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Proposal for biophilic functional architecture in hospitals, to manage patient well-being and investment options

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Abstract. Introduction: Biophilic architecture is a proposal for designing hospitals, integrating natural elements in designs and for investment options . **Objective:** To propose functional hospital and clinic designs for patient comfort and investment options. **Methodology:** Qualitative approach and phenomenological design, the perceptions of five specialists in biophilic and hospital architecture and investments in clinics were collected. **Results:** The findings highlight the use of water, plants and natural light, wood and stone for the biophilic design of hospitals, achieving functionality of spaces and implying potential options for investors, due to the use of low-cost materials; barriers such as the lack of local regulations and budgetary restrictions that limit its implementation in Peru were identified. **Conclusion:** The proposal for hospital and clinic designs for patient well-being and investment options imply regulations for healthy, sustainable designs focused on human needs and profitable investment options.
Keywords: Biophilic functional architecture, hospitals, managing well-being, patients, investment

Propuesta de arquitectura funcional biofílica en hospitales, para gestionar bienestar de pacientes y opciones de inversión

Resumen. Introducción: La arquitectura biofílica es un propuesta para diseñar hospitalarios, integrando elementos naturales en diseños y para opciones de inversión **Objetivo:** Proponer diseños hospitalarios y clínicas funcionales para el confort del paciente y opciones de inversión. **Metodología:** enfoque cualitativo y diseño fenomenológico, se recopilaron las percepciones de cinco especialistas en arquitectura biofílica y hospitalaria e inversiones en clínicas. **Resultados:** Los hallazgos destacan el uso de agua, plantas y luz natural, madera y piedra para el diseño biofílico de hospitales, logrando funcionalidad de los espacios e implicando potenciales opciones de inversionistas, por el uso de materiales de bajo costo; se identificaron barreras como la falta de normativas locales y restricciones presupuestarias que limitan su implementación en Perú. **Conclusión:** La propuesta de diseños hospitalarios y clínicas para el bienestar de pacientes y opciones de inversión implican normatividad para diseños saludables, sostenibles y centrados en necesidades humanas y opciones rentables de inversión.
Palabras clave: Arquitectura funcional biofílica, hospitales, gestionar bienestar, pacientes, inversión

Proposta de Arquitetura funcional biofílica em hospitais, para gerenciar o bem-estar dos pacientes e opções de investimento

Resumo. Introdução: A arquitetura biofílica é uma abordagem para ambientes hospitalares, integrando elementos naturais nos projetos e oferecendo oportunidades de investimento. **Objetivo:** Propor projetos hospitalares que priorizem o conforto do paciente e opções de investimento. **Metodologia:** Foi adotada uma abordagem qualitativa e fenomenológica, reunindo as percepções de cinco especialistas em arquitetura biofílica, hospitalar e investimentos em clínicas. **Resultados:** Os achados destacam o uso de água, plantas, luz natural, madeira e pedra no design hospitalar biofílico, promovendo funcionalidade nos espaços e atraindo potenciais investidores devido ao uso de materiais de baixo custo. No entanto, a falta de regulamentações locais e as restrições orçamentárias dificultam sua implementação no Peru. **Conclusão:** A proposta de projetos hospitalares e clínicos focados no bem-estar dos pacientes e nas opções de investimento exige a criação de regulamentações que promovam a saúde, a sustentabilidade e o bem-estar humano, além de viabilizar investimentos rentáveis.
Palavras-chave: Arquitetura funcional biofílica, hospitais, gerenciamento do bem-estar, pacientes, investimento.

Introduction

Biophilic architecture has emerged as an innovative approach in the design of built spaces, especially in hospital settings, where patient well-being is paramount. This approach is based on the premise that integrating natural elements, materials, and colors into architectural design can improve the physical and mental health of individuals. According to Gębczyńska-Janowicz et al. (2022), incorporating natural elements into the hospital environment not only contributes to aesthetics, but also has a significant impact on patient satisfaction and comfort, which can facilitate their recovery. This theoretical principle underlines the importance of considering biophilia as an essential component in hospital design, especially in the context of the Ate district, where the aim is to improve patient functionality and well-being. Recent research has explored the impact of biophilic architecture in various healthcare contexts. For example, Febrianto et al. (2021) analyzed how nature-based education can influence building design, highlighting that the connection with natural elements can act as a therapeutic agent, improving the user experience in clinical settings. Likewise, Xie et al. (2022) conducted a study showing that cognitive immersion in architectural environments that incorporate nature can improve patients' aesthetic and emotional perception, which in turn positively influences their overall well-being. These studies contribute to the current knowledge on the importance of biophilia in hospital design, providing evidence that the integration of natural elements can improve the patient experience.

Despite these advances, there are significant gaps in the literature on the application of biophilic architecture in hospitals, especially in specific contexts such as that of the Ate district. For example, although the impact of biophilia on patient satisfaction has been documented, clear and specific indicators that measure functionality and well-being in Peruvian hospital environments have not yet been established. According to a study by Morandotti and Besana (2021), the lack of local regulations governing the implementation of biophilic architecture limits its practical application in hospitals, justifying the need to investigate how these principles can be effectively integrated into hospital design. Furthermore, the literature review suggests that research on the relationship between natural elements and patient experience in hospitals is still incipient, highlighting the need for studies that address this topic in more depth (Hamka et al., 2021). Therefore, the aim of this article is to evaluate how the application of biophilic architecture in the design of the Ate district hospital influences the functionality and well-being of patients, using specific indicators of comfort, satisfaction and recovery, through the identification and analysis of natural elements, materials and colours in the hospital environment. This objective seeks to fill the gaps identified in the literature and advance knowledge of the impact of biophilic architecture on the health and well-being of patients in hospital environments.

Method

Study Design

This study was conducted using a qualitative, basic type approach, with a phenomenological design. This approach allows to explore and understand the experiences and perceptions of professionals in relation to the application of biophilic architecture in the hospital environment. The research focuses on evaluating how these elements influence the functionality and well-being of patients, using specific indicators of comfort, satisfaction and recovery.

Selection of Participants

The study sample consisted of five professionals specialized in biophilic architecture and/or hospital infrastructure to select the corresponding references. Inclusion criteria for participants were: (1) having at least five years of experience in the design of hospital spaces or in the implementation of biophilic architecture principles, and (2) having worked on recent projects related to health and well-being in architectural environments. Professionals who did not have direct experience in hospital design or who were not familiar with biophilic architecture were excluded.

Data Collection Procedures

For data collection, a structured interview guide containing 08 items designed to explore bibliographic aspects related to biophilia and its application in hospitals was used. The interviews were conducted in a semi-structured manner, which allowed the participants to express their opinions and experiences freely, while keeping the focus on relevant topics to comment on the bibliographic reference studies; based on three specific objectives shown and argued in the Results section.

Data Analysis

The data obtained from the interviews were analysed using a thematic analysis approach, which allows for the identification of recurring patterns and themes in the participants' responses. This method is suitable for phenomenological design, as it facilitates the understanding of the experiences lived by professionals in relation to biophilic architecture and its impact on the functionality and well-being of patients.

Research Limitations

This study faced several limitations. First, there is a paucity of local regulations governing the implementation of biophilic architecture in Peru, which may hinder the practical application of the principles discussed. Second, budgetary constraints in the hospitals analyzed may limit the inclusion of certain biophilic elements in the design, which could affect the research results. These limitations should be considered when interpreting the study findings and recommendations.

Results

Regarding specific objective 1, which is ***to show the importance of natural elements in a hospital*** . Lei et al. (2021), in their research entitled "A quantitative study for biophilic design of the indoor workplace to improve health and productivity performance", the results showed that groups with vegetation in proportions of 0.2%, 5%, 12% and 20% were tested, in addition to a group without biophilia. The group with 12% biophilic design showed the greatest improvement in psychological, physiological and productive aspects.

The conclusions indicate that work performance improves with the presence of vegetation, demonstrating a positive relationship between biophilia and psychological and productive well-being in a work environment. Regarding the results obtained by Ashley et al. (2021), in their research entitled "Effects of virtual reality versus biophilic environments on pain and distress in cancer patients: a pilot case-crossover study", it consisted of conducting a pilot study in a health center that treats cancer to 33 patients with various types of cancer, the participants were analyzed in a control room, a room with green therapy and a virtual reality room, in which they receive chemotherapy. The results obtained were that patients report that being in the green therapy room and the virtual reality room is more pleasant compared to the control room. In addition, their conclusions are that it was determined that a biophilic green therapy or a virtual reality environment can reduce the pain and distress of an oncology patient while receiving chemotherapy. Likewise, biophilic architecture design can incorporate nature into our surroundings and design places of inspiration and regeneration that connect humans with their environment. Although it is difficult to find a space that can accommodate all biophilic design elements, many contributing elements can enhance the space and well-being. It is more than just adding a plant or two to the space. A positive effect can be created through filtered sunlight, plants, green walls, water features, natural textures and materials, and views of nature (Hady, 2021).

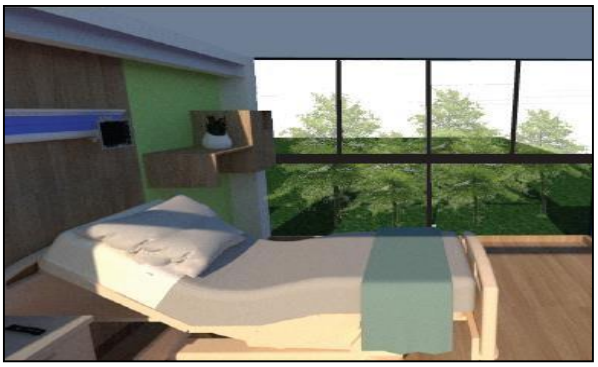
Figure 1. Natural elements in a hospital

Source: Own elaboration

Likewise, natural elements encompass three dimensions that inhibit boredom, which are complexity through visual richness, mystery because it encourages exploration of an environment, and coherence because it allows immediate understanding (Rosenbaum et al., 2018).

Figure 2. Hospitalization area with a view of the green area

Source: Acosta, 2021.



Many scientific researches in environment and health support that untouched nature or wilderness stimulates many positive energies and serves as a positive restorative environment for humans and is an effective platform for stress management, health promotion, psychotherapy and disease deterrence (Almusaed et al., 2022).

Regarding specific objective 2, which is ***to show the importance of natural materials in a hospital.*** by Aguirre et al. (2021), in their research entitled "Biophilic architecture applied in the proposal of a post-COVID physical and mental rehabilitation center - Huánuco region 2021", published by the School of Architecture of the Continental University, 2021, it can be inferred from these results that indeed the use of biophilic architecture through natural elements considerably improves the well-being of users (patients), since, in the present research, the objective is to define the link between biophilia and post-Covid 19 patients, which considers the natural environment as something of utmost importance in healthcare environments. Coming to the conclusion that natural materials such as wood, stone and bamboo generate well-being in users (patients), positively influencing them. Habitability also influences well-being positively, as well as landscaping treatment has the same influence on well-being.

Figure 3. Presence of natural materials in the hospital

Figure 3. Presence of natural materials in the hospital
Source: Aguirre et al, 2021.

Natural materials are a fundamental part of the indirect experience with nature, this category being an important experience to practice biophilia (Lee and Park, 2020). In this sense, Gillis and Gatersleben (2015) mention that natural materials are biophilic attributes. Likewise, studies in hospitalized patients showed that they prefer the use of wood in certain parts of their rooms.

Figure 4. Presence of wood in hospitalization area.
Source: Najarro, 2022.

Similarly, Sabaa et al. (2022) states that natural materials such as wood in decorations and ornamentation allow evoking natural analogues in an organic, non-living and indirect way of nature, through colors, shapes, sequences and patterns.

Regarding specific objective 3, which is ***to show the importance of natural colors in a hospital.*** Acosta (2021), in his research entitled "Criteria of Biophilic Architecture: Option for the well-being of patients in the Internment Area of the Eleazar Guzmán Barrón Regional Hospital - Nuevo Chimbote, 2021", it can be inferred from these results that indeed the use of biophilic architecture considerably improves the comfort of a hospital, since, in the present research, the objective is to define criteria that, when applied to the hospital under study, can generate well-being in users (patients).

That is to say, 69% of participants expressed the need to improve the colors in different areas of the hospital so that they can achieve comfort in the study hospital, and they also agree with the well-being they would achieve with biophilic architecture. Using biophilic architecture design involves applying three categories which are the direct experience of nature (natural light, air, plants, animals, water, landscapes, fire, and ecosystems), the indirect experience of nature (images of nature, natural materials, colors, shapes similar to those found in nature), and the experience of space and place that provides natural features such as open views, places of retreat, clear paths with natural landmarks, cultural and ecological elements (Richardson and Butler, 2022). Furthermore, Luo et al. (2023) mention that there is

also biophilic virtual reality, which consists of observing natural landscapes with special virtual reality glasses. These projected natural spaces contemplate natural colors such as the blue sky, plants moving in the wind, clouds, flowing water, flying birds, and music appropriate to the situation.

Figure 5. Virtual reality in hospital

Source: Luo et al., 2023

Furthermore, there is a study that mentions, participants in a biophilic environment had 14% better short-term memory performance and better emotions compared to their performance in a non-biophilic environment; therefore, the biophilic indoor environment may play an important role in improving health and cognitive function, suggesting that VR could have the potential to reduce stress and improve cognitive function by providing exposures to natural elements in a variety of indoor environments where access to nature may not be possible, such as waiting rooms in clinics, dental offices, etc., where occupants often experience discomfort and anxiety (Yin et al., 2018). Similarly, stress reduction theory relates to restoration and identifies the benefits of outdoor natural environments after excessive psychological and physiological arousal, or excessively low arousal. It also considers the element of fatigue, but as a result of emotional stressors. Positive changes in physiological systems, behavior, emotional states, and cognitive functioning have been shown to occur as a result of exposure to nature. This theory laid the groundwork for subsequent studies that evaluated the benefits of other forms of nature, such as images, smells, natural colors, and views of nature, with respect to stress recovery in a variety of settings (Peters et al., 2020).

Figure 6. Paintings that symbolize nature.

Source: Sabaa et al., 2022

Discussion

In contrast, with some Scientific Articles for the respective objectives :

Objective of the article found: To evaluate the influence of biophilia on hospital design and its effect on patient recovery. Methodological design of the article found: Qualitative research with a phenomenological approach. Most important conclusion of the article found: Integrating natural elements into hospital design significantly improves patient satisfaction and well-being. Thematic gaps of the article found: Lack of studies analyzing the practical implementation of biophilia in hospitals in developing countries. Gębczyńska-Janowicz et al. (2022)

Objective of the article found: To investigate how biophilic elements affect patients' perception of the hospital environment. Methodological design of the article found: Qualitative study with semi-structured interviews. Most important conclusion of the article found: Patients report a greater sense of calm and comfort in environments that incorporate natural elements. Thematic gaps of the article found: Need for more research on the relationship between biophilia and clinical recovery Tekin et al. (2021)

Objective of the article found: To analyze the relationship between biophilic design and the mental health of patients in hospitals. Methodological design of the article found: Qualitative research with a phenomenological approach. Most important conclusion of the article found: Biophilia not only improves physical well-being, but also has a positive impact on the mental health of patients. Thematic gaps of the article found: Scarcity of studies evaluating the implementation of biophilia in Latin American hospitals Hammed (2023)
Objective of the article found: To evaluate how biophilia can be integrated into hospital design to improve the patient experience. Methodological design of the article found: Qualitative study with case analysis. Most important conclusion of the article found: The implementation of biophilic principles in hospital design is essential to improve the patient experience. Thematic gaps of the article found: Lack of regulations that regulate biophilia in hospital design in Peru Santos (2022)

Objective of the article found: To investigate the effectiveness of biophilic elements in reducing stress in hospitalized patients. Methodological design of the article found: Qualitative research with interviews and observations. Most important conclusion of the article found: Natural elements such as plants and natural light are effective in reducing stress in patients. Thematic gaps of the article found: Need for longitudinal studies that evaluate the long-term impact of biophilia on patients' health. Reference: Xie et al. (2021)

Objective of the article found: To evaluate the impact of biophilia on patient satisfaction in hospital settings. Methodological design of the article found: Qualitative study with a phenomenological approach. Most important conclusion of the article found: Patient satisfaction increases significantly in environments that incorporate biophilic elements. Thematic gaps of the article found: Scarcity of studies that analyze biophilia in hospitals in developing countries. Reference: Guerra-Centeno (2023)
Objective of the article found: To analyze the relationship between biophilic design and patient recovery in hospitals. Methodological design of the article found: Qualitative research with patient interviews. Most important conclusion of the article found: Biophilia contributes to a faster and more effective recovery in hospitalized patients. Thematic gaps of the article found: Need for more research on the implementation of biophilia in Latin American hospitals Domínguez et al. (2022)

Objective of the article found: To evaluate the impact of biophilia on the functionality of hospital spaces. Methodological design of the article found: Qualitative study with case analysis. Most important conclusion of the article found: Biophilia improves the functionality of hospital spaces, facilitating patient care. Thematic gaps of the article found: Lack of studies that address biophilia in hospitals in Peru Figueroa and Román (2021)

Objective of the article found: To investigate the relationship between biophilia and the mental health of patients in hospitals. Methodological design of the article found: Qualitative research with interviews with patients and medical staff. Most important conclusion of the article found: Biophilia has a positive

impact on the mental health of hospitalized patients. Thematic gaps of the article found: Need for studies that evaluate the implementation of biophilia in hospitals in developing countries Montero (2023)

Objective of the article found: To evaluate how biophilia can be integrated into hospital design to improve the patient experience. Methodological design of the article found: Qualitative study with case analysis. Most important conclusion of the article found: The implementation of biophilic principles in hospital design is essential to improve the patient experience. Thematic gaps of the article found: Lack of regulations that regulate biophilia in hospital design in Peru Bettini et al (2022). The study by Gonzales Ttito, Y. M., et al. (2023) comprehensively addresses the implementation of biofilic functional architecture in hospitals, focusing on how it can enhance patient well-being. The proposal suggests that an adequate space design not only aids recovery but also optimizes resource management. Additionally, it outlines investment options to ensure the economic feasibility of these initiatives, emphasizing the importance of prevention in health emergencies through multifunctional infrastructures.

Therefore, the above is supported by the background information, which indicates that natural elements such as the presence of plants, whether natural, artificial or virtual, through biophilia are of great importance because they improve a hospital. This is also reinforced by the theories, which highlight and specify the positive effect through the presence of natural plants, filtered sunlight, water sources and views of nature, which help to enhance the qualities of applying biophilia to a hospital.

Therefore, the above is supported by the background, indicating that natural materials such as wood, stone and bamboo in landscaping treatment through biophilia improve a hospital. Likewise, this is strengthened by the theories, which highlight and recommend in this regard the areas directly and indirectly where these materials can be used to enhance the qualities of applying biophilia to a hospital; which are also influenced, according to Barreto & Sánchez (2021), by the responsibility and management of the professional capacity of the nursing staff of a public hospital.

This study highlights the importance of properly managing the professional capacity of nursing staff in public hospitals, an essential factor in ensuring quality of care. The authors underline the need for ongoing training and professional responsibility in improving standards of care. This approach is linked to biophilia, considering that staff well-being influences the creation of an efficient and healthy hospital environment, aligned with innovative strategies to improve the institutional image Silva et al. (2023).

The article explores various innovative strategies to improve the institutional image of hospitals, focusing on the design of spaces that promote biophilia. The authors argue that a positive institutional image benefits both the well-being of patients and the investment of developers. The incorporation of biophilic architecture principles, such as the use of natural light and vegetation, can transform hospital environments into more pleasant and efficient places for all users, constituting a Public Management Proposal to face health emergencies and importance in which Artificial Intelligence can also be used Alcas et al. (2021).

This study proposes a public management approach to address health emergencies: Highlighting the fundamental role of artificial intelligence in hospitals. The authors argue that efficient resource management is crucial for a rapid and effective response in crisis situations. This proposal is complemented by bioarchitecture by integrating technologies and designs that optimize both processes and patient well-being, especially in critical moments such as health emergencies.
Therefore, the above is supported by the background, indicating that natural colors, through the application of biophilia, actually improve a hospital. This is also reinforced by the opinion of the theories, which highlight and specify the provision of the application of colors, as well as the types of colors and shapes that should be used that represent nature such as the blue sky, landscape colors to enhance the qualities of applying biophilia to a hospital.

Recommendations for future research

Based on the results obtained and the limitations identified, it is suggested that future research focus on the following areas:

Longitudinal studies: Conduct research that evaluates the long-term impact of biophilia on the health and well-being of patients in hospitals, to better understand its effectiveness in recovery.

Research in local contexts: Expand the study focus to hospitals in different regions of Peru and other developing countries, to assess how local regulations and budgetary constraints affect the implementation of biophilia.

Regulatory development: Investigate the creation of regulations that govern the implementation of biophilic architecture in hospitals, which could facilitate its adoption and standardization in hospital design.

Diversity of methods: Using a combination of qualitative and quantitative methods to gain a more complete picture of the impact of biophilia on patient well-being.

Cost analysis: Evaluate the cost-benefit of implementing biophilic elements in hospitals, to provide a solid foundation to support cost-effective investment in these designs.

These recommendations may help to overcome current limitations and explore aspects not addressed in this study, thus contributing to the advancement of knowledge in the field of biophilic architecture and its impact on health.

Conclusions

The findings of this research indicate that biophilic architecture generates significant benefits for patient well-being when integrated into hospital design. It has been shown that the inclusion of natural elements, such as water, plants and light, improves both patient comfort and recovery. In addition, the use of natural materials, such as wood and stone, contributes to the psychological and functional well-being of hospital spaces. However, important limitations were identified, such as the lack of local regulations governing the implementation of biophilic architecture in Peru and budgetary restrictions that hinder the inclusion of certain biophilic elements in the hospitals analyzed.

In response to the research objective, which was to evaluate how the application of biophilic architecture in the design of the Ate district hospital influences the functionality and well-being of patients, it is concluded that biophilia has a positive impact on these aspects. Using specific indicators of comfort, satisfaction and recovery, it was possible to identify and analyse the natural elements, materials and colours present in the hospital environment, thus confirming the hypothesis raised.

This study is classified as an original research article, with a qualitative research methodological design, basic type, and a phenomenological approach. This methodology allowed a deep understanding of the experiences and perceptions of professionals in relation to biophilia, thus contextualizing the conclusions within the appropriate framework.

Finally, the implications of this work are broad. It proposes that future research focus on the development of regulations that govern the implementation of biophilic architecture in hospitals, as well as on the realization of longitudinal studies that evaluate the long-term impact of these elements on the health and well-being of patients. In addition, it would be beneficial to explore the relationship between biophilia and mental health in different cultural and geographical contexts, which could further enrich the field of study and contribute to the creation of healthier and more sustainable hospital environments with the use of low-cost materials; barriers such as the lack of local regulations and budgetary restrictions that limit its implementation in Peru were identified; in addition, hospital and clinic designs for patient well-being and profitable investment options are proposed.

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