9, 10, 11]. According to Jiang et al. (2014), therapeutic gardens stimulate the healing of stress-related diseases. They alleviate pressures and improve mood in patients through sensory stimulation, silent spaces, aromatherapy sections, and/or colour therapy.

3.3. Horticultural Therapy Programmes

Programmes based on plant cultivation, such as horticultural therapy, have demonstrated positive effects on physical recovery as well as on patients' moods [Articles: 5, 7, 11]. Uwajeh et al. (2018) demonstrated that gardening promotes the maintenance of physical strength, improves cognitive activity, and reduces stress as assessed by heart rate and blood pressure. Similarly, Kam et al. (2010) showed an improvement in the mood of patients diagnosed with Anxiety-Depression undergoing horticultural therapy.

3.4. Impact on behavioural and cognitive diseases

It has been observed that the connection with outdoor spaces promotes cognitive-behavioural improvement in patients with Alzheimer's disease (AD) [Articles: 5, 6]. Uwajeh et al. (2018) demonstrated that contemplation of therapeutic gardens and engaging in manual work within them offer significant benefits for these patients by promoting a sense of independence and delaying functional and cognitive decline, thus improving their quality of life. Also, Gueib et al. (2020) demonstrated the benefit of active participation in horticultural work, as measured through the self-consciousness questionnaire. They observed improvement in anosognosia in patients with AD, highlighting the positive impact of horticultural activities on cognitive functions and self-awareness in this population.

3.5. Impact on mood disorders (anxiety and depression)

Therapeutic gardens have been demonstrated to aid in the treatment of mood disorders such as anxiety and depression [Articles 3, 5, 6, 11]. Wang et al. (2022) demonstrated positive outcomes in patients with depression exposed to virtual reality. In this experimental study, it was concluded that patients diagnosed with mild to moderate depression showed an improvement in their emotional state (measured by the Self-rating Depression Scale SDS) after undergoing virtual reality exposure to images of green-blue spaces.

3.6. Socialisation

Restorative outdoor spaces promote socialisation between patients and the environment [Articles 2, 5, 7, 9]. Weerasuriya et al. (2018) conducted a literature review and concluded that outdoor healing spaces facilitate increased interaction with the external environment through the engagement of the five senses. Similarly, Erbino et al. (2015) noted that patients diagnosed with schizophrenia and/or personality disorders tend to gravitate towards areas of the garden that evoke a more familiar atmosphere, indicating the potential of therapeutic gardens to create a comforting and engaging environment for individuals with mental health conditions.

3.7. Self-orientation

Outdoor spaces have been observed to improve temporal-spatial orientation [Articles 7, 8, 9, 10]. Exposure to seasonal changes, such as perceiving the diverse colours of nature, connects the patient to the environment, as expressed by Paraskevopoulou et al. (2018). They noted that the changing colours of the crown of an autumn tree (deciduous trees) with predominantly green and yellow hues elicited more intense and positive emotions in hospitalised patients. Additionally, Huisman et al. (2012) demonstrated that the luminosity of outdoor spaces leads to a reduction in the total hospitalisation time of patients by preventing the onset of confusion syndrome. Lastly, Weerasuriya et al. (2018) correlated nature with the reflection of one's life. Trees, representing strength, solidarity, permanence, and resilience, along with seasonal changes, help us comprehend the transformation and regeneration of species and the universe, fostering a spiritual connection through understanding the importance of the existence of every living being.

4. Bring theory into practice: Proposal Guidelines

4.1. Design with Purpose: Stress Reduction Theory (SRT) and Salutogenic Model

The Stress Reduction Theory (SRT), proposed by Roger Ulrich in 1991, constitutes a cornerstone in the creation of restorative environments. It posits that exposure to natural environments after stressful experiences facilitates psychophysiological recovery. This theory clarifies that when the human body perceives no stress, it triggers the activation of the parasympathetic nervous system, resulting in reduced levels of cortisol, heart rate, and blood pressure. Consequently, individuals experience notable improvements in their overall well-being.

Moreover, other clinical studies suggest that populations adopting the Salutogenic Model tend to demonstrate greater longevity, choose healthier lifestyles, and exhibit greater resilience to stress (Lindström et al., 2006). By placing the user at the centre and providing them with self-employed tools for healing, the results indicate elevated perceptions of health, quality of life, and mental well-being. Antonovsky attributed these positive outcomes to the notion of a "sense of coherence," emphasizing its fundamental role in promoting mental well-being.

Considering all of the above, the initial step in designing restorative spaces is to identify users and their requirements. The design should encompass areas for quiet contemplation, rehabilitation, social participation, physical activity, family gatherings, rest, or a combination of these elements. This approach aims to allow everyone to choose what they need.

4.2. Create a pleasant space: Homeostasis and Allostasis

The concept of allostasis (Seth, 2023), the body's ability to adapt to changes and allostatic load, and the accumulation of physiological stress, are fundamental in designing a therapeutic garden in a hospital setting. These concepts provide the key to understanding the importance of human adaptation and, consequently, ensuring that the design can provide spaces that respect patients' necessary recovery times in relation to their environment.

At this design stage, the proposal is to offer a place where people can find peace while their physiological responses are recalibrated, stress hormones dissipate, and balance is restored, nurturing the body's innate tendency towards harmony. There should be no abrupt changes between the inside of the enclosure and the outside. In line with this objective, the space is proposed to become a learning field about nature where everything flows.
Therefore, the design plan should incorporate transition elements such as entrances that accompany this entry, spaces that encourage exploration and the discovery of subtle forms,

where combinations of open and closed spaces emerge for the comfort and privacy of patients and their families. Comfortable seating should also be included in sunny and shaded areas.

4.3. Focus on nature: Biophilia, Green, and Blue Spaces

The concept of biophilia, as described by Gillis et al. (2015), pertains to the innate inclination of human beings to seek a connection with nature. Integrating biophilia into restorative outdoor spaces involves designing elements that leverage this primal connection. In therapeutic gardens, this can be achieved by incorporating natural elements such as wood, stones, and diverse vegetation, stimulating the senses and fostering a deeper connection with the environment, as emphasised by Kellert (2005). To further enhance user engagement and preferences, studies by White et al. (2021) and Vert et al. (2020) highlight the importance of also providing blue areas within these green spaces.

Consequently, it is important to consider a variety of plants with contrasting shapes, colours, textures, and aromas, such as lavender, rosemary, and oregano, as well as water elements that produce sounds, such as fountains or small lakes. Wind chimes made of bamboo in pergolas are an effective resource, as is the placement of stones among ornamental spaces. Nighttime lighting should complement the circadian rhythm of both people and plants, with soft and diffuse lighting that also integrates with the design strategy being recommended; working with lighting and gardening specialists is advised in this regard. Avoiding the placement of white lights together is advised, as it can disrupt the harmony of the design. Additionally, using native flora is recommended both for its ecological benefits and ease of maintenance, and it is crucial to consider how climatic conditions can influence these elements when developing the design plan.

4.4. Promote User Comfort and Safety

To design an inclusive and safe space, it is essential to focus on accessibility and the protection of all users. This involves creating wide and level paths, strategically placing ramps, and arranging rest areas appropriately. The use of materials such as gravel or sand should be avoided, as they could pose obstacles for people with limited mobility. Additionally, it is crucial to select non-toxic materials in construction and avoid plants with thorns or poisonous berries to ensure everyone's safety. Water sources should be shallow to minimise risks. The subconscious impact of design should also be considered, incorporating cultural sensitivity, and promoting inclusion throughout the space design process.

4.5. Additional Considerations

To enhance the quality of the outdoor space, consider using plants that efficiently utilize water and adapt to the local climate (UN, 2022), along with rainwater collection systems for irrigation. Embrace natural pest control by incorporating insect-repellent plants, such as citronella, and attracting natural predators to eliminate the need for harmful chemicals. Clear signage that includes plant details, site features, and safety rules will improve the experience and encourage responsible use. Finally, designated, easily accessible tool storage areas will ensure smooth maintenance and create a safe, tidy space for everyone.

5. The Benito Menni Complex: Application of guidelines for a new model design

The Benito Menni Complex is in Sant Boi de Llobregat, Catalonia, Spain, and was established in 1854 with a specific focus on addressing mental health disorders. To date, the Benito Menni space has no record of previous interventions of this type and scale.

5.1. General aspects

The Benito Menni Complex embarks on an ambitious transformation to upgrade its facilities and strengthen ties with the community. The focal point of this renovation is the creation of the Garden of the Senses (Fig. 3), a natural integrative element that harmoniously connects the indoor and outdoor spaces of the complex. The demolition and strategic relocation of three existing buildings, along with the construction of an underground parking lot (Fig. 4), allow for a complete integration of nature into the complex.

The project also proposes the change of use for two facilities to open the precinct to the public: a cafeteria and a conference hall. This strategic change is expected to foster a renewed sense of community among diverse user groups.

It is worth noting that all elements of the project have been carefully designed to facilitate a gradual adaptation to each of the spaces (Fig. 5).

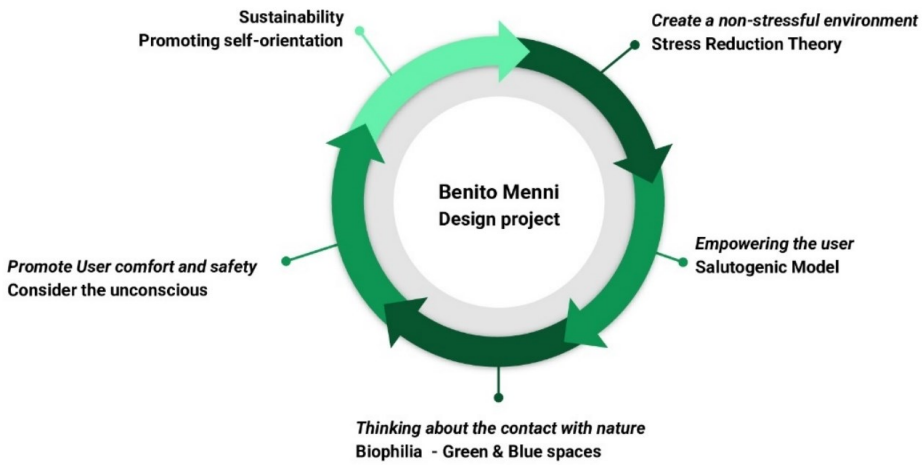

Figure 3. Evidence-based models to make Benito Menni´s plan design

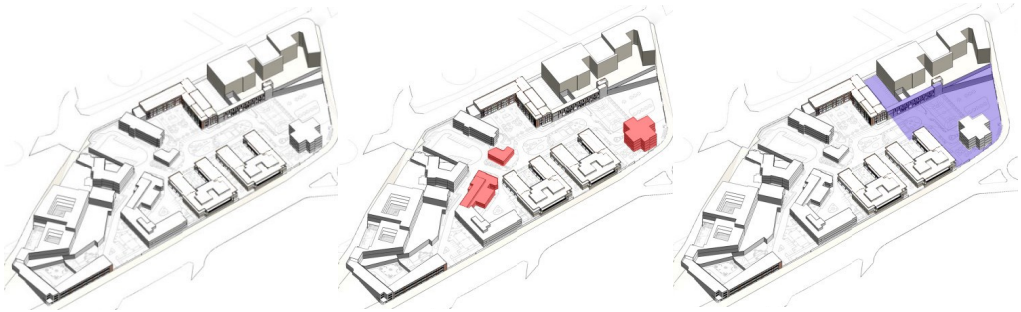

Figure 4. Preliminary decisions. Current situation, demolition, and parking

Figure 5. Masterplan for Benito Menni Complex

5.2. Specific aspect: The Garden of the Senses

This project centres on a unique garden (Fig. 6) that seamlessly blends all areas of the complex, creating a unified space that's both visually appealing and topographically diverse. The design aims to engage all five senses, encouraging users to be mindful of their inner experiences (introspection) and their surroundings (extrospection). As Sami (2021) emphasizes, this heightened awareness is crucial for the recovery process.

Figure 6. "The Garden of the Senses"

This central garden incorporates various zones, including the park, the square, relaxation areas, spaces for gardening and physical activities, covered areas, water features, walking paths, private courtyards, and meeting areas (Fig. 7).

The design takes into account the region's moderate climate, with mild winters (average 9-12°C) and hot summers (average 23-26°C). Barcelona's proximity to the sea creates a humid atmosphere, with summer highs often exceeding 30°C.

Figure 7. Concept plan

5.2.1. Garden subdivisions

The central area of the compound serves as a green axis, fostering biological continuity with extensive tree masses that link the various healthcare units. Its sinuous layout facilitates easy access, even over slight inclines.

Circuits within the compound are carefully designed, featuring dense tree cover, such as Celtis australis or Sophora, to provide privacy between spaces. For introspective strolls, wider paths with beige pavement are chosen, while extroverted walks opt for narrower, dark brown paths. This intentional architectural choice controls movement without relying heavily on signage, reducing user stress (Fig.8).

Each unit includes private spaces with smaller trees and plants suited for specific therapies. Complementing this, appropriate furniture like chess tables encourages socialization and engaging activities for patients, relatives, and staff.

The design incorporates raised gardens that offer urban views and facilitate diverse therapies centred around health, companionship, and interaction with nature and others. These spaces promote family gatherings, and shared activities like readings and snacks, fostering a sense of community.

Safety is a priority, addressed through thoughtful design. Topographic changes, vegetation, and safety features replace harsh metal fences with natural barriers, blending seamlessly with the landscape. These measures aim to create a calm, secure atmosphere, enhancing positivity among patients (Fig.9).

The facility offers a variety of spaces for physical activity and leisure. Pergolas with tables and chairs serve as versatile dining and social areas, both covered and open-air. Dedicated walking and running trails cater to fitness enthusiasts, alongside spaces for horticultural activities like plant propagation. Relaxation zones with benches and flowerbeds provide tranquil retreats, while aromatic gardens and winter greenhouses offer year-round nature experiences.

Figure 8. Inside render

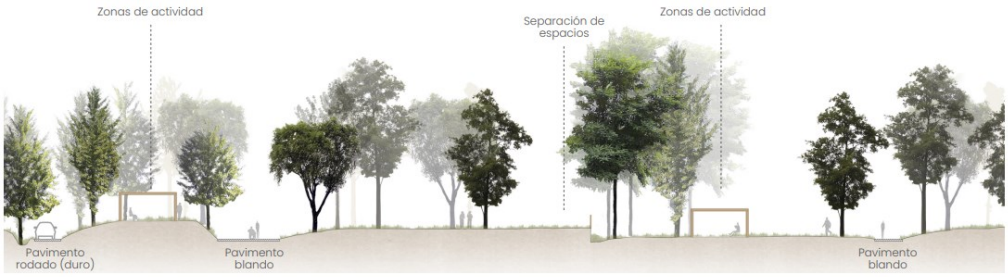

Figure 9. Cross section

6. Conclusion

In conclusion, the scientific evidence on the impact of therapeutic outdoor spaces in hospital settings was analyzed, and whether the creation and use of these spaces have a positive impact on users was evaluated. The findings of the selected articles strongly support the

implementation of restorative spaces as an effective strategy to complement traditional medicine and improve the well-being of patients, family members, and healthcare workers.

"Therapeutic gardens" and the implementation of nature-based rehabilitation programs offer a wide range of benefits: they reduce stress, anxiety, and depression; promote physical recovery; improve mental and cognitive health; foster self-awareness, autonomy, and introspection; and encourage socialization. Building on these findings, a guide for designing these typologies in healthcare environments (hospitals) is proposed, using their implementation in the Benito Menni Mental Health Complex project as an example.

The research landscape in the field of architecture is considered encouraging compared to previous decades. However, to conclude, it is argued that further high-quality evidence studies are still needed to continue evaluating how architecture impacts human beings.

7. Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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