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The Impact of Design on Healthcare

Restorative Interiors

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Abstract

As widely recognized, people's experiences are significantly influenced by their environment, particularly in healthcare settings, which impacts therapeutic outcomes (Galise, 2021). This project proposes a redesign of the Obstetrics department at Santa Croce Hospital in Cuneo, known for high-risk pregnancies and preterm births, through a domestic approach and restorative design improvements that enhance environmental factors. The goal is to humanize hospital environments (Montaccini & Tedesco, 2015) for patients, families, and staff, fostering feelings of welcome and easy access to information. Despite advancements in care, the quality of healthcare facilities often lags behind, even though evidence shows that physical spaces affect mental and emotional health. The project seeks to enhance health, sensory nourishment, and psychological regeneration for patients and medical staff by incorporating materials and forms that evoke nature. Initial interventions included creating homelike spaces with relaxation zones. The redesign prioritizes sensitivity and perception alongside functionality, addressing diverse elements from color schemes to furniture. Stress-exposed individuals require regenerative spaces enhanced by natural elements and light regulation through biophilic design. In the first stage of the ongoing redesign, results from a questionnaire have been shared with staff and patients to evaluate changes in livability and spatial perception. This contribution aims to analyze responses for project advancement while offering critical insights into the limits of light interventions on existing spaces without hindering operational efficiency.

1. Healing Environments

An in-depth investigation into the potential contaminations and boundaries in the relationship between art/design and health represents a significant research perspective within the field of healing environments in healthcare, promising intriguing developments.

A healing environment, as defined by McCullough (2010), is one that exerts a nurturing and therapeutic effect on individuals from both physical and psychosocial perspectives. Understanding the dynamics between place, patient, and the healing process is fundamental for optimizing these environments as potential innovation factors in the design of healthcare spaces. A universally recognized reference point is Roger Ulrich's studies from the 1980s, which demonstrated the positive impact of natural green elements within healing environments. His research showed that merely viewing green spaces from a hospital room window could significantly reduce medication use and shorten recovery times. Building on this evidence, the incorporation of nature as a healing tool has gained popularity in recent years. Healing gardens, for instance, are now utilized as therapeutic spaces for dementia patients. Beyond biophilic design in healthcare facilities, this concept encompasses the creation of environments that foster calmness and reduce stress for patients, staff, and visitors. This includes enhancing contact with art, designing harmonious color schemes, and providing sensory stimulation to promote space familiarity and tranquility. This research presents an action-research case conducted by the Architecture and Design Department at the University of Genoa. The focus was on enhancing the regenerative properties of healthcare spaces designated for perinatal and neonatal

assistance at S. Croce e Carle Hospital in Cuneo, considering that the benefits of the transformation should also be understood as a priority for the medical staff who work constantly and uninterruptedly in the facility. In addition to being used for healthcare, the spaces represent a workplace of excellence, whose layout and organizational improvement were strongly desired by the hospital's management and medical staff. The intervention involved interior design modifications to an existing wing, utilizing decorative and furnishing elements that improve spatial perception for both patients and medical personnel. Therefore, the site had to be transformed while active, which presented a challenge to understand the constraints for a light intervention that could bring tangible and measurable benefits to the place of care and work. This highly topical challenge involves maximizing impact against limited resources and where constraints present an opportunity. Employing methods from Evidence-Based Design (EBD) (Hamilton & Watkins, 2009) facilitated a connection between research on healing environments and practical design applications within an existing context. The EBD approach incorporates users - both patients and staff - in the evaluation process of the design using tools that provide foundational support for environmental planning. Particular attention was given to defining objectives through co-design activities with users, alongside utilizing evaluation or measurement tools to identify the most suitable solutions. This process anticipates gradual interventions over time within the existing building, adaptable according to ongoing research findings and the evolving needs of stakeholders. The design intervention is preceded by an analysis phase and an evaluation phase, detailed in this article. To convert project insights into research questions, extensive references were made to environmental psychology and regenerative factors derived from Attention Restoration Theory (Kaplan, 1995). This theory explores the psychological relationship between humans and their living environments as a focal point in restorative design. The overarching goal of this process is to ensure that action-research cases conducted by academic researchers – guided by these principles – become integral to designer training. This integration aims to equip future designers with skills that systematically consider how built spaces can meet the psychological needs of their users (Pazzaglia & Tizi, 2022).

2. Research Method and Design Approach

2.1. The Role of Domesticity: From Home to Healthcare

The redesign of the obstetrics department begins with a structural analysis and assessment of identified needs, facilitated by collaboration between the project team and hospital staff.

To enhance functionality and ambiance, the redesign focuses on key communal areas: the entrance atrium, serving as a welcoming and social space, and the corridor leading to patient rooms. A critical aspect of the design is the implementation of a specific colour palette, strategically selected to mitigate the clinical perception of the hospital environment for both patients and staff. The application of colour alters spatial perception, creating a more domestic atmosphere. In the early 1920s, Gio Ponti initiated a critical analysis of this topic in Italy. In 1928, his reflections on the role of the home were published in the editorial of the inaugural issue of Domus.

Ponti succinctly delineated the primary characteristics of the "Italian house," described as a comfortable space that both embraces and interacts with the natural environment (Ponti, 1928). Subsequent years witnessed a proliferation of projects that focused on this theme. Domestic space is conceptualized as a distinct entity, separate from the external world, yet simultaneously equipped to encompass all essential functions necessary for human survival (Molinari, 2020). Nevertheless, the notion of space remains in a state of continuous transformation and is a subject of extensive contemporary discourse. Today, many projects are grounded in the reinterpretation, reappropriation, and domestication of those interstitial spaces that have long remained outside the embrace of domesticity.

An interesting example of this is the Brera project at Humanitas, initiated in 2023 by the Pinacoteca di Brera in collaboration with the IRCCS Istituto Clinico Humanitas in Rozzano. "In a place filled with powerful emotions, such as a hospital, art possesses a profound and transformative energy", reads the concept of the project. The format, focused on highlighting the beauty of art and its emotional and communicative power, introduces art into care environments by incorporating elements from masterpieces by thirteen renowned artists, such as Raphael, Hayer, Piero della Francesca, and Lotto. Covering approximately 400 square metres, the art depicts gestures of care and closeness, interspersed with Italian landscapes that blend into unexpected and imaginative views. This aligns with the project's primary goal: to comfort and reassure the patients. A series of frames designed to create truly immersive experiences, installed through a skillful interplay between "art as care" and "care as art". These choices seem to encourage a

2.2. Co-Designing for Belonging

With the increasing focus on a holistic approach to healthcare that integrates the quality of the physical environment with clinical care, the design of healthcare spaces is evolving to include not only functional aspects but also environmental and psychological dimensions (Huisman et al., 2012).

As widely demonstrated in the literature, the physical characteristics of hospital environments can significantly influence

the psychological and physical well-being of patients and the performance of healthcare staff (Ulrich et al., 2008). The intervention was carried out in two separate wards and two separate phases: this made it possible to collect the evaluations of employees and patients, who provided comments and points of view concerning the first ward implemented. The design choice applied to the first ward came about as a result of a shared design process with the healthcare staff: in fact, the project used a co-design process, finding botanical elements and natural colours the key to a successful project (Figs. 1-3).

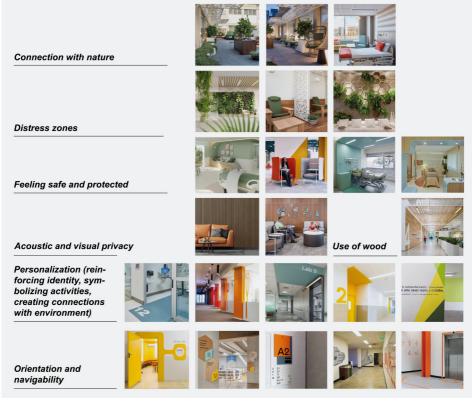


Figure 1. Mind map with inspirational images and keywords (credits: the authors, 2024).



Figure 2. Material moodboard built together with the hospital team as part of the project after comparing different proposals and noting the key words of the project (credits: the authors, 2024).

Their operational experience helped identify key issues to improve patients' psychophysical well-being, such as reducing environmental stress and optimising spaces for comfort and hospitality (Andrade et al., 2015). Expected outcomes include an improvement in patients' perceived well-being, which would also positively affect the overall quality of care and staff satisfaction. The project was subsequently evaluated through a survey by patients and staff to understand the strengths and weaknesses encountered after actively experiencing the space in the following months. The active participation of patients and staff through a survey was valuable in defining the design choices applied to the second intervention ward to adapt the space to the specific needs of the users involved (Chaudhury et al., 2005).



Figure 3. Final project moodboard (credits: the authors, 2024).

The expected outcomes include an improvement in patients' perceived well-being, which would also positively affect the overall quality of care and staff satisfaction. Indeed, to evaluate the effectiveness of these improvements, in July 2024 and after the wall coverings were installed, a questionnaire was distributed to both patients and healthcare staff to assess the impact of the intervention on the daily operation of the ward (Fig. 4). In this way, after the start of the improvement intervention, it was possible to have a direct and unbiased comparison with respect to the perception of the spaces.

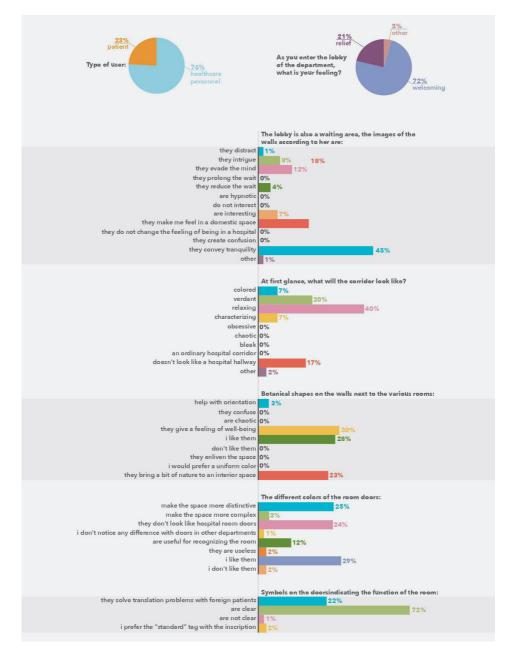


Figure 4. Comparative infographic of responses regarding perceptions of renovated spaces, values in percent (credits: the authors, 2024).

The 59 responses - 14 from patients and 45 from healthcare staff - consistently indicated an improvement in the spaces, with 73% recognizing a sense of hospitality and 16% experiencing relief. The botanical wall applications conveyed tranquility (43%), made the space feel more homelike (18%), and helped ease the mind (12%); they also contributed to a sense of well-being (30%) by bringing elements of nature into enclosed spaces (23%). The corridors were described as relaxing (42%), verdant (20%), and not resembling typical hospital environments (17%). The modifications to the doors made the space more distinctive (25%) and less like a conventional hospital setting (24%). The new orientation symbols were clear (72%) and helped address translation issues for foreign patients (22%). Overall, respondents reported a more relaxed, quiet, and harmonious perception of the environment.

The surveys administered to patients and hospital staff revealed an overall perception of a more comfortable and harmonious environment. This sense of calm was notably enhanced through natural colours and botanical-inspired graphic elements, which created a tranquil atmosphere. Respondents reported that the renewed environment fosters a greater sense of serenity, improving their daily experience within the facility. This positive effect was further amplified by the presence of soft, enveloping seating, complemented by wall coverings that help shift thoughts away from the hectic pace of the hospital. These elements have made the space more comfortable and welcoming, enabling patients and staff to engage with the environment calmer and more relaxed.

2.3. Restorative Design

Promoting individual well-being within real-world contexts and fostering relationships with physical and social spaces can help alleviate stress and mental fatigue at various scales. In this regard, the principles of environmental psychology (Pazzaglia & Tizi, 2022) have been applied to the S. Croce e Carle Hospital wards. Specific environments can transport individuals away from the sources of mental exhaustion. These settings create an organized whole that facilitates orientation while offering a variety of stimuli that capture involuntary attention without requiring cognitive effort, thereby allowing for the subsequent recovery of directed attention. The proposed action-research case aims to enhance the regenerative properties of existing spaces, enabling individuals - particularly those experiencing intense stress in healthcare settings - to recover cognitive resources and reduce stress levels. Restorative design plays a crucial role in creating regenerative interior environments, which can be achieved through both radical new designs and interventions in existing spaces. Key concepts such as being away, extent, fascination, and compatibility (Kaplan, 1995) are transformed into strategies that enhance connections to nature, optimize lighting, create destressing areas, ensure privacy and a sense of control, reduce noise, and utilize sensory information related to materials, textures, colors, and the specific characteristics of each element. The focus of this research is on the ability of natural contexts to promote regeneration. Elements of visual stimulation referencing the natural world were incorporated to create an environment that allows individuals to feel distanced from everyday life through the use of unique graphics.

- Creation of Destressing Areas: Spaces designed to ensure emotional comfort and acoustic and visual privacy through careful spatial design, incorporating visually stimulating elements and tactile materials such as wood.
- Connection with Nature: Integrating biophilic design principles by introducing regenerative patterns and upgrading spaces that connect with the outdoor environment through loggias and large windows.
- Orientation and Navigability: Designing spaces that are easily navigable for all users while reinforcing group identity, symbolizing activities, and fostering stronger connections with the environment.
- Design of Color and Light: Thoughtful use of color and lighting to enhance the overall atmosphere.

3. The Biophilic Principles and the Project Connection After clarifying the set goals and the research method to

achieve satisfactory results in line with the expectations of healthcare personnel along with the needs and considerations of patients, we decided to pursue the principles of biophilic design as guidelines to elaborate design responses. Biophilia is based on the concept that humans have an innate affinity to nature and living systems, which can significantly impact their well-being. The term was popularized by a biologist (Wilson 1984), who proposed that this connection to nature is deeply rooted in our biology and psychology. In practical terms, biophilia often manifests in design and architecture by incorporating natural elements into spaces, such as natural light, plants, and organic shapes, to enhance human health and reduce stress. This concept is increasingly applied in various fields, including healthcare, where biophilic design aims to create environments that promote healing and comfort for patients and caregivers.

Modifying hospitals' design by humanizing spaces is possible reconnecting with nature through 14 Patterns of Biophilic Design (Browning et al., 2014) based on scientific research, consisting of a broad view of biophilic design tools and applications as well as opportunities to increase the health of individuals for the different care levels (stress reduction, cognitive performance, emotion and mood enhancement). These strategies can be grouped into three main clusters: benefits of nature in the space, benefits of nature analogs, and benefits of nature of the space, which become the guidelines of the S. Croce Hospital project.

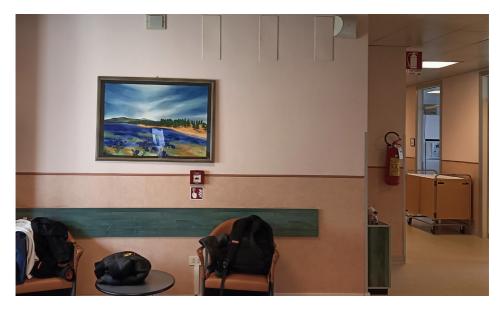


Figure 5. Entrance to the department with previous furnishing, wall decoration and corridor aesthetic before the intervention (credits: the authors, 2024).



Figure 6. Entrance to the department featuring a relaxation and reception area, equipped with custom-designed furniture and bespoke wallpaper after the intervention (credits: the authors, 2024).

3.1. Feeling Protected in a Cozy Space

To execute the project, literary materials addressing the benefits of the biophilic approach, along with examples of designs applied to architectural structures, were thoroughly reviewed. The 14 Patterns of Biophilic Design identified several design strategies compatible with the intervention possibilities offered by the hospital unit. These included the use of natural light, which has been shown to influence the functioning of the circadian system positively (Figueiro et al., 2011), the incorporation of natural materials, the selection of colours that reflect those found in the natural world, and the replication of natural forms, all of which can reduce diastolic blood pressure (Tsunetsugu et al., 2007) and enhance creative performance (Lichtenfeld et al., 2012).

Focusing specifically on the lobby space of the Obstetrics Department, which serves as a boundary element between the external and internal environments, it becomes a symbolic welcome space. It physically opens the doors to the user within a healthcare setting while also mentally transporting them, establishing a connection with nature. Upon crossing the threshold, the environment is characterised by a wallpaper featuring shades of green, bringing the outdoor environment inside the walls (Figs. 5–6).

An interesting observation made by hospital staff was that patients, upon entering, immediately lower their voices and feel integrated into a calming atmosphere.

3.2. Details, Surfaces and Space Customization

The personalization of spaces is one of the most significant trends in contemporary interior design, aiming to create aes-

iting multisensory experiences. Environmental psychology has highlighted that elements such as textures, materials, and customized tactile surfaces can profoundly influence spatial perception, affecting both the emotional state and behaviour of users (Ulrich et al., 2008). The presented project stands out for its extensive use of space customization, addressing the need to create tailored environments that enhance the overall experience, making the space more welcoming and comfortable. The design approach abandons rigid geometries and straight lines in favor of curved and sinuous forms inspired by natural patterns (Fig. 7), consistent with the principles of biophilia, which suggest that incorporating natural elements into built environments can improve users' psychophysical well-being (Kellert & Calabrese, 2015). This approach favors the adoption of enveloping and soft seating, which convey a sense of warmth and relaxation (Augustin & Fell, 2015). The common areas of the department have been further enhanced using botanical and biophilic forms, which have been shown to evoke restorative sensations in the mind (Kaplan & Kaplan, 1989). A key element of this intervention is the custom-made uphol-

thetically pleasing, functional environments capable of elic-

A key element of this intervention is the custom-made upholstered seating explicitly designed to fit predefined spaces. The sinuous shape of the sofa, combined with the softness of the botanical elements, welcomes patients into an inviting, domestic, and reassuring environment. Sensory engagement through tactile materials and natural forms significantly impacts the perception of comfort and well-being (Pallasmaa, 2012).

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Figure 7. Detail of the wallpaper. In the background, the department doors are wrapped in green film (credits: the authors, 2024).

In collaboration with the Tappezzerie Druetta team, composed of highly skilled artisans, the most suitable coverings were selected, ensuring an optimal balance between practical and aesthetic needs. The color palette, developed in harmonious tones, follows principles of visual perception linking color to emotional states, with deeper hues for seating and lighter, brighter tones for cushions and backrests, in line with theories on the impact of color on well-being (Elliot & Maier, 2014). The mobile elements, thanks to their versatility, can be swapped and adapted over time, allowing further customization of the space. The balance achieved between formal, material, and chromatic research has made it possible to create a spacious and welcoming seating area designed to accommodate patients and families during waiting periods or visits. It provides the necessary comfort in potentially stressful situations such as hospital stays.

3.3. Wayfinding and Orientation as Elements to Generate Protection

Other means to ensure comfort include the proper design of the organised complexity, e.g. by means of effective orientation and wayfinding systems that ensure informative comfort. Indeed, among the 14 patterns of biophilic design, we find references to using perspective in interior spaces, which amplifies the perception of the surrounding space while at the same time conveying a sense of protection - therefore helping to reduce stress (Grahn & Stigsdotter, 2010). In accordance with these attentions, the project is also developed on the study of a different perception of the traditional totally anonymous and sometimes haunting corridors, which give patients feelings of disorientation.

In drafting the project, an in-depth study was made of the signicity of colour and its application to wayfinding, in relation to the mechanisms of sensory perception of the environment. According to J. Malkin (1992), a designer and researcher in the field of wellness in healthcare spaces, wayfinding is a general term for what people do whenever they walk or drive from one place to another. People guide themselves through landmarks, using visual elements to reinforce their path or route. In a hospital, the most obvious wayfinding problems are two: corridors that are all the same and doors that are given the same treatment and thus look alike. The design intervention focuses on the colours of the doors, on the range of green, as an element of personalising corridor sections to break the verticality and create more excellent orientation. In addition, on the walls of the corridor (Fig. 8), botanical elements similar to those on the wallpaper in the atrium seem to spill out at the doors; they are stylized designs applied on pre-space, which help to further characterise the entrances to the patients' rooms.

With regard to wayfinding, it was decided to combine room numbers with pictograms that associate essential images with the functions of the rooms and do not require translation, having a high number of patients from non-European countries. Signage, when combined with images, can be more effective and draw more attention by virtue of having combined with a sufficiently interesting element that will be noticed and help to memorize the route (Fig. 9) better. This decision was co-designed with the health care staff after numerous patients experienced a sense of bewilderment due to the placement of exclusive textual signs that were unreadable and difficult to memorize.



Figure 8. View of the corridor in the department, showcasing decorative elements installed on the wall and wrapping on the doors, aligned with the green palette identified in the project (credits: the authors, 2024).



Figure 9. Identification signage for the patient rooms within the department (credits: the authors, 2024).

4. Conclusions

During the Renaissance, the artistic value of hospitals was widely acknowledged, with many historic buildings now serving as popular tourist destinations that blend art and beauty (Galimberti, 2012). However, this relationship between art and health has become less pronounced in modern times. This shift, alongside a growing need for humanized healthcare spaces, prompted the design request from the healthcare facility in Cuneo. This paper outlines the development of a recently completed healthcare interior design project, focusing on key phases of the process. Health ethics, when integrated with effective communication and decorative elements, can significantly enhance the well-being of individuals in healthcare environments. Additionally, spatial reorganization and volume optimization are essential components of a humanization process that reshapes the perception of these spaces. The analysis of case studies reinforces the hypothesis that renovating ward spaces contributes to improving patient recovery. Furthermore, the use of materials, forms, and objects inspired by nature can transform healthcare environments, creating a more supportive atmosphere.

This challenge lies in balancing the intersecting needs, expertise, and methodologies of a multidisciplinary approach. Engaging all stakeholders in the humanization process is essential. Feedback collected during the project phase highlights the importance of the hospital environment in patient recovery. The therapeutic process is enhanced within well-designed, welcoming spaces. The integration of natural elements, communal spaces, and decorative features significantly improves the quality of care and psychological well-being.

A multidisciplinary approach enables collaboration between healthcare and design sectors, helping to mitigate feelings of alienation and isolation in clinical settings. This project aims to improve the quality of spaces within the obstetrics ward, which is already recognized for its substantial medical contributions. The humanization strategy addresses patients' psychosensory needs by incorporating insights from medical sciences, communication studies, and design disciplines. Following the renovation, interactions between patients and healthcare professionals are expected to improve, with restorative features positively affecting well-being and mood. Furthermore, optimal color conditions have been shown to enhance staff engagement and cognitive focus (Del Nord & Peretti, 2012). This initiative represents the first phase of a broader modernization and refurbishment effort, which will extend to other departments in the near future. The same humanization approach will be applied to upcoming projects, with plans for further expansion. Ultimately, the goal is to redefine the hierarchy of design requirements, balancing sensitivity, user perception, and spatial functionality.

Based on these findings, it is recommended that similar humanization strategies be implemented in other healthcare settings, focusing on departments such as intensive care, pediatrics, and geriatrics. Future research could explore the impact of biophilic design elements on patient recovery across different medical contexts, considering the specific psychological and physiological needs of patients in each setting. Long-term studies are needed to assess the impact of these interventions on patient outcomes, staff satisfaction, and operational effi-

ciency. Quantitative research could provide valuable insights into measurable benefits, including recovery time and health-care costs. Furthermore, the flexibility of healthcare spaces should be prioritized to allow for adaptability to evolving needs and integrating technologies such as smart lighting and environmental control systems could enhance therapeutic qualities. Additionally, inclusive design approaches should be explored to ensure that spaces cater to the needs of diverse patient populations, staff, and visitors. Finally, ongoing collaboration between healthcare professionals, designers, and researchers is essential to ensure continuous feedback and adaptation of humanization strategies.

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